

Introduction

Hypocalcemia, especially in the hypovolemic trauma patient population, has been highlighted as an emerging issue in recent literature. It has been shown that up to 56% of patients involved in a traumatic event are hypocalcemic upon arrival at the Emergency Department (ED). A deficiency in calcium has associations with increased morbidity and mortality, as well as poor coagulation, among other pathologies. In addition, patients injured by a traumatic event often display hemodynamic instability and require blood product administration to compensate for trauma-induced hypovolemia. Studies have shown, at times, these citrated blood products can exacerbate the issue of hypocalcemia. Proper assessment of calcium levels in trauma patients is important as it appears to have a close correlation with, and is a potential early predictive measure for, patient outcomes.

Objectives

The purpose of this research project was to ascertain the facility's trauma patient population for blood calcium levels to determine baseline calcium readings. The researchers sought to understand current circumstances and inform future studies to improve patient care and outcomes.

Methods

A retrospective chart audit was undertaken to gather data to assess calcium levels. Data points included age, time of blood draw, serum calcium level (mg/dl), albumin level(mg/dl), administration of blood products and duration, if applicable, systolic blood pressure, injury type and injury mechanism. Payne's Formula was used to adjust calcium levels for albumin and results recorded for analysis.

Payne's Formula

$$Ca_{adj}(mg/dl) = (Ca_T[mg/dl] + 0.25[4.0 - albumin, g/l])$$

Results

It was discovered that approximately 35.9% (n=409) of our trauma patient population from January 2020 through December 2020, can be considered hypocalcemia according to total blood serum calcium levels at or below 8.5 mg/dl. After the adjustment made using Payne's Formula, the resulting adjusted calcium levels approximated 38.4% (n=157) remained <8.5 mg/dl. These results indicate the high rate of hypocalcemia in the cohort.

Conclusion

Subsequent to this study and literature review, it was determined that the optimum measurement for calcium is in ionized form. The facility is transitioning to gather ionized calcium on all Level 1 and Level 2 trauma patients going forward. Given the low correlation of total adjusted calcium to ionized calcium levels when using Payne's Formula to account for albumin, and subsequently, the likelihood of error inherent in this widely used and accepted method of assessment, the IStat EG7 will replace serum calcium measurement to collect ionized calcium values for trauma patients within Emergency Services and the Emergency Department going forward. This adjustment to protocol allows our facility to raise our calcium quantification to industry standards and move into additional data collection to contribute to this ongoing project and support improved patient outcomes. The investigators will have the ability to more accurately determine the occurrence of hypocalcemia in hypovolemic patients after a traumatic event. Comprehensive staff education is a central piece in the implementation of this protocol for Emergency Medical Services and the Emergency Department.

References

1. Ditzel, R., Oak, S., Eisenhart, & Siegler, J. (2019). A Review of Transfusion- And trauma-induced hypocalcemia: Is it time to change the lethal diamond? *Journal of Trauma and Acute Care Surgery*, 434-439.
2. Dyer, M., & Neal, M. (2017). Defining the lethal triad. *Damage Control Management in the Polytrauma Patient*, 41-53.
3. Elisaf, M., Liamis, G., Liberopoulos, E., & Siamopoulos, K. (2001). Mechanisma of Hypocalcemia in Alcoholic Patients. *Nephron*, 459-460.
4. Ho, K., & Leonard, A. (2011). Concentration -dependent effect of hypocalcemia on mortality of patients with critical bleeding massive transfusion: a cohort study. *Anaesth Intensive Care*, 1-11.
5. Pfitzenmeyer, P., Martin, I., Athis, P., Grumbach, Y., Delmestre, M., Blonde-Cynober, F., Brondel, L. (2007). A new formula for correction of total calcium level into ionized serum calcium values in very elderly patients. *Archives of Gerontology and Geriatrics*, 151-157.

