Continuous Renal Replacement Therapy in Pediatric Patients with Acute and Acute-on-chronic Liver Failure

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Background

Pediatric acute and acute-on-chronic liver failure can frequently lead to multiple organ dysfunction and associated acute kidney injury necessitating renal replacement therapy (CRRT). The etiology of AKI in this setting is often multifactorial including hepatorenal syndrome, abdominal compartment physiology, nephrotoxic medication exposure and de novo intrinsic renal injury. The natural prognosis carries high mortality despite maximum support. (1). Other outcomes such as renal recovery at intensive care unit (ICU) discharge are not well described in the pediatric population.

Additionally, anticoagulation management in this population is challenging as patients often have underlying bleeding diatheses as a result of the primary disease process. Use of regional anticoagulation with citrate (RCA) is controversial as loss of citrate metabolism in the setting of liver failure leads to citrate accumulation in the body and chelation of ionized calcium and citrate toxicity (the phenomenon known as “citrate lock”) . Citrate toxicity might lead to bleeding complications and hypocalcemia might results in hemodynamic instability and arrythmias. There is no consensus definition of “citrate lock” that has been validated in pediatric patients. RCA is the standard anticogulation regimen used in the CRRT program of Texas Children’s Hospital.

Objectives

To describe the population of pediatric patients receiving CRRT with concomitant acute and acute-on-chronic liver failure and evaluate major outcomes.

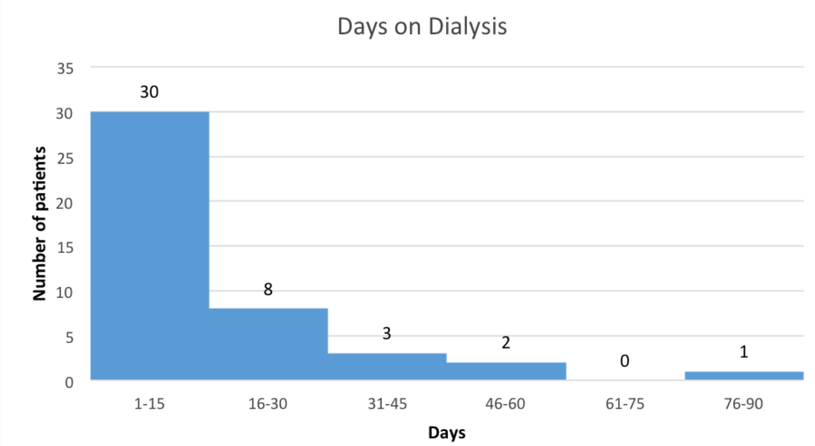
To establish frequency of citrate lock by applying a standard definition and evaluate major complications.

Methods

- Retrospective review of electronic medical records for patients with liver failure who received CRRT from 2/2011-9/2013 at Texas Children’s Hospital.
- Citrate lock was defined as Total Calcium/ionized Ca >10.

Results

Demographics	Percentages
Total number of patients	44
Gender • Male • Female	 • 27% • 73%
Age • <1 year • 1-2 years • 2-5 years • 5-8 years • >8 years	 • 34.1% • 11.4% • 11.4% • 9.1% • 34.1%
Most common liver diagnosis: Biliary Atresia	31.8%
Most common CRRT indication: Fluid Overload	38.6%
Concomitant therapeutic plasma exchange	38.6%



Outcomes	Mean ± SD or N, (Percentages)
Mortality	26, (63.6%)
Length of hospital stay, days	52.8 ± (44.5)
Length of PICU stay, days	31.8 ± 29.8
Length of ventilation, days	18.9 ± 14.4
Liver transplanted	20, (45.5%)
Fluid overload at CRRT initiation, %	21.3 ± 19
Fluid overload > 15% at CRRT initiation	19, (43.2%)
Citrate lock	37, (84.1%)
Noted in chart as having citrate lock	13, (29.5%)
Days of citrate lock	7.89 ± 9.1
Required intermittent HD	13, (29.5%)
eCCL at ICU discharge	67.8 ± 47.9
ESRD	2*, (4.5%)

- No bleeding complications reported in association with citrate use
- No adverse hemodynamic events were reported associated with hypocalcemia
- Common interventions for citrate toxicity were:
  - Decreasing citrate dose
  - Increasing diffusive clearance
  - Transiently stopping citrate (2 patients)

Conclusions

- Regional anticogulation with citrate appears safe in pediatric liver failure patients with severe AKI requiring CRRT
- Citrate lock is very common and might be underrecognized.
  - Recognition might be improved if a standardized definition is applied
- Long-term implications need to be considered as duration of RRT dependency is long and not all patients recover renal function at ICU discharge.
  - 6 patients met RIFLE-L, 2 patients met RIFLE-E (2)
  - 47% of survivors required intermittent HD after ICU discharge

References

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