

AAP DISTRICT VIII SECTION ON NEONATAL PERINATAL MEDICINE

2021 ANNUAL CONFERENCE QUALITY IMPROVEMENT ABSTRACT SUBMISSION FORM

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Title: Improving Electrolyte and Mineral Homeostasis in Extremely Premature Infants

Authors: Sofia M. Markee, DO, Janell F. Fuller, MD, Ann-Marie Yaroslaski, RD, LD, Eleni E. Shenk, PharmD, Jessie R. Maxwell, MD

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Background: Infants ≤ 28 weeks gestational age (GA) are at increased risk for developing electrolyte and mineral abnormalities due to having a reduced baseline bone mineral content. Significant calcium accretion occurs during the third trimester, whereby nearly 80% of fetal calcium stores are obtained. Phosphorus deficiency is often present in these infants, with $\sim 54\%$ of extremely preterm infants having metabolic bone disease. Infants ≤ 28 weeks GA rely heavily on the content of parenteral nutrition given in the first few days of life to provide appropriate electrolytes. The current standard of care is to provide early, aggressive parenteral nutrition and early enteral feeds. Parenteral nutrition has been studied to determine optimal dextrose, amino acid and lipid content, but there is limited evidence on how to optimize calcium and phosphorus content.

Aim/Objective: Our primary outcome is to improve calcium and phosphorus levels over the first week of life in extremely premature infants ≤ 28 weeks GA by optimizing parenteral nutrition. Secondary outcomes included monitoring serum creatinine and ionized calcium levels.

Methods: After obtaining IRB approval, we completed a prospective cohort study in 13 infants ≤ 28 weeks GA in a tertiary-care level neonatal intensive care unit between March 2020 and September 2020. Serum calcium and phosphorus levels were measured daily during the first week of life or until full enteral feeds were reached, whichever occurred first. Total feeding volumes (ml/kg/day) were also followed. Upon review of this cohort, a custom parenteral nutrition form was designed and utilized for the next cohort of patients (October 2020 to January 2021), introducing calcium and phosphorus to parenteral nutrition earlier. A comparison was made between the first cohort (n=14) and the second cohort (n=9) during the first week of life. Additionally, serum creatinine and ionized calcium levels were compared between the two cohorts. A Grubb's analysis was used to identify and remove outliers followed by a student's t-test analysis. A p -value of < 0.05 is considered statistically significant.

Results: Mean serum calcium levels on day of life (DOL) 1 between the two cohorts were similar ($6.57 \text{ mg/dL} \pm 0.25 \text{ mg/dL}$ and $6.74 \text{ mg/dL} \pm 0.12 \text{ mg/dL}$ for cohorts 1 and 2, respectively ($p=0.6$)). On DOL 2 mean serum calcium levels for cohorts 1 and 2 were again similar ($7.86 \text{ mg/dL} \pm 0.16 \text{ mg/dL}$ and $7.60 \text{ mg/dL} \pm 0.32 \text{ mg/dL}$, respectively ($p=0.4$)). Interestingly, the mean serum creatinine on DOL 1 was nearly significantly decreased in cohort 2 compared to cohort 1 ($0.90 \text{ mg/dL} \pm 0.05 \text{ mg/dL}$ for cohort 1 compared to $0.76 \text{ mg/dL} \pm 0.05 \text{ mg/dL}$ for cohort 2 ($p=0.07$)). Mean serum creatinine remained $< 1 \text{ mg/dL}$ throughout the first week of life for infants in cohort 2, while it trended higher in cohort 1 over the first week of life. Mean ionized calcium decreased between day of birth (DOB) and DOL1 in cohort 1 by 0.05 mmol/L from 1.02 mmol/L to 0.97 mmol/L but continued to gradually increase in cohort 2 by 0.01 mmol/L from 0.99 mmol/L on DOB to 1 mmol/L on DOL 1.

Summary/Discussion: The use of our specially designed custom parenteral nutrition form in cohort 2 for infants ≤ 28 weeks GA allowed for a more consistent and gradual increase in the calcium present in the parenteral nutrition. Prior to the use of this new standardized form, the amount of calcium added to parenteral nutrition increased and decreased on a day-to-day basis (observed in cohort 1). Creatinine levels were lower with use of the new standardized parenteral nutrition form and ionized calcium levels remained in goal range with less therapeutic intervention in cohort 2 compared to cohort 1. Phosphorus levels did not significantly improve during the first week of life in cohort 2 compared to cohort 1 with this intervention. Our next intervention is to implement the addition of calcium gluconate 0.5 mEq/dL to a stock parenteral nutrition bag with dextrose and amino acids for use on DOB for those born ≤ 28 weeks GA, beginning February 2021. We hypothesize that this additional intervention will result in a significant impact on calcium and phosphorus stabilization in infants ≤ 28 weeks GA during the first week of life.