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Complications of Continuous Renal Replacement Therapy: A retrospective cohort study

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Background

Continuous renal replacement therapy (CRRT) is frequently employed in intensive care units. CRRT concept was introduced in 1977 by Peter Kramer and its usage has drastically increased within the past two decades. This despite equivalence between CRRT and traditional RRT in randomized trials. CRRTrelated adverse events in adult ICU patients have not been studied comprehensively. The purpose of this study is to retrospectively review these adverse events in a large cohort in a tertiary medical center.

Objectives

To determine the incidence of mechanical, metabolic, and hemodynamic complications related to CRRT in a large retrospective cohort.

CRRT characteristics

Dovico n(%)		Prismaflex,		Prisma
		423(71)		172(29)
CRRT module,				CVVHDF
n(%)	CVVH 501(90)		SCOF 4(0.0)	2(0.1)
Standard CRRT orders were Q _b 200 ml/min and Q _{UF} 30				
ml/kg/h, with 50% pre-dialyzer dilution. PBP (ACD-A)				
started at 300 ml/h unless patients had severe liver				
failure.				

Methods

This study was approved by the local IRB. This is a retrospective cohort study of all consecutive adult ICU patients (\geq 18 years) who underwent CRRT between December 9 2006 and December 31, 2009 at Mayo Clinic, Rochester, MN. We excluded patients who did not have research authorization, or who were re-admitted to the ICU. We reviewed electronic medical records to evaluate the incidence of CRRT-related adverse events. Data was extracted, both manually and electronically, by research and clinical fellows who had been trained to gather this data. We used three comprehensive databases for the data extraction. These included the Multidisciplinary Epidemiology and Translational Research in Intensive Care (METRIC) ICU datamart, the Mayo Clinic Life Science System (MCLSS) and the hemodialysis database. We presented the data as median and IQR, mean and SD, or count and percentage as appropriate. Timeto-event analysis was used to compare the survival of patients who developed hypotension within the first hour of CRRT to other patients.

Mayo clinic, Rochester, MN

Baseline characteristics

Total		505
Conden		J3J
Gender		000 (00)
	Male (%)	366 (62)
	Female (%)	229 (38)
Race		
	White (%)	500 (84)
	Black (%)	10 (2)
	Other (%)	85 (14)
Age, Year (median, IQR)		62 (52,72)
BMI, kg/m ² (median, IQR)		29 (25,34)
Baseline creatinine, mg/dL (median, IQR)		2.8 (1.5,3.9)
Charlson index score (median, IQR)		3 (1,5)
SOFA score (median, IQR)		10 (6,14)
APACHE III score (median, IQR)		114 (96,133)
ICU LOS, Day (median, IQR)		9 (4,16)
Hospital LOS, Day (median, IQR)		21 (10,39)
CRRT duration, Day (median, IQR)		4 (2,7)
CRRT indication		
	AKI (%)	553 (93)
	Drug overdose (%)	1 (0.02)
	ESRD (%)	41 (6.98)
Catheter site		
	Right IJ (%)	319 (54)
	Left IJ (%)	90 (15)
	Femoral (%)	119 (20)

Adverse events and outcomes

Catheter related complication			
		All AEs (%)	172 (29)
		Bleeding (%)	120 (20)
		Arterial puncture (%)	4 (0.6)
		Hematoma (%)	8 (1)
		Other (%)	39 (6)
First-hour hypotension (%)			258 (43)
Temperature during CRRT,	°C (median, IQR)		35.2 (34,36)
Significant hypothermia (<35°C), n(%)			259 (44)
ICU mortality, n (%)			236 (40)
Hospital mortality, n (%)			303 (51)
New onset thrombocytopen	ia, n (%)	<50% baseline	216 (40)
New onset anemia, n (%)		Hgb < 10 g/dL	179 (31)
Patient with at least one AE/SAE, n (%)			573 (97)
Seri	ous adv	verse eve	ents
Arrhythmia (%)			484 (81)
	Sinus tachycardia		306 (51)
	A-fib		64 (11)
	A-flutter		6 (1)
VT		14 (2)	
Sinus bradycardia		43 (7)	
	V-fib		19 (3)
	Asystole		20 (3)
	Others		12 (2)
CPR (%)			28 (5)

