SYLLABUS

THE 29TH INTERNATIONAL CONFERENCE ON
ADVANCES IN CRITICAL CARE NEPHROLOGY

Updates in ICU Medicine: Controversies, Challenges and Solutions

AKI & CRRT 2024

MARCH 12-15, 2024

MANCHESTER GRAND HYATT
SAN DIEGO, CALIFORNIA

Jointly Provided by

UC San Diego SCHOOL OF MEDICINE *and* CRRT, INC.

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AKI&CRRT 2024

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(guides to presentation outlines if available)

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CONFERENCE DESCRIPTION AND LEARNER OBJECTIVES

The CRRT conference provides a comprehensive review of advances in clinical care, research and technology in critical care medicine with a focus on the kidney and renal support techniques. The conference is designed to facilitate interdisciplinary interactions among caregivers involved in the management of patients in intensive care units. Physicians, nurses, pharmacists, nutritionists and other allied personnel from industry have opportunities to learn from each other. The conference utilizes a combination of invited lectures; case based small group workshops, debates, hands on interactive and simulation based workshops. Attendees have an opportunity to interact with the faculty through focused panel discussions and symposia.

At the end of this conference attendees should be able to:

1. Describe the recent advances in the pathophysiology and management of critically ill patients with a focus on sepsis, multi-organ failure, infections, lung and kidney injury in different settings.
2. Discuss the best ways to identify, treat and follow up patients with acute kidney injury (AKI) resulting from different causes utilizing biomarkers, imaging and lab studies and applying educational tools to raise awareness of AKI.
3. Describe the principles and practice of renal replacement techniques including CRRT, IHD and plasma exchange and demonstrate how to setup and use these techniques for managing critically ill patients.

ACCREDITATION STATEMENT

This activity has been planned and implemented in accordance with the accreditation requirements and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of University of California San Diego School of Medicine and CRRT Inc.. The University of California San Diego School of Medicine is accredited by the ACCME to provide continuing medical education for physicians.

The University of California San Diego School of Medicine designates this live activity for a maximum of **31.0** *AMA PRA Category 1 Credits™* . Physicians should claim only the credit commensurate with the extent of their participation in the activity.

NEEDS ASSESSMENT

Several sources of information were utilized to identify the practice gaps prompting this educational conference. These include literature review of multiple publications in Pubmed, publications from the American Society of Nephrology, International Society of Nephrology, published KDIGO and European Best Practice and NICE guidelines and feedback from participants and faculty at prior CRRT conferences and discussions with the organizing committee.

TARGET AUDIENCE

The CRRT target audience includes: MD/DOs, NP/PA/Nurses, Dieticians, Industry, Pharmacists, Residents and Fellows. Specialties include: Anesthesiology, Cellular & Molecular Medicine, Critical Care, Emergency Medicine, Family & Preventive Medicine, Geriatrics, and Internal Medicine.

CULTURAL & LINGUISTIC COMPETENCY AND IMPLICIT BIAS

Continuing medical education (CME) providers are required by state Assembly Bills 1195 and 241, and the standards created by the California Medical Association (CMA), to include components that address cultural and linguistic competency and implicit bias in CME activities. The planners and presenters of this activity has been asked to provide meaningful consideration of these standards in the selection and presentation of content. Additional resources can be found on the UC San Diego CME website:
https://medschool.ucsd.edu/education/cme/tools/Pages/Cultural-Competency.aspx

CME ACTIVITIES

The following Pre-Conference Events, Plenary Sessions, Workshops, Morning Symposia and Meet the Expert Sessions qualify for CME Credit:

Monday and Tuesday Elective Workshops
Practice Based Learning in CRRT: The Science and the Art
POCUS Workshop

Wednesday
MEET THE EXPERT SESSIONS 1 & 2
MORNING SYMPOSIA - A & B
OPENING SESSION I: PATIENT CHARACTERISTICS
GROUP 1 - SIMULTANEOUS STANDARD WORKSHOPS
GROUP 2 - SIMULTANEOUS STANDARD WORKSHOPS

Thursday
MEET THE EXPERT SESSIONS 3 & 4
MORNING SYMPOSIA - C & D
GROUP 3 - SIMULTANEOUS STANDARD WORKSHOPS
SESSION II: CONTROVERSIES IN CRITICAL CARE NEPHROLOGY
SESSION III: EMERGING CONCEPTS IN AKI AND RRT

Friday
MEET THE EXPERT SESSIONS 5 & 6
MORNING SYMPOSIA - E & F
SESSION IV: IMPROVING OUTCOMES IN AKI
SESSION V: FUTURE TRENDS IN CRRT AND CRITICAL CARE

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Disclosure Summary
29th International Conference on Advances in Critical Care Nephrology – AKI & CRRT
March 12 – 15, 2024

Disclosure Summary Statement *(for Activity Disclosure to Learners)*
It is the policy of University of California San Diego School of Medicine Continuing Professional Development to ensure that the content of accredited continuing education and related materials is accurate, balanced, objective, and scientifically justified. Education must be free of the influence or control of ineligible companies, and protect learners from promotion, marketing, and commercial bias. All persons in a position to control the content of accredited continuing education must disclose all financial relationships held with ineligible companies, prior to assuming a role in the activity. Those relationships deemed relevant to the education are mitigated prior to the activity through one of the following strategies, depending on the nature of relationship and the role of the person: 1) divesting the financial relationship, 2) altering the individual's control over content, and/or 3) validating the planning decisions and/or content through independent peer review. All relevant financial relationships are mitigated prior to the activity and mitigation strategies and necessary steps for implementation are communicated to individuals prior to them assuming their role in the activity. Persons who refuse or fail to disclose are disqualified from participating in the activity. Activities are evaluated by participants and peer reviewers to determine if the content was free of bias and met acceptable scientific standards. This information is considered in future activity planning. ***All relevant financial relationships and the nature of those relationships are noted below. All relevant financial relationships have been mitigated.***

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Armando Vázquez, MD	Planning Committee Member	Advisor-Baxter International, Inc.|Advisor-B. Braun Medical, Inc.|Advisor-Medtronic (Any division)|Advisor-Fresenius
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Munster, NR GERMANY

** Faculty Member Participating in Non-CME Sessions Only*

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AKI & CRRT 2024 would like to acknowledge the following exhibitors:

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SUNDAY & MONDAY, MARCH 11 & 12

PRE-CONFERENCE WORKSHOP

Practice Based Learning in CRRT: The Science and the Art

(Page numbers are present if presentation outline was submitted)

•Describe the underlying concepts and review the process of decision making for prescribing and delivering CRRT
•Learn machine set-up for different modalities, alarm conditions, troubleshooting, monitoring and charting
•Utilize the tools provided to manage complex cases

Co-Chairs: Ashita Tolwani, MD and Jorge Cerda, MD

MONDAY, March 11 - SESSION 1 *(all workshop attendees)*

1:30-1:45pm **Opening Remarks** - Ashita Tolwani, Jorge Cerda
1:45-6:00pm **CRRT PRINCIPLES**
1:45-2:00 **Introduction to CRRT Master Class** – Ashita Tolwani
2:00-2:30 **Patient Selection, Modality, and Dose** – Jorge Cerda
2:30-3:15 **The ABC of the CRRT Prescription** – Ashita Tolwani
3:15-3:45 **Access, Membrane, Circuit** – Manish Kaushik 35
3:45-4:15 **Solutions and Fluid Balance** – Javier Neyra
4:15-4:30 Coffee Break
4:30-4:50 **Drug Dosing and Adjustments** – Linda Awdishu
4:50-5:10 **Nutritional Support During CRRT** – Michael Connor
5:10-6:00 **Dysnatremias and Acid Base Disorders** – Lenar Yessayan 35
6:00 pm **Adjourn**

TUESDAY MORNING, March 12 - SESSION 2

8:00am-9:35am **IMPLEMENTING CRRT**
8:00-8:20 **Initiation and Discontinuation** – Manish Kaushik 36
8:20-8:40 **Integrating Multidisciplinary Support Team for CRRT Delivery** – Linda Awdishu
8:40-9:00 **Paper to Digital, e-Prescribing and Charting for CRRT During AKI in the ICU** – Ian Baldwin ..37
9:00-9:20 **Developing Quality Measures for CRRT Delivery** – David Askenazi
9:20-9:35 **Introduction to Workshops** – Ashita Towani
9:35-9:50 Coffee Break

SESSION 3

9:50am-12:15pm **WORKSHOPS** - Breakout Sessions
Rotating at 45 minute intervals: 9:50-10:35am; 10:40-11:20am; 11:25am-12:15pm

Room #1: **Knowing your Circuit, Alarms, and Other Tricks**.....38
Ian Baldwin, Katrina Eggleston, Pam Carroll, Katie Plomaritas

Room #2: **The When, How, and Why of CRRT?** – Jorge Cerda and Rajit Basu

Room #3: **Citrate Lab and Other Anticoagulation Alternatives: Concepts to Build Your Protocol** 39
Lenar Yessayan and Michael Connor

12:15-1:00pm *Lunch Hosted by Conference for Workshop Participants*

Workshop schedule continues on following page

TUESDAY AFTERNOON, March 12 - SESSION 3

PRE-CONFERENCE WORKSHOP

Practice Based Learning in CRRT: The Science and the Art

SESSION 4

1:00-3:00pm **WORKSHOPS - Breakout Sessions**

Rotating at 35 minute intervals: 1:00-1:35pm, 1:40-2:15pm, 2:25-3:00pm

Room #1: Connectology with Hybrid Systems: ECMO, Apheresis, ECCOR
Keith Wille, Ian Baldwin and Katie Plomaritas 40

Room #2: Precision Solute Control and Dynamic Dosing with CRRT
Manish Kaushik and Ashita Tolwani

Room #3: POCUS How to Use it for Fluid Management with CRRT
Ron Wald and Javier Neyra

3:00-3:15 *Coffee Break*

SESSION 5 - NON-CME

3:15pm-5:30pm *This Session is Non-CME, Please refer to the Final Program or Website for details*

5:30-7:30pm **Tuesday Evening Reception & Poster Review** - *For All Conference Attendees*

TUESDAY, MARCH 12

(Page numbers are present if presentation outline was submitted)

Point of Care Ultrasound (POCUS): Science and Practice

This course is designed for nephrology and critical care providers to learn the basics of Point-Of-Care Ultrasound with a specific focus on frequent pathologies found in acutely ill patients. This workshop will include brief didactic sessions and hands-on sessions. At the end of this workshop, the trainees will have basic knowledge about indications for POCUS, normal/abnormal findings, and how this can be integrated in the evaluation of the patients. The aim is to provide the introductory practical skills necessary to continue their training autonomously. A quiz will be administered pre-and post- course for assessment.
Faculty: W. Beaubien-Souligny; K. Kashani; A. Shaw, R. Wald; J. Deschamps; V. Niyyar

Learning Objectives:
The core focus on this course is as follows:

1. **Cardiac:**
   - A. Qualitative assessment of chamber size and systolic function;
   - B. Identification of severe valvulopathy;
   - C. Assessment of pericardial fluid and tamponade physiology
2. **Thoracic:**
   - A. Qualitative assessment of pleural effusion size and characteristics;
   - B. Identification of pneumothorax;
   - C. Assessment of alveolar consolidation and interstitium
3. **Abdominal:**
   - A. Identification of kidney and bladder and assessment of kidney size and echogenicity, and evaluation of urinary obstruction;
   - B. Identification of intraperitoneal fluid;
   - C. Qualitative assessment of abdominal aorta size
4. **Vascular and Vascular Access:**
   - A. Patency and caliber of main veins for catheter placement;
   - B. Identifying the presence of a thrombus;
   - C. Basic examination of an arteriovenous fistula/graft
5. **Hemodynamic and Fluid Evaluation:**
   - A. Inferior vena cava visualization and assessment;
   - B. Venous Doppler assessment;
   - C. Estimating stroke volume / cardiac output

Schedule - Participants will be allocated into groups of 4 and will rotate through each of 5 stations to review the principles of image identification and interpretation and get hands-on experience with the ultrasound probes.

8:00-8:20am	**Welcome and Pre-quiz** 44
8:20-8:45	**Introduction to Basics of Lung Ultrasound**
8:45-9:15	**Lungs: Hands-on** (group 1) **/ Image Review Session** (group 2)
9:15-9:45	**Lung Part 2** (group switch)
9:45-10:00	*Coffee Break*
10:00-10:20	**Introduction to Basic Echocardiography**
10:20-10:50	**Heart: Hands-on** (group 1) **/ Image Review Session** (group 2)
10:50-11:10	**Heart Part 2** (group switch)
11:10-12:30	**Vascular Ultrasound and Vascular Access**
12:30-1:15	*Lunch Hosted by Conference for Workshop Participants*
1:15-1:35	**Introduction to Abdominal and Renal Ultrasound**
1:35-2:05	**Abdomen: Hands-on** (group 1) **/ Image Review Session** (group 2)
2:05-2:35	**Abdomen Part 2** (group switch)
2:35-2:50	*Coffee Break*
2:50-3:10	**Introduction to Fluid Status Assessment: Putting it all together**
3:10-3:40	**Fluid Assessment: Hands-on** (group 1) **/ Image Review Session** (group 2)
3:40-4:10	**Fluid assessment 2** (group switch)
4:10-4:30	**Post-quiz and Conclusion**
4:30	**Adjourn**

5:30-7:30pm **Tuesday Evening Reception & Poster Review -** *For All Conference Attendees*

WEDNESDAY MORNING, MARCH 13

SESSION I: PATIENT CHARACTERISTICS

8:20-10:30am **Plenary 1 - MINI-SYMPOSIA**

Organ Dysfunction in the Critically Ill Patient: Emerging Concepts

Co-Chairs: Neesh Pannu and Michael Joannidis

8:20-8:30 **Opening Remarks**
Ravindra L Mehta

8:30-8:45 **Hidden in Plain Sight; Chloride in Acute Heart Failure** 48
Amir Kazory

8:45-9:00 **What's New in Organ Crosstalk**
Kathleen Liu

9:00-9:15 **Sepsis in 2024: What's Next?**
Derek Angus

9:15-9:30 **Trajectories of Critical Illness – Defining Endotypes from Routine Data**
John Prowle

9:30-9:45 **Early Multi-modal Vasopressors in Critical Care – Is That a Thing?**
Ashish Khanna

9:45-10:00 **The Forgotten (Right) Ventricle in Critical Care Medicine**
Andrew Shaw

10:00-10:30 **SPECIAL LECTURE**
Greening Critical Care: Can We Do It?
Yes: Jean-Louis Vincent
Maybe: Marlies Ostermann
No: Derek Angus
Moderator: Claudio Ronco

10:30-11:00 **Industry Demonstration Showcase (2)**
Coffee Break / Faculty Picture

WEDNESDAY AFTERNOON, MARCH 13

Continuation of:

SESSION I: PATIENT CHARACTERISTICS

4:00-6:00pm **Plenary 2 - MINI-SYMPOSIA**
Acute Kidney Injury (AKI): Pathophysiology

Co-Chairs: Samira Bell and Luis Juncos

4:00-4:15 **AKI in the Neurocritical Unit**
Zaccaria Ricci

4:15-4:30 **AKI After Burn Injury**
Matthieu Legrand

4:30-4:45 **AKI in Renal and Non-renal Solid Organ Transplantation**
Vincenzo Cantaluppi

4:45-5:00 **AKI in the Context of Invasive Management of Heart Disease** 56
Matthew James

5:00-5:15 **Arterial and Venous Blood Pressure in Cardiac Surgery Associated AKI**
Andrew Shaw

5:15-5:30 **Kidney-Ventilator Interactions and Kidney Protective Ventilation** 57
Sean Bagshaw

5:30-6:00 **ADQI UPDATE**

5:30-5:45 **ADQI 29: AKI in Liver Cirrhosis**
Mitra Nadim and Akash Deep

5:45-6:00 **ADQI 30: Adsorption-based Extracorporeal Therapies** 57
Claudio Ronco and Thiago Reis

6:00pm **Adjourn**

6:00-8:00pm **EXHIBIT RECEPTION AND POSTER SESSION**

1: CLINICAL RESEARCH IN AKI II
Lui Forni and Etienne Macedo (Moderators)

2: CLINICAL RESEARCH IN AKI (Session 3)
Michael Connor and Kathleen Liu (Moderators)

3. EPI AND OUTCOMES (Session 2)
Mitch Rosner (Moderator)

THURSDAY MORNING, MARCH 14

SESSION II: CONTROVERSIES IN CRITICAL CARE NEPHROLOGY

10:15am-12:30pm **Plenary 3 - MINI-SYMPOSIA**

Challenges in ICU Management

Co-Chairs: Matthew Legrand and Marlies Ostermann

10:15-10:30 **From Fluid Responsiveness to Fluid Overload: Identifying Fluid Intolerance** 65

William Beaubien-Souligny

10:30-10:45 **RAAS Biomarkers and Emerging Evidence in Critical Care**

Ashish Khanna

10:45-11:00 **Health Disparities in the ICU: What are the Next Steps?**

Amira Mohamed

11:00-11:15 **Learning Health Systems: Do They Exist and Can They Work?**

Derek Angus

11:15-11:30 **Don't You Forget About Me: Non-ATN Causes of AKI in the ICU**

Mitch Rosner

11:30-11:45 **Vascular Access for AKI: Tunneled or non-Tunneled?**

Vandana Niyyar

11:45-12:15 **SPECIAL LECTURE**

San Diego AKI & CRRT Award

Translating Discoveries to Enhance Management in AKI

Citrate Reimagined: A Simple Solution to CRRT Anticoagulation Challenges

Ashita Tolwani

12:15-12:30 **Top Abstract Awards**

12:30-2:00pm *Lunch*

THURSDAY AFTERNOON, MARCH 14

SESSION III: EMERGING CONCEPTS IN AKI AND RRT

2:00-3:45pm **Plenary 4 - MINI-SYMPOSIA**
Novel Strategies in AKI Management

Co-Chairs: Danielle Soranno and Patrick Murray

2:00-2:15 **Bicarbonate Therapy for AKI. Yes or No?**
Lui Forni

2:15-2:30 **Application for AKI Early Detection and Prediction Models in Clinical Practice**
SeJoong Kim

2:30-2:45 **Target Blood Pressure to Prevent AKI: Higher or Normotension?**
Nattachai Srisawat

2:45-3:00 **The Aging Kidney: An Old Age Problem**
Michael Joannidis

3:00-3:15 **Clinical Decision Support for AKI: Are We There Yet?**
Neesh Pannu

3:15-3:30 **Urinary Microscopy to Identify Subclinical AKI** 66
Rolando Claure-Del Granado

3:30-3:45 **Waste Not Want Not: The Case for Acute Dialysis**
Ravindra Mehta

3:45-4:15 **Industry Demonstration Showcase**

Coffee Break

THURSDAY AFTERNOON, MARCH 14

Continuation of:

SESSION III: EMERGING CONCEPTS IN AKI AND RRT

4:15-6:00pm **Plenary 5 - MINI-SYMPOSIA**
Challenges and Controversies in Renal Support and CRRT

Co-Chairs: Kat Gist and Michael Connor

4:15-4:30 To Dialyze or Not: That is the Question?
Mitra Nadim

4:30-4:45 **Dynamic Phenotyping for Dialysis Delivery in the ICU**
Ravindra L Mehta

4:45-5:00 **Leveraging Personal Health Platforms for AKI Followup**
Rajit Basu

5:00-5:15 **Dialysis in AKI: When is a Good Thing Bad?**
Kathleen Liu

5:15-5:30 **Albumin and Clinical Outcomes in AKI and CRRT**
Kianoush Kashani

5:30-6:00 **ADQI UPDATE**

5:30-5:45 **ADQI 31: Endpoints for AKI Trials**
Alex Zarbock and Lui Forni

5:45-6:00 **ADQI 32: Role of Sex and Gender in AKI (Sex^{XY} ADQI)**
Danielle Soranno and Marlies Ostermann

6:00 **Adjourn** - *Free Evening*

FRIDAY MORNING, MARCH 15

SESSION IV: IMPROVING OUTCOMES IN AKI

8:00-10:30am **Plenary 6 - MINI SYMPOSIA**
Global Burden of AKI
Co-Chairs: Etienne Macedo and Nattachai Srisawat

8:00-8:15 **Personalization and Standardization of RRT in the ICU: Lessons from Pediatrics**
David Askenazi

8:15-8:30 **Education in AKI: What's Needed?**
Jorge Cerda

8:30-8:45 **Long-COVID Manifesting as Kidney Disease**
Emmanuel Burdmann

8:45-9:00 **Quality of Life Post AKI**
Marlies Ostermann

9:00-9:15 **Nephrology Consultation in the ICU: Who Benefits?**
Harin Rhee

9:15-9:30 **What Outcomes Matter to Patients and Their Relatives?** 68
Sean Bagshaw

9:30-9:45 **Does Treating AKI in Low Resourced Regions Matter?**
Mignon McCulloch

9:45-10:00 **Variation in Pediatric CKRT Practices Across the Globe**
Akash Deep

10:00-10:15 **CRRT Net Initiative: Lessons Learned and Applied**
Javier Neyra

10:15-10:30 **ADQI 33: Obstetric AKI**
Rajasekara Chakravarthi

10:30-11:00 *Coffee Break*

FRIDAY MORNING, MARCH 15

SESSION V: FUTURE TRENDS IN CRRT AND CRITICAL CARE

11:00am-1:00pm **Plenary 7 - MINI SYMPOSIA**
Emerging Strategies in AKI and Extracorporeal Support
Co-Chairs: Vincent Wu and Jorge Cerda

11:00-11:15 **Transitions from CRRT to IRRT: Strategies for Success**
Ron Wald

11:15-11:30 **Reassessing AKD Care and Outcomes: Time to Abandon Conventional Beliefs**
Vincent Wu, MD

11:30-12:35 **Update from Ongoing and Late Breaking Trials**
8-10 minutes each
1. The RELIEVE-AKI Trial - Raghavan Murugan
2. The RECOVER AKI Trial - Javier Neyra
3. Dialyzing Wisely Trial - Oleksa Rewa 69
4. The HERRIC Registry - Vedran Premuzic
5. The RELAX Trial - Christian Nusshag 70
6. WE-ROCK, the Pediatric RRT Collaborative - Kat Gist 69
7. The DIAMOND Study - Jay Koyner
8. The SIN-AKI Study - Vincenzo Cantaluppi

12:35-12:55 **Critical Care Nephrology: Literature Review**
Kianoush Kashani

12:55-1:00 **Closing Remarks**
Ravindra L. Mehta
Chairman

1:00pm **Conference Adjourns**

WEDNESDAY MORNING, MARCH 13

11:00am-12:30pm **SIMULTANEOUS STANDARD WORKSHOPS GROUP 1**

A01 Enhancing Communication in the Workplace: Conversations in Clinical Encounters (C,N,AP) 49

This experiential workshop is designed to support patient care by promoting curiosity, listening and perspective taking skills and will include ways to achieve competence in responding mindfully to stressful and demanding situations in patient encounters. Along with brief interactive didactics, we will use medical improv, reflective and experiential exercises to enhance skills for patient interactions. *(G. Mehta, JM Maury, Ostermann)*

B02 Citrate Anticoagulation for CRRT: How to Use it? (C,N,AP) 50

Regional citrate anticoagulation (RCA) is increasingly utilized for CRRT. Advances in technology have enabled automated citrate anticoagulation. However, concerns remain about its ease of use and application in patients with liver failure and reduced tissue perfusion. This workshop will discuss the best approaches for utilizing RCA for CRRT. *(Tolwani, Joannidis, Ricci)*

C03 Focus on POCUS: Assessment of Fluid Responsiveness, Hemodynamic Monitoring and Targets (C,N) 51

Determining which patient needs fluids, what type, when and how much will be addressed in this workshop which will cover the principles and strategies for volume assessment with point of care ultrasound and hemodynamic monitoring in critically ill patients. *(Fuhrman, Souligny, Deschamps)*

D04 Managing Patients with Combined Kidney and Liver Failure (C,N,AP)

Patients with combined liver and kidney failure are difficult to manage. This workshop will discuss the pathophysiology and illustrate best approaches for differential diagnosis and management of these patients. *(Nadim, Deep, Juncos)*

WEDNESDAY AFTERNOON, MARCH 13

2:00-3:30pm **SIMULTANEOUS STANDARD WORKSHOPS GROUP 2**

A05 Enhancing Communication in the Workplace: Addressing Conflict and Uncertainty (C,N,AP)

This workshop will share evidence-based communication tools useful in situations of conflict and decisional uncertainty. We will use clinical scenarios with role-plays to highlight challenges in decisional conversations with patients of diverse ages, cultures, and socio-economic status, and especially on situations of conflict with patients and families regarding treatment. *(G Mehta, Kashani, Basu, Fuhrman)*

B06 Precision Solute Control and Dynamic Dosing with CRRT? (I,N,AP) 52, 53

CRRT techniques have evolved with availability of new technology to customize dialysis delivery. This interactive case based workshop will discuss how to apply the technology for dose adjustments, monitoring for adequacy, modality selection and transitions in CRRT. *(Claure, Kaushik, Prowle)*

C07 Starting, Transitioning and Stopping RRT for AKI: Science and Art (A) 53

One of the most vexing issues for clinicians is determining when to initiate RRT in critically ill patients, when and how to transition modalities and when it can be stopped. This workshop will use case studies to explore various approaches and establish the principles for clinical decisions for renal support. *(Mehta, Bagshaw, Lumlertgul)*

D08 Managing Patients with Sepsis: Modifying the Course with (ECOS) (C,N,AP) 55

Septic patients often require ECOS to allow time for recovery. This workshop covers the rationale and strategies for the practical application of extracorporeal support techniques for sepsis. Case studies will be utilized to delineate different options. *(Pickkers, Reis, Cantaluppi)*

THURSDAY MORNING, MARCH 14

8:15-9:45am **SIMULTANEOUS STANDARD WORKSHOPS GROUP 3**

MEET THE EXPERT BREAKFAST (Electives, CME Available)

WEDNESDAY, MARCH 13

ME1 - How do I Manage the Patient with Septic AKI - 7:00-8:00am
Derek Angus and Jean-Louis Vincent

ME2 - How do I Dose Volume during CRRT? - 7:00-8:00am
Claudio Ronco and Ashita Tolwani

THURSDAY, MARCH 14

ME3 - How I Use AKI Biomarkers in My Practice - 7:00-8:00am
Alex Zarbock and Stuart Goldstein

ME4 - How do I Manage the Oliguric Patient? - 7:00-8:00am
Ashish Khanna and Jean Louis Vincent

FRIDAY, MARCH 15

ME5 - Deciding who Needs to Start and Stop RRT - 7:00-8:00am
Ron Wald and Marlies Ostermann

ME6 - How do I Assess the Volume Status of My Patient? - 7:00-8:00am
Kianoush Kashani and Peter Pickkers

MORNING SYMPOSIA (CME Available for A, B, C, D, E & F)

WEDNESDAY, MARCH 13 - 7:00-8:00am

A - Plasma Exchange in Critically Ill Patients: Who, When and How
Akash Deep and Ian Baldwin (Moderators)
Vedran Premuzic and Dana Fuhrman *(Discussants)* 45

B - Deresuscitation in the ICU: How to use Diuretics, Ultrafiltration and Dialysis
Kat Gist and Matthew Legrand (Moderators)
Patrick Murray, Amir Kazory and Raghavan Murugan *(Discussants)*.....46

S1 - Additional Morning Session Offered *(Non-CME)* see Final Program for details

THURSDAY, MARCH 14 - 7:00-8:00am

C - Optimization of the CRRT Program to Improve Outcomes ……58, 59, 60
Ashita Tolwani (Moderator)
Manish Kaushik, Ian Baldwin and Oleksa Rewa *(Discussants)*

D - Onco Nephrology: Practical Considerations in Managing AKI in Patients with Cancer
Patrick Murray and Michael Zapitelli (Moderators)
Mitch Rosner, Marlies Ostermann and Linda Awdishu *(Discussants)*

FRIDAY, MARCH 15 - 7:00-8:00am

E - Innovations in Caring for Patients with Electrolyte & Acid Base Problems ……67
Etienne Macedo (Moderator)
Lenar Yessayan and Nuttha Lumertgul *(Discussants)*

F - Optimizing Fluid Management in the ICU: Fit for Purpose?
Michael Connor *(Moderator)*
Andrew Shaw and Ashish Khanna *(Discussants)*

EPIDEMIOLOGY AND OUTCOMES FROM AKI

Poster Number

RESEARCH IN AKI

RRT TECHNIQUE CHARACTERISTICS

RRT APPLICATIONS AND TARGETED INTERVENTION

NEW TECHNOLOGY

RRT RESEARCH

NURSING ISSUES

AKI & CRRT 2024

Practice Based Learning in CRRT: The Science and the Art

Access, Membrane, Circuit

Manish Kaushik MD
3:15-3:45
Monday, March 11

Educational Objectives:
1. Describe vascular access options for CRRT
2. Describe membranes used for CRRT filter and new developments in membrane structure
3. Describe overall circuit design including pressure monitoring and troubleshooting during CRRT

Content Description:
Delivery of CRRT and its impact on quality of care are influenced by various factors. Hardware used during CRRT, including dialysis catheters, CRRT machine and CRRT hemofilters, play an integral part in delivery of CRRT and its impact on solute and fluid control. The choice and integrity of vascular access are key to smooth performance of CRRT, even when other factors to optimise filter life including anticoagulation are in place. The impact of membrane choice on solute control, clearance of larger molecular weight substances and possible immunomodulation during sepsis have to be considered when choosing hemofilters for CRRT. During CRRT constant monitoring of circuit pressures and their trend provide key information with regards to the performance of CRRT. An understanding of the CRRT circuit is key to identify issues and troubleshoot. This session will discuss the general principles of vascular access, membranes and circuit and the implementation of these principles to guide choice during prescription.

Suggested Reading:
1. Luis A. Juncos, Kiran Chandrashekar, Nithin Karakala, Ian Baldwin. Vascular access, membranes and circuit for CRRT. Seminars in Dialysis 2021; 6:406-415.
2. Etienne Macedo, Ravindra Mehta. Continuous Dialysis Therapies: Core Curriculum 2026. Am J Kidney Dis. 2016;68(4):645-657

Dysnatremias and Acid Base Disorders

Lenar Yessayan MD, MS
5:10-6:00
Monday, March 11

Educational Objectives:
1. Understand the application of a variety of techniques to achieve controlled correction of serum sodium levels in dialysis requiring kidney disease.
2. Understand the principles of management of acidosis with buffers and RRT
3. Understand the role and limitation of kidney replacement therapy in lactic acidosis.
4. Understand the role of RRT in select cases of drug poisoning associated with metabolic acidosis.

Content Description:
Disorders of serum sodium concentration and complex acid–base disorders are common in critically ill patients who may have concomitant acute kidney injury, chronic kidney disease or end-stage kidney disease. Acidosis can

have significant consequences on organ systems, and potentially increase mortality. Severe hyponatremia when rapidly corrected may lead to osmotic demyelination syndrome. Continuous renal replacement therapy offers the ability to correct acidosis by transferring large amounts of bicarbonate while avoiding the salt and volume load associated with buffered solution infusion. It also offers the ability to slowly and safely correct severe hyponatremia.

The talk will address acidosis management in critically ill patients with AKI,and discuss renal replacement therapy approaches in states associated with acid-base disorders. It will also discuss the application of a variety of techniques to achieve controlled correction of serum sodium in patients with severe hyponatremia.

Suggested Reading:

1. Yessayan L, Szamosfalvi B, Rosner M. H. (2021). Management of dysnatremias with continuous renal replacement therapy. Semin Dial. 2021; 34(6): 472-9.
2. Yessayan L, Yee J, Frinak S, Szamosfalvi B. Continuous Renal Replacement Therapy for the Management of Acid-Base and Electrolyte Imbalances in Acute Kidney Injury. Adv Chronic Kidney Dis. 2016;23(3):203-10.
3. Yessayan L, Yee J, Frinak S, Szamosfalvi B. Treatment of severe hyponatremia in patients with kidney failure: role of continuous venovenous hemofiltration with low-sodium replacement fluid. Am J Kidney Dis. 2014;64(2):305-10.
4. Jaber S, Paugam C, Futier E, Lefrant JY, Lasocki S, Lescot T, et al. Sodium bicarbonate therapy for patients with severe metabolic acidaemia in the intensive care unit (BICAR-ICU): a multicentre, open-label, randomised controlled, phase 3 trial. Lancet. 2018;392(10141):31-40.
5. Cerda J, Tolwani AJ, Warnock DG. Critical care nephrology: management of acid-base disorders with CRRT. Kidney Int. 2012;82(1):9-18.

Initiation and Discontinuation

Manish Kaushik MD
8:00-8:20
Tuesday, March 12

Educational Objectives:

1. Discuss recent trials in timing of dialysis initiation in critically ill patients with AKI.
3. Discuss a pragmatic approach to initiation of dialysis in critically ill patients with AKI.
3. Discuss approach to stopping dialysis in critically ill patients based on studies that have suggested criteria for discontinuation of dialysis in AKI

Content Description:

Dialysis may be a life-saving intervention in patients with severe complications of AKI. However, in absence of life-threatening complications, the optimal timing of dialysis initiation is not well understood. Recent larger randomised trials have informed us on timing of dialysis initiation. Notably, prophylactic or early initiation, as well as delay in initiation, may both render harm to patients. However, based on the results o these trials a pragmatic approach to dialysis initiation may be developed. On the other hand, patients who have recovered sufficient kidney function must be considered for timely liberation from dialysis, an important outcome measure. However there are no guidelines that provide recommendations for liberation from dialysis. Many observational and retrospective studies have suggested criteria that may predict successful discontinuation dialysis. This session will review the current understanding on initiation and discontinuation of dialysis in AKI and discuss an approach for both.

Suggested Reading:

1. Zarbock A,Kellum JA,Schmidt C,et al.Effect of early vs delayed initiation of renal replacement therapy on mortality in critically ill patients with acute kidney injury: the ELAIN Randomized Clinical Trial. JAMA 2016; 315:2190.
2. Gaudry S, Hajage D, Schortgen F, et al., AKIKI Study Group. Initiation strategies for renal-replacement therapy in the intensive care unit. N Engl J Med 2016; 375:122 – 133.
3. Barbar SD, Clere-Jehl R, Bourredjem A, et al., IDEAL-ICU Trial Investigators and the CRICS TRIGGERSEP Network. Timing of renal-replacement therapy in patients with acute kidney injury and sepsis. N Engl J Med 2018; 379:1431 – 1442.
4. The STARRT-AKI Investigators, Canadian Critical Care Trials Group, Aus- && tralian and New Zealand Intensive Care Society Clinical Trials Group, United Kingdom Critical Care Research Group, Canadian Nephrology Trials Net- work, Irish Critical Care Trials Group. Bagshaw SM, Wald R, et al. Timing of initiation of renal-replacement therapy in acute kidney injury. N Engl J Med 2020; 383:240 – 251.
5. Stéphane Gaudry, David Hajage, Laurent Martin-Lefevre, et al. Comparison of two delayed strategies for renal replacement therapy initiation for severe acute kidney injury (AKIKI 2): a multicentre, open-label, randomised, controlled trial. Lancet 2021; 397(10281):1293-1300

Paper to Digital, e-Prescribing and Charting for CRRT During AKI in the ICU

Ian Baldwin RN, PhD, FACCCN
8:40-9:00
Tuesday, March 12

Educational Objectives:

1. Review the past and progress with paper and documents for CRRT prescription.
2. Understand the concepts and key elements of CRRT prescription and charting.
3. Describe and understand software build and inclusion of CRRT language and new clinical design needed.
4. To consider the benefits and new dimensional thinking for CRRT use in the future.

Content Description:

Recent experience during the COVID-19 Pandemic mandated new paperless documentation and a surge into e-prescribing for CRRT. Intensive Care Unit (ICU) clinical information systems (CIS) may not provide for CRRT beyond the basic data fields for fluid balance charting. Contemporary needs are prescribing therapy mode settings, circuit 'life', fluids used, fluid balance, anticoagulation methods, biochemistry data and results, forward plans, and other decisions associated with CRRT during the course of an illness in ICU. The final construct is a shared design with nurses, pharmacists and doctors having different access to functionality, different screen views, entries, sign off needs and charting. The three key domains are prescribing (orders), charting (recording), forward planning and consideration of deviations (monitoring). The removal of paper has some benefits and the new approach with Live and networked digital function creates a new future. The future may also include machine learning and AI with decision making and more for clinicians to use when prescribing.

Suggested Reading:

Arabi YM, Azoulay E, Al-Dorzi HM, Phua J, Salluh J, Binnie A, et al. How the COVID-19 pandemic will change the future of critical care. Intensive Care Med. 2021;47(3):282-91.

See EJ, Bellomo R. How I prescribe continuous renal replacement therapy. Critical care (London, England). 2021;25(1):1.

Stevens JS, Velez JCQ, Mohan S. Continuous renal replacement therapy and the COVID pandemic. Semin Dial. 2021;34(6):561-6.

Karkar A, Ronco C. Prescription of CRRT: a pathway to optimize therapy. Annals of intensive care. 2020;10(1):32.

Neyra JA, Yessayan L, Thompson Bastin ML, Wille KM, Tolwani AJ. How To Prescribe And Troubleshoot Continuous Renal Replacement Therapy: A Case-Based Review. Kidney360. 2021;2(2):371-84.
Teixeira JP, Neyra JA, Tolwani A. Continuous KRT: A Contemporary Review. Clin J Am Soc Nephrol. 2023;18(2):256-69.

Verma S, Palevsky PM. Prescribing Continuous Kidney Replacement Therapy in Acute Kidney Injury: A Narrative Review. Kidney Med. 2021;3(5):827-36.

Zamanzadeh D, Feng J, Petousis P, Vepa A, Sarrafzadeh M, Karumanchi SA, et al. Data-driven prediction of continuous renal replacement therapy survival. Research square. 2023.

Knowing your Circuit, Alarms, and Other Tricks

Ian Baldwin RN, PhD, FACCCN
9:50-12:00
Tuesday, March 12

Educational Objectives:

1. Review the CRRT circuit, simple to complex and the human interface.
2. To follow the pathway from handover, assessment, priorities and a plan accepting management of CRRT.
3. To consider the new and junior users of CRRT, and the experienced expert.
4. Describe and show some 'tricks' from a list and what they can provide for clinical care, trouble-shooting and optimal use of CRRT.

Content Description:

The circuit for CRRT in association with the pumps, membrane, fluids and software creates a therapy. This system and machine set up is an extracorporeal blood pathway where safety checks and assessments are needed. The handover of patient care when CRRT is in use mandates the nurse as operator to undertake these standard checks efficiently and with compliance. The experienced user may have some tricks to be more efficient, confirm data with logic and to be prepared for the unexpected and the forward time in ICU . The tricks list can be varied and long, however this presentation will consider the value of three key data displayed : Net Ultrafiltration rate (NUF rate), Ultrafiltration Pressure (UF pressure), Transmembrane Pressure (TMP), and the bubble trap (gas, blood and fluids flow).

Suggested Reading:

1. Boyle M and Baldwin I. 2010 Understanding the Continuous Renal Replacement Therapy circuit for Acute Renal failure support; A quality issue in the Intensive Care Unit. AACN Advanced Critical Care Vol. 21 No. 4 pp. 365 - 75
2. Bellomo R, Baldwin I, Ronco C, Kellum J A. 2021. ICU-Based Renal Replacement Therapy. SCCM Journal, March , Vol. 49 No. 3. Pg. 406-418.
3. Baldwin I, Mottes T. Acute kidney injury and continuous renal replacement therapy: A nursing perspective

for my shift today in the intensive care unit. Semin Dial. 2021;34(6):518-29.
4. Juncos LA, Chandrashekar K, Karakala N, Baldwin I. Vascular access, membranes and circuit for CRRT. Semin Dial. 2021;34(6):406-15.

5. Zhang L, Baldwin I, Zhu G, Tanaka A and Bellomo R. 2015 Automated electronic monitoring of circuit pressures during continuous renal replacement therapy : a technical report. Crit care and Resuscitation. Vol. 17 No. 1 March.
6. Baldwin I and Fealy N. 2009 Nursing for renal replacement therapies in the Intensive Care Unit: historical, educational, and protocol review. Blood Purification. 27: 174 – 181.
7. Baldwin I and Fealy N. 2009 Clinical nursing for the application of renal replacement therapies in the Intensive Care Unit. Seminars in Dialysis. Vol. 22 No. 2. pp 189 – 193.

Citrate Lab and Other Anticoagulation alternatives: Concepts to Build Your Protocol

Lenar Yessayan MD, MS
9:50-12:00
Tuesday, March 12

Educational Objectives:

1. Learn how to set up citrate and heparin anticoagulation for CRRT using prismaflex/prismax or Nxstage

2. Determine appropriate labs to obtain for each anticoagulation technique.

3. Troubleshoot anticoagulation issues based on CRRT parameters, labs, and patient clinical condition.

Content Description:

The workshop will cover technical aspects of citrate and heparin prescriptions, determination of citrate toxicity and trouble-shooting causes of hypocalcemia.

Suggested Reading:

Legrand M, Tolwani A. Anticoagulation strategies in continuous renal replacement therapy. Semin Dial. 2021 Nov;34(6):416-422. PMID: 33684244

Tolwani AJ, Prendergast MB, Speer RR, Stofan BS, Wille KM. A practical citrate anticoagulation continuous venovenous hemodiafiltration protocol for metabolic control and high solute clearance. Clin J Am Soc Nephrol. 2006 Jan;1(1):79-87. PMID: 17699194.

Yessayan L, Sohaney R, Puri V, Wagner B, Riddle A, Dickinson S, Napolitano L, Heung M, Humes D, Szamosfalvi B. Regional citrate anticoagulation "non-shock" protocol with pre-calculated flow settings for patients with at least 6 L/hour liver citrate clearance. BMC Nephrol. 2021 Jul 2;22(1):244. PMID: 34215201

Szamosfalvi B, Puri V, Sohaney R, Wagner B, Riddle A, Dickinson S, Napolitano L, Heung M, Humes D, Yessayan L. Regional Citrate Anticoagulation Protocol for Patients with Presumed Absent Citrate Metabolism. Kidney360. 2020 Dec 18;2(2):192-204. PMID: 35373034.

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Yessayan L, Sohaney R, Puri V, Wagner B, Riddle A, Dickinson S, Napolitano L, Heung M, Humes D, Szamosfalvi B. Regional citrate anticoagulation "non-shock" protocol with pre-calculated flow settings for patients with at least 6 L/hour liver citrate clearance. BMC Nephrol. 2021 Jul 2;22(1):244. PMID: 34215201

Szamosfalvi B, Puri V, Sohaney R, Wagner B, Riddle A, Dickinson S, Napolitano L, Heung M, Humes D, Yessayan L. Regional Citrate Anticoagulation Protocol for Patients with Presumed Absent Citrate Metabolism. Kidney360. 2020 Dec 18;2(2):192-204. PMID: 35373034.

Connectology with Hybrid Systems: ECMO, Apheresis, ECCOR

Ian Baldwin RN, PhD, FACCCN
1:00-3:00
Tuesday, March 12

Educational Objectives:
to review
1. Rules for safe use of the extracorporeal circuit.
2. Apheresis with CRRT machines.
3. Devices in parallel or in series
4. Two CRRT machines, one or two vascular access, two techniques, simultaneously.
5. Adsorption therapies with CRRT machines and circuit.

Content Description:
This presentation links to others discussing the use of continuous renal replacement therapy (CRRT) with ECMO and ECCOR in this session.

continued on following page

Conventional CRRT machines do have additional mode(s) and functions to provide apheresis (TPE), or combined plasma exchange with adsorption (e.g. CPFA). There are more recent adsorption cartridges using sorbents, (e.g.Cytosorb) that may be used alone or with supplied connection tubing become an addition to the CRRT circuit and therapy.

Some centers have also progressed experience with use of two CRRT machines providing two techniques (CRRT and Apheresis) simultaneously in the acutely ill. Advanced or hybrid techniques are possible when blood flow outside the body is done safely, with care and following agreed clinical principles. Dialysis grade connectors, tubing, and adherence to some key rules make for a future with many 'add ons' or after-market options to CRRT. Outcome data is limited, but some case reports are inspiring.

This presentation will provide a review for these key areas, with a focus on Apheresis, consider publications and the literature and show some creative and interesting ideas being done.

Suggested Reading:

Baldwin I, Todd S. Therapeutic plasma exchange in the intensive care unit and with the critically ill, a focus on clinical nursing considerations. J Clin Apher. Aug;37(4):397-404.2022.

Fridey J L KAA: Therapeutic apheresis (Plasma exchange or cytapheresis) : Indications and technology. Waltham, MA, UpToDate, 2021, Feb 05.

Yorgin PD, Eklund DK, al-Uzri A, Whitesell L, Theodorou AA: Concurrent centrifugation plasmapheresis and continuous venovenous hemodiafiltration. Pediatr Nephrol 2000;14:18-21.

Sirignano RM, Meyer EK, Fasano R, Paden ML: Pediatric Tandem Therapeutic Apheresis: A Multidisciplinary Approach. ASAIO J 2018;64:382-388.

Ahmed S, Kaplan A: Therapeutic Plasma Exchange Using Membrane Plasma Separation. Clin J Am Soc Nephrol 2020;15:1364-1370.

Redant S, De Bels D, Ismaili K, Honore PM: Membrane-Based Therapeutic Plasma Exchange in Intensive Care. Blood Purif 2021;50:290-297.

Nakae H, Yonekawa C, Wada H, Asanuma Y, Sato T, Tanaka H: Effectiveness of combining plasma exchange and continuous hemodiafiltration (combined modality therapy in a parallel circuit) in the treatment of patients with acute hepatic failure. Ther Apher 2001;5:471-475.

Tufan Pekkucuksen N, Sigler KE, Akcan Arikan A, Srivaths P: Tandem plasmapheresis and continuous kidney replacement treatment in pediatric patients. Pediatr Nephrol 2021;36:1273-1278.

Kaushik M, Liew ZH, Sewa DW, Phua GC, Cao L, Krishnamoorthy TL, Ng SY, Lim AEL, Ng LC, Koniman R, Teo SH, Tan HK, Initiative SINGAPORE: Description of parallel and sequential configurations for concurrent therapeutic plasma exchange and continuous kidney replacement therapy in adults. J Clin Apher 2021;36:211-218.

Nakae H, Yonekawa C, Wada H, Asanuma Y, Sato T, Tanaka H: Effectiveness of combining plasma exchange and continuous hemodiafiltration (combined modality therapy in a parallel circuit) in the treatment of patients with acute hepatic failure. Ther Apher 2001;5:471-475.

Tufan Pekkucuksen N, Sigler KE, Akcan Arikan A, Srivaths P: Tandem plasmapheresis and continuous kidney replacement treatment in pediatric patients. Pediatr Nephrol 2021;36:1273-1278.

Kaushik M, Liew ZH, Sewa DW, Phua GC, Cao L, Krishnamoorthy TL, Ng SY, Lim AEL, Ng LC, Koniman R, Teo SH, Tan HK, Initiative SINGAPORE: Description of parallel and sequential configurations for concurrent therapeutic plasma exchange and continuous kidney replacement therapy in adults. J Clin Apher 2021;36:211-218.

Sanchez AP, Ward DM, Cunard R. Therapeutic plasma exchange in the intensive care unit: Rationale, special considerations, and techniques for combined circuits. Ther Apher Dial. 2022 Dec;26 Suppl 1:41-52. doi: 10.1111/1744-9987.13814. Epub 2022 Dec 5. PMID: 36468345.

Multifiltrate

Lenar Yessayan MD, MS
3:15-4:45
Tuesday, March 12

Educational Objectives:
1. Understand the multiFiltratePRO machine set-up and functionality.
2. Highlight key safety features of the machine.

Content Description:
The session will provide an overview of the multiFiltratePRO device by Fresenius Medical Care. This continuous renal replacement therapy device is used in numerous global markets, and the discussion will cover the device's setup, functionality, and key safety features.

Complementary Role of Kidney Biomarkers and Transcriptomic Endotyping in Sepsis Associated AKI

Christian Nusshag MD
10:55-11:15
Tuesday, March 12

Educational Objectives:
1) Describe the rational and goal of endotyping for sepsis and acute kidney injury in this context.
2) Discuss the potential advantages of endotpying in sepsis-associated acute kidney injury for clinical management and outcome prediction.
3) Compare the role of endotyping to kidney function and damage biomarkers.

Content Description:
Acute kidney injury (AKI) is the most frequent organ dysfunction in critically ill patients with sepsis. Optimal clinical management, including the timing of renal replacement therapy (RRT), is still unclear, caused by the inherent heterogeneity of the syndrome. We sought to apply transcriptomic endotypes in combination with classical kidney function and newer kidney damage biomarkers to a cohort of critically ill patients with sepsis to investigate their interdependent role in predicting kidney outcome. Based on Nanostring gene expression analyses of 33 signature mRNAs, patients were assigned to one of three pre-described endotypes (inflammopathic (IE), adaptive (AE), coagulopathic (CE)). An overall endotype assignment for each subject was calculated using a multi-class logistic regression model which generated a probability of endotype assignment (for each subject, the total probability [p(Inflammopathic) + p(Adaptive) + p(Coagulopathic)] sums to 1). The respective endotypes were compared with biomarkers of kidney function, stress or damage.

Clinical outcomes were recorded over a follow-up period of 30d (RRT, AKI trajectory, 7/30d all-cause mortality).

Suggested Reading:
1)Sepsis-associated acute kidney injury: consensus report of the 28th Acute Disease Quality Initiative workgroup.Zarbock A, Nadim MK, Pickkers P, Gomez H, Bell S, Joannidis M, Kashani K, Koyner JL, Pannu N, Meersch M, Reis T, Rimmelé T, Bagshaw SM, Bellomo R, Cantaluppi V, Deep A, De Rosa S, Perez-Fernandez X, Husain-Syed F, Kane-Gill SL, Kelly Y, Mehta RL, Murray PT, Ostermann M, Prowle J, Ricci Z, See EJ, Schnei-

der A, Soranno DE, Tolwani A, Villa G, Ronco C, Forni LG. Nat Rev Nephrol. 2023 Jun;19(6):401-417. doi: 10.1038/s41581-023-00683-3. Epub 2023 Feb 23.
PMID: 36823168 Review.

2)Biomarker Enrichment in Sepsis-Associated Acute Kidney Injury: Finding High-Risk Patients in the Intensive Care Unit. Baeseman L, Gunning S, Koyner JL.Am J Nephrol. 2024;55(1):72-85. doi: 10.1159/000534608. Epub 2023 Oct 16. PMID: 37844555 Review.

3) The pathophysiology of sepsis and precision-medicine-based immunotherapy.
Giamarellos-Bourboulis EJ, Aschenbrenner AC, Bauer M, Bock C, Calandra T, Gat-Viks I, Kyriazopoulou E, Lupse M, Monneret G, Pickkers P, Schultze JL, van der Poll T, van de Veerdonk FL, Vlaar APJ, Weis S, Wiersinga WJ, Netea MG.Nat Immunol. 2024 Jan;25(1):19-28. doi: 10.1038/s41590-023-01660-5. Epub 2024 Jan 2. PMID: 38168953 Review.

4)Pediatric Sepsis Endotypes Among Adults With Sepsis.
Wong HR, Sweeney TE, Hart KW, Khatri P, Lindsell CJ. Crit Care Med. 2017 Dec;45(12):e1289-e1291. doi: 10.1097/CCM.0000000000002733.PMID: 28991828

5)Validation of Inflammopathic, Adaptive, and Coagulopathic Sepsis Endotypes in Coronavirus Disease 2019.
Sweeney TE, Liesenfeld O, Wacker J, He YD, Rawling D, Remmel M, Coyle S, Midic U, Kotsaki A, Kanavou A, Leventogiannis K, Kontogeorgou I, Giamarellos-Bourboulis EJ. Crit Care Med. 2021 Feb 1;49(2):e170-e178. doi: 10.1097/CCM.0000000000004786. PMID: 33201004

6)Defining critical illness using immunological endotypes in patients with and without sepsis: a cohort study.
Balch JA, Chen UI, Liesenfeld O, Starostik P, Loftus TJ, Efron PA, Brakenridge SC, Sweeney TE, Moldawer LL. Crit Care. 2023 Jul 20;27(1):292. doi: 10.1186/s13054-023-04571-x. PMID: 37474944

7)Unsupervised Analysis of Transcriptomics in Bacterial Sepsis Across Multiple Datasets Reveals Three Robust Clusters. Sweeney TE, Azad TD, Donato M, Haynes WA, Perumal TM, Henao R, Bermejo-Martin JF, Almansa R, Tamayo E, Howrylak JA, Choi A, Parnell GP, Tang B, Nichols M, Woods CW, Ginsburg GS, Kingsmore SF, Omberg L, Mangravite LM, Wong HR, Tsalik EL, Langley RJ, Khatri P. Crit Care Med. 2018 Jun;46(6):915-925. doi: 10.1097/CCM.0000000000003084.PMID: 29537985

Point of Care Ultrasound (POCUS): Science and Practice

William Beaubien-Souligny Dr
8:00-4:00
Tuesday, March 12

Educational Objectives:

1.Cardiac: A. Qualitative assessment of chamber size and systolic function; B. Identification of severe valvulopathy; C. Assessment of pericardial fluid and tamponade physiology
2.Thoracic: A. Qualitative assessment of pleural effusion size and characteristics; B. Identification of pneumothorax; C. Assessment of alveolar consolidation and interstitium
3. Abdominal: A. Identification of kidney and bladder and assessment of kidney size and echogenicity, and evaluation of urinary obstruction; B. Identification of intraperitoneal fluid; C. Qualitative assessment of abdominal aorta size
4.Vascular and vascular access: A. Patency and caliber of main veins for catheter placement;
B. Identifying the presence of a thrombus; C. Basic examination of an arteriovenous fistula/graft
5. Hemodynamic and fluid evaluation: A. Inferior vena cava visualization and assessment; B. Venous Doppler assessment; C. Estimating stroke volume / cardiac output

Content Description:

This course is designed for nephrology and critical care providers to learn the basics of Point-Of-Care Ultrasound with a specific focus on frequent pathologies found in acutely ill patients. This workshop will include brief didactic sessions and hands-on sessions. At the end of this workshop, the trainees will have basic knowledge about indications for POCUS, normal/abnormal findings, and how this can be integrated in the evaluation of the patients. The aim is to provide the introductory practical skills necessary to continue their training autonomously. A quiz will be administered pre-and post- course for assessment.

Morning Symposium A - Plasma Exchange in Critically Ill Patients: Who, When and How

Dana Fuhrman DO, MS
7:00-8:00
Wednesday, March 13

Educational Objectives:

1. Identify the indications/cohort of critically ill patients who would benefit from plasma exchange
2. Understand the practical and technical issues in providing plasma exchange to critically ill patients
3. Be familiar with the timing of initiation of plasma exchange in the trajectory of a patient's illness
4. Understand the use of plasma exchange in patients with fulminant hepatic failure and in those with septic shock

Content Description:

Extracorporeal therapies in critically ill patients play an important role in removing toxins, fluid and immune modulation. Therapeutic apheresis encompasses the removal of plasma (plasmapheresis) or blood cells (cytapheresis, i.e., erythrocytes, leukocytes, or platelets) from the patient's blood. If plasma is removed not for donation but for therapeutic purposes and is replaced by donor plasma, colloid, or crystalloids or a mixture thereof, it defines therapeutic plasma exchange (TPE). TPE serves to remove pathogenic substances (e.g., autoantibodies or toxic agents) and/or to administer deficient substances present in plasma of healthy donors. The indications for TPE have been refined over time. Many patients who require TPE are critically ill needing admission to the intensive care unit (ICU). TPE is an invasive procedure with often emergent indications, demanding its execution as soon as possible. Thus, a rapid response by experienced staff, with specific equipment, close monitoring, and multidisciplinary management are essential. In this symposium, we discuss the indications of TPE in critically ill patients, techniques (how to) used in performing TPE either alone or in combination with CRRT; complications and trouble shooting. We will discuss the role of TPE in specific conditions like fulminant hepatic failure and septic shock.

Suggested Reading:

1.Michael M, Elliott EJ, Ridley GF, Hodson EM, Craig JC. Interventions for haemolytic uraemic syndrome and thrombotic thrombocytopenic purpura. Cochrane Database Syst Rev. 2009 Jan 21;2009(1):CD003595.
2.Szczepiorkowski ZM, Winters JL, Bandarenko N, Kim HC, Linenberger ML, Marques MB, et al. Guidelines on the use of therapeutic apheresis in clinical practice--evidence-based approach from the Apheresis Applications Committee of the American Society for Apheresis. J Clin Apher. 2010;25(3):83-177.
3.Reeves HM, Winters JL. The mechanisms of action of plasma exchange. Br J Haematol. 2014 Feb;164(3):342-51.
4.Cortina G, McRae R, Chiletti R, Butt W. Therapeutic Plasma Exchange in Critically Ill Children Requiring Intensive Care. Pediatr Crit Care Med. 2018 Feb;19(2):e97-e104.
5.Padmanabhan A, Connelly-Smith L, Aqui N, Balogun RA, Klingel R, Meyer E, et al. Guidelines on the Use of Therapeutic Apheresis in Clinical Practice - Evidence-Based Approach from the Writing Committee of the American Society for Apheresis: The Eighth Special Issue. J Clin Apher. 2019 Jun;34(3):171-354.
6.Pham HP, Schwartz J. Therapeutic Plasma Exchange in Guillain-Barre Syndrome and chronic inflammatory demyelinating polyradiculoneuropathy. Presse Med. 2019 Nov;48(11 Pt 2):338-46.
7.Abe T, Matsuo H, Abe R, Abe S, Asada H, Ashida A, et al. The Japanese Society for Apheresis clinical practice guideline for therapeutic apheresis. Ther Apher Dial. 2021 Dec;25(6):728-876.
8.Alexander EC, Deep A. Therapeutic plasma exchange in children with acute liver failure (ALF): is it time for incorporation into the ALF armamentarium? Pediatr Nephrol. 2022 Aug;37(8):1775-88.
9.Foglia MJ, Pelletier JH, Bayir H, Fleck A, Konyk L, McSteen C, et al. Tandem Therapeutic Plasma Exchange Reduces Continuous Renal Replacement Therapy Downtime. Blood Purif. 2022;51(6):523-30.
10.Fuhrman DY, Thadani S, Hanson C, Carcillo JA, Kellum JA, Park HJ, et al. Therapeutic Plasma Exchange Is Associated With Improved Major Adverse Kidney Events in Children and Young Adults With Thrombocytopenia at the Time of Continuous Kidney Replacement Therapy Initiation. Crit Care Explor. 2023 Apr;5(4):e0891.
11.Baldwin I, Todd S. Therapeutic plasma exchange in the intensive care unit and with the critically ill, a focus on clinical nursing considerations. J Clin Apher. 2022 Aug;37(4):397-404. doi: 10.1002/jca.21984. Epub 2022 Apr 6. PMID: 35385601; PMCID: PMC9539889.

Morning Symposium B - Deresuscitation in the ICU: How to use Diuretics, Ultrafiltration and Dialysis

Amir Kazory MD, FASN, FACC
7:00-8:00
Wednesday, March 13

Educational Objectives:
1. Describe mechanisms leading to loop diuretic resistance and how to mitigate them
2. Discuss the principles of diuretic therapy and ultrafiltration in patients with acute heart failure
3. Discuss the nuances of fluid removal with CRRT in the critically-ill

Content Description:
Fluid overload is associated with morbidity and mortality in a variety of clinical scenarios including critical illness and heart failure as it exerts pathologic sequelae in almost every organ system. Proper management of patients with fluid overload requires knowledge of the underlying pathophysiology, objective evaluation of volume status, selection of appropriate therapeutic options, and maintenance and modulation of tissue perfusion. A subset of critically-ill patients may need therapeutic interventions for fluid management including diuretic therapy. In the presence of a failing kidney or suboptimal response to diuretics, fluid removal is often a challenge and may be necessitate use of strategies such as sequential nephron blockade or renal replacement therapy. In order to utilize these therapies for their maximum potential it is necessary to recognize the factors which influence fluid balance and have an understanding of the principles of fluid management with these techniques.

This symposium will describe the basic methods for fluid management with diuretics and CRRT in the critically ill and those patients with acute heart failure. We will discuss the key clinical findings of the most recent landmark trials, their implications, and their shortcomings followed by selected practical considerations and recommendations. We will use case studies to further delineate the best practices for achieving optimal fluid balance and euvolemia in this setting.

Suggested Reading:
A. Fluid Overload & Deresuscitation in Critical Illness:
1. Malbrain M, Osterman M: Everything you need to know about deresuscitation. Intensive Care Med 2022;48:1781–1786.
2. Vignon P, Evrard B, Asfar P, Busana M, Calfee CS, Coppola S, Demiselle J, Geri G, Jozwiak M, Martin GS, Gattinoni L, Chiumello D: Fluid administration and monitoring in ARDS: which management? Intensive Care Med. 2020 Dec;46(12):2252-2264.
3. Silversides JA, et al: Feasibility of conservative fluid administration and deresuscitation compared with usual care in critical illness: the Role of Active Deresuscitation After Resuscitation−2 (RADAR−2) randomised clinical trial. Intensive Care Medicine. 2017; 43: 155-170.

B. Diuretic Resistance Mechanisms and Strategies to Mitigate:
1. Novak JE, Ellison JH: Diuretics in states of volume overload: Core Curriculum 2022. Am J Kidney Dis 2022;80(2):264-276.
2. Ellison DH, Felker JM: N Engl J Med 2017;377:1964-75.
3. Cox ZL, Rao VS, Testani JL: Classic and novel mechanisms of diuretic resistance in cardiorenal syndrome. Kidney 360. 2022;3: 954–967.

C. Fluid Balance Management in Critical Illness:
1. Côté JM, Goulamhoussen N, McMahon BA, Murray PT: Diuretic combinations in critically ill patients with respiratory failure: A systematic review and meta-analysis. World J Crit Care Med 2022; 11(3): 178-191.

continued on following page

2. Côté JM, Bouchard J, Murray PT, Beaubien-Souligny W: Diuretic strategies in patients with resistance to loop-diuretics in the intensive care unit: A retrospective study from the MIMIC-III database. Journal of Critical Care 2021;65:282–291.
3. Escudero VJ, Mercadal J, Molina-Andu´ jar A, Piñeiro GJ, Cucchiari D, Jacas A, Carramiñana A and Poch E: New Insights into Diuretic Use to Treat Congestion in the ICU: Beyond Furosemide. Front. Nephrol. 2022;2:879766.
4. Mercier JA, Ferguson TW, Tangri N: A machine learning model to predict diuretic resistance. KIDNEY360, 2023; 4: 15–22.
5. Famous KR, et al, for the ARDS Network: Acute respiratory distress syndrome subphenotypes respond differently to randomized fluid management strategy. Am J Respir Crit Care Med 2017 Feb 1;195(3):331-338.

D. Fluid Balance in Heart Failure

Kazory A. Combination diuretic therapy to counter renal sodium avidity in acute heart failure: trials and tribulations. Clin J Am Soc Nephrol. 2023 Oct 1;18(10):1372–81.
Kazory A, Ronco C. Tackling congestion in acute heart failure: is it the primetime for "combo diuretic therapy?". Cardiorenal Med. 2023 Feb 14;13(1):184–8.
Kazory A, Sgarabotto L, Ronco C. Extracorporeal ultrafiltration for acute heart failure. Cardiorenal Med. 2023;13(1):1–8.
Kazory A, Ronco C, Koratala A. Cardiorenal interactions in acute heart failure; renal proximal tubules in the spotlight. Cardiorenal Med. 2024 Jan 16;
Kazory A, Costanzo MR. Extracorporeal isolated ultrafiltration for management of congestion in heart failure and cardiorenal syndrome. Adv Chronic Kidney Dis. 2018 Sep;25(5):434–42.

E. Fluid removal, AKI, and CRRT

Bouchard J, Soroko SB, Chertow GM, et al. Fluid accumulation, survival and recovery of kidney function in critically ill patients with acute kidney injury. Kidney Int. 2009;76(4):422-427
Mehta RL, Pascual MT, Soroko S, Chertow GM, Group PS. Diuretics, mortality, and nonrecovery of renal function in acute renal failure. JAMA. 2002;288(20):2547-2553
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Balakumar V, Murugan R. Kidney Replacement Therapy for Fluid Management. Critical Care Clinics. 2021
Murugan R, Balakumar V, Kerti SJ, et al. Net ultrafiltration intensity and mortality in critically ill patients with fluid overload. Crit Care. 2018;22(1):223.PMC6151928
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Murugan R, Hoste E, Mehta RL, et al. Precision Fluid Management in Continuous Renal Replacement Therapy. Blood Purif. 2016;42(3):266-278
Murugan R, Kerti SJ, Chang CH, et al. Association of Net Ultrafiltration Rate With Mortality Among Critically Ill Adults With Acute Kidney Injury Receiving Continuous Venovenous Hemodiafiltration: A Secondary Analysis of the Randomized Evaluation of Normal vs Augmented Level (RENAL) of Renal Replacement Therapy Trial. JAMA Netw Open. 2019;2(6):e195418.PMC6563576
Murugan R, Kerti SJ, Chang CH, et al. Association between Net Ultrafiltration Rate and Renal Recovery among Critically Ill Adults with Acute Kidney Injury Receiving Continuous Renal Replacement Therapy: An Observational Cohort Study. Blood Purif. 2021:1-13
Murugan R, Kashani K, Palevsky PM. Precision net ultrafiltration dosing in continuous kidney replacement therapy: a practical approach. Intensive Care Med Exp. Nov 28 2023;11(1):83.
Neyra JA, Mehta RL, Murugan R. Fluid management during CRRT: A case-based approach. Nephron. Oct 4 2023

Hidden in Plain Sight; Chloride in Acute Heart Failure

Amir Kazory MD, FASN, FACC
8:30-8:45
Wednesday, March 13

Educational Objectives:

1. Describe the shortcomings of a sodium-centric approach in heart failure
2. Discuss the correlation of serum chloride and sodium levels with outcomes in heart failure
3. Discuss the findings of the clinical studies exploring the impact of carbonic anhydrase inhibition on the outcomes in heart failure

Content Description:

The cardiorenal literature has long been dominated by a sodium-centric view. However, mechanisms affecting sodium homeostasis in patients with heart failure (HF) commonly lead to concurrent changes in the serum levels of chloride as well. There is a growing body of evidence on a strong link between low serum chloride levels and adverse outcomes in HF, which might be even more potent than that of sodium. Maladaptive neurohormonal activation and unresponsiveness to diuretics have been proposed as potential mechanisms to explain this phenomenon. In parallel with accumulating evidence on the predictive value of chloride in various HF populations, the limited available interventional studies that were aimed at increasing serum chloride levels have also shown promising results. More recent trials of carbonic anhydrase inhibition, which modulates chloride transport in the proximal tubules, have shown improvement in congestion. More studies are needed elucidate the role of chloride as a key cardiorenal connector and whether hypochloremia represents a modifiable risk factor (i.e., target of therapy) or a mere marker of disease severity and poor prognosis.

