Growth during the first 3 months of life in infants in the Neonatal Intensive Care Unit with congenital kidney failure requiring early RRT

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Introduction

*Neonates with congenital kidney failure (CKF) who require RRT
- require prolonged continuous renal replacement therapy (CRRT).
- are chronically ill.
- have severe pulmonary hypoplasia requiring extensive ventilator time.
- have additional comorbidities that make health maintenance complex (1).

*Adequate nutrition is critical for these patients to grow, however there is scant data on strategies to optimize nutrition in this population.

*A recent study of 8 neonates with CKF on Carpediem™, using clearance dosing of 2000 ml/1.73 m^2/hr and a 90 mL/kg/day nutrition goal, showed a weight z-score >0 was never achieved. The median goal was 90 ml/kg even at 6 weeks of age. With this approach, they demonstrated a negative growth velocity for the first 3 months of RRT. Adequate growth velocity was not met for 6 months after birth (2).

Methods/Measurements

Methods
- Performed a retrospective review of nutrition goals for 24 neonates with congenital kidney failure who required RRT within the first month of life and survived to 90 days
- Evaluated the effect of a decrease in our standard RRT dosing, from BSA dosing of 2000/1.72/m^2 to 24mL/kg/hour in May 2018
- Evaluated changes in calorie and protein recommendations in 2019 and 2021

Outcome measurements
- Primary outcome - weight z-score ≥-2 vs. < -2
- Secondary outcome - height z-score ≥-2 vs. <-2

Table 1: Demographics for entire 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
Gestational Age (weeks)	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
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
- 2000mL/1.73m^2/hr	5 (26.3%)	1 (9.1%)	4 (50.0%)		2 (25.0%)	3 (27.3%)	
- 24mL/kg/hr	14 (73.6%)	10 (90.9%)	4 (50.0%)		6 (75.0%)	8 (72.7%)	
Calorie goals				**<0.01**			0.53
- 90-110 kcal/kg/day	**12 (63.2%)**	**4 (36.4%)**	**8 (100.0%)**		5 (62.5%)	7 (63.6%)	
- At least 130 kcal/kg/day	**3 (15.8%)**	**3 (27.2%)**	**0 (0.0%)**		2 (25.0%)	1 (9.1%)	
- At least 140 kcal/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. 210.0)	0.97

Results

- 11 (58%) had weight z-score ≥- 2 and 8 (42%) had height z-score ≥-2.
- No statistically significant comorbidities were observed
- Less clearance had better z-scores for weight (continuously) but did not show a difference between binary z-score evaluation
- Higher calorie and protein goal targets were associated with increased binary weight z-scores (both p< 0.01) but there was no statistical difference for height z-score.
- In this very small sample size of patients, those who are alive at 90 days with a weight z-score ≥-2 have a higher survival trend.

Conclusions

- Neonates with congenital kidney failure on RRT have complex problems and hospital courses, and nutrition is an essential outcome for success.
- A 24 mL/kg/hour clearance rate may be associated with better weight gain
- Higher caloric and protein targets were associated with higher weight and height growth.
- Additional studies are needed to understand optimal nutrition for growth and development in context of the effects of RRT.

References
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