ACUTE RESPIRATORY DISTRESS SYNDROME (ARDS) AFTER TRAUMA: IMPROVING INCIDENCE, BUT STILL HIGHLY MORBID AND MORTAL

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Background: Acute Respiratory Distress Syndrome (ARDS) is an infrequent, yet morbid inflammatory complication in injury victims. With the current project we sought to estimate trends in its incidence, determine clinically relevant outcomes, and identify risk factors for ARDS and related mortality.

Methods: The national TQIP dataset (2010-2014) was queried, after exclusion of patients who expired/had a length of stay (LOS) <48 hours. Demographics, injury characteristics and outcomes were compared between patients who developed ARDS and those who did not. Logistic regression models were fitted for the development of ARDS and mortality respectively, adjusting for age, gender, race, severity of neurologic injury, overall injury severity, presenting hypotension, mechanism of injury, blood products transfused and pre-existing comorbidities.

Results: Out of the 808,195 TQIP patients, 165,244 were excluded. Incidence of ARDS decreased over the study years (3% to 1.1%, $p<0.001$), but related mortality increased (18.9% to 21%, $p=0.001$). ARDS patients spent on average an additional 14.7±10.3 days in the hospital, 9.7±7.9 in the ICU, and 6.6±9.4 on mechanical ventilation (all $p<0.001$). Older age, male gender, African American race, and interestingly pre-injury steroids increased risk for ARDS, while blood product transfusions did not. Only age, male gender, lower GCS and higher ISS predicted mortality among ARDS patients.

Conclusion: Although the incidence of ARDS after trauma appears to be improving slightly, mortality has increased. As risk factors for ARDS or mortality are not easily modifiable, the need to develop treatments for the syndrome cannot be overemphasized.

LETTING LOOSE: IMPACT OF A DECISION SUPPORT TOOL ON RESTRAINT USE REDUCTION IN A NEUROTRAUMA INTENSIVE CARE UNIT (NTICU)

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Background: Physical restraint use in acute care settings is associated with poor patient outcomes, including soft tissue injury, nosocomial infections, delirium, and complications of immobility and death. The purpose of this study was to determine if: 1) use of an evidence-based restraint decision wheel (RDW) safely reduces use of restraints in a neurotrauma patient population, and 2) relationships exist amongst registered nurse (RN) characteristics and confidence in use of the RDW.

Methods: This IRB approved quasi-experimental pre-post intervention study was conducted in a 12-bed Neurotrauma Intensive Care Unit (NTICU) at a Level 1 trauma center. Restrained adults ≥ 18 years of age admitted to and RNs practicing in the NTICU comprised the convenience samples. The study intervention used, with permission, was Hurlock-Chorostecki and Kielb's RDW to support nursing assessment for restraint use. Restraint use and device dislodgement were monitored daily. Nurse characteristics and confidence in restraint use was measured, with permission, using the Henever RN Restraint Confidence Survey. Patient data was compared 3-months retrospectively to the 3-months post-intervention period for the following: age, gender, ICU admission diagnosis, traumatic/non-traumatic brain injury present, dementia, alcohol and substance abuse, and tobacco history. Comparisons were analyzed using Chi square and independent samples t-tests. The level for statistical significance was established as $\alpha=0.05$ and analyzed using SAS **Enterprise Guide** 7.1.

Results: There was no statistical difference ($p > 0.05$) in patient (pre, n=73; post, n=69) characteristics or impact of characteristics on mean time (minutes) in restraints pre versus post implementation, except for patients without Delirium (negative CAM-ICU) spent significantly more total mean time restrained (minutes) in post vs. pre study periods ($p=0.0326$). There were no statistical differences ($p>0.05$) pre to post study phase in use of type of restraint. Trends showed brain injured patients spent more time in restraints and more time in restrictive restraints. For non-brain injured patients total time and restrictive restraints trended down. No observational difference in RN characteristics or confidence were noted pre to post implementation. Nurse findings were limited by sample size (n=11).

Conclusions: Nurse confidence in restraint use may not change with use of the RDW in a NTICU. Consistent with prior research, the study findings suggest using the RDW may reduce restraint use in non-brain injured ICU patients. This study was the first to explore use of the RDW in a neurotrauma population and findings suggest use of the RDW may not be effective in brain injured ICU patients.

