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

We analyzed electrical medical record of 320 pediatric patients with venous pH below 7.25 who visited a pediatric emergency room (PER) of a tertiary hospital in South Korea. We found a high incidence of acute kidney injury (AKI) among acidotic patients, and those with metabolic acidosis and especially high anion gap metabolic acidosis were at a higher risk of AKI.

Introduction

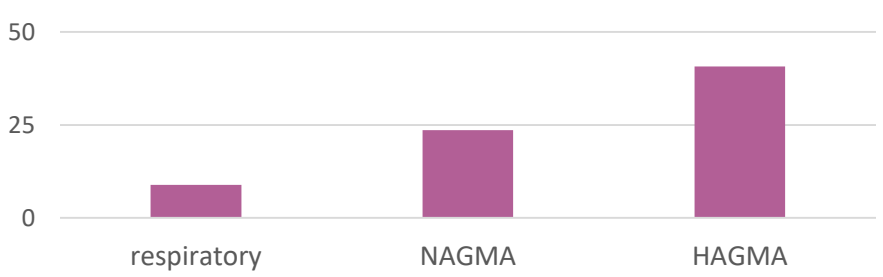
- AKI : independent risk factor for adverse outcomes
  survivors at risk of CKD, hypertension and proteinuria
- Diagnosis requires serial sCr and/or urine output
  : difficult to measure in the PER
- Acid-base status easily assessed in the PER, using point-of care venous blood gas analysis (VBGA)
- Acidotic patients may be at risk of AKI

Methods and Materials

- Retrospective single-center study
  - Children under 18 years
  - who visited Seoul National University Children's Hospital
  - from 2020 to 2023
  - with acidemia (venous blood pH < 7.25)
- AKI diagnosed and staged according to KDIGO criteria
- Respiratory acidosis (pCO2 > 50), metabolic acidosis (HCO3- < 20)
- Serum anion gap = Na-Cl-HCO3 : high (16 or higher) or normal (below 16)

Patient Characteristics (n=320)

Male, n (%)	179 (55.9%)
Age in years, mean (SD)	4.61 (4.907)
AKI, n (%)	
- none	251 (78.4%)
- stage 1	27 (8.4%)
- stage 2	11 (3.4%)
- stage 3	31 (9.7%)
RRT, n (%)	
- CRRT	27 (8.4%)
- HD	2 (0.6%)
Types of acidosis	
- Respiratory	158 (49.4%)
- Metabolic	137 (42.8%)
- Mixed	25 (7.8%)



Graph 1. Incidence (%) of AKI by types of acidosis.

Results

1. 320 patients with venous pH below 7.25 (mean 7.15; SD 0.10) identified
- 80 (25.0%) discharged; 160 (50.0%) general ward; 69 (21.5%) ICU
- **AKI in 69 patients (21.6%)**
- 245 (76.6%) had significant underlying diseases

2. Respiratory vs. metabolic acidosis
- No significant difference in pH between respiratory (mean pH = 7.1575) and metabolic acidosis (mean pH = 7.1734) (p=0.114)
- **Incidence of AKI higher in metabolic acidosis (36.0%) than respiratory acidosis (8.9%)** ($\chi 2$=31.737; p=0.000) : consistently higher across all stages of AKI

3. High anion gap (HAGMA) vs. normal anion gap metabolic acidosis (NAGMA)
- no significant difference in pH between HAGMA and NAGMA (p=0.099)
- **higher incidence of AKI in HAGMA (40.7%) vs. NAGMA (23.6%) (p=0.036)**

4. Differences across AKI stages (Table 1)
- **pH decreased as AKI worsened** (F=9.322; p=0.000)
- **Higher lactate level** (F=2.658; p=0.049), and **higher incidence of hyponatremia** ($\chi 2$=11.530; p=0.001) observed as AKI worsened
- Patients with AKI more likely to be admitted (91%) than those without (67%)
- No significant difference in length of stay or proportion of ICU admission

AKI stage	0 (n=244)	1 (n=27)	2 (n=11)	3 (n=31)	Total (n=313)
Age	3.95 (4.34)	7.22 (6.03)	8.55 (6.70)	6.03 (5.82)	4.60 (4.91)
pH	7.17 (0.08)	7.12 (0.10)	7.11 (0.10)	7.09 (0.15)	7.16 (0.10)
pCO2	64.28 (28.17)	44.45 (35.44)	34.68 (17.85)	41.47 (19.80)	59.30 (29.33)
pO2	59.40 (42.47)	47.37 (16.64)	53.91 (37.47)	55.81 (39.72)	57.81 (40.46)
HCO3-	22.89 (8.13)	13.09 (7.84)	13.56 (7.82)	14.03 (5.68)	20.90 (8.75)
lactate	3.23 (29.95)	3.49 (4.20)	3.88 (2.46)	5.03 (4.79)	3.45 (3.30)
Na	138.078 (4.27)	136.48 (7.26)	137.55 (6.61)	138.67 (9.65)	137.98 (5.39)
K	4.52 (0.81)	4.66 (1.26)	5.36 (1.10)	5.22 (1.67)	4.63 (1.00)
Cl	103.823 (5.29)	102.63 (7.40)	106.00 (8.63)	108.00 (11.37)	104.20 (6.54)
iCa	1.29 (0.09)	1.28 (0.11)	1.23 (0.17)	1.16 (0.31)	1.27 (0.14)
BUN	14.18 (6.17)	16.44 (8.89)	31.73 (14.02)	49.90 (40.58)	18.53 (17.89)
Cr	0.534 (0.25)	0.85 (0.27)	1.33 (0.56)	3.14 (4.38)	0.85 (1.59)
LOS	19.02 (56.25)	11.15 (15.26)	12.64 (14.29)	31.40 (28.14)	19.44 (48.97)

Table 1. variables according to AKI stages; mean (SD); LOS = length of stay.

Discussion

- A remarkably high incidence (21.6%) of AKI among acidemic patients
- Even higher incidence in patients with metabolic acidosis (36.0%)
- POCT VBGA not so precise when it comes to differential diagnosis
  - NAGMA group mostly did not have diarrhea or renal tubular acidosis
  - 10 (3.1%) patients did not fit into metabolic or respiratory acidosis

Conclusions

Over 20% of acidotic patients who visited our PER developed AKI, and those with metabolic acidosis and especially HAGMA were at an even higher risk. Physicians need to be aware of the high risk of AKI in the presence of acidosis.

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