Use of Crit-Line to Reduce Intradialytic Hypotension in Hospitalized Patients Receiving Dialysis

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Background

- Intradialytic hypotension (IDH) occurs during 20-30% of dialysis sessions and results in symptoms, shorter and less adequate treatments, end-organ complications, morbidity, and mortality
- The Crit-Line continuously reports change in intravascular blood volume during dialysis and has been used for blood pressure control and volume removal in outpatients
- We hypothesize that using the Crit-Line for hospitalized patients with AKI and ESKD will enable nurses to pre-emptively adjust the treatment and avoid IDH

Methods

- Time series study in all hospitalized adult AKI and ESKD patients undergoing acute hemodialysis at the University of Colorado Hospital
- 3-month control period: nurses did not use the Crit-Line to adjust dialysis treatment, baseline data was collected
- 1-month run-in period: nurses learned how to use the Crit-Line data and adjust dialysis treatments accordingly, no data was collected
- 6-month intervention period: nurses actively observed the Crit-Line data and adjusted dialysis treatments accordingly, intervention data was collected
- Data including IDH, treatment changes, and patient demographics were collected during the control and invention periods

Results

- 328 total patients: 161 from the control period (33 in the ICU), 167 from the intervention period (39 in the ICU)
- Patient characteristics were similar in both groups (Table 1)
- IDH occurred in 23.5% of all patients during the control period and 18.7% of all patients during the intervention period (p=0.22, Table 2)
- In hemodialysis treatments in the ICU, there was a significant reduction in IDH in the intervention period compared to the control period (23.9% vs. 46.2%, odds ratio 0.71, 95% CI 0.51-0.99, Table 3, Figure 1)
- Among all hemodialysis treatments and hemodialysis treatments only in the ICU, there was no statistical difference in frequency of saline or albumin given, blood flow rate, treatment time, patient symptoms, or length of hospital stay (Table 2, Table 3)

Table 1

Patient Characteristics

	Control Period (n=161)	Crit-Line Period (n=167)
Age (years)	56.9 ± 15.0	56.2 ± 15.0
Female N (%)	66 (41.0)	68 (41.0)
Race/Ethnicity N (%)		
White	82 (50.9)	86 (51.5)
Black	38 (23.6)	42 (25.2)
Hispanic/Latino	45 (28.0)	47 (28.0)
ESKD N (%)	114 (70.8)	120 (71.9)
AKI N (%)	47 (29.2)	47 (28.1)
Diabetes N (%)	84 (52.2)	81 (48.5)
HTN N (%)	142 (88.2)	139 (83.2)
CVD N (%)	55 (34.2)	63 (37.8)
Obstructive sleep apnea N (%)	37 (22.9)	43 (25.7)
Sepsis N (%)	35 (22.0)	47 (28.0)
Circulatory shock N (%)	22 (13.7)	23 (13.8)
Admission to ICU N (%)	33 (20.5)	39 (23.4)

Table 2

Outcomes among all hemodialysis treatments

	Control Period (n=357 treatments)	Crit-Line Period (n=321 treatments)	Odds Ratio (95% CI)	p-value
Intradialytic hypotension (%)	84 (23.5)	60 (18.7)	0.75 (0.47-1.1)	0.22
Frequency of saline given (%)	60 (17.2)	42 (13.3)	0.73 (0.47-1.1)	0.16
Frequency of albumin given (%)	40 (11.4)	30 (9.8)	0.85 (0.48-1.48)	0.56
Change in blood flow rate (%)	71 (20.5)	80 (25.2)	1.3 (0.87-1.96)	0.20
Shortened treatment time (%)	27 (7.6)	25 (7.8)	1.03 (0.59-1.81)	0.91
Adverse patient symptoms during treatment (%)	43 (12.0)	38 (11.8)	0.98 (0.61-1.59)	0.94