Electrolyte abnormalities

Sodium - mmol/L		
Baseline		
Hyponatremia episode		
Lowest Sodium		
Significant hyponatremia (<125) %		
Hypernatremia episode		
Highest Sodium		
Significant hypernatremia (>150) %		
Potassium - mmol/L		
Baseline		
Hypokalemia episode		
Lowest Potassium		
Significant hypokalemia (< 3 mEq/dL) %		
Hyperkalemia episode		
Highest Potassium		
Significant hyperkalemia (>5.5) %		
Total Calcium – mg/dL		
Baseline		
Hypocalcemia episode		
Lowest Calcium		
Significant hypocalcemia (<7) %		
Hypercalcemia episode		
Highest Calcium		
Significant hypercalcemia (>11)%		
Ionized Calcium – mg/dL		
Baseline		
Hypocalcemia episode		
Lowest Calcium		
Significant hypocalcemia (<4)%		
Hypercalcemia episode		
Highest Calcium		
Significant hypercalcemia (>6)%		
Phosphorus - mg/dL		
Baseline		
Hypophosphatemia episode		
Lowest Phosphorus		
Significant hypophosphatemia (<1.5)%		
Hyperphosphatemia episode		
Highest Phosphorus		
Significant hyperphosphatemia (>5.5)%		
Magnesium - mg/dL		
Baseline		
Hypomagnesaemia episode		
Lowest Magnesium		
Significant hypomagnesaemia (<1.5)%		
Hypermagnesemia episode		
Highest Magnesium		
Significant hypermagnesemia (>4)%		

Median=139	IQR= 134-143			
146 (25)				
Median=137	IQR= 135-139			
4 (0	.6)			
170 ((29)			
Median=144	IQR= 142-146			
39 ((7)			
Median=4.5	IQR= 3.9-5.1			
268 ((45)			
Median=3.6	IQR= 3.4-3.9			
25 ((4)			
Median=4.7	IOR= 4 4-5 2			
89 (*	15)			
83 (12)				
Madian-97				
	10)			
113 (13)			
iviedian = 9.35	IUK=8.6-10.3			
10 (3)				
207 (35)			
Median=10.7	IQR=9.6-11.7			
131 (39)				
Median=4.53	IQR= 4.13-4.85			
547 (92)			
Median = 4.05	IQR= 3.68-4.37			
268 ((45)			
368 ((62)			
Median=5.89	IQR= 5.41-6.33			
263 ((44)			
Median=5.4	IQR= 4.1-6.8			
346 ((58)			
Median=2.3	IQR= 1.9-2.9			
28 ((5)			
397 ((67)			
Median=5.2	IQR= 4.3-6.5			
246 ((42)			
Median=2.2	IQR= 1.9-2.5			
190 ((32)			
Median=1.8	IOR= 1.7-1.9			
25/	6)			
222 (20)				
235 (Median-2-4				
101CUIAII-2.4	2)			
2 (0	.5)			

Discussion

Hypotension was one of the most important complications in the first hour of CRRT. Patients with hypotension in the first hour had significantly worse survival (figure-below). Electrolyte imbalances were very common despite vigorous monitoring and standard protocols. Life threatening electrolyte imbalances were very rare. Catheter related complications were common (28%), although most were minor adverse events

Survival KM curve



Survival difference based on the development of hypotension within the 1st hour of CRRT initiaiton

Conclusions

Hemodynamic, mechanical and biochemical complications of CRRT are common. Future studies should focus on the clinical significance of these events and possible modifications to prevent them.