

Selective Measurement of Ionized Calcium Levels in Trauma:

Early iCal Associated with worse outcomes

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Background

- Recent data suggests that **hypocalcemia** plays a key role in the **outcomes of trauma** patients.
- Hypocalcemia occurs **frequently in critically ill patients** including the severely injured trauma patient (Kyle et al).
- There have been **no published prospective studies** on iCal in trauma.
- Joint Trauma System guideline (2019): “**Earlier calcium use recommended**. One gram of calcium IV/IO should be given to patients in hemorrhagic shock during or immediately after transfusion of the first unit of blood product and with ongoing resuscitation after every 4 units of blood products.
- The reason for the administration of calcium after 4 units of blood has been attributed to the **citrate compounds** in the blood preservative that **bind up the free calcium** resulting in hypocalcemia
- Hypocalcemia leads to **decreased heart contractility** and **overall hypoperfusion** that can occur after massive hemorrhage.
- Henrickson et al, *Military Medicine*: 86.8% of patients assessed by far forward surgical teams were hypocalcemic **prior to blood transfusions**.
- Blood product administration **exacerbates the existing** or developing hypocalcemia?

Methods

- Retrospective analysis of trauma data repository from the University of Colorado Hospital ED.
 - COMIRB 19-2921 is a data repository that collects data on all trauma patients seen at UCH.
- Trauma patients >15 years old were included
- We assumed normal distributions and used unpaired t-tests to compare group means.
- Primary/secondary outcomes: iCal & hypocalcemia, acidosis, coagulation derangements

Hypothesis

We hypothesized that the occurrence of early (<4hr) iCal measurement will reflect injury severity and predict outcomes.

Results

- There were 1431 patients included, of which only 76 (5%) had iCals measured within the first 4hr.
 - These 76 patients were, on average, hypocalcemic (mean iCal 1.09, SD 0.15).
- Proportion of patients with penetrating injury was higher in those having iCals drawn in 4hr (36% vs 7%)
- Mean ISS as well as shock index were higher for those with early iCal measurement (23 vs 9 and 0.98 vs 0.66, respectively; $P < 0.0001$)
- Of those with early iCal measurement, 66% (50/76) received blood, but only 10% of those (5/50) had iCal drawn before blood.
- Patients with iCal measured in the first 4hr spent more time in the ICU and hospital (mean ICU- and hospital-free days 13 vs 23 and 18 vs 26, respectively; $P < 0.0001$) and had higher overall mortality (16% vs 2%)

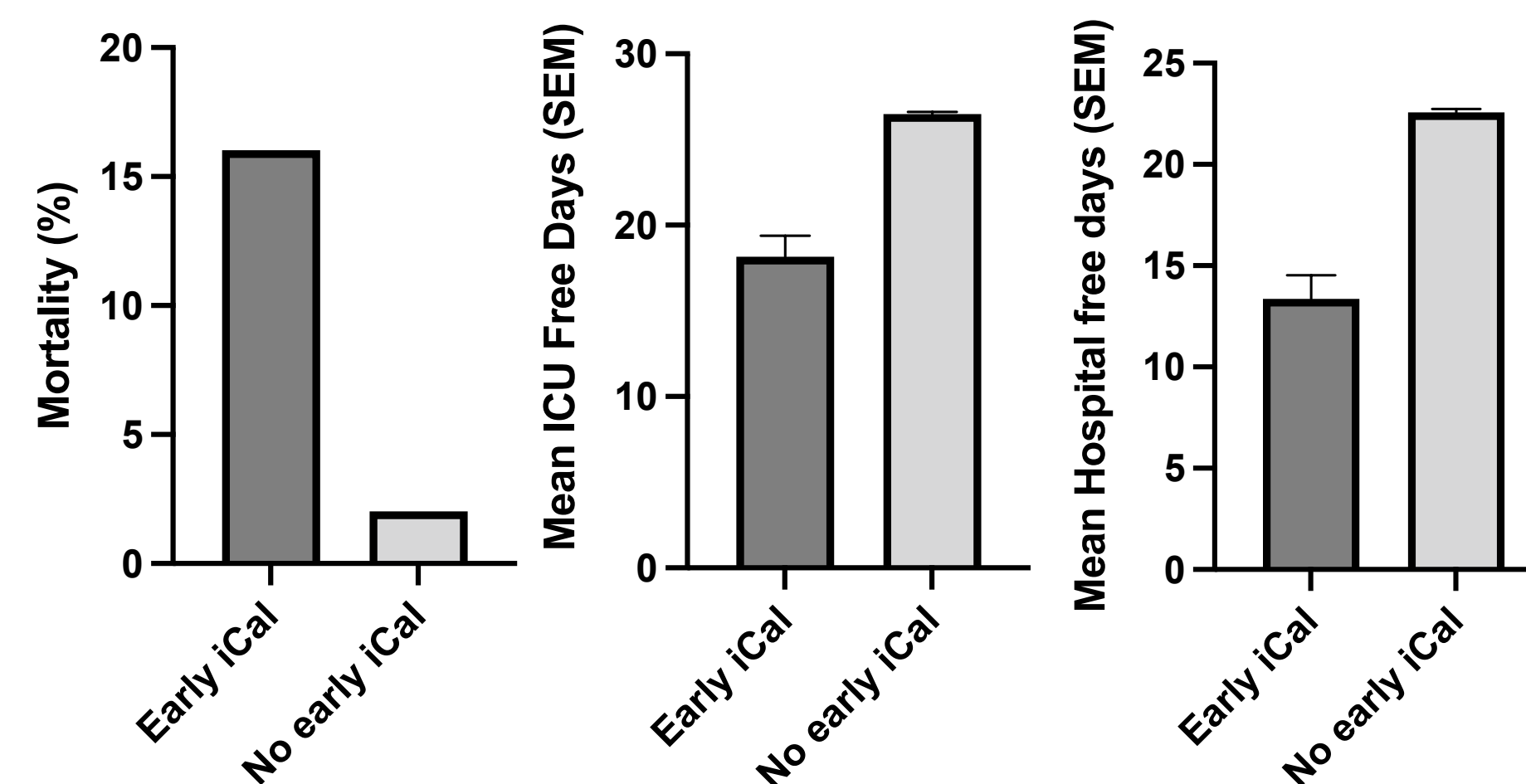


Figure 1. Mortality, hospital- and ICU-free days based on occurrence of early (<4hr) iCal measurement.

Conclusions

- A select group of trauma patients get iCals drawn early in their course.
- The mere event of this lab measure predicts a longer time in the ICU and hospital as well as higher mortality
- These findings suggest that there is something influencing trauma providers to draw an iCal, and injury severity (ISS) and shock appear to contribute to that decision-making.
- There is additional information tipping off clinical gestalt that is related to how well these patients will do.
- We **supported the hypothesis** that hypocalcemia occurs with traumatic injury and that it is proportional to the injury severity and units of blood product transfused.
- Novel study associating early calcium measurement and replacement with survival.

Implications

- This analysis implores a prospective design for studying hypocalcemia in trauma.
 - Future clinical trial to study the association of early calcium replacement on survival in trauma patients?
- The findings of this study potentially represent a target for a low-cost, easy-to-administer invention in the prehospital, combat setting.
- Providers may use ionized calcium levels to inform clinical judgment and to develop more informed prognoses.

Disclosures

There are no conflicts of interest to report amongst the authors or principal investigators of this study.

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