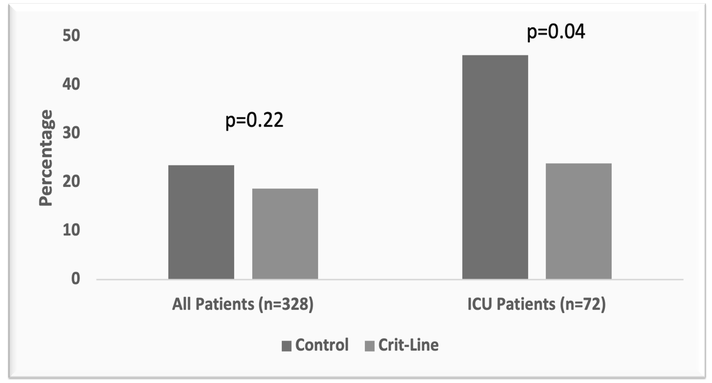
Table 3

Outcomes among hemodialysis treatments in the ICU

	Control Period (n=52 treatments)	Crit-Line Period (n=46 treatments)	Odds Ratio (95% CI)	p-value
Intradialytic hypotension (%)	24 (46.2)	11 (23.9)	0.71 (0.51-0.99)	0.04
Frequency of saline given (%)	14 (27.5)	9 (20.0)	0.66 (0.25-1.8)	0.40
Frequency of albumin given (%)	13 (25.5)	6 (13.3)	0.44 (0.14-1.39)	0.17
Change in blood flow rate (%)	20 (39.2)	17 (37.0)	0.91 (0.40-2.06)	0.82
Shortened treatment time (%)	5 (9.6)	4 (8.7)	0.89 (0.25-3.19)	0.86
Adverse patient symptoms during treatment (%)	7 (13.5)	5 (10.9)	0.78 (0.22-2.75)	0.70

Figure 1

IDH events in control vs. Crit-Line periods



Discussion

- Use of the Crit-Line was associated with a reduction in IDH in patients undergoing dialysis in the ICU (29% reduction in IDH)
- In all patients, IDH occurred less frequently during the intervention period than during the control period (though the difference was not statistically significant)
- Strengths: population size, run-in period, utilization of pre-existing technology, direct chart review
- Limitations: non-randomized, number of ICU patients, ESKD defined by chart review, outcomes reported by nurses
- Next steps: larger, longer duration RCT studying the use of the Crit-Line in ICU patients undergoing dialysis and incorporation of clinically relevant endpoints such as time to recovery of AKI, cardiovascular events, and mortality

References

1. Shingarev R, Wille K, Tolwani A. Management of complications in renal replacement therapy. Semin Dial. 2011; 24:164-168.
2. Obialo CI, Hernandez B, Carter D. Delivered dialysis dose is suboptimal in hospitalized patients. Am J Nephrol. 1998; 18:525-530.
3. Balter P, Artemyev M, Zabetakis P. Methods and challenges for the practical application of Crit-Line monitor utilization in patients on hemodialysis. Blood Purif. 2015; 39:21-24.
4. Balter P, Ficociello LH, Taylor PB, et al. A year-long quality improvement project on fluid management using blood volume monitoring during hemodialysis. Curr Med Res Opin. 2015; 31:1323-1331.
5. Parker TF 3rd, Hakim R, Nissenson AR, et al. A quality initiative. Reducing rates of hospitalizations by objectively monitoring volume removal. Nephrol News Issues. 2013; 27:30-32.
6. Kron S, Leimbach T, Wenkel R, et al. Relative blood volume monitoring during renal replacement therapy in critically ill patients with septic shock: a preliminary report. Blood Purif. 2015; 40:133-138.
7. Ronco C, Bellomo R, Ricci Z. Hemodynamic response to fluid withdrawal in overhydrated patients treated with intermittent ultrafiltration and slow continuous ultrafiltration: role of blood volume monitoring. Cardiology. 2001; 96:196-201.
8. K/DOQI clinical practice guidelines for cardiovascular disease in dialysis patients. Am J Kidney Dis. 2005; 45(Suppl 3):16-153.

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