Suggested Reading:

1. Kazory A. Combination diuretic therapy to counter renal sodium avidity in acute heart failure: trials and tribulations. Clin J Am Soc Nephrol. 2023 Oct 1;18(10):1372–81.
2. Kazory A, Ronco C. Tackling congestion in acute heart failure: is it the primetime for “combo diuretic therapy?”. Cardiorenal Med. 2023 Feb 14;13(1):184–8.
3. Kazory A. Chloride and cardiorenal interactions in heart failure. Nephron. 2023;147(1):6–8.
4. Rivera FB, Alfonso P, Golbin JM, Lo K, Lerma E, Volgman AS, et al. The role of serum chloride in acute and chronic heart failure: A narrative review. Cardiorenal Med. 2021 Apr 19;11(2):87–98.
5. Kazory A, Ronco C. Emergence of chloride as an overlooked cardiorenal connector in heart failure. Blood Purif. 2020;49(1–2):219–21.
6. Meekers E, Dauw J, Martens P, Dhont S, Verbrugge FH, Nijst P, et al. Renal function and decongestion with acetazolamide in acute decompensated heart failure: the ADVOR trial. Eur Heart J. 2023 Oct 1;44(37):3672–82.
7. Verbrugge FH, Martens P, Dauw J, Nijst P, Meekers E, Augusto SN, et al. Natriuretic Response to Acetazolamide in Patients With Acute Heart Failure and Volume Overload. J Am Coll Cardiol. 2023 May 23;81(20):2013–24.
8. Mullens W, Dauw J, Martens P, Verbrugge FH, Nijst P, Meekers E, et al. Acetazolamide in Acute Decompensated Heart Failure with Volume Overload. N Engl J Med. 2022 Sep 29;387(13):1185–95.

A01
Enhancing Communication in the Workplace: Conversations in Clinical Encounters

Gita Mehta MD
11:00-12:30
Wednesday, March 13

Educational Objectives:

1. Examine the principles and value of accepting imperfection.
2. Discuss and practice communication skills that support patient care:deep listening, understanding different perspectives, responding with empathy.
3. Review communication skills that assist in difficult conversations.

Content Description:

Effective communication leads to increased clinician trust, higher patient satisfaction and improved clinical outcomes for the patient. Moreover, clinicians skilled at communication have better work satisfaction and reduced burnout. Communication skills can be learned, and our workshop is designed to strengthen foundational skills using activities, reflections, and medical improvisation. We will address relational listening, perspective taking, and responding with empathy to establish trust in the clinician-patient relationship.

Presentation Outline:

1.Interactive experiential workshop to increase understanding of communication skills.
2 Building inclusion safety with an exercise in being imperfect.
3.Practicing medical improv techniques to learn foundational communication skills.
4.Reflection to increase self-awareness and construction of new meaning.
5.Group discussion of a challenging case scenario to enable application and translation to medical practice.

Suggested Reading:

1.Watson, Katie JD. Perspective: Serious Play: Teaching Medical Skills With Improvisational Theater Techniques. Academic Medicine 86(10):p 1260-1265, October 2011. | DOI: 10.1097/ACM.0b013e31822cf858
2.Belinda Fu (2018): Common Ground: Frameworks for Teaching Improvisational Ability in Medical Education, Teaching and Learning in Medicine, DOI: 10.1080/10401334.2018.1537880
3.Boissy A, Windover AK, Bokar D, Karafa M, Neuendorf K, Frankel RM, Merlino J, Rothberg MB. Communication Skills Training for Physicians Improves Patient Satisfaction. J Gen Intern Med. 2016 Jul;31(7):755-61. doi: 10.1007/s11606-016-3597-2. Epub 2016 Feb 26. PMID: 26921153; PMCID: PMC4907940.
4. Singh Ospina N, Phillips KA, Rodriguez-Gutierrez R, Castaneda-Guarderas A, Gionfriddo MR, Branda ME, Montori VM. Eliciting the Patient's Agenda- Secondary Analysis of Recorded Clinical Encounters. J Gen Intern Med. 2019 Jan;34(1):36-40. doi: 10.1007/s11606-018-4540-5. Epub 2018 Jul 2. PMID: 29968051; PMCID: PMC6318197.
5. Katzman, J. , Weiss, E. , Ojeda, C. , Katzman, W. and Felsman, P. (2023) A Pilot Experience with Improvisational Theater to Reduce Burnout in Psychiatric Residency. Creative Education, 14, 1094-1110. doi: 10.4236/ce.2023.145070.
6.Mehta, A. , Hendel-Paterson, B. , Shah, N. , Hemphill, J. , Adams, N. , Fredrickson, M. (2024) Intelligent play: How improv can improve clinician's emotional intelligence. The Clinical Teacher, e13730. doi: https://doi.org/10.1111/tct.13730
7.Chan CA, Chou E, LaDisa AG, Mehta A, Zelenski A, Longtin K. Using nominal group technique to determine skills that applied improvisation can teach health profession education learners. PEC Innov. 2023 Jul 25;3:100194. doi: 10.1016/j.pecinn.2023.100194. PMID: 37576803; PMCID: PMC10415759.
8.Chan CA, Windish DM, Spak JM, Makansi N. State-of-the-art review of medical improvisation curricula to teach health professional learners communication. Adv Health Sci Educ Theory Pract. 2023 Nov 3. doi: 10.1007/s10459-023-10296-x. Epub ahead of print. PMID: 37921903.
9.Hoffman A, Utley B, Ciccarone D. Improving medical student communication skills through improvisational theatre. Med Educ. 2008;42:537–538.
10.Kaplan-Liss E, Lantz-Gefroh V, Bass E, Killebrew D, Ponzio N, Savi C, O'Connell C. Teaching Medical Students to Communicate With Empathy and Clarity Using Improvisation. Acad Med. 2018;93(3):440-43.

B02
Citrate Anticoagulation for CRRT: How to Use it?

Ashita Tolwani MD
11:00-12:30
Wednesday, March 13

Educational Objectives:

1. Review the principles of regional citrate anticoagulation (RCA) for CRRT rationale, mechanism, and metabolic effects/complications
2. Discuss the practical issues for citrate implementation: prescription, monitoring, and troubleshooting acid-base complications.
3. Discuss lessons learned from RCA in the pediatric population.

Content Description:

Regional citrate anticoagulation (RCA) has been shown to prolong circuit life while reducing the incidence of hemorrhagic complications and lowering transfusion needs. Citrate is infused into the blood at the beginning of the extracorporeal circuit and provides anticoagulation by chelating ionized calcium and thus preventing the progression of the coagulation cascade. About 50% of the calcium-citrate is removed via the filter. The remainder enters the systemic circulation of the patient, where it is diluted and metabolized by the liver to bicarbonate, releasing ionized calcium back to the circulation. Since a portion of the calcium-citrate complex is filtered across the hemofilter and lost in the effluent, a systemic calcium infusion is usually necessary. Anticoagulation is limited to the circuit by maintaining normal levels of ionized calcium in the systemic circulation. Citrate has metabolic effects, too. It can cause both, metabolic alkalosis and metabolic acidosis, depending on whether it is metabolized in liver and muscle, or accumulates (ie. liver failure, cardiovascular shock). In children, especially infants and those with liver disease, RCA prescription and monitoring is associated with unique and significant challenges, but is feasible to perform safely.

Guided by a case-based approach, this workshop will discuss the best approaches for utilizing RCA for CRRT, including how to trouble-shoot the metabolic consequences of RCA in both the adult and pediatric population.

Suggested Reading:

1. Buccione E, Bambi S, Rasero L, Tofani L, Piazzini T, Della Pelle C, El Aoufy K, Ricci Z, Romagnoli S, Villa G. Regional Citrate Anticoagulation and Systemic Anticoagulation during Pediatric Continuous Renal Replacement Therapy: A Systematic Literature Review. J Clin Med. 2022 May 31;11(11):3121.
2. Li R, Gao X, Zhou T, Li Y, Wang J, Zhang P. Regional citrate versus heparin anticoagulation for continuous renal replacement therapy in critically ill patients: A meta-analysis of randomized controlled trials. Ther Apher Dial. 2022 Dec;26(6):1086-1097.
3. Mann, K. G., et al. "Citrate Anticoagulation and the Dynamics of Thrombin Generation." Journal of Thrombosis and Haemostasis: JTH, vol. 5, no. 10, Oct. 2007, pp. 2055–61. PubMed, doi:10.1111/j.1538-7836.2007.02710.x.
4. Morabito S, Pistolesi V, Tritapepe L, Fiaccadori E, et al. Regional citrate anticoagulation for RRTs in critically ill patients with AKI. Clin J Am Soc Nephrol 2014; 9(12):2173.
5. Oudemans-van Straaten HM, Ostermann M. Bench-to-bedside review: Citrate for continuous renal replacement therapy, from science to practice. Crit Care. 2012 Dec 7;16(6):249.
6. Ricci, Davide, et al. "Citrate Anticoagulation during Continuous Renal Replacement Therapy." Contributions to Nephrology, vol. 190, 2017, pp. 19–30. PubMed, doi:10.1159/000468833.
7. Schneider AJ, Journois D, Rimmelé T. Complications of regional citrate anticoagulation: accumulation or overload? Critical Care (2017) 21:281
8. Szamosfalvi, Balazs, et al. "Automated Regional Citrate Anticoagulation: Technological Barriers and Possible Solutions." Blood Purification, vol. 29, no. 2, 2010, pp. 204–09. PubMed, doi:10.1159/000245648.

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9. Wang PL, Meyer MM, Orloff SL, Anderson S. Bone resorption and “relative” immobilization hypercalcemia with prolonged continuous renal replacement therapy and citrate anticoagulation. Am J Kidney Dis 2004;44:1110-1114
10. Zarbock A,et a.; RICH Investigators and the Sepnet Trial Group. Effect of Regional Citrate Anticoagulation vs Systemic Heparin Anticoagulation During Continuous Kidney Replacement Therapy on Dialysis Filter Life Span and Mortality Among Critically Ill Patients With Acute Kidney Injury: A Randomized Clinical Trial. JAMA. 2020 Oct 27;324(16):1629-1639. doi: 10.1001/jama.2020.18618. PMID: 33095849; PMCID: PMC7585036.
11. Davis et al. Citrate Anticoagulation During Continuous Renal Replacement Therapy in Pediatric Critical Care. Pediatric Critical Care Medicine. 2014. 15:471-485.
12. Bunchman et al. Pediatric Convective Hemofiltration: Normocarb Replacement Fluid and Citrate Anticoagulation. American Journal of Kidney Disease. 2003. 42: 1248-1252
13. Liet et al. Regional citrate anticoagulation for pediatric CRRT using integrated citrate software and physiological sodium concentration solutions. Pediatric Nephrology. 2014. 29: 1625-1631
14. Yessayan L, Sohaney R, Puri V, Wagner B, Riddle A, Dickinson S, Napolitano L, Heung M, Humes D, Szamosfalvi B. Regional citrate anticoagulation "non-shock" protocol with pre-calculated flow settings for patients with at least 6 L/hour liver citrate clearance. BMC Nephrol. 2021 Jul 2;22(1):244

C03
Focus on POCUS: Assessment of Fluid Responsiveness, Hemodynamic Monitoring and Targets

William Beaubien-Souligny Dr
11:00-12:30
Wednesday, March 13

Educational Objectives:
1. Review the information that can be gathered from a complete POCUS assessment
2. Review the relevance of POCUS-derived information
3. Discuss the differences between POCUS assessment in adults and children

Content Description:
Point-Of-Care ultrasound enable the clinician to assess hemodynamic information in critically ill patients including cardiac function, venous congestion, cardiac output, and more. Combined with other sources of information, this can help define the phenotype of the patient and individualize management. In this workshop, we will offer an overview of the different type of information that can be gathered from POCUS including their respective limitations. We will then discuss through various cases how combining POCUS and other sources of clinical information can help us to determine the most appropriate intervention based of the physiology of the patient and the appreciation of the concept of fluid tolerance. Finally, we will discuss the differences is POCUS related to the care of adults and children.

Suggested Reading:
1. Kattan E, Castro R, Miralles-Aguiar F, Hernández G, Rola P. The emerging concept of fluid tolerance: A position paper. J Crit Care. 2022 Oct;71:154070. doi: 10.1016/j.jcrc.2022.154070. Epub 2022 Jun 2. PMID: 35660844.
2. Kenny JS, Prager R, Rola P, Haycock K, Basmaji J, Hernández G. Unifying Fluid Responsiveness and Tolerance With Physiology: A Dynamic Interpretation of the Diamond-Forrester Classification. Crit Care Explor. 2023 Dec 12;5(12):e1022. doi: 10.1097/CCE.0000000000001022. PMID: 38094087; PMCID: PMC10718393.
2. Gan H, Cannesson M, Chandler JR, Ansermino JM: Predicting fluid responsiveness in children: a systematic review. Anesthesia and analgesia 2013, 117(6):1380-1392.
3. Joannidis M, Forni LG, Klein SJ, Honore PM, Kashani K, Ostermann M, Prowle J, Bagshaw SM, Cantaluppi V, Darmon M et al: Lung-kidney interactions in critically ill patients: consensus report of the Acute Disease Quality Initiative (ADQI) 21 Workgroup. Intensive Care Med 2019.

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4. Maitland K, Kiguli S, Opoka RO, Engoru C, Olupot-Olupot P, Akech SO, Nyeko R, Mtove G, Reyburn H, Lang T et al: Mortality after fluid bolus in African children with severe infection. N Engl J Med 2011, 364(26):2483-2495.
5. Silversides JA, Fitzgerald E, Manickavasagam US, Lapinsky SE, Nisenbaum R, Hemmings N, Nutt C, Trinder TJ, Pogson DG, Fan E et al: Deresuscitation of Patients With Iatrogenic Fluid Overload Is Associated With Reduced Mortality in Critical Illness. Crit Care Med 2018, 46(10):1600-1607.
6. Beaubien-Souligny W, Bouchard J, Desjardins G, Lamarche Y, Liszkowski M, Robillard P, Denault A: Extracardiac Signs of Fluid Overload in the Critically Ill Cardiac Patient: A Focused Evaluation Using Bedside Ultrasound. Can J Cardiol 2017, 33(1):88-100.
8. Iida N, Seo Y, Sai S, Machino-Ohtsuka T, Yamamoto M, Ishizu T, Kawakami Y, Aonuma K: Clinical Implications of Intrarenal Hemodynamic Evaluation by Doppler Ultrasonography in Heart Failure. JACC Heart Fail 2016, 4(8):674-682.
9. Miller TE, Myles PS: Perioperative Fluid Therapy for Major Surgery. Anesthesiology 2019, 130(5):825-832.
10. Kattan E, Ospina-Tascon GA, Teboul JL, Castro R, Cecconi M, Ferri G, Bakker J, Hernandez G, Investigators A-S: Systematic assessment of fluid responsiveness during early septic shock resuscitation: secondary analysis of the ANDROMEDA-SHOCK trial. Critical care 2020, 24(1):23.

B06
Precision Solute Control and Dynamic Dosing with CRRT?

Rolando Claure-Del Granado MD, FASN, FISN
2:00-3:30
Wednesday, March 13

Educational Objectives:

1. Discuss concept of CRRT dose and prescription of CRRT for solute and fluid control.
2. Discuss integration of fluid management as component of CRRT dose.
3. Discuss dynamic CRRT dosing in response to physiological and clinical needs of the patient.

Content Description:

Effective management of patients with CRRT in multi-faceted. Prescription of CRRT effluent at an appropriate dose adequate to achieve solute and fluid control is an important initial step. Equally important, the delivery of prescribed CRRT dose is essential for effective CRRT and may influence quality of care. Various multi-center randomized control trials have suggested delivery of at least 20-25 mL/kg/hour of effluent dose. In practice, technical aspects of CRRT modality, delivery of replacement fluid pre- or post-filter, CRRT fluids, and anticoagulation, all influence the delivered CRRT dose. A distinct advantage CRRT offers is the ability to dynamically adjust the effluent dose and fluid removal rates in response to changing physiological and clinical patient condition. This workshop will describe dose prescription and delivery with CRRT and provide an approach to integrate the different domains of solute management for targeted intervention in critically ill patients. We will use case studies to describe various approaches for achieving plasma homeostasis, fluid removal and regulation with CRRT.

Suggested Reading:

1. Sean M. Bagshaw, Madarasu Rajasekara Chakravarthi, Zaccaria Ricci, Ashita Tolwani, M. Neri, S. De Rosa, John A. Kellum, Claudio Ronco: Precision Continuous Renal Replacement Therapy and Solute Control. Blood Purification 2016; 42:238-247.
2. Javier A. Neyra, Lenar Yessayan, Melissa L. Thompson Bastin, Keith M Wille, Ashita J. Tolwani: How to Prescribe and Troubleshoot Continuous Renal Replacement Therapy: A Case Based Review. Kidney360 2021; 2:371-384.
3. Gianluca Vill, Sergio Fabbri, Sara Samoni, Matteo Cecchi, Antonio Fioccola, Caterina Scire-Calabrisotto, Gaia Mari, Diego Pomare Montin, Stefano Romagnoli: Methods for Dose Quantification in Continuous Renal Replacement Therapy: Toward a More Precise Approach. Artificial Organs 2021; 45:1300-130.

B06
Precision Solute Control and Dynamic Dosing with CRRT?

Manish Kaushik MD
2:00-3:30
Wednesday, March 13

Educational Objectives:
1. Discuss concept of CRRT dose and prescription of CRRT for solute and fluid control.
2. Discuss integration of fluid management as component of CRRT dose.
3. Discuss dynamic CRRT dosing in response to physiological and clinical needs of the patient.

Content Description:
Effective management of patients with CRRT in multi-faceted. Prescription of CRRT effluent at an appropriate dose adequate to achieve solute and fluid control is an important initial step. Equally important, the delivery of prescribed CRRT dose is essential for effective CRRT and may influence quality of care. Various multi-center randomized control trials have suggested delivery of at least 20-25 mL/kg/hour of effluent dose. In practice, technical aspects of CRRT modality, delivery of replacement fluid pre- or post-filter, CRRT fluids, and anticoagulation, all influence the delivered CRRT dose. A distinct advantage CRRT offers is the ability to dynamically adjust the effluent dose and fluid removal rates in response to changing physiological and clinical patient condition. This workshop will describe dose prescription and delivery with CRRT and provide an approach to integrate the different domains of solute management for targeted intervention in critically ill patients. We will use case studies to describe various approaches for achieving plasma homeostasis, fluid removal and regulation with CRRT.

Suggested Reading:
1. Sean M. Bagshaw, Madarasu Rajasekara Chakravarthi, Zaccaria Ricci, Ashita Tolwani, M. Neri, S.De Rosa, John A. Kellum, Claudio Ronco: Precision Continuous Renal Replacement Therapy and Solute Control. Blood Purification 2016; 42:238-247.
2. Javier A. Neyra, Lenar Yessayan, Melissa L. Thompson Bastin, Keith M Wille, Ashita J. Tolwani: How to Prescribe and Troubleshoot Continuous Renal Replacement Therapy: A Case Based Review. Kidney360 2021; 2:371-384.
3. Gianluca Vill, Sergio Fabbri, Sara Samoni, Matteo Cecchi, Antonio Fioccola, Caterina Scire-Calabrisotto, Gaia Mari, Diego Pomare Montin, Stefano Romagnoli: Methods for Dose Quantification in Continuous Renal Replacement Therapy: Toward a More Precise Approach. Artificial Organs 2021; 45:1300-130.

C07
Starting, Transitioning and Stopping RRT for AKI: Science and Art

Sean Bagshaw MD, MSc
2:00-3:30
Wednesday, March 13

Educational Objectives:
1. Describe the factors affecting timing of initiation and stopping of RRT in critically ill patients.
2. Compare various approaches and practical aspects for initiating and stopping RRT.
3. Discuss the principles and evidence for timely intervention with RRT in the ICU.

Content Description:
One important and still controversial aspect of the management of critically ill patients is the selection, timing of initiation, and cessation of acute renal replacement therapy (RRT).(1-3) The lack of consensus on what

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parameters should guide the decision to start RRT has led to a wide practice variation. Selected studies have suggested that "early" RRT could improve outcomes in AKI. However, there are disparate definitions for what constitutes “early” or “delayed” or “late” initiation. The parameters used to assess kidney function are neither sensitive nor specific and do not constitute reliable markers alone on which to base intervention.(4) While timely intervention with RRT can provide opportunity for improvement in clinical, physiologic and biochemical parameters, there is risk of subjective patients to acute RRT with its known risk profile when this may not have been necessary. Observational studies, which are at risk of bias, and one randomized trial (ELAIN) suggested that early RRT initiation may have a beneficial effect on survival (5, 6); however, more recent multi-center randomized trials (7) have not shown patient or kidney outcome benefit with early RRT initiation. In the small single center ELAIN trial, mortality was lower at 90 days for patients allocated to early RRT (CRRT) within 8 hrs of reaching at stage 2 AKI compared with who were allocated to delayed RRT initiation, defined as within 12 hrs of reaching stage 3 AKI. In contrast, the AKIKI(8), IDEAL-ICU (9) and STARRT-AKI (10) trials all showed no difference in the primary outcome of mortality at 60-90 days between early (accelerated) and delayed (standard) RRT initiation strategies. These trials also all showed that a substantial proportion of patients allocated to the delayed (standard) RRT initiation strategy did not receive RRT, largely due to early death or kidney recovery from AKI. Moreover, in the STARRT-AKI trial, patients allocated to early (accelerated) RRT were significant more likely to remain dialysis dependent at 90-days and were more likely to experiences adverse events, largely hypotension and electrolyte abnormalities. The further build on this, there has been a paucity of evidence published to guide clinicians on when to attempt a liberation trial of RRT in critically ill patients.(11) This represents a major knowledge gap in our understanding of how best to apply RRT to critically ill patients. This workshop will aim to provide context to this evolving literature and present illustrative cases on the principles for patient selection, optimal timing for initiation, RRT modality, and on strategies for assessing when to trial stopping RRT in critically ill patients.

Suggested Reading:

1. Wald R, Beaubien-Souligny W, Chanchlani R, Clark EG, Neyra JA, Ostermann M, et al. Delivering optimal renal replacement therapy to critically ill patients with acute kidney injury. Intensive Care Med. 2022;48(10):1368-81.
2. Ostermann M, Bagshaw SM, Lumlertgul N, Wald R. Indications for and Timing of Initiation of KRT. Clin J Am Soc Nephrol. 2022.
3. Ostermann M, Bellomo R, Burdmann EA, Doi K, Endre ZH, Goldstein SL, et al. Controversies in acute kidney injury: conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Conference. Kidney Int. 2020;98(2):294-309.
4. Lumlertgul N, Peerapornratana S, Trakarnvanich T, Pongsittisak W, Surasit K, Chuasuwan A, et al. Early versus standard initiation of renal replacement therapy in furosemide stress test non-responsive acute kidney injury patients (the FST trial). Crit Care. 2018;22(1):101.
5. Karvellas CJ, Bagshaw SM, McDermid RC, Stollery DE, Gibney RT. Acetaminophen-induced acute liver failure treated with single-pass albumin dialysis: report of a case. Int J Artif Organs. 2008;31(5):450-5.
6. Zarbock A, Kellum JA, Schmidt C, Van Aken H, Wempe C, Pavenstadt H, et al. Effect of Early vs Delayed Initiation of Renal Replacement Therapy on Mortality in Critically Ill Patients With Acute Kidney Injury: The ELAIN Randomized Clinical Trial. JAMA. 2016;315(20):2190-9.
7. Gaudry S, Hajage D, Benichou N, Chaibi K, Barbar S, Zarbock A, et al. Delayed versus early initiation of renal replacement therapy for severe acute kidney injury: a systematic review and individual patient data meta-analysis of randomised clinical trials. Lancet. 2020;395(10235):1506-15.
8. Gaudry S, Hajage D, Schortgen F, Martin-Lefevre L, Pons B, Boulet E, et al. Initiation Strategies for Renal-Replacement Therapy in the Intensive Care Unit. N Engl J Med. 2016;375(2):122-33.
9. Barbar SD, Clere-Jehl R, Bourredjem A, Hernu R, Montini F, Bruyere R, et al. Timing of Renal-Replacement Therapy in Patients with Acute Kidney Injury and Sepsis. N Engl J Med. 2018;379(15):1431-42.
10. STARRT-AKI Investigators, Bagshaw SM, Wald R, Adhikari NKJ, Bellomo R, da Costa BR, et al. Timing of Initiation of Renal-Replacement Therapy in Acute Kidney Injury. N Engl J Med. 2020;383(3):240-51.
11. Katulka RJ, Al Saadon A, Sebastianski M, Featherstone R, Vandermeer B, Silver SA, et al. Determining the optimal time for liberation from renal replacement therapy in critically ill patients: a systematic review and meta-analysis (DOnE RRT). Crit Care. 2020;24(1):50.

D08
Managing patients with Sepsis: Modifying the Course with (ECOS)

Thiago Reis MD
2:00-3:30
Wednesday, March 13

Educational Objectives:

-Rationale for extracorporeal blood purification in sepsis.
-Techniques for extracorporeal blood purification in sepsis.
-Performing of extracorporeal blood purification in sepsis.

Content Description:

Sepsis and septic shock remain drivers for morbidity and mortality in critical illness. The clinical picture of patients presenting with these syndromes evolves rapidly and may be characterised by: (a) microbial host invasion, (b) establishment of an infection focus, (c) opsonisation of bacterial products (e.g. lipopolysaccharide), (d) recognition of pathogens resulting in an immune response, (e) cellular and humoral effects of circulating pathogen and patho− gen products, (f) immunodysregulation and endocrine effects of cytokines, (g) endothelial and organ damage, and (h) organ crosstalk and multiple organ dysfunction. Each step may be a potential target for a specific therapeutic approach. At various stages, extracorporeal therapies may target circulating molecules for removal. In sequence, we could consider: (a) pathogen removal from the circulation with affinity binders and cartridges (specific), (b) circulating endotoxin removal by haemoperfusion with polymyxin B adsorbers (specific), (c) cytokine removal by haemoperfu− sion with sorbent cartridges or adsorbing membranes (non−specific), (d) extracorporeal organ support with different techniques for respiratory and cardiac support (CO2 removal or extracorporeal membrane oxygenation), and renal support (haemofiltration, haemodialysis, or ultrafiltration). The sequence of events and the use of different techniques at different points for specific targets will likely require trials with endpoints other than mortality. Instead, the primary objectives should be to achieve the desired action by using extracorporeal therapy at a specific point.

Suggested Reading:

Ronco C, Chawla L, Husain-Syed F, Kellum JA. Rationale for sequential extracorporeal therapy (SET) in sepsis. Crit Care. 2023;27(1):50. Published 2023 Feb 7. doi:10.1186/s13054-023-04310-2

Ronco C, Reis T. Continuous renal replacement therapy and extended indications. Semin Dial. 2021;34(6):550-560. doi:10.1111/sdi.12963

Reis T, Reis F, Fagundes A Jr, da Hora Passos R, Neves FAR. Rationale for Adsorption in Extracorporeal Blood Purification. Contrib Nephrol. 2023;200:107-117. doi:10.1159/000527707

AKI in the Context of Invasive Management of Heart Disease

Matthew James Dr
4:45-5:00
Wednesday, March 13

Educational Objectives:

1. Appreciate variation in risk of acute kidney injury following invasive coronary procedures and risk stratification approaches
2. Recognize evidence-based strategies to reduce the risk of acute kidney injury following invasive coronary procedures
3. Understand how risk prediction tools for cardiorenal outcomes can be used to inform treatment decisions related to invasive versus conservative management for patients with pre-existing chronic kidney disease

Content Description:

This session will review the epidemiology of acute kidney injury associated with invasive heart procedures, variation in care and outcomes, and evidence-based strategies for the prevention of acute kidney injury following diagnostic and therapeutic coronary interventions. The role of risk stratification for kidney and cardiovascular outcomes in the context of acute and stable cardiovascular diseases will be reviewed, and risk-guided strategies to guide decision making for use of invasive versus conservative management of coronary heart disease will be presented.

Suggested Reading:

1. Tsai TT , Patel UD , Chang TI , et al. Validated contemporary risk model of acute kidney injury in patients undergoing percutaneous coronary interventions: insights from the National Cardiovascular Data Registry Cath-PCI Registry. J Am Heart Assoc. 2014;3(6):e001380.

2. Huang C , Li SX , Mahajan S , et al. Development and validation of a model for predicting the risk of acute kidney injury associated with contrast volume levels during percutaneous coronary intervention. JAMA Netw Open. 2019;2(11):e1916021.

3. James MT, Har BJ, Tyrrell BD, Faris PD et al. Effect of Clinical Decision Support With Audit and Feedback on Prevention of Acute Kidney Injury in Patients Undergoing Coronary Angiography: A Randomized Clinical Trial. JAMA. 2022 Sep 6;328(9):839-849.

4. James MT, Tonelli M, Ghali WA, Knudtson ML et al. Renal outcomes associated with invasive versus conservative management of acute coronary syndrome: propensity matched cohort study. BMJ. 2013 Jul 5;347:f4151.

Kidney-Ventilator Interactions and Kidney Protective Ventilation

Sean Bagshaw MD, MSc
5:15-5:30
Wednesday, March 13

Educational Objectives:
1. Describe the physiologic effects of mechanical ventilation on kidney function.
2. Describe the physiologic effects of "injurious" mechanical ventilation on kidney function.
3. Explore interventions to mitigate the detrimental effects of mechanical ventilation on kidney function.

Content Description:
Kidney function and lung function are closely interconnected and dysfunction in either or both organ systems is highly prevalent in critically ill patient. The practice of critical care demands an intimate knowledge of the link between both normal and abnormal lung function. Lung injury impairs gas exchange and elicits systemic inflammation that can have direct consequences on kidney function. Likewise, the fluid accumulation and metabolic derangements resulting from acute kidney injury (AKI) can imposed several physiologic challenges to normal lung function. Invasive mechanical ventilation (IMV) and renal replacement therapy are commonly utilized in the routine care of critically ill patients. IMV can elicit important declines in kidney function by several physiological (hemodynamic and neurohormonal) and pathophysiological (inflammatory) mechanisms. This lecture will focus on kidney-ventilator interactions and the principles of kidney-protective ventilation.

Suggested Reading:
1. Pannu N, Mehta RL. Effect of mechanical ventilation on the kidney. Best Pract Res Clin Anaestheiol 2004; 18(1):189-203.
2. Van den Akker JPC et al. Invasive mechanical ventilation as a risk factor for acute kidney injury in the critically ill: a systematic review and meta-analysis. Crit Care 2013;17(3):R98.
3. Husain-Syed F et al. Lung-Kidney Cross-Talk in the Critically Ill Patient. AJRCCM 2016;194(4):402-14.

ADQI 30: Adsorption-based Extracorporeal Therapies

Thiago Reis MD
5:45-6:00
Wednesday, March 13

Educational Objectives:
-Rationale for Adsorption-based Extracorporeal Therapies

-Techniques for Adsorption-based Extracorporeal Therapies

-Performing Adsorption-based Extracorporeal Therapies

Content Description:
A strong rationale supports the development of adsorp- tion-based extracorporeal blood purification in conditions such as sepsis, acute kidney disease, uremia, and acute liver failure. The retention of compounds as a consequence of acute or chronic organ dysfunction might have detrimental effects. When a causative effect of an accumulated compound in a pathogenic condition is demonstrated, a rationale for the removal of this solute is also established. Adsorption is a mass transfer mechanism in which a solute chemically interacts with the surface of a

solid structure (sorbent) and is removed from its solvent (i.e., blood or plasma). Traditional extracorporeal blood purification techniques utilize semipermeable mem- branes and depend mainly on diffusion and convection as mechanisms of mass transfer. Protein-bound solutes and water-soluble compounds with molecular weight above 25 kDa are scantly removed by either diffusive or convec- tive clearances. In contrast, recently developed resins have demonstrated safety aligned with notable adsorp- tive capability, which enables the extraction of endotoxins, inflammatory mediators, and uremic toxins. The understanding of the kinetics of these elements and the improvement in patient selection are key factors to propel exploratory and confirmatory trials that ultimately will lead to the expected changes in clinical practice.

Suggested Reading:

Reis T, Reis F, Fagundes A Jr, da Hora Passos R, Neves FAR. Rationale for Adsorption in Extracorporeal Blood Purification. Contrib Nephrol. 2023;200:107-117. doi:10.1159/000527707

Ronco C, Bellomo R. Hemoperfusion: technical aspects and state of the art. Crit Care. 2022;26(1):135. Published 2022 May 12. doi:10.1186/s13054-022-04009-w

Ricci Z, Romagnoli S, Reis T, Bellomo R, Ronco C. Hemoperfusion in the intensive care unit. Intensive Care Med. 2022;48(10):1397-1408. doi:10.1007/s00134-022-06810-1

Morning Symposium C. Optimization of the CRRT Program to Improve Outcomes

Oleksa Rewa MD MSc.
7:00-8:00
Thursday, March 14

Educational Objectives:

1. Discuss what data streams might be used to obtain the information necessary to improve CRRT delivery

2. Outline how these may be represented and reported

3. Examples of 2 Dashboards used to to improve the performance of CRRT

Content Description:

We will begin by presenting what data streams information can come from in order to optimize CRRT Programs. These will include machine data, EMR data, organizational and healthcare systems data. The strengths, weaknesses, and purposes of each of these data streams will be discussed.
Further, we will then showcase how this data can be utilized to create reports across different formats, each with its own purpose.
Finally, 2 examples of Dashboards will be presented, one from the pediatric critical care patient population, and the other from a novel healthcare systems level implementation science quality improvement initiative, Dialyzing Wisely, and how it can integrate all of these data streams and translate evidence into practice in order to improve and optimize CRRT programs across an entire healthcare system.

Suggested Reading:

1. Lin et al., Dataset supporting blood pressure prediction for the management of chronic hemodialysis, Scientific Data 2019(6): 313
2. Rewa et al., Quality indicators of continuous renal replacement therapy (CRRT) care in critical ill patients: a systematic review, Intensive Care Medicine 2017(43): 750.

References continued on following page

3. Rewa et al., A modified Delphi process to identify, rank and prioritize quality indicators for continuous renal replacement therapy (CRRT) care in critically ill patients, Journal of Critical Care 2018(47): 145-152.
4. Opgenorth et al., Improving the quality of the performance and delivery of continuous renal replacement therapy (CRRT) to critically ill patients across a healthcare system: QUALITY CRRT: a study protocol, BMJ Open 2022(12): e054583.
5. Ruiz et al., Development, implementation and outcomes of a quality assurance system for the provision of continuous renal replacement therapy in the intensive care unit, Scientific Reports 2020(10): 20616.
6. Opgenorth et al., A study protocol for improving the delivery of acute kidney replacement therapy (KRT) to critically ill patients in Alberta - Dialyzing Wisely, BMC Nephrology 2022(23): 369.
7. Mottes et al., Process based quality improvement using a continuous renal replacement therapy dashboard, BMC Nephrology 2019 (20):17.
8. Bagshaw et al., Timing of Initiation of Renal-Replacement Therapy in Acute Kidney Injury, New England Journal of Medicine 2020 383(3): 240.

Morning Symposium C. Optimization of the CRRT Program to Improve Outcomes

Ian Baldwin RN, PhD, FACCCN
7:00-8:00
Thursday, March 14

Educational Objectives:

1. Review the context of CRRT use (the Village) and the many involved for best outcomes (the Village people).
2. Describe key roles and contributions of each group; and the leaders, champions.
3. Appreciate the importance of linking and comparing to others (other Villages) and the practice experts (Village Chiefs) by congress, literature, webinar and more (Village 'news' and Rules and documents).
4. Celebrate and value success and achievement (Village party).

Content Description:

Continues Renal Replacement Therapy (CCRT) requires a group of people providing expertise along the 'pipeline' for successful clinical use and can include vendors, those in the local hospital supply chain, biomedical technicians, pharmacy, clinicians; medical and nursing. In some centres the model of care and the CRRT program is associated with the local dialysis or nephrology team. In any case the Intensive Care Unit (ICU) clinical team requires a smaller group who should be acknowledged and supported as the 'champions' with a role to resource and sustain the program, undertake quality and audit, key communications. The champions are best represented by key doctors nurses, local managers, teachers and clinician nurses. When CRRT is considered a program or specialty initiative, team meetings are vital to keep momentum and manage change or updates and the champions team are best to write and maintain a policy or protocol. E-mail lists, smart phone apps, and or notice board news letters are some ideas for linking to the clinical users across a 24/7 ICU setting . The turnover and constant new people in larger ICU's can make the champions group work constant, and succession planning is always a key strategy for keeping the use of CRRT to a high standard and be well resourced. The frequency of use helps negate many needs as familiarity and high exposure ensures confidence and more . Some publications are available to refer and this presentation will provide a review of key ideas for the multi-disciplinary team and CRRT; It takes a Village.

Suggested Reading:

Teixeira JP, Neyra JA, Tolwani A. Continuous KRT: A Contemporary Review. Clin J Am Soc Nephrol. 2023 Feb 1;18(2):256-269. doi: 10.2215/CJN.04350422. Epub 2022 Aug 18. PMID: 35981873; PMCID: PMC10103212.

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Opgenorth D, Reil E, Lau V, Fraser N, Zuege D, Wang X, et al. Improving the quality of the performance and delivery of continuous renal replacement therapy (CRRT) to critically ill patients across a healthcare system: QUALITY CRRT: a study protocol. BMJ open. 2022;12(2):e054583.

Clark WR, Garzotto F, Neri M, Lorenzin A, Zaccaria M, Ronco C. Data analytics for continuous renal replacement therapy: historical limitations and recent technology advances. The International journal of artificial organs. 2016;39(8):399-406.

Lee KH, Sol IS, Park JT, Kim JH, Shin JW, Park MR, Lee JH, Kim YH, Kim KW, Shin JI. Continuous Renal Replacement Therapy (CRRT) in Children and the Specialized CRRT Team: A 14-Year Single-Center Study. J Clin Med. 2019 Dec 31;9(1):110. doi: 10.3390/jcm9010110. PMID: 31906191; PMCID: PMC7019966.

Rhee H, Jang GS, Han M, Park IS, Kim IY, Song SH, Seong EY, Lee DW, Lee SB, Kwak IS. The role of the specialized team in the operation of continuous renal replacement therapy: a single-center experience. BMC Nephrol. 2017 Nov 13;18(1):332. doi: 10.1186/s12882-017-0746-8. PMID: 29132321; PMCID: PMC5683314.

Oh HJ, Lee MJ, Kim CH, Kim DY, Lee HS, Park JT, Na S, Han SH, Kang SW, Koh SO, Yoo TH. The benefit of specialized team approaches in patients with acute kidney injury undergoing continuous renal replacement therapy: propensity score matched analysis. Crit Care. 2014 Aug 13;18(4):454. doi: 10.1186/s13054-014-0454-8. PMID: 25116900; PMCID: PMC4145553.

Rewa OG, Eurich DT, Noel Gibney RT, Bagshaw SM. A modified Delphi process to identify, rank and prioritize quality indicators for continuous renal replacement therapy (CRRT) care in critically ill patients. J Crit Care. 2018 Oct;47:145-152. doi: 10.1016/j.jcrc.2018.06.023. Epub 2018 Jun 30. PMID: 29990792.

Morning Symposium C. Optimization of the CRRT Program to Improve Outcomes

Manish Kaushik MD
7:00-8:00
Thursday, March 14

Educational Objectives:

1. Discuss quality metrics that are recommended to be tracked to evaluate performance, effectiveness and quality of CRRT delivered.
2. Discuss how to leverage on electronic medical records to record and analyse quality metrics for CRRT.

Content Description:

Voluminous literature on technical and clinical aspects of CRRT have answered key questions with regards timing, dosing, modality, and anticoagulation for CRRT. However, an overlooked aspect till recently was recording and tracking quantifiable measures of CRRT delivery to ensure its impact on quality of care. This session will review suggested quality indicators for CRRT delivery and discuss how electronic medical records can be used to monitor and generate CRRT dashboards to evaluate performance of a CRRT program.

Suggested Reading:

1. Oleksa G. Rewa, Ashita Tolwani, Theresa Mottes, Luis A. Juncos, Claudio Ronco, Kianoush Kashani, Mitchell Rosner, Michael Haase, John Kellum, Sean M. Bagshaw, ADQI Consensus Meeting Members on behalf of ADQI XXII. Quality of care and safety measures of acute renal replacement therapy: Workgroup statements from the 22nd acute disease quality initiative (ADQI) consensus conference. Journal of Critical Care 2019; 54:52–57

A09
Pediatric AKI and RRT: Beyond the Basics

Michael Zappitelli MD, MSc
8:15-9:45
Thursday, March 14

Educational Objectives:
1. Understand how understanding the epidemiology of AKI and fluid overload in children impacts CRRT treatment decisions
2. Discuss key prescription issues for CRRT and PD (briefly) specific to children and neonates
3. Use case scenarios to discuss challenging CRRT clinical problems, including use of tandem therapies

Content Description:
In recent years our understanding of acute kidney injury (AKI) in critically ill children and young adults has increased exponentially. AKI is not only common among critically ill children and young adults, it is also associated with increased morbidity and mortality, and has significant effects that are far reaching to other organ systems. Fluid overload (FO), a pathologic state of excessive positive fluid balance is also common in critically ill children and young adults, and like AKI, is associated with increased morbidity and mortality.
Approximately 1-5% of critically ill children and young adults with the most severe form of AKI and pathologic FO require continuous renal replacement therapy (CRRT) for maintenance of fluid homeostasis and metabolic control. Provision of pediatric CRRT has evolved from the use of machines designed for adults and older children to more advanced machines and filters designed for smaller children and neonates. These newer devices with smaller filters, better control of blood flow, more accurate ultrafiltration (UF) have led to an increase in the use of pediatric CRRT. In order to utilize these therapies safely, it is necessary to understand the basics of CRRT prescription. This workshop will not discuss all aspects of pediatric CRRT prescriptions, as we want to go beyond the basics. However, the workshop will discuss key concepts in more detail than usual (e.g., clearance, blood prime, neonatal considerations). We will also use case studies to discuss complex situations (e.g., liver failure, hyperammonemia, hyponatremia, tandem therapies).

Suggested Reading:
1. Goldstein SL, Somers MJ, Baum MA, et al. Pediatric patients with multi-organ dysfunction
2. Ricci Z, Goldstein SL. Pediatric Continuous Renal Replacement Therapy. Contrib Nephrol. 2016;187:121-130. doi:10.1159/000442370
3. Menon S, Broderick J, Munshi R, et al. Kidney Support in Children using an Ultrafiltration Device: A Multicenter, Retrospective Study. Clin J Am Soc Nephrol. 10 07 2019;14(10):1432-1440. doi:10.2215/CJN.03240319
4. Goldstein SL, Vidal E, Ricci Z, et al. Survival of infants treated with CKRT: comparing adapted adult platforms with the Carpediem™ . Pediatr Nephrol. Aug 20 2021;doi:10.1007/s00467-021-05180-y
5. Garzotto F, Vidal E, Ricci Z, et al. Continuous kidney replacement therapy in critically ill neonates and infants: a retrospective analysis of clinical results with a dedicated device. Pediatr Nephrol. Sep 2020;35(9):1699-1705. doi:10.1007/s00467-020-04562-y
6. Raymakers-Janssen PAMA, Lilien M, van Kessel IA, Veldhoen ES, Wösten-van Asperen RM, van Gestel JPJ. Citrate versus heparin anticoagulation in continuous renal replacement therapy in small children. Pediatr Nephrol. Oct 2017;32(10):1971-1978. doi:10.1007/s00467-017-3694-4
7. Ricci Z, Guzzi F, Tuccinardi G, Romagnoli S. Dialytic dose in pediatric continuous renal replacement therapy patients. Minerva pediatrica. 2016;68(5):366-373. doi:R15Y9999N00A16041503 [pii]
8. Zoica BS, Deep A. Extracorporeal renal and liver support in pediatric acute liver failure. Pediatr Nephrol. May 2021;36(5):1119-1128. doi:10.1007/s00467-020-04613-4
9. Eloot S, De Rudder J, Verloo P, et al. Towards an Algorithm-Based Tailored Treatment of Acute Neonatal Hyperammonemia. Toxins (Basel). Jul 13 2021;13(7)doi:10.3390/toxins13070484
10. Ames EG, Powell C, Engen RM, et al. Multisite Retrospective Review of Outcomes in Renal Replacement Therapy for Neonates with Inborn Errors of Metabolism. J Pediatr. Jul 2022;246:116-122.e1. doi:10.1016/j.jpeds.2022.03.043References

C11
Improving Care for Patients After Hospitalization for AKI

Matthew James Dr
8:15-9:45
Thursday, March 14

Educational Objectives:
1. Recognize the long-term outcomes associated with hospitalization with acute kidney injury
2. Identify gap in care following acute kidney injury that can be targeted to improve long-term outcomes
3. Understand evidence-based approaches to risk stratification and targeted ambulatory care approaches following discharge for patients hospitalized with acute kidney injury

Content Description:
This presentation will review the relationships between acute kidney injury and long-term health outcomes. Potential modifiable gaps in care that could be targeted to improve long-term outcomes will be highlighted. Evidence-based approaches to risk stratification to guide follow-up care and new models of ambulatory care that have been implemented and evaluated to improve the hospital to home transition of care following AKI will also be discussed.

Suggested Reading:
1. James MT, Pannu N, Hemmelgarn BR, Austin PC et al. Derivation and External Validation of Prediction Models for Advanced Chronic Kidney Disease Following Acute Kidney Injury. JAMA. 2017 Nov 14;318(18):1787-1797.
2. James MT, Bhatt M, Pannu N, Tonelli M. Long-term outcomes of acute kidney injury and strategies for improved care. Nat Rev Nephrol. 2020 Apr;16(4):193-205.
3. Silver SA, Adhikari NK, Bell CM, Chan CT et al. Nephrologist Follow-Up versus Usual Care after an Acute Kidney Injury Hospitalization (FUSION): A Randomized Controlled Trial. Clin J Am Soc Nephrol. 2021 Jul;16(7):1005-1014.

C11
Improving Care for Patients After Hospitalization for AKI

Jorge Cerda, MD
8:15-9:45
Thursday, March 14

Educational Objectives:
1. Recognize the short- and long-term outcomes associated with hospitalization with AKI and their burden (J Cerda)
2. Identify risk stratification strategies for different outcomes following AKI that can be used to guide follow-up care after hospitalization with AKI (M James)
3. Propose evidence-based post-discharge therapeutic approaches and processes of ambulatory care for patients after hospitalized with AKI (N Lumlertgul)

Content Description:
This presentation will review the relationships between acute kidney injury and long-term health outcomes and the burden of this problem. We will highlight potential modifiable gaps in care that could be targeted to improve long-term outcomes. We will discuss evidence-based approaches to risk stratification to guide follow-up care, and new models of ambulatory care designed to improve post-discharge care following in-hospital AKI.

References on following page

Suggested Reading:

1. Lewington AJ, Cerda, J, Mehta RL: Raising awareness of acute kidney injury: A global perspective of a silent killer. Kidney Int, 2013; 84(3):457-67.
2. Hoste EAJ, Kellum JA, Selby NM, Zarbock A, Palevsky PM, Bagshaw SM, Goldstein SL, Cerdá J, Chawla LS. Global epidemiology and outcomes of acute kidney injury. Nature Reviews Nephrology 2018,14(10):607-625 Epub https//doi.org/10.1038/s41581-018-0052-0.
3. Cerdá J, Liu KD, Cruz D, Jaber B,. Koyner JL, Heung M, Okusa M and Faubel S, for the AKI Advisory Group of the American Society of Nephrology. Promoting Kidney Function Recovery in Patients with Acute Kidney Injury Requiring Renal Replacement Therapy, Clin J Am Soc Nephrol 2015;10(10):1859-67.
4. Heung M, Faubel D, Watnick D, N. Cruz DM, Koyner K;, Mour H, Liu KD, Cerda J, Lukaszewski M, Vijayan A; for the ASN AKI Advisory Group. Outpatient Dialysis for Patients with Acute Kidney Injury: Opportunities to Improve Care. Clin J Am Soc Nephrol 2015;10:1868-74.
5. Kathleen Liu, Stuart Goldstein, Anitha Vijayan, Chirag Parikh, Kianoush Kashani, Mark Okusa, Anupam Agarwal and Jorge Cerdá*, on behalf of the AKI! Now Initiative of the American Society of Nephrology. The AKI! Now initiative: Recommendations for Awareness, Recognition and Management of AKI. Clin J Am Soc Nephrol. 2020;15(12):1838-1847.
6. Vijayan A, Abdel-Rahman EM, Liu D, Goldstein SL, Agarwal A, Okusa MD, Cerda J; AKI!Now Steering Committee Recovery after Critical Illness and Acute Kidney Injury. Clin J Am Soc Nephrol 2021;16(10):1601-1609.
7. Ortiz-Soriano V, Butler CR, Levy M, Huen SC, Castaneda JL, Sakhuja A, Basu RK, Liu KD, Cerda, J, Neyra JA. Survey of current practices for outpatient hemodialysis for AKI patients. Kidney Int Rep 2021;6(4):1156-1160.
8. Javier A. Neyra; Leslie Gewin; Jia H Ng; Erin F. Barreto; Bonnie Freshly; Jeff Willett; Emaad M, Abdel-Rahman6; Ian McCoy; Diana Kwon; Samuel A Silver; Jorge Cerda; Anitha Vijayan; Challenges in the care of patients with AKI requiring outpatient dialysis: A report from the AKINow Recovery workgroup. Kidney 360, 2023;doi 10.34067/KID.0000000000000332.
9. Barreto EF, Cerda J, Freshly B, Gewin L, Kwong YD, McCoy IE, Neyra JA, Ng JH, Silver SA, Vijayan A, Abdel-RahmanEM. Optimum Care of AKI Survivors Not Requiring Dialysis after Discharge: An AKINow Recovery Workgroup Report Kidney360. 2024 Jan 1;5(1):124-132. doi: 10.34067/KID.0000000000000309. Epub 2023 Nov 21.PMID: 37986185.
10. James MT, Bhatt M, Pannu N, Tonelli M. Long-term outcomes of acute kidney injury and strategies for improved care. Nat Rev Nephrol. 2020 Apr;16(4):193-205.
11. James MT, Pannu N, Hemmelgarn BR, Austin PC et al. Derivation and External Validation of Prediction Models for Advanced Chronic Kidney Disease Following Acute Kidney Injury. JAMA. 2017 Nov 14;318(18):1787-1797.2.
12. Sawhney S, Tan Z, Black C, Marks A, Mclernon DJ, Ronksley P, James MT. Validation of Risk Prediction Models to Inform Clinical Decisions After Acute Kidney Injury. Am J Kidney Dis. 2021 Jul;78(1):28-37.
13. Clark EG, James MT, Hiremath S, Sood MM, Wald R, Garg AX, Silver SA, Tan Z, van Walraven C. Predictive Models for Kidney Recovery and Death in Patients Continuing Dialysis as Outpatients after Starting in Hospital. Clin J Am Soc Nephrol. 2023 Apr 18;18(7):892-903.
14. Silver SA, Adhikari NK, Bell CM, Chan CT et al. Nephrologist Follow-Up versus Usual Care after an Acute Kidney Injury Hospitalization (FUSION): A Randomized Controlled Trial. Clin J Am Soc Nephrol. 2021 Jul;16(7):1005-1014.4.
15. Thanapongsatorn P, Chaikomon K, Lumlertgul N, Yimsangyad K, Leewongworasingh A, Kulvichit W, Sirivongrangson P, Peerapornratana S, Chaijamorn W, Avihingsanon Y, Srisawat N. Comprehensive versus standard care in post-severe acute kidney injury survivors, a randomized controlled trial. Crit Care. 2021 Aug 31;25(1):322. 5.
16. Silver SA, Adhikari NK, Jeyakumar N, Luo B, Harel Z, Dixon SN, Brimble KS, Clark EG, Neyra JA, Vijayaraghavan BKT, Garg AX, Bell CM, Wald R. Association of an Acute Kidney Injury Follow-up Clinic With Patient Outcomes and Care Processes: A Cohort Study. Am J Kidney Dis. 2023 May;81(5):554-563.e1.
17. Jeong R, James MT, Quinn RR, Ravani P, Bagshaw SM, Stelfox HT, Pannu N, Clarke A, Wald R, Harrison TG, Niven DJ, Lam NN. Follow-up Care of Critically Ill Patients With Acute Kidney Injury: A Cohort Study. Kidney Med. 2023 Jun 21;5(8):100685.
18. Brar S, Ye F, James MT, Harrison TG, Pannu N; Interdisciplinary Chronic Disease Collaboration (ICDC). Processes of Care After Hospital Discharge for Survivors of Acute Kidney Injury: A Population-Based Cohort Study. Am J Kidney Dis. 2024 Feb;83(2):216-228.

D12
Managing the Heart Failure Patient with Worsening Renal Function (WRF)

Amir Kazory MD, FASN, FACC
8:15-9:45
Thursday, March 14

Educational Objectives:
1. Describe the mechanisms and implications of worsening renal function (or rise in serum creatinine) and prognostic value of congestion in heart failure
2. Discuss the principles of diuretic therapy in heart failure and provide an update on current strategies for adults
3. Discuss the indications, outcomes and updates on the use of renal replacement therapy in patients with heart failure

Content Description:
Patients with acute decompensated heart failure (ADHF) often develop rise in serum creatinine (RSC). Cardiorenal interactions represent a complex pattern in these patients rendering their care a challenge that needs to be addressed by multidisciplinary approaches. Congestion, the hallmark of acute decompensated heart failure, represents the primary reason for hospitalization and the driver of adverse outcomes in these patients. Diuretic-based medical regimens remain the mainstay of management of ADHF. However, it is often difficult to determine which subset of patients can be managed with diuretic therapy, and which patient population may benefit from renal replacement therapy. This workshop will provide an overview of the underlying mechanisms and implications of RSC in ADHF as well as prognostic value of congestion in this setting. We will discuss the decongestive strategies proposed for management of ADHF and cardiorenal syndrome in children and adults. We will also describe mechanical removal of excess fluid through ultrafiltration therapy and discuss the key clinical findings of the most recent landmark trials, their implications, and their shortcomings followed by selected practical considerations and recommendations.

Suggested Reading:
McCallum W, Tighiouart H, Kiernan MS, Huggins GS, Sarnak MJ. Relation of kidney function decline and NT-proBNP with risk of mortality and readmission in acute decompensated heart failure. Am J Med (2019), 10.1016/j.amjmed.2019.05.047

Ahmad T, Jackson K, Rao VS, et al. Worsening renal function in patients with acute heart failure undergoing aggressive diuresis is not associated with tubular injury. Circulation; 137 (2018): 2016-2028

Kazory A, Ronco C. Are we barking up the wrong tree? Rise in serum creatinine and heart failure. Blood Purif 2019; 19:1-3

Gist KM, Kwiatkowski DM, Cooper DS. Acute kidney injury in congenital heart disease. Curr Opin Cardiol. 2018; 33: 101-107

Ricci Z, Raggi V, Marinari E, Vallesi L, Di Chiara L, Rizzo C, Gist KM. Acute Kidney Injury in Pediatric Cardiac Intensive Care Children: Not All Admissions Are Equal: A Retrospective Study. J Cardiothorac Vasc Anesth 2021; S1053-0770(21)00341-4

Kazory A, Ronco C. Ultrafiltration therapy for acute decompensated heart failure: lessons learned from 2 major trials. Am Heart J 2013; 166:799-803

Kazory A, Costanzo MR. Extracorporeal Isolated Ultrafiltration for Management of Congestion in Heart Failure and Cardiorenal Syndrome. Adv Chronic Kidney Dis 2018; 25: 434-44

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Kazory A, Sgarabotto L, Ronco C. Extracorporeal Ultrafiltration for Acute Heart Failure. Cardiorenal Med. 2022 Nov 2. doi: 10.1159/000527204. Online ahead of print

Koratala A, Ronco C, Kazory A. Diagnosis of Fluid Overload: From Conventional to Contemporary Concepts. Cardiorenal Med. 2022;12(4):141-154. doi: 10.1159/000526902. Epub 2022 Sep 12.

Nassiri AA, Ronco C, Kazory A. Resurgence of Urgent-Start Peritoneal Dialysis in COVID-19 and Its Application to Advanced Heart Failure. Cardiorenal Med. 2021;11(1):1-4. doi: 10.1159/000513496. Epub 2021 Jan 7.

Jentzer JC, Bihorac A, Brusca SB, Del Rio-Pertuz, et al. Contemporary Management of Severe Acute Kidney Injury and Refractory Cardiorenal Syndrome: JACC Council Perspectives. J Am Coll Cardiol. 2020 Sep 1;76(9):1084-1101. doi: 10.1016/j.jacc.2020.06.070

From Fluid Responsiveness to Fluid Overload: Identifying Fluid Intolerance

William Beaubien-Souligny Dr
10:15-10:30
Thursday, March 14

Educational Objectives:
- To understand the concept of fluid tolerance and the potential harms of chasing fluid responsiveness during resuscitation.
- To identify contexts where progressive fluid accumulation could mediate adverse outcomes.
- How the evaluation of fluid tolerance affect decision related to fluid removal on renal replacement therapy.

Content Description:
Rather than indiscriminate fluid administration, a common modern approach in the management of critically ill patients past the initial resuscitation efforts has been to assess fluid responsiveness. In this presentation, we will explore how to go beyond the assessment of fluid responsiveness and integrate other sources of information to evaluate fluid tolerance. We will discuss how appreciating the concept of fluid tolerance may influence decisions regarding renal replacement therapy.

Suggested Reading:
1. Kattan E, Castro R, Miralles-Aguiar F, Hernández G, Rola P. The emerging concept of fluid tolerance: A position paper. J Crit Care. 2022 Oct;71:154070. doi: 10.1016/j.jcrc.2022.154070. Epub 2022 Jun 2. PMID: 35660844.
2. Argaiz ER, Rola P, Haycock KH, Verbrugge FH. Fluid management in acute kidney injury: from evaluating fluid responsiveness towards assessment of fluid tolerance. Eur Heart J Acute Cardiovasc Care. 2022 Nov 2;11(10):786-793. doi: 10.1093/ehjacc/zuac104. PMID: 36069621.
3. Kenny JS, Prager R, Rola P, Haycock K, Basmaji J, Hernández G. Unifying Fluid Responsiveness and Tolerance With Physiology: A Dynamic Interpretation of the Diamond-Forrester Classification. Crit Care Explor. 2023 Dec 12;5(12):e1022. doi: 10.1097/CCE.0000000000001022. PMID: 38094087; PMCID: PMC10718393.

Urinary Microscopy to Identify Subclinical AKI

Rolando Claure-Del Granado MD, FASN, FISN
3:15-3:30
Thursday, March 14

Educational Objectives:
1. Understand the principles of urinary microscopy and its role in detecting subclinical AKI
2. Identify key urinary sediment findings indicative of subclinical AKI
3. Integrate urinary microscopy findings into clinical practice for early detection and management of subclinical AKI

Content Description:
Diagnosing subclinical acute kidney injury (AKI) poses a significant challenge in clinical practice, as traditional biomarkers may fail to detect subtle changes in renal function. However, leveraging urinary sediment analysis has emerged as a promising tool for early detection and management of AKI.

Urinary sediment refers to the solid material present in urine, consisting of cells, casts, crystals, and other elements. In cases of AKI, changes in urinary sediment can provide valuable insights into renal health, even before changes in serum creatinine or urine output become apparent.

One key feature of urinary sediment analysis is the presence of renal tubular epithelial cells (RTECs), which shed into the urine during injury to the renal tubules. Subclinical AKI often manifests with an increase in RTECs in the urine sediment, indicating ongoing renal damage despite the absence of clinically apparent changes in kidney function. Moreover, the presence of cellular casts, such as granular casts and muddy brown casts, can further corroborate the diagnosis of AKI. These casts form when cellular debris aggregates within the renal tubules, reflecting severe tubular injury characteristic of AKI.

Additionally, the identification of urinary biomarkers, such as neutrophil gelatinase-associated lipocalin (NGAL) and kidney injury molecule-1 (KIM-1), in the sediment can enhance the sensitivity and specificity of AKI detection. These biomarkers are released into the urine in response to renal injury, providing early indicators of kidney damage.

Furthermore, the analysis of urinary crystals can offer insights into the underlying etiology of AKI. For instance, the presence of calcium oxalate crystals may suggest ethylene glycol poisoning, while uric acid crystals can indicate underlying conditions like tumor lysis syndrome.

Utilizing urinary sediment analysis for diagnosing subclinical AKI enables clinicians to detect renal injury at an early stage, facilitating prompt intervention and preventing progression to overt AKI. By incorporating this non-invasive and readily available diagnostic tool into clinical practice, healthcare providers can improve outcomes for patients at risk of AKI.

Suggested Reading:
1. Ronco C, Kellum JA, Haase M. Subclinical AKI is still AKI. Crit Care. 2012 Jun 21;16(3):313. doi: 10.1186/cc11240. PMID: 22721504; PMCID: PMC3580601.
2. Moledina DG, Parikh CR. Phenotyping of Acute Kidney Injury: Beyond Serum Creatinine. Semin Nephrol. 2018 Jan;38(1):3-11. doi: 10.1016/j.semnephrol.2017.09.002. PMID: 29291759; PMCID: PMC5753429.
3. Vanmassenhove J, Van Biesen W, Vanholder R, Lameire N. Subclinical AKI: ready for primetime in clinical practice? J Nephrol. 2019 Feb;32(1):9-16. doi: 10.1007/s40620-018-00566-y. Epub 2018 Dec 6. PMID: 30523562.

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4. Ostermann M, Zarbock A, Goldstein S, et al. Recommendations on Acute Kidney Injury Biomarkers From the Acute Disease Quality Initiative Consensus Conference: A Consensus Statement. JAMA Netw Open.2020;3(10):e2019209. doi:10.1001/jamanetworkopen.2020.19209
5. Claure-Del Granado R, Macedo E, Mehta RL. Urine microscopy in acute kidney injury: time for a change. Am J Kidney Dis. 2011 May;57(5):657-60. doi: 10.1053/j.ajkd.2010.11.020. Epub 2011 Jan 22. PMID: 21257241.
6. Silva-Aguiar RP, Teixeira DE, Peres RAS, Peruchetti DB, Gomes CP, Schmaier AH, Rocco PRM, Pinheiro AAS, Caruso-Neves C. Subclinical Acute Kidney Injury in COVID-19: Possible Mechanisms and Future Perspectives. Int J Mol Sci. 2022 Nov 17;23(22):14193. doi: 10.3390/ijms232214193. PMID: 36430671; PMCID: PMC9693299.
7. Claure-Del Granado, Rolando; Macedo, Etienne; Chávez-Íñiguez, Jonathan S. Biomarkers for Early Diagnosis of AKI: Could It Backfire?. Kidney360 3(10):p 1780-1784, October 27, 2022. | DOI: 10.34067/KID.0001012022
8. Goldani JC, Poloni JA, Klaus F, Kist R, Pacheco LS, Keitel E. Urine microscopy as a biomarker of Acute Kidney Injury following cardiac surgery with cardiopulmonary bypass. Braz. J. Nephrol. 2020;42(1):18-23. https://www.scielo.br/pdf/jbn/2019nahead/2175-8239-jbn-2018-0133.pdf

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Morning Symposium E - Innovations in Caring for Patients with Electrolyte and Acid Base Problems

Lenar Yessayan MD, MS
7:00-8:00
Friday, March 15

Educational Objectives:

Understand the critical determinants of serum sodium during renal replacement therapy.
Understand the application of a variety of techniques to achieve controlled correction of electrolytes:
1. Adjustment of replacement fluid (RF) or dialysate composition
2. Regulation of CRRT dose based on kinetic modeling
3. The use of separate electrolyte infusion (s)

Content Description:

Disorders of serum sodium concentration are common in critically ill patients who may have concomitant acute kidney injury, chronic kidney disease or end-stage kidney disease. Many of these patients may require customized serum sodium level management with dialysis which, if not strictly controlled, can lead to significant complications. Thus, controlled correction of the serum sodium level is necessary to avoid the development of osmotic demyelination syndrome in hyponatremic patients and dialysis disequilibrium syndrome in hypernatremic patients. Continuous kidney replacement therapy offers unique benefits through the ability to slowly and safely correct dysnatremias that can be tailored to specific patient needs and should be considered in select patients (1-3).

Suggested Reading:

1. Yessayan L, Szamosfalvi B, Rosner M. H. (2021). Management of dysnatremias with continuous renal replacement therapy. Semin Dial. 2021; 34(6): 472-9.
2. Yessayan L, Yee J, Frinak S, Szamosfalvi B. Continuous Renal Replacement Therapy for the Management of Acid-Base and Electrolyte Imbalances in Acute Kidney Injury. Adv Chronic Kidney Dis. 2016;23(3):203-10.
3. Yessayan L, Yee J, Frinak S, Szamosfalvi B. Treatment of severe hyponatremia in patients with kidney failure: role of continuous venovenous hemofiltration with low-sodium replacement fluid. Am J Kidney Dis. 2014;64(2):305-10.
4. Paquette F, Goupil R, Madore F, Troyanov S, Bouchard J. Continuous venovenous hemofiltration using customized replacement fluid for acute kidney injury with severe hypernatremia. Clin Kidney J. 2016;9(4):540-2.

