Supplementary Material

Detailed Methods

We performed a time series quality improvement study in all hospitalized adult AKI requiring RRT and ESKD patients undergoing acute hemodialysis at the University of Colorado Hospital from December 2019 through January 2021. AKI and ESKD were identified through chart review of nephrology notes during the hospital admission. Continuous renal replacement therapy sessions were not included. We included intermittent hemodialysis treatments performed in the acute dialysis unit as well as portable treatments performed in the intensive care units (ICU). Patients at our Institution undergo portable dialysis in the ICU if the nephrologist and/or primary hospital team determine the patient is too medically unstable to travel to the acute dialysis unit. The initial control period was 3 months in length, during which baseline data was collected on all patients undergoing hemodialysis. Next, there was 1-month run-in period used for training the nurses to use RBVM. Crit-Line was used for all patients undergoing acute dialysis. The CLiC^{TM} device and Crit-Line IV device were used. Nurses actively monitored and adjusted treatments according to Crit-Line. No data was collected during the run-in period. This period ensured all of the nurses were trained properly and to manage any logistical or technical issues that occurred prior to starting the intervention.

Nurses were given an intervention algorithm developed by the study team that provided information on adjustments to the dialysis prescription based on Crit-Line. The nurses began to monitor blood volume change 30 minutes after initiation of dialysis. Crit-Line includes the dynamics of blood volume changes in profiles. Profile A is displayed when measurements taken over the previous 15 minutes result in a profile of ≤ 3% per hour and is represented as a flat or

upward slope. Profile A indicates that the patient's plasma refill rate is occurring at the same or greater rate than the ultrafiltration (UF) rate and suggests the UF rate might be increased without intradialytic symptoms. Profile B is displayed when measurements taken over the previous 15 minutes result in a profile that is >3% to ≤ 6.5% per hour and is the ideal profile. Profile B is a gradual slope and is ideal as it finds the best compromise between a higher UF rate and prevention of intradialytic symptoms. Profile C is displayed when the measurements taken over the previous 15 minutes result in a profile of >6.5% per hour. Profile C is a steep slope and indicates a rapid decrease in blood volume and suggests a higher risk for intradialytic symptoms and suggest the UF rate should be decreased. After assessing the patient for symptoms and vital signs, nurses would make changes to the UF goal until the patient converted to Profile B. For profile C, nurses would decrease the UF goal by 200 mL and recheck the blood volume profile every 15 minutes after the UF goal was decreased. They would continue to decrease the UF goal by 200 mL every 30 minutes until the curve converted to Profile B. If the patient developed hypotension, the nurses performed standard of are interventions including placing the patient in modified Trendelenburg position and turn UF rate to minimum. If symptoms persisted, they administered normal saline or albumin bolus per physician order. They continued to monitor, treat and record blood pressure every 5 minutes until any symptoms related to hypotension had been relieved.

During the intervention period, Crit-Lines were used for all patients undergoing acute dialysis and nurses were actively monitoring and adjusting treatment accordingly. As in the control period, data was actively collected on all patients. Both periods were 3 months in duration. Due to the COVID-19 pandemic and delays and stopping of research protocols, the intervention period was not done over 3 consecutive months.

During both the control and the intervention periods, data collected included demographics, medical history, medication use, vital signs, time on dialysis, blood flow rates and net ultrafiltration. Length of stay in the hospital and ICU were also collected. Additionally, dialysis nurses documented on data collection sheets the following: hypotensive events, tachycardia, modifications made to the dialysis prescription during treatment and patient symptoms during treatment (e.g. cramping, dizziness, chest pain). Modifications made to dialysis prescriptions included fluids or medications given, changes in blood flow, duration of treatment or ultrafiltration rate. Modifications and patients symptoms documented on data collection sheets were confirmed by chart review. The study protocol was approved by the Colorado Multiple Institutional Review Board (Aurora, CO). Use of RBVM is included in the consent for inpatient dialysis treatment that patients or their medical decision maker complete, so separate consent for this study was not deemed necessary.

Outcomes

The primary outcome was number of IDH events, defined by the NKF KDOQI Guidelines as a fall in systolic blood pressure by ≥20mmHg or a fall in mean arterial pressure by ≥10mmHg with associated symptoms.[8] Secondary outcomes included modifications made to the dialysis treatment as described above, patient symptoms and length of hospital and ICU stay.

Statistical Analysis

Standard descriptive statistics of baseline characteristics and outcome variables were reported for all patients during the control and interventional periods. Between-group comparisons of repeated, dichotomous events were assessed using the generalized estimating

equation models with a binomial distribution. Between-group comparisons of repeated, ordinal events were assessed using the generalized estimating equation models with a multinomial distribution. Categorical variables were presented as numbers and percentages and continuous variables were presented as means and standard deviations. Two-tailed p-values <0.05 were considered statistically significant. Subgroup analyses were conducted for patients with and without AKI and dialysis treatments performed in the intensive care unit (ICU). All analyses were carried out with SAS (version 9.4; SAS Institute Inc, Cary, NC, USA).

Supplementary References

S1. Preciado P, Zhang H, Thijssen S, Kooman JP, van der Sande FM, Kotanko P. All-cause mortality in relation to changes in relative blood volume during hemodialysis. *Nephrol Dial Transplant*. Aug 1 2019;34(8):1401-1408. doi:10.1093/ndt/gfy286

S2. du Cheyron D, Terzi N, Seguin A, et al. Use of online blood volume and blood temperature monitoring during haemodialysis in critically ill patients with acute kidney injury: a single-centre randomized controlled trial. *Nephrol Dial Transplant*. Feb 2013;28(2):430-7. doi:10.1093/ndt/gfs124

S3. du Cheyron D, Lucidarme O, Terzi N, Charbonneau P. Blood volume- and blood temperature-controlled hemodialysis in critically ill patients: a 6-month, case-matched, open-label study. *Blood Purif*. 2010;29(3):245-51. doi:10.1159/000266481