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Abnormal Calcium Levels during Trauma Resuscitation are Associated with Increased Mortality, Increased Blood Product Use, and Greater Hospital Resource Consumption: A Pilot Investigation

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To the Editor

Response to Dr. Freundlich et al

We would like to thank Dr. Freundlich and colleagues for their informed comments regarding our study. The concerns regarding the lack of adjusting the analysis to reflect serum pH, serum lactate, and the cationic difference between calcium gluconate and calcium chloride are points well taken. Serum pH does impact free calcium levels through ionic coupling with bicarbonate. *In vivo* this equilibration occurs very quickly. Thus measured iCa^{2+} levels reliably reflect available calcium stores unless the pH is changing very rapidly. Error can be introduced into iCa^{2+} measurements if samples are stored for a long period of time before being analyzed. In refrigerated samples, the pH generally drops and the measured iCa^{2+} will be falsely elevated whereas the opposite occurs in frozen samples. All of the labs we report were from fresh samples. Lactate is known to bind calcium similar to

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Author Contributions:

E.J.M. and J.W.C. designed the study; E.J.M. performed the data acquisition; E.J.M. M.D.S., D.N.H., M.D.N., L.J.K., and J.W.C. performed data analysis; all authors interpreted the data; E.J.M. and J.W.C. prepared the manuscript, which all authors critically revised.

albumin; so this would only alter total calcium levels, not iCa^{2+} . Regarding calcium repletion, calcium chloride contains 27 mg/mL elemental calcium whereas calcium gluconate contains only 9.3 mg/mL. In our pilot study only two patients received a single dose of calcium gluconate, and in both cases, received calcium chloride for all subsequent doses. Given the limited sample size, we chose not to exclude these cases. In future studies with larger patient numbers, we will be careful to evaluate and report elemental calcium. Thank you again for these insightful comments.

Sincerely,

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Dear Editorial Staff

In the event you wish to publish an erratum. FFP IQR range should read [1–3] rather than [103] and Total Units 10 should be [n (%)] rather than [median (IQR)].

Appreciatively,

Emily J. MacKay, DO