What Outcomes Matter to Patients and Their Relatives?

Sean Bagshaw MD, MSc
9:15-9:30
Friday, March 15

Educational Objectives:
1. Describe the outcomes that are important to patients and families?

Content Description:
There are 3 fundamental questions that should be asked when considering the evaluation of novel or existing interventions in critically ill patients:

1. Will the intervention improve the chances a patient will survive?
2. Will the intervention improve the chances a patient will preserve (or improve) their function (e.g., physical function; ADL, IADL)?
3. Will the intervention improve the chance a patient will feel better (e.g., mental health; cognitive function; health-related quality-of-life)?

These questions should correlate with patient and family perceptions of their experience and outcomes after critical illness. These can then be a focus for novel endpoint development perceived to have importance to patients and families in clinical trials.

Clinical trials in critical care, and particularly in critical care nephrology, have traditionally focused on endpoints believed to be patient-centered and have clinical importance: mortality, use of renal replacement therapy (RRT), kidney recovery (i.e., new chronic kidney disease [CKD]; progression to kidney failure (maintenance dialysis) and the composite endpoint of major adverse kidney events (MAKE) defined by death, KRT dependence and changes to kidney function (i.e., relative changes to estimate glomerular filtration rate [eGFR]). How these endpoints rank in terms of importance to patients and their families is not certain. Kidney failure and longer-term RRT is certainly associated with impaired health-related quality-of-life. However, clinical trials have generally not routinely integrated a wider spectrum of survivorship endpoints that may have great (or even greater relative) importance to patients (i.e., disability; return to home, social function; return to work) and their families (e.g., caregiver burden).

This lecture will discuss the spectrum of outcomes (and endpoints for clinical trials) that are plausibly important to patients and their families and warrant consideration.

Suggested Reading:
1. Villeneuve PM, Clark EG, Sikora L, Sood MM, Bagshaw SM: Health-related quality-of-life among survivors of acute kidney injury in the intensive care unit: a systematic review. Intensive Care Med 2016, 42(2):137-146.
2. Rubin EB, Buehler AE, Halpern SD: States Worse Than Death Among Hospitalized Patients With Serious Illnesses. JAMA Intern Med 2016, 176(10):1557-1559.
3. Auriemma CL, O'Donnell H, Jones J, Barbati Z, Akpek E, Klaiman T, Halpern SD: Patient perspectives on states worse than death: A qualitative study with implications for patient-centered outcomes and values elicitation. Palliat Med 2022, 36(2):348-357.
4. Dinglas VD, Cherukuri SPS, Needham DM: Core outcomes sets for studies evaluating critical illness and patient recovery. Curr Opin Crit Care 2020, 26(5):489-499.
5. Hauschildt KE, Seigworth C, Kamphuis LA, Hough CL, Moss M, McPeake JM, Iwashyna TJ, National Heart L, Blood Institute P, Early Treatment of Acute Lung Injury N: Financial Toxicity After Acute Respiratory Distress Syndrome: A National Qualitative Cohort Study. Crit Care Med 2020, 48(8):1103-1110.
6. Andersen SK, Butler RA, Chang CH, Arnold R, Angus DC, White DB: Prevalence of long-term decision regret and associated risk factors in a large cohort of ICU surrogate decision makers. Crit Care 2023, 27(1):61.

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7. Cameron JI, Chu LM, Matte A, Tomlinson G, Chan L, Thomas C, Friedrich JO, Mehta S, Lamontagne F, Levasseur M et al: One-Year Outcomes in Caregivers of Critically Ill Patients. N Engl J Med 2016, 374(19):1831-1841.
8. Lautrette A, Darmon M, Megarbane B, Joly LM, Chevret S, Adrie C, Barnoud D, Bleichner G, Bruel C, Choukroun G et al: A communication strategy and brochure for relatives of patients dying in the ICU. N Engl J Med 2007, 356(5):469-478.

Update from Ongoing and Late Breaking Trials

WE-ROCK, the Pediatric RRT Collaborative

Katja Gist DO, MSc
11:30-12:30
Friday, March 15

Educational Objectives:
1. Describe WE-ROCK
2. Summarize major findings from WE-ROCK
3. Delineate next steps

Content Description:
This presentation will summarize the formation of the Worldwide Exploration of Renal Replacement Outcomes Collaborative in Kidney Disease (WE-ROCK), the findings from the primary study objectives and completed ancillary proposals. Next steps and future sustainability will also be summarized.

Suggested Reading:
Menon S, Krallman KA, Arikan AA, Fuhrman DY, Gorga SM, Mottes T, Ollberding N, Ricci Z, Stanski NL, Selewski DT, Soranno DE, Zappitelli M, Zang H, Gist KM; WE-ROCK Investigators. Worldwide Exploration of Renal Replacement Outcomes Collaborative in Kidney Disease (WE-ROCK). Kidney Int Rep. 2023 Jun 5;8(8):1542-1552. doi: 10.1016/j.ekir.2023.05.026. PMID: 37547524; PMCID: PMC10403688.

Update from Ongoing and Late Breaking Trials

Dialyzing Wisely Trial

Oleksa Rewa MD MSc.
11:30-12:30
Friday, March 15

Educational Objectives:
1. Overview of the Dialyzing Wisely Program
2. Presentation of the Dialyzing Wisely Pathways
3. Current program status

Content Description:
There is significant variability in the provision of acute dialysis therapy in Alberta's ICUs. The performance of this therapy is also not routinely monitored, and care is not in keeping with best evidence. This has created a significant knowledge gap that the Dialyzing Wisely program aims to address.

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The goal of Dialyzing Wisely is to improve the performance of acute dialysis to all critically ill patients in Alberta. However, once we can show proof of concept, this can be expanded to any jurisdiction. To do this, we have created 3 pathways for adult critically ill patients, adult cardiac patients and pediatric critically ill patients being considered for acute dialysis.

We have engaged with ICUs, CICUs, CVICUs, PICUs and PCICUs across the province of nearly 5 million people. We have currently rolled out this program across nearly all centers, and are providing regualar audit and feedback reports to sites.

We are currently in the process of creating user dashboards in order to hand over this initiative to sites in order to ensure its sustainability and the ongoing high quality, evidence-based provision of acute renal replacement therapy.

Suggested Reading:

1. Rewa et al., Quality indicators of continuous renal replacement therapy (CRRT) care in critical ill patients: a systematic review, Intensive Care Medicine 2017(43): 750.
2. Rewa et al., A modified Delphi process to identify, rank and prioritize quality indicators for continuous renal replacement therapy (CRRT) care in critically ill patients, Journal of Critical Care 2018(47): 145-152.
3. Opgenorth et al., Improving the quality of the performance and delivery of continuous renal replacement therapy (CRRT) to critically ill patients across a healthcare system: QUALITY CRRT: a study protocol, BMJ Open 2022(12): e054583.
4. Ruiz et al., Development, implementation and outcomes of a quality assurance system for the provision of continuous renal replacement therapy in the intensive care unit, Scientific Reports 2020(10): 20616.
5. Opgenorth et al., A study protocol for improving the delivery of acute kidney replacement therapy (KRT) to critically ill patients in Alberta - Dialyzing Wisely, BMC Nephrology 2022(23): 369.
6. Gaudry et al., Initiation Strategies for Renal-Replacement Therapy in the Intensive Care Unit, New England Journal of Medicine 2016 375(2): 122.
7. Bagshaw et al., Timing of Initiation of Renal-Replacement Therapy in Acute Kidney Injury, New England Journal of Medicine 2020 383(3): 240.

Update from Ongoing and Late Breaking Trials

The RELAX Trial

Christian Nusshag MD
11:30-12:30
Friday, March 15

Educational Objectives:

1) Describe the therapeutic options for ICU patients with SARS-CoV-2-induced acute respiratory distress syndrome.
2) Describe the principle of plasma exchange.
3) What is the rationale for using plasma exchange in ICU patients with severe COVID-19? What are the potential risks?

Content Description:

Recent evidence points to a multilevel inflammatory syndrome as a driving factor in some of the most critically ill coronavirus disease 2019 (COVID-19) patients in ICU, with overlapping features with other hyperinflammatory or autoimmune diseases. The underlying mechanisms are thought to be a dysregulated innate and adaptive immune response, the formation of (prothrombotic) autoantibodies, a hyperinflammatory cytokine storm-like state, and endothelial and complement dysfunction with microcirculatory clot formation. As there are few other therapeutic options in this context (apart from corticosteroids), plasma exchange (PE) has been discussed as a potential

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rescue therapy for severe COVID-19 as it removes inflammatory mediators, balances the hypercoagulable state, stabilizes endothelial membranes and potentially eliminates harmful autoantibodies. In addition, PE has been shown to be safe and beneficial in other hyperinflammatory conditions such as sepsis, hemophagocytic lymphohistiocytosis, and influenza. However, PE is an invasive procedure with potential side effects, and current evidence is limited to case reports and case series. In this session, we summarize the current evidence and report for the first time the results of a randomized controlled trial (RELAX trial).

Suggested Reading:

1) Plasma Exchange in Patients With Severe Coronavirus Disease 2019: A Single-Center Experience. Nusshag C, Morath C, Speer C, Kaelble F, Zeier M, Boxberger M, Schulze-Schleithoff E, Fiedler MO, Weigand MA, Merle U. Crit Care Explor. 2021 Aug 20;3(8):e0517.

2) Gustine JN, Jones D: Immunopathology of hyperinflammation in COVID-19. Am J Pathol 2021; 191:4–17

3) Cao X: COVID-19: Immunopathology and its implications for therapy. Nat Rev Immunol 2020; 20:269–270

4) Zuo Y, Estes SK, Ali RA, et al: Prothrombotic autoantibodies in serum from patients hospitalized with COVID-19. Sci Transl Med 2020; 12:eabd3876

5) McFadyen JD, Stevens H, Peter K: The emerging threat of (micro)thrombosis in COVID-19 and its therapeutic implications. Circ Res 2020; 127:571–587

6) Keith P, Day M, Perkins L, et al: A novel treatment approach to the novel coronavirus: An argument for the use of therapeutic plasma exchange for fulminant COVID-19. Crit Care 2020; 24:128

7) Patel P, Nandwani V, Vanchiere J, et al: Use of therapeutic plasma exchange as a rescue therapy in 2009 pH1N1 influenza A—An associated respiratory failure and hemodynamic shock. Pediatr Crit Care Me 2011; 12:e87–e89

8) Fernandez J, Gratacos-Ginès J, Olivas P, et al: Plasma exchange: An effective rescue therapy in critically ill patients with coronavirus disease 2019 infection. Crit Care Med 2020; 48:e1350–e1355

9) Gucyetmez B, Atalan HK, Sertdemir I, et al; COVID-19 Study Group: Therapeutic plasma exchange in patients with COVID19 pneumonia in intensive care unit: A retrospective study. Crit Care 2020; 24:492

10) Honore PM, Barreto Gutierrez L, Kugener L, et al: Plasma exchange in critically ill COVID-19 patients improved inflammation, microcirculatory clot formation, and hypotension, thereby improving clinical outcomes: Fact or fiction? Crit Care 2020; 24:55

AKI & CRRT 2024

EPIDEMIOLOGY AND OUTCOMES FROM AKI

1

Clinical Profile & Outcomes Of AKI Cases At A Tertiary Care Centre In,Hyderabad, Telangana, India

MAHESH KOTA[1], RAJASEKARA CHAKRAVARTHI M[1], VIJAY VARMA P[1]

[1]*YASHODA HOSPITAL*

Objectives:
To study demographics, comorbids, causes of AKI, renal replacement therapy offered ,duration of ICU stay and hospital stay for the first two hundred AKI cases admitted at Yashoda hospitals ,Hitech city, Hyderabad, Telangana.

Materials and methods:
In this prospective observational study,first two hundred patients with AKI admitted to Yashoda hospital,Hitech city,Hyderabad were studied with a detailed clinical history ,physical and laboratory evaluation.

Results:
Of the first two hundred patients with AKI,126 of them were males,74 were females, mean age of the patients in the study was 60.52 years,mean ICU stay was 3.69 days and mean duration of hospital stay was 5.87days. Among the patients with AKI ,hypertension was the common comorbid condition seen in 150 members, followed by diabetes mellitus seen in 106 members.Coming to the causes of AKI in the study group,multiple factors as a cause of AKI was seen in 34 members and 166 members has a single responsible factor as a cause of AKI.In patients with multifactorial AKI,CRS+CIAKI was common cause in seen in 18 members. Out of 166 members where single factor was the cause of AKI ,urosepsis was the common cause seen in 20 members followed LRTI which was seen in 20 members.Out of hundred patients with AKI ,DIRI was seen in 24 members ,among which diuretic was the common cause seen in 10 members,followed by CIAKI seen in 6 members.Among 200 patients with AKI ,RRT of any modality was offered in 50 members,among HD was done in 32 patients,HDF was done in 10 members,SLED was done in 4 members and CRRT-CVVVHDF was done in 4 members.Among the four patients who was subjected to CRRT ,two patients had complete recovery of renal function and two patients expired.

Conclusions:

Sepsis of any etiology was the most common cause of AKI in the study group.

RRT of any modality was offered in almost quarter patients in the study group.

Need for RRT,higher grade of AKI,poor hemodynamics and delayed initiation of RRT in needy patients was assosiated with very poor outcomes.

Drug induced renal injury which was seen in 24 members in the study group are the cohort of patients where it can be avoided with proper awareness among treating doctors.

As a single episode of AKI can decrease residual renal function and predispose to CKD,in a developing nation like India with less percapita income,lot of awareness has to be created among doctors at gross root level to prevent AKI further progression to CKD.

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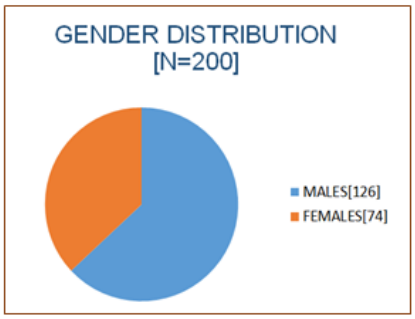
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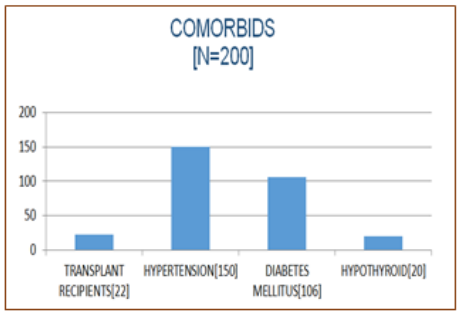
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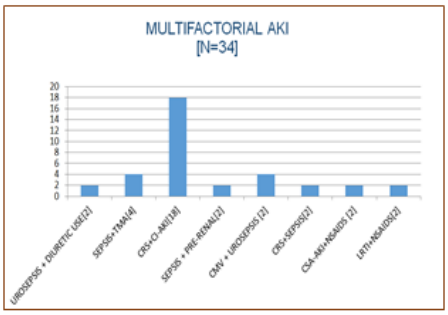
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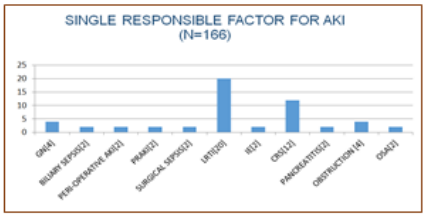
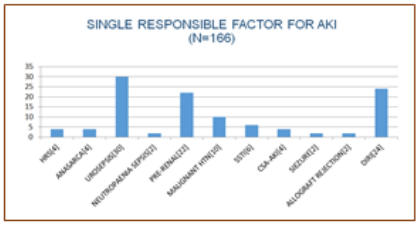
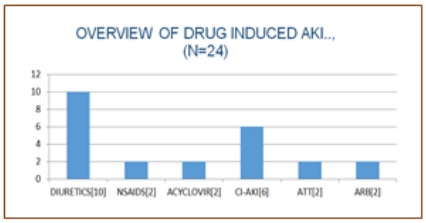

SINGLE RESPONSIBLE FACTOR FOR AKI
(N=166)


SINGLE RESPONSIBLE FACTOR FOR AKI
(N=166)


OVERVIEW OF DRUG INDUCED AKI..,
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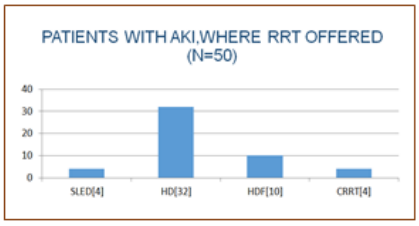
ACYCLOVIR[2]
CI-AKI[6]
ATT[2]
ARB[2]


PATIENTS WITH AKI,WHERE RRT OFFERED
(N=50)
SLED[4]
HD[32]
HDF[10]
CRRT[4]

2

SGLT2i during AKI and its association with major adverse kidney events

Jonathan S Chavez Iniguez[1], Luz Alcantar-Vallin[1], Ramon Medina-Gonzalez[1], Guillermo Navarro-Blackaller[1], Alejandro Martinez-Gallardo Gonzalez[1], Miguel Perez-Venegas[1], Edgar J Carmona-Morales[1]

[1]*Hospital Civil de Guadalajara*

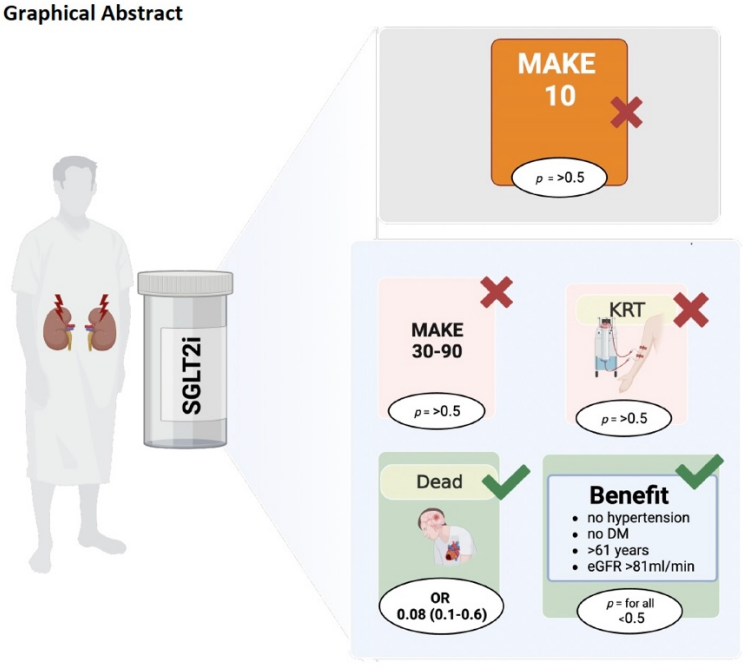
Background: The association between administration of sodium glucose type 2 inhibitors (SGLT2i) during acute kidney injury (AKI) and the incidence of major adverse kidney events (MAKE) is not known.

Methods: In this retrospective cohort study, included patients who had AKI and received SGLT2i during the hospitalization, then compared versus those without. Analyzed the association between AKI and SGLT2i use with the outcomes as MAKE at 10, 30-90 days, each of the MAKE components and prespecified patients subgroups.

Results: From 2021 to 2023, 374 patients were included, 316 without SGLT2i and 58 with. Baseline characteristics differ markedly between groups, patients with SGLT2i, compared to those without, were older, higher proportion of history pf diabetes, hypertension, chronic heart failure and chronic kidney disease, required less often hemodialysis, presented AKI stage 3 less frequently. A logistic regression analysis nearest-neighbor matching showed that SGLT2i use was not associated with the risk of MAKE10, OR 1.08 (0.45 - 2.56), neither with MAKE30-90 OR 0.76 (0.42 - 1.36). For death, the stepwise approach demonstrated SGLT2i associated with reducing risk, OR 0.08 (0.01 - 0.64), and no effect was found to kidney replacement therapy (KRT). Subgroups of patients associated with reduction in the risk of MAKE with AKI and SGLT2I use, were those older than 61 years, with eGFR >81, and those without history of hypertension or DM (p= <0.05 for all).

Conclusion: The use of SGLT2i during AKI had no effect on MAKE in the short and medium term but may be some subgroups of patients that could have benefit.

Graphical Abstract



3

Decrease in platelets in patients with AKI and its association with major adverse kidney events

Jonathan S Chavez Iniguez[1], Luz Alcantar-Vallin[1], Guillermo Navarrro-Blackaller[1], Ramon Medina-González[1], Alejando Martinez-Gallardo Gonzalez[1], Juan A Gómez-Fregoso[1], Gonzalo Rodríguez-García[1]

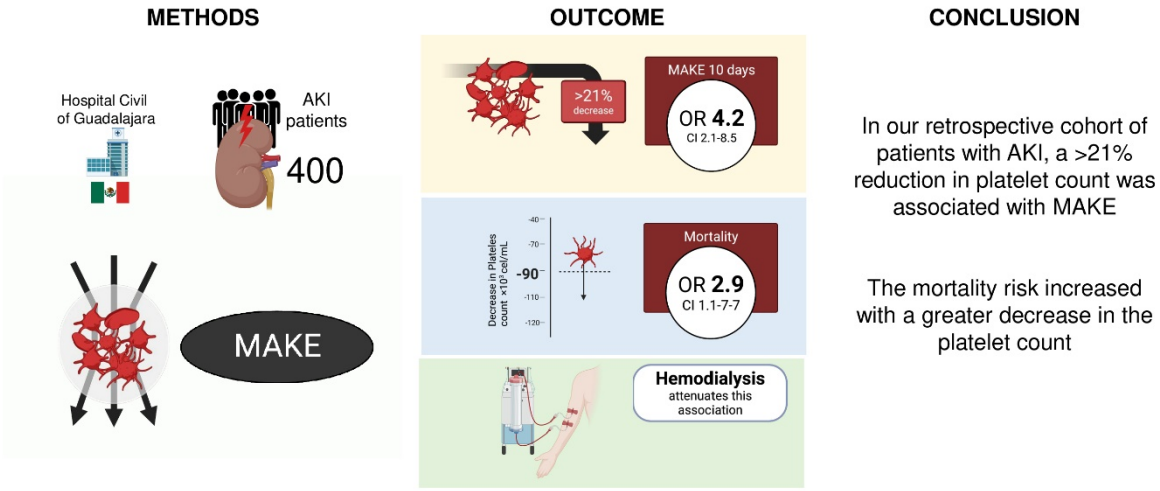
[1]*Hospital Civil de Guadalajara*

Introduction: The reduction in platelets in critically ill patients is a marker of severity. It is unknown whether this association holds in acute kidney injury (AKI). We analyze the association between platelet reduction in patients with AKI and its relationship with the major adverse kidney events (MAKE).

Methods: In this retrospective cohort, we included AKI patients at the Hospital Civil of Guadalajara. Divided them by whether their platelet count fell >21% during the first 10 days. Our objectives were to analyze the association between platelet reduction >21% and MAKE at 10 days (MAKE10), at 30-90 days (MAKE30-90) and death.

Results: From 2017 to 2023, 400 AKI patients were included, 134 had a reduction in platelets >21%. The mean age was 54 years, 60% were male and 44% had sepsis. The mean baseline platelet count was 194×103 cel/µL, and KDIGO3 was met in 65%. Those with hemodialysis (HD) had lower platelet counts. After multiple adjustments, platelet reduction >21% was associated with MAKE10 (OR 4.2, CI 2.1-8.5), but not with MAKE30-90. The mortality risk increased 3-fold (OR 2.9, CI 1.1-7.7, p= 0.02) with a greater decrease in the platelet count (<90×103 cel/µL). As the platelet decreased worsened, MAKE was more likely. These associations lost significance when accounting for starting HD.

Conclusion: In our retrospective cohort of patients with AKI, a >21% reduction in platelet count was associated with MAKE. Our results are useful to generate hypotheses and motivate us to continue studying this association with a more robust design.



4

Blood transfusion reactions and risk of acute kidney injury and major adverse kidney events

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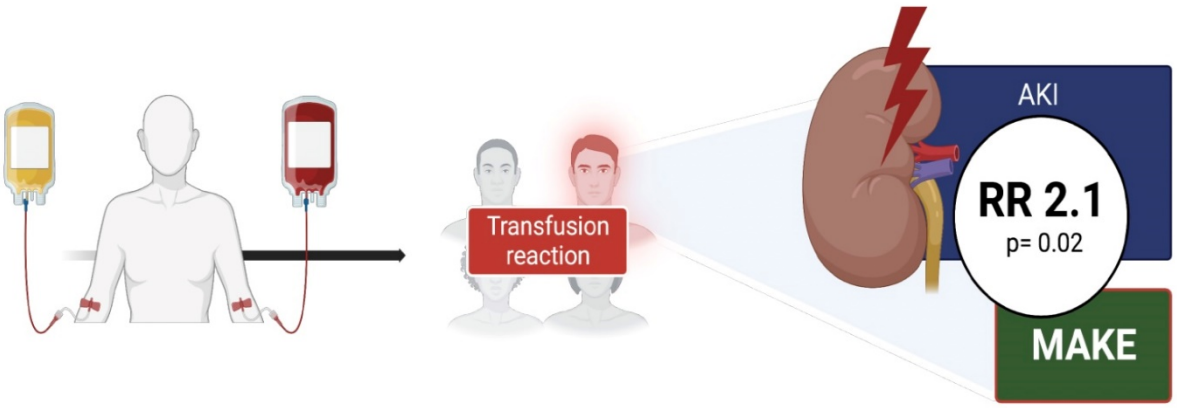
Background: Blood transfusion reactions may have a negative impact on organ function. It is unknown whether this association holds true for acute kidney injury (AKI). Therefore, we conducted a cohort study to assess the association between transfusion reactions and the incidence of AKI and major adverse kidney events.

Methods: In this retrospective cohort study, we included patients who received transfusion of blood products during hospitalization at the Hospital Civil of Guadalajara. We analyzed them according to the development of transfusion reactions, and the aim was to assess the association between transfusion reactions and AKI during long-term follow-up.

Results: From 2017 to 2021, 81,635 patients received a blood product transfusion, and 516 patients were included. The most common transfusion was red blood cell packaging (50.4%), fresh frozen plasma (28.7%) and platelets (20.9%); of those, 129 (25%) had transfusion reactions. Patients who had transfusion reactions were older and had more comorbidities. The most common type of transfusion reaction was allergic reactions (70.5%), followed by febrile nonhemolytic reactions (11.6%) and anaphylactoid reactions (8.5%). Most cases were considered mild. AKI was more prevalent among those who had transfusion reactions (14.7%) than among those who did not (7.8%), p= < 0.01; those with AKI had a higher frequency of diabetes, vasopressors, and insulin use. Transfusion reactions were independently associated with the development of AKI (RR 2.1, p= < 0.02). Major adverse kidney events were more common in those with transfusion reactions. The mortality rate was similar between subgroups.

Conclusion: In our retrospective cohort of patients who received blood product transfusions, 25% experienced transfusion reactions, and this event was associated with a 2-fold increase in the probability of developing AKI and some of the major adverse kidney events during long follow-up.



5

Intravenous contrast medium and renal outcomes in pre-existing acute kidney injury - a multicenter propensity-score adjusted study

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Purpose: While patients with acute kidney injury (AKI) may still require contrast-enhanced CT scans as an integral part of their clinical management, limited evidence exists regarding the risk of the subsequent development of persistent AKI, acute kidney disease (AKD), and dialysis, particularly in those with pre-existing AKI.

Method: This retrospective multicenter study included hospitalized patients with pre-existing acute kidney injury who underwent CT scans between 2001 and 2019. The balance of baseline characteristics between patients with and without contrast media was achieved using inverse probability of treatment weighting (IPTW) based on propensity score estimated by generalized boost model. The association between contrast media and renal outcomes was estimated using logistic regression in the IPTW-adjusted cohort.

Results:
A total of 17560 patients (mean age, 66± 17 years; 57.1% men) were enrolled; 9438 received contrast CT, and 8122 received non contrast CT. After IPTW adjustment, the overall weighted incidence of post-CT 7-day AKI (19.0 vs. 19.1%) was similar between contrast CT and non-contrast CT group, but post CT 7-day dialysis rates was significantly higher in the contrast group (5.9 vs. 4.8%, OR: 1.23, 95% CI: 1.12, 1.36, P<0.001). However, no significant differences were found in the 30-day AKD rate (21.0 vs 20.7%, OR: 1.02, 95% CI: 0.97, 1.08, P=0.443) and the 30-day dialysis rate (5.0 vs 4.7%, OR: 1.08, 95% CI: 0.98, 1.20, P=0.122) between contrast CT and non-contrast group.

Conclusion: The utilization of contrast-enhanced CT scans in patients with pre-existing acute kidney injury was associated with a higher risk of 7-day dialysis, while no significant association was observed with long-term renal complications.

Outcome	Contrast	Non-Contrast	OR (95% CI)	P value
(1)Post-CT 7 days				
Post-CT AKI	19.0%	19.1%	0.94, 1.05)	0.851
Stage 1	6.0%	5.7%	.95, 1.14)	0.437
Stage 2	3.5%	3.5%	.88, 1.12)	0.924
Stage 3	9.6%	9.9%	.90, 1.04)	0.417
post-CT Dialysis	5.9%	4.8%	.12, 1.36)	<0.001
(2)Post-CT 30 days				
post-CT AKD	21.0%	20.7%	.97, 1.08)	0.443
Stage 1	6.4%	6.2%	.95, 1.14)	0.371
Stage 2	4.3%	4.4%	.87, 1.08)	0.612
Stage 3	10.3%	10.0%	.96, 1.11)	0.426
post-CT Dialysis	5.0%	4.7%	.98, 1.20)	0.122

6

Long-Term Outcomes of Acute Kidney Injury in Acute Decompensated Heart Failure: Identifying True Cardiorenal Syndrome and Unveiling Prognostic Significance

Peerapat Thanapongsatorn[1], Atiwat Tanomchartchai[2], Jarin Assavahanrit[2], Nattachai Srisawat[3]

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Introduction:
Cardiorenal syndrome (CRS) type 1, characterized by acute kidney injury (AKI) in acute decompensated heart failure (ADHF), is complex due to varied definitions, including AKI from excessive fluid removal. This study aimed to explore the incidence, predictors, and long-term outcomes of AKI in ADHF.
Methods:
A prospective observation study of ADHF patients categorized into CRS type 1, Pseudo-CRS, and non-AKI groups, followed for 12 months. CRS type 1 involved AKI with clinical congestion, while Pseudo-CRS included AKI with clinical decongestion (clinical congestion score < 2). The primary outcome was a 1-year composite of mortality or HF rehospitalization. The secondary outcomes were mortality, HF rehospitalization, and long-term renal outcomes.
Results:
Among 250 consecutive ADHF patients, 46% developed CRS type 1, 16.5% had Pseudo-CRS, and 37.6% had non-AKI. Chronic kidney disease and BUN were significant risk factors for CRS type 1, with odds ratios of 1.37 (p=0.002) and 1.05 (p<0.001), respectively. CRS type 1 patients exhibited shorter times to AKI development and peak serum creatinine compared to Pseudo-CRS (1 day vs. 4 days and 2 days vs. 4 days, respectively). At 12 months, composite outcomes of mortality or HF rehospitalization and CKD progression were significantly higher in CRS type 1 than Pseudo-CRS and non-AKI, at 63.5% vs. 31.7% vs. 36.1%, and 28.1% vs. 16.2% vs. 11.4%, respectively (p<0.001, p=0.024).
Conclusion:
Distinguishing between CRS Type 1 and Pseudo-CRS is vital, highlighting significant disparities in short-term and long-term outcomes. Notably, Pseudo CRS exhibits comparable long-term cardiovascular and renal outcomes to those without AKI.

	CRS type 1 (N=115)	Pseudo CRS (N=41)	Non-AKI (N=94)	P-value
Composite outcomes of mortality and rehospitalization from heart failure, n (%)	73 (63.5)	13 (31.7)	34 (36.1)	< 0.001
1-year mortality, n (%)	29 (25.2)	4 (9.8)	12 (12.8)	0.021
Rehospitalization from heart failure, n (%)	50 (43.5)	10 (24.4)	24 (25.8)	0.011
CKD progression at 1 year (% among survivors with sCr available)	23 (28.1)	6 (16.2)	9 (11.4)	0.024
ESRD (% among survivors)	3 (3.5)	1 (2.7)	0 (0)	0.38
Serum creatinine, mean±SD				
3-months	1.47±0.98	1.13±0.47	1.06±0.59	0.99
1-year	1.51±1.13	1.26±0.60	1.08±0.68	1.00

7

Kidney Disease Awareness and Knowledge Among Families and Pediatric Survivors of Severe Acute Kidney Injury

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[1]*Indiana University School of Medicine*

Purpose: Acute kidney injury (AKI) is common in pediatric patients and is associated with poor outcomes including increased risk of chronic kidney disease. It is unknown whether pediatric AKI survivors and their families are aware of their AKI diagnosis and understand the associated risks. We sought to identify awareness and disease-specific knowledge among pediatric AKI survivors and their families.

Methods: We performed a single center cross-sectional survey of AKI awareness and knowledge in pediatric patients with KDIGO Stage II or III AKI near the time of discharge. Families answered questions on AKI diagnosis awareness and AKI knowledge using the Kidney Knowledge Survey (KiKS).

Results: We included 96 patients in this study, the median age was 3.5 (IQR: 0, 10) and 50% were male. 68% were admitted to the ICU during their hospitalization.

Of those surveyed, 75% of families were unaware their child had experienced AKI and 94% were unaware they had a 'problem with their kidneys' (Figure 1A). Overall, the median AKI objective knowledge score was 60% (IQR: 31%, 69%). There was no difference in knowledge score between those that recognized their episode of AKI and those that did not. Those with nephrology consultation were more likely to have awareness of their AKI diagnosis as were those who self-reported as White race (Table 1).

In total, 69% of families correctly defined AKI as when 'your kidneys suddenly stop working well'. Most families recognized dehydration (56%) and infection (81%) as risk factors for AKI, however fewer recognized other risk factors such as ibuprofen use (31%) (Figure 1B). Only 38% of families reported AKI was discussed during their admission, and 92% stated they wanted to learn more about AKI (Figure 1C).

Conclusion: Most families of pediatric survivors of severe AKI were unaware that their child had AKI or problems with their kidneys. Many lacked understanding of AKI risk factors and knowledge of kidney health and desired more information.

Characteristics	Total (N=96)	Aware of AKI (N=24)	Unaware of AKI (N=72)	p-value
Age, median (IQR)	3.5 (0, 10)	4 (2, 12.5)	2 (0, 11.5)	.28
Male, n (%)	48 (50)	18 (75)	30 (42)	.005
White race, n (%)	78 (81)	24 (100)	54 (75)	.025
BRIEF Literacy Score, median (IQR)	18 (15.5, 19.5)	18.5 (16.5, 19.6)	18 (15.5, 19.5)	.36
Kidney Knowledge Score, median (IQR)	60% (31, 69)	60% (56, 65)	52% (29, 71)	.55
Primary medical service, n (%)	39 (41)	13 (54)	26 (36)	<.001
Length of Stay, median (IQR)	9 (5, 57)	7 (3, 8)	20 (6, 70)	<.001
Required Dialysis, n (%)	6 (6)	4 (17)	2 (3)	.014
Nephrology consultation, n (%)	42 (43)	18 (75)	24 (33)	<.001

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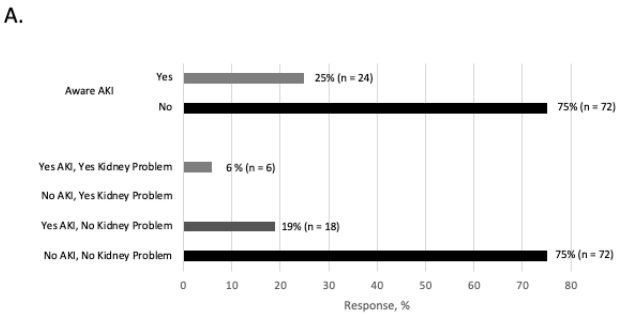
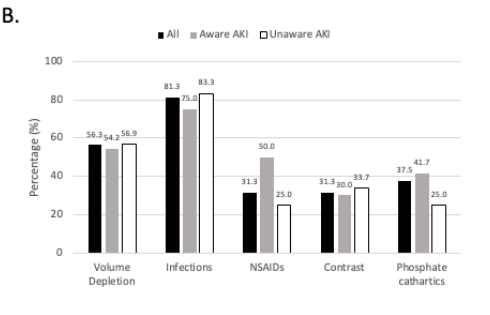
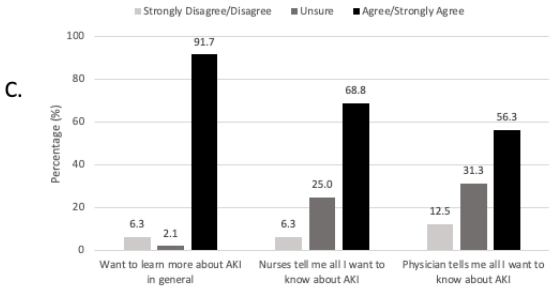


Proportion of families who reported being aware of their child having experienced AKI. The bottom panel stratifies this question further based on the response to the additional question "Do you have a problem with your kidney health?"



Identification of specific AKI risk factors. This figure shows the proportion of families who recognized specific risk factors for AKI.



Family responses to questions regarding whether physicians or nurses met their informational needs and whether they desired to learn more about AKI in general.

8

Clinical Profile & Outcomes Of AKI Cases At A Tertiary Care Centre In,Hyderabad, Telangana, India

MAHESH KOTA[1], RAJASEKARA CHAKRAVARTHI M[1]

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Objectives;
To study the incidence, causes ,staging and outcomes of AKI (acute kidney injury) in patients suffering from malignancy

Materials and methods;
A total of 200 cancer patients with AKI admitted in Basavatarakam Indo American Cancer hospital, Hyderabad, India were studied.

Results;
Out of 200 patients in the study, 124 were males and 76 were females. Most of the patients are in 51 to 60 years age group(80 patients) and the mean age of the patients was 54.76 years. Hypertension was the common comorbid illness seen in 140 patients followed by diabetes mellitus seen in 48 patients. Bladder cancer was common malignancy seen in 24 patients, followed by breast cancer, lung cancer and AML seen in 20 patients. Multifactorial AKI was seen in 44 patients ,though each and every variant of malignancy has specific cause of AKI, sepsis was commonly seen in all types of malignancies. Renal biopsy was done in 9 patients, where cast nephropathy was seen in patients with multiple myeloma, chronic tubulointerstitial nephritis was seen in amyloidosis, ATIN(acute tubule interstitial nephritis) and ATN(acute tubular necrosis) was seen in lung cancer, membranous nephropathy and acute interstitial nephritis was seen in renal cell carcinoma and thrombotic microangiopathy was seen in a patient with AKI who underwent bone marrow transplantation for aplastic anemia.140 patients underwent conservative management for AKI without dialysis had complete recovery from AKI.60 patients received dialysis for AKI, of which 4 patients received hemoperfusion with

HA-230 filter for methotrexate has completely recovered,8 patients with multiple myeloma underwent dialysis with theranova filter got completely recovered ,4 patients with multiple myeloma underwent dialysis with theranova was dialysis dependent.4 patients who underwent SLED for AKI has completely recovered,12 patients who underwent SLED for AKI were dialysis dependent and 4 patients who underwent SLED has expired.20 patients received CRRT for AKI and among them Oxiris filter was used in 4 members. Only 1 patient who received CRRT had complete renal recovery,4 patients were dialysis dependent and 15 patients who was on CRRT expired during hospital stay.

Conclusions;
Sepsis was the common cause of AKI in many cancer variants. More the severity of AKI was associated with more adverse out comes. All types of AKI like pre-renal, intrinsic renal and obstructive element was seen in patients in the background of malignancy.

9

Epidemiology of Sepsis-Associated Acute Kidney Injury

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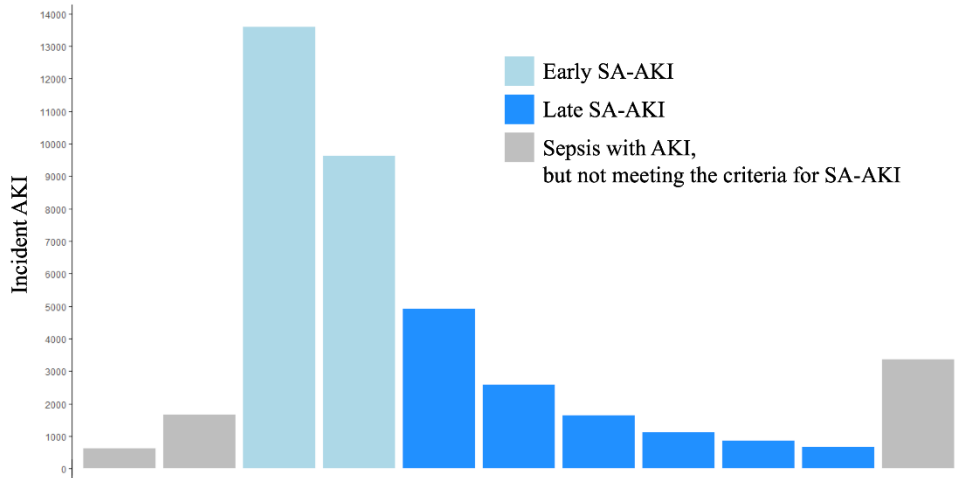
Background
The ADQI defined sepsis-associated AKI (SA-AKI) as meeting both Sepsis-3 and KDIGO criteria within 7 days of sepsis diagnosis and further categorized it as early or late (within 48 hours or later). Despite this definition, there is limited knowledge about its epidemiology. This study aimed to describe the epidemiological characteristics of SA-AKI, including its early and late subtypes.

Methods
A multicenter retrospective study utilized EHR data from two academic hospitals, focusing on ICU admissions for individuals aged 18 and above from February 2010 to June 2022. Patients with ESKD or kidney transplant were excluded. Using culture and antibiotics time stamps, we identified infection occurrence and classified sepsis if the SOFA score reached 2 or more during the same period. To identify AKI, we used KDIGO SCr and urine output criteria. Baseline SCr was defined as the closest outpatient measurement within 7 to 365 days before admission. If unavailable, prior inpatient SCr meeting the same conditions was used. If still unidentifiable, the lowest SCr value from 7 days before admission to discharge was considered. AKI within 48 hours of sepsis onset was defined as early SA-AKI, while occurrence after 48 hours but within 7 days was defined as late SA-AKI. When comparing the characteristics of the two subtypes of SA-AKI, the χ^2 test was used for categorical variables, the t-test was employed for parametric continuous variables, and the Mann-Whitney U test was utilized for non-parametric ones.

Results
Among 188,106 identified ICU patients, 63,621 met Sepsis-3 criteria. Among those, 34,980 developed SA-AKI, with 23,229 (66.4%) classified as early and 11,751 (33.6%) as late. In SA-AKI patients (Figure), the median age was 60 [IQR 48-70], 55.6% were male, 25% had diabetes, 30.3% had cardiovascular disease, and 16.8% had CKD. The early group had significantly higher SOFA scores at sepsis onset (5.8 vs 5.0) and a higher rate of septic shock (19.1 vs 16.0%) compared to the late group (both $p < 0.01$). However, for clinical outcomes, the early group had lower hospital mortality (21.0 vs 26.3%), and more ICU-free days (18.1 vs 16.6), mechanical ventilator-free days (19.6 vs 17.8), and RRT-free days (21.5 vs 19.9) compared to the late group (all $p < 0.01$).

Conclusion
Early SA-AKI occurred in approximately two-thirds of SA-AKI patients who presented with higher acuity of illness at onset but had better outcomes compared to patients with late SA-AKI.

Figure. The incidence of AKI daily from the onset of sepsis



days from sepsis onset	-2	-1	0	1	2	3	4	5	6	7	8+
number of patients	618	1,669	13,594	9,635	4,911	2,570	1,639	1,112	844	675	3,369
% (per SA-AKI patients)	-	-	38.9%	27.5%	14.0%	7.3%	4.7%	3.2%	2.4%	1.9%	-

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10

An Exploration of the Association of Sex and Pubertal Status with AKI and AKD in Critically Ill Children

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Purpose
Animal studies have shown that estrogen is protective in ischemic acute kidney injury (AKI) and testosterone is associated with worse outcomes. Recent epidemiologic studies suggest that males have higher rates of hospital acquired AKI, but females have worse kidney outcomes after AKI. Few investigators have explored the effects of sex on pediatric AKI. Therefore, our objective was to examine the association of sex and pubertal status with AKI and acute kidney disease (AKD) in a pediatric intensive care (PICU) cohort.

Methods
This is a retrospective cohort study of patients 60 days-18 years of age admitted to a quaternary care PICU between the years of 2009-2016. Patients that were dialysis dependent at the time of admission, had an estimated glomerular filtration rate <60 ml/min/1.73m2, a history of kidney transplant, or did not have a measured baseline creatinine were excluded. AKI and AKD were defined by Kidney Disease: Improving Global Outcomes (KDIGO) guideline definitions through 30 days. The final regression models included significant variables from univariable analyses. Severity of illness was assessed using the Pediatric Index of Mortality (PIM) 2 score. We stratified patients by pubertal status based on age: prepubertal up to age 8 years; peripubertal 9-15 years; postpubertal >/=16 years.

Results

Among the 5922 included patients (median age 8 years), 2547 (43%) were female. Of those with AKI, 44% were female (483/1093) and of those with AKD 41% were female (202/493). When examining the entire cohort, as well as the prepubertal (3,138; 42% female) and peripubertal (1,703; 45% female) groups, there was no significant association between sex and either AKI or AKD. However, in the postpubertal subset of patients (1,081; 45% female), female sex emerged as an independent protective factor for both AKI (adjusted odds ratio [aOR]: 0.61; confidence interval [CI]: 0.44-0.82; p=0.001) and for AKD (aOR: 0.60; CI: 0.40-0.91; p=0.015) (see Table 1).

Conclusions

Our data demonstrates that in a broad cohort of critically ill children, female sex is protective against hospital-acquired AKI and AKD at 30 days but only for postpubertal patients. There is a need for further work exploring sex as a biological variable in differing AKI phenotypes and for longer term kidney outcomes such as chronic and end-stage kidney disease.

Table 1: Multivariable analyses examining the association of variables significant for AKI and AKD in a univariable analysis in postpubertal children admitted to a quaternary care PICU (n=1081)

Outcome: AKI n=300 (28%)	**Odds Ratio**	**95% CI**	**p-value**
Sex (female)	0.61	0.44-0.82	**<0.01**
BMI (kg/m^2)	1.05	1.03-1.08	**<0.01**
Baseline Creatinine (mg/dL)	0.61	0.28-1.33	0.21
PIM-2 Score	5.92	0.93-37.95	0.06
Outcome: AKD n=149 (14%)			
Sex (female)	0.60	0.40-0.91	**0.01**
BMI (kg/m^2)	1.03	1.00-1.06	**0.02**
Baseline Creatinine (mg/dL)	4.54	1.58-13.08	**<0.01**
PIM-2 Score	3.96	0.46-33.73	0.21

11

Prescription Trends Of Renal Replacement Therapy In Covid-19-Associated Acute Kidney Injury And Sepsis-Associated Acute Kidney Injury In Colombia

Diana Carolina Vargas Angel[1], Kateir Mariel Contreras Villamizar[1], Camilo Alberto Gonzalez Gonzalez[2], Santiago Ortiz[3], Jose Bareño Silva[4], Kelly Chacon[2], Nancy Yomayusa[2]

[1]*Hospital Universitario San Ignacio,* [2]*Keralty,* [3]*Pontificia Universidad Javeriana,* [4]*Universidad CES*

Objective: During the SARS-COV-2 pandemic there was a higher incidence of acute kidney injury (AKI) and the requirement for renal replacement therapy (RRT). The aim of this study was to describe the characteristics of RRT prescription in COVID-19-associated AKI compared to patients with sepsis-associated AKI.

Method: Observational, analytical, parallel-cohort retrospective study of hospitalized patients with COVID-19-associated AKI(n=176) and non-COVID-19 sepsis-associated AKI (n=242), in the period November 2016 to December 2022, in 4 institutions in Bogotá, Colombia. Clinical and renal support characteristics were determined by descriptive statistics. Analysis was performed in RStudio®.

Results: COVID-19-associated AKI patients had lower urinary volume before the initiation of RRT compared to patients with non-COVID-19 sepsis-associated AKI, higher accumulated fluid balance, and anuria being the main indication for the initiation of RRT (60.23% vs 49.17%, p=0.028). The most frequent modality of initiation in patients with non-COVID-19 sepsis-associated AKI was continuous renal replacement therapy (CRRT) (65.7%), with hemodiafiltration being the most common (37.6%). Catheter and RRT-related complications were similar in both cohorts. The characteristics of RRT prescription are resume in Table 1.

Conclusion: CRRT was the most frequently prescribed modality, anuria being the first indication for the initiation of RRT and hyperkalemia most common in COVID-19-associated AKI

Table 1. Renal Supportive Therapy

CHARACTERISTICS	All (n=418)	COVID-19 AKI (n=176)	Sepsis AKI (n=242)	p value
Urinary output at RRT (mL/24h) Median (IQR)	400 (901)	546.5 (1498)	322.5 (624)	**0.022**
Fluid Balance at RRT (mL) Median (IQR)	4493 (6391)	6177.5 (7135)	3703 (4891)	**<0.001**
RRT Indication n (%)				
Uremia	80(19.1)	20(11.3)	60(24.7)	**<0.001**
Water overload	117(27.9)	37(21.0)	80(33.0)	**0.037**
Hyperkalemia	118(28.2)	67(38.0)	51(21.0)	**0.002**
Metabolic acidemia	123(29.4)	31(17.6)	92(38.0)	**<0.001**
Anuria	225(53.8)	106(60.2)	119(49.1)	**0.028**
Modality				
HDFVVC	169(40.4)	78(44.3)	91(37.6)	
HDI	145(34.6)	65(36.9)	80(33.0)	
HFVVC	63(15.0)	8(4.5)	55(22.7)	
HDVVC	31(7.4)	18(10.2)	13(5.3)	**<0.001**
SLED	9(2.1)	7(3.9)	2(0.8)	
SCUF	1(0.2)	0(0)	1(0.4)	
Catheter Complications				
Haematoma	6(1.4)	1(0.5)	5(2.0)	0.203
Dysfunction	11(2.6)	2(1.1)	9(3.7)	0.103
Infection	6(1.4)	2(1.1)	4(1.6)	0.661
Arterial puncture	4(0.9)	0(0)	4(1.6)	0.086
RRT Complications				
Hypophosphatemia	13(3.1)	2(1.1)	11(4.5)	**0.047**
Hypotension	22(5.2)	11(6.2)	11(4.5)	0.441
Hypokalemia	5(1.2)	0(0)	5(2.0)	0.055
In-hospital mortality n (%)	292 (69.8%)	144 (81.2%)	148 (61.2%)	**<0.001**
Renal recovery n (%)	119 (28.4)	89(36.7)	30(17)	**<0.001**

12

Epidemiology and Long-term Outcome of Critically Ill Patients Requiring Renal Replacement Therapy in Southeast Asia and India (InSEA-RRT Registry)

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Background: Acute kidney injury (AKI) contains a high short-term morbidity and mortality. However, little is known regarding long-term outcomes. We aimed to evaluate effect of renal replacement therapy (RRT) modalities on 2-year major adverse kidney events (2-year MAKE) in patients with severe (stage 3) AKI.

Methods: We analyzed the data from InSEA RRT registry—a multicenter prospective cohort study conducted between April 2019 and December 2023. Critically ill patients with stage 3 AKI as defined by KDIGO were enrolled and classified by recovery status after 28 days or at hospital discharge as early, late, and nonrecovery. Primary outcome was 2-years MAKE which is a composite of persistent kidney dysfunction, long-term dialysis, and all-cause mortality on 2-year after enrollment.

Results: A total of 2,216 patients from 25 hospitals across Southeast Asia were enrolled. Among these, 1,033 (47%) patients died, 508/1,054 (48%) patients experienced early recovery, 277/1,054 (26%) late recovery, and 269/1,054 (26%) non-recovery AKI. 1,563 (72%) patients received RRT. The incidence of 2-year MAKE was 46.6 per 100 person-years of all patients. In severe AKI required RRT, there were no significant differences in 2-year MAKE among those initially treated with intermittent hemodialysis, peritoneal dialysis, sustained low efficiency dialysis compared to continuous renal replacement therapy (CRRT) (IHD/SLED vs CRRT, adjusted HR 1.16; 95% CI, 0.93-1.14; P=0.185 and PD vs CRRT, adjusted HR 1.00; 95% CI, 0.67-1.49; P=0.994). Non-recovery was more likely to develop MAKE than recovery (adjusted HR 7.44; 95% CI, 6.18-8.96; P<0.001). Patients with older, male, pre-existing chronic kidney disease and malignancy were significantly independent risk for 2-year MAKE.

Conclusions: RRT modalities were not associated with 2-year MAKE. Non-recovery AKI was independently associated with adverse long-term outcomes. Recognition and close follow-up of patients with non-recovered AKI is crucial. Novel intervention might improve long-term outcomes and need further study.

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Prevalence and Risk Factors of AKI among Children Presenting with Acidosis in a Pediatric Emergency Room of a Tertiary Hospital

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Purpose
Acute kidney injury (AKI) is a common complication of various illnesses and is well known to be associated with adverse outcomes. However, diagnosis of AKI is possible only after serial measurement of kidney function and/or urine output, which is not always performed in a busy pediatric emergency room (PER). On the other hand, venous blood gas analysis (VBGA), widely performed as point-of-care testing (POCT) in the PER, is quick to help physicians with clinical decisions. We hypothesized that children with acidosis on VBGA are at risk of AKI, and explored prevalence and risk factors of AKI in acidotic patients who visited PER.

Methods
We retrospectively reviewed the electronical medical record of children under 18 years of age who visited the emergency department of Seoul National University Children's Hospital from 2020 to 2023, and identified patients with acidosis (venous blood pH <7.25). Underlying conditions, cause of acidosis, kidney function, and length of hospital stay were assessed.

Results
A total of 320 patients (M:F 179:142, mean age 4.6 years) were found to have acidosis (respiratory:metabolic:mixed 158:137:25). Half (n=160) of them were admitted to general wards and 21.5% to the intensive care unit. 245 (76.6%) of the patients had significant underlying diseases such as neurological (28.8%) and endocrine (15.9%) diseases associated with acidosis.
AKI was identified in 69 patients (21.6%; stage 1 in 27, 2 in 11, 3 in 31), and 29 (9.0%) required kidney replacement therapy. Causes of AKI included diabetic ketoacidosis (DKA), dehydration, and cardiac arrest. AKI was significantly more common in those with metabolic acidosis (36.0%) than in respiratory acidosis (8.9%). Comparing those with high anion gap metabolic acidosis (HAGMA) and normal anion gap metabolic acidosis (NAGMA), AKI was more common in the HAGMA group (40.7%) compared to the NAGMA group (23.6%). Patients with AKI were more likely to be admitted (91%) than those without (67%). There was no significant difference between length of hospital stay or proportion of ICU admission.

Conclusion
Among acidotic patients who visited PER, AKI were diagnosed in over 20%, and those with metabolic acidosis and HAGMA are at a higher risk. Physicians need to be aware of the high risk of AKI in the presence of acidosis.

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Incidence and Risk Factors for AKI in Preterm Infants Treated with Vancomycin

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Purpose: Vancomycin (VCM) is a widely used antibiotic for the treatment of gram-positive microorganisms and one of the known causes of AKI, which can be life-threatening in preterm infants. Perinatal characteristics, such as gestational age or birthweight, and neonatal morbidities, including patent ductus arteriosus or necrotizing enterocolitis (NEC), may contribute to VCM-induced AKI. Additionally, recent studies have suggested that piperacillin-tazobactam (TZP) may aggravate VCM-induced nephrotoxicity in adults and adolescents. This study explored the factors, including the concomitant use of TZP, associated with VCM-induced AKI in preterm infants.

Methods: This retrospective study included preterm infants with birth weight < 1,500g who were born between 2018 and 2021 in a tertiary center and received VCM for a minimum of 3 days. AKI was defined as a minimum increase in serum creatinine (sCr) of 0.3 mg/dL, and an increase in sCr of at least 1.5 times the baseline level during VCM use and up to 1 week following VCM discontinuation. Data on perinatal and postnatal factors were collected and analyzed.

Results: Of the 70 infants who used VCM, 17 cases who expired before seven postnatal days or who already had AKI before VCM use were excluded. Among the remaining 53 cases, AKI occurred in 10 patients (18.9%) at a median of 7 days (3 to 11 days) after starting VCM. When the AKI and non-AKI groups were compared, gestational age at birth, birth weight, pathogen-proven sepsis, duration of VCM, postmenstrual age at starting VCM, highest concentration of VCM, patent ductus arteriosus at starting VCM, and co-administration of TZP were not statistically different. However, a history of NEC was significantly high in the AKI group (5 (50.0%) vs 2 (4.7%), OR 20.05 [3.11-134.94], p-value 0.002). Among the factors analyzed, gestational age at birth, patent ductus arteriosus at starting VCM, and history of NEC were selected for multivariable analyses. In multivariable logistic regression, gestational age at birth significantly differed between the two groups. In addition, backward stepwise regression also showed that AKI was associated with low gestational age (adjusted OR: 0.58, 95% CI: 0.35–0.98) and a history of NEC (37.65, 3.08–459.96).

Conclusions: In very-low birthweight infants, a lower gestational age and history of necrotizing enterocolitis, but not concomitant use of piperacillin-tazobactam, were associated with VCM-induced AKI.

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Epidemiology of Sepsis-Associated Acute Kidney Injury in Adolescent Patients Admitted to Adult ICUs

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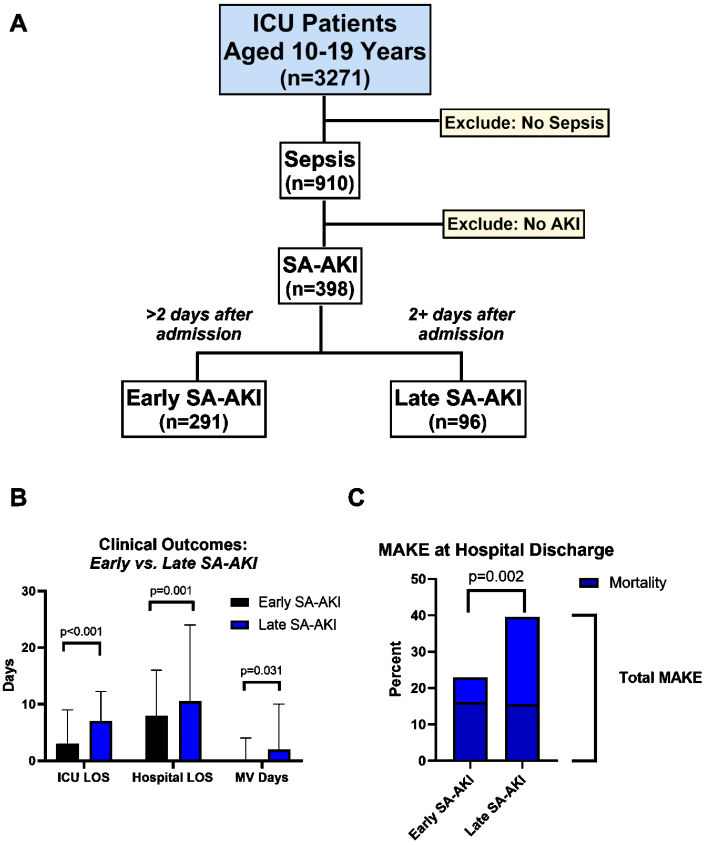
Purpose: Sepsis-associated acute kidney injury (SA-AKI) is associated with increased mortality in adults and children. Critically ill children are typically admitted to a pediatric intensive care unit (ICU) with pediatric-specific expertise. However, adolescents represent a unique population that can be served in either pediatric or adult ICUs. Little is known about the epidemiology of SA-AKI in adolescents admitted to adult ICUs.

Methods: This multicenter observational cohort included adolescent patients aged 10 -19 years admitted to two tertiary adult ICUs (UAB and University of Kentucky) from 2/2010 to 6/2022. AKI was defined by KDIGO creatinine and

urine output criteria. Sepsis was defined per adult Sepsis-3 criteria, and SA-AKI according to ADQI definition: AKI within 0 to +7 days of sepsis onset. Early SA-AKI was defined as AKI within 48 hours of sepsis onset, while late was within 2-7 days. Major adverse kidney events (MAKE) (death, dialysis dependence, and persistent kidney dysfunction (stage 1 AKI or greater for 7+ days)) were defined at hospital discharge.

Results: A total of 3,271 adolescents were admitted to an adult ICU during this study. Sepsis was diagnosed in 910 (27.8%) patients and 387 (11.8%) developed SA-AKI. Among patients with SA-AKI, the median age was 18 years (IQR 16-19 years). Patients with SA-AKI had higher mean Sequential Organ Failure Assessment scores at sepsis onset (5.6 vs 4.8, p<0.001) and were more likely to have septic shock (14.0% vs 7.0%, p=0.002) compared to patients with sepsis but no AKI. Patients with SA-AKI had higher mortality than their counterparts with sepsis alone (16.0% vs 7.7%, p<0.001). Patients with late versus early SA-AKI had longer hospital lengths of stay (LOS) (median 10 vs 8 days, p=0.001), ICU LOS (median 7 vs 3 days, p <0.001), and more days on mechanical ventilation (median 2 vs 0 days, p=0.03). Finally, patients with late SA-AKI had higher frequency of MAKE (39.6% vs 23.0%, p=0.002) despite no difference in hospital mortality (16.2% vs 15.6%, p=1.0).

Conclusion: Similar to prior studies in adult patients, we found adolescent patients admitted to an adult ICU with SA-AKI had higher mortality than patients with sepsis alone. Late SA-AKI compared to early SA-AKI had no difference in mortality, but a difference in MAKE was observed at hospital discharge. Further work comparing this age group to older (and younger) cohorts and validating adult-based SA-AKI definitions in adolescents is ongoing.



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A Simple Risk Score for Prediction of Severe Acute Kidney Injury after IV Cisplatin: Derivation and External Validation from a Contemporary Multicenter Cohort

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BACKGROUND: Prior studies that investigated risk factors for cisplatin-associated AKI (CP-AKI) were limited by small sample size, lack of external validation, non-contemporary data, and liberal definitions of AKI based on small changes in serum creatinine (SCr). We sought to develop and externally validate a prediction model for severe CP-AKI.

METHODS: We collected data on adults receiving their first dose of IV cisplatin from 2006-2022 from six geographically-diverse academic cancer centers across the US. The primary outcome was severe CP-AKI, defined as a ≥2-fold rise in SCr or receipt of kidney replacement therapy within 14 days following IV cisplatin administration. Independent predictors of CP-AKI were identified using a multivariable logistic regression model, which was developed in a derivation cohort (DC) and tested in an external validation cohort (VC). For the primary model, continuous variables were examined using restricted cubic splines. A simple risk model was also generated by converting the odds ratios from the primary model into risk points.

RESULTS: A total of 25,129 patients were included, with 11,808 in the DC (median age 59 [IQR 50-67]) and 13,321 in the VC (median age 60 [IQR 50-67]). The incidence of CP-AKI was 5.2% and 3.3% in the DC and VC, respectively. Each of the following was independently associated with CP-AKI in the DC: age, hypertension, diabetes mellitus, SCr, hemoglobin, white blood cell count, platelet count, serum albumin, serum magnesium, and cisplatin dose (Figure 1A). A simple risk score consisting of 9 covariates predicted a higher risk of CP-AKI in a monotonic fashion in both the DC and VC (Figure 1B and 1C). Compared to patients in the lowest risk category, those in the highest had a 22.27-fold (95% CI, 13.42-37.75) higher odds of CP-AKI in the DC and a 15.40-fold (95% CI, 9.58-24.52) higher odds in the VC. The primary model had a c-statistic of 0.75 and showed better discrimination for CP-AKI compared to previously published models, the c-statistics for which ranged from 0.59 to 0.68 (DeLong p-value <0.001). Based on our primary model, we developed an online CP-AKI risk calculator (kidneycalc.org/cp-aki-calculator/).

CONCLUSIONS: A simple risk score based on readily available variables from patients receiving IV cisplatin can predict risk of severe CP-AKI.