TITLE: ALTEPLASE DOSING STRATEGIES IN CRITICALLY ILL PATIENTS WITH MASSIVE PULMONARY EMBOLISM

BACKGROUND: The American College of Chest Physicians and British Thoracic Society Guidelines recommend intravenous thrombolysis as first-line therapy for massive pulmonary embolism (PE) in patients without contraindications. Limited data exists on the safety and effectiveness of standard alteplase (SA) vs non-standard alteplase (NSA) dosing regimens for massive PE.

METHODS: This single-center retrospective case series included adult patients admitted to the intensive care unit (ICU) and received alteplase for massive PE confirmed on computed tomography with hemodynamic instability from 2013-2019. Hemodynamic instability was defined as systolic blood pressure (SBP) < 90 mmHg or ≥ 20% change in SBP from baseline. Outcomes assessed included hemodynamics, bleeding episodes, oxygen saturation (O_2 sat), and need for intubation within 48 hours of alteplase administration. Appropriate hemodynamic response was defined as SBP > 90 mmHg or > 20% increase in SBP, heart rate (HR) < 90 beats per minute (bpm), or O_2 sat > 92%. Major bleeding was defined as a fatal bleeding event, a decrease in hemoglobin ≥ 2g/dL from baseline, or bleeding requiring ≥ 2 units of whole blood or red blood cells. Data are described as descriptive.

RESULTS: Of the 128 patients who received alteplase during the study period, 17 met inclusion and had a mean age of 63±14yrs and mean weight of 105±26kg. Of these, 82% of patients received SA 100 mg over two hours. SA patients had similar hospital and ICU length of stay vs NSA (5±3 vs 8±5days and 2±1 vs 2±0.1days, respectively). Appropriate hemodynamic response was similar between groups for SBP (51% SA vs 35% NSA), HR (29% SA vs 33% NSA), and O_2 sat (93% SA vs 100% NSA). No differences in laboratories were seen pre- and post-alteplase administration between groups. Time to hemodynamic improvement was faster with NSA (14±11 SA vs 3±1 NSA mins). Major bleeding was more likely with SA (75% SA vs 33% NSA). Need for intubation was similar between groups (14% SA vs 33% NSA). Overall, no in-hospital mortality occurred.

CONCLUSIONS: Alteplase for massive PE in this case cohort seemed to be safe and effective and a hemodynamic response following administration was achieved between groups. With various dosing strategies utilized in practice, future large, randomized controlled trials are essential to further evaluate these regimens.

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INCIDENCE AND EFFECTS OF HYPERCHLOREMIA AND CEREBRAL SALT WASTING IN CRITICALLY ILL PATIENTS WITH TRAUMATIC BRAIN INJURY

Background:
Hyperosmolar agents, including hypertonic saline and mannitol, are routinely used for the management of intracranial pressure (ICP) in patients with traumatic brain injury (TBI). The Brain Trauma Foundation supports the use of hyperosmolar therapy to lower ICP in severe TBI but does not offer a recommendation regarding the optimal agent. While our institution utilizes both hypertonic saline and mannitol, this study focuses on hypertonic saline. Hypertonic saline is hypothesized to decrease ICP by reducing blood viscosity, improving microcirculatory flow and consequent constriction of pial arterioles. While hypertonic saline is clearly beneficial in reducing ICP, there are risks including hypernatremia, hyperchloremia, and acute kidney injury (AKI). The development of cerebral salt wasting (CSW) has been observed in TBI patients who received hyperosmolar therapy. Current literature has limited information on the incidence of hyperchloremia and CSW in TBI patients treated with hypertonic saline.

Methods:
This study was a retrospective, single center, medical record review of patients with TBI treated with hypertonic saline. Patients were included if they aged 18 years or older, were admitted to the Surgical Trauma Neuro Intensive Care Unit (STNICU), and treated with at least one dose of hypertonic saline for elevated ICPs. Patients were excluded if under 18 years of age, pregnant, or incarcerated. This study was approved by the Institutional Review Board. Pearson's χ^2 test was used for statistical analysis.

