

# 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

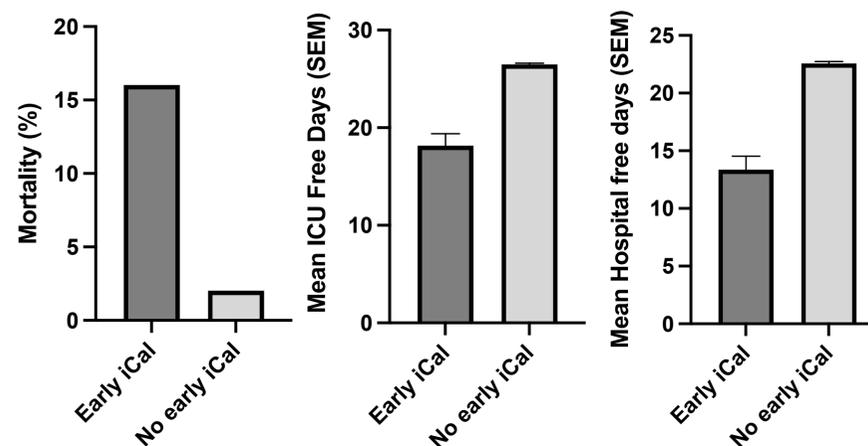
- Retrospective analysis of trauma data repository from the University of Colorado Hospital ED.
  - COMIRB 19-2921 is a data repository that collects data on all trauma patients seen at UCH.
- Trauma patients >15 years old were included
- We assumed normal distributions and used unpaired t-tests to compare 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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