Figure on following page

A

Risk Factor	Odds Ratio (95% CI)	Score
Age (years)		
≤45	1 (REF)	0
46-60	2.93 (2.09–4.17)	2.5
61-70	4.13 (2.95–5.92)	3.5
>70	5.15 (3.52–7.67)	4.5
Hypertension	1.34 (1.12–1.61)	1
Diabetes	1.27 (1.00–1.60)	1
Smoker	1.19 (0.99–1.43)	1
Hemoglobin (g/dl)		
≥12.0	1 (REF)	0
11.0-11.9	1.39 (1.08–1.79)	1
<11.0	1.56 (1.23–1.97)	1.5
WBC count (per mm^3)		
≤12.0	1 (REF)	0
>12.0	1.61 (1.26–2.03)	1.5
Serum albumin (g/dl)		
>3.8	1 (REF)	0
3.3-3.8	1.28 (1.01–1.61)	1
<3.3	1.73 (1.30–2.29)	1.5
Serum Magnesium (mg/dl)		
≥2.0	1 (REF)	0
<2.0	1.62 (1.35–1.93)	1.5
Cisplatin dose (mg)		
≤50	1 (REF)	0
51-75	2.25 (1.54–3.35)	2
76-100	3.27 (2.16–5.00)	2.5
101-125	3.58 (2.24–5.73)	3
126-150	6.41 (4.34–9.65)	5.5
151-200	9.07 (6.24–13.50)	7.5
>200	12.02 (7.92–18.55)	10

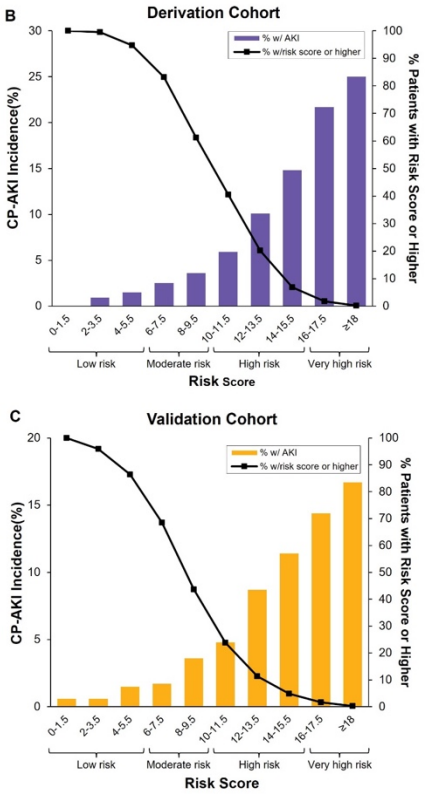

Figure 1

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Glucarpidase for Treatment of High-Dose Methotrexate-associated AKI

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BACKGROUND: Treatment with high-dose methotrexate (MTX) results in high rates of acute kidney injury (AKI), hepatotoxicity, and bone marrow suppression. Glucarpidase is a recombinant bacterial enzyme that cleaves MTX, but evidence supporting its use for MTX-associated AKI (MTX-AKI) is scarce.

METHODS: We examined the association between glucarpidase use and clinical outcomes in adults with MTX-AKI from 28 major cancer centers across the U.S. The primary end point was kidney recovery at hospital discharge, defined as a composite of survival to hospital discharge without kidney replacement therapy-dependence and serum creatinine <1.5-fold baseline. Key secondary outcomes were overall survival, time to kidney recovery, and neutropenia and transaminitis on day 7. We compared outcomes in patients who received glucarpidase within 96 hours after MTX initiation with those in patients who did not, using multivariable logistic and Cox regression models.

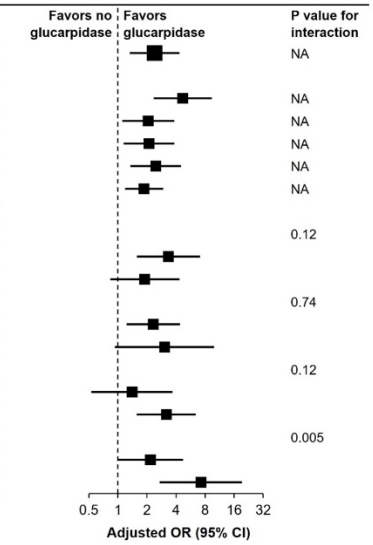
RESULTS: Of 708 patients with MTX-AKI, 209 (29.5%) received glucarpidase. Overall, 339 patients (47.9%) had a primary end point event. Glucarpidase receipt was associated with a 2.41-fold higher adjusted odds of kidney recovery (95% CI, 1.33–4.37) compared to no glucarpidase receipt (Figure 1A). In a prespecified sensitivity analysis, patients

who received glucarpidase in the first 60 hours following MTX initiation had a 4.67-fold higher adjusted odds of kidney recovery (95% CI, 2.33–9.36) compared to patients who did not receive it in the first 60 hours (Figure 1A). Among patients with AKI stage 3, the adjusted odds ratio for kidney recovery among glucarpidase-treated versus non-glucarpidase-treated patients was 7.22 (95% CI, 2.70–19.31) (Figure 1A). Patients treated with glucarpidase also had longer overall survival (adjusted hazard ratio 0.45; 95% CI, 0.26–0.88 [Figure 1B]) and shorter time to kidney recovery (adjusted hazard ratio 0.58; 95% CI, 0.34 – 0.97 [Figure 1C]), as well as lower rates of neutropenia and transaminitis on day 7.

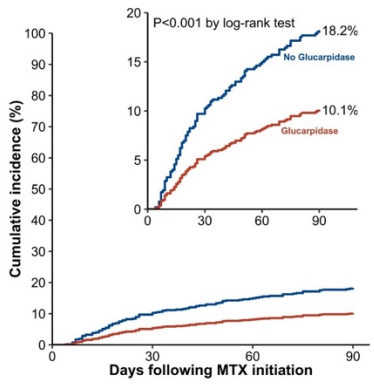
CONCLUSIONS: In this study involving adults with MTX-AKI, those treated with glucarpidase had a higher odds of kidney recovery and longer survival compared to those not treated with glucarpidase. Randomized clinical trials of glucarpidase in patients with MTX-AKI are needed.

A. Primary Outcome: Kidney Recovery

	No. Events/ No. Patients (%)	Adjusted OR (95% CI)*	P value for interaction
Primary analysis	339/708 (47.9)	2.41 (1.33–4.37)	NA
Sensitivity analyses			
1. Glucarpidase in first 60h	339/708 (47.9)	4.67 (2.33–9.36)	NA
2. Limited to 2012 or later	331/665 (49.8)	2.05 (1.11–3.82)	NA
3. Multiple imputation	339/708 (47.9)	2.11 (1.15–3.85)	NA
4. Adjusted for site	339/708 (47.9)	2.47 (1.35–4.50)	NA
5. Inverse probability weighting	270/565 (47.8)	1.86 (1.19–2.95)	NA
Subgroups			
Age, years			0.12
<65	184/368 (50.0)	3.34 (1.57–7.10)	
≥65	155/340 (45.6)	1.90 (0.83–4.37)	
Sex			0.74
Male	203/495 (41.0)	2.32 (1.22–4.39)	
Female	136/213 (63.8)	3.04 (0.93–9.92)	
Baseline eGFR, ml/min/1.73m^2			0.12
<90	82/267 (30.7)	1.40 (0.53–3.67)	
≥90	257/441 (58.3)	3.17 (1.56–6.43)	
Maximum initial severity of AKI			0.005
Stage 1 or 2	274/466 (58.8)	2.18 (1.00–4.76)	
Stage 3	65/242 (26.9)	7.22 (2.70–19.31)	



B. Overall Survival



C. Time to Kidney Recovery

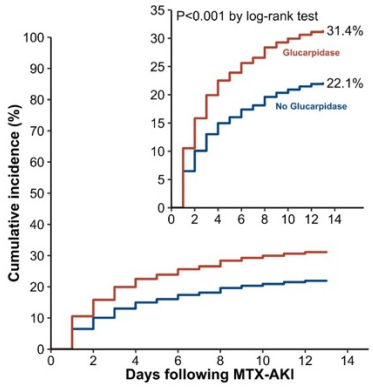


Figure 1

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Post-operative AKI as a Predictor of Diastolic Dysfunction After Pediatric Heart Transplant

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Background: Acute kidney injury (AKI) has been associated with diastolic dysfunction in pre-clinical studies but has not been evaluated in a clinical setting. This study aims to explore the association between post-operative AKI and diastolic dysfunction in pediatric heart transplant (HT) recipients.
Methods: This was a single center retrospective review of patients ≤21y who underwent HT between May 2010 and July 2023. Exclusion criteria included multi-organ or repeat transplants and post-operative mechanical circulatory support. AKI was defined and staged per the KDIGO criteria. Right ventricular end-diastolic pressure (RVEDP) and pulmonary capillary wedge pressure (PCWP) obtained from routine cardiac catheterizations in the 1st post-HT year were used as markers of diastolic function. A mixed effects regression model with an autoregressive correlation structure was used for hemodynamic measurements.
Results: We included 102 patients, 41 (40%) females. Median age at transplant was 3y (IQR 0-13). Pre-transplant cardiac diagnosis was congenital heart disease (CHD) in 55 (54%) and cardiomyopathy in 47 (46%) patients. Post-operative AKI was noted in 33 (32%) patients; 18 (18%) had stage 2 or 3 AKI. AKI was more common in patients with CHD than cardiomyopathy [24/31 (44%) vs 9/38 (19%), p=0.008]. Mean RVEDP and PCWP were 1 mmHg higher in patients with AKI than those without AKI (RVEDP 95% CI 0.5-1.7, p=0.008; PCWP CI 0.3-1.7, p=0.008) after adjusting for pre-transplant cardiac diagnosis, ischemia time >4h, and time since HT (Figure 1).
Conclusion: AKI was independently associated with higher RVEDP and PCWP in the 1st year after HT in our cohort. Therefore, AKI may serve as a predictor of prolonged diastolic dysfunction in this patient population.

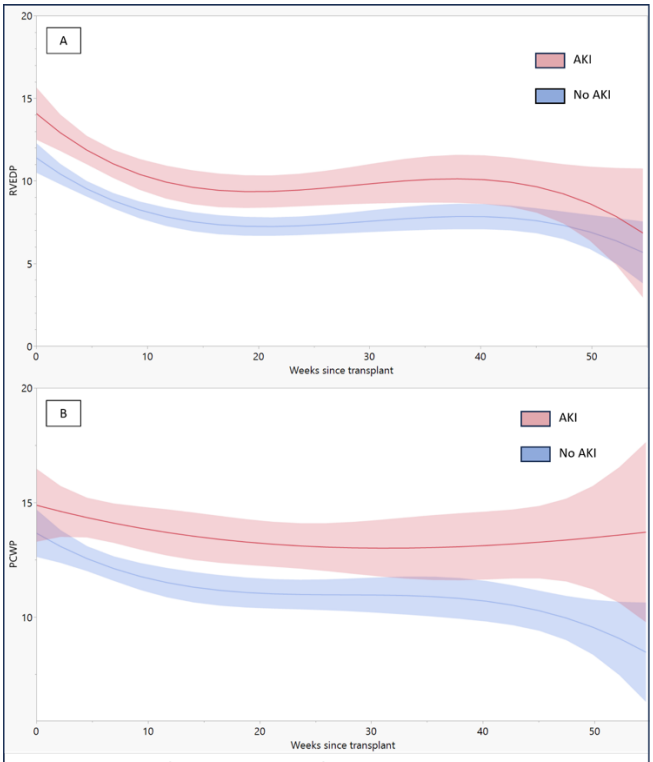

Figure 1: Visualization of hemodynamic trends after pediatric heart transplant in patients with and without AKI. Panel A depicts trends in right ventricular end-diastolic pressure (RVEDP), and Panel B shows trends in pulmonary capillary wedge pressure (PCWP), with the post-transplant period plotted on the x-axis in weeks. LOESS (locally estimated scatterplot smoothing) lines illustrate the trend of RVEDP and PCWP over time. Shaded areas represent 95% confidence intervals.

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Delayed Cross Consultation To Nephrology, A Common Issue.

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INTRODUCTION:
Non-nephrologist's physicians are responsible for first evaluate patients and must have the ability to identify risk factors, to effectively stratify the risk of developing or progressing the renal insult or AKI.
METHODS:
A retrospective study was carried out at the Hospital Universitario "Dr. José Eleuterio González" in Monterrey, Mexico, where cross consultations (CC) to the nephrology department of the present year were analyzed. CC from the emergency department (ED) and ICU, with a complete clinical record, and AKI were included. Those with incomplete data or CKD were excluded.
RESULTS:
A total of 62 CC were analyzed. The mean age of the patients were 51.5 years, 40 patients (64.5%) were men. 24 (38.7%) CC were made from the ICU and 38 (61.2%) from the ED. 44 (70%) were diagnosed with AKI 3 according to KDIGO at the time of the CC.
The mean admission creatinine (CrS) was 4.5 mg/dL and a blood urea nitrogen (BUN) was 87.3 mg/dL, but by the time of cross consultation there were 5.6 mg/dL and 75.32 mg/dL of creatinine and BUN respectively. 43 patients (69%) had community acquired AKI (CA-AKI) defined as those with a CrS more than 1.2 mg/dL at admission. Among patients with CA – AKI, 34 (54.8 %) had early CC. The mean hours between admission and CC were 109 hours.
The Spearman correlation between the time it took to complete the CC and the CrS levels on admission is -0.782 with a p-value of < 0.001. The results of the Mann-Whitney U test assessing differences in time taken by the attending physician to activate a nephrology consultation after detecting CA-AKI finds a significant correlation. Spearman's rank correlation coefficient is -0.689, indicating a strong negative correlation between the severity of CrS levels upon admission and the time it takes for the non-nephrology physician to CC a nephrologist.
CONCLUSION:
As the level of CrS increases, the time for a nephrology cross-consultation is shorter. This is proportional to the number of CC that we receive.
We must encourage health professionals, to perform an AKI risk assessment that focuses on medical record, clinical scenario, and physical examination. This will help identify the patient that could eventually develop AKI and, in those with high risk, call the nephrologist as fast as possible to prevent further damage. Prevention is key to avoid the heavy burden of mortality and morbidity associated with AKI.

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Understanding Uncertainty: A Novel Prediction Model Of Mortality Associated With AKI And CRRT

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Introduction: Continuous renal replacement therapy (CRRT) is an important form of mechanical support in the intensive care unit (ICU) as it can effectively manage volume, electrolyte, and acid-base balances in critically ill patients. Despite this, utilization of CRRT is still associated with a high mortality rate, ranging from 50-64%. Given the risks and costs associated with CRRT, it is important to ensure that it is utilized appropriately. Currently, no standard model exists for determining prognosis of patients on CRRT. Utilizing retrospective data, we developed a predictive model of mortality associated with CRRT that uniquely includes pressor requirement as a factor.

Methods: This is a retrospective, single-center study assessing chart data of all patients admitted to Temple University Hospital between August 2016 to July 2023 who were placed on CRRT at any point during admission. Patients who with end-stage kidney disease (ESKD) were excluded. 1637 patients met inclusion criteria and were included in the analysis. Mortality was defined as patients who expired during admission or were placed in hospice. Pressor requirement was defined as total number of intravenous vasopressors utilized prior to CRRT initiation. The model was developed initially from univariate analysis of 14 risk factors, with 7 of those risk factors included in logistical regression. Dataset was split 70% for training and 30% for testing of the model, and area under curve (AUC) was calculated to measure discriminative capacity.

Results: Overall mortality rate was 70%. Mortality was 53% for patients did not receive pressors, 72% for those on one pressor, 80% on two, and greater than 84% with three or more. Age, female sex, BMI, maximum lactate, creatinine, and low albumin were all significantly associated with mortality and were included in the prediction model. Our logistic regression model had an Area Under Curve (AUC) of 0.84.

Discussion: While mortality risk is high for all patients started on CRRT, the risk increases substantially for those requiring vasopressors. Previous studies to develop a model for prognosis of patients started on CRRT have been published, but upon our own review of available literature, this model is unique in its inclusion of vasopressor requirement. With further validation, our model could offer a useful tool for clinicians determining whether to start CRRT or to avoid it in patients whose outcomes may not be meaningfully altered.

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Evaluating Renal Angina Tools for Predicting Acute Kidney Injury in Critically Ill Adults at Fundación Cardioinfantil in an Emerging Upper-Middle-Income Economy.

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Methodology: A retrospective observational study was conducted from January 31 to September 30, 2020, among patients aged >18 admitted to ICU at Fundación Cardioinfantil, Bogotá, Colombia. Exclusion criteria included renal replacement therapy dependency before admission, prior AKI diagnosis, kidney transplant history, referral from another ICU, or ICU discharge before 48 hours. Demographic and lab data collected for seven days post-admission were applied to Malhotra et al. renal angina tool (1). AKI was defined per KDIGO classification, with KDIGO 2 and 3 labeled as severe AKI. The Youden method estimated an optimal cutoff point, and the GiViTi model assessed calibration.

Results: Of 1,625 patients admitted to ICU, 481 were included in the study; 38.7% were female with a median age of 61.3 years. The primary comorbidity associated with AKI was sepsis, present in 54.3% of patients. In total, 158 patients (32.8%) developed AKI. Utilizing a cut point of 5, the Malhotra et al. scale exhibited a sensitivity of 81.6% (95% CI 74.7 - 87.3%), a specificity of 42.4% (95% CI 37% - 48%) and a negative likelihood ratio of 0.43 (95% CI 0.30 - 0.62). An optimal cut point of 8 was determined using the Youden method with a sensitivity of 52.3% (95% CI 43.2% - 59.3%), specificity of 79.3% (95% CI 74.4% - 83.54%), and a negative likelihood ratio of 0.61 (95% CI 0.53 - 0.73). The Area under the ROC curve (AUC) was 0.698 (95% CI 0.649, 0.748). There was low calibration, with the GiViTi calibration belt encompassing the bisector only in the low probabilities.

Conclusion: Using Malhotra et al. original cutoff point, the tool had good sensitivity but poor specificity. Although an optimal cutoff improved specificity, it reduced sensitivity; the tool's discrimination capacity is adequate. We recommend the original cutoff point of 5 for this population, as the tool effectively identifies low-risk patients, potentially minimizing AKI preventive interventions. This suggests a more targeted, cost-effective AKI management in ICU settings, beneficial in emerging economies. The low calibration indicates a need for a modified tool to better predict severe AKI risk in this population.

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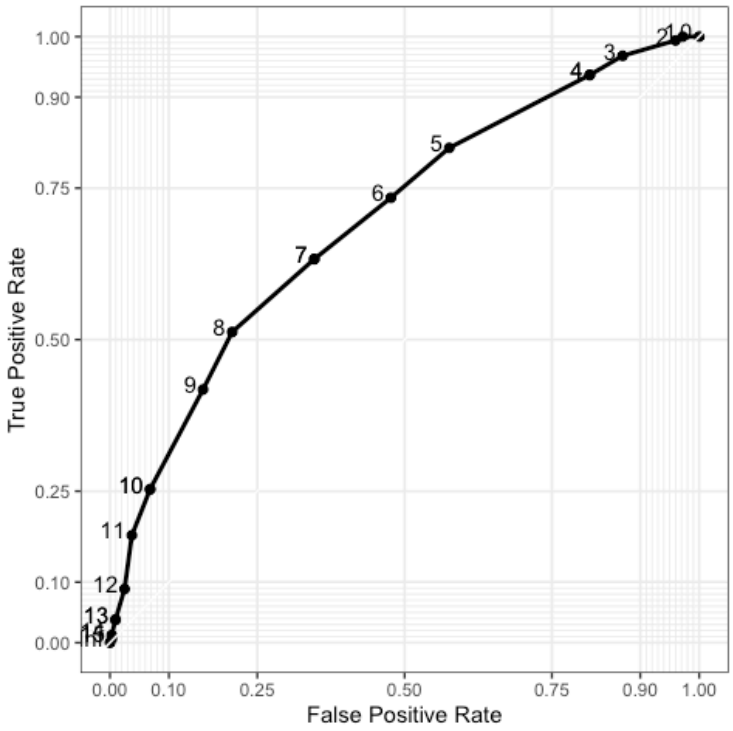

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High dose of diuretic therapy predicts acute kidney injury and outcomes after cardiac surgery

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Objective: To evaluate high dose of diuretic after cardiac surgery in the incidence and prognosis of patients with cardiac surgery-associated acute kidney injury (CSAKI)

Methods: Patients who underwent cardiac surgery from January 1, 2019, to December 31, 2019, were enrolled. The occurrence and clinical outcome of acute kidney injury (AKI) were evaluated. Univariate and multivariate logistic regression models were used to analyze the risk factors of postoperative AKI. Furthermore, the Kaplan-Meier analysis was performed to assess the relationship between diuretics and 3-year all-cause mortality.

Results: Of 1891 patients, 608 (32.2%) patients developed AKI. The in-hospital mortality was significantly higher in the AKI group compared to the non-AKI group (1.8% vs 0.2%, P< 0.001). The area under the receiver operating characteristic (ROC) curve for the first 24 hours use of diuretics to predict severe AKI was 0.765 (cutoff value 57.5mg). The area under the ROC curve for the first 24 hours use of diuretics to predict AKI requiring renal replacement therapy (AKI-RRT) was 0.880 (cutoff value 95mg). The area under the ROC curve for the first 24 hours use of diuretics to predict in-hospital mortality was 0.846 (cutoff value 230mg). Logistic regression model showed older age, male,

hypertension, cardiopulmonary bypass (CPB) duration >120min, aortic cross clamp (ACC) duration >90min, ultrafiltration volume >2500, low cardiac output syndrome and postoperative use of diuretics>230mg within 24h were independent risk factors of in-hospital mortality. The Kaplan-Meier analysis demonstrated that early use of diuretics(>42.5mg) was associated with an increased risk of 3-year all-cause mortality (P< 0.019).

Conclusions: Postoperative use of diuretics more than 57.5mg, 95mg and 230mg within 24h can predict severe AKI, AKI-RRT and in-hospital mortality well, respectively. High dose of diuretics (>230mg) was one of the independent risk factors of in-hospital mortality. It is important to pay attention to those using high doses of diuretics following cardiac surgery.

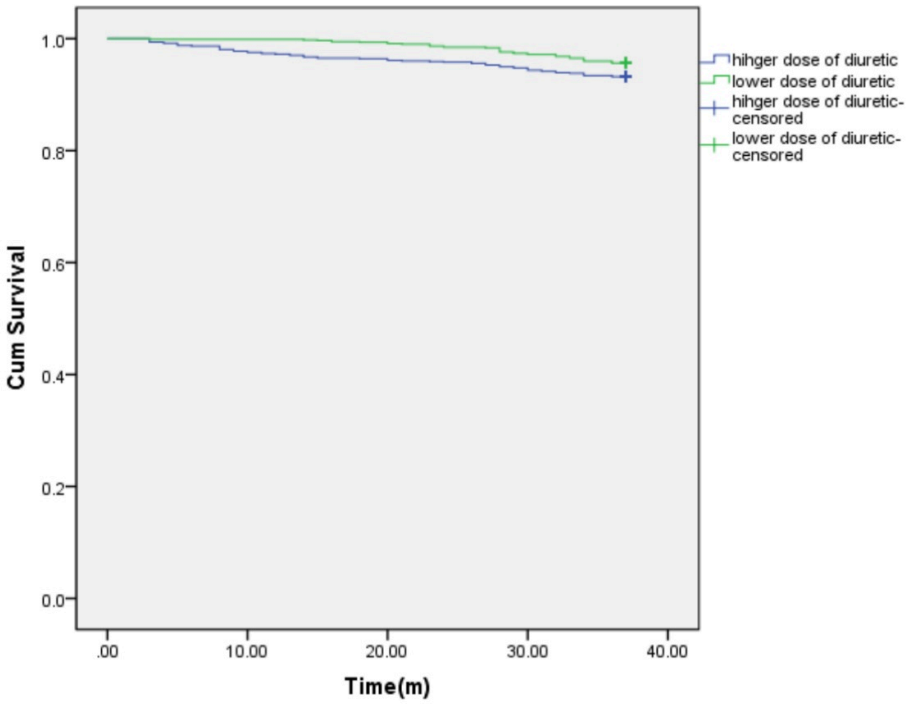

Figure 2 Kaplan-Meier curves for 3-year all-cause mortality

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The Relationship between Short-term Blood Pressure Variability and Acute Kidney Injury After Cardiac Surgery

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Objective: To explore the effect of short-term blood pressure variability (BPV) after cardiac surgery on the pathogenesis of acute kidney injury (AKI), in order to improve the prevention and treatment strategy of cardiac surgery associated AKI.

Methods: All patients after cardiac surgery in our hospital from August to December, 2019 were included. The diagnosis of AKI was defined according to the KDIGO 2012 guidelines. The 24h blood pressure variability was measured by three commonly used indicators: Standard deviation (SD), Coefficient of Variation (CV), and average real variability (ARV).

Results: A total of 1380 patients were enrolled, of which 452 patients developed postoperative AKI (32.75%). The 24h BPV, including 24h ARV, 24h SD, and 24h CV, in the AKI group were significantly higher than those in the non-AKI group (9.64±6.03 vs 8.57±4.80mmHg, P=0.001; 8.16±4.47 vs 7.22±3.65mmHg, P<0.001; 10.63±5.78 vs 9.23±4.64, P<0.001). The AKI incidence increased with the increase of postoperative 24h BPV (24h ARV, $\chi 2$=11.046, P=0.011; 24h SD, $\chi 2$=13.923, P=0.003; 24h CV, $\chi 2$=13.555, P=0.004). The 24h BPV (24h ARV, 24h SD, 24h CV) were divided into four groups according to quartiles (Q1, Q2, Q3, and Q4). The AKI incidence increased with the increase of 24h BPV (24hARV, $\chi 2$=11.046, P=0.011; 24hSD, $\chi 2$=13.923, P=0.003; 24hCV, $\chi 2$=13.555, P=0.004). After adjusted for the confounding factors by multivariate logistic regression analysis, the risk of AKI in the Q4 group was significantly higher than that in the Q1 reference group. The AKI risk of ARV.Q4 group (24h ARV>11.67mmHg) was 1.61 (95%CI: 1.13, 2.29, P=0.008), the AKI risk of SD.Q4 group (24h SD>9.67mmHg) was 1.69 (95%CI: 1.18, 2.40, P=0.004), and AKI risk in the CV.Q4 group (24h CV>12.45%) was 1.73 (95%CI: 1.21, 2.46, P=0.003).

Conclusions: For cardiac surgery patients, the increased postoperative BPV significantly increased the risk of AKI. This remained statistically significant after adjusted for other potential confounders.

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The reasonable control range of short-term blood pressure variability in CKD patients

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Objections: CKD patients are the high-risk population of blood pressure variability(BPV) and the control range of short-term BPV after cardiac surgery is important. So we analyze the appropriate range of BPV in this high-risk group to reduce the AKI incidence.

Methods: All patients underwent cardiac surgery in our hospital from August 1, 2019 to December 31, 2019 were included. The 24h BPV uses three indicators: Standard deviation (SD), Coefficient of Variation (CV), and average real variability (ARV).The ROC curve determined the optimal cut-off point for increasing the incidence of AKI at 24h after surgery. The restricted cubic spline function was used to further visualize the relationship between 24h BPV and AKI after cardiac surgery.

Results: A total of 1380 patients were included. According to the 24h BPV quartile, patients were divided into four groups (Q1, Q2, Q3, and Q4). The risk factors with significant difference in 24h BPV after operation were age ≥ 65, history of hypertension, and preoperative eGFR<60ml/min/1.73㎡ (24h ARV: P=0.005, P=0.032, P<0.001; 24h SD: P=0.038, P=0.011, P<0.034; 24h CV: P=0.012, P=0.026, P=0.024). There were 160 CKD patients (11.6%). In the ROC curve, the optimal critical value of 24h BPV was significantly lower than that of non-CKD population. The 24h ARV after surgery was divided into 9 groups. The association between postoperative 24h BPV and the occurrence of AKI was linear in the CKD population, but a nonlinear "J"-shaped curve in the non-CKD population. Taking 24hARV 0~4.99mmHg as a reference, the risk of AKI in the higher ARV group continued to increase (adjusted OR value increased from 3.59 to 12.83), and the incidence of AKI in the non-CKD population increased significantly from 24.5% in the reference group to 51.4% in the highest group. (adjusted OR increased from 1.29 to 3.17). The incidence of AKI was about 25% when the 24h ARV was 0~9.99mmHg.

Conclusions: In the CKD population, there is a linear relationship between 24h BPV and AKI incidence. The 24h postoperative blood pressure fluctuation needs to be strictly controlled. However, in the non-CKD population, it showed a "J"-shaped curve relationship, and the incidence of AKI was the lowest at 24h ARV 0~9.99mmHg, about 25%.

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Incidence and Outcome of Acute Kidney Injury in Hospitalized Patients by An Electronic Alert

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Objectives: This study was to establish an electronic alert system and determine the incidence and mortality rate of acute kidney injury (AKI) among hospitalized adult patients in a tertiary metropolitan hospital of China.

Methods: A total of 99847 patients from Zhongshan Hospital, Fudan University, Shanghai, China between October 1st, 2018 and September 30th, 2019 were screened by the hospital medical database. The presence and severity of AKI were assessed by the KDIGO criteria. AKI patients (9.9%) were distinguished by electronic alerts.

Results: The average age of AKI patients was (61 ± 15.2) years, the median length of stay (LOS) 11 (6.5, 17) d, the hospital cost 3 8364（13769，85514）yuan. The in-hospital mortality rate of AKI patients was 5.7% (563/9 898). Community acquired AKI (CA-AKI) accounted for 37.9%, hospital acquired AKI (HA-AKI) 62.1%. Incidence of AKI stage 1, stage2 and stage 3 were 8% (7 955/9 9847), 0.7% (709/9 9847) and 1.2% (1 234/9 9847), in-hospital mortality were 4% (316/7 955), 11.4% (81/709) and 13.5% (166/1 234). The length of stay, hospital cost and mortality of AKI patients increased with AKI stages. Only 7.8% of AKI patients received nephrology consultation and 1.2% was recorded in discharge diagnosis. Multivariate logistic regression showed that age, AKI stage, HA-AKI, RRT, heart failure, malignancy, hypoalbuminemia and anemia were independent risk factors of in-hospital mortality of AKI patients.

Conclusion: AKI is prevalent in the hospitalized patients with serious misdiagnosis and low nephrology consultation rate. Slight elevations of serum creatinine are associated with significantly increased mortality, LOS and hospital cost. The establishment of AKI electronic alerts and active intervention of nephrologists can significantly increase the recognition of AKI patients and may help prevent AKI and improve the prognosis of AKI patients.

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Epidemiological Study of Acute Kidney Injury in Hospitalized Patients with Malignant Tumors

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Objections: Acute kidney injury (AKI) is one of the most common complications in patients with malignant tumors. This study intends to provide basis for further optimizing the prevention and treatment of malignant tumor related AKI by analyzing the clinical risk factors and progression of them.

Methods: The clinical data of all inpatients with malignant tumors in Zhongshan Hospital from January 1 to December 31, 2019 were collected. The patients were divided into AKI group and Non AKI group according to the KDIGO guideline. AKI group was further divided into AKI-stage1 and critical AKI group (include AKI-stage2 and stage3). Multivariate logistic regression analysis was used to explore the clinical risk factors related to the incidence of AKI and AKI progression.

Results: A total of 68379 patients were enrolled in this study, of which the incidence of AKI was 11.3% (n = 7734). The incidence of community-acquired AKI and hospital acquired AKI was 3.4% (n = 2367) and 7.8% (n = 5368). The

incidence of critical AKI was 1.1% (n = 810). The incidence of AKI in urinary system tumors, hematological system tumors and digestive system tumors ranked the top three (26.1% vs 12.9% vs 11.9%). Multiple logistic regression analysis showed that the risk factors for AKI progression included male, hypertension, heart failure, emergency hospitalized, malignancy-associated hematological, nephrotoxic drugs, surgical treatment, chemotherapy, interventional therapy, SCr ≥ 115 μmol / L, eGFR < 60 ml / min / 1.73 m2, ALB < 35 g / L, anemia, leukocyte elevation, hyponatremia, hyperkalemia, hypercalcemia. After correcting electrolyte disorder, nephrotoxic drug use, abnormal liver function, anemia and leukocyte elevation, the incidence of AKI in patients undergoing surgery, chemotherapy and interventional therapy can be significantly reduced. The mortality of AKI in male reproductive system tumors, head and neck tumors and female reproductive system tumors was the highest (7.0% vs 3.3% vs 3.1%). The mortality of AKI patients was 1.7%, that of non AKI patients was 0.0016%, and that of critical AKI patients was 7.4%.

Conclusion: Malignant tumor related AKI is related to many factors, such as male, age, tumor status, nephrotoxic drugs using, accompanying complications, electrolyte disorder, abnormal liver function, inflammation, anemia and so on. Correcting the above risk factors is beneficial to prevent malignant tumor related acute renal injury.

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Establishment of Acute Kidney Injury Model in Hospitalized Patients with Malignant Tumors

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Objective: Acute renal injury (AKI) is a common complication in tumor patients with lowly remission rate and highly mortality. The purpose of this study is to establish a prediction model for the occurrence and progression of malignancy-related AKI.

Methods: All patients with malignant tumors discharged from our hospital from January 1 to December 31, 2019 were included. Patients with AKI stage2 and 3 were defined as critical AKI. Patients were randomly divided into modeling cohort and validation cohort. The risk factors related to AKI were statistically analyzed by the modeling cohort. According to the risk assessment model of logistic regression β and OR value corresponding to the value is assigned to score the risk factors, and the prediction scoring model of AKI and critical AKI is established. Finally, the area under the AUC curve (AUROC) and Hosmer-Lemeshow goodness of fit test are used to evaluate the effectiveness and reliability of the model.

Results: Totally of 66012 patients were enrolled, including 52798 in the modeling cohort and 13214 in the validation cohort. There was no significant difference in baseline information between the two cohorts. In the modeling cohort, logistic regression analysis showed that the relevant risk factors of AKI were male, BMI < 18.5kg/m2, hypertension, COPD, stroke, heart failure, emergency hospitalized, treated by surgery, chemotherapy, nephrotoxic drugs, Electrolyte disorder, abnormal liver function, serum creatinine (SCR) ≥ 115 μmol / L, eGFR < 60 ml / min / 1.73m2, anemia, elevated leukocytes. Combined with the risk assessment model β and OR value corresponding to the value is used to assign and score the risk factors, and the AUC value of AKI risk prediction model is 0.750; The prediction accuracy of the model was 92.09%. The AUC value of critical AKI prediction model was 0.834; The prediction accuracy of the model was 98.71%. The P values of Hosmer lemeshow test were 0.216 and 0.115, suggesting that the model fit well. The area under AUC curve of AKI model in validation cohort was 0.758; The area under AUC curve of critical AKI prediction model was 0.836; There was no significant difference in AKI and critical AKI prediction models between the modeling cohort and the validation cohort.

Conclusion: This study established a universal risk scoring system for malignant tumors related AKI and critical AKI, which is used for early prediction of the occurrence and progression of AKI in the clinic.

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The Impact of Timing of Angiography on Acute Kidney Injury after Cardiac Surgery in Patients with Preoperative Renal Dysfunction

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Background: Acute Kidney Injury (AKI) related to cardiac surgery is one of the common complications of cardiac surgery. Preoperative angiography helps to evaluate heart disease, but it may increase the risk of AKI. Although with the progress of surgical technology, more and more patients with preoperative renal dysfunction can undergo cardiac surgery, there is little research on the impact of angiography on postoperative AKI in these patients. This study explores whether angiography will increase the risk of AKI after cardiac surgery in patients with preoperative renal dysfunction (15≤eGFR<60 ml/min/1.73m2).

Methods: Retrospectively enrolled patients with preoperative renal dysfunction (15≤eGFR<60 ml/min/1.73m2) who underwent angiography and cardiac surgery from January 2015 to December 2020. The main outcome was postoperative AKI (KDIGO criteria). Univariate analysis and multivariate regression were used to determine the relationship between the timing of angiography and AKI.

Results: A total of 888 patients with preoperative renal dysfunction (15≤eGFR<60 ml/min/1.73m2) were continuously enrolled. The incidence of AKI was 48.31%. Male (OR=1.903), interval between angiography and surgery (0-2d OR=2.161; 3-6d OR=3.291), and aortic cross-clamping time (OR=1.009) were considered as predictors of AKI. In patients with 15≤eGFR<30ml/min/1.73m2, the interval between angiography and surgery was also associated with AKI (0-2d OR=4.826; 3-6d OR=5.252), 30≤eGFR<45ml/min/1.73m2 (0-2d OR=2.952; 3-6d OR=3.677), but not associated with AKI in patients with 45≤eGFR<60 ml/min/1.73m2.

Conclusion: In patients with preoperative renal dysfunction, the interval between angiography and cardiac surgery (0-2d and 3-6d) is associated with AKI. For patients with poorer preoperative renal function, the interval between angiography and cardiac surgery is very worthy of attention.

RESEARCH IN AKI

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Serum DcR3 as a New Predictor of Renal Outcomes in Patients With Sepsis-Associated Acute Kidney Injury

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[1]*Taipei Veterans General Hospital*

Introduction:
Decoy receptor 3 (DcR3), also known as tumor necrosis factor receptor superfamily member 6B (TNFRSF6B), is implicated in the severity of several conditions, including sepsis, ARDS, and hemorrhagic fever with renal syndrome. While serum DcR3 levels in septic patients show a positive correlation with markers like CRP, IL-6, and procalcitonin, its elevated levels have been linked to unfavorable outcomes in ARDS patients. However, its role in sepsis-associated acute kidney injury (SA-AKI) remains largely unexplored. This study sought to elucidate the influence of DcR3 on the outcomes of SA-AKI patients.

Methods:
A single-center prospective cohort study was initiated, encompassing patients with SA-AKI necessitating renal replacement therapy (RRT) in intensive care units (ICU) between 2018 and 2019. During hospitalization, demographic and laboratory details were documented, and blood samples were taken before RRT onset to assess DcR3 via ELISA assay. Concurrently, we engaged the THP-1 cell line, exposing it to 100ng/ml LPS stimulation for 24 hours, to analyze mRNA levels of TNFRSF6B and related inflammatory cytokines. SiRNA was utilized to ascertain the impact of DcR3 blockade following LPS stimulation.

Results:
The study integrated 114 SA-AKI patients, yielding an overall survival rate of 54%. No significant association emerged between serum DcR3 levels and mortality in SA-AKI patients. Nonetheless, among survivors, elevated DcR3 levels were linked to an increased likelihood of long-term dialysis dependency (HR: 1.060, 95% CI: 1.018-1.103, P=0.004). Moreover, LPS stimulation elevated mRNA levels of TNFRSF6B and inflammatory cytokines (IL-1, IL-6, TNF-a) in THP-1 cells, but these effects were counteracted by SiRNA, suggesting that DcR3's role as a precursor in sepsis-induced cytokine synthesis and its association with intensified kidney failure severity.

Conclusion:
Higher serum DcR3 levels in SA-AKI patients might predispose them to an increased risk of long-term dialysis dependency. Given its primary role in cytokine storms, targeting DcR3 presents a promising immunomodulatory avenue for managing SA-AKI.

Clinical characteristics	Renal recovery (n=26)	Dialysis dependent (n=26)	P value
Age, yrs	65.77±21.68	73.24±14.86	0.109
APACHE II score	22.77±7.32	25.93±7.41	0.058
DcR3, ng/ml	20.28±13.49	41.02±41.79	<0.001
Length of hospital stay, day	49.39±55.83	38.42±33.97	0.223

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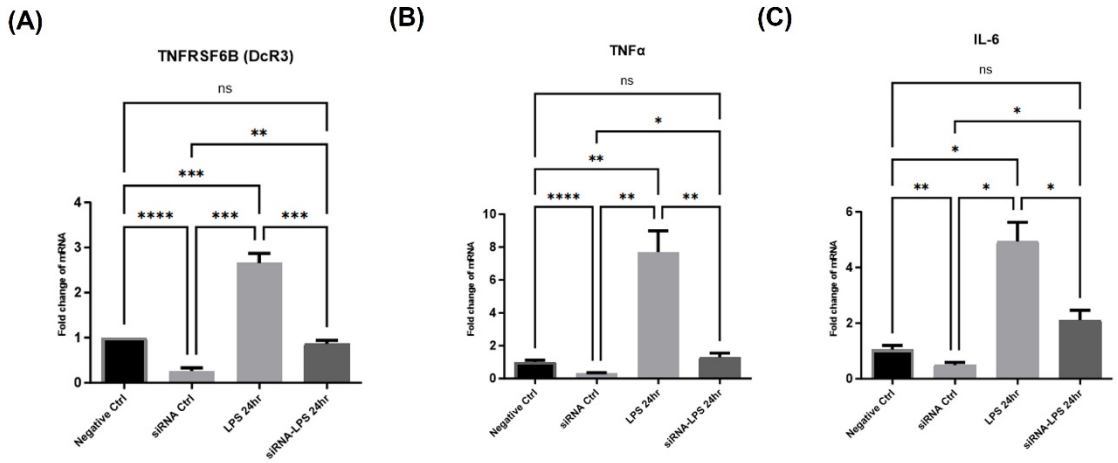

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An analysis of kidney injury in ovarian cancer

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Introduction:
Cancer of the female genital organs is one of the causes of obstructive hydronephrosis (1). The aim of this study is to find a predictive biomarker of the development of nephropathy in ovarian cancer.
HDUN and cyst development in the ovary

Method:
In a retrospective study, we explored 123 cases of ovarian cancer for the development of nephropathy that were managed at our hospital. We tried to get a predictive biomarker for its development by using denominators such as pretherapy serum levels of HE4, CA125, stage of cancer, and glomerular nitration rate (GFR) at presentation and recurrence. The mean values of serum levels of HE4 and CA125 were used.
Hematological parameters such as hemoglobin (Hb), total leukocyte count (TLC), and platelet counts were also analyzed, although no significant correlation could be established.

Result:
We got 17 (13.8%) cases of ovarian cancer that developed nephropathy presenting as 12 (9.7%) cases of hydroureteronephrosis (HDUN) and 5 (4%) cases of a simple cyst. CA125 was increased in 11/12 and 5/5 cases respectively. HE4 was increased in 11/12 cases of HDNU and 5/5 cases of the cyst. HDUN was found in the advanced stage (stage III & IV) in 11/15 (73.3%) of cases; the simple cyst was also seen more in the advanced stage in 4/5 (80%) of cases. Recurrence of ovarian cancer was seen in 8/12 (66.6%) cases with HDUN and 3/5 (60%) cases of the cyst. The average GFR was 93.61 mL/min in HDUN and 84.5 mL/min in cyst cases.

Conclusion:
The development of nephropathy was associated more with the advanced stage of ovarian cancer. Recurrence was seen in 8/12 (66.6%) of cases with HDNU and 3/5 (60%) of cases with renal cysts. To find a predictive biomarker for the

development of neuropathy, a larger cohort is needed, which I couldn't see in the available literature, especially nephropathy in association with ovarian cancer.

Table 1: Clinicopathological parameters associated with HDUN and cyst of kidney in ca ovary and their correlation

	HDUN	**Cyst**	**P-value**
No. of cases	12	5	
Mean CA125	1167.9 (11)	466.5 (4)	0.7531
Mean HE4	635.6 (6)	560.4 (3)/ 90.6	0.2500
FIGO Staging			
Stage I-II	2	1	
Stage III-IV	11	4	
Mean TLC	8100 (mean)	11880 (2)	0.4182
GFR	93.61 (5)	84.5 (4)	0.2500
Recurrence	8/12 (66.6%)	3/5 (60%)	
Mean Hb%	11.3 (9)	11.95 (2)	0.6909
Mean platelet count	292.2 (9)	272 (2)	0.9091

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Prospective Validation of the PERSEVERE-II AKI Model for Acute Kidney Injury Prediction in Pediatric Septic Shock

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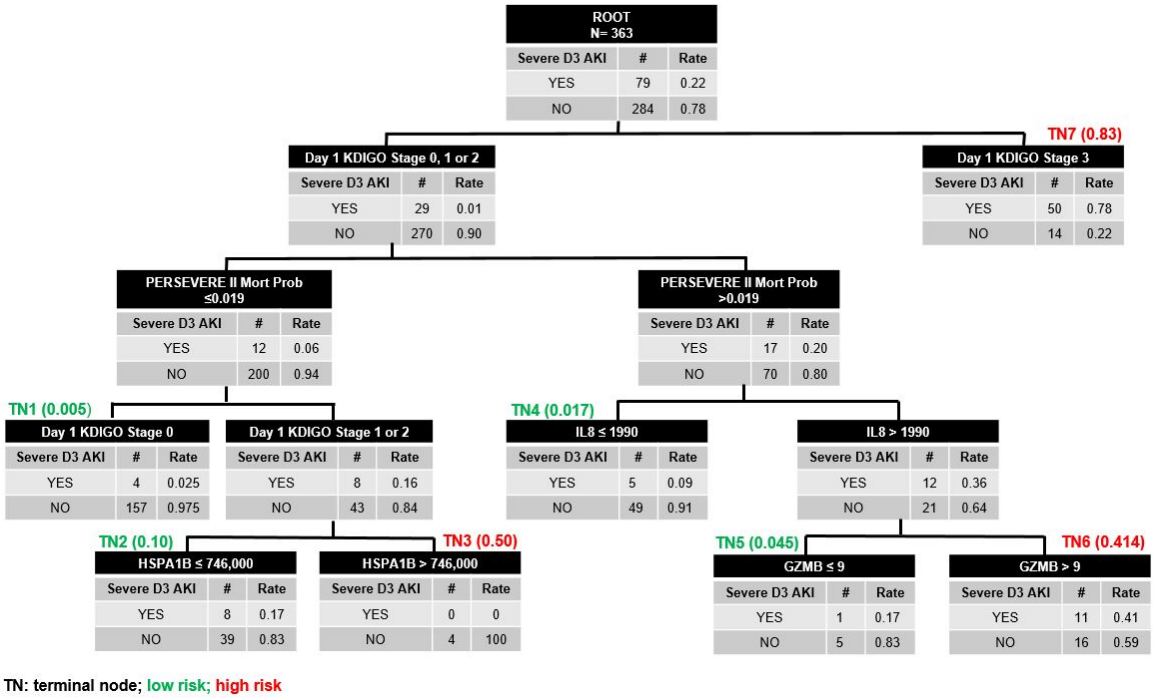
Background: Acute kidney injury (AKI) is a frequent complication of sepsis that is associated with poor outcomes. The treatment of sepsis-associated AKI (SA-AKI) is supportive, with no known effective therapies. Early identification of patients at highest risk for severe SA-AKI could facilitate targeted employment of kidney protective strategies and enrich future clinical trials. We have previously derived a multi-biomarker pediatric SA-AKI model (the PERSEVERE-II AKI Model) that predicted Day 3 (D3) severe SA-AKI with impressive test characteristics (AUC 0.95, 95%CI 0.92-0.98, sensitivity 92%, specificity 89%). We sought to prospectively validate this tool in a separate cohort.

Methods: Secondary analysis of a prospective study of patients aged 0-25 admitted to 11 PICUs with septic shock from 3/19 to 12/22. Subjects were excluded if they had missing data, died before D3, or had CKD without known baseline serum creatinine (SCr) (n=63). The PERSEVERE biomarkers (C-C chemokine ligand 3, granzyme B [GZMB], heat shock protein 70 kD 1B [HSPA1B], IL-8 and matrix metallopeptidase 8) were measured on Day 1 (D1) and combined with platelet count to assign a PERSEVERE-II mortality probability. D1 KDIGO AKI Stage, PERSEVERE-II mortality probability, GZMB, HSPA1B and IL-8 levels were subsequently used to assign a D3 severe AKI probability (Figure 1). The performance of this model was assessed and compared to D1 context-free SCr elevation.

Results: Among 363 subjects, 79 (22%) suffered D3 severe SA-AKI. The PERSEVERE-II AKI Model (Figure 1) predicted D3 severe SA-AKI with an AUC of 0.89 (95%CI 0.85-0.93), sensitivity 77% (95%CI 66-86), specificity 88%

(95%CI 84-92), PPV 65% (95%CI 54-74), and NPV 93% (89-96). Compared to subjects with D1 AKI by SCr (n=152), those predicted to have D3 severe SA-AKI by the model (n=94) had higher incidence of D3 severe SA-AKI (65% vs. 45%, p=0.003) and renal replacement therapy use (40% vs 26%, p=0.021), and lower rates of renal recovery from early AKI (37% vs 53%, p=0.019). Finally, the model performance was superior to that of degree of D1 SCr elevation above baseline (AUC 0.89 [95%CI 0.85-0.93] vs. 0.82 [95%CI 0.76-0.88], p=0.004).

Conclusion: We have prospectively validated the PERSEVERE-II SA-AKI Model for prediction of D3 severe SA-AKI in pediatric septic shock. The vital next step to translating this tool to the bedside is timely biomarker availability.



TN: terminal node; low risk; high risk

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Cystatin C Has the Potential to Enhance the Practicality of the Kidney Functional Reserve Test in Real-Life Scenarios

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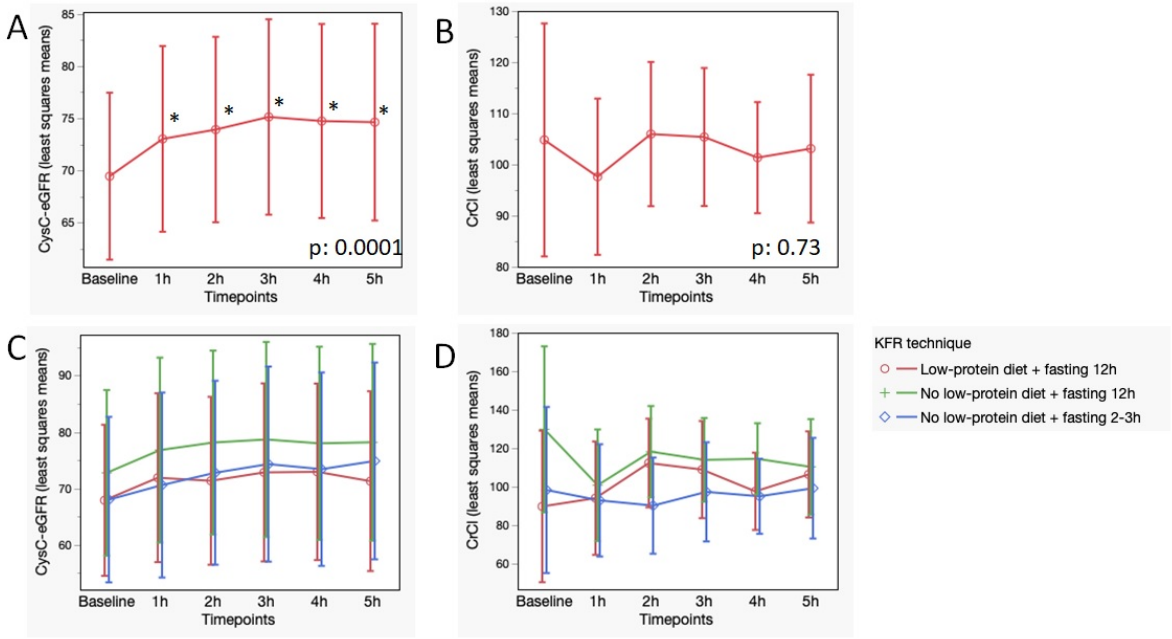
The Kidney Functional Reserve (KFR) test quantifies the capacity of the kidneys to increase filtration in response to stress and allow the identification of individuals at risk of Acute Kidney Injury (AKI). KFR is measured by assessing the glomerular filtration rate (GFR) before and after a stimulus, usually a protein meal. Unstimulated and stimulated GFR are usually evaluated by clearance measurements, such as nuclear medicine or creatinine clearance (CrCl). However, clearance measurement is cumbersome and limit the clinical utility of the test. Cystatin C estimated GFR (CysC-eGFR) can be equivalent to measured clearance methods in the determination of KFR in people with chronic kidney disease. The ideal method to perform sample collection is also complex, most protocols suggesting a fasting period before the test and animal data suggesting that a low-protein diet one day before would be needed to enhance

results. This study aims to compare CysC-eGFR-based KFR with CrCl-based GFR in real-life scenarios, including patients admitted the day before the surgery, and to assess the need for low-protein diet and fasting before the test.

Participants undergoing cardiac surgery (n=16), kidney surgery (n=12) and healthy volunteers (n=4) performed a KFR test by the measurement of CrCl and plasma cystatin C levels before and after the ingestion of a shake containing 1.5g/kg powdered whey protein. Twelve tests were conducted after one day of low-protein diet and 12h fasting, 10 tests after normal diet and 12h fasting and 10 tests after normal diet and 3 hours fasting. Stimulated GFR was assessed hourly for 5 hours after the protein meal. Creatinine and cystatin C levels were performed using a clinical chemistry analyser (Konelab, Thermo™). Mixed models with repeated measures were used to assess GFR over the time.

CysC-eGFR based KFR was shown to be more consistent than CrCl based KFR. Plasma levels of CysC were increased at the first hour after protein ingestion, earlier than the 2-3h usually reported for CrCl. CrCl did not show a sustained increase in GFR after protein meal in the patients evaluated. Different techniques of KFR measurement had no influence in the trajectory of CysC-eGFR or CrCl (Figure 1).

CysC-eGFR based KFR is easier to perform than measured clearance methods and seems to be feasible in real-life scenarios even in the absence of extensive preparation before the test.



Source	p-value
Time	<.0001*
KFR technique	0.8586
Interaction between time and KFR technique	0.8852

Source	p-value
Time	0.7837
KFR technique	0.3754
Interaction between time and KFR technique	0.9193

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Dysmagnesemia association with acute kidney disease among critically ill patients with acute kidney injury

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Background: Acute kidney injury (AKI) is common in the hospital and is associated with increased mortality and morbidity, with even more dire consequences in case of AKI transition to Acute kidney disease (AKD). Serum magnesium, an intracellular cation, plays a vital role in cell functions and involves mineral bone and vascular calcification. Low serum magnesium levels have been linked to endothelial dysfunction, atherosclerosis, and inflammation, with a decline in renal function and increased risk of death in CKD and hemodialysis patients. This study aims to assess the significance of various magnesium level derangements as a risk factor for progression to AKD in AKI critically ill patients.

Methods: This retrospective study was conducted among patients with AKI admitted to the intensive care units at Mayo Clinic from January 2007 to December 2017. Serum magnesium levels among patients with AKI were categorized into four groups: <1.7, 1.7-1.9, 1.9-2.1, 2.1-2.3, and >2.3 mg/dL, respectively, with 1.9-2.1 mg/dL as the reference. AKD was defined as AKI that persisted more than seven days after the AKI onset. Binary logistic regression was used to evaluate the independent association between serum magnesium levels and AKD.

Results: Among 20,139 critically ill patients with AKI, the mean age was 66±16 years, and 57.3% were male. The mean serum magnesium at AKI onset was 1.9±0.4 mg/dl. The incidence of AKD was 31.2%. The highest AKD rate was 70.7% in magnesium levels at 1.7-1.9 mg/dl. At magnesium levels <1.7, 1.9-2.1, 2.1-2.3, and >2.3 mg/dL, AKD occurred 30.8%, 28.2%, 30.7%, and 40.9% respectively. In multivariable analysis, serum magnesium levels were associated with increased risk of AKD with Odds ratio of 1.17 (95% CI 1.06-1.28), 1.14 (95%CI 1.02-1.27), and 1.61 (95% CI 1.44-1.88) when magnesium levels <1.7, 2.1-2.3, and >2.3 mg/dL, respectively.

Conclusion: Hypomagnesemia (<1.7 mg/dL) and hypermagnesemia (> 2.1 mg/dL) during AKI are associated with higher AKD rates. Future trials are required to assess the role of magnesium level correction as a modifiable risk factor for AKD

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Prognostic Nutritional Index as a Predictive Marker for Acute Kidney Injury in the Adult Critical Illness Population: A Systematic Review and Meta-Analysis

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Background:
The Prognostic Nutritional Index (PNI), integrating nutrition and inflammation markers, has been increasingly recognized as a prognostic predictor in diverse patient cohorts. Recently, its effectiveness as a predictive marker for Acute Kidney Injury (AKI) in various clinical settings has garnered attention. This study aims to assess the predictive capability of PNI for AKI in critically ill populations through systematic review and meta-analysis.

Methods:
The study focused on an adult critical illness population assessed for PNI with AKI development as the outcome. A systematic review was conducted using databases: MEDLINE, EMBASE, PubMed, and CNKI up to August 2023. Included trials reported the PNI cutoff point and its predictive capacity for AKI. Data on study characteristics, subgroup covariates and diagnostic performance of PNI, including sensitivity, specificity, and event rates, were extracted. Diagnostic test accuracy meta-analysis was performed. Subgroup analyses, and meta-regression were utilized to investigate heterogeneity. The GRADE framework evaluated the confidence in the meta-analysis's evidence.

Results:
The analysis encompassed 16 studies with 17 separate cohorts, totaling 21,239 patients. The pooled sensitivity and specificity of PNI for AKI prediction were 0.67 (95% CI 0.58–0.74) and 0.74 (95% CI 0.67–0.80), respectively. The pooled positive likelihood ratio was 2.49 (95% CI 1.99–3.11), and the negative likelihood ratio was 0.46 (95% CI 0.37–0.56). The pooled diagnostic odds ratio (DOR) was 5.54 (95% CI 3.80–8.07), with an SROC indicating a pooled diagnostic accuracy of 0.76. Subgroup analysis showed that PNI's sensitivity was higher in medical versus surgical populations (0.72 vs. 0.55; $p < 0.05$) and in studies excluding CKD patients compared to those including them (0.75 vs. 0.56; $p < 0.01$). Overall, diagnostic performance was superior in the non-CKD group.

Conclusion:
PNI serves as an effective tool for identifying patients at low risk for AKI development, particularly in non-CKD populations.

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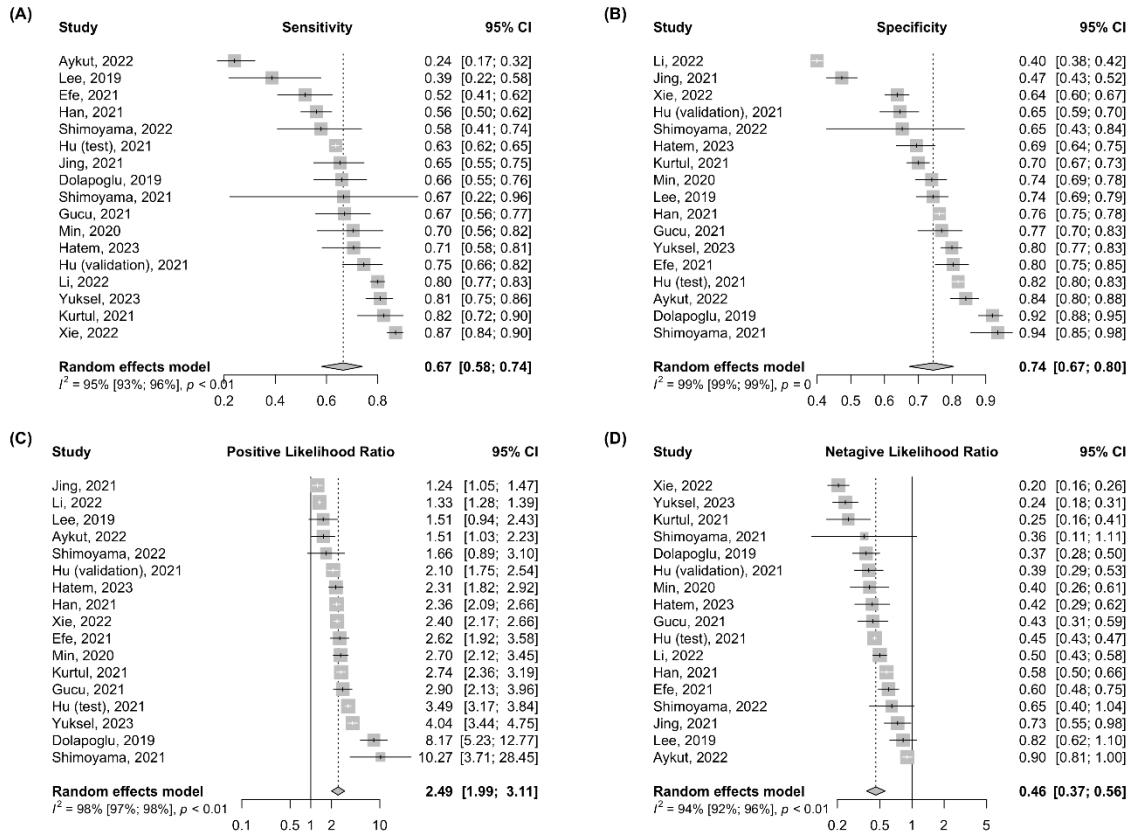

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Standardized Approach to Reduce Fluid Overload

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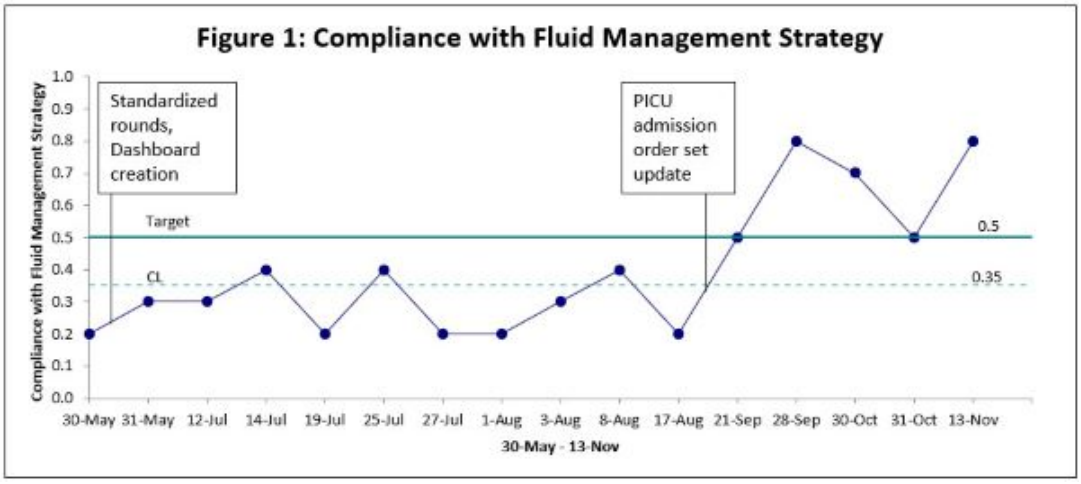
Purpose: Fluid overload, the pathologic state of positive fluid balance, is common in the pediatric intensive care unit (PICU) and independently associated with poor outcomes. Despite the importance of eliminating unnecessary variation in fluid balance assessment and administration, there is a lack of quality improvement based processes to measure and assess fluid balance in critically ill children. We sought to implement a fluid management strategy to standardize measurement and assessment of fluid balance and fluid administration in the PICU. This important first step is needed as a foundation for targeting optimal fluid balance and mitigating harmful effects of fluid overload.

Methods: Our aim is adherence to four components (process measures) of the fluid management strategy in ≥50% of PICU patients. These include: 1) creation and implementation of a fluid balance dashboard, 2) documented daily weights on all PICU patients, 3) fluid balance discussed on rounds daily, and 4) active total IV fluid order for patients receiving continuous IV fluids. We are using PDSA cycles to implement, track, and improve compliance to each measure.

Summary of results: 160 PICU patient encounters were reviewed from May-November 2023. Compliance with the fluid management strategy has been ≥50% since September 2023 (Figure 1). The center lines for each process measure are:

100% patients on fluid balance dashboard, 80% documented daily weights, 60% fluid balance reported on rounds, and 70% with an active total IV fluid order. Documentation of daily weights has shown the most variation, though compliance remains adequate with a center line of 80%. Updating our PICU admission order set to include a total IV fluid order for all admissions has led to sustained improvement in active total IV fluid orders from 30%-70% to 90%-100%.

Conclusions reached: We achieved our aim of ≥50% compliance with our fluid management strategy since September 2023. Our next PDSA cycles will address compliance with total IV fluid orders and work to address barriers. Future work will involve daily utilization of the fluid balance dashboard to evaluate each patient's cumulative fluid balance and highlight patients with likely pathologic fluid balance that may require intervention.



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Healthcare Professional Perspectives on Creatinine During Critical Illness

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Purpose
Creatinine remains the standard biomarker for assessing kidney function, but its reliability in acute illness is limited by non-steady state conditions, reduced creatinine generation, and altered volume of distribution. This study aimed to evaluate healthcare professionals' ability to interpret kidney function based on creatinine values within theoretical critical care scenarios.

Methods
Twelve hypothetical clinical scenarios, reflective of typical critical care patients, were developed. Each scenario detailed demographics, comorbidity, acute condition, and 7-day clinical course. A kinetic model was used to predict the trajectory of serum creatinine based on physiological principles, expected alterations in muscle mass, underlying glomerular filtration rate (GFR) and fluid balance. The study was created in the form of an online survey and distributed through social media and healthcare professional networks in critical care nephrology.

Results
Out of a total of 103 respondents, 100 actively participated in the survey, representing 16 countries; 43 (43%) were attending grade and 74 (74%) worked primarily in critical care medicine. Over the first 7-days of all twelve scenarios, in

only 43% of days did participants correctly estimate the true GFR category (< 5, 5-14, 15–29, 30-44, 45–59, 60–90 or >90ml.min-1.1.73m-2) from the modelled creatinine trajectory. Similarly, on 63.5% of days, respondents correctly adjudicated the presence or absence of a fall in GFR compatible with AKI stages 1-3 (33%, 50% or 66% GFR decrease from baseline). At discharge from critical care (scenario range 12-42 days), only 20.8% of participants accurately predicted the true GFR category from the modelled creatinine at that time point.

Conclusion
Within a group of largely expert clinicians with an interest in critical care nephrology, there was great variation in the estimation of underlying kidney function based on provided creatinine values. This may be due to difficulty simultaneously accounting for non-steady state conditions and acute alterations in creatinine generation and distribution. Notably, prolonged critical illness is associated with significant sustained muscle wasting, substantially reducing creatinine production and participants were particularly poor at estimating underlying GFR at discharge from provided creatinine values. These findings highlight the need for alternative, unbiased measures of kidney function during and after critical illness.

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Acute Kidney Injury from Isolated IgG4-related Infiltrative Kidney Disease, A Case Report

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Background: IgG4-related disease (IgG4-RD) is a systemic disease which can involve nearly all organ. Renal involvement includes acute kidney injury from interstitial nephritis, membranous nephropathy and renal infiltrative lesion. Symptomatic IgG4-related kidney disease (IgG4-RKD) without extrarenal organ involvement is extremely rare condition.

Case report: We reported a case of 48-year-old male with isolated renal IgG4-RD presented with abdominal pain. His laboratory investigation showed acute kidney injury, proteinuria and hypoalbuminemia. Whole abdominal CT scan showed infiltrative lesions at both kidneys and ureters with hydronephrosis. His kidney biopsy revealed lymphocytic and plasma cell infiltration, 82 plasma cell/HPF, storiform fibrosis without obliterative phlebitis. After treatment with corticosteroid, he had improvement of renal function and had remission of the infiltrative lesion.