Results:
Of 117 patients included, 77 met criteria for hyperchloremia. The mean baseline chloride was 106.4 ± 6.4 mmol/L and mean chloride after hypertonic saline administration was 125.3 ± 7.22 mmol/L (χ^2 = 0.24). Throughout the study, 65.3% of patients developed hyperchloremia. CSW developed in 10.08% of patients. The mean sodium level was 146 mmol/L in patients who received a continuous infusion of hypertonic saline and 142.9 mmol/L in patients who received a bolus. AKI occurred in 15.9% of patients. There was a 29.4% incidence of mortality. Acidemia occurred in 9.2% of patients. Hospital length of stay (LOS) was 21.5 ± 23.92 days and ICU LOS was 10.9 ± 8.5 days. Duration of mechanical ventilation was 6.8 ± 6.8 days. Most patients were discharged to rehabilitation (38.5%).

Conclusions:
This study demonstrated that approximately 65.3% of patients developed hyperchloremia after receiving hypertonic saline. The incidence of CSW, AKI, and acidemia was relatively low.

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Evaluation of prescribing patterns of the adult critical care electrolyte replacement protocol

Background

The complexity of electrolyte abnormalities in critically ill patients has been associated with suboptimal treatment of electrolyte disorders. Addressing such abnormalities is imperative to avoid potential consequences, including homeostatic instability, metabolic issues, and increased morbidity and mortality. The adult critical care electrolyte replacement protocol is a nursing driven protocol that addresses potassium, magnesium, and phosphorus. The purpose of this medication use evaluation was to determine appropriateness of protocol utilization, appropriateness in patients with renal impairment, and to evaluate the number of patients who would've benefited from potassium phosphate.

Methods

This is an institutional review board exempt quality improvement study. This was a retrospective cohort evaluating patients admitted to the cardiac care unit (CCU), surgical trauma neuro intensive care unit (STNICU), and medical intensive care unit (MICU) from March 1 to May 31, 2019. The study included patients 18 years of age or older in the CCU, STNICU, and MICU who received electrolyte replacement via the adult critical care electrolyte replacement protocol. Patients were excluded if admitted to the cardiovascular intensive care unit (CVICU) or if replacement was given from a different order set/protocol or based on provider's discretion. The current protocol has restriction against use in patients with serum creatinine greater than 2 mg/dL, urine output less than 0.5 mL/kg/hr, or weight less than 60 kg.

Data collected was based on chart review and included patient MRN, demographics (date of birth, height, and weight), urine output was greater than 0.5 mL/kg/hr, ICU location, date of admission and discharge to the hospital and ICU, baseline and rechecked electrolyte values, electrolyte replacement received throughout ICU admission, timing of replacement and of level rechecks, appropriateness of protocol use based on current restrictions and replacement, and potential benefit from potassium phosphate as a replacement option. Descriptive statistics were used to analyze all endpoints.

Results

A total of 65 charts were reviewed with 42 patients included. There were 39 patients in the potassium group, 21 in the magnesium group, and 13 in the phosphorus group. For all groups, average time to replacement was greater than 2 hours, with a range of 15 minutes to 15 hours and 14 minutes.

Inappropriate replacement or no replacement occurred 25.56 percent, 21.90 percent and 25.88 percent of the time for potassium, magnesium and phosphorus respectively. Potassium levels were inappropriately rechecked 31.02 percent of the time. The protocol was used in 15.5 percent of patients who met one of the three contraindications. In 79.49 percent of patients, additional potassium replacement was given outside of the protocol. Magnesium levels were inappropriately rechecked 24.76 percent of the time. The protocol was used in 13.95 percent of patients who met contraindications. Additional magnesium replacement outside of the protocol occurred in 33.33 percent of the patients. Phosphorus levels were inappropriately rechecked 32.94 percent of the time. The protocol was used in 20 percent of patients who met contraindications. Additional phosphorus replacement outside of the protocol occurred in 15.38 percent of the patients, and 84.62 percent of patients would've benefited from potassium phosphate.

Conclusion

Patients required additional replacement outside of the protocol, demonstrating that the protocol is not providing sufficient replacement. This indicates a change needed for more aggressive replacement. The current protocol only includes sodium phosphate for phosphorus replacement, but with 84.62 percent of patients who would've benefited from potassium phosphate, it should be added to the protocol as an option. Considerations should be made about oral versus intravenous replacement in patients who can tolerate oral. Lastly, an electronic generated advisory should be created to reminder providers when protocol use is inappropriate to order and remind nurses when a level requires replacement.

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