Conclusion: Isolated renal IgG4-RD is rare and can be difficult to diagnosed. The disease can be present as acute interstitial nephritis, glomerular disease, retroperitoneal fibrosis, and rarely mass or infiltrative lesions. The disease likely to response well to corticosteroid; thus, the diagnosis shall not be delayed. The delayed diagnosis may lead to organ fibrosis and dysfunction.

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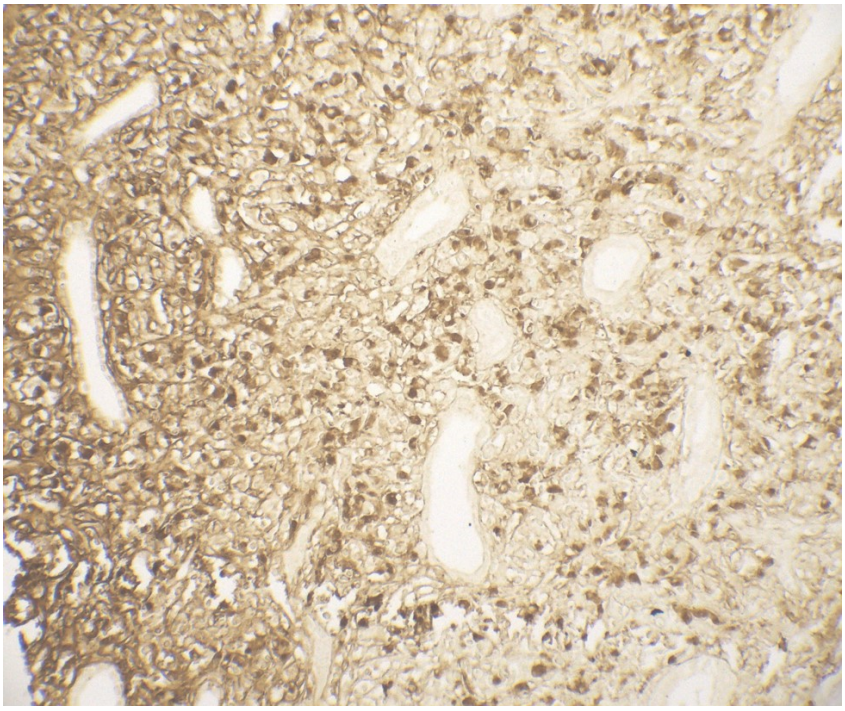

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Renal Recovery after Iodinated Contrast Administration in Patients with Acute Kidney Injury Requiring Dialysis

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[1]*Tan Tock Seng Hospital, Singapore,* [2]*University of Toronto, Toronto, ON, Canada,* [3]*St Michael's Hospital, Toronto, ON, Canada*

Introduction
Acute kidney injury (AKI) is common in critically ill patients, who often receive iodinated contrast media (ICM) for a variety of investigations and interventions. While ICM may be nephrotoxic, there is a knowledge gap regarding the effects of the receipt of ICM in patients with dialysis-requiring AKI (AKI-D). The administration of ICM to patients with severe AKI may cause further injury and delay kidney recovery.

Methods
We performed a retrospective cohort study that included all patients admitted to St Michael's Hospital, in Toronto, Canada with AKI-D from January 2007 to December 2022. Patients who died during the index hospitalization, who had premorbid estimated glomerular filtration rate (eGFR) < 15ml/min/1.73m2, had missing premorbid serum creatinine (sCr) and whose admission sCr was greater than 200µmol/L, or whose dialysis was initiated at another site were excluded. Research Ethics Board of Unity Health Toronto approved the study.
The primary exposure was the receipt of any form of ICM within 2 weeks of commencing acute dialysis. The primary outcome of our study was dialysis dependence at hospital discharge. Secondary outcomes included discharge eGFR, change in eGFR and dialysis duration. The association between the exposure and primary outcome was evaluated with logistic regression and inverse probability weighting using the propensity score for the receipt of ICM.

Results

Of the 1597 patients with AKI-D who underwent dialysis at SMH, 663 patients died during the hospital admission. 792 patients who survived to hospital discharge were included. Patients who received ICM were younger (60.1 vs 63.1, p=0.013) and more likely to experience an intensive care stay (89.7% vs 69.6%, p<0.001). 67 out of 223 (30.0%) of patients who received ICM were discharged on dialysis compared with 191 out of 569 (33.6%) patients who did not receive ICM (p = 0.39).

After weighting for the propensity score of receiving contrast, patients who received ICM were not more likely to be dialysis-dependent at hospital discharge (Odds Ratio 1.39, 95% CI 0.92-2.05). The results were consistent across pre-defined subgroups and in sensitivity analyses.

Conclusion

Among critically ill patients with AKI-D, exposure to ICM did not associate with dialysis dependence at discharge. The enhanced diagnostic certainty and therapeutic benefits afforded by contrast-enhanced investigations and interventions should be prioritized over the theoretical risk of perpetuating AKI.

	Iodinated Contrast (n = 223)	No Iodinated Contrast (n = 569)	All Patients (n = 792)	P value
Age – years	60.1 ± 13.5	63.1 ± 15.5	62.2 ± 15.0	0.013
Male sex – no. (%)	152 (68.2)	376 (66.1)	528 (66.7)	0.635
Prexisting DM - no. (%)	53 (23.8)	171 (30.1)	224 (28.3)	0.093
Charlson Comorbidity Score - mean	2.52 ± 2.20	2.95 ± 2.49	2.83 ± 2.42	0.024
Premorbid eGFR – ml/min/1.73m2	73.5 ± 28.8	68.9 ± 30.5	70.2 ± 30.1	0.051
Admission serum Cr	247.4 ± 257.9	312.4 ± 315.8	294.1 ± 301.9	0.006
Weight – kg	88.3 ± 26.5	84.7 ± 27.3	85.7 ± 27.1	0.136
Cardiac Surgery – no. (%)	23 (10.3)	87 (15.3)	110 (13.9)	0.088
Characteristics at RRT initiation				
Admitted to ICU at RRT initiation – no. (%)	200 (89.7)	396 (69.6)	596 (75.3)	<0.001
Mechanical ventilation – no. (%)	162 (75.0)	254 (44.7)	416 (53.1)	<0.001
Vasoactive support – no. (%)	146 (65.8)	227 (40.0)	373 (47.3)	<0.001
Cr at RRT initiation – µmol/L	454.7 ± 248.4	502.8 ± 266.2	489.2 ± 262.0	0.020
SOFA score (mean)	13.6 ± 3.9	11.6 ± 4.4	12.2 ± 4.4	<0.001
Initial dialysis modality – no. (%)				<0.001
CRRT	84 / 223 (37.7)	104 / 566 (18.3)	188 / 792 (23.7)	
SLED	27 / 223 (12.1)	71 / 566 (12.5)	98 / 792 (12.4)	
IHD	112 / 223 (50.2)	394 / 566 (69.2)	506 / 792 (63.9)	

39. Addition of Urine NGAL to Serum Creatinine Improves Prediction of Cefepime Clearance in Pediatric ICU Patients at High Risk of AKI

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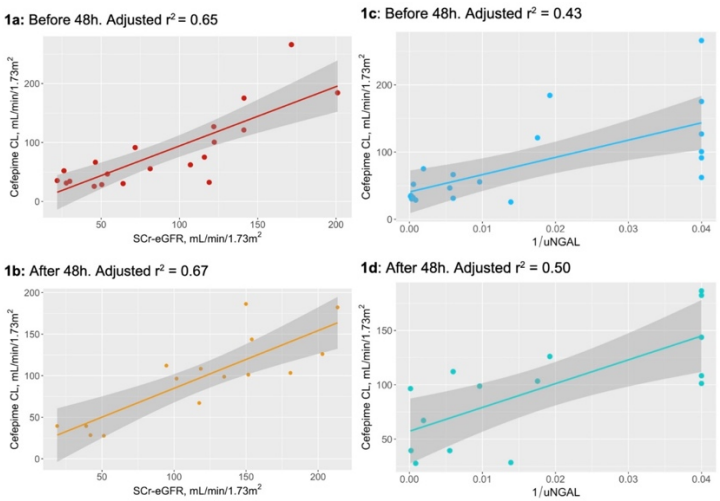
Background: Cefepime (FEP) is commonly used for empiric treatment of sepsis in the Pediatric ICU (PICU). FEP has renal clearance (CL), requiring dose-adjustment with changing kidney function, including AKI. Serum creatinine (SCr) is used to estimate glomerular filtration rate (eGFR), but elevations in tubular injury biomarkers such as neutrophil gelatinase-associated lipocalin (uNGAL) may precede SCr elevation. uNGAL is ordered in our PICU in patients at elevated risk of AKI based on a renal angina index (RAI, AKI risk score) of ≥8. It is unknown if uNGAL can predict changes in FEP CL before changes in SCr. We sought to determine if including uNGAL improved prediction of FEP CL in PICU patients at risk of AKI.

Materials: We prospectively enrolled patients admitted to the PICU with RAI of ≥8, prescribed FEP, and not receiving extracorporeal therapy. FEP concentrations were measured from scavenged residual clinical blood samples. We analyzed FEP concentrations using pharmacokinetic (PK) modeling software (MwPharm++) and a pediatric FEP PK model to estimate FEP CL. We used linear regression to compare uNGAL, SCr-eGFR (defined by bedside Schwartz for patients <18 and by race-neutral CKD-EPI equations for patients ≥18), and SCr-defined AKI as predictors of FEP CL normalized to body surface area (BSA) before and after 48h post-PICU admission (b48h/a48h).

Results: Twenty patients (mean 11.6y, 50% female) were included. Patients had 4-9 FEP concentrations; 15 (75%) had concentrations a48h. Twelve (60%) had SCr-defined AKI on PICU admission and 10 (50%) had elevated uNGAL using threshold of 150 ng/mL. In univariate analyses, SCr-eGFR was associated with FEP CL b48h (adjusted [a]r2=0.65) and a48h (ar2=0.67) (Figure 1a-b). uNGAL values were skewed so geometric inverse was used; 1/uNGAL was associated with FEP CL b48h (ar2=0.43) and a48h (ar2=0.50) (Figure 1c-d). In multivariable regression, combining SCr-eGFR and 1/uNGAL improved model performance: ar2=0.69 b48h and 0.72 a48h. Elevated uNGAL was associated with a ~40% decrease in FEP CL after controlling for SCr-AKI.

Conclusions: uNGAL concentrations at PICU admission are associated with decreased FEP CL b48h and a48h. Addition of uNGAL to SCr-eGFR may improve prediction of cefepime CL.



1a: FEP CL vs SCr-eGFR before 48h post-PICU admission: FEP CL (mL/min/1.73 m²) = 1.01*SCr-eGFR – 6.4. **1b**: FEP CL vs SCr-eGFR after 48h post-PICU admission. FEP CL (mL/min/1.73 m²) = 1.01*0.694*SCr-EGFR +15.4. **1c**: FEP CL vs 1/uNGAL before 48h post-PICU admission. FEP CL (mL/min/1.73 m²) = 2570*(1/uNGAL) + 40.7. **1d**: FEP CL vs 1/uNGAL after 48h post-PICU admission. FEP CL (mL/min/1.73 m²) = 2190*(1/uNGAL) + 57.2. Shaded areas represent 95% confidence interval for local mean based on LOESS regression. Figure created with RStudio for Mac and BioRender.com.

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Effect on kidney function recovery guiding decongestion with VExUS in patients with cardiorenal syndrome 1, a randomized control trial

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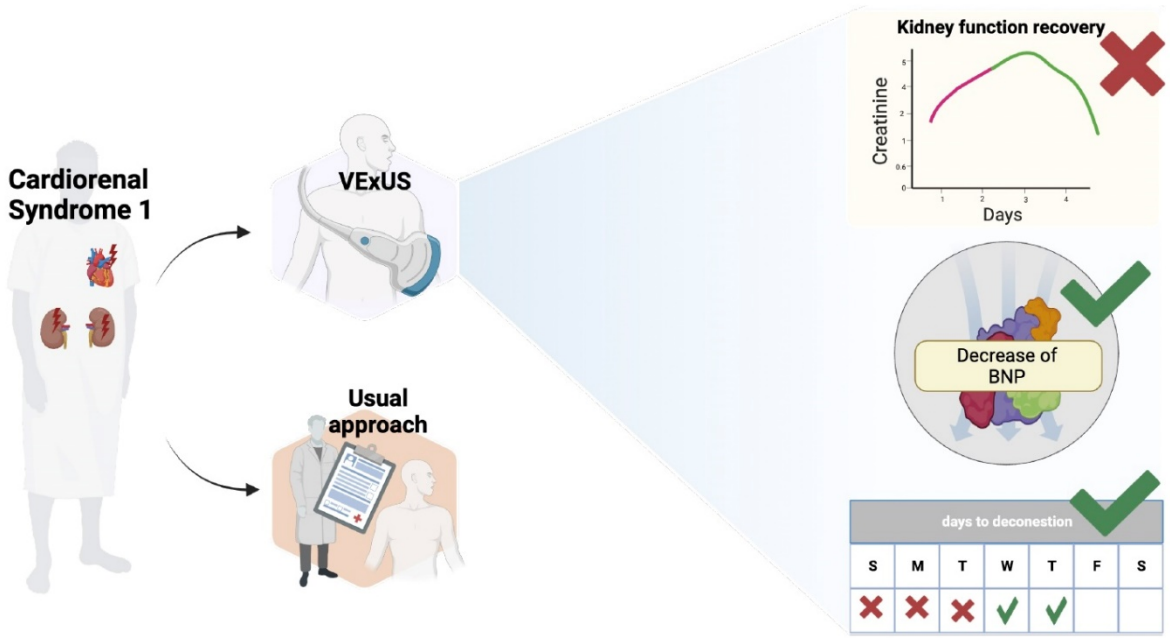
Introduction: In cardiorenal syndrome type 1 (CRS1) vascular congestion is central to the pathophysiology of heart failure and thus a key target for management. The Venous Evaluation by Ultrasound System (VExUS) could guide decongestion effectively and thereby improve outcomes.
Methods: In this randomized clinical trial, patients with CRS1 (i.e., increase in creatinine ≥0.3 mg/dL) were randomized to guide decongestion with VExUS compared to usual clinical evaluation. The primary endpoint was to assess kidney function recovery (KFR), and the key secondary endpoint was decongestion evaluated by physical examination and changes in brain natriuretic peptide (BNP) and CA-125. Exploratory endpoints included days of hospitalization and mortality.
Results: From March 2022 to February 2023, a total of 140 patients were randomized 1:1 (70 in the VExUS and 70 in the Control group). KFR was not statistically different between groups. However, VExUS improved more than twice the odds to achieve decongestion (OR 2.6, 95% CI 1.9-3.0, p=0.01) and the odds to reach a decrease of BNP >30% (OR 2.4; 95% CI 1.3-4.1, p = 0.01). The survival at 90 days, recongestion and CA-125 were similar between groups.
Conclusion: In patients with CRS1, we observed that VExUS-guided decongestion did not improve the probability of KFR but improved the odds to achieve decongestion.
Clinicaltrials.gov identifier: NCT05927285



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The Effects of Sodium-Glucose Cotransporter-2 Inhibitor on Long-Term Outcomes in Post-Severe Acute Kidney Injury Survivors: Preliminary Analysis

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[1]*Division of Nephrology, Department of Medicine, Chulalongkorn University,* [2]*Department of Medicine, Buddhachinaraj Phitsanulok Hospital,* [3]*Department of Medicine, Central Chest Institute*

Background: Currently, there is no specific treatment for post-acute kidney injury (AKI) survivors, and the role of sodium-glucose cotransporter-2 inhibitor (SGLT2i) in post AKI survivors is unestablished.

Objective: To determine whether the SGLT2i can decrease 1-year Major Adverse Kidney Events (MAKE365) in post AKI setting.

Methods: This multicenter randomized controlled trial was conducted at 3 tertiary care hospitals. AKI stage 2 and 3 survivors (by KDIGO 2012 criteria), who were dialysis independence, and had at least an estimated glomerular filtration rate (eGFR) of 20 ml per minute per 1.73 m2 of body-surface area, were randomized into 2 groups treated with empagliflozin 10 mg/day or placebo for 1 year. The primary outcome was MAKE365 (defined as end-stage kidney disease, a sustained decrease in eGFR or doubling of serum creatinine for ≥50% from baseline, or death at 1 year).
Results: Both groups were still blinded during the preliminary analysis. The study enrolled 188 patients, in this preliminary analysis only 99 patients (52 in group A and 47 in group B) completed 1 year follow up. Sixty percent of the patients were male in both groups, half of them had diabetes mellitus and 25% had chronic kidney disease. Median baseline eGFR was 75 and 72 ml/min/1.73 m2 in group A and B respectively. At 12-month follow up, 21 patients in group A and 27 patients in group B developed MAKE365 (40.0% vs. 57.0%, HR 1.55, 95% CI 0.87-2.75), p = 0.133). Death occurred in 15 percent and 6 percent in group A and B (HR 0.39, 95% CI 0.10-1.48) p = 0.167). 44 patients in each group had persistent renal dysfunction (85% vs. 94%, p = 0.155)

Conclusion: In our preliminary result, there was no clear difference in renal and non-renal outcomes between groups.

	A (N= 52)	B (N=47)	p-value
1-year MAKE, n (%)	**21 (40)**	**27 (57)**	**0.090**
Hospital 1	8/11 (73)	8/10 (80)	
Hospital 2	6/18 (33)	10/17 (59)	
Hospital 3	7/23 (30)	9/20 (45)	
1-year MAKE category, n (%)			
Dead	8 (15)	3 (6)	0.155
Dialysis	0 (0)	0 (0)	-
Persistent renal dysfunction	44 (85)	44 (94)	0.155
1-year MAKE incidence (95% CI), per 1000 person-year	**540 (334, 826)**	**876 (577, 1000†)**	
Hospital 1	1000† (697, 1000†)	1000† (646, 1000†)	
Hospital 2	410 (151, 893)	894 (428, 1000†)	
Hospital 3	363 (146, 748)	629 (288, 1000†)	
1-year MAKE Hazard ratio (95 % CI) *	Reference	1.59 (0.90, 2.82)	0.109
1-year MAKE Hazard ratio (95 % CI) considering for cluster effects of hospitals**	Reference	1.55 (0.87, 2.75)	0.133
1-year mortality rate (95 % CI), per 1000 person-year	**171 (74, 337)**	**66 (14, 194)**	
1-year mortality hazard ratio (95 % CI)*	Reference	0.39 (0.10, 1.48)	0.167
1-year mortality hazard ratio (95 % CI) considering for cluster effects of hospitals**	Reference	0.39 (0.10, 1.46)	0.161

* Cox proportional Hazard regression model; ** Multilevel mixed-effects parametric survival models
† The incidence rate per 1000 person-year which exceeded 1000 was simplified as 1000.

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Preventing gentamicin-induced acute kidney injury by oral pentoxifylline co-treatment; a randomized, placebo-controlled, clinical trial

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Background:
The major Achilles' heel of aminoglycosides in current clinical practice is their adverse effects, most notably nephrotoxicity. The aim of the present clinical trial was to determine the possible nephroprotective effects of pentoxifylline against gentamicin-induced acute kidney injury (AKI) in patients with different infectious diseases.

Method:
We conducted a double-blinded, randomized clinical trials in non-critically ill patients with infectious diseases during 14 months in three teaching hospitals in Iran. Eligible patients under gentamicin treatment were allocated into either placebo (400 mg three times a day orally) or pentoxifylline (400 mg three times a day orally) groups for 7 days. Demographic, clinical, laboratory, and therapeutic information of patients were recorded. Malondialdehyde (MDA) and tumor necrosis factor-alpha (TNF-α) levels in serum were measured on days 0 and 7 of treatment. Gentamicin-induced AKI was defined as an increase in serum creatinine level by either more than 0.5 mg/dl or a 50% increase in serum creatinine level compared to baseline values.

Results:
Thirty patients in the placebo and 30 subjects in the pentoxifylline group completed the study. Except for urinary magnesium level, other demographic, clinical, and laboratory characteristics of patients were comparable at baseline between pentoxifylline and placebo groups. The incidence of gentamicin-induced AKI in the placebo group was 19.6 times higher than that in the PTX group during the study (OR = 19.6, 95%CI=3.08–114.32; P value=0.001). In addition, the rate of acute tubular necrosis (ATN) at day 7 of gentamicin treatment in pentoxifylline group was significantly lower than that in the placebo group (10% and 56.7%, respectively; P value = 0.001). The mean± standard deviation time onset of ATN was 4.00±2.32 and 5.58±1.59 days in pentoxifylline and placebo recipients, respectively (P value < 0.001). Significant decrease in serum levels of MDA and TNF-α in pentoxyfylline recipients compared to placebo group was identified at day 7 (P value < 0.001 for both indexes). Pentoxifylline was also well tolerated by all patients.

Conclusion:
This multicenter, randomized, placebo-controlled, clinical trial findings suggested that the co-administration of 400 mg pentoxyfylline orally three times daily along with gentamicin was both well-tolerated and effective in preventing the gentamicin-induced AKI in patients with different infectious diseases.

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The Store-Operated Calcium Channel Inhibitor Auxora improves Renal Function Following Ischemia-Induced Acute Kidney Injury In Rats

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Background: Activation of immune and vasoactive pathways are thought to contribute to the development of acute kidney injury (AKI). Both endothelial cells and CD4+ lymphocytes express the store-operated calcium channel Orai1 and previous studies suggest that Orai1 activity contributes to activation of T-helper 17 cells in AKI of rats and humans. This study was conducted to evaluate the selective Orai1 store-operated calcium channel inhibitor Auxora (CM4620) on the development or recovery from AKI in a rat model of ischemia reperfusion injury.

Methods: In study I, male Sprague-Dawley rats (~250-300 g), instrumented with chronic indwelling jugular catheters were subjected to bilateral renal ischemia (40 minutes) and reperfusion (I/R) or sham-surgery. Treatment of rats with intravenous infusion of Auxora (16 mg/kg over 4 hours) or placebo was initiated within 30 min I/R and GFR was evaluated 24 h post I/R by transcutaneous clearance of FITC-sinistrin. Study II evaluated recovery of renal function following established loss of GFR, determined by FITC-sinistrin clearance between 2-4 h post I/R. Rats were then randomized and Auxora or placebo treatment initiated at 6 hours post I/R and repeated at 24 and 48 hours. GFR was then evaluated at 72 h post I/R.

Results: In study I, GFR was 0.81±0.11 ml/min/100g b.w in sham-controls and markedly reduced by 73% in placebo-treated post I/R rats 24 h post I/R (0.22 ± 0.04 ml/min/100g). The reduction in GFR was significantly attenuated in Auxora-treated rats (0.35 ± 0.04 ml/min/100g b.w.; $p<0.05$ vs. placebo). In addition, the number of Th17 cells (CD4+/IL17+) was attenuated by approximately 50% in kidney of Auxora-treated rats vs. placebo ($p<0.05$). In study II, there was a reduction of GFR by about 50% between 2-4 h post-I/R rats vs. baseline; there was no difference in GFR prior to randomization (0.43±0.02 vs 0.39±0.05 ml/min/100g in placebo vs. Auxora, respectively). Importantly, GFR recovery was significantly greater in Auxora-treated animals vs. placebo controls (0.81±0.03 vs. 0.47±0.04 ml/min/100g in Auxora vs. placebo, respectively; $p<0.001$) 72 h following I/R.

Conclusions: These data suggest Auxora has therapeutically beneficial effects in a rat model of AKI and can hasten recovery of renal function. The basis for improved function may relate to alterations in inflammation and/or improved vascular function.

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Intravenous Administration of UNI-494 Ameliorates Acute Kidney Injury in Rat Model of Delayed Graft Function

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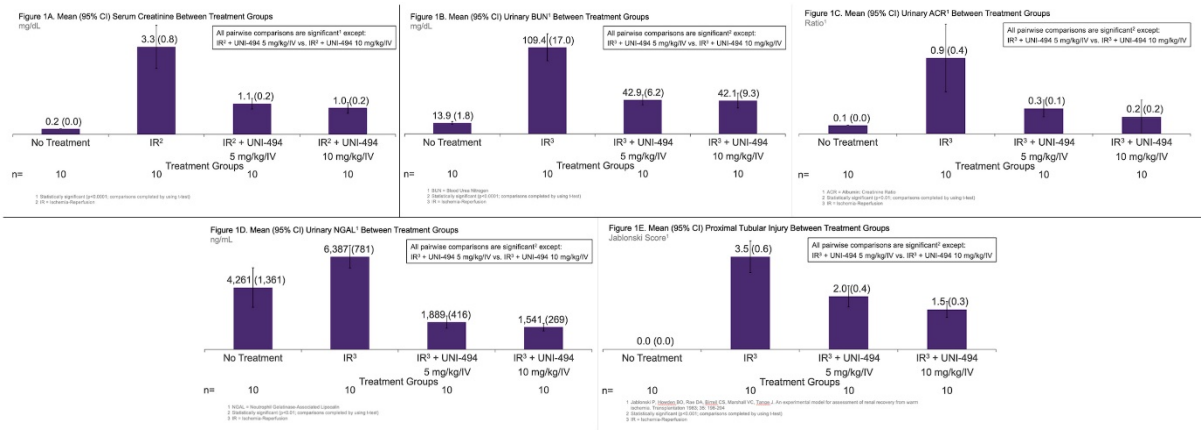
Introduction: There are no FDA approved drugs for the treatment of acute kidney injury (AKI), which affects 10-15% of hospitalized patients and often results in renal transplantation or lifelong dialysis. UNI-494 is a novel nicotinamide ester derivative and selective mitochondrial ATP-sensitive potassium channel activator that may be beneficial for several disease states, including AKI. We present results from a study evaluating the in vivo efficacy of intravenous (IV) UNI-494 in the unilateral renal ischemia-reperfusion (I/R) rat model of AKI, which is a well-established model of delayed graft function (DGF) (Cavaille-Coll, 2013).

Methods: Rats were anesthetized, the right kidney was removed, and I/R was induced by clamping the renal vessels in the left kidney for 30 minutes. UNI-494 was administered IV 30 minutes prior to I/R. After 24 hours of reperfusion in metabolic cages, blood samples were collected for serum creatinine (sCr) and BUN levels, and urinary samples were collected for ACR and NGAL. The clamped left kidney was collected and processed for histology for tubular injury scores.

Results: In this study, I/R induced significant increases of sCr, BUN, ACR, NGAL, and proximal convoluted tubular injury scores in the vehicle treated I/R group vs No I/R sham group. A single IV dose of UNI-494 at 5 mg/kg/IV or 10 mg/kg/IV reduced the kidney functional markers sCr, BUN, ACR, tubular injury marker (NGAL), and proximal tubular injury scores (all $p<0.001$, Figure 1).

Conclusion: The results indicate that UNI-494 dose dependently prevented AKI markers in an AKI rat model and therefore is a potential candidate for the prevention of DGF and other AKI clinical conditions.



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UNI-494 Phase I Safety, Tolerability and Pharmacokinetics: Trial in Progress

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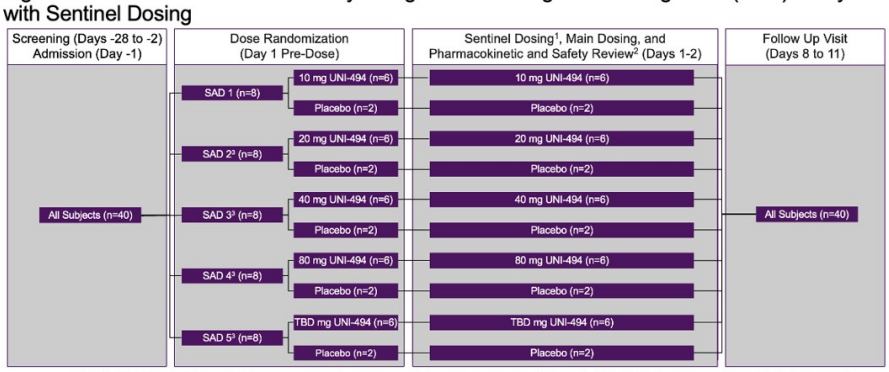
Background: Acute kidney injury (AKI) is a clinical syndrome defined by the sudden loss of kidney function, resulting in an inability to maintain electrolyte, acid-base and water balance. Currently, there are no effective treatments for AKI approved by the US Food and Drug Administration or the European Medicines Agency (EMA); management of the condition is primarily supportive. The most common cause of AKI was thought to be ischemia. However, more recently the focus has shifted from clinical causes to the underlying cellular processes inherent in these situations, in particular the dysfunction of mitochondria in AKI. UNI-494 is a novel nicotinamide ester derivative and selective mitochondrial ATP-sensitive potassium channel activator that improves mitochondrial function and may be beneficial for several disease states, including AKI.

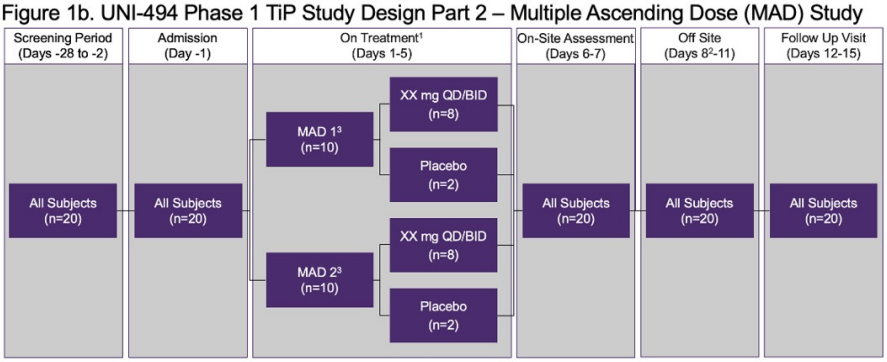
Methods: This is a single-center, double-blind, placebo-controlled, randomized single ascending dose (SAD) (Part 1) and multiple ascending dose (MAD) (Part 2) study in healthy male subjects and female subjects of non-childbearing potential. Part 1 will enroll up to approximately 40 subjects in 5 cohorts of 8 subjects each (randomized to a ratio of 6 active and 2 placebo per cohort). There will be an interim decision meeting after each cohort/period, to review the safety, tolerability, and PK data up to 48 h post-dose in order to decide the dose level for the subsequent cohort. Part 2 will enroll approximately 20 subjects in 2 cohorts of 10 subjects each, randomized to a ratio of 8 active treatment to 2 placebo who will be dosed for 5 days. The dose level for the Part 2 Cohort 1 will be selected based on the safety, tolerability and PK data from Part 1.

Figure 1a. UNI-494 Phase 1 TiP Study Design Part 1 – Single Ascending Dose (SAD) Study with Sentinel Dosing



1 The first two subjects of each cohort (i.e one receiving active and one subject receiving placebo; (sentinel group) will be dosed prior to the remaining subjects (main group)
2 After review of safety data up to the 24 hours post-dose period, the decision of whether to dose the remaining subjects in the cohort (5 for UNI-494 and 1 for Placebo) will be made
3 The doses from SAD 2 to SAD 5 will be determined during interim data review based on safety, tolerability and PK data from preceding cohorts
SOURCE: Data on File; Updated as of 12/06/23

Figure 1b. UNI-494 Phase 1 TiP Study Design Part 2 – Multiple Ascending Dose (MAD) Study



1 Sentinel dosing in Part 2 will be based on the safety, tolerability, and PK data from Part 1
2 Discharge from clinical unit 48 h post-final dose (Day 8)
3 It is planned that subjects will be dosed once daily in the fasted state
SOURCE: Data on File; Updated as of 12/06/23

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Trauma of Origin- The Impact of Maternal Acute Kidney Injury on Progeny

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Purpose: Acute Kidney Injury (AKI) results in both short- and long-term systemic sequelae. The impact of AKI on future generations, however, has not been studied. Here, we investigate the impact that AKI in female mice has on their progeny.

Methods: BLK/6J female mice underwent bilateral ischemia-reperfusion AKI. Control groups included sham operated mice and unmanipulated controls. To confirm that sufficient AKI had been obtained, serum BUN values were measured 24hrs post-procedure. Two weeks after recovery, all mice underwent testing via transcutaneous Glomerular Filtration Rate (tGFR) to assess kidney function. They were then bred and allowed to deliver naturally. Serial measurements of progeny weight and length occurred at birth and then weekly through 42 days of age.

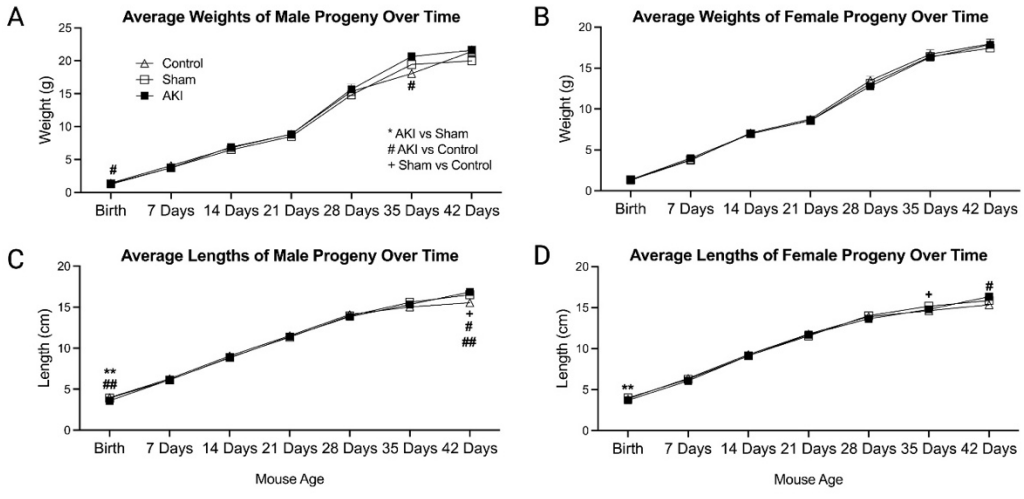
Results:
Weights (Figure 1A, 1B): At birth, male pups from AKI dams had lower weights than males born to control dams (p=0.02); whereas female pups had no significant changes across all groups. By day 7 all animals' weights had "caught up" to their counterparts in other groups; this was present until around day 35 of life. For males by day 35, AKI weights had surpassed those in control and sham groups (p=0.04). This trend was not seen in females.

Lengths (Figure 1C, 1D): At birth, males from AKI-dams were significantly shorter than males from control dams (p=0.005) while females from AKI-dams were significantly shorter than those from sham dams (p=0.01). Similar to the weight data, all animals "caught up" to their counterparts by day 7 of life. At day 42, however, both males and females born to AKI-dams surpassed animals in other groups in length (p=0.0002 in males and p=0.04 in females).

Body Mass Composition and tGFR: Progeny underwent body mass composition and tGFR measurements prior to sacrifice. There were no significant findings across groups for body composition or tGFR in both males and females.

Conclusion: The anthropometrics of the progeny were also significantly impacted at the time of birth. Growth was more impacted in males than females. Throughout the study, progeny from post-AKI dams did obtain "catch up" growth with sham and control progeny. Further studies are needed to elucidate any other sequelae in the progeny, such as neurocognitive deficits, nephron endowment, and ability to recover from episodes of AKI.

Figure 1: Progeny weights and lengths stratified by sex



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Urinary Angiopoietin-2 Levels are Associated with Risk of Adverse Kidney Outcomes in the Intensive Care Unit

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Background: Previous studies have shown that elevated plasma concentrations of angiopoietin-2 (Ang-2) are strongly associated with the development and progression of acute kidney injury (AKI). However, it is less known whether Ang-2 is present in urine and whether urinary Ang-2 (uAng-2) concentrations are prognostic for kidney-associated outcomes.

Objective: To understand the association of uAng-2 with the development of AKI, renal replacement therapy (RRT), and mortality in the intensive care unit (ICU).

Methods: We analyzed 192 ICU participants with and without AKI enrolled from three hospitals affiliated with the University of Washington (Seattle, WA) from March 2020 to May 2021. AKI was defined as an increase in serum creatinine (SCr) during hospitalization ≥ 0.3 mg/dl or 50% from a baseline SCr, consistent with KDIGO guidelines. Urinary and plasma samples were collected to measure Ang-2 by immunoassay using the MesoScale Discovery platform. Participants were stratified into tertiles (n=64) based on uAng-2 concentrations normalized to urine creatinine, then a log-linear regression was used to determine the risk of AKI, RRT, and mortality.

Results: Among 192 participants (65% men, average age 54.6 years) 44% developed AKI during hospitalization, 12% received RRT, and 35% died. After adjusting for demographics and comorbidities, tertile 3 (highest uAng-2) individuals were more likely to develop AKI (1.21; 95% CI, 1.08 to 1.35, P=0.001) or die during hospitalization (1.65; 95% CI, 1.02 to 2.67, P=0.041) compared to tertile 1 (lowest uAng-2). Participants in tertile 2 had no significant difference in risk of AKI or mortality compared to tertile 1. Although more individuals in tertile 3 received RRT, the differences were non-significant. Urinary Ang-2 was minimally correlated with plasma Ang-2 (r=0.28).

Conclusion: Elevated uAng-2 concentrations are associated with the development of AKI during hospitalization and hospital mortality. The minimal correlation between plasma and urine Ang-2 indicates the need for further research to identify the source of uAng2.

Table 1. Risk of Hospital AKI by Tertiles of Urine Ang-2

Urine Ang-2 indexed to urine creatinine	Number at Risk, N	Number of Events, n	Unadjusted RR (95% CI)	p-value	Adjusted RR (95% CI)	p-value
Tertile 1	64	22	1.0 (Reference)	-	1.0 (Reference)	-
Tertile 2	64	21	0.99 (0.87 to 1.12)	0.852	0.95 (0.84 to 1.08)	0.449
Tertile 3	64	42	1.23 (1.10 to 1.38)	< 0.001	1.20 (1.07 to 1.35)	0.001

Adjusted for age, sex, race, body mass index, invasive mechanical ventilation on study enrollment, and COVID-19 status

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The Incidence and Risk Factors for Acute Kidney Injury During Colistin Therapy

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Introduction: Colistin is an important antibiotic in the treatment of multidrug resistant organisms such as Acinetobacter baumannii and Pseudomonas aeruginosa, but acute kidney injury (AKI) due to nephrotoxicity is still a problem.
Methods: We retrospectively analyzed 96 patients with the use of colistin during hospitalization between 2021 and 2022. AKI was determined according to the serum creatinine criteria of the Kidney Disease: Improving Global Outcomes (KDIGO) classification. AKI stage 2 or 3 were classified as severe AKI and AKI recovery was defined as return of serum creatinine to below 1.5 times the baseline level.
Results: The mean age at hospitalization was 68.7 ± 11.8 years and the mean length of hospital stay was 55.7 ± 57.5 days. Most common cause of using colistin was pneumonia (59.4%), main microorganism was Acinetobacter baumannii (72.9%), and representative concomittent nephrotoxic drug was vancomycin (54.2%). AKI occurred in 58 (60.4%) of the 96 patients. Based on KDIGO classification, 34 (58.6%) patients were stage 1, 17 (29.3%) were stage 2 and 7 (12.1%) were stage 3. The dose of colistin was significantly higher in severe AKI group than non-severe AKI group (345.6 ± 158.5 mg vs 286.6 ± 74.5 mg, p = 0.017). AKI recovery occurred in 15 (25.9%) of the 58 patients. CRP was significantly lower in AKI recovery group than non-recovery group (3.2 ± 5.4 vs 10.5 ± 10.0, p = 0.001). In multivariate analysis, the independent risk factors for colistin-induced severe AKI were higher dose of colistin (HR, 1.005; 95% CI, 1.003-1.008; p < 0.001) and identification of Pseudomonas aeruginosa (HR, 2.746; 95% CI, 1.176-6.416; p = 0.020).
Conclusion: The incidence of severe AKI was higher when the dose of colistin was higher or Pseudomonas aeruginosa was identified. We should pay attention to the appropriate dose of colistin and the risk factors of AKI for prevention of colistin-induced AKI.

Variables	Exp.	95% C.I.	P
P.Aeruginosa	2.741	1.176-6.416	0.020
Colistin dose	1.005	1.003-1.008	< 0.001

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Serum creatinine ratio as predictor of patient-centered long-term outcome after cardiac surgery

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Introduction:
Acute kidney injury (AKI) in patients undergoing cardiac surgery relate to the development of major adverse kidney events up to day 90 (MAKE90). We tested whether the serum creatinine ratio (sCrRatio), defined as the ratio between the highest serum creatinine in the first five post-operative days and the pre-operative measurement, can predict major adverse kidney events up to day 90 (MAKE90).
Methods:
A development cohort and an external validation cohort with patients undergoing cardiac surgery were investigated.

Results:
In the development cohort (n=6576), 54.2% of patients developed AKI by post-operative Day 5 using the kidney disease global outcomes (KDIGO) criteria, and in the validation cohort (n=554) this was 28.4%. The cut-off value (where sensitivity was equal to specificity) for sCrRatio was 1.25 in the development cohort. The incidence of MAKE90 in the development cohort was 16.7% and in the validation cohort 24.4%. In the development cohort, the positive and negative predictive value (PPV and NPV (95% Confidence Interval)) for patients with AKI to develop MAKE90 were 25% (23-26) and 92% (91-93), for sCrR higher than cut-off they were 33% (31-35) and 90% (90-91). In the validation cohort they were 42% (34-51) and 83% (79-88) and 47% (38-54) and 81% (2.37-6.03), respectively.
Conclusion:
Calculation of the sCrRatio is simple and identifies patients at risk for meeting the MAKE criteria 90 days after cardiac surgery.

	KDIGO-AKI	sCrRatio	KDIGO-AKI	sCrRatio
To predict MAKE90:	(development)	(development)	(validation)	(validation)
Sensitivity	78% (75-80%)	70% (67-73%)	53% (43-63%)	42% (34-51%)
Specificity	52% (50-53%)	67% (66-68%)	77% (72-81%)	84% (79-88%)
Positive Likelyhood Ratio	1.61 (1.55-1.68)	2.11 (2.00-2.23)	2.26 (1.72-2.96)	2.61 (1.87-3.63)
Negative Likelyhood Ratio	0.43 (0.39-0.48)	0.45 (0.41-0.49)	0.61 (0.50-0.76)	0.69 (0.59-0.81)
Positive Predictive Value	25% (23-26%)	33% (31-35%)	42% (34-51%)	47% (38-55%)
Negative Predictive Value	92% (91-93%)	90% (90-91%)	83% (79-88%)	81% (79-84%)
Accuracy	56% (55-57%)	67% (66-75%)	71% (66-75%)	73% (69-78%)

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Cardiovascular and Mortality Benefits of Glucagon-Like Peptide-1 Analogues in Diabetic Patients Undergoing Acute Dialysis

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Background: Glucagon-like Peptide-1 Analogues (GLP-1a) have demonstrated efficacy in cardiovascular (CV) outcomes. However, previous studies have excluded patients with advanced kidney disease and those undergoing dialysis, despite the eminent CV risk in this population.

Purpose: This study aims to investigate the benefits of GLP-1a in patients undergoing dialysis due to kidney injury.

Methods: A cohort of diabetic patients undergoing acute dialysis was identified from the TriNetX global database. Through propensity-score matching, two groups of patients treated with either GLP-1a or insulin were created for a head-to-head comparison. Kaplan-Meier Analyses, Log-Rank Tests, and Hazard Ratio Tests were utilized to compare outcomes, focusing on mortality and major adverse cardiovascular events (MACE), including acute myocardial infarction, coronary artery bypass, cardiac arrest, cerebral infarction, and nontraumatic intracerebral hemorrhage. Subgroup analyses were conducted to assess the benefits of initiating GLP-1a therapy during acute dialysis.

Results: Out of 23,028 diabetic patients undergoing acute dialysis, 671 patients were included in each propensity-matched group treated with either GLP-1a or insulin. GLP-1a use during acute dialysis was associated with a reduced risk of mortality (hazard ratio [HR] = 0.62, 95% confidence interval [CI] = 0.47-0.83) and MACE (HR = 0.67, 95% CI = 0.49-0.91). In the treatment-naïve subgroup, the initiation of GLP-1a therapy during acute dialysis significantly reduced both mortality (p = 0.043) and MACE (p = 0.037).

Conclusion: GLP-1a use is correlated with a lower risk of MACE and all-cause mortality in patients undergoing acute dialysis.

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Association Between Ultrafiltration During Cardiac Surgery Requiring Cardiopulmonary Bypass and Acute Kidney Injury

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Introduction:
Acute kidney injury (AKI) is one of the common complications of cardiopulmonary bypass (CPB) procedures. CPB leads to inflammation, bleeding, and hemodilution, which increases the risk of AKI. Euvolemic hemodilution is used to avoid clotting during CPB, and ultrafiltration occurs to maintain volume balance by the end of CPB. This study aimed to assess the association of the weight-adjusted ultrafiltration (UF) volume on the risk of AKI following CPB surgeries.

Methods:
Adult patients (≥ 18 years old) who underwent cardiac surgery with CPB were included in this cohort. These were divided into four groups based on the weight-adjusted UF volume, including 1) no volume removal, 2) 0.1-17.9, 3) 18-29.9, and 4) >30 ml/kg of actual body weight . We collected demographics, laboratory findings, comorbidities, medications, and surgical details. We also explored the association between UF volume and AKI according to Nadir hemoglobin levels and RBC volume transfusion.

Results:
Among 2,369 patients with a median (IQR) age of 65.6 (56-73) years, 840 (35.4%) developed AKI after cardiac surgery. We found a similar incidence of AKI post-CPB in patients with no UF volume, 0.1 – 17.9 and 18.0 – 29.9 ml/kg with 34.4% (N=123), 34.3% (N=387) and 33.7% (N=173) respectively, the patients with UF volume > 30ml/kg had a higher incidence rate of 42.7% (N=157). Increased weight-adjusted UF volume(ml/Kg) was found to be significantly associated with AKI with an odds ratio (OR) of 1.12 (95% CI: 1.06, 1.17, P < 0.001). After adjusting for covariates, the association remained significant with an OR of 1.14 (95% CI: 1.07, 1.20, P < 0.001). Higher UF was also associated with an increased risk of AKI in patients with nadir hemoglobin levels of 6-8 g/dL (adjusted OR:1.24 and 1.22, P .02). UF at higher nadir hemoglobin (10-12 g/dl) showed no significant association with AKI. UF with lower RBC volume transfusion (≤330ml) requirements was associated with AKI. There was no association between UF and AKI among patients with a higher RBC volume transfusion.

Conclusions:
This study underscores the importance of carefully considering ultrafiltration strategies during cardiac surgeries to potentially mitigate the risk of AKI. Even after adjusting for covariates, the association between higher ultrafiltration and AKI risk warrants continued research and optimizing techniques to improve patient safety.

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Urine Olfactomedin-4 is Associated with Furosemide Responsiveness and Receipt of Kidney Replacement Therapy

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Purpose:
Anticipating who will need kidney replacement therapy (KRT) is an opportunity for prognostic enrichment to facilitate early and appropriate KRT initiation. Furosemide stress test (FST) response can predict KRT receipt and has been integrated into clinical decision support tools, but providers may avoid giving diuretics to hemodynamically unstable patients. Furosemide acts in the Loop of Henle (LOH), so a LOH-specific acute kidney injury (AKI) biomarker may predict furosemide response, without needing to wait for FST. Olfactomedin-4 (OLFM4) is a glycoprotein produced by injured LOH epithelial cells. We hypothesize that urine OLFM4 (uOLFM4) may predict FST response and KRT receipt among patients at risk for severe AKI.

Methods:
From 5/2022 to 11/2023, all patients in a single center pediatric intensive care unit (PICU) were screened with the renal angina index (RAI) within 24 hours of admission. RAI >8 (RAI+) identifies patients at increased risk of KDIGO Stage 2/3 AKI. Urine was collected from lab residuals or bladder catheter waste daily. uOLFM4 levels were measured via enzyme-linked immunosorbent assay. AKI was staged using KDIGO creatinine criteria. To capture clinical FSTs, response was measured in any patient who received a furosemide dose > 0.75 mg/kg. Urine output > 3 mL/kg/hr in the four hours after dosing was considered responsive.

Results:
127 RAI+ patients provided 294 samples for uOLFM4 measurement. 52 patients underwent 147 FSTs (median day 2; IQR 1-4), yet only 33% of FSTs were performed in the first 48h. 29 patients received KRT. uOLFM4 was increased in patients who failed FST on day of sampling ($p<0.01$, AUC 0.70, 95% CI 0.57 – 0.84; Fig. 1a) and 24h after sampling ($p<0.01$, AUC 0.72, 95% CI 0.57 – 0.85: Fig. 1b). uOLFM4 603 ng/mL had 52% sensitivity, 78% specificity to predict FST 24h after sampling (Youden Index 0.32). uOLFM4 increased with AKI severity and KRT ($p <0.01$; Fig. 1c). First 48h uOLFM4 was higher in patients who received KRT within 7 days ($p <0.0001$; Fig. 1d) and had fair predictive performance for KRT (AUC 0.71; 95% CI 0.61 – 0.81). uOLFM4 of 603 ng/mL had 54% sensitivity, 78% specificity to predict KRT receipt (Youden Index 0.3).

Conclusions:
Urine OLFM4 in the first 48h of PICU admission is associated with FST responsiveness and receipt of KRT among RAI+ patients. We suggest uOLFM4 may provide an earlier assessment of ultimate diuretic responsiveness and lead to earlier KRT initiation in the appropriate patient.

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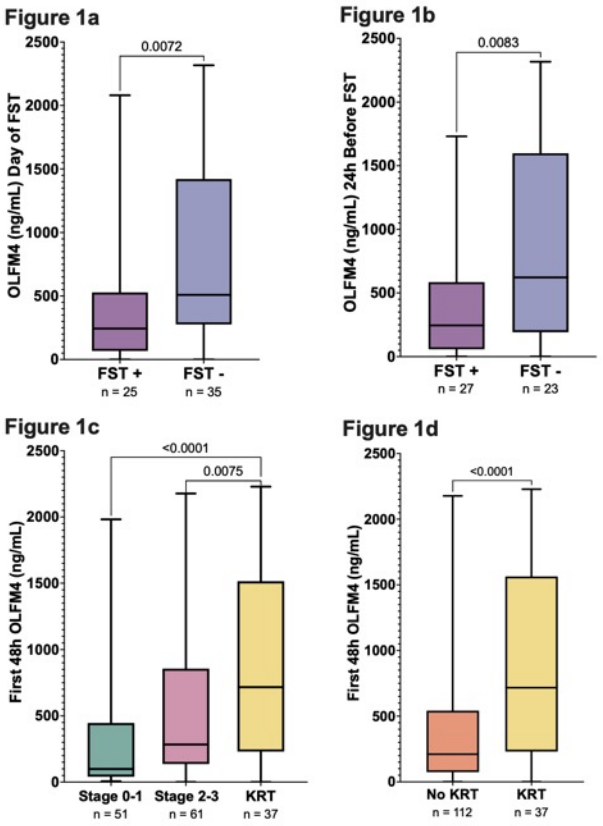

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Abnormal Polyunsaturated Fatty Acid Metabolism is Associated with a Phenotype with Marked Sepsis-Associated Acute Kidney Injury in Pediatric Sepsis

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Background: Pediatric sepsis has overall lower mortality than adult patients, but still a sizeable proportion of children die with progressive multiorgan failure. Preclinical and observational evidence show that modulation of linoleic acid (LA) metabolism, the major omega-6 polyunsaturated fatty acid in diet, influence inflammation. The first step in its metabolism and the rate limiting enzyme is delta-6-desaturase (D6D). LA metabolism has not yet been studied in human sepsis.
Sepsis-associated acute kidney injury (AKI) is characterized by abnormal energy metabolism, with animal models suggesting that functional recovery and survival is at least in part dependent on restoring the capacity of renal tubular epithelial cells to use fatty acid oxidation.

Aims: To study the association between metabolites of LA and AKI in pediatric sepsis.
Methods: We utilized ultra-performance liquid chromatography to analyze untargeted metabolomics in a cohort of 107 children with sepsis. We categorized sepsis phenotypes as previously described into phenotypes A-D. We built a heat map featuring comparisons between pairs of phenotypes. For this study we focused on the polyunsaturated fatty acid metabolic pathways.

Results: Phenotype D group showed higher incidence of AKI with creatinine increase between 2.60 and 3.47-fold

compared with other phenotypes at 24h of admission to intensive care unit ($p < 0.05$). We found that LA was not significantly different in phenotype D compared with others. Conversely, arachidonic acid (AA) was lower in phenotype D compared with phenotypes A-C, with statistically significant difference when compared with phenotype C, along with lower AA metabolites such as 5-HETE. Metabolites of LA, both via non-enzymatic pathway (13-HODE, 9-HODE), and through CYP450 (12,13-DiHOME, 9,10-DiHOME) were significantly increased in phenotype D.

Conclusions: AKI is markedly increased in patients with pediatric sepsis phenotype D. While phenotype D showed no significant changes in LA levels, LA inflammatory metabolites were increased, and AA was decreased along with its metabolites. This constellation could be explained by overactivation of D6D with possibly inhibition of delta-5-desaturase (D5D). In summary, children with sepsis with phenotype D, a group with increase in AKI and mortality, showed polyunsaturated fatty acid metabolism abnormalities suggesting hyperactivation of an inflammatory pathway of LA metabolites independent of AA.

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Early Compartmentalization of Acute Kidney Injury Using a Point of Care Kidney Evaluation Routine (POCKER)

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Introduction: Acute kidney injury (AKI) has high morbidity and mortality. Timely etiological diagnosis is essential for early therapeutics. The traditional approach requires extension studies and therapeutic tests that can delay diagnosis for several hours.
Objective: Develop a diagnostic tool performed at the bedside that can compartmentalize AKI quickly and effectively.

Methodology: All acute kidney injury consultations from September 2022 to September 2023 of one center were prospectively included. Patients with chronic kidney disease and transplant recipients were excluded. At the time of the consultation, a bedside evaluation was performed that included:

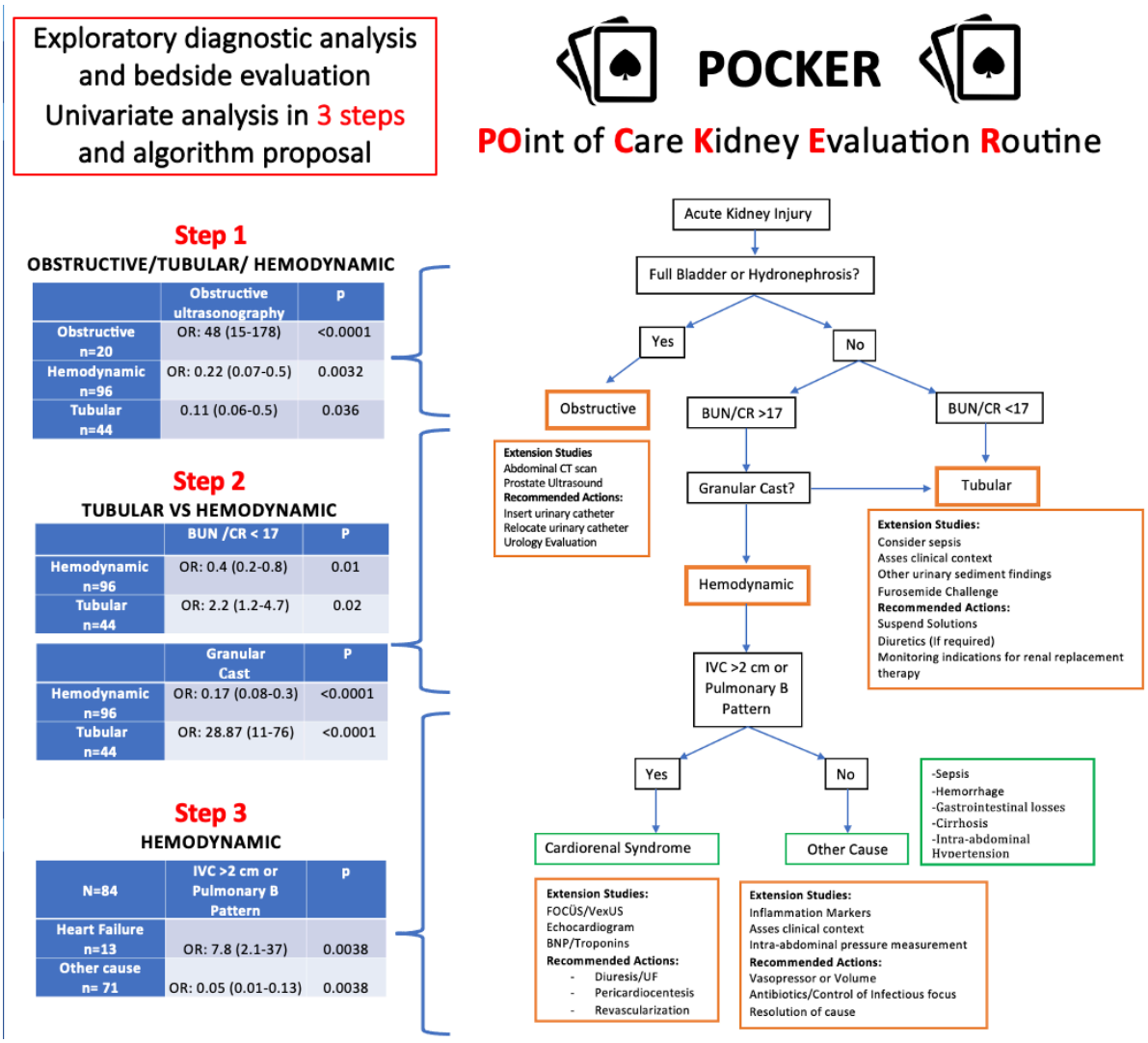
1. Ultrasonography: bladder, kidney, inferior vena cava and lung.
2. Urinary sediment dichotomized for presence or absence of granular cast.
3. BUN/Creatinine ratio, mean arterial tension and pulse pressure.

All patients received the conventional evaluation according to the treating physician in charge, at the end of their AKI event, a consensus was reached between 3 nephrologists on the compartmental and etiological diagnosis: (hemodynamic, tubular or obstructive). They were followed for 30 days for clinical outcomes (mortality at initiation of renal replacement therapy, kidney recovery and acute kidney disease (AKD)).The data from the bedside evaluation was evaluated in relation to the 3 diagnostic compartments, and a bedside evaluation algorithm is proposed.

Results: 165 patients were analyzed, 45.45% women, mean age was 57.8 years (± 14.61), 95 (57.58%) had a stage 3 AKI, 96 (58.18%) were diagnosed as hemodynamic, 44 (26.67%) as tubular, and 20 (12.12%) obstructive. At 30 day follow up, 105 (63.6%) recovered kidney function, 17 (10.3%) required renal replacement therapy, 27 (16.3%) had AKD and 44 (26.6%) died, the most prevalent cause was sepsis 57 (34%). In an exploratory analysis of compartments vs. bedside evaluation, the presence of a full bladder or hydronephrosis had OR: 48 (15-178) for obstructive AKI, after

excluding obstructive AKI the presence of granular cast and a BUN/Cr <17 had OR: 28.87 (11-76) and 2.2 (1.2-4.7) respectively for tubular AKI. And when analyzing hemodynamic AKI an IVC >2cm and or pulmonary B pattern had an OR: 7.8 (2.1-37) for cardiorenal syndrome.

Conclusions: Bedside evaluation can quickly and effectively diagnose the compartment of AKI. The "POint of Care Kidney Evaluation Routine" POCKER algorithm is proposed.



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Association between Urine Neutrophil Gelatinase-associated Lipocalin and Proteinuria in Non-Cardiac Postoperative Neonates

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Proteinuria can signify both glomerular damage and nephron tubular damage and is associated with progression of acute kidney injury (AKI) to chronic kidney disease. Urine neutrophil gelatinase associated lipocalin (uNGAL) is associated with AKI in neonates. We aimed to identify if there was an association between proteinuria, microalbuminuria, and uNGAL in neonates following non-cardiac procedures.

Infants admitted to the level IV NICU, <1 year of age, and undergoing non-cardiac surgery were eligible for inclusion and prospectively enrolled. Urine was collected preoperative and at 12, 24, 36, 48, 72 and 96 hours postoperative. Demographic, perioperative, and postoperative data was collected through postoperative day 5. Urine NGAL was analyzed via the uNGAL test (Bioporto, Denmark) along with urine microalbumin, urine protein, and urine creatinine by an automated chemistry analyzer. Proteinuria was defined as a threshold of ≥ 0.8 mg of protein per mg of urine creatinine (uCr) and microalbuminuria was defined as a threshold of ≥ 20 mg of albumin per g of mg uCr. Elevated uNGAL was considered ≥ 150 ng/mL. Statistical analysis between elevated and non-elevated uNGAL subgroups was performed using chi-square, Fisher's exact, Wilcoxon rank-sum test. Analysis with the uNGAL subgroups were additionally examined through linear mixed-effect models.

Nine-one neonates underwent 120 non-cardiac surgical procedures during the study period. There were 39 procedures with elevated urine NGAL postoperative prior to 48 hours. Descriptive statistics of the cohort are provided in Table 1. Proteinuria occurred in 507/609 urine samples and Microalbuminuria occurred in 608/609 urine samples. Median urine protein to uCr ratios (UPC) was higher in the elevated uNGAL sub-group (2.2 mg/mg [IQR: 1.4, 3.4] vs. 1.3 mg/mg [IQR: 0.9, 2.0], $p<0.001$). Median urine microalbumin ratios to uCr (UMC) were also higher in the elevated uNGAL group (251 mg/g [132, 757] vs. 168 mg/g [109, 295], $p=0.001$).

Microalbuminuria and proteinuria occur frequently following non-cardiac surgical procedures. Elevated UPC and UMC concentrations are associated with uNGAL values ≥ 150 ng/dL prior to 48 hours postoperative.

Table on following page

Characteristics	Total Number N=120	uNGAL concentration (ng/mL) < 150 N=81	uNGAL concentration (ng/mL) ≥150 N=39	p value
Demographic & Preoperative				
Female Sex (%)	65 (54%)	40 (49%)	25 (64%)	0.19
Race (%)				0.03
Asian	1 (1%)	1 (1%)	0 (0%)	
Black	29 (24%)	15 (19%)	14 (36%)	
White	78 (65%)	59 (73%)	19 (48%)	
More than 1 race	1 (1%)	1 (1%)	0 (0%)	
Unknown/not disclosed	11 (9%)	5 (6%)	6 (15%)	
Ethnicity (%)				0.05
Hispanic or Latino	2 (2%)	2 (2%)	0 (0%)	
Not Hispanic or Latino	111 (93%)	77 (95%)	34 (87%)	
Unknown/not disclosed	7 (6%)	2 (2%)	5 (13%)	
Birth Gestational Age (weeks) [IQR]	33 [26,36]	34 [27, 36]	31 [25, 35]	0.07
Postmenstrual Age (weeks) [IQR]	40 [37, 46]	40 [38, 46]	40 [36, 48]	0.25
Identified preoperative renal anomaly (%)	17 (14%)	10 (12%)	7 (18%)	0.59
Past medical history of AKI (%)	26 (22%)	12 (15%)	14 (36%)	0.02
Known Patent Ductus Arteriosus(%)	28 (23%)	19 (23%)	9 (23%)	1
Albumin concentration (%)	3.0 [2.6, 3.3]	3.1 [2.8, 3.3]	2.6 [2.5, 3.1]	0.003
Procedural				
Duration of Anesthesia (min) [IQR]	227 [168, 276]	219 [161, 271]	241 [179,288]	0.27
Duration of Surgery (min) [IQR]	174 [119,221]	169 [110, 214]	177 [138, 233]	0.25
Emergent Procedure (%)	10 (8%)	2 (2%)	8 (21%)	0.002
Surgical Approach (%)				0.002
Laparotomy	52 (43%)	24 (30%)	28 (72%)	
Thoracotomy	3 (3%)	2 (2%)	1 (3%)	
Laparoscopy	29 (24%)	25 (31%)	4 (10%)	
Thoracoscopy	2 (2%)	2 (2%)	0	
Neurosurgical	7 (6%)	6 (7%)	1 (3%)	
More than 1	5 (4%)	4 (5%)	1 (3%)	
Other	22(18%)	18 (22%)	4 (10%)	
Estimated Blood Loss (mL) [IQR]	2 [0,11]	1 [0, 6]	10 [0, 30]	0.01
Vasopressors Exposure (%)	9 (8%)	5 (6%)	4 (10%)	0.47
Nephrotoxic Medication Exposure (%)	30 (25%)	18 (22%)	12 (31%)	0.43
5% Albumin Recipient (%)	58 (48%)	32 (40%)	26 (67%)	0.009
Packed Red Blood Cell Transfusion (%)	24 (20%)	8 (10%)	16 (41%)	<0.001
Platelet Transfusion (%)	5 (4%)	1 (1%)	4 (10%)	0.04
Total Intraoperative Intake (mL) [IQR]	106 [65, 168]	100 [61,150]	125 [76, 218]	0.06
Postprocedural				
Nephrotoxic Medication Exposure (%)	28 (23%)	19 (23%)	9 (23%)	1
Pressors (%)	6 (5%)	3 (4%)	3 (8%)	0.39
Anchor Weight (kg) [IQR]	3.3 [2,.7, 4.3]	3.4 [2.8, 4.4]	2.9 [2.4, 4.1]	0.04
% Weight Change POD 1 [IQR]	3% [0, 7%]	3% [0,7%]	3 % [0,9]	0.85
% Weight change POD 2 [IQR]	4 % [0, 10%]	3% [0, 8]	7% [2, 13]	0.05
Wt Change ≥ 20% prior to POD 5 (%)	14 (12%)	7 (9%)	7 (18%)	0.22
% Cumulative Net Fluid Balance POD 1 [IQR]	14%[10%, 20%]	13% [10, 17]	19 %[10, 23]	0.01
% Cumulative Net Fluid Balance POD 2[IQR]	17% [13%, 23%]	16%[13, 21]	20% [14, 27]	0.01
Cumulative Net Fluid Balance ≥20% prior to POD 5 (%)	103 (86%)	70 (86%)	33 (85%)	1
Median postoperative serum albumin concentration [IQR]	2.5 [2.3, 2.9]	2.7 [2.4, 3.1]	2.3 [2.1, 2.6]	<0.001

*Abbr: Postoperative day (POD), Interquartile range [IQR]

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Acute Kidney Injury Acknowledge Between Mexican Physicians and Students, Where Are We Standing?

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Acute kidney injury (AKI) is a common pathology, with a high incidence and a high impact when is not early recognized. Even when the definition and importance of an early recognition should be learned in medical school, between the non-nephrologist physicians, there still is a misconception of definition and identification of AKI. The standardization in identification of AKI risks and its approach is important to improve healthcare and perform a precision medicine. The first step is to suspect, then recognize.
We perform a survey where the participants (medical students and physicians from different specialties) access Google Forms via a link. We evaluate physicians knowledge of AKI using 10 questions with 1 correct answer (except for the No. 8, multiple answers):
1. Which of the following classifications is correct to define AKI?
a. KDIGO
2. What is the definition of AKI?
a. Elevation of basal creatinine ≥ 0.3 mg/dl in 48 hrs, elevation of creatinine 1.5 times the known basal value in the last 7 days or a decrease in urine volume < 0.5 ml/kg/hr for 6 hrs.
3. What is considered the first cause of AKI?
a. Hypovolemia
4. Which of the following parameters indicates acute deterioration of renal function?
a. Serum creatinine
5. Which of the following renal replacement therapy (RRT) modalities is used in hemodynamically unstable patients?
a. Continuous renal replacement therapy
6. What is the ideal management of AKI?
a. Correct the underlying disease or cause.
7. Do you consider urinary sediment as a diagnostic tool for AKI?
a. Yes
8. Which of the following are considered risk factors for the development of AKI?
a. Diabetes, hypertension, personal history of CKD, personal history of preeclampsia, personal history of AKI, prematurity at birth
9. How do you define temporality of kidney disease? (AKI, AKD, CKD)
a. AKI 1 - 7, AKD from 7 to 90 and CKD >90 days
10. Which of the following situations warrants urgent RRT?
a. Metabolic acidosis refractory to treatment
Descriptive statistics were used. Results are shown in Table 1.
Those in clinical residency average 8/10 correct answers vs surgical residency 6/10 and students 7/10. 38 (37.6%) of the responders still use RIFLE and AKIN definitions for AKI. Less than half recognize preterm birth as a risk factor.

There is still a gap of knowledge in AKI. It is important to use technology, teamwork, and interdisciplinary educational meetings as opportunities to explore the knowledge around AKI in other medical areas.

Table on following page

RESULTS

101 responders answer our survey, the obtained results are presented in the Table 1.

Variables	*n=101 (%)*	*Students (n=36)*	*Social Service (n=14)*	*Resident in surgical field (n=16)*	*Resident in clinical field (n=31)*	*Graduated physician (n=4)*
Age						
Mean	26.13	23	24	28	28	36
Sex						
Female	53 (52.5)	22 (61.1)	8 (57.1)	10 (62.5)	12 (38.7)	1 (25)
Academic achievement						
Student	36 (35.6)					
*Social Service**	14 (13.9)					
Resident in surgical field	16 (15.8)					
Resident in clinical field	31 (30.7)					
Graduated physician	4 (4)					
Questionnaire results						
1°	56 (55.4)	18 (50)	6 (42.8)	9 (56.2)	21 (67.7)	2 (50)
2°	72 (71.3)	19 (52.7)	8 (57.1)	12 (75)	30 (96.7)	3 (75)
3°	80 (79.2)	22 (61.1)	13 (92.8)	15 (93.7)	27 (87)	4 (100)
4°	91 (90.1)	33 (91.6)	10 (71.4)	14 (87.5)	30 (96.7)	2 (50)
5°	50 (49.5)	12 (33.3)	11 (78.5)	2 (12.5)	23 (74.1)	3 (75)
6°	98 (97)	35 (97.2)	14 (100)	15 (93.7)	31 (100)	2 (50)
7°	57 (56.4)	19 (52.7)	8 (57.1)	7 (43.75)	21 (67.7)	3 (75)
8°						
DM	76 (75.2)	27 (75)	8 (57.1)	12 (75)	25 (80.6)	4 (100)
Hypertension	82 (81.2)	29 (80.5)	12 (85.7)	12 (75)	25 (80.6)	4 (100)
History of CKD	70 (69.3)	25 (69.4)	11 (78.5)	8 (50)	24 (77.4)	3 (75)
History of preeclampsia	52 (51.5)	21 (58.3)	6 (42.8)	7 (43.7)	17 (54.8)	1 (25)
Previous episodes of AKI	90 (89.1)	33 (91.6)	14 (100)	13 (81.2)	28 (90.3)	2 (50)
History of preterm at birth	35 (34.7)	13 (36.1)	6 (42.8)	2 (12.5)	14 (45.1)	1 (25)
9°	74 (73.3)	26 (72.2)	8 (57.1)	10	27 (87)	3 (75)
10°	90 (89.1)	29 (80.5)	13 (92.8)	13	31 (100)	4 (100)

*In Mexico the last year of medical school is called social service.

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Intravenous Gemini for Prevention of Acute Kidney Injury

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Purpose and Background
The purpose of this study was to evaluate Gemini pretreatment in an ischemia reperfusion model of AKI.

Due to its severe nature, AKI represents a significant health problem, especially in patients with co-morbidities such as diabetes. Approximately 1% of all hospitalized patients present with AKI upon admission. Phosphorylated hexaacyl disaccharide (PHAD), the active ingredient in Gemini, is a synthetic small molecule that preconditions the innate immune response via a more selective activation of toll-like receptor 4 (TLR4), characterized by an attenuated pro-inflammatory response relative to traditional TLR4 agonists such as lipopolysaccharide (LPS), while retaining the capacity to engage the innate immune response. We hypothesize that Gemini preconditioning will elicit an attenuated proinflammatory response following ischemic reperfusion (IR).

Methods
Rats were administered vehicle or Gemini intravenously at 0.07 and 0.35mg/kg at 24 and/or 48 hours prior to undergoing bilateral IR to induce acute kidney injury (AKI). A surgical sham group was also included. Blood and urine

was collected pre-dose, and post-surgery at 24 and 72 hours (termination), and serum was assessed for BUN and creatinine levels. Urine was evaluated for c-reactive protein (CRP). Kidneys were evaluated for histological changes at 72 hours.

Results
Pretreatment with Gemini reduced serum BUN, serum creatinine and urine CRP in a dose dependent manner at 24 and 48 hours post-dose with significance at 0.35 mg/kg ($p<0.05$) relative to IR control. A single dose of 0.35mg/kg Gemini also significantly reduced the total degree of acute necrosis in cortical and medullary tubules ($p<0.05$). Neutrophil inflammation was significantly reduced ($p<0.05$) with a single pretreatment of Gemini at 0.35mg/kg.

Conclusion
Pretreatment with Gemini significantly improved kidney function as demonstrated by reductions in BUN, creatinine and CRP, and reduced kidney injury as evident in the reductions in cortical and medullary tubular necrosis. Gemini also reduced AKI-related inflammation attributed to neutrophils in the kidney. These results demonstrate the premise of trained immunity as a means of prevention of AKI. The collective improvement in renal function along with the reductions in cellular necrosis and neutrophilic inflammation demonstrate Gemini pretreatment attenuates the severity of IR AKI.

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Proteinuria is a Risk Factor for Acute Kidney Injury after Cardiac Surgery in Patients with Stage 3-4 Chronic Kidney Disease: A Case-Control Study

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Background: Acute Kidney Injury (AKI) is a common complication after cardiac surgery, and preoperative renal dysfunction is an important risk factor. Proteinuria indicates renal structural damage, but there is less research on the risk of proteinuria and AKI after cardiac surgery in patients with renal dysfunction. This study aims to clarify whether proteinuria can predict AKI after cardiac surgery in patients with renal dysfunction.

Methods: Patients with stage 3-4 Chronic Kidney Disease (CKD) undergoing cardiac surgery were included in this retrospective study. AKI was defined according to KDIGO criteria. The main study was the relationship between proteinuria and AKI in patients with stage 3-4 CKD.

Results: The entirecohort (n=1546) had an AKI incidence of 53.55%. The in-hospital mortality rate of patients with AKI was higher than that of patients without AKI (AKI vs. no AKI, 4.7 vs. 0.8%, P<0.001). Multivariable logistic regression analysis showed that proteinuria is an independent risk factor for AKI (Trace-1+ OR=2.37; 2+-3+ OR=5.16) and AKI requiring renal replacement therapy (Trace-1+ OR=3.64; 2+-3+ OR= 5.71). Mild proteinuria (Trace-1+ OR=2.59) is also an independent risk factor for in-hospital mortality. In diabetic patients, mild proteinuria (OR=1.925) rather than severe proteinuria (2+-3+) is a risk factor for AKI in patients with renal dysfunction and diabetes.

Conclusion: In populations with renal dysfunction, the incidence of AKI is high, which seriously affects renal function and overall prognosis. Preoperative proteinuria, as a simple and inexpensive routine examination, still has value in predicting AKI in patients with impaired renal function.

RRT TECHNIQUE CHARACTERISTICS

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Comparison of Filter Lifetime Between Hypertonic versus Isotonic Regional Citrate Anticoagulation During Continuous Kidney Replacement Therapy

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Background: Regional citrate anticoagulation (RCA) is the standard anticoagulant in continuous kidney replacement therapy (CKRT). Owing to current evidence, there is no data showing the difference of isotonic and hypertonic citrate in terms of CKRT circuit survival
Objectives: To study the difference of filter life time between hypertonic and isotonic regional citrate anticoagulation (RCA).

Methods: This is a single center retrospective cohort study of patients receiving CKRT at King Chulalongkorn Memorial Hospital, Thailand, between February 2023 to September 2023. Primary outcome was filter lifetime and secondary outcomes were circuit ionized calcium, citrate doses, blood transfusion and other factors that might affect clotting.

Results: One hundred ninety nine filters were evaluated in this study, 98 filters in hypertonic group and 101 filters in isotonic group. Baseline characteristics and clinical outcomes were well balanced between groups, except for the underlying ESRD was higher in hypertonic RCA. The filter lifetimes were significantly longer in hypertonic group (median of 72 hours (IQR 45-72) vs. 52 hours (IQR 28-72), p-value <0.001). The Kaplan-Meier plot showed similar results with significant difference with Log-rank test of p <0.001. Univariate analysis indicated that isotonic RCA, CKRT prescriptions, sieving coefficient, circuit ionized calcium and citrate doses were related to circuit clotting. However, when adjusted these factors in multivariate analysis, isotonic RCA (adjusted HR 2.42 (1.1-5.28), p = 0.026), citrate doses (adjusted HR 0.47 (0.32-0.70), p <0.001) and circuit ionized calcium (adjusted HR 0.38 (0.22-0.66), p = 0.001) were statistically related to premature clots.

Conclusion: Hypertonic RCA had a significant longer filter lifetime compared to isotonic RCA. However, more data on a well-constructed randomized controlled trial is needed to confirm these findings.

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Outcomes of Continuous Renal Replacement Therapy Versus Peritoneal Dialysis as a Renal Replacement Therapy Modality in Patients Undergoing Extracorporeal Membrane Oxygenation

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Background:
Among patients undergoing extracorporeal membrane oxygenation (ECMO) support, acute kidney injury (AKI) emerges as a prevalent complication and typically leads to renal replacement therapy (RRT). Given the hemodynamically unstable nature of ECMO-supported patients, continuous renal replacement therapy (CRRT) and peritoneal dialysis (PD) appear as suitable RRT modalities. This study aimed to evaluate and compare the outcomes of patients on ECMO who receive these distinct modes of RRT.

Methods:
We conducted a single-center retrospective cohort study from February 2018 to October 2023 among ECMO-supported patients who developed AKI and subsequently required RRT at the Central Chest Institute of Thailand. The patient cohort was categorized into two groups based on the RRT modality employed: CRRT and PD. Patient profiles and outcomes, including hospital mortality, length of stays, RRT and ECMO durations, and RRT complications, were analyzed and compared.

Results:
A total of 43 patients, consisting of 21 treated with CRRT and 22 with PD during ECMO therapy, were included in the study. There was no statistically significant difference in in-hospital mortality rates between the two groups (80.9% in CRRT vs 90.9% in PD, $p = 0.35$). ICU and hospital lengths of stay were no difference. However, CRRT exhibited a significantly shorter median RRT duration compared to PD (4 days vs. 7.5 days, $p = 0.0007$) and demonstrated a markedly lower rate of catheter malposition (4.7% vs. 31.8%, $p = 0.046$). The rates of catheter infection and catheter site bleeding were not statistically significant (4.7% in CRRT vs. 22.7% in PD, $p = 0.19$, and 9.5% in CRRT vs. 18.2% in PD, $p = 0.66$, respectively). Additionally, circuit clotting was observed in 38.1% of CRRT patients, while the incidence of PD leakage was 22.7%. The occurrences of refractory hyperkalemia and refractory metabolic acidosis demonstrated no significant differences between CRRT and PD (4.7% vs. 27.3% and 9.5% vs. 9.1%, $p = 0.10$, 0.61, respectively).

Conclusion:
Among ECMO-supported patients receiving RRT, there was no difference between CRRT and PD in terms of in-hospital mortality and hospital length of stay. However, PD did exhibit a higher incidence of catheter-related complications.

Table on following page

	CRRT (N=21)	PD (N=22)	p-value
In-hospital mortality, n (%)	17 (80.9)	20 (90.9)	0.35
Hospital lengths of stay, days	18 (9,28)	24.5 (18,31)	0.22
RRT durations, days	4 (3,5)	7.5 (5,14)	0.0007
Complications, n (%)			
Catheter infection	1 (4.7)	5 (22.7)	0.19
Catheter malposition	1 (4.7)	7 (31.8)	0.046
Catheter site bleeding	2 (9.5)	4 (18.2)	0.66
PD leakage	0 (0)	5 (22.7)	0.048
Circuit clot	8 (38.1)	0 (0)	0.034
Refractory hyperkalemia	1 (4.7)	6 (27.3)	0.10
Refractory metabolic acidosis	2 (9.5)	2 (9.1)	0.61

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Acute Renal Replacement Therapy In Pediatric Patients: A National Survey Assessing Programmatic Delivery of Care

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Background: Advances in pediatric renal replacement therapy (RRT) technology, along with the challenges of providing multidisciplinary care for medically complex patients, have led to an increased need for critical care nephrology expertise and support across pediatric, neonatal, and cardiac intensive care units (ICUs). In response to these growing needs, individual children’s hospitals have implemented Acute Care Nephrology (ACN) programs to improve the delivery of safe, timely, and effective evidence-based care for children with AKI and other non-renal conditions that can benefit from RRT.

Objective: Given inherent variations in practices, resources, and RRT modalities from physician, nursing, and infrastructure perspectives, we aimed to evaluate current practices of ACN programs across the United States (US).

Methods: An electronic survey was distributed to the top 50 pediatric nephrology programs from the US News & World Report Best Children's Hospitals 2023 ranking. Questions included details of programmatic structure, therapies provided, volume of procedures, quality improvement (QI), and educational practices.

Results: 47 centers (94%) completed the survey (Table 1 results by center volume). Overall, 79% of respondents have a dedicated ACN program, with 53% jointly managed within their chronic dialysis program. 68% have a medical director with a median (IQR) full time equivalent (FTE) of 10% (5, 20%), though 13% (6 programs) report 0 FTE. Only 45%

have an ACN nursing director. Other available personnel include nurse educator (53%), program administrator (17%), advanced practice provider (13%), and QI specialist (21%). ACN focused QI programs are present in only 40%, with an additional 34% of centers collecting some metrics related to patients, circuits, and access, while 36% do not track any data. The most common barriers for implementing QI programs include lack of protected time, resources, and support from leadership. Despite variability in program size, structure, and modalities offered, 81% of responding centers identified a need for increased medical director FTE, and 90% identified a need for increased nursing director FTE.

Conclusions: This data provides a first-of-its-kind description of the current structure/delivery of care in pediatric ACN practices from hospitals across the US and identifies potential areas for systematic improvement in the delivery, monitoring, and comprehensive approach to pediatric acute RRT.

Table 1. Survey responses from hospitals across the US by patient volume (i.e., estimated CRRT patient days per year).

Estimated patient volume [avg. CRRT patient days per year]	< 250	250-499	500-749	750-999	>1000
Number of survey respondents by volume [%, (number of programs)]	19% (9)	30% (14)	21% (10)	9% (4)	17% (8)
Have an established ACN program	66% (6)	64% (9)	100% (10)	100% (4)	75% (6)
ACN is part of chronic dialysis	55% (5)	64% (9)	50% (5)	25% (1)	37.5% (3)
Have a medical director	33% (3)	71% (10)	70% (7)	100% (4)	88% (7)
Current % FTE for medical director [Median; (IQR)]	20% (12.5; 22.5)	6% (0; 13.75)	10% (7.5; 10)	12.5% (7.5; 17.5)	15% (10; 20)
Needed % FTE requested for medical director [Median; (IQR)]	21% (10; 25)	20% (15; 25)	22.5% (16.3; 32.3)	17.5% (13.8; 21.3)	20% (17.5; 26.3)
Have a nursing director	22% (2)	35% (5)	40% (4)	100% (4)	63% (5)
Current % FTE for nursing director [Median; (IQR)]	10% (5; 15)	50% (5; 100)	45% (36.3; 60)	28.5% (25.3; 47.5)	40% (20; 40)
Needed % FTE for nursing director [Median; (IQR)]	20% (20; 25)	50% (20; 50)	27.5% (25; 50)	50% (43.7; 62.5)	50% (23.8; 62.3)
Have a dedicated APP	0	14% (2)	0	25% (1)	37.5% (3)
Have a nurse educator	33% (3)	42% (6)	90% (9)	75% (3)	37.5% (3)
Have a program administrator	0	21% (3)	10% (1)	25% (1)	25% (2)
Have a dedicated pharmacist	33% (3)	21% (3)	20% (2)	50% (2)	75% (6)
Have a QI leader	0	29% (4)	30% (3)	25% (1)	25% (2)
Have a QI program	22% (2)	29% (4)	50% (5)	75% (3)	62.5% (5)
Have dedicated ACN nurse(s)	11% (1)	7% (1)	10% (1)	75% (3)	62.5% (5)
Perform CRRT in the NICU	22% (2)	71% (10)	90% (9)	75% (3)	75% (6)
Perform CRRT in the CICU	66% (6)	100% (14)	100% (10)	100% (4)	100% (8)
Perform CRRT via Carpediem	55% (5)	35% (5)	40% (4)	50% (2)	62.5% (5)
Perform ultrafiltration via Aquadex	33% (3)	35% (5)	10% (1)	75% (3)	50% (4)
Perform CRRT via Aquadex with mCVVH	0	29% (4)	10% (1)	75% (3)	50% (4)
Perform MARS	11% (1)	7% (1)	0	25% (1)	12.5% (1)
Plasmapheresis is managed by nephrology	0	35% (5)	30% (3)	25% (1)	88% (7)
LDL apheresis is managed by nephrology	11% (1)	7% (1)	10% (1)	25% (1)	25% (2)

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The Use of Arteriovenous Fistula and Arteriovenous Graft in Critically Ill End-stage Kidney Disease Patients for Continuous Renal Replacement Therapy

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Purpose of the Study
We aim to demonstrate the safety of using arteriovenous fistula (AVF)/arteriovenous graft (AVG) for continuous renal replacement therapy (CRRT) in critically ill end-stage kidney disease (ESKD) patients using 16-gauge angiocaths. There is a lack of studies characterizing the safety profile using functional vascular access in critically ill ESKD patients. If this technique is validated it would provide nephrologists another option for access in ESKD patients requiring CRRT. With the training of both the dialysis and ICU nursing staff, this intervention has the potential to avoid temporary dialysis catheter placement which is potentially associated with multiple complications in ESKD patients and shortening time to CRRT initiation.

Methods
A retrospective single-center study in a large tertiary care hospital where this procedure was performed in 50 patients who were 18 years or older, ESKD on maintenance hemodialysis (HD) with functional AVF/AVG who required CRRT ranging from 2012 to 2019. The AVF/AVG was accessed using 16-gauge angiocaths and changed every 72 hours with M100 filter. This excluded ESKD patients on HD via a tunneled catheter or peritoneal dialysis (PD). Data collected from medical charts included demographics, duration and characteristics on CRRT and AVF/AVG complications if any. Based on the analysis criteria, 35 out of 50 of the patients matched the parameters to be included for analysis.

Results
The patient population consisted of 23 males (65.7%) and 12 females (34.3%) with a mean age of 66 years old. The average length of time on CRRT was 3.8 ± 3.9 days with AV fistula used in 85.7% and AV grafts in 14.3% of patients. The blood flow rate ranged between 150 to 200 and anticoagulation was required for 17 patients (48.6%). Complications did not occur in 71.4% (25) of patients but in the remaining, the most common adverse events were clotting (11.4%), bleeding (2.86%), or inability to cannulate (8.6%).

Conclusions
Our study has shown that using AVF/AVG in critically ill ESKD patients has little to no adverse events. There were minor vascular access complications caused by using AVF/AVG for CRRT, however, they did not contribute negatively to patient outcomes. This technique has the potential to provide faster and safer access to initiating CRRT in ESKD patients. To evaluate the safety, benefits, and outcomes, further research is needed to compare temporary dialysis catheters versus AVF/AVG for CRRT.

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In vitro Testing of the Accuracy of Electrolyte Correction in Blood Priming on the Aquadex machine

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Introduction: Newer filters and devices for continuous renal replacement therapy (CRRT) have reduced the need for blood primes in smaller patients. With these new devices, the need for blood priming remains an important part of any institution's program. The optimal method for treating packed red blood cells (PRBC) to present a more homeostatic product has not been determined.

Methods: We sought to test our blood prime protocol. Our current guidelines require a 1:1 ratio of bicarbonate mixture (15 mEq of NaHCO3 (150 mEq/L) with 85 mL sterile water) and PRBC of the same volume. The patient, upon initiation, is given 100 g or 300 g of calcium gluconate (100 mg/mL), depending on the extracorporeal volume of the circuit. We tested our blood prime in-vitro, using a sterile bag to mimic the circuit. We had six scenarios based on the bicarbonate mixture and calcium dose. We used 20 mL volumes of both bicarbonate mixture and PRBC (baseline, 125%, 150%) with 1 mL and then 0.6 mL of calcium gluconate. Arterial blood gas testing was performed on PRBCs alone (Gas 1), the bicarbonate/PRBC mixture after five minutes (Gas 2), and the addition of calcium (Gas 3). Four different PRBC units were used. We evaluated four laboratory values: pH, calcium, sodium, and potassium.

Results: We had a total of 84 blood gases. Gas 1 showed a pH (IQR) of 6.6 (6.6,6.6), calcium 0.16 mmol/L (0.16,0.16), sodium 80 mEq/L (79,92), and potassium 14 mEq/L (14,14). Gas 2, at varying bicarbonate mixture-to-PRBC ratios (1:1, 1.25:1 and 1.5:1) showed an increase in pH (7.13 (7.09,7.23); 7.22 (7.19,7.23); 7.33 (7.32,7.44)) ($p<0.01$); no change in calcium (0.16 (0.16,0.16)) ($p=1$); increase in sodium (124.5 (123.5,148.5); 145 (136,153); 179 (179,179)) ($p<0.01$), and decrease in potassium (14 (14,14); 14 (13.65,14); 9.9 (9.7,13.5)) ($p<0.01$). Gas 3, at two different calcium doses (0.6 mL and 1 mL) showed no significant change in pH (7.22 (7.2,7.46); 7.19 (7.11,7.26)) ($p=0.11$); a change in the distribution for calcium (1.85 (1.22,1.85); 1.85 (1.85,1.85)) ($p<0.01$); no significant change in sodium (148 (134,166); 143 (117,179)) ($p=0.46$); and no significant change in potassium (14 (12.05,14); 14 (9.4,14)) ($p=0.9$).

Conclusion: To improve acidosis, increasing sodium bicarbonate can be effective. However, hypernatremia can be a potential issue. To correct hypocalcemia, a smaller dose of calcium can be used. Hyperkalemia remains an issue. Additional testing is needed to modify our protocol.

Table 1: Labs and blood gases at each bicarbonate mixture and calcium scenario

		0.6 mL CaGluc (100 mg/mL)				1 mL CaGluc (100 mg/mL)			
Variable	Gas	1:1 (Bicarb:PRBC)	1.25:1 (Bicarb:PRBC)	1.5:1 (Bicarb:PRBC)	p-value	1:1 (Bicarb:PRBC)	1.25:1 (Bicarb:PRBC)	1.5:1 (Bicarb:PRBC)	p-value
pH	1	6.6	6.6	6.6	1	6.6	6.6	6.6	1
	2	7.13 (6.6,7.22)	7.21 (6.6,7.23)	7.41 (6.6,7.47)	0.23	7.09 (6.6,7.11)	7.18 (6.6,7.2)	7.29 (6.6,7.32)	**0.03**
	3	7.2 (7.12,7.23)	7.21 (7.21,7.26)	7.44 (7.4,7.47)	**0.03**	7.11 (7.09,7.13)	7.19 (7.14,7.2)	7.3 (7.26,7.37)	**<0.01**
Calcium (mmol/L)	1	0.16	0.16	0.16	1	0.16	0.16	0.16	1
	2	0.16 (0.16,0.19)	0.16 (0.16,1.45)	0.16 (0.16,0.8)	0.82	0.16 (0.16,1.85)	0.16 (0.16,1.85)	0.16 (0.16,1.85)	1
	3	1.85 (1.85,1.85)	1.85 (1.37,1.85)	0.99 (0.61,1.15)	**0.01**	1.85 (1.85,1.85)	1.85 (1.85,1.85)	1.85 (1.85,1.85)	1
Sodium (mEq/L)	1	80 (79-80)	92 (80,93.5)	94 (93,95)	**0.02**	92 (92,92.5)	80 (79.5,80.5)	77 (77,77)	**<0.01**
	2	122 (80,150)	135 (93,153.8)	179 (94.5,179)	0.16	117 (92,124)	125 (80,145)	179 (77,179)	0.17
	3	141 (119,151.5)	135 (134,149)	179 (179,179)	**0.04**	117 (114,118)	143 (112.5,144.5)	179 (179,179)	**<0.01**
Potassium (mEq/L)	1	14 (14,14)	14 (14,14)	14 (14,14)	1	14 (14,14)	14 (14,14)	14 (14,14)	1
	2	14 (14,14)	14 (12.6,14)	12.8 (11.7,14)	**<0.01**	14 (14.14)	14 (14,14)	9.7 (9.4,14)	**<0.01**
	3	14 (14,14)	12.6 (12.1,14)	11.6 (11.4,12)	**<0.01**	14 (14,14)	14 (14,14)	9.3 (9.3,9.45)	**<0.01**

Gas 1: baseline blood gas on PRBC; Gas 2: blood gas after adding bicarbonate mixture; Gas 3: blood gas after adding calcium gluconate; Bicarb: bicarbonate mixture; PRBC: packed red blood cells; CaGluc: calcium gluconate

All values are reported as a median with IQR. P-values represent Wilcoxon signed rank for continuous variables

RRT APPLICATIONS AND TARGETED INTERVENTION

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Meropenem dosing recommendations in critically ill patients receiving prolonged intermittent renal replacement therapy.

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Background: Meropenem is a carbapenem antibiotic that has been used for managing critically ill patients with severe infections. Acute kidney injury is one of the most common complications of sepsis for which clinicians utilize prolonged intermittent renal replacement therapy (PIRRT) to remove excess fluid and metabolic waste products. Meropenem can be removed via PIRRT due to its pharmacokinetics (PK). Unfortunately, PK studies of meropenem in patients undergoing PIRRT therapy are limited. There is no standard meropenem dosing recommendation that existed for these patients. Our study aimed to evaluate the probability of target attainment (PTA) of various meropenem regimens in critically ill patients receiving PIRRT utilizing Monte Carlo simulation (MCS)

Methods: Mathematical models with first order elimination were created using published demographic and pharmacokinetics in adult critically ill patients. Different daily PIRRT with dialysis technique and effluent rate of 18L/h with various PIRRT duration of 4, 6, 8, 10 h were performed in the models. Early and late PIRRT occurred at the beginning of and 14-20 h after drug administration were simulated. MCS predicted drug disposition during the first 48 h in 10,000 virtual patients for each drug regimen. Desired pharmacodynamic target to calculate PTA was 40% of free drug concentration that exceeds 4 times of the MIC of 2 mg/L. The optimal dosing regimens were defined as the ones reached 90% of PTA in all PIRRT settings.

Results: All recommended meropenem dosing regimens in the clinical resources were evaluated for PTA in our models. Interestingly, some dosing suggestions achieved less than 90% of the PTA target. For early PIRRT with duration less than or equal 6 h, the regimen of 500 mg q 8 h with supplemental dose of 500 mg after PIRRT is recommended while PIRRT duration of more than 6 h requires a dose of 750 mg q 12 h with a supplemental dose of 500-750 mg after PIRRT. Additionally, the dosing regimen of 1000 mg loading dose, then 500 mg q 8 h is recommended for late PIRRT duration less than or equal 6 h. For late PIRRT of 8 and 10 h, the recommended doses should be 1000 mg q 12 h and 750 mg q 8 h, respectively.

Conclusion: Previous recommended meropenem dosing regimens could not attain the PTA target. The dosing regimens should be considered based on PIRRT characteristics such as duration of treatment and time to commence PIRRT. Clinical validation is needed to confirm the results of our study.

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Assessing the delivery of prescribed clearance in pediatric ECMO patients <20 kilograms requiring CRRT through in-line hemofiltration

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Introduction: Extracorporeal Membrane Oxygenation (ECMO) in neonates and children is a necessary therapy for several disease processes. Acute kidney injury (AKI) is prominent in the pediatric ECMO population worldwide, estimated at 40-61% (1), because ECMO can induce AKI, increasing the likelihood of hypoperfusion from persistent fluid shifts and endothelial damage due to hemolyzed red cells produced by the ECMO circuit. This often necessitates the implementation of continuous renal replacement therapy (CRRT). In 2016, in all intensive care units at Children's of Alabama, we implemented continuous venoarterial or venovenous hemodialysis (CVAHD/CVVHD) with ultrafiltration using the hemofilter in the ECMO circuit for patients <20kg. Our goal was to streamline procedure and mitigate the risks associated with increasing extracorporeal volume when a CRRT machine is incorporated into the ECMO circuit.

Methods: This is a retrospective chart review of pediatric patients weighing <20 kg on ECMO who required CRRT. Patients were initiated on CVAHD or CVVHD via the hemofilter (Minntech HPH400, Medcomp, Minneapolis, MN), which is placed post-oxygenator returning to the venous side of the ECMO circuit at the level of the bridge. The analysis encompasses comparative demographics, patient diagnoses, CRRT modalities, and survival. Appropriate delivery of clearance and fluid removal is defined as successfully delivering the prescribed amount of clearance and meeting fluid removal goals with the Alaris pump, which has a maximum volume rate of 999mL/hr. Patients at COA with AKI or chronic kidney disease are prescribed 24mL/kg/hr of clearance across all continuous modalities to start.

Results: Of the 441 subjects who have undergone ECMO at COA between 2014 and 2022, 98 (22%) required CRRT. 71 were <20kg and received CRRT via in-line hemofilter. Two patients required a conversion to a CRRT machine for reasons unrelated to clearance. The remainder of the patients successfully received prescribed clearance and fluid removal on CVAHD/CVVHD through the hemofilter for the entirety of their CRRT/ECMO course.

Conclusion: Our findings indicate that patients <20kg on ECMO who need CRRT can achieve prescribed clearance and fluid removal goals with CVAHD/CVVHD through the ECMO in-line hemofilter. Notably, this strategy obviates the need for a CRRT machine, eliminating the complexities associated with additional machinery and extracorporeal volume in this smaller patient population.

Table on following page

Table 1. ECMO patients at COA since 2014

	ECMO w/ external CRRT machine N = 27	ECMO w/ in-line filter N = 71
Patient ECMO runs	27(27.8%) Prismaflex – 16 (59.3%) Prismax – 11 (40.7%)	71 (73.2%)
Patient days Average (SD) Median (IQR)	 12.3 (10.6)) 8.0 (5.5, 16))	 9.2 (10.6) 7 (4.5, 14.5)
Patient age (years) Average (SD) Median (IQR)	 12.2 (6.0) 14.3 (7.8, 16.5)	 0.44 (160 days) (0.77) 0.04 (17 days) (0.02, 0.75)
Patient weight (kg) Average Median	 62.0 (29.3) 61.2 (41.4, 77.6)	 5.5 (3.8) 4.11 (3.5, 8.1)
Chronic Diagnosis *Cardiac *Endocrine *Genetic *GI *Hematology/Oncology *Neurology *Psychology *Pulmonary *Renal/Urology *Rheumatology *Skeletal/muscular *No chronic diagnosis	 0 1 (3.7%) 4 (14.8%) 1(3.7%) 5 (18.5%) 1 (3.7%) 0 0 2 (7.4%) 1 (3.7%) 1 (3.7%) 11 (40.7%)	 14 (19.7%) 1 (1.4%) 6 (8.4%) 0 2 (2.8%) 0 1 (1.4%) 18 (25.4%) 9 (12.7%) 0 1 (1.4%) 19 (27.1%)
Diagnosis leading to ECMO *Congenital and acquired cardiac abnormalities * Congenital diaphragmatic hernia *Multiorgan failure due to infectious reason *Respiratory failure/pulmonary hypertension *Other	 4 (14.8%) 0 19 (70.4%) 4 (14.8%) 0	 16(22.5%) 15 (21.1%) 19 (26.8%) 21 (29.6%) 2 (2.8%)
Reason for CRRT *Ammonia *Electrolytes *Fluid provision *Fluid overload *Ingestion *Peritoneal dialysis failure *Rhabdomyolysis *Tumor lysis *Uremia *Unknown	 0 7 (25.9%) 1 (3.7%) 12 (44.4%) 2 (7.4%) 2 (7.4%) 1 (3.7%) 0 0 2 (7.4%)	 1 (1.4%) 31 (43.7%) 8 (11.3%) 18 (25.4%) 0 3 (4.2%) 1 (1.4%) 0 9 (12.7%) 0
Location *CVICU *NICU *PICU	 4 (14.8%) 1 (3.7%) 22 (81.5%)	 19 (26.7%) 42 (59.2%) 10 (14.1%)
Survival?	14 (51.9%)	23 (32.4%)

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Anticoagulation Practices in Patients Requiring Aquapheresis in a Pediatric Cardiac Intensive Care Unit

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BACKGROUND
Patients on Aquapheresis require anticoagulation to maintain patency of the circuit and filter. The standard practice for patients receiving Aquapheresis is Heparin anticoagulation. Bivalirudin has been shown to have lower risk of bleeding and thrombotic events, with shorter time to reach partial thromboplastin time (PTT) goal levels for patients on extracorporeal membrane oxygenation (ECMO) or with ventricular assisted devices (VAD). At our institution in the cardiothoracic intensive care unit, the anticoagulation of choice for patients on ECMO or with VADs is Bivalirudin. Although Heparin is the anticoagulation modality for Aquapheresis, when patients had therapeutic Bivalirudin anticoagulation at time of Aquapheresis initiation, we continued Bivalirudin anticoagulation for Aquapheresis therapy. In this study we aim to investigate the safety and feasibility of utilizing Bivalirudin as anticoagulation compared to Heparin in patients requiring Aquapheresis.

METHODS
Patients receiving Aquapheresis in the cardiothoracic intensive care unit were reviewed retrospectively. We collected clinical data and investigated the factors affecting circuit duration, clotting, and bleeding events in patients treated with Heparin vs. Bivalirudin while on Aquapheresis.

RESULTS
A total of twelve patients were included, ranging from 9 days old to 37 years old. Indications for Aquapheresis were severe acute kidney injury and/or fluid overload. Nine patients were anticoagulated with Heparin, and three patients were anticoagulated with Bivalirudin. There were 27 circuits reviewed among the twelve patients. In the Bivalirudin group there were no systemic clotting or bleeding events. There was one clotting event with superior vena cava (SVC) thrombosis in the heparin group and no bleeding events. There was no significant difference between circuit hours when using Bivalirudin vs. Heparin for anticoagulation (mean 41.38 vs. 36.7 hours respectively). There was a significant reduction in hours required to reach therapeutic levels in patients receiving Bivalirudin compared to heparin (mean 4 vs. 13.46 hours, $p = 0.02$)

CONCLUSIONS
Our results suggest that Bivalirudin anticoagulation achieves therapeutic levels faster and is not inferior to Heparin anticoagulation for Aquapheresis therapy. Our study is retrospective and has very limited sample size, however, it highlights the potential benefit of Bivalirudin anticoagulation that needs further evaluation.

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Risk factors for severe thrombocytopenia during continuous kidney replacement therapy in neonate

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Background : In infants, kidney replacement therapy (KRT) is rarely performed, in patients with acute or chronic kidney injury or metabolic disease such as hyperammonemia. While often lifesaving, KRT sometimes poses significant risk to the patients including hemodynamic instability, bleeding, and infection, especially in small subjects. Particularly in neonates and premature infants, thrombocytopenia is commonly observed during continuous KRT (CKRT). Thrombocytopenia in critically ill patients undergoing CKRT is associated with increased mortality. In this study, we evaluated risk factors and outcomes related to thrombocytopenia in neonates.

Methods: This retrospective single-center study reviewed the clinical records of patients who underwent CKRT from June 2013 to October 2022 in Neonatal Intensive Care Unit (NICU) of our center. Data, including demograhic characteristics, diagnosis, vital signs, laboratory were recorded. Thrombocytopenia and severe thrombocytopenia were defined as less than 150,000/uL. and less than 50,000/uL, respectively.

Results: The data of 38 patients were analyzed. The indications for CKRT were acute kidney injury (AKI) along with oliguria (n=19, 50%), circulatory failure(n=10, 26%) , hyperammonemia (n=8, 21%) , sepsis(n=1, 2%). 12 patients could stop CKRT after median 69 hours [4 to 363hours], a patient switched maintenance KRTD after 3days and 28 patients expired in median 23 days [1 to 110 days]. All patients developed thrombocytopenia and 28 patients(74%) had severe thrombocytopenia. Thrombocytopenia was found 6.1hours after commencement of CKRT, reached its nadir in 1day, and recovered 7days of CKRT in 10 cases excluding 28 patients who demised in status of thrombocytopenia. When compared with moderate thrombocytopenia, those with severe thrombocytopenia were more commonly having thrombocytopenia before the application of CRRT (p-value < 0.05). while birth weight, gestational age, sepsis, using anticoagulation or inotropics, albumin, creatinine level were not different between the two groups. When severe thrombocytopenia occurred within 48 hours after the initiation of CKRT, mortality was higher with 81% .

Conclusions: Thrombocytopenia is common in cases of CKRT performed in NICU, and severe thrombocytopenia, whose risk factors included having thrombocytopenia before the application of CRRT. Mortality rates were higher when severe thrombocytopenia lower than 50,000/uL occurred within 48 hours after commencement of CKRT.

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Implementation and Evaluation of an Educational Program for Continuous Renal Replacement Therapy for Pediatric Critical Care Fellows Using a Hybrid of Gamification and Team Based Learning

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Background: Continuous renal replacement therapy (CRRT) is a critical treatment in pediatric intensive care units. It is crucial for pediatric critical care medicine (CCM) fellows to grasp CRRT principles in-depth. Our aim was to develop an effective training program for accelerated competency acquisition, optimizing care for critically ill children undergoing CRRT.

Program Design and Methods: We employed Educational Design Research (EDR) to develop an evidence-based, theory-informed program. The strengths of EDR lie in its pragmatic approach to address educational problem(s) and innovate solutions through an iterative design process, set in a real-world educational environment.
Our program consisted of a two-part workshop, utilizing a blended learning of course work and simulations. The course work was distinctive, combining multimodal approaches and strategically integrating Team Based Learning (TBL) and online game-based learning components. Our design principles revolved around a modified TBL for the course, enriched with engaging "choose your own adventure (CYOA)" branching scenarios as pre-course work.

Participants engaged clinical scenarios on the "Survey Monkey" platform, presented in a CYOA format. This was followed by an in-person course where TBL elaborated on the pre-course content, complemented by hands-on activities. Part two built on key concepts from the first, introducing more complex simulations.

Results: We evaluated the program using Kirkpatrick's four-level model. Eighteen CCM fellows participated. Feedback highlighted the program as being fun, engaging and relevant to their current practice (mean 4.89, SD 0.31). The CYOA was notably enjoyable and preferred over the traditional pre-course reading methods (mean 4.9, SD 0.30). Both the TBL format and the group activities/simulations were deemed effective (mean 4.88, SD 0.32) and met personal expectations (mean 4.96, SD 0.20).

Conclusion: By integrating TBL and gamification within a blended learning framework, we successfully developed an impactful CRRT training for pediatric CCM fellows. Plans underway include expanding this program locally to multiple healthcare disciplines (i.e., nursing, advanced practice provider, etc.) and multi-institutionally for combined remote TBL sessions. Ongoing evaluation will focus on knowledge acquisition and practice transfer, aiming to enhance care quality for pediatric patients receiving CRRT.

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Patterns in Saline Flush Intervals Observed in Hemodialysis (HD): The Scheduling of Saline Flushes and its Correlation with HD Treatment Variables.

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[1]*Outset Medical*

Extracorporeal circuit clotting (ECC) is a well-established complication of hemodialysis (HD) and is associated with an increased need for the administration of anticoagulants (e.g., heparin). The use of anticoagulants often leads to treatment interruptions, adverse events and can overall decrease efficacy of treatment. Coagulation is most often associated with clotting of the filter, problematic vascular access, fluctuations in blood pressure, and/or inefficient pre-dialysis anticoagulation efforts. Intermittent Predilution Convective Hemodialysis (IPCH) via Saline Flush, addresses the burden of ECC by providing a less hemotoxic anticoagulant, allows for less treatment interruptions due to ECC, and increases hourly clearance by adding convective clearance (middle molecule clearance) to standard hemodialysis treatment.

An analysis of acute hemodialysis (AHD) treatments performed by the Tablo® Hemodialysis System was performed to quantify the use of IPCH via Saline Flush in patients receiving in hospital AHD. A multivariate analysis with high-pressure alarm occurrence as the dependent variable and key treatment parameters as covariates was done. The objective is to look at the associations of occurrence of high-pressure alarms with key treatment and patient parameters.

A total of 3,864 AHD treatments were analyzed across multiple acute-care centers. The mean cycle time was 203.1 ± 50.5 min, mean blood and dialysate flow rates of 331.3 ± 54.2 and 292.4 ± 30.3 ml/min, respectively. A positive association (OR: 1.21, CI: [1.06,1.39], p=<0.001) was noted between high-pressure alarming (detection of a measurable increase in circuit pressure (venous, arterial) and a detection of low-systolic blood pressure. Conversely, the continuous monitoring of intradialytic pressure, and the automated saline delivery mechanism proves to be precise, with the observation of low saline flush intervals (administration of saline in short bursts) reporting a negative association (OR: 0.72, CI: [0.54, 0.97], p=<0.001) with high-pressure alarming.

Patients requiring HD, in the acute-care setting, are at a higher risk for ECC, yet precise machine alarming (i.e., high-pressure alarm) can mitigate this patient risk. The standard of prescribing anticoagulants (e.g., heparin) in HD is no longer the state-of-the-art, therefore the ability to prescribe automated low-flush interval saline flushing (short-bursts) can be of great advantage.

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The Role of Critical Care Nephrology in Antibody-Mediated Cardiac Transplant Rejection Managed with Extracorporeal Blood Purification Technique

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Introduction: Therapeutic plasma exchange (TPE) using a CRRT machine allows the removal of pathogenic substances and can be offered as initial treatment for antibody-mediated rejection (AMR) in cardiac transplant. The role of the nephrologist is essential, since is in charge of the prescription. The filter TPE 2000 as membrane filtration, with an effective surface area of 0.35 m2 of polypropylene with ethylene oxide sterilization, targets large-molecular-weight substances present in plasma as immunoglobulin.

Clinical case: A 24-year-old woman, post cardiac transplantation 4 months prior to admission for dilated cardiomyopathy, arrived to ER with progressive dyspnea, orthopnea and oliguria. VS: BP 91/64 mmHg, HR 120bpm, 24 RR, O2 sat 85%. Echocardiography: LVEF 20%, severe cardiac graft dysfunction with severe impairment of biventricular function TAPSE 0. A myocardial biopsy was performed. She presented pulseless electrical activity and ALS were performed for 2 minutes, successfully. Inotropic and vasopressors were started, orotracheal intubation was required and the patient was transferred to ICU. Biopsy results shows acute cellular rejection 2R. Positive for changes compatible with AMR. Steroids and TPE were offered. 5 sessions of plasma exchange with TPE 2000 membrane were given, prescription with 1.5 plasma exchange each one with albumin at 25% (Table 1). Vasopressor reduction, inotropic withdrawal, and LVEF increase to 40% were achieve after treatment. There was also a decrease in inflammatory biomarkers as C-reactive protein and iL-6. The patient continues with immune suppressant therapy, and she is stable as she waits for the next step in regard of the heart failure and a possible second transplant.

Discussion: Allograft dysfunction due to AMR is one of the worst complications post heart transplantations. Many therapies have been useful for these patients as steroids, immunoglobulin intravenous and TPE. In this case we were able to evaluate the allograft disfunction previously to TPE, and sub sequential improvement which was LVEF pre-TPE 20% to post-TPE 40%. This can guide us to continue the research about TPE in AMR as there is no evidence-based guidelines that establish this therapy for patients as complex as this are. In Latin America is not a common practice in this kind of patients, so, more research should be achieved so we can offer extracorporeal blood purification techniques to patients as critically ill as the one presented here.

Table 1. Prescription dose.

Weight (kg)	Htco (%)	Plasma Volume (ml)	Plasma Exchange (1.5)	Blood flow	Substitution Flow (ml/h)	Plasma UF (ml/h)	Total Volume (ml)
54	49	1823	2,735	120	1000	0	3000
54	38.5	2159	3,300	120	1000	0	3500
54	40	2106	3,200	120	1000	100	3500
54	32	2387	3,580	120	1000	100	3500
54	26	2596	3,893	120	1000	100	3510

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Growth during the first 3 months of life in infants in the Neonatal Intensive Care Unit with dialysis dependent chronic kidney failure

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Background: Survival of neonates with chronic kidney failure (CKF) requiring dialysis has increased as technology to support these patients has improved. Many of these neonates require prolonged continuous renal replacement therapy (CRRT), are chronically ill, have severe pulmonary hypoplasia requiring extensive ventilator time, and additional comorbidities. Adequate nutrition is critical for these patients, yet scant data exist on energy requirements and growth outcomes.

Methods: We sought to discover if our nutrition recommendations for neonates and infants on CRRT were adequate for weight and height growth. We performed a retrospective review of 19 neonates at Children's of Alabama who required CRRT within the first month of life between 2016 and 2022. Of the 24 infants with CKF who required CRRT in the first month of life, 19 (79.2%) survived. Our primary outcome was weight z-score ≥-2 vs. < -2. Our secondary outcome was height z-score ≥-2 vs. <-2. We compared demographics, comorbidities, transition to peritoneal dialysis (PD), the effect of a decrease in our standard dosing of RRT clearance, from body surface area dosing of 2000/1.72/m2, to 24mL/kg/hour, in May 2018, and daily energy goal modifications in 2019 and 2021 across our neonatal dialysis program by groups.

Results: Of the 19 subjects who survived to 90 days, 11 (58%) had a weight z-score ≥- 2 and 8 (42%) were <-2. Alternatively, 8 (42%) had a height z-score ≥-2 and 11 (58%) were <-2. One fourth (26.3%) required extracorporeal membrane oxygenation (ECMO). Despite many comorbidities, none were statistically significant regarding z-score at 90 days for either weight or height. Patients who transitioned to PD sooner had better z-scores in weight and height. Those with lower CRRT clearance had better z-scores for weight, with no difference seen in height. Higher calorie and protein goal targets were associated with increased patients' 90-day weight z-scores (both $p< 0.01$) but there was no statistical difference for height z-score.

Conclusion: Care of these babies is very complex; many will not survive. Growth is essential for their progress as they work towards a chronic dialysis modality. A 24 mL/kg/hour clearance rate and higher caloric and protein targets were associated with higher rates of patients staying within the normative curves. Additional studies are needed to understand the effects of RRT on growth and development.

Table on following page

Table 1. Demographics for cohort and comparison between those with weight and height z-score ≥-2 vs. <-2 at 90 days of life

	ALL	Weight Z Score ≥-2	Weight Z Score <-2	P value	Height Z Score ≥-2	Height Z Score <-2	P value
	N = 19	N = 11	N = 8		N = 8	N = 11	
Sex				0.10			1.00
- Female	4 (21.1%)	4 (36.4%)	0 (0.0%)		2 (25.0%)	2 (18.2%)	
- Male	15 (78.9%)	7 (63.6%)	8 (100.0%)		6 (75.0%)	9 (81.8%)	
Birth weight (g)	2505 (2234, 2850)	2740 (2380, 2990)	2304 (2186, 2591)	0.28	2539 (2173, 2950)	2505 (2282, 2845)	0.93
Birth length(cm)	46.0 (42.5, 49.0)	48.0 (43.3, 49.3)	44.5 (42.8, 46.3)	0.41	47.0 (45.5, 48.8)	43.0 (42.3, 48.0)	0.30
Weeks Gestational Age (WGA)	35.9 (34.4, 37.0)	35.9 (34.4, 36.6)	34.6 (35.2, 37.0)	0.84	35.1 (34.2, 35.9)	36.1 (34.7, 37.0)	0.23
Day of life CRRT started	5.0 (4.0, 6.0)	5.0 (4.0, 6.0)	5.5 (4.0, 6.3)	0.77	4.0 (3.5, 4.8)	6.0 (5.0, 6.0)	0.14
Required ECMO	5 (26.3%)	3 (27.2%)	2 (25.0%)	1.00	2 (25.0%)	3 (27.3%)	1.00
Premature (<37 WGA)	13 (68.4%)	8 (72.7%)	5 (62.5%)	0.64	7 (87.5%)	1 (9.1%)	0.23
Pneumothorax	14 (73.6%)	8 (72.7%)	8 (100.0%)	1.00	5 (62.5%)	9 (81.8%)	0.60
Pulmonary hypertension	8 (42.1%)	5 (45.5%)	4 (50.0%)	1.00	3 (37.5%)	6 (54.5%)	0.65
Necrotizing Enterocolitis	5 (26.3%)	2 (18.2%)	3 (37.5%)	0.60	4 (50.0%)	1 (9.1%)	0.11
Days on ventilator	48.0 (33.0, 57.0)	45.0 (26.0, 55.5)	51.5 (42.3, 57.0)	0.71	34.5 (12.0, .0)	51.0 (44.0, 57.0)	0.13
Days on CRRT	102.0 (82.0, 154.0)	123.0 (82.0, 167.0)	93.5 (80.0, 150.0)	0.56	118.5 (74.8, 177.0)	98.0 (85.0, 142.5)	0.90
Transition to PD	12 (63.2%)	8 (72.7%)	4 (50.0%)	0.38	5 (62.5%)	7 (63.6%)	1.00
PD start age in days	89.0 (64.3, 127.5)	84.0 (61.3, 127.5)	102.5 (80.0, 128.0)	0.67	68.0 (41.0, 164.0)	89.0 (84.0, 119.0)	0.37
Dosing on CRRT				0.11			1.00
- April 2016 to May 2018	5 (26.3%)	1 (9.1%)	4 (50.0%)		2 (25.0%)	3 (27.3%)	
- May 2018 to September 2022	14 (73.6%)	10 (90.9%)	4 (50.0%)		6 (75.0%)	8 (72.7%)	
Calorie goals				<0.01			0.53
- 90-110kcal/kg/day	12 (63.2%)	4 (36.4%)	8 (100.0%)		5 (62.5%)	7 (63.6%)	
- At least 130kcal/kg/day	3 (15.8%)	3 (27.2%)	0 (0.0%)		2 (25.0%)	1 (9.1%)	
- At least 140kcal/kg/day	4 (21.1%)	4 (36.4%)	0 (0.0%)		1 (12.5%)	3 (27.3%)	
Protein goals				<0.01			0.96
- 3.5-4g/kg/day	12 (63.2%)	4 (50.0%)	8 (72.7%)		5 (62.5%)	7 (11.0%)	
- At least 4g/kg/day	7 (36.8%)	7 (87.5%)	0 (0.0%)		7 (87.5%)	0 (0%)	
Alive at discharge	14 (73.6%)	10 (90.9%)	4 (50.0%)	0.11	7 (87.5%)	7 (63.6%)	0.34
Age at discharge/death	188.0 (113.0, 210.0)	188.0 (113.0, 221.0)	170.0 (95.0, 209.8)	0.56	171.5 (121.8, 214.5)	192.0 (101.0, 210.0)	0.97

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Comparing Efficiency and Safety of Double Filtration Plasmapheresis with Therapeutic Plasma Exchange in the Treatment of Lupus Nephritis

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Background: Large number of antibodies are the significant characteristics of lupus nephritis (LN), and therapeutic plasma exchange (TPE) was used to quickly remove the antibodies and control the symptoms. Considering plasma limitation, double filtration plasmapheresis (DFPP) has been recently administrated in LN treatment. This study was to discuss the efficiency and safety of these two techniques in the treatment of LN.

Methods: This retrospective study recruited the patients pathological conformed as LN from May 2019 to December 2021 who received either TPE or DFPP treatment. The clinical parameters before and after plasmapheresis, adverse events, patient survival rate and renal outcomes during follow-up were collected to compare the effectiveness and safety.

Results: A total of 33 LN patients confirmed by renal biopsy were included in this study, including 12 cases of DFPP and 21 cases receiving TPE treatment. There was no statistical significance between two types of plasmaphereses in the levels of anti-dsDNA antibody titers, 24h urinary protein and SLEDAI during the follow up. During the 6 months after

treatment, patients' all-cause of mortality rate (16.6% vs. 14.3%, P=0.89) demonstrated no statistical significance between two groups. The kidney survival showed statically higher in DFPP groups when compared to TPE group (90% vs. 50%, P=0.04) in the survival patients. During the follow-up, there was no significant difference in the total rate of adverse events between the two group (18.6% vs. 20.0%, P=0.11).

Conclusion: There is no significant difference in the short-term efficacy and safety of TPE and DFPP in the treatment of LN. For the treatment of LN, DFPP is an effective alternative to TPE for patients with plasma limitation.

	DFPP Group	TPE Group	P value
All-cause of mortality	16.6%	14.3%	0.89
Kidney survival (total)	75%	42.9%	0.12
Kidney survival (survival)	90%	50%	0.04
Adverse events:	18.6%	20.0%	0.11
-Allergic reaction	0	8.5%	
-hemorrhage	0	0	
-hypotension	8.5%	3.4%	
-filter coagulation	11.4%	6.8%	
-infection	0	0	

NEW TECHNOLOGY

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The Performance of ChatGPT-3.5 versus ChatGPT-4 on CRRT Alarm Troubleshooting Questions

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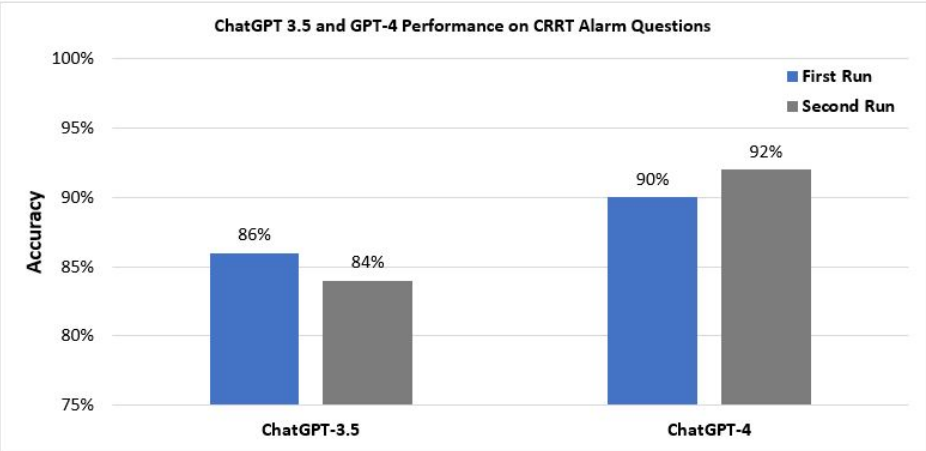
Background: Accurate interpretation of CRRT machine alarms is crucial in the intensive care setting. ChatGPT, with its advanced natural language processing capabilities, has emerged as a tool that is evolving and advancing in its ability to assist with healthcare information. This study is designed to evaluate the accuracy of the ChatGPT-3.5 and ChatGPT-4 models in addressing queries related to CRRT alarm troubleshooting.

Methods: The assessment consisted of two rounds of evaluation for ChatGPT-3.5 and ChatGPT-4, with each model addressing 50 CRRT machine alarm questions verified by two critical care nephrologists. Accuracy was determined by comparing the model responses to a predetermined answer key, and consistency was noted by comparing outcomes across the two rounds. Consistency was assessed by comparing outcomes across the two rounds, utilizing the Cohen's kappa statistic to measure inter-rater reliability and control for chance agreement.

Results: ChatGPT-3.5 scored 86.0% (43/50) on the first run and 84.0% (42/50) on the second run. ChatGPT-4 scored 90.0% (45/50) on the first run and 92% (46/50) on the second run. Overall agreement between ChatGPT-3.5 first and second runs was 84.0% (kappa = 0.759), with the same response in 42 of 50 questions, of which 39 were correct, and three were incorrect. Overall agreement between ChatGPT-4 first and second runs was 92.0% (kappa = 0.889), with the same response in 46 of 50 questions, of which 44 were correct and two were incorrect. Furthermore, when assessing open-ended questions and narrative responses, both ChatGPT versions produced answers that aligned with the multiple-choice answer key without leading to potentially harmful recommendations.

Conclusion: Within CRRT machine alarms and troubleshooting, ChatGPT-4 outperformed ChatGPT-3.5 in accuracy and consistency. However, there is still potential for further development to achieve even greater reliability. This advancement is essential for ensuring the highest patient care and safety standards in managing CRRT machine-related issues.



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Advancing Patient Education in Critical Care Nephrology: ChatGPT's Role in CRRT and AKI Information Dissemination

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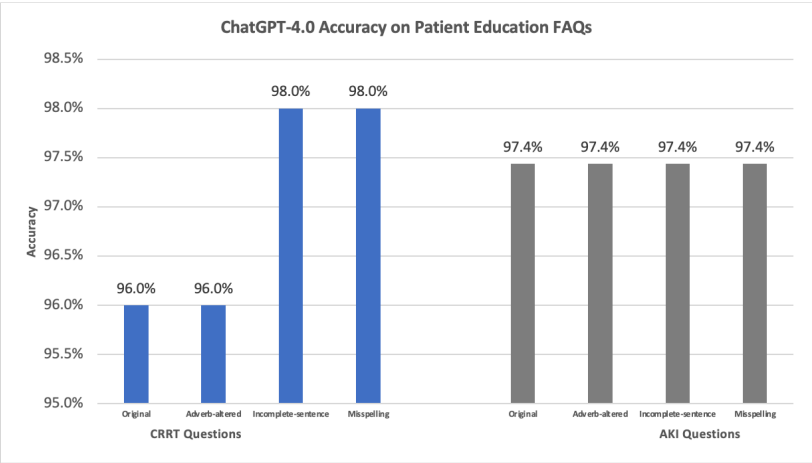
Background:
Continuous Renal Replacement Therapy (CRRT) and Acute Kidney Injury (AKI) are critical areas in nephrology where precise information is essential. Though the capability of ChatGPT in addressing complex clinical nephrology inquiries remains under exploration, its effectiveness in simpler, patient education-oriented questions has not been thoroughly assessed. This study aims to evaluate the proficiency of ChatGPT 4.0 in responding to such questions, especially when subjected to various linguistic alterations.

Methods:
Eighty-nine questions were sourced from the Mayo Clinic Handbook for educating patients on CRRT and AKI. These questions were categorized as original questions in well-written layperson's terms, paraphrased questions with different interrogative adverbs, paraphrased questions resulting in incomplete sentences, and paraphrased questions containing misspelled words. Two nephrologists specializing in critical care nephrology verified the questions for medical accuracy. A chi-squared statistical test was conducted to ascertain if notable discrepancies exist in ChatGPT 4.0's performance across these different question formats.

Results:
Overall accuracy for all questions was high, with original and adverb-altered questions scoring 96.63% and incomplete sentences and misspellings scoring 97.75%. The chi-squared test revealed no statistically significant difference in performance (p-value: 0.94) in accuracy for all questions. For CRRT questions, accuracy was 96.00% for original and paraphrased questions with different adverbs and 98.00% for paraphrased questions with incomplete sentences and misspellings. In contrast, AKI questions consistently showed a 97.30% accuracy rate across all question types. A comparison of CRRT and AKI question responses revealed no substantial statistical disparity (p-value: 0.10).

Conclusion:
ChatGPT 4.0 exhibits a high level of accuracy in responding to patient education level for CRRT and AKI, maintaining consistent performance across various linguistic modifications. Future studies must explore its integration into actual clinical practice for patient education. This would provide a more comprehensive understanding of its applicability and effectiveness in real-world medical settings.



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Extracorporeal therapy using microbeads to treat refractory septic shock by removing excessive reactive oxygen species

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Introduction
Extracorporeal hemoperfusion therapies that remove endotoxin or cytokines were considered promising but have still been deemed ineffective. We aim to develop an extracorporeal therapy using microbeads that could effectively treat refractory septic shock by removing excessive reactive oxygen species.

Methods
The mesocellular silica foams (MCF) microbeads were synthesized using a modified template method, while the cerium oxide nanoparticles (CeNP) were synthesized in an aqueous phase using 6-aminohexanoic acid. CeNP-loaded MCF microbeads (CeMCF) were obtained by mixing CeNPs solution with MCF microbeads. Male Sprague-Dawley rats (n = 7 each group) were used in animal experiments. Rats were anesthetized, intubated, and mechanically ventilated, and cannulated in the right common carotid artery, right common femoral artery, and left common femoral vein, and circuit was set up using tubing, a peristaltic pump, and a microbead cartridge. A lethal dose of lipopolysaccharide (5 mg/kg) was intravenously injected. Hemoperfusion was performed for 4 hours at a flow rate of 1.5 ml/min. Resusciation with intravenous normal saline and norepinephrine (upto 1 mcg/kg/min) were performed.

Results
MCF with a size of about 500 micrometers and high surface area (244.73 m2/g) and pore volume (0.56 cm3/g) were synthesized. 1 g of MCF was mixed with 5 mg/mL CeNPs, resulting in 100% loading efficiency (Ce 12.54 wt% in CeMCF microbeads). The resulting CeMCF microbeads had sufficient reactive oxygen species scavenging properties in hydrogen peroxide and hydroxyl radical assays, with CeMCF exhibiting up to 90% scavenging efficiency at a concentration of 10mg. To enhance hemocompatibility, microbeads were coated with polyvinylpyrrolidone. In cartridge system tests, CeMCF microbeads showed significant hydrogen peroxide removal efficiency, with approximately 40% removal after 1 cycle, 50% after 2 cycles, and 96% after 7 cycles, while MCF microbeads showed no significant removal. In refractory septic shock animal model, the treatment significantly improved the survival rate compared to the control group (100% vs. 0%, p-value < 0.001). The treated group showed better recovery from refractory septic shock, while the control group remained refractory to the maximum dose of vasopressor (p-value < 0.001 for both MAP and norepinephrine dose).

Conclusion
Our findings suggest that hemoperfusion with CeMCF microbeads could be a promising therapy option for septic shock treatment.

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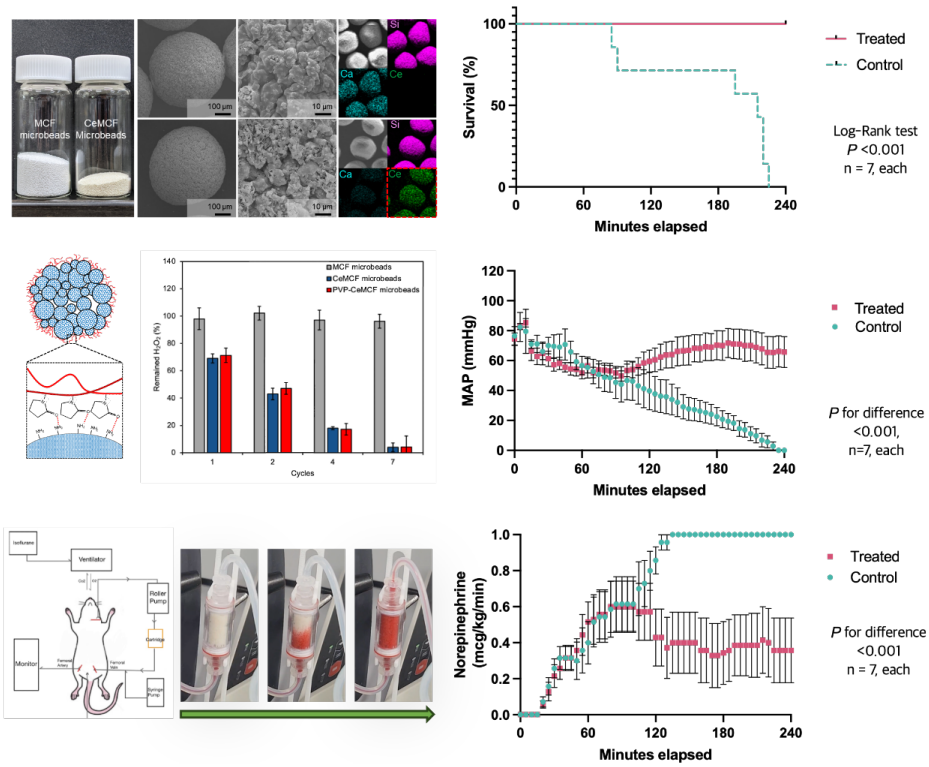

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Improving Management of Acute Kidney Injury Due to Lithium Intoxication: Assessing the Role of ChatGPT-4 in Identifying Lithium Preparations

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Background:
The prompt recognition and management of drug intoxications, especially in cases of acute kidney injury (AKI), are paramount. Lithium, a common nephrotoxin, poses significant challenges with its narrow therapeutic index. The advent of artificial intelligence (AI) presents a novel tool for rapidly identifying these substances and facilitates timely diagnosis and treatment. This study focuses on lithium as a prototype of a dialyzable drug to assess the capacity of AI models, specifically ChatGPT-4, in distinguishing between lithium and non-lithium medications based on image recognition.

Methods:
This study involved analyzing twenty-five images of various lithium preparations, detailing the medication type, dose, and an assessment of accuracy. An additional twenty-five non-lithium medication images were included as controls. These images were processed by ChatGPT-4 at a resolution of 200 DPI, and the AI's ability to identify medication type, dose, and imprint was assessed. The performance was benchmarked against verified data from webpoisoncontrol.org.

Results:
ChatGPT-4 demonstrated a high accuracy rate (92%) in identifying lithium drug preparations, which is critical in managing drug-induced AKI. However, misidentifications accounted for 8% of the lithium preparations, where specific

cases included confusing lithium carbonate 600mg capsules with potassium chloride ER 750 mg or lithium carbonate 300 mg capsules for Bupropion 300 mg tablets. ChatGPT-4 also accurately identified 100% of the non-lithium images, indicating its efficacy in distinguishing between lithium and non-lithium medications.

Conclusion:
The study highlights the potential of ChatGPT-4 as a supportive tool in identifying drugs that could lead to nephrotoxicity or those that are cleared by the kidney. However, the occasional misidentifications emphasize the crucial role of human oversight in the AI-assisted drug identification process, particularly in the context of AKI, where the stakes of medication errors are high.

Figure 1: ChatGPT-4 Accuracy in Identifying Lithium and Non-Lithium Medications

N =	Lithium Preparation per Poison Control	Medication per GPT-4	Dose per GPT-4	Type	Imprint per Poison Control	Imprint per GPT-4	GPT-4 Correct vs Incorrect
1	Lithium Carbonate 600 mg	Lithium Carbonate	600 mg	capsule	54 702	54 702	Correct
2	Lithium Carbonate 450 mg	Lithium Carbonate	450 mg	tablet	54 346	54 346	Correct
3	Lithium Carbonate 150 mg	Lithium Carbonate	150 mg	capsule	54 213	54 213	Correct
4	Lithium Carbonate 300 mg	Lithium Carbonate	300 mg	tablet	54 107	54 107	Correct
5	Lithium Carbonate 300 mg	Lithium Carbonate	300 mg	capsule	APO 300	APO 300	Correct
6	Lithium Carbonate 600 mg	Lithium Carbonate	600 mg	capsule	G222 600	G222 600	Correct
7	Lithium Carbonate 300 mg	Lithium Carbonate	300 mg	capsule	G221 300	G221 300	Correct
8	Lithium Carbonate 300 mg	Lithium Carbonate	300 mg	capsule	West-ward 3189	West-ward 3189	Correct
9	Lithium Carbonate 150 mg	Lithium Carbonate	150 mg	capsule	H 97	H 97	Correct
10	Lithium Carbonate 300 mg	Lithium Carbonate	300 mg	capsule	H 98	H 98	Correct
11	Lithium Carbonate 600 mg	Lithium Carbonate	600 mg	capsule	H 141	H 141	Correct
12	Lithium Carbonate 150 mg	Lithium Carbonate	150 mg	capsule	West-ward 3188	West-ward 3188	Correct
13	Lithium Carbonate ER 450 mg	Lithium Carbonate ER	450 mg	tablet	WW 277	WW 277	Correct
14	Lithium Carbonate ER 300 mg	Lithium Carbonate ER	300 mg	tablet	223	223	Correct
15	Lithium Carbonate ER 450 mg	Lithium Carbonate ER	450 mg	tablet	224 G	224 G	Correct
16	Lithium Carbonate 300 mg	Lithium Carbonate	300 mg	tablet	430	430	Correct
17	Lithium Carbonate 150 mg	Lithium Carbonate	150 mg	capsule	G220 150	G220 150	Correct
18	Lithium Carbonate 300 mg	Lithium Carbonate	300 mg	tablet	54 452	54 452	Correct
19	Lithium Carbonate 300 mg	Lithium Carbonate	300 mg	capsule	54 463	54 463	Correct
20	Lithium Carbonate ER 300 mg	Lithium Carbonate ER	300 mg	tablet	M LC 300	M LC 300	Correct
21	Lithium Carbonate ER 300 mg	Lithium Carbonate ER	300 mg	tablet	LITHOBID 300	LITHOBID 300	Correct
22	Lithium Carbonate 150 mg	Lithium Carbonate	150 mg	capsule	WW 3188	WW 3188	Correct
23	Lithium Carbonate 150 mg	Lithium Carbonate	150 mg	capsule	A 101	A 101	Correct
24	Lithium Carbonate 600 mg	Potassium Chloride ER	750 MG	capsule	A 103	A 103	Incorrect
25	Lithium Carbonate 300 mg	Bupropion	300 mg	capsule	A 102	A 102	Incorrect

C =	Non-Lithium Medication per Poison Control	Medication per GPT-4	Dose per GPT-4	Type	Imprint per Poison Control	Imprint per GPT-4	GPT-4 Correct vs Incorrect
1	Losartan potassium 50 mg	Losartan potassium	50 mg	tablet	952	952	Correct
2	Ketrolac 10 mg	Ketrolac	10 mg	tablet	M 134	M 134	Correct
3	Simethicone 80 mg	Simethicone	80 mg	tablet	44 137	44 137	Correct
4	Pantoprazole sodium DR 20 mg	Pantoprazole sodium DR	20 mg	tablet	93/11	93/11	Correct
5	Loperamide HCl 2 mg	Loperamide HCl	2 mg	capsule	N 020 2	N 020 2	Correct
6	Lisinopril 20 mg	Lisinopril	20 mg	tablet	3760	3760	Correct
7	Chlorthalidone 50 mg	Chlorthalidone	50 mg	tablet	M 75	M 75	Correct
8	Furosemide 40 mg	Furosemide	40 mg	tablet	54 583	54 583	Correct
9	Hydrochlorothiazide 25 mg	Hydrochlorothiazide	25 mg	tablet	LL H 14	LL H 14	Correct
10	Metoprolol succinate ER 50 mg	Metoprolol succinate ER	50 mg	tablet	369	369	Correct
11	Aspirin 325 mg	Aspirin	325 mg	tablet	TCL 011	TCL 011	Correct
12	Gabapentin 600 mg	Gabapentin	600 mg	tablet	G 31	G 31	Correct
13	Calcitriol 0.5 mcg	Calcitriol	0.5 mcg	capsule	93 658	93 658	Correct
14	Carvedilol 25 mg	Carvedilol	25 mg	tablet	R 255	R 255	Correct
15	Cinacalcet HCl 30 mg	Cinacalcet	30 mg	tablet	WPI 16	WPI 16	Correct
16	Torsemide 100 mg	Torsemide	100 mg	tablet	par 654	par 654	Correct
17	Allopurinol 300 mg	Allopurinol	300 mg	tablet	MP 80	MP 80	Correct
18	Enalapril maleate 10 mg	Enalapril maleate	10 mg	tablet	M E17	M E17	Correct
19	Prazosin 5 mg	Prazosin	5 mg	capsule	93 4069	93 4069	Correct
20	Sevelamer HCl 800 mg	Sevelamer	800 mg	tablet	G 447	G 447	Correct
21	Spironolactone 100 mg	Spironolactone	100 mg	tablet	G 5013	G 5013	Correct
22	Amlodipine besylate 5 mg	Amlodipine besylate	5 mg	tablet	G 1530 5	G 1530 5	Correct
23	Calcium acetate 667 mg	Calcium acetate	667 mg	capsule	54 215	54 215	Correct
24	Metoprolol tartrate 100mg	Metoprolol tartrate	100 mg	tablet	N 734 100	N 734 100	Correct
25	Ramipril 10 mg	Ramipril	10mg	capsule	54 602	54 602	Correct

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Reduced dysfunction of hemodialysis catheters via a blood flow control system ～an ex vivo evaluation～

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Purpose
To assess the potential improvement in hemodialysis catheter dysfunction by implementing blood pump control based on pressure changes in the blood circuit.

Materials & Method
The roller pump with a blood flow control system and ex vivo pig vein was employed. An ex vivo pig vein evaluation system was developed and used in laboratory. The catheters were inserted into an extracted pig vein of approximately 10 mm in diameter and 100 mm in length. The pig vein was connected to the blood circuit and the vein was filled with 50% glycerol solution and circulated at a flow rate of 800 mL/min. The blood flow in the catheters was set at 150 mL/min. The blood flow was controlled by an external signal to reduce its speed when the catheter dysfunction occurred due to suction of the vessel wall by the catheter. The control conditions involved decreasing the blood flow to 50mL/min/s when the internal pressure of the blood circuit before the roller pump reached -120 mmHg or -180 mmHg. The roller pump was stopped when the internal pressure reached -200 mmHg.

Result
The pressure in the circuit during the normal operation changed in the range of -70 to -110 mmHg. Under the conditions of the internal pressure of the blood circuit before the pump reached -120 mmHg, after the internal pressure reached -120 mmHg and blood flow control started, blood flow showed 50.6±31.4 mL/min, internal pressure showed -172±16.8 mmHg. And then all the catheters dysfunction well improved and didn't stop the blood pump in this case. Under the conditions of the internal pressure of the blood circuit before the pump reached -180 mmHg, when blood flow control started after the internal pressure reached -180 mmHg, blood flow showed 46.9±50.1 mL/min, internal pressure showed -197±12.7 mmHg. And then the catheters dysfunction didn't improve and stopped the blood pump.

Conclusion
Controlling the blood pump prior to the occurrence of excessive negative internal pressure in the blood circuit could effectively reduce the frequency of blood pump stoppages.

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The impacts of skeletal muscle mass and quality on kidney recovery of patients with acute kidney injury receiving continuous renal replacement therapy

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Introduction: Although there are increasing interests in kidney recovery after acute kidney injury (AKI), little is known about patients with severe AKI requiring continuous renal replacement therapy (CRRT). It is known that sarcopenia is associated with poor prognosis not only in chronic inflammatory conditions but also in acute disease. Recent study revealed that muscle mass and quality were significant determinants of mortality in patients with CRRT. However, few studies evaluated the effect of sarcopenia on kidney recovery in patients receiving CRRT.

Methods: We collected 2051 AKI patients who underwent CRRT from eight medical centers between 2006 and 2021. The skeletal muscle area (SMA) was measured from the automated software from CT images at 3rd lumbar vertebra within 15 days of CRRT initiation, and classified as normal attenuation muscle area (NAMA) and low attenuation muscle area (LAMA) according to muscle density. We used Fine and Gray model to investigate the effects of muscle index adjusted by body mass index (BMI) on kidney recovery.

Results: Of the 813 CRRT survivors, 682 (83.9%) patients were discharged without RRT. Increased SMA/BMI was independently associated with decreased risk of RRT dependence. Also, the 4th quartile of NAMA/BMI was significantly associated with decreased RRT dependence risk. However, non-significant effects of LAMA/BMI were observed.

Conclusion: In patients with severe AKI receiving CRRT, not only the quantity but also the quality of muscle affects RRT dependence.

Table on following page

SMA/BMI	Model1		Model2		Model3	
Q1 [0.99, 3.93]	ref		ref		ref	
Q2 (3.93, 4.74]	0.93	(0.74, 1.16)	1.01	(0.80, 1.27)	1.06	(0.83, 1.35)
Q3 (4.74, 5.56]	1.12	(0.91, 1.39)	**1.29**	**(1.01, 1.64)**	1.28	(0.99, 1.65)
Q4 (5.56, 9.76]	**1.35**	**(1.09, 1.66)**	**1.50**	**(1.17, 1.93)**	**1.48**	**(1.12, 1.95)**
Linear	**1.10**	**(1.04, 1.17)**	**1.12**	**(1.05, 1.20)**	**1.11**	**(1.03, 1.20)**
LAMA/BMI	**Model1**		**Model2**		**Model3**	
Q1 [0.08, 1.98]	ref		ref		ref	
Q2 (1.98, 2.43]	1.07	(0.87, 1.32)	1.14	(0.92, 1.41)	1.12	(0.90, 1.40)
Q3 (2.43, 2.97]	0.85	(0.69, 1.05)	0.97	(0.78, 1.20)	0.96	(0.76, 1.21)
Q4 (2.97, 6.51]	0.87	(0.71, 1.08)	0.98	(0.79, 1.21)	1.03	(0.81, 1.30)
Linear	0.93	(0.84, 1.02)	0.98	(0.89, 1.08)	1.02	(0.92, 1.14)
NAMA/BMI	**Model1**		**Model2**		**Model3**	
Q1 [0.05, 1.40]	ref		ref		ref	
Q2 (1.40, 2.12]	1.05	(0.84, 1.31)	1.10	(0.88, 1.38)	1.02	(0.80, 1.31)
Q3 (2.12, 2.99]	1.21	(0.97, 1.49)	1.27	(1.01, 1.60)	1.11	(0.86, 1.41)
Q4 (2.99, 7.44]	**1.52**	**(1.23, 1.87)**	**1.55**	**(1.21, 1.98)**	**1.38**	**(1.06, 1.81)**
Linear	**1.15**	**(1.08, 1.22)**	**1.14**	**(1.06, 1.23)**	**1.10**	**(1.02, 1.19)**

Model 1=crude

Model 2=Model 1+Sex+Age+Charlson comorbidity index+HTN+Sepsis

Model 3=Model 2+Creatinine+White blood cell+Hb+Albumin+PT INR+SOFA score+APACHE II score

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A Study of Dilution Modes, Middle Molecule Clearance and TMP under Different Operational Conditions in CVVH

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Introduction: An experimental study assessing specifically the effect of dilution modes on effective solute clearance in CRRT was investigated under CVVH mode, with pure post-dilution as the reference mode. The clearances for both small and middle molecules were measured for varying degrees of post/pre-dilution balance and different flow conditions.

Materials and Methods: The Prismaflex (Baxter) machine was used to deliver replacement fluid at different dilution points [pre-blood pump dilution (PBP), PRE, and POST]. Simulated treatment (N=3 for each condition) involved 6 l of bovine blood (Hct ~ 35%, 34oC-36oC) processed at zero net ultrafiltration for a duration of 240 minutes. A 1.4 m2 hemofilter (HF 1400; Baxter) was used. The three experimental conditions were: 1) blood flow rate (QB): 190 mL/min; replacement flow rate (QR): 2 L/hr (33 mL/min), 2) QB: 290 mL/min; QR: ~3 L/hr (50 mL/min, 3) QB: 380 mL/min; QR: ~4 L/hr (67 mL/min). These conditions were chosen to maintain filtration > 25% in POST. Solute clearance estimates at various time points were based on mass balance calculations.

Results and Discussion: No significant differences ($p > 0.05$) in inulin clearance between post-dilution and pre-dilution

mode, post-dilution and pre-pump-dilution mode, and pre-dilution and pre-pump-dilution mode were observed. Decreases in MM SC and clearance, in concert with increases in TMP. w/o changes in filter pressure over time were seen post dilution only.

Conclusions: 1) SM solute clearance is not affected by TMP increases 2) MM SC decreased substantially in POST with time, likely due to secondary membrane effects, evidenced by predictable pressure changes. 3) The data obtained by varying Pre- and Post-percentages are predictable for SM but not for MM. 4) Higher clearance values for MM can be achieved in Pre and PBP rather than in Post only under low TMP. These results should be considered when TMP increases in post Dilution CVVH and MM removal rates need to be preserved. These results may indicate that current practice of filter use of over 48 hours may maintain SM removal only to sacrifice MM removal in that no meaningful MM removal may happen in long duration filter patency POST dilution CVVH.

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Innovation of a neonatal peritoneal dialysis catheter to Expand Dialysis Capabilities for Critically Ill Neonates in Low and Middle Income Countries

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Purpose: Peritoneal dialysis (PD) serves as the primary dialysis therapy for neonates facing acute kidney injury (AKI) in low- and middle-income countries (LMICs) due to its safety, simplicity, and cost-effectiveness. However, despite recent advancements, the pediatric population lacks dedicated PD catheters, leaving them underserved. Consequently, clinicians in in LMICs often use adult-designed catheters off-label. This practice heightens the risk of complications such as catheter occlusion due to fibrin clots and omentum wrapping, particularly in smaller catheters with fixed diameter sideports within the pigtail loop (e.g., Seldinger inserted Cook Multipurpose Drainage Catheter), leading to frequent occlusion at the proximal sideport.

Methods & Results: Our catheter design addresses this issue by integrating variable-diameter sideports at both the inner and outer loop diameters. This design aims to distribute flow rate more evenly across each sideport, minimizing occlusion risks. In a numerical simulation using an 8.5 Fr Cook Pigtail Multipurpose Drainage Catheter (Figure 1a), 70% of the drained fluid entered through the two most proximal sideports, increasing fluid pressure and attracting fibrin clots and omentum. To counteract this, our design reduces fluid pressure at these ports compared to the standard design by duplicating the amount of sideports. Additionally, the proximal holes are half the size of the distal ones, ensuring balanced flow rates (Figure 1b).

Experimental evaluation consisted of a fibrin clot analog placed in the inner loop diameter, simulating an intraabdominal pressure of approximately 15 mmHg (Figure 1c). The experimental catheter was made from an 8.5 Fr polyethylene tube and thermoformed into a pigtail tip and the sideports were made with biopsy punchers. Drainage volume after 5 minutes was recorded under occluded and unoccluded states. Figure 1d illustrates the difference in drainage volume between occluded and unoccluded states for each catheter design. The control catheter displayed a significant difference, suggesting compromised drainage performance due to the fibrin clot analog, while our catheter design showed minimal variance.

Conclusion: This cost-effective solution reduces fluid pressure at proximal sideports, ensuring uniform distribution along the catheter's length, thereby diminishing particle concentration and lowering the risk of catheter occlusion.

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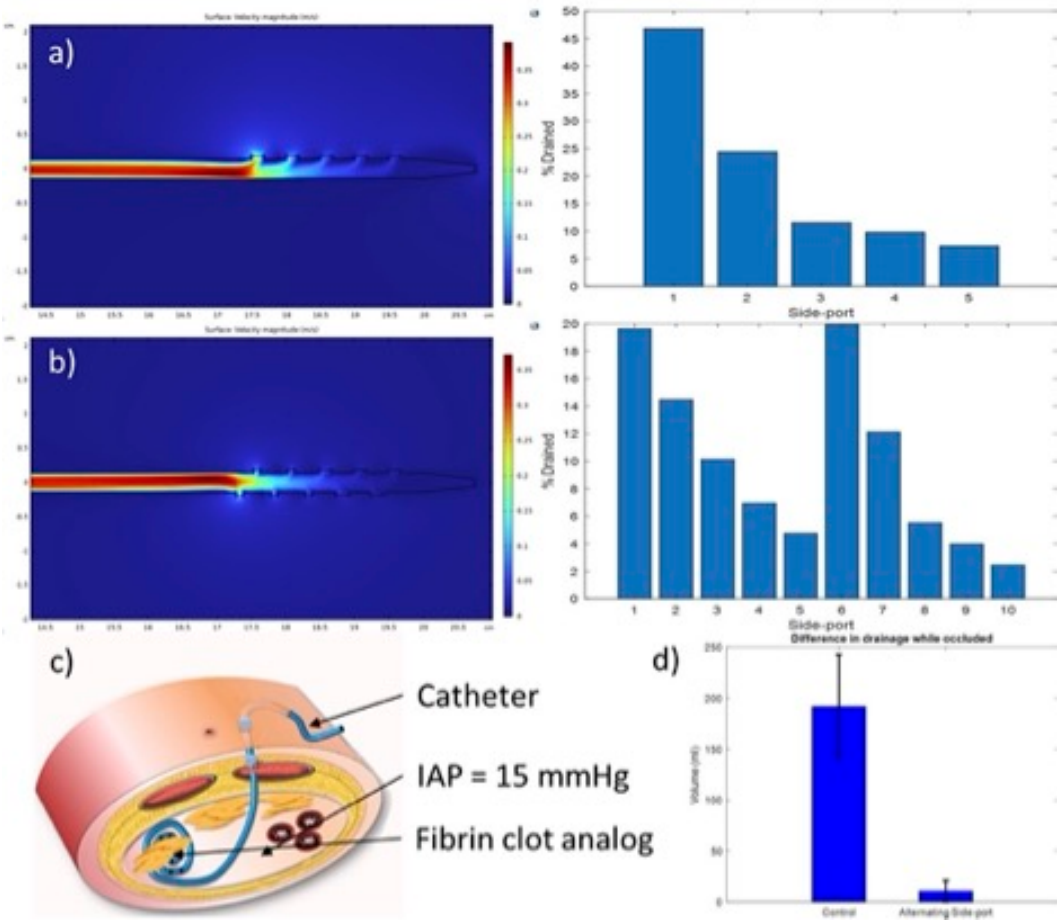

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Transdermal Measurement Detects GFR Changes during Cardiopulmonary Bypass: A Pre-Clinical Ovine Study

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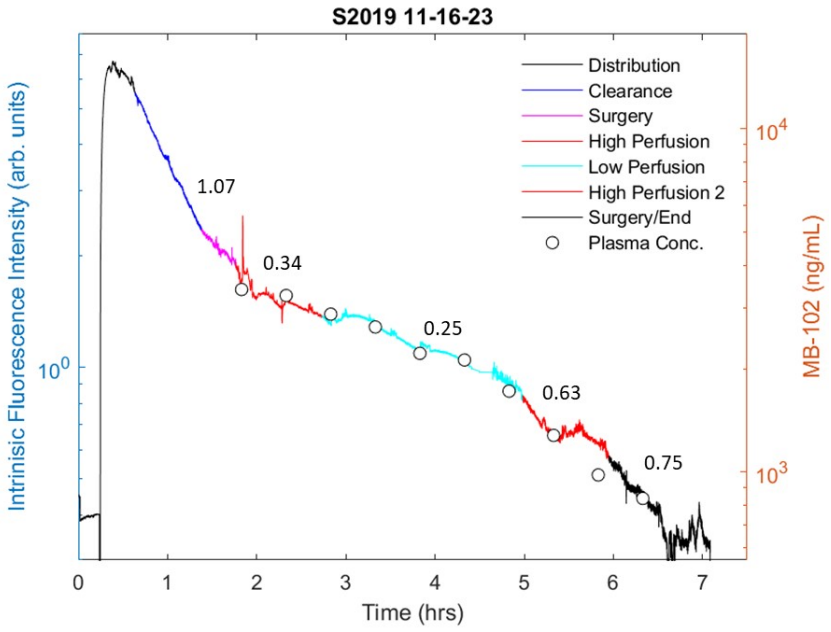
Background: Acute kidney injury (AKI) is associated with increased morbidity and mortality in patients undergoing CPB. AKI diagnosis currently depends on changes in serum creatinine and/or oliguria which are measured in the post-operative period. Relmapirazin (MB-102) is a fluorescent GFR marker detectable by transdermal measurement; decreases in transdermal fluorescent intensity can be translated continuously in real-time to an accurate GFR (tGFR) in patients with stable chronic kidney disease (CKD). We aimed to leverage continuous tGFR assessment to assess for potential GFR changes associated with renal perfusion in a CPB ovine model.

Methods: Experiments were conducted over a three day period. The tGFR sensor was attached and the sequence of studies were: 1) injection before CPB distribution then transdermal fluorescent monitoring pre-CPB (1 hour), during CPB (4 hours), and after (1 hour) CPB and 2) injection for 4 hours POD1 & POD2. CPB started with a high perfusion rate, then transitioned to a low rate and then back to a high rate. Plasma samples were collected hourly for MB-102 measurement during CPB.

Results: Continuous transdermal fluorescence intensity and hourly plasma MB-102 concentrations are depicted in the Figure. Numeric clearance rates (fluorescent intensity/hour) extrapolated from decrease in transdermal fluorescence are depicted next to each phase of the experiment. Transdermal clearance rate was 0.72/hour on POD1 and 0.99/hour on POD2.

Conclusions: Transdermal MB102 detection of fluorescent intensity approximated plasma disappearance closely. Transdermal MB102 detection of fluorescent intensity change occurred instantaneously with changes in renal perfusion on CPB. We detected persistent decrease in transdermal clearance rates on POD1 with recovery to baseline clearance POD2. We suggest real-time transdermal GFR assessment is possible during CPB with our technology.



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POCUS for diagnosis of congestive kidney due to severe acidemia

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A 51-year-old woman with mitochondrial myopathy with chronic heart failure was admitted due to loss of appetite and failure to thrive. She presented with acute kidney injury (AKI) and severe acidemia. Given her medical history and physical examination, prerenal causes (hypovolemia/hypotension) of AKI were considered most likely. However, with a significantly elevated NT-proBNP level of 14700, congestive kidney was also considered. Bedside echocardiography showed no evidence of low output syndrome, whereas VExUS (Venous Excess Ultrasound) Score indicated assessed as Grade 2 (moderate congestion). In addition to administering fluids for the suspected prerenal causes (hypovolemia/hypotension), sodium bicarbonate was administered suspecting a negative impact of severe acidemia on cardiac function. With the improvement of acidemia and only a small volume of fluid therapy, there was a rapid improvement in AKI with normalization of VExUS score. This suggested that the main cause of AKI was congestive kidney. This case demonstrated the significant contribution of VExUS in accurate diagnosis and treatment.

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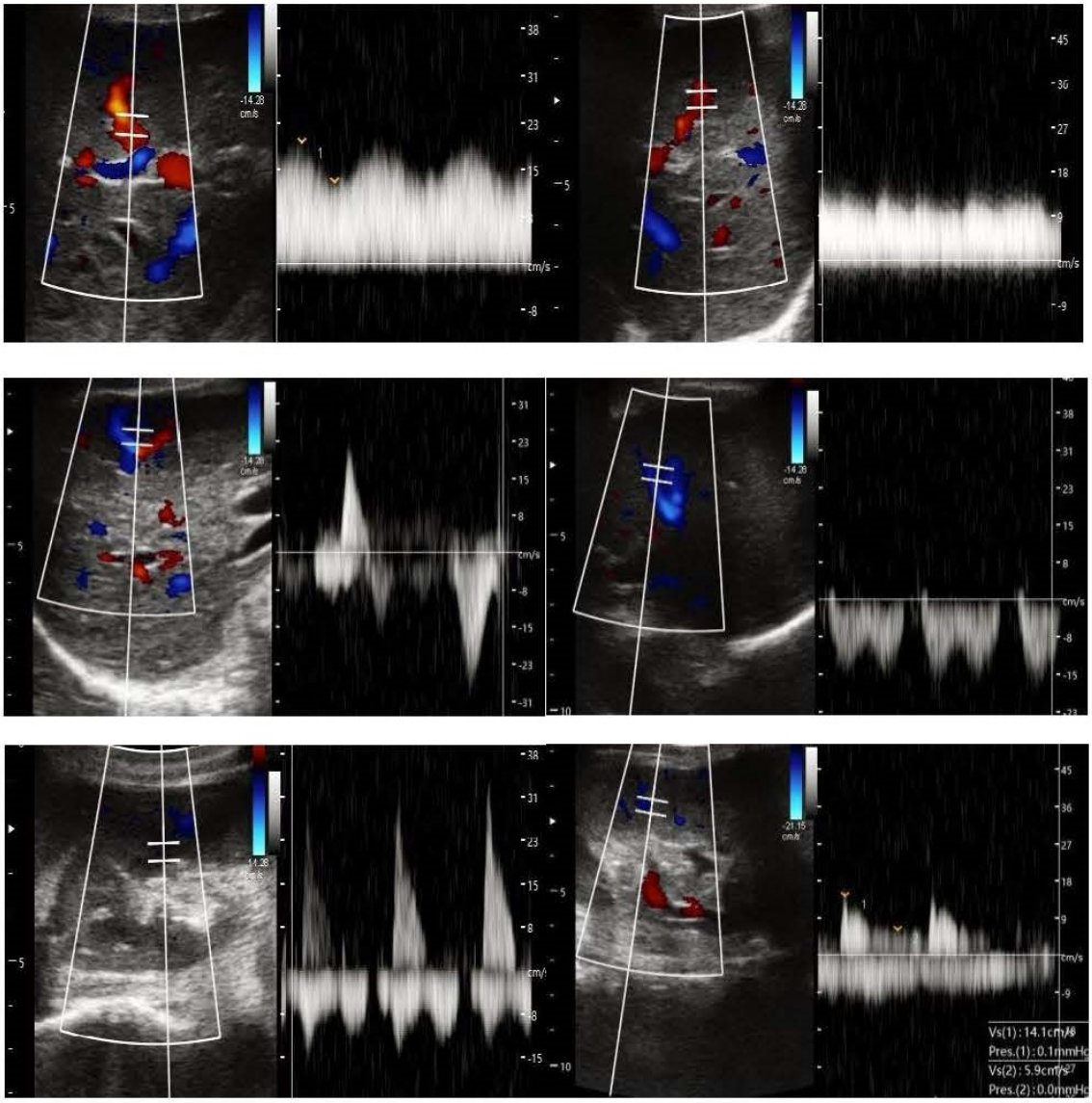
Figure: VExUS score before and after alkali administration

(A) Before alkali administration

VExUS: Grade 2, mildly abnormal

(B) After alkali administration

VExUS: Grade 1, normal



RRT RESEARCH

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When Time is Everything: Reducing Time to Continuous Renal Replacement Therapy Initiation

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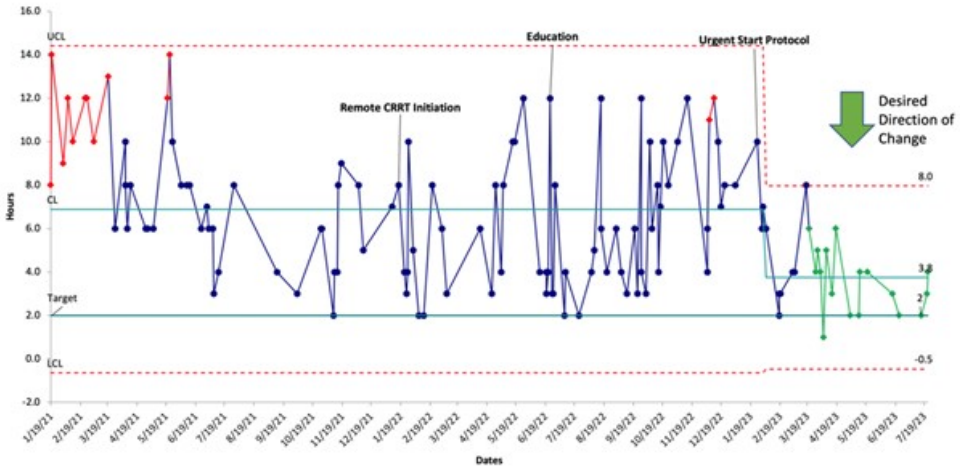
Purpose: Continuous renal replacement therapy (CRRT) is often used in critically ill patients and is an invasive and technically complex form of extracorporeal support. In some patients, such as those with hyperkalemia or inborn errors of metabolism with hyperammonemia, CRRT needs to be initiated quickly to prevent mortality or serious morbidity. The time from decision to initiate CRRT to CRRT initiation is often prolonged, leading to delays and poor patient outcomes. The purpose of this study is to make sustainable improvements in our time to CRRT initiation through new processes, ongoing education and continuous QI process improvement from baseline (2020) to current; the ultimate goal is achievement and sustaining CRRT <2 hours from decision to CRRT initiation.

Methods: Since 2020, Riley hospital CRRT committee maintained a prospective CRRT database. An interdisciplinary CRRT team meets monthly. After performing a current state assessment of barriers to timely CRRT initiation, the CRRT Team has completed several PDSA cycles including remote initiation (Winter 2021), education (Spring/Summer 2022), and an Urgent Start CRRT Protocol (Winter 2023). Time from decision to initiation of CRRT was determined based on placement of orders and documentation of CRRT initiation. In cases with delayed CRRT initiation, root cause analysis was performed to identify areas for future improvement.

Results / Conclusion: There was a sustained and significant decrease in the time to CRRT initiation during the multiple PDSA cycles throughout the 2.5 years of the project (Figure 1). The implementation of CRRT telemedicine initiations improved timeliness, with telemedicine starts occurring on average 3.0 hours after decision to initiate therapy compared to 5.8 hours for all in-person CRRT starts ($p < 0.001$). The largest improvement in timeliness occurred after the initiation of an Urgent Start Protocol, which has been used in 3 patients to date, resulting in time to initiation of 115, 90, and 70 minutes.

Figure 1. Statistical Process Control Chart of Time from Decision to Initiate to CRRT Initiation



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Impact of Daily Fluid Balance on Mortality in Patients with AKI on Continuous Kidney Replacement Therapy

Abigail Bradner[1], Akshith Doddi[1], Ambika Ramesh[1], Aisha Abbasi[1], Khaled Shawwa[1]

[1]*West Virginia University*

Background: Patients with multiple organ failure receive large amounts of resuscitative fluid; however, this places them at high risk for fluid overload (FO). Previous investigations on the impact of fluid balance on mortality in patients with AKI on continuous kidney replacement therapy (CKRT) has yielded conflicting results. Multiple studies have investigated fluid balance at different time intervals of CKRT, looking at initial or final fluid balance or after 72 hours of therapy. Previous reports have suggested a differential effect of sepsis on the relationship between fluid balance and mortality in this group of patients.

Methods: Patients with acute kidney injury (AKI) who required CKRT between 1/1/2012 and 1/1/2021 and were admitted to a tertiary academic hospital were included. Cox proportional hazard model was used to evaluate predictors of death during follow up. Daily fluid balance was treated as a time-dependent covariate.

Results: There were 669 patients with AKI that required CKRT during the study period. Over-all mortality was observed in 449 (67%) patients. Patients who died during follow up were older (62 vs 55), and had higher SOFA score (10 vs 9), higher norepinephrine equivalent (NEE) requirement (0.21 vs 0.16 mcg/kg/min), higher lactate (5.2 vs 3.4 mmol/L), lower mean arterial pressure (MAP) (75 vs 80 mmHg), and higher Charlson comorbidity index (8 vs 6) at CKRT initiation compared to survivors, $p<0.001$ for all comparisons. Fluid balance at time of CKRT initiation was comparable between survivors and non-survivors (0.9 vs 1.1, $p=0.5$). After adjusting for variables that were different between the two groups and clinically relevant ones (norepinephrine equivalents, mechanical ventilation, MAP and fluid balance at time of CRRT initiation, Charlson comorbidity index, age, sex, SOFA score, lactate and weight), daily fluid balance was associated with worse mortality in patients with (HR= 1.2, 95% confidence interval [CI] 1.18-1.26, $p<0.001$) or without sepsis (HR= 1.18, 95%CI: 1.07-1.3, $p<0.001$) per 1 Liter increase.

Conclusion: In this study, daily fluid balance, treated as a time-dependent covariate, showed association with mortality. This was independent of sepsis and septic shock.

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ChatGPT: Transforming CRRT Fluid Management - Revolutionizing Calculations for Lightened Nurse Workload and Enhanced Patient Care

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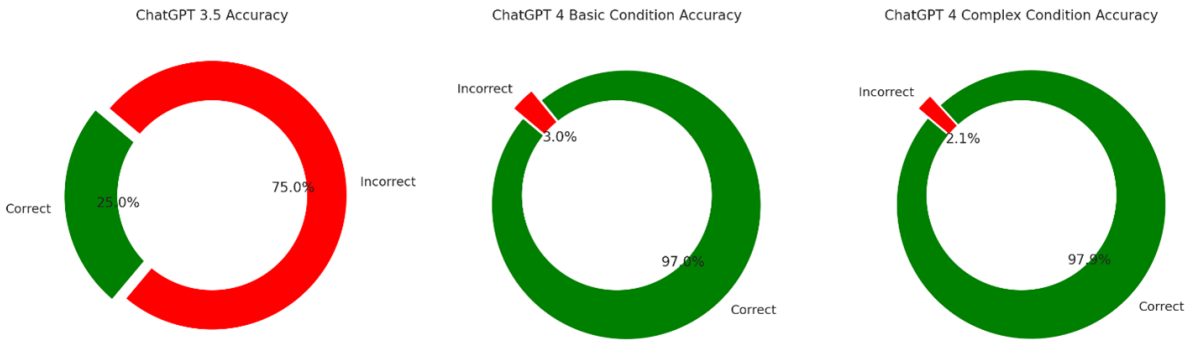
Background: Calculating ultrafiltration (UF) rates for Continuous Renal Replacement Therapy (CRRT) in critically ill patients is a complex and essential task in Intensive Care Units (ICUs). Chat Generative Pre-trained Transformer (ChatGPT) has the potential for various medical applications, from research to patient care. This study evaluates the performance of ChatGPT-3.5 and ChatGPT-4 in calculating UF rates.

Methods: We developed 100 hypothetical case scenarios with varying fluid removal goals, intakes, and outputs. ChatGPT-3.5 and ChatGPT-4 were provided these cases to calculate UF rates. Inaccurate initial calculations were corrected by providing the right formula to ChatGPT. Further complexity was added by incorporating intermittent intravenous fluids, blood products, and sudden changes in intake and output at various time intervals after starting fluid removal. The accuracy of calculating UF rates was assessed.

Results: ChatGPT-3.5 achieved a 25% accuracy rate (25 correct out of 100 cases) in calculating UF rates for CRRT. In contrast, ChatGPT-4 demonstrated a remarkable improvement, achieving 97% accuracy (97 out of 100 cases) under basic conditions and 98% (95 out of 97 cases) under added complexity.

Conclusion: ChatGPT-4 demonstrated significantly higher accuracy than ChatGPT-3.5 for complex CRRT UF rate calculations. This tool can offer a promising path for automating CRRT UF rate calculations, potentially alleviating the nurses' workload and enhancing the quality of healthcare delivery in ICUs.



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Prediction of Intradialytic Hypotension (IDH) by Machine Learning: A Systematic Review

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Introduction: Intradialytic hypotension (IDH) is a common complication associated with increased morbidity, mortality, and cardiovascular events. Several machine learning (ML) algorithms have been recently developed to predict IDH. We aim to systematically review the ML models employed to predict IDH, their performance, methodological integrity, and clinical applicability.

Methods: We conducted this systematic review with a pre-established protocol registered at the International Prospective Register of Systematic Reviews (PROSPERO ID: CRD42022362194). A comprehensive search was performed across six databases from inception to July 20, 2023. Two independent investigators (JN and NN) reviewed the articles, extracted data, and evaluated the risk of bias using the Prediction model Risk of Bias Assessment Tool (PROBAST).

Results: Out of 84 screened articles, 42 studies underwent full-text review to include 16 studies with 14,500 adult patients on hemodialysis and 2,349 patients with acute kidney injury receiving continuous renal replacement therapy. Fourteen studies (87.5%) were found to have a high risk of bias. The IDH incidence was reported between 1.2% and 51%. A diverse range of predictive ML tools were used to predict IDH, with eXtreme Gradient Boosting (XGBoost) being the most frequent, appearing in 7 studies (AUROC ranges: 0.82-0.97). Internal validation of ML models was conducted in 12 studies, while only one study performed internal and external validation.

Conclusions: While the need for prediction of IDH using ML tools led to significant efforts, lack of thorough external and clinical validation, heterogeneity among the models and settings has resulted in a significant challenge to offer ML tools as a global solution for IDH prevention and management. Future studies should focus on external and clinical validation of these models, to enhance chances of clinically relevant change in clinical practices.

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Survival Advantage of Early RRT Initiation during Pediatric ECMO

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Background and aims:
Acute kidney injury (AKI) and fluid overload are common comorbidities associated with increased morbidity and mortality in children supported with extracorporeal membrane oxygenation (ECMO). Understanding the optimal time to initiate RRT in neonatal and pediatric ECMO patients may influence their survival. The study aims to characterize RRT practices, timing of RRT initiation, and outcomes during ECMO support in children.

Methods:
Observational retrospective cohort study of children from birth to 18 years of age from the ELSO Registry Database who received ECMO support from January 1, 2016, to December 31, 2020. Primary outcome was mortality in a time-to-event analysis assessed at ECMO decannulation and hospital discharge. Multivariable Cox proportional-hazards model adjusting for a propensity score based on pre-ECMO factors was used to determine if the timing of RRT initiation was associated with improved survival.

Results:
Data for 14318 patients undergoing their first ECMO run were included in the study. Median age and weight were 71 days old (IQR, 3-983) and 4.3 kilograms (IQR, 3.2-13.6), respectively. Survival to ECMO decannulation and hospital discharge accounted for 82.5% and 60.4% of patients, respectively. Before ECMO initiation, AKI and chronic kidney disease occurred in 10.8% and 0.7% of the cohort, with RRT being initiated in 3.2% of patients. During ECMO support, 26.1% of patients received RRT, with a median time from ECMO cannulation to RRT initiation of 19 hours (IQR, 4-55). Multivariable logistic regression demonstrated that the need for RRT before ECMO cannulation and during ECMO support were independent predictors for mortality to ECMO decannulation and hospital discharge. In patients supported with RRT during ECMO, survivors to ECMO decannulation and hospital discharge were started on RRT significantly earlier (p 0.001 and p <0.001, respectively) compared to non-survivors. Patients initiated on RRT between 24-72 hours after cannulation were more likely to survive to decannulation and showed a trend towards survival to hospital discharge.

Conclusions:
The need for RRT before cannulation and during ECMO were independent factors for mortality to decannulation and hospital discharge. Initiation of RRT 24-72 hours after ECMO cannulation seems to provide a survival advantage compared to initiation <24 hours and >72 hours. Prospective studies on RRT initiation may improve outcomes in the pediatric ECMO population.

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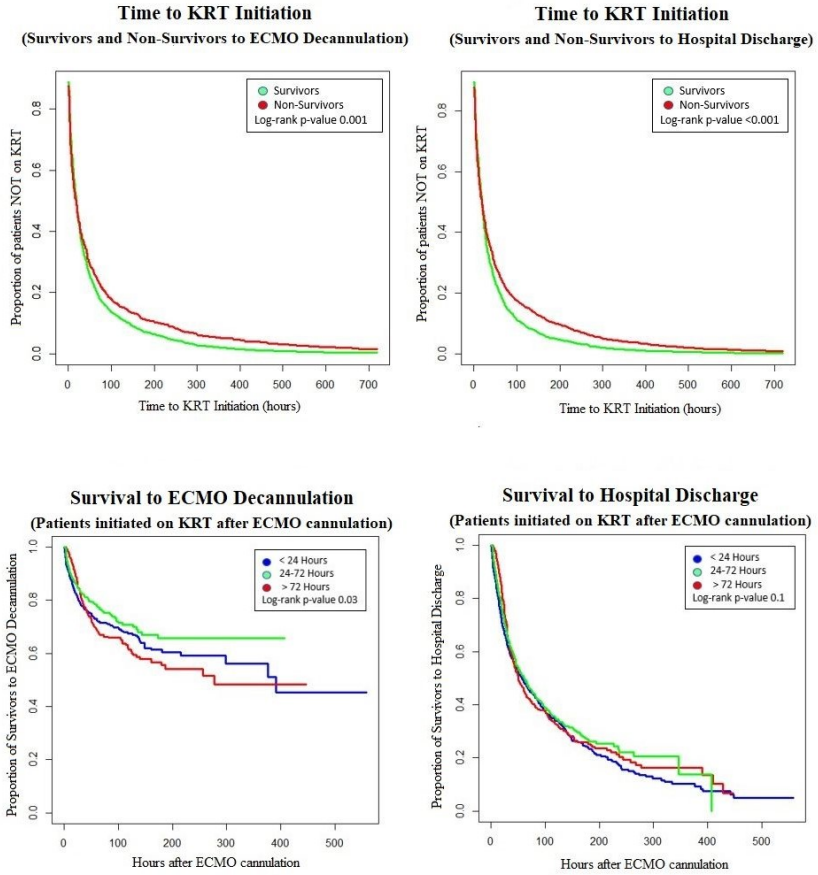

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Monte Carlo Simulations (MCS) of Various Cefepime Dosing Strategies in Adolescents Receiving CRRT Support Continuous Infusions for Pharmacodynamic Target Attainment

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Background: Adolescents receiving CRRT are a vulnerable population with high morbidity and mortality. Sepsis is a leading cause of acute kidney injury requiring CRRT; CRRT can alter drug pharmacokinetics (PK). Cefepime (FEP) is commonly used for sepsis and is cleared by CRRT, yet data regarding FEP PK and pharmacodynamic (PD) target attainment in adolescents receiving CRRT are scarce.

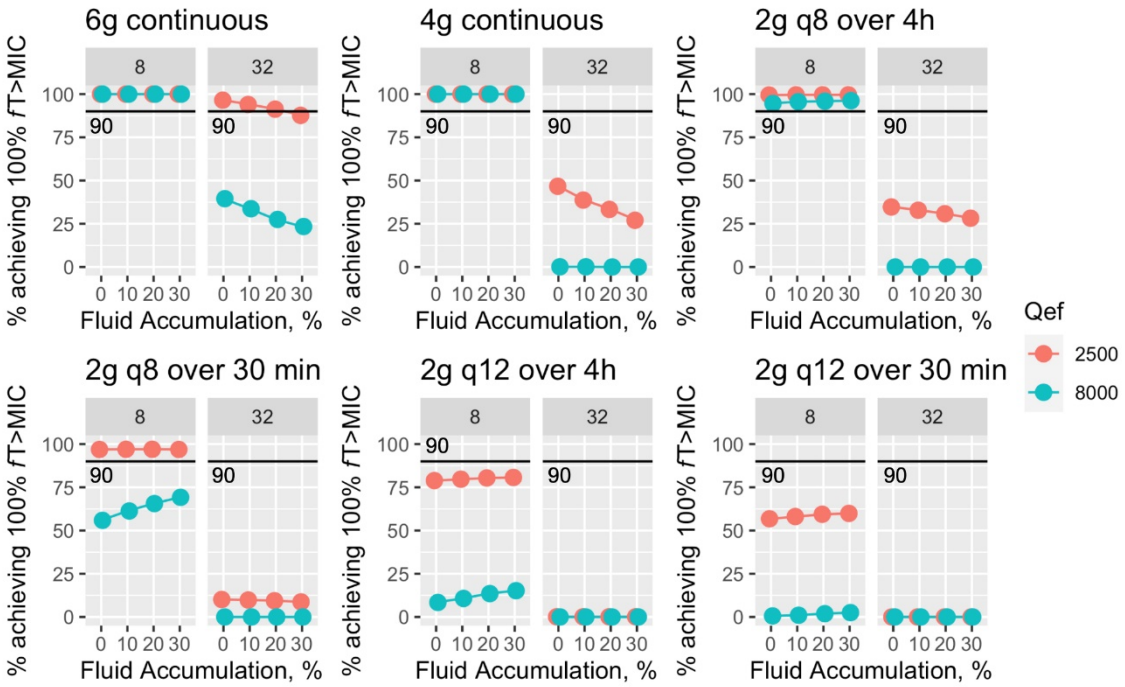
Materials: Using the precision dosing software MwPharm++ (Mediware, Czech Republic), we created a model "object" to account for elements of the CRRT prescription, including filter size, blood flow rate, dialysis/replacement fluid flow rates, drug sieving coefficient (expected dialysis membrane permeability, proportional to protein binding), and treatment duration. The object was based on a four-compartment PK model (central, peripheral, filter, cartridge) of meropenem in pediatric CRRT. This object was inserted into an existing pediatric FEP PK model and used for Monte Carlo

simulations (MCS). 1000-fold MCS were performed using six dosing strategies (Fig 1) in adolescents aged 12-25 years and ≥50 kg with negligible residual kidney function across two different CRRT prescriptions (standard-dose with total effluent flow [Qef] 2500 mL/hr/1.73 m^2 and high-dose with Qef 8000 mL/hr/1.73 m^2) and four fluid accumulation categories (0-30%). Since beta-lactam efficacy is based on the percentage of time that free drug concentration exceeds bacterial minimum inhibitory concentration (%fT>MIC), probability of target attainment (PTA) was assessed based on percentage of patients who achieved 100% fT>1xMIC and 4xMIC using an MIC of 8 mg/L for Pseudomonas aeruginosa.

Results: Results are summarized in Figure 1. Continuous infusions (CI) of 6g or 4g FEP or 2g over 4h every 8 hours allowed for >90% PTA for 100%fT>1x MIC in all cases. For, 100%fT>4x MIC, >90% PTA was only achieved by 6g CI for standard-dose dialysis and ≤20% fluid accumulation. Decreased PTA was seen with less frequent dosing, shorter infusions, and higher-dose CRRT.

Conclusions: A newly created CRRT-object was successfully inserted into an existing FEP PK model for investigating different FEP dosing strategies for adolescent patients on CRRT. The results suggest that when targeting 100% fT>4xMIC or using higher-dose CRRT, CI would allow for higher PTA than intermittent dosing.

Figure 1: Visual representation of simulation output. Black lines represent PD target of 90% probability of target attainment. *f*T>MIC: time free concentration exceeds minimum inhibitory concentration, q12: every 12 hours, q8: every 8 hours, Q_{ef}: total effluent flow, measure of dialysis dose provided.



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Continuous Renal Replacement Therapy and Mortality in Critically Ill Obese Adults

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Purpose: The outcomes of critically ill adults with obesity on continuous renal replacement therapy (CRRT) are poorly characterized. The impact of CRRT dose on these outcomes is uncertain. This study aimed to determine if obesity conferred a survival advantage for critically ill adults with acute kidney injury (AKI) on CRRT. Secondarily, we evaluated whether the dose of CRRT predicted mortality in this population.

Methods: A retrospective, observational cohort study performed at an academic medical center in Minnesota. The study population included critically ill adults with AKI managed with CRRT. The primary outcome of 30-day mortality was compared between obese [body mass index (BMI) ≥30 kg/m2] and non-obese (BMI <30 kg/m2) patients. Multivariable regression assessed was used to assess CRRT dose as a predictor of outcomes. An analysis included dose indexed according to actual body weight (ABW), adjusted body weight (AdjBW), or ideal body weight (IBW).

Summary of Results: Among 1,033 included patients, the median (IQR) BMI was 26 (23,28) kg/m2 in the non-obese group and 36 (32,41) kg/m2 in the obese group. Mortality was similar between groups at 30 days (54% vs. 48%; P = 0.06) but lower in the obese group at 90 days (62% vs. 55%; P = 0.02). CRRT dose predicted an increase in mortality when indexed according to ABW or AdjBW (HR 1.2-1.16) but not IBW (HR 1.04).

Conclusions: In critically ill adults with AKI requiring CRRT, short-term mortality appeared lower in obese patients compared to non-obese patients. Among weight calculations, IBW appears to be preferred to promote safe CRRT dosing in obese patients.

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CKRT Pediatric Mobility Pathway: a Pilot Study

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Purpose
Data on safety and feasibility of mobilizing pediatric patients on continuous kidney replacement therapy (CKRT) is limited. In alignment with the literature to support early mobility, the authors set out to confirm standard of care and establish a novel pediatric early mobility tool to address specific needs and considerations for patients on CKRT.

Methods
A national survey was distributed to hospitals to confirm the standard of care of mobility for pediatric patients on CKRT. Institutions were surveyed on mobility practices while patients were on circuit. Following the surveys, the CKRT Mobility Pathway was developed and adopted for use at our institution. An interdisciplinary team of authors, including intensive care and nephrology medical team providers, physical and occupational therapy clinicians, and nursing, defined clinical criteria within each mobility stage. The tool outlines exclusion criteria, assesses patient participation, daily clinical status, and maximizes medical line safety to promote the highest level of mobility. The pathway was then piloted. Retrospective data were collected and analyzed.

Results
A total of 25 survey responses were collected. Eighty-five percent of survey respondents reported they defer edge of bed or out of bed mobility for pediatric patients on CKRT as standard of care. Eighty percent of respondents reported they did not have an adopted tool to guide or assess risks for mobilizing their patients on CKRT. A total of 5 patients were included in the pilot study. The average age for included participants was 12 years. Twenty percent of included participants mobilized to the edge of bed and forty percent transferred out of bed while on circuit. There were no adverse events.

Conclusion
Mobility practices are limited and inconsistent for pediatric patients nationwide while receiving CKRT, and to our knowledge there is no mobility tool designed specifically for this population. Mobilization of pediatric patients is feasible and can be safe when risk factors are assessed. The novel CKRT Mobility Pathway can be used to guide mobility with consideration of nuanced medical and CKRT circuit management, and may support standardization of mobility practices across the interdisciplinary ICU team. This pathway has the potential to standardize language and mobility expectations, and promote earlier and safe mobility events for this patient population. The results from this small pilot study can guide future larger studies.

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Characteristics and Outcomes of Continuous Renal Replacement Therapy in Pediatric Sepsis: Report from the Worldwide Exploration of Renal Replacement Outcomes Collaborative in Kidney Disease (WE-ROCK)

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Purpose: Sepsis is common in the pediatric intensive care unit and often complicated by acute kidney injury (AKI). As there are no therapies for septic AKI, continuous renal replacement therapy (CRRT) is often needed. Limited data exist regarding characteristics and outcomes of children with sepsis requiring CRRT. We aimed to describe these elements in children with sepsis compared to those without, and identify factors associated with the development of Major Adverse Kidney Events at 90 days (MAKE-90).

Methods: A secondary analysis of WE-ROCK, an international (9 countries), multicenter (34 centers), retrospective study of subjects aged 0-25 years treated with CRRT for AKI or fluid overload (FO) from 2015-2021. Patients had sepsis if they met ≥2 SIRS criteria and were treated for infection at CRRT start. Patients suffered MAKE-90 if they had any of the following at 90 days: mortality, persistent kidney dysfunction (>25% eGFR decline), or RRT dependence. We compared 1) patients with sepsis vs. those without and 2) those with sepsis who suffered MAKE-90 vs. those who did not. Logistic regression was used to estimate odds ratios and 95% CI for MAKE-90 in children with sepsis.

Results: Among 1016 patients, 446 (44%) had sepsis at CRRT start and 650 (64%) suffered MAKE-90. At CRRT start, those with sepsis had higher severity of illness by PELOD-2 (7 [3-10] vs. 5 [2-7], p<0.001) and vasoactive-inotropic score (VIS) (10 [0-30] vs. 0 [0-13], p<0.001), and higher %FO (10% [4-21] vs. 6% [2-16], p<0.001). Children with sepsis were less likely to liberate from RRT by 28 days (30% vs. 38%, p<0.001), had longer duration of CRRT (7 days [5-15] vs. 5 [3-13], p=0.03), more MAKE-90 (70% vs. 61%, p=0.002) and higher mortality (47% vs. 31%, p<0.001); however, survivors were less likely to be RRT dependent at 90 days (10% vs. 18%, p=0.011). On univariable analysis, several factors were associated with MAKE-90 (Table 1). Only increasing age and duration of vasoactive support maintained associations with MAKE-90 on multivariable regression, while decreasing vasoactive support over the first

48 hours on CRRT was protective (Table 1).

Conclusions: Septic children requiring CRRT have unique clinical characteristics and outcomes, including higher rates of MAKE-90 but lower 90-day RRT dependence, compared to those without sepsis. Both duration of and trend in vasoactive support early in CRRT course appear to be potentially modifiable risk factors for MAKE-90 in this population.

Table 1: Univariate and multivariable analyses examining the association between demographic and clinical variables and the development of MAKE-90 in children with sepsis requiring CRRT.

Variable	Univariate Analysis (n=393)			Multivariable Analysis (n=393)		
	MAKE-90 (n=260)	No-MAKE-90 (n=133)	*p*	aOR	95% CI	*p*
Age, years	11 (3-16)	7 (2-13)	0.031*	1.05	1.01-1.09	0.006
Baseline Serum Creatinine, mg/dl	0.40 (0.23-0.65)	0.48 (0.35-0.62)	0.036*	0.69	0.44-1.08	0.10
PRISM III	14 (11-19)	16 (11-21)	0.18			
PELOD-2 at CRRT Initiation	6 (3-10)	6 (3-8)	0.49			
VIS at CRRT Initiation	10 (0-26)	6 (0-27)	0.50			
Time from ICU Admission to CRRT, days	2 (1-8)	2 (1-4)	0.22			
Initial CRRT Modality			0.94			
CVVH, n (%)	25 (9.6)	15 (11)				
CVVHD, n (%)	24 (9.2)	13 (9.8)				
CVVDHF, n (%)	206 (79)	104 (78)				
mCVVH, n (%)	2 (0.8)	0 (0)				
SCUF, n (%)	3 (1.2)	1 (0.8)				
Vasoactive Change 1st 48h CRRT			0.033*			
Never Required, n (%)	51 (20)	30 (23)		--	--	--
Unchanged/Increased, n (%)	62 (24)	17 (13)		0.93	0.39-2.22	0.87
Decreased, n (%)	146 (56)	86 (65)		0.51	0.26-1.01	0.05
Percentage of Day 1-7 of CRRT Requiring Vasoactives	50 (13-100)	38 (0-76)	0.006*	1.01	1.00-1.02	0.007
CRRT Dose Day 1-2, ml/kg	43 (32-58)	44 (32-60)	0.74			
CRRT Dose Day 1-7, ml/kg	43 (33-59)	45 (32-60)	0.92			
Time to First Negative Fluid Balance, days	1 (0-1)	1 (0-1)	0.77			
Median Fluid Balance Day 1-2, ml/kg/day	-6 (-19,7)	-7 (-21,10)	0.60			
Median Fluid Balance Day 1-7, ml/kg/day	-4 (-13,3)	-7 (-16,4)	0.087*	1.0	1.0-1.0	0.81

Continuous variables reported as median (IQR)

*Variables with $p<0.15$ on univariate analysis were included in the multivariable model, which also adjusted for center.

Abbreviations: PRISM III- Pediatric Risk of Mortality III score; PELOD-2- Pediatric Logistic Organ Dysfunction 2 score; VIS- vasoactive-inotropic score; CRRT- continuous renal replacement therapy; CVVH- continuous veno-venous hemofiltration; CVVHD- continuous veno-venous hemodialysis; CVVHDF- continuous veno-venous hemodiafiltration; mCVVH- modified continuous veno-venous hemofiltration; SCUF- slow continuous ultrafiltration

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Renal Replacement Therapy With A Cytokine Absorption Filter (Oxiris®) In Patients With Septic Shock: A Case-Control Study Nested In A Cohort

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Sepsis-associated acute kidney injury has a multifactorial etiology. Among therapeutic tools, hemoadsorption techniques seek to modulate the inflammatory response.

The development of the AN69 membrane allowed the creation of the oXiris hemofilter. The clinical evidence of the efficacy and safety of the oXiris filter is limited.

The authors raised the need to determine the effect of the use of hemofiltration with a cytokine removal filter (oXiris) on the reduction in 28-day mortality of patients with SA-AKI, as well as on the support dose vasopressor, oxygenation parameters and inflammatory markers.

Materials/methods: From Nov2020-May2023, a case-control study nested in a cohort was carried out in an ICU in Medellin, Col.Patients admitted to the ICU with diagnosis of septic shock of any origin according to Sepsis3, requirement for invasive ventilatory support and with AKI according to the KDIGO2012 classification and indication for RRT, were recruited. Follow-up was carried out from admission to discharge. Surviving patients were followed up after 28 days.Clinical Trials NCT04952714.

Results: 93 patients were recruted: 31 received treatment with the oXiris filter and 62 with the standard filter (AN69ST). The median age was 62 years(IQR 70–48). 53% of the population were men. The mean BMI was 27.7±5.
The main etiology was pulmonary origin(59.1%). Only 24% patients had SARS-COV2 infection.

Duration of RRT was 5 days(IQR 9–3), without a significant difference between groups. The onset time from admission was 2 days(IQR 8–1). Circuit anticoagulation was mainly with Heparin(61.2%). 11.8% patients were treated with Oxiris and anticoagulation with Citrate.

No adverse events related to the use of the Oxiris filter were reported.

Overall hospital mortality was 63.4% (64.5%vs62.9% p0.88). No differences were found in 28-day mortality(64.5%).The median LOS was 19 days(IQR 27.5–9.5), with no differences between groups(p0.072). A reduction in ventilation days was found in the Oxiris group(10vs19 p0.032). A difference is reported in the behavior of the SOFA score(p0.03) up to 72 hours.

Conclusions: CRRT with an oXiris filter reduces the levels of inflammatory cytokines in septic shock, translating into improvement in SOFA up to 72 hours. In our study, no differences were found in in-hospital or 28-day mortality probably due to the multicausal nature of mortality in the ICU. However, a significant difference was found in ventilation days in favor of the oXiris filter.

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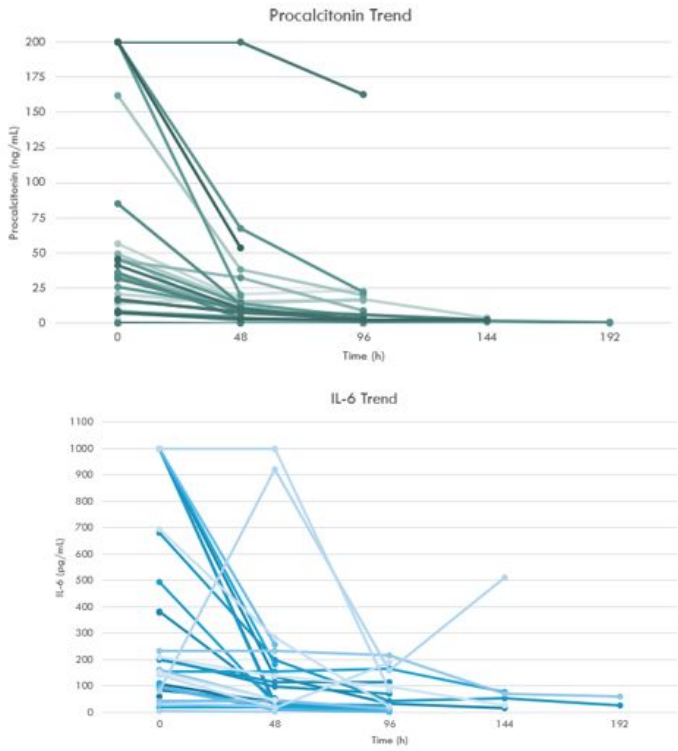

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Extracorporeal Membrane Oxygenation (ECMO) and Continuous Renal Replacement Therapy (CRRT): A Descriptive Review of Observations

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Introduction: Continuous Renal Replacement Therapy (CRRT) is a slow dialysis process, especially for hemodynamically unstable patients. It is indicated for patients in the ICU to correct acid-base and/or electrolyte disturbances and to maintain the desired volume balance. There are various strategies employed in the United States about the modalities of CRRT, including those performing hemofiltration only (Continuous Veno-Venous Hemofiltration/CVVH), hemodialysis (Continuous Veno-Venous Hemodialysis only/ CVVHD) or a combination of both (Continuous Veno-Venous Hemodiafiltration/ CVVHDF). During the COVID-19 pandemic, we observed an uptake in the number of patients requiring Extracorporeal Membrane Oxygenation (ECMO) as salvage therapies for severe Acute Respiratory Distress Syndrome (ARDS) and patients with cardiac dysfunction with or without respiratory compromise. Often, these patients require ECMO and CRRT in various combinations to maximize the efficacy [1]. Here, we analyze the different combinations of ECMO and CRRT, demographic data, incidence of hemolysis, and mortality rates, and assess dialysis dependence after 120 days following hospital discharge.

Methods: This is a retrospective study involving all patients with CRRT and ECMO from 2018-2022. All patients on ECMO were initially screened, with subsequent exclusion of patients not requiring CRRT while on ECMO. Baseline demographics, including gender, age, race, diagnosis requiring CRRT, ECMO, and whether patients were already on CRRT before ECMO initiation, chronic Hemodialysis (HD), were obtained.

Results: Electronic charts of 583 patients were analyzed. In this cohort, 79.9% were on Veno-Arterial ECMO (VA-ECMO), and 20.1% were on Veno-Venous ECMO (VV-ECMO). Of the 583 patients, 574 (84.4%) were White, 2.96% Black, 2.26% Asian, 1.39% American Indian or Alaska Native, while 9% were from other or unknown races. At ICU discharge, 64.15% were alive. The dialysis dependence at 120 days post-hospital discharge was 9.1%.

Conclusions: After analysis of patients on ECMO and CRRT, we found that most survivors were liberated from dialysis at the end of 120 days post-hospital discharge, while ICU mortality rates were 64%. This aligns with what was observed in other studies [1, 2]. The strength of this study is its larger sample size. The modifiable factors associated with kidney function recovery and ICU death are being evaluated.

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Outcomes in Transplant Patients on ECMO±CRRT

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Introduction: Patients receiving Extracorporeal Membrane Oxygenation (ECMO) frequently require concurrent use of Continuous Renal Replacement Therapy (CRRT) for management of Acute Kidney Injury (AKI) and its associated complications. Compared to ECMO alone, ECMO+CRRT associates with increased mortality.

Objective: To determine how clinical outcomes differ between non-transplant and transplant patients treated with either ECMO alone or ECMO+CRRT.

Methods: A single-center, retrospective study of adult patients admitted to the ICU at Mayo Clinic Rochester between January 2015 and March 2022. Patients treated with ECMO±CRRT during the study period were included.

Results: ECMO±CRRT was utilized in 565 patients, including 21 patients with a history of solid organ transplantation. Non-transplant patients were older (≥65 yrs, 37.9% vs. 14.3%, p=0.036) and had less hypertension (49.1% vs. 81.0%, p=0.006), and diabetes mellitus (27.0% vs. 61.9%, p=0.002). Non-transplant and transplant patients received ECMO alone (75.0% vs 66.7%, p=0.442) and ECMO+CRRT (25.5% vs 33.3%, p=0.442) comparably. Non-transplant and transplant patients treated with ECMO alone had similar median ICU LOS (8.0 days vs. 8.2 days, p=0.895) and median hospital LOS (18.9 days vs. 23.9 days, p=0.308). Non-transplant and transplant patients treated with ECMO+CRRT had similar median ICU LOS (17.8 days vs. 25.7 days, p=0.250), but transplant patients had significantly longer median hospital LOS (34.9 days vs. 129.2 days, p=0.016). Between non transplant and transplant patients, no differences in ICU mortality (OR 0.56; 95% CI 0.2-1.6) and hospital mortality (OR 0.79; 95% CI 0.32-1.93) were seen. Compared to use of ECMO alone, the use of ECMO+CRRT associated with increased ICU mortality (OR 1.77; 95% CI, 1.2-2.6).

Conclusion: Non-transplant and transplant patients receiving ECMO±CRRT had similar ICU and hospital mortality. Amongst patients treated with ECMO+CRRT, transplant patients incurred significantly longer hospital LOS. Future studies are needed to identify modifiable risk factors leading to longer hospital LOS among transplant patients who receive ECMO+CRRT.

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Validation of a Prognostic Model for Adverse Events In Advanced Chronic Kidney disease in the Chinese Population

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Background: Currently, the Grams model has been developed to estimate risks of adverse events among advanced chronic kidney disease （CKD） patients in Western populations. Its utility is noteworthy as it predicts multiple adverse events within a single model while taking competing risks into account. While no external validation has been conducted among Asian, especially Chinese population, restricting further practical application and clinical benefits evaluation. We aimed to validate the performance of Grams model for estimating risks of major adverse events among Chinese CKD population.

Methods: The Grams model was validated in the Chinese Cohort Study of Chronic Kidney Disease (C-STRIDE) study, a multicenter prospective cohort study. Participants with eGFR<30ml/min/1.73m2 during baseline and follow-up were enrolled. The discrimination and calibration of the model were evaluated using the concordance index （C index）, the ratio of observed and expected outcomes （O/E ratio）, and the calibration curve. The clinical usefulness of the model was assessed through decision curve analysis. Intercept recalibration was used to update the model.

Results: Among 1333 included participants (54(IQR-64） years（52.4%） male) （28.96%） developed KRT（ 8.85%） developed CVD（6.60%） died during the follow-up period. The Grams model showed a moderate to good discrimination for three outcomes, with 2-year C index of 0.720,0.656, and 0.712, and 4-year C index of 0.686,0.658, and 0.684, respectively. According to the O/E ratios and calibration curves, the calibration for KRT was relatively accurate (2-year O/E ratio 0.855;4-year O/E ratio 0.764, but the model overestimated the predicted probability of CVD (2-year O/E ratio:0.662;4-year O/E ratio:0.575and death(2-year O/E ratio:0.184;4-year O/E ratio:0.281. Intercept recalibration led to closer alignment of observed and predicted risks. Decision curve analyses revealed the superior net benefit of the Grams model compared with currently recommended eGFR threshold.

Conclusion: The Grams model exhibited moderate prediction performance in Chinese population. Despite its limitations, the model offered a superior net benefit over currently recommended decision strategy, suggesting its potential use in clinical decision-making processes. Further investigations are warranted to improve the performance of the Grams model in Chinese population.

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The Impact of Continuous Kidney Replacement Therapy on In-Hospital Mortality Among Patients Receiving Extracorporeal Membrane Oxygenation

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Background: In critically ill patients, the concurrent treatment with continuous kidney replacement therapy (CKRT) alongside extracorporeal membrane oxygenation (ECMO) has gradually increased. Integrating CKRT can benefit volume management and kidney function support in patients with acute kidney injury (AKI), but its effect on mortality is unclear and not well-defined. We aimed to evaluate the impact of CKRT on in-hospital mortality among patients receiving ECMO support.

Methods: A Retrospective study was conducted among critically ill patients receiving ECMO with or without CKRT at Mayo Clinic from 2015 to 2021. The patients were stratified into three groups based on their treatment: 1) ECMO alone, 2) ECMO with CKRT for volume management without AKI, and 3) combined ECMO and CKRT for AKI. Logistic regression was used to evaluate the independent association between CKRT with ECMO and in-hospital mortality.

Result: Of 202 patients receiving ECMO, the mean age was 57±17 years, and 61% were male. The overall in-hospital mortality rate was 56%. In the ECMO alone group, ECMO with CKRT for those without and with AKI, the in-hospital mortality rate was 39%, 92%, and 65%, respectively. Following adjustments for potential confounders, patients receiving ECMO with CKRT for volume management associated with in-hospital mortality with adjusted OR of 10.84 (95% CI 1.35-87.11). Patients ECMO with AKI associated with 20.4 (95% CI 2.40-148.69).

Conclusion: Receiving CKRT is associated with increased in-hospital mortality in patients with ECMO treatment, likely due to the impact of volume overload and AKI. Further comprehensive studies are required to assess contributed factors to predict and mitigate risks for better patient outcomes.

Table 1. Baseline characteristics

Characteristic	Total (n=202)	ECMO (n=109)	ECMO + CRRT without AKI (n=30)	ECMO + CRRT with AKI (n=63)	P-value
Age	57±17	58±16	66±14	52±17	0.008
Male	123(61)	65(59)	17(57)	41(66)	0.60
Race, White	172(85)	93(85)	28 (93)	51(80)	0.51
BMI (kg/m2)	29±6	29±6	29±5	30±7	0.66
Comorbidities, n (%)					
Diabetes	41(22)	20(19)	10(36)	11(19)	0.16
Hypertension	101(54)	56(54)	20(71)	25(43)	0.056
CHF	58(31)	31(30)	13(46)	14(25)	0.12
CAD	40(20)	20(18)	13(43)	7(11)	0.001
Cirrhosis	25(13)	14(14)	3(11)	8(14)	0.90
Sepsis during admit	85(43)	32(30)	15(50)	38(61)	<0.001
APACHE III score	102±35	95±33	101±33	116±34	0.005
AKI stage					<0.001
1	55(27)	31(28)	24(80)	0	
2	45(22)	16(15)	0	29(46)	
3	43(21)	9(8)	0	34(54)	
Sodium	142±5	140±5	144±3	143±5	<0.001
Potassium	4.4±0.7	4.1±0.6	4.6±0.8	4.7±0.8	<0.001
Chloride	100±6	100±6	100±4	100±6	0.76
HCO3	18±5	18±5	17±5	18±6	0.93
Calcium	10.3±1.8	9.5±1.6	10.9±1.8	10.7±1.7	0.001
Phosphorus	5.2±1.6	4.8±1.4	5.8±1.5	5.6±1.7	0.001
Magnesium	2.3±0.5	2.2±0.5	2.2±0.4	2.4±1.6	0.02
Albumin	2.8±0.6	2.8±0.7	2.6±0.6	2.7±0.6	0.47

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Clinical factors associated with hospital mortality in critically ill adult COVID patients with AKI requiring CRRT

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Background: Acute kidney injury (AKI) is a common complication of critically ill COVID patients which is associated with adverse outcomes. We examined clinical factors associated with hospital mortality in critically ill adult COVID patients with AKI who required continuous renal replacement therapy (CRRT).

Methods: We conducted a retrospective cohort study including data from two large academic medical centers: the University of Kentucky (UKY) and Mount Sinai (MS). Adult (age ≥18 years) patients with AKI requiring CRRT admitted from March 2020 to April 2021 were included in the study. Patients with end-stage kidney disease or renal transplantation were excluded. Multivariable Poisson regression analyses were used to identify clinical predictors of hospital mortality. Selected covariates were age, sex, race, mechanical ventilation use, days from intensive care unit (ICU) admission to CRRT initiation, and SOFA score at ICU admission or at CRRT initiation. Standardized mortality ratios were calculated for each site by dividing the number of observed deaths by the number of expected deaths. We used the mortality reported in the STOP COVID cohort for AKI patients requiring RRT to calculate the number of expected deaths.

Results: A total of 178 patients were included. Patients were predominantly men (68.2%) and white (57.9%). Median hospital and ICU lengths of stay were 20 days and 14 days, respectively. Mechanical ventilation and extracorporeal membrane oxygenation were utilized in 97.2% and 17.4% of patients, respectively. Overall, 130 (73.0%) patients died in the hospital (mortality rate of 2.7 per 100 person-days). In multivariable analyses, SOFA score ≥12 at ICU admission (MRRadj = 1.88; 95% CI 1.17 – 3.01) was associated with increased risk of mortality while black race (MRRadj = 0.56; 95% CI 0.31 – 1.01) was associated with a decreased risk of mortality. The standardized mortality ratios were 1.04 (95% CI 0.82 – 1.31) and 1.15 (95% CI 0.89 – 1.48) at UKY and MS, respectively.

Conclusions: More than two-thirds of critically ill adult COVID patients with AKI requiring CRRT died during hospitalization. SOFA score ≥12 at ICU admission was an independent predictor of hospital mortality, and black patients had lower risk of mortality. Further studies are needed to identify modifiable risk factors that can facilitate timely interventions in this susceptible population.

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Hyperglycemia and Kidney Outcomes in Critically ill Children and Young Adults on Continuous Renal Replacement Therapy

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Purpose: Hyperglycemia is common in critically ill children and young adults. Although studies investigating hyperglycemia in this group have shown neutral mortality outcomes, the data on the effects of hyperglycemia in young persons needing continuous renal replacement therapy, remain sparse. We sought to investigate the association of hyperglycemia on kidney and mortality outcomes in critically ill children treated with Continuous Renal Replacement Therapy (CRRT) using data from the WE-ROCK collaborative.

Methods: We performed secondary analysis of the multi-center multi-national retrospective WE-ROCK study. Exposure variables included glucose control during the first 7 days on CRRT. We defined those with average serum glucose of >150mg/dL per Pediatric Organ Dysfunction Information Update Mandate criteria as hyperglycemic and those with average serum glucose <150mg/dL as euglycemic. Our primary outcome was MAKE-90 (90-day mortality, or persistent kidney dysfunction [eGFR>125% baseline or dialysis dependence]).

Results: Of the 989 participants, 48% (477/989) were hyperglycemic during their first 7 days on CRRT. The groups were similarly matched with respect to severity of illness, only 3 participants had pre-existing diabetes mellitus. Insulin was used in 24% of participants in the hyperglycemic group and 6.8% in euglycemic group. The participants in the hyperglycemic group exhibited higher rates of death (44% vs. 32% p<0.001) and longer length of stay (46 vs 24 days p=0.018) compared to those in the euglycemic group (Table). Young persons with hyperglycemia demonstrated higher odds of MAKE-90 (OR 1.40, CI 1.02-1.8) however this association did not remain in multivariable modeling.

Conclusion: Among children and young adults on CRRT for AKI or fluid overload, hyperglycemia is associated with increased mortality and worse kidney outcomes, however these associations were blunted by their critical illness. Intensive glucose controls may improve kidney outcomes, however further studies are required to further evaluate this risk and define the optimal glucose ranges to improve outcomes in this high-risk population.

Clinical outcomes of euglycemia and hyperglycemia groups in children requiring CRRT

Characteristic	N	Euglycemia N=512	Hyperglycemia N = 477	p-value
In hospital mortality	989	162 / 512 (32%)	210 / 477 (44%)	**<0.001**
Successful of initial CRRT liberation	636	198 / 347 (57%)	143/ 289 (49%)	0.056
KST dependence at discharge	617	57 / 350 (16%)	45 / 267 (17%)	0.851
KST dependence at 90 days	621	51 / 351 (15%)	41 / 270 (15%)	0.820
SCr at 90 days	479	0.40 (0.26, 0.65)	0.46 (0.29, 0.73)	0.127
Length of stay	97	24 (10, 45)	46 (28, 98)	**0.018**
CRRT duration (days)	989	12.0 (7.3, 14.0)	5.5 (3.0, 11.0)	**0.048**

Association between MAKE 90 outcomes and Hyperglycemia

Characteristic (N=978)	Unadjusted OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Hyperglycemia	1.40	1.02,1.80	**0.038**	1.23	0.91,1.66	0.169

Adjusted for age, PELOD score prior to CRRT initiation, and presence of sepsis.

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Association of vasopressor use during renal replacement therapy (RRT) and survival

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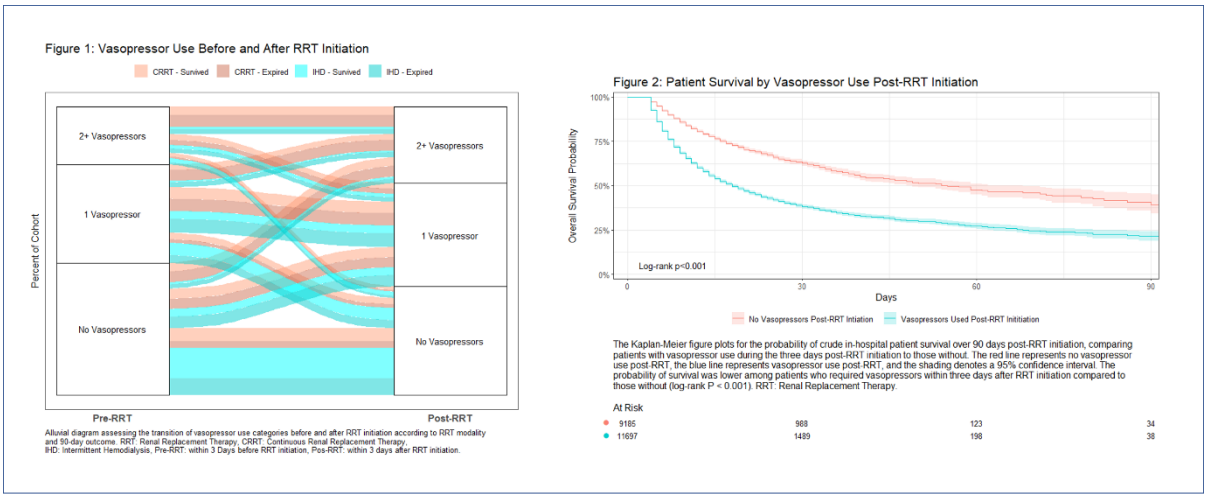
Introduction
Acute RRT modalities could contribute differentially to hemodynamic instability. Although vasopressors are used to treat hemodynamic instability, their impact on clinical outcomes after RRT initiation is unknown.
Methods
We analyzed adult critically ill patients with acute kidney injury requiring RRT in U.S. hospitals providing continuous RRT (CRRT) and intermittent hemodialysis (IHD) using the Premier PINC AI Healthcare Database; discharged from January 1, 2018 to June 30, 2021. Data on vasopressor and intravenous (IV) fluid use 3 days before and after RRT initiation were extracted. Cox regression was used to examine the effects of vasopressor and IV fluid use on hospital mortality by day 90, accounting for demographics, comorbidities, and ICU care processes. As the interaction between RRT modality and vasopressor use on mortality was significant, the final analysis was stratified by initial RRT modality.
Results
Of 20,996 patients analyzed, the mean age was 63 years, 38% were women, and 37% were treated with CRRT. 72% of patients received vasopressors (16% pre-RRT, 21% post-RRT, and 35% pre- and post-RRT). 77% of CRRT and 44% of IHD patients received vasopressors after RRT initiation (Fig 1). Lower 90-day survival was found in patients with vasopressor use post-RRT initiation (21%, 95% CI:19%-24%) compared to patients without (39%, 95% CI: 34%-45%; p<0.001; Fig 2). Stratifying by RRT modality and adjusting for age, sex, race, surgical admission, COVID-19, septic shock, ECMO, mechanical ventilation, and days in the ICU before RRT initiation, an independent association with hospital mortality was found with both modalities for the number of vasopressors used (CRRT, 1 pressor: HR 1.51, 95% CI: 1.37-1.66; 2 pressors: HR 1.96, 95%CI: 1.78-2.16; IHD, 1: HR 1.58, 95%CI: 1.47-1.69; 2+: HR 2.22, 95%CI: 2.04-2.42), and average daily IV fluid use (CRRT, middle tertile: HR 1.11, 95% CI: 1.01-1.21; top tertile: HR 1.17, 95%CI:1.08-1.28; IHD, middle tertile: HR 1.14, 95%CI: 1.07-1.23; top tertile: HR 1.12, 95%CI: 1.04-1.21). There was no interaction between vasopressor and IV fluid use on mortality.
Conclusion
Vasopressor use and higher average daily IV fluid use during the 3 days following RRT initiation were both independently associated with higher hospital mortality in patients initiated on CRRT or IHD, regardless of vasopressor use before RRT. The magnitude of risk was more significant in patients receiving multiple vasopressors post-RRT initiation.



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Reintubation in Critically Ill Children and Young Adults on Continuous Renal Replacement Therapy

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PURPOSE: Fluid overload (FO) and acute kidney injury (AKI) are known contributors to longer duration of mechanical ventilation (MV), extubation failure (EF), and prolonged length of stay in critically ill adults and children. However, the relationship between FO and AKI necessitating treatment with continuous renal replacement therapy (CRRT) and MV and extubation outcomes are not well-described in the pediatric literature. We sought to describe rate of reintubation/extubation failure (EF) and to identify factors associated with reintubation/EF in this population.

METHODS: A secondary analysis of WE-ROCK database of young persons (< 25 years) receiving CRRT for AKI or FO from 2015 to present. Our primary outcomes were 1) reintubation (any second intubation), and 2) EF (reintubation < 72 hours after initial extubation). We compared those with reintubation/EF to those successfully extubated.

RESULTS: Of 1,016 patients in the cohort, 876 required MV (86%). Excluded were 107 patients for missing data, so 769 (88% of MV cohort) were included. Overall, 6.5% (50/769) of patients experienced reintubation and 2.7% (20/739 with specific MV data) failed extubation (Table 1). Patients on CRRT at time of initial extubation were at significantly higher risk of reintubation and EF (p<0.001). Fluid overload was not found to be significantly associated with reintubation or EF.

CONCLUSIONS: In a retrospective, multicenter, multinational study of children and young adults treated with CRRT for AKI or FO, those on CRRT at time of extubation were more likely to experience reintubation/EF, though FO was not significantly associated with either outcome. To our knowledge, this is the first study investigating MV and extubation outcomes in this patient population.

Characteristics and Outcomes		Reintubation				Extubation Failure		
	N	**No**, N = 719	**Yes**, N = 50	p-value	N	**No**, N = 719	**Yes**, N = 20	p-value
Age, years	769	7.8 (1.4, 14.7)	11.1 (1.6, 14.4)	0.410	739	7.8 (1.4, 14.7)	12.6 (4.8, 17.3)	0.090
Age categories	769			0.791	739			0.591
<1 month		39 (5%)	4 (8%)			39 (5%)	1 (5%)	
1 month – 1 year		105 (15%)	7 (14%)			23 (3%)	1 (5%)	
1-5 years		164 (23%)	8 (16%)			164 (23%)	2 (10%)	
5-15 years		240 (33%)	19 (38%)			105 (15%)	2 (10%)	
5-21 years		148 (21%)	10 (20%)			240 (33%)	9 (45%)	
>21 years		23 (3%)	2 (4%)			148 (21%)	5 (25%)	
Female sex	769	327 (45%)	20 (40%)	0.451	739	327 (45%)	8 (40%)	0.627
ICU admission weight (kg)	764	24 (11, 53)	30 (11, 51)	0.772	734	24 (11, 53)	39 (15, 58)	0.319
Body Mass Index	763	19 (16, 23)	18 (16, 23)	0.430	733	19 (16, 23)	17 (15, 22)	0.375
Baseline SCr (mg/dL)	442	0.41 (0.26, 0.64)	0.40 (0.23, 0.63)	0.800	422	0.41 (0.26, 0.64)	0.55 (0.37, 0.66)	0.131
ICU admission SCr (mg/dL)	768	0.88 (0.44, 1.76)	0.81 (0.49, 1.81)	0.852	739	0.88 (0.44, 1.76)	1.13 (0.59, 2.43)	0.261
Initial modality of CRRT	766			0.862	736			0.632
CVVH		56 (8%)	2 (4%)			56 (8%)	1 (5%)	
CVVHD		66 (9%)	4 (8%)			66 (9%)	0	
CVVHDF		576 (80%)	44 (88%)			576 (80%)	19 (95%)	
mCVVH		8 (1%)	0			8 (1%)	0	
SCUF		10 (1%)	0			10 (1%)	0	
%FO at initial extubation	156			0.478	146			>0.999
<5%		26 (18%)	2 (18%)			26 (18%)	0	
5-10%		22 (15%)	1 (9%)			22 (15%)	0	
10-20%		39 (27%)	1 (9%)			39 (27%)	0	
>/=20%		58 (40%)	7 (64%)			58 (40%)	1 (100%)	
CRRT at initial extubation	253	108 (46%)	18 (90%)	**<0.001**	243	108 (46%)	10 (100%)	**<0.001**
ICU length-of-stay (days)	769	24 (12, 44)	48 (26, 73)	**<0.001**	739	24 (12, 44)	37 (26, 70)	0.006
CRRT duration (days)	769	7 (3, 15)	14 (6, 42)	**<0.001**	739	7 (3, 15)	15 (8, 23)	**0.002**
Total mechanical ventilation duration (days)	401	11 (6, 23)	19 (11, 36)	**0.008**	388	11 (6, 23)	22 (12, 47)	0.053
Hospital length-of-stay (days)	769	35 (20, 67)	63 (38, 92)	**<0.001**	739	35 (20, 67)	58 (37, 88)	**0.025**
In-hospital mortality	769	297 (41%)	24 (48%)	0.353	739	297 (41%)	5 (25%)	0.143
Serum creatinine at hospital discharge (mg/dL)	378	0.42 (0.26, 0.73)	0.58 (0.42, 0.80)	**0.028**	370	0.42 (0.26, 0.73)	0.58 (0.45, 0.80)	0.065
Serum creatinine at 90 days	369	0.40 (0.26, 0.65)	0.52 (0.36, 0.92)	**0.039**	358	0.40 (0.26, 0.65)	0.53 (0.42, 0.91)	0.052

Data are represented as median (IQR) and compared using Wilcoxon rank sum test; categorical data are represented as n (%) and compared using Fisher's exact test and Pearson's Chi-squared test as appropriate for individual variables
Abbreviations: CVVH: continuous venovenous hemofiltration; CVVHD: continuous venovenous hemodialysis; CVVHDF: continuous venovenous hemodiafiltration; mCVVH: modified continuous venovenous hemofiltration; FO: fluid overload; SCr: serum creatinine; SCUF: slow continuous ultrafiltration

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Sex Differences in Mortality Among Critically Ill Patients Receiving Continuous Kidney Replacement Therapy

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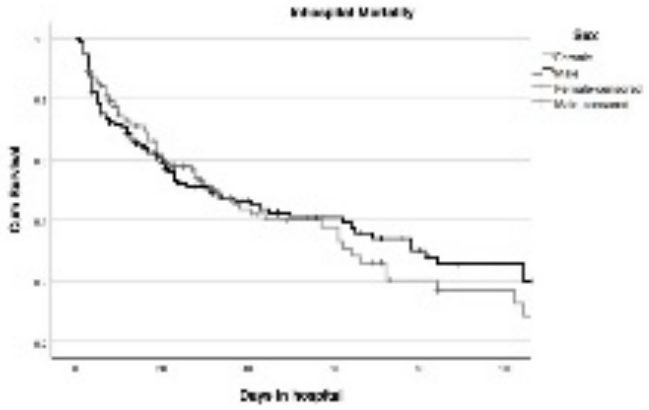
Introduction
In critically ill patients, disease severity and comorbidities are known factors affecting patient outcomes. However, the impact of biological sex on patient outcomes in critically ill patients requiring continuous kidney replacement therapy (CKRT) remains unknown.

Methods
This is a propensity score-matched retrospective study based on the patients who received CKRT from March 2013 to December 2022 at the 3rd affiliated hospital in South Korea. Adult patients received CKRT were included, and end-stage kidney disease patients on maintenance dialysis were excluded. The outcome measurement was in-hospital mortality.

Results
Among the 3,556 adult patients received CKRT, 63.5% were male. The mean age was 65.2±14.2 years, and the proportion of hypertension and diabetes were 52.5% and 46.1%, respectively. Male patients were younger by 2.6 years and had slightly higher SOFA scores than females. Trauma, surgery, and ventilator requirement were more frequent in male patients. After a 1:1 propensity-score match (PSM), 145 patients from each group with no difference in age, comorbidity, and disease severity were retrieved for the analysis. In the PSM model, CKRT was applied median of 4(2-7) days, with median CKRT doses of 31.3(29.2, 33.1). In median 19(7-35.5) days of hospital stay, 53.8% of the patient died, and there was no difference on in-hospital mortality between male (57.9%) and female (49.7%, p=0.159) patients. Kaplan-Meier survival analysis showed the same trend (Log rank=0.747)(Fig. 1). In the cox proportional hazard model, only old age (HR 1.013(1.001-1.023)) and higher SOFA score (HR 1.098(1.050-1.149)) was associated with increased risk of in-hospital mortality.

Conclusion
In critically ill patients required CKRT, biologic sex made no difference for in-hospital mortality. Kidney outcome and long term patient outcome needs to be further evaluated.



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Dimensions and Dynamics in Pediatric Continuous Renal Replacement Therapy

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BACKGROUND

Continuous renal replacement therapy (CRRT) is commonly utilized in the intensive care unit for management of kidney dysfunction. Few studies have investigated the underlying fluid dynamics of these circuits leading to a critical gap in our understanding of safe and effective dialysis treatments. This gap has also stunted our growth in advancing extracorporeal devices for the pediatric population. Thus, we sought to describe the fluid dynamics in a cohort of pediatric patients.

METHODS

This retrospective review included 22 children, aged 0-26 years, previously admitted to the University of Iowa Stead Family Children's Hospital Neonatal or Pediatric Intensive Care Unit for CRRT (filter sizes HF20, M60, and HF1000, IRB 202212339). Patient body surface area (BSA) at CRRT start and average blood flow between 24-48 hours post-CRRT start were collected. Similar data was collected for pressure drop and access, filter, effluent, return, and transmembrane pressures. Linear regression models were used to investigate associations between blood flow, BSA, and CRRT pressures.

RESULTS

A significant correlation was found between patient BSA and blood flow ($p < 0.001$). A positive correlation was found between BSA and transmembrane pressure ($p = 0.005$). A positive correlation was also found between blood flow and pressure drop and filter pressure ($p = 0.033$ and $p = 0.014$, respectively. Furthermore, this positive correlation between blood flow and filter pressure were only significant for the HF20 filter ($p < 0.001$).

CONCLUSION

These data suggest patient blood flow drives CRRT pod pressures and has created a standardized approach for choosing CRRT circuits by BSA and blood flow. These data may also point to important characteristics for pediatric extracorporeal device developers to consider when designing pediatric specific devices in the future.

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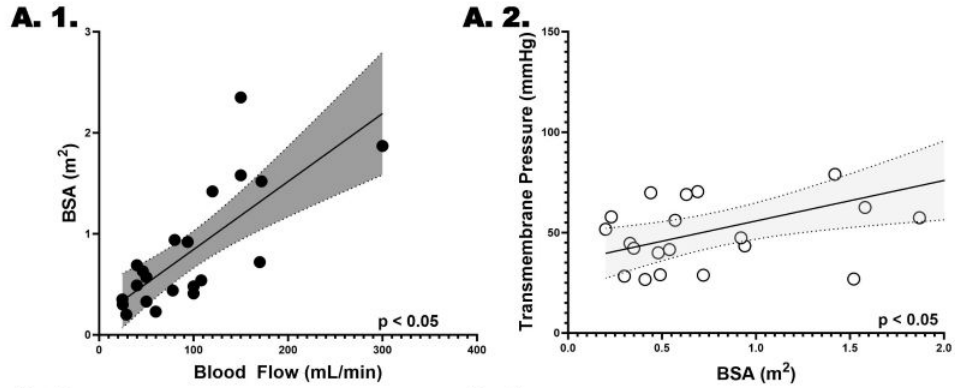

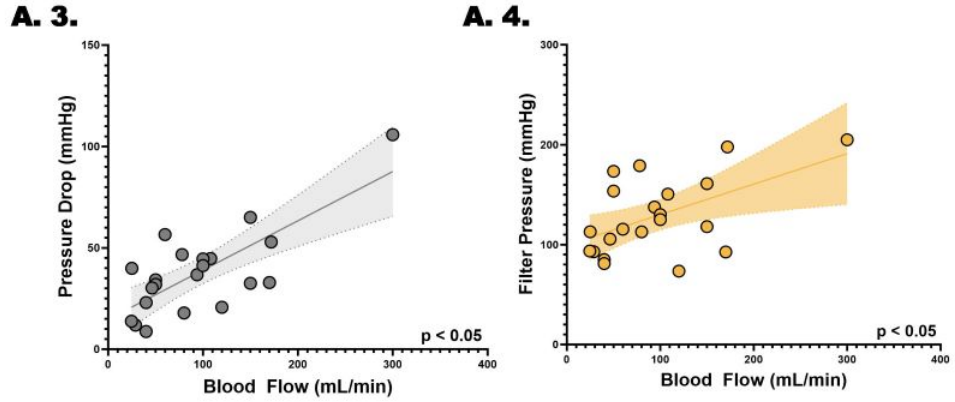

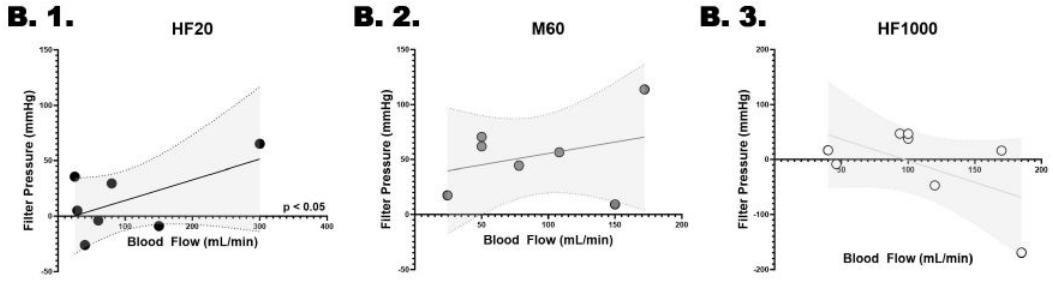

Table 1.	Std. Error	R^2	F-Statistic	p-value
A.1. BSA: Blood Flow	16.29	0.5897	28.75	**< 0.001**
A.2. BSA: Transmembrane Pressure	7.494	0.3314	9.915	**0.005**
A.3. Blood Flow: Pressure Drop	7.073	0.2088	5.279	**0.033**
A.4. Blood Flow: Filter Pressure	12.93	0.2785	7.336	**0.014**
B.1. Blood Flow: HF20 Filter Pressure	7.262	0.9193	56.92	**< 0.001**
B.2. Blood Flow: M60 Filter Pressure	28.44	0.1264	0.7237	0.434
B.3. Blood Flow: HF1000 Filter Pressure	38.81	0.3078	2.669	0.154

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The Impact of Hypermagnesemia on Clinical Outcomes in Patients Receiving Continuous Kidney Replacement Therapy

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Introduction:
Preliminary studies have reported that an increase in magnesium levels may improve renal recovery in specific types of acute kidney injury (AKI) patients. However, it remains uncertain whether hypermagnesemia improves outcomes in all AKI patients, and the impact of hypermagnesemia during continuous kidney replacement therapy (CKRT) on the prognosis of CKRT patients remains unclear. Therefore, the objective of this study was to investigate the relationship between serum magnesium levels and clinical outcomes in CKRT patients.
Method:
We conducted a retrospective analysis of data from 2,625 all-cause AKI patients who underwent continuous kidney replacement therapy (CKRT) recorded in the Chang Gung Research Database, a multicenter medical repository, spanning from January 1, 2001, to December 31, 2019. Patients were stratified into two groups based on their serum magnesium levels at the initiation of CKRT: normal (1.3-2.0 meq/L) and high (≥2.0 meq/L). In-hospital mortality, 90-day renal recovery, one-year ventricular arrhythmia, and one-year all-cause mortality were compared between the two groups using inverse probability of treatment weighting. Weights were estimated through generalized boosted models adjusted for potential confounders.
Results:
Among the 2,625 patients, 1,194 (36.4%) had elevated serum magnesium levels at the commencement of CKRT. The high magnesium group exhibited a higher in-hospital mortality rate than the normal magnesium group (76.2% vs. 72.7%, p=0.028). After adjustment, high magnesium was independently associated with an increased risk of in-hospital death (odds ratio [OR] 1.20, 95% confidence interval [CI] 1.06-1.37). Moreover, the high magnesium group showed higher one-year all-cause mortality (OR 1.14, 95% CI 1.07-1.21) and an elevated risk of one-year ventricular arrhythmia (OR 4.77, 95% CI 1.59 - 14.29). Patients with hypermagnesemia exhibited 90-day renal recovery rate similar to that of individuals with normal magnesium levels.
Conclusion:
Our study provides evidence that hypermagnesemia is linked to worse clinical outcomes in patients undergoing CKRT. Furthermore, hypermagnesemia did not associated with improved renal recovery in CKRT patients. Close monitoring and correction of serum magnesium levels are recommended in this population to enhance overall outcomes.

		Before GBM-IPTW	Before GBM-IPTW	After GBM-IPTW	After GBM-IPTW	After GBM-IPTW	
	Total (n = 2,625)	Mg >2.0 (n = 1,194)	Mg 1.3-2.0 (n = 1,431)	Mg >2.0 (n = 2415.1)	Mg 1.3-2.0 (n = 2453.6)	Odds ratio of Mg > 2.0	P value
In-hospital death	1956 (74.5)	916 (76.7)	1040 (72.7)	76.2	72.7	1.20 (1.06, 1.37)	0.005
90-day renal non-recovery	1638 (62.4)	736 (61.6)	902 (63.0)	63.1	62.8	1.01 (0.90-1.14)	0.845
1-year all-cause death	2023 (77.1)	942 (78.9)	1081 (75.5)	78.4	75.6	1.14 (1.07-1.21)	<0.001
1-year ventricular arrythmia	7 (0.3)	5 (0.4)	2 (0.1)	0.8	0.2	4.77 (1.59-14.29)	0.005

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Regional citrate anticoagulation in membrane therapeutic plasma exchange: a retrospective study

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PURPOSE: Heparin or low molecular weight heparin (LMWH) is the most common anticoagulant in membrane therapeutic plasma exchange (mTPE). For patients with bleeding risk, no anticoagulation strategy is usually chosen, which would result in a shorter filter lifespan. Regional citrate anticoagulation (RCA) has a satisfying anticoagulation efficacy and does not increase bleeding risk. However, RCA use is limited in mTPE even in patients with bleeding risk due to the lack of evidence. Thus, we aimed to investigate the efficacy of RCA in a retrospective observational study.

METHODS: Patients undergone mTPE at Peking University First Hospital in 2021 were involved in the study. mTPE sessions are divided into LMWH group, RCA group and no anticoagulation (NA) group. Endpoints were defined as therapy interruption due to clotting and clot in vein ampulla. Comparisons among 3 groups were performed using Kruskal-Wallis H test for continuous data and Chi-square test for categorical data. The efficacy of the 3 anticoagulation strategies was assessed by binary logistic regression analysis.

RESULTS: A total of 132 patients with 508 mTPE sessions were involved in the analysis. 328 sessions were divided into LMWH group, 40 sessions into RCA group and 40 sessions into NA group. NA group has longer PT, lower platelet counts than the other 2 groups (PT: 14.03±1.31s in NA, 11.06±1.29s in LMWH, 11.04±1.10s in RCA group, $p < 0.001$; platelet counts: 87.45±101.89 ×109/l in NA, 198.88±79.11×109/l in LMWH, 179.15±101.62 ×109/l in RCA group, $p < 0.001$), APTT was not statistically different among the 3 groups. However, NA group has the highest rate of therapy interruption (10.0% in NA, 4.8% in LMWH, 2.1% in RCA group, $p < 0.001$) and clot in vein ampulla(12.5% in NA,5.2% in LMWH, 4.3% in RCA group, $p < 0.001$).
On adjustment by PT, APTT, platelet level, compared with LMWH coagulation, NA showed a 3.3-fold risk of therapy interruption due to clotting (95%CI:0.74-14.90), while RCA showed a 0.51-fold risk of therapy interruption (95%CI:0.14-1.80), but the differences did not reach statistical significance. Similarly, compared with LMWH coagulation, NA showed a much higher risk of clot in vein ampulla (OR:11.6, 95%CI:2.68-50.3), while RCA showed a similar risk of clot in vein ampulla (OR: 1.07, 95%CI:0.30-3.76).

CONCLUSION: RCA is as effective as LMWH anticoagulation and better than NA in mTPE. In patients with increased bleeding risk, RCA should be adopted in mTPE rather than NA.

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DICAM Is A Prognostic Indicator For Mortality In Critically Ill Patients With Acute Kidney Injury Requiring Continuous Kidney Replacement Therapy: A Multicenter Cohort Study

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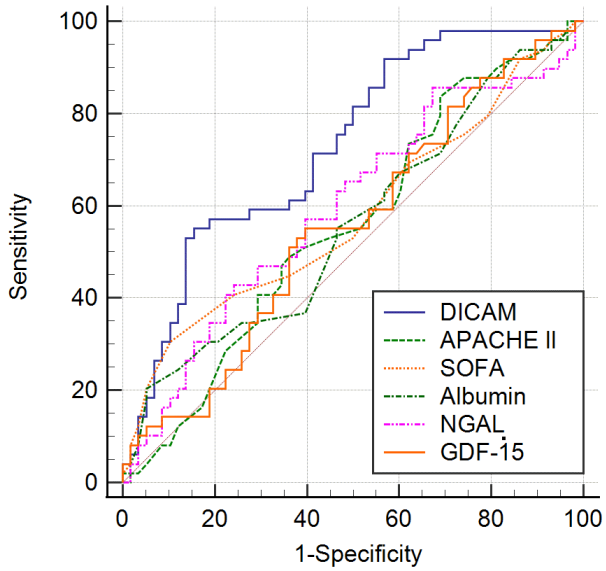
Introduction: Acute kidney injury (AKI) is a common complication in critically ill patients, and its association with increased mortality underscores the need for reliable prognostic markers. This study investigated the potential of dual immunoglobulin domain-containing cell adhesion molecule (DICAM), an inflammation-associated transmembrane protein, as a mortality prediction indicator in critically ill AKI patients requiring continuous kidney replacement therapy (CKRT).

Methods: A prospective multicenter cohort study was conducted involving critically ill patients with AKI who required CKRT. Blood samples were collected prior to CKRT initiation on the day of CKRT and were available for 112 patients. The primary outcome was in-hospital mortality and the association was analyzed using Cox regression analysis, applying DICAM as both a dichotomous and continuous variable.

Results: The mean age was 65.7 ± 14.8 years and 88 patients (76.5%) were male. The median DICAM level was 13.8 ng/dL (the median level was 7.5 ng/dL in healthy control). The high DICAM group showed significantly higher in-hospital mortality compared to the low DICAM group (adjusted hazard ratio [aHR], 2.05, 95% confidence interval [CI], 1.11–3.76, P = 0.021). In addition, DICAM, analyzed as a continuous variable, demonstrated a significant association with a mortality rate (aHR, 1.02, 95% CI, 1.01–1.03, P = 0.001). The predictive power (area under the curve value) of DICAM for mortality was higher compared to other classical prognostic markers such as APACHE II and SOFA scores, albumin, NGAL, and GDF-15 (Figure 1). DICAM had a positive correlation with SOFA score, NGAL, GDF-15, and lactate levels.

Conclusion: Elevated DICAM levels are independently correlated with an increased risk of in-hospital mortality among critically ill patients with AKI requiring CKRT. DICAM may be a valuable prognostic marker in this population. Further research is required to unravel the underlying mechanisms and validate these findings.



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Correlation Between Ionized and Total Magnesium in Children on Continuous Renal Replacement Therapy

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Background: Abnormal magnesium levels are associated with poor outcomes, including 28-day mortality, in critically ill children. Regional citrate anticoagulation (RCA) during continuous renal replacement therapy (CRRT) may cause magnesium (Mg) depletion by chelating ionized Mg (iMg), potentially leading to negative Mg balance. However, data regarding iMg in critically ill children undergoing CRRT are lacking, and existing data regarding concordance between iMg and total Mg (tMg) levels are conflicting. Our objective was to assess associations between iMg and both tMg and iCa in critically ill children during CRRT with RCA. We hypothesize that iMg will not correlate with tMg but will with iCa.

Methods: Over the course of a year, we prospectively collected blood samples to measure iMg immediately before, 1-2, and 18-24 hours after CRRT initiation. We compared them to tMg and iCa concentrations obtained for clinical purposes. We categorized iMg, tMg, and iCa based on normal reference ranges of 0.44-0.65, 0.66-1.07 and 1.0-1.3 mmol/L, respectively. Linear mixed effect modeling was used to assess iMg trends after CRRT initiation. Fisher's exact test and Cohen's Kappa statistics assessed category agreement. Pearson's correlation coefficients and linear regression measured correlations.

Results: 17 patients contributed 48 iMg, 37 tMg, and 49 iCa samples, respectively. 12% (N=2/17) of patients had low iMg at CRRT start, which increased to 35% (N=6/17) at 1-2 hours, and 70% (N=12/17) at 18-24 hours. A progressive decrease in iMg was observed over time (Coefficient = - 0.005, $p < 0.001$). iMg and tMg concentrations showed moderate correlation ($r = 0.71$, $p < 0.0001$) and demonstrated category agreement ($p = 0.019$). Contrarily, iMg and iCa concentrations were not associated ($r = 0.15$, $p = 0.28$), nor showed category agreement ($p = 0.069$). Within 24 hours of CRRT onset, 4/17 patients received supplemental Mg added in their parenteral nutrition compared to baseline; one patient received a Mg bolus.

Conclusion: We showed a moderate correlation between iMg and tMg (but not with iCa) in critically ill children receiving CRRT with RCA. The increased prevalence of ionized hypomagnesemia within 24 hours of CRRT initiation highlights the need for vigilant magnesium monitoring.

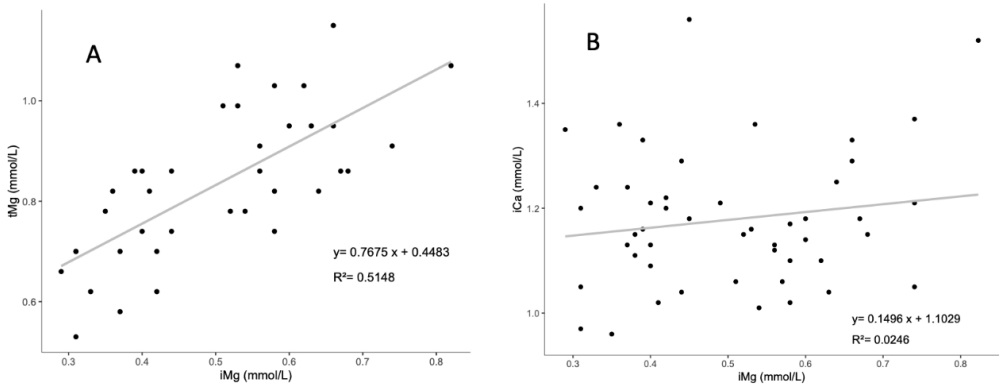

Figure 1: Correlations between iMg with tMg/iCa in CRRT. Grey line indicates the simple linear regression line. A: Pearson's Correlation coefficient for iMg and tMg showed moderate association ($r = 0.717$, $p < 0.0001$). B: Pearson's correlation coefficient for iMg and iCa showed no correlation ($r = 0.15$, $p = 0.28$).

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Sodium Balance in Hyponatremic Patients Receiving Custom Dilution Continuous Renal Replacement Therapy Fluids

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Rapid or over correction of serum sodium in an intensive care unit patient can lead to devastating patient outcomes, such as osmotic demyelination syndrome (ODS). ODS is characterized by mental status changes, paralysis and respiratory failure. Risk factors for ODS include chronic hyponatremia, over or rapid correction of serum sodium, preexisting alcohol use, malnutrition and presence of liver disease. Hyponatremic patients requiring continuous renal replacement therapy (CRRT) are high risk of rapid sodium correction due to the standard 140mEq/L sodium chloride concentration in the fluids. Our institution instituted a collaborative protocol between nephrology and pharmacy to create custom CRRT dilution solutions for patients at risk of ODS. Patients with a serum sodium <120mEq/L are eligible for the protocol. The CRRT bags are diluted with sterile water according to the calculation of the patient's desired sodium change in 24 hours (6-8mEq/L/day).

This is a retrospective cohort study evaluating the effectiveness of the hyponatremia protocol on serum sodium changes in the first 24h and 48h of CRRT therapy. Adult patients (18+) admitted to an ICU at the University of Kentucky from 2021 to 2023 were identified by having received the protocol orders, with a nadir serum sodium of <120mEq/L. Comparator patients were identified throughout the same timeframe with a nadir serum sodium <120mEq/L, who did not receive the custom dilution fluids for CRRT. The primary study outcome is the change in serum sodium from baseline to the 24h change, and proportion of patients achieving the goal sodium.

A total of 18 patients were found eligible for this evaluation: nine patients received the protocol, and nine did not. The baseline serum sodium was not different between the two cohorts: protocol 117mEq/L (114-118) vs non-protocol 117mEq/L (114-118), p=0.94. The serum sodium at 24h was significantly lower in the protocol group: 122mEq/L (121-125) vs 130mEq/L (128-132), p= 0.046 and lower at 48h: 123mEq/L (121-131) vs 135mEq/L (129- 138), p=0.05. All nine protocol patients (100%) met the 24h sodium goal whilst using the protocol, vs (66%) met the goal without the protocol, p= 0.05.

In this small cohort study, patients were more likely to have a slower sodium correction, and more likely to meet their sodium goals with custom dilution CRRT fluids, versus standard CRRT fluids. Further validation should be done with a larger cohort.

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A Miniaturized Version of the Manual Single Lumen Alternating Micro-Batch (mSLAMB) Dialysis Device for Neonates

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Background: Acute kidney injury is common in critically ill neonates, especially low-weight newborns. In severe cases, renal replacement therapy (RRT) may be warranted, which presents considerable challenges. In the US, available RRT devices are cleared to a lower weight limit of 2.5 kg and require a double lumen or two separate single lumen catheters. Further, neonates in low-income countries often only have peritoneal dialysis available. We developed a miniaturized manual Single Lumen Alternating Micro-Batch (mSLAMB) device to provide clearance and ultrafiltration (UF) via one single lumen access for smaller patients. We hypothesized that mSLAMB performs clearance and UF effectively.

Methods: We approximated a 3 kg neonate blood volume (220mL) by diluting expired packed red blood cells with 0.9% NaCl to a hematocrit (Hct) of 35%; heparin and 1 g of urea (454 mg/dl) were added. We conducted 3 UF experiments (60 cycles each) and 12 clearance experiments (30 cycles each). A cycle consisted of aspirating 10 mL of blood from the bag, passing it through a hemofilter (Stavro XR11 (8mL) in UF, Polyflux 2H (17mL) filters in clearance studies) and returning it. For each UF cycle, 1 mL of ultrafiltrate was removed; Hct was measured after every 10 cycles. For clearance experiments, we tested 4 configurations in triplicate, with varied timing and volume of 0.9% NaCl used to refresh the dialysis compartment: 10mL every 5 cycles (1), every 2 cycles (2), every cycle (3), or with 20mL every 2 cycles (4). To assess clearance, we measured blood urea nitrogen and potassium every 5 cycles. We compared the clearance of the configurations using Mann-Whitney test. Net UF was compared to Hct increase.

Results: In the UF study, the initial median Hct was 34.1% (IQR 1.5). After 60 cycles, the median Hct increased to 52.6% (IQR 1.3), which was higher than predicted (47%). In the 30 cycle clearance study, median urea reduction ratio (URR) and potassium reduction rate (KRR) was 31.0% (IQR 20.3) and 35.0% (IQR 14.7), respectively. Table 1 shows the median URR, KRR by configuration. Configurations 3 and 4 significantly outperform configurations 1 and 2.

Conclusions: The mSLAMB performs in-vitro UF and clearance efficiently. We will assess causes for UF and predicted Hct discrepancy. mSLAMB provides a potential new option to support neonates with RRT, due to its minimal extracorporeal volume and sole single lumen access.

Experiment	Config. 1	Config. 2	Config. 3	Config. 4
		URR (%)		
1	8.7	28.1	34.5	32.4
2	11.0	18.9	37.5	41.2
3	13.8	29.5	39.3	40.9
Median	**11.0**	**28.1**	**37.5**	**40.9**
		Potassium Reduction Rate (%)		
1	17.8	31.5	38.5	36.8
2	18.6	29.7	41.8	44.7
3	18.3	33.2	41.6	46.1
Median	**18.3**	**31.5**	**41.6**	**44.7**

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Association between Sex, Delivery of Renal-Replacement Therapy and Outcome: A Secondary Analysis of the STARRT-AKI Trial

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Purpose: Risk Differences in acute kidney injury (AKI) and outcomes stratified by sex are well described. Whether there are important sex-specific differences in the delivery of and outcomes after RRT, mediated by biological, social and/or cultural influences, remains uncertain.

Methods: We performed a secondary analysis of the STARRT-AKI trial. We included patients analyzed in the modified intention-to-treat cohort. The main exposure was sex. The primary outcome was 90-day mortality. Secondary outcomes were 90-day RRT dependence and RRT-free days. We performed a sex-aggregated analysis to describe baseline characteristics, features of RRT, and outcomes. We used logistic regression and interaction testing to explore the effect of sex and RRT initiation strategy on outcomes.

Results: We included 2927 patients, of which 32.0% were female (n=937). A total of 470 accelerated-strategy patients (32.1%) and 467 standard-strategy patients (31.9%) were female. At baseline, there were similar proportions of females and males with hypertension (54.0% vs 56.9%, p=0.15), diabetes mellitus (29.8% vs 31.1%, p=0.47) and chronic kidney disease (43.8% vs 42.5%, p=0.55). More females were admitted for medical indications (70.8% vs 65.3%, p=0.01), while more males had surgical admissions (27.3% vs 34.7%, p=0.01). SAPS II at enrollment was similar (median [IQR] 57 [46-72] vs 58 [46-72], p=0.44). Fewer females were receiving mechanical ventilation (75.4% vs 81.6%, p<0.01) compared with males, while receipt of vasopressors was similar (64.1% vs 65.3%, p=0.56). Females and males were similarly likely to start RRT (77.9% [n=730] vs 78.7% [n=1566], p=0.93) and receive initial therapy with CRRT (69.6% vs 69.1%, p=0.93). Mortality at 90-days was 42.5% for females vs 44.4% for males (adj-OR 0.88; 95%CI 0.74-1.04, p=0.14). RRT dependence at 90-days was 8.6% for females vs 8.1% for males (adj-OR 1.14; 95%CI 0.76-1.69, p=0.53). There were no significant differences by sex in the composite of death or RRT dependence or RRT-free days at 90 days. There were no interactions with allocated RRT initiation strategy by sex on mortality or RRT dependence (p=0.18, p=0.31).

Conclusion: In this secondary analysis of the STARRT-AKI trial, we found females were more often admitted for medical diagnoses and less likely to be receiving mechanical ventilation, however, there were no differences in the receipt of RRT, initial modality, outcomes, or effect modification by sex and RRT initiation strategy.

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Early Goal-Directed Renal Replacement Therapy in Severe Pneumonia Associated Acute Kidney Injury

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Introduction: Pneumonia is one of the crucial issues in the development of acute kidney injury (AKI), especially severe pneumonia. This study is to evaluate the efficacy of early goal-directed renal replacement therapy (GDRRT) for the treatment of severe pneumonia-associated AKI.

Methods: In this real-world, retrospective cohort study, we recruited 180 patients with severe pneumonia, hospitalized in a third-class general hospital in East China between January 1st, 2017 to December 31st, 2021. Clinical data on baseline characteristics, biochemical indicators, and data on renal replacement therapy were collected. Patients were divided into Early and Late RRT groups mainly according to the fluid status, progression of inflammation and pulmonary radiology. We investigated the in-hospital all-cause mortality (the primary end point) and renal recovery (the secondary end point) between the two groups.

Results: Among the 154 patients finally recruited, there were 70 patients in Early RRT group and 84 patients in late RRT group. There were no significant differences in demographic characteristics between the two groups. The duration of admission to RRT initiation was significantly shorter in Early RRT group [2.5（1.0, 8.75） vs. 5（1.5,13.5） d, P=0.027]. At RRT initiation, patients in Early RRT group displayed a lower percent fluid overload, lower doses of vasoactive agents, higher level of CRP and higher rate of radiographic progression than those in Late RRT group. The all-cause of in-hospital mortality was significantly lower in Early RRT group than in Late group (52.5% vs. 86.5%, p＜ 0.001). Patients in Early RRT group displayed a significantly higher proportion of complete renal recovery at discharge ((40.0% vs. 8.1%, P<0.001).

Conclusion: This study clarified that early GDRRT for the treatment of severe pneumonia-associated AKI based on fluid status and inflammation progression, was associated with reduced hospital mortality and better recovery of renal function. Our preliminary study supposed that early initiation of RRT might be an effective approach to severe pneumonia-associated AKI.

	Early RRT Group	Late RRT Group
Basic renal function	CKD stage ≥3	
Fluid status	SCr criteria for AKI 1–2 stage; UO ≤0.5 mL/kg/h ≥6 h; PFO>1%; Mild to moderate pulmonary edema	Scr criteria for AKI 3 stage; UO ≤0.3 mL/kg/h ≥24 h or anuria ≥12h; Multiple cavity effusion; Congestive heart failure; Severe pulmonary edema or refractory hypoxemia
Inflammation	PCT ≥3 or CRP ≥90	
Radiology	Radiographic progression within 72h after treatment	
Metabolism		Serum potassium ≥6.5 mmol/L or severe metallic acidosis, pH ≤7.2
Hemodynamics		Persistent hypotension with high dose vasoactive drugs

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A Delphi Consensus to Prioritize Next Steps Addressing Racial Disparities in Critical Care Research

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Introduction: Disparities in critical care necessitate prioritized research to comprehend their extent and causes. This study aimed to establish a thought leader consensus for the future trajectory of critical care medicine (CCM) research, focusing on documenting, assessing, and understanding racial disparities.

Methods: Utilizing a modified Delphi method, we sought consensus on addressing racial disparities in future CCM research through a preparation phase, pre-meeting survey, roundtable meeting, and post-meeting survey. Nine thought leaders on racial disparities in critical care or health disparities research in the roundtable.
Prior to the meeting, participants were asked to complete a pre-meeting survey aligned with the four workshops topics titled: 1. Standardizing the Collection of Race, Ethnicity and Language Variables in Research, 2. Establishing Robust Researchers from Minoritized Backgrounds' Recruitment, 3. The Role of Minority Serving Institutions in Research and 4. Health Disparity Education and Community Engagement Majority agreement was defined as ≥ 50% agreement among the members. Consensus agreement was defined as ≥ 80% agreement.

Results: The roundtable meeting exposed a significant lack of data on health disparities in Critical Care Medicine (CCM), emphasizing the urgent need for comprehensive research. Participants unanimously stressed the importance of larger data sources through robust recruitment of minority participants and consensus on standardizing race, ethnicity, and language data collection. The post-meeting survey highlighted a unanimous call for targeted studies on race and ethnicity categories, with 55.6% disagreement on the role of Institutional Review Boards (IRBs) in minority researcher recruitment. However, 66.7% supported conducting local recruitment efforts outside the IRB process, emphasizing engagement with minority communities. The survey underscored the regulatory role of IRBs and the importance of research foundations, funding, and mentorship in promoting diversity in research.

Conclusions: Standardizing race, ethnicity, and language data collection is vital for understanding health disparities in CCM. Post-survey results reinforce this focus, highlighting the need for targeted investigations and nuanced approaches to IRBs in minority researcher recruitment. These insights underscore a commitment to methodological rigor and diversity in CCM research.

Figure on following page

Figure 1: Summary of consensus results:

Do you agree with the following statement? "The initial focus in reducing healthcare disparities in critical care research should be on increasing the number of minority research participants."					
Yes	100%				
No	0%				
Do you agree that language preference can impact outcomes in critical illness?					
Yes	100%				
No	0%				
Regarding the action *Defining what changes are needed in CCM research structures and processes that would better equip the field to address health disparities*, how would you rate the importance of the following topics?					
	Not important	Slightly Important	Moderately Important	Important	Very Important
Increase in minority researchers	0%	0%	12.5%	50%	37.5%
Education of current researchers	0%	0%	25%	25%	50%
Increase in minority participants	0%	0%	0%	0%	100%
Community involvement in research	0%	12.5%	12.5%	25%	50%
Other	50%	0%	0%	0%	50%

NURSING ISSUES

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Pediatric Continuous Renal Replacement Therapy High Fidelity Simulation

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Purpose: Continuous Renal Replacement Therapy (CRRT) is a high risk, low use therapy in many pediatric hospitals, and requires specialized knowledge and skills. Due to its complexity, high fidelity simulation offers a realistic and safe environment for nurses to develop and refine skills. We designed and implemented 3 scenarios for nurses performing CRRT to improve clinical skills and confidence.

Methods: Three clinical scenarios were developed modeling real and hypothetical clinical situations. Scenarios highlighted core practices such as safety checks, anticoagulation, interdisciplinary communication, machine alarms, and clinical CRRT related emergencies. Learners were assigned roles (e.g., bedside nurse, super-user, charge nurse, observer) prior to the start of each scenario. After simulation, a debrief was conducted to review learner performance compared to the standard of care. Using a 5-point Likert Scale, nurses self-reported confidence level in 10 categories including overall care of the CRRT patient, adjusting flowrates, titrating regional anticoagulation, documentation, fluid balance, troubleshooting pressure alarms, troubleshooting weight/flow alarms, calling peers for assistance, calling the superuser for assistance, and calling the pediatric nephrologist for assistance. Surveys were completed anonymously before and after participation. The percentage of responses times the raw score (1=not comfortable through 5=Very comfortable) was calculated to determine an overall confidence percentage for each of the 10 categories.

Summary of the Results: One hundred sixteen respondents participated in the pre-simulation survey and 117 in the post-simulation survey. The largest improvement in raw self-reported confidence was in calling a superuser for assistance (75% vs 89%). Percentage increase in score was largest in troubleshooting pressure alarms (25%). Participants from the lower volume unit demonstrated the largest increase in scores while superusers demonstrated the smallest increase in raw scores. There was a slight decrease in confidence calling peers for assistance among bedside nurses but not the superusers.

Conclusion: Nursing confidence levels related to the care of the pediatric CRRT patient improved after participating in high fidelity simulation. This effect was most prevalent among low- volume participants. Further areas of educational focus were able to be identified based on responses.

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Acute renal replacement therapy (RRT) in pediatric patients: a national survey assessing nursing structure and standards in RRT education

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Background: Renal replacement therapy (RRT) in critically ill children is an essential treatment for acute kidney injury (AKI), fluid overload and a few non-renal indications. Nurses performing RRT require specific training and expertise, as RRT is technically complex, and few machines are designed for neonatal or infant patients. Despite the intricacy of delivering pediatric RRT, no standards for nursing education exist; furthermore, there is significant heterogeneity of nursing structure by center. We sought to gather information regarding these variations via a national survey.

Methods: A survey was sent to the top 50 pediatric nephrology programs from the US News & World Report 2023 ranking and eight Canadian centers. Questions included programmatic volume, modalities, structure, and nursing education. We analyzed data focusing on RRT staff and education methods.

Results: 53 centers completed the survey (Table 1). Over half of respondents in every volume group have an established acute care program (81% total). Almost half of all programs have a nursing director (41.5%), and 11.3% have an advanced practice provider. Over half (52.8%) of respondents have combined chronic and acute programs, and only 22.6% of respondents report having nurses who only provide acute therapies. Most (58.5%) programs perform RRT in ≥3 units, 64.2% use ≥3 machines in their institution and 86.8% of institutions use ≥2 anticoagulants. Up to seven different healthcare roles are utilized to set up and manage RRT, with 43.4% of institutions training ≥2 roles. In 96.2% of institutions, education is standardized, and 64.2% have minimum criteria to evaluate CRRT competencies for nurses, yet the methods of education vary widely. Additionally, 39.6% of institutions have a dedicated QI program, while more than half (56.3%) track RRT data.

Conclusions: This Acute Care Nephrology survey provides data on RRT program structure, education, quality improvement, including census, machine type, and access data. The survey reveals significant practice variation across institutions, such as multiple machines, anticoagulation types and education content and methods. This increases the complexity of delivering this already involved therapy, highlighting the importance of education for healthcare professionals who care for these children. Collaboration across institutions can help identify standardized education for those providing RRT therapies to ensure safety and improve patient outcomes.

Table on following page

Table 1. Acute Renal Replacement Therapy Nursing Structure and Education

Estimated patient volume	**< 250**	**250-499**	**500-749**	**750-999**	**>1000**	**Unknown**
Number of survey respondents by volume	9	14	10	4	8	4
Have an established acute care program	5 (55%)	9 (64%)	10 (100%)	4 (100%)	6 (75%)	4 (100%)
CRRT is performed in:						
*NICU	2 (16.7%)	10 (66.7%)	9 (90%)	3 (75%)	6 (75%)	2 (50%)
*PICU	12 (100%	15 (100%)	10 (100%)	4 (100%)	8 (100%)	4 (100%)
*CICU	6 (50%)	14 (93.3%)	10 (100%)	4 (100%)	8 (100%	4 (100%)
*Other		OR (1)	Neonatal CVICU (1)			
Machines used:						
*Prismax	4 (33.3%)	6 (40%)	4 (40%)	1 (25%)	3(37.5%)	2 (50%)
*Prismaflex	10 (83.3%)	7 (46.7%)	7 (70%)	3 (75%)	6 (75%)	3 (75%)
*NxStage	3 (25%)	2 (13.3%)	1 (10%)	1 (25%)	0	1 (25%)
SCUF w/ Aquadex	0	5 (33.3%)	1 (10%)	3 (75%)	4 (50%)	2 (50%)
Modified Aqua	0	4 (26.7%)	1 (10%)	3 (75%)	4 (50%)	2 (50%)
*Carpediem	4 (33.3%)	5 (33.3%)	4 (40%)	2 (50%)	5 (62.5%)	0
CRRT initiation is performed by:						
Acute/Chronic Dialysis RN	2 (12.7%)	4 (26.7%)	2 (20%)	1 (25%)	3 (37.5%)	1 (25%)
Acute Dialysis RN	2 (16.7%)	2 (13.3%)	1 (10%)	2 (50%)	3 (37.5%)	1 (25%)
ICU RN	6 (50%)	7 (46.7%)	2 (10%)	1 (25%)	2 (25%)	1 (25%)
Resource ICU RN	6 (50%)	7 (46.7%)	6 (60%)	1 (25%)	3 (37.5%)	1 (25%)
Resource RN	3 (25%)	1 (6.7%)	0	0	0	0
ECMO specialist	2 (16.7%)	3 (20%)	2 (20%)	0	2 (25%)	0
Respiratory Therapist			1 (10%)			
Other		5 (33.3%)		1 (25%)		2 (50%)
QI program	6 (50%)	6 (40%)	2 (20%)	2 (50%)	3 (37.5%)	2 (50%)
Data tracking	4 (33.3%)	6 (40%)	4 (40%)	1 (25%)	2 (25%)	1 (25%)
Standardized initial education program for bedside nurses?	12 (100%)	15 (100%)	9 (90%)	4 (100%)	7 (87.5%)	4 (100%)
Initial Education						
*Bedside orientation	9 (75%)	13 (86.7%)	10 (100%)	4 (100%)	6 (75%)	4 (100%)
*Didactics	8 (66.7%)	15 (100%)	9 (90%)	4 (100%)	6 (75%)	3 (75%)
*Hands-on	11 (91.7%)	14 (93.3%)	10 (100%)	4 (100%)	7 (87.5%)	4 (100%)
*High fidelity simulation	5 (41.7%)	4 (26.7%)	3 (30%)	2 (50%)	0	3 (75%)
*Other	2 (16.7%)	2 (13.3%)	1 (10%)	1 (25%)	1 (12.5%)	0
*Specific training is not provided	0	0	0	0	0	0
Standardized continuing education program for bedside nurses?	11 (91.7%)	14 (93.3%)	90 (90%)	4 (100%)	7 (87.5%)	3 (75%)
Continuing Education						
*Bedside orientation	7 (58.3%)	9 (60%)	6 (60%)	2 (50%)	5 (62.5%)	0
*Didactics	6 (50%)	11 (73.3%)	8 (80%)	3 (75%)	7 (87.5%)	1 (25%)
*Hands-on	11 (91.7%)	12 (80%)	10 (100%)	2 (50%)	6 (75%)	3 (75%)
*High fidelity simulation	3 (25%)	3 (20%)	4 (40%)	1 (25%)	1 (12.5%)	3 (75%)
*Other	1 (8.3%)	4 (26.7%)	1 (10%)	1 (25%)	2 (25%)	0
*Specific training is not provided	1 (8.3%)	1 (6.7%)	0	1 (25%)	0	0
Frequency for maintaining CRRT competencies						
*Yearly or more frequently	8 (66.7%)	12 (80%)	9 (90%)	3 (75%)	4 (50%)	1 (25%)
*Q2years		1 (6.7%)				
*PRN	3 (25%)	2 (13.3%)			2 (25%)	1 (25%)
*Not offered				1 (25%)		
*Other	1 (8.3%)		1 (10%)		2 (25%)	2 (50%)
Minimal criteria for evaluating CRRT competencies?	6 (50%)	11 (73.3%)	6 (60%)	2 (50%)	7 (87.5%)	2 (50%)