



Assessing the Risk of Hypovitaminosis and Vitamin C Deficiency in Critically Ill Pediatric Patients Undergoing Cardiopulmonary Bypass

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BACKGROUND

Vitamin C (Ascorbic Acid) is an essential water-soluble vitamin with numerous physiological roles:

- Cofactor for endogenous catecholamine production
- Scavenges free radicals, decreasing oxidative injury
- Improves endothelial function and integrity, resulting in dramatically less leak and edema

Cardiopulmonary bypass can lead to significant inflammation, endothelial dysfunction, and interruption of nutrition during the perioperative period.

Children with congenital heart disease and undergoing cardiac surgery might be at increased risk for low circulating vitamin C levels.

Primary objective: This study aimed to investigate the risk of hypovitaminosis C and vitamin C deficiency in pediatric patients with congenital heart disease undergoing surgical repair using cardiopulmonary bypass.

METHODS

An ongoing, prospective single-center observational study evaluating the perioperative time course of vitamin C levels in critically ill pediatric patients undergoing congenital heart surgery using CPB.

Projected sample size of 50 neonates and children with congenital heart disease will provide 82% power to identify significant correlation between Vit C levels and outcomes (Hospital length of stay, mechanical ventilation free days, and vasoactive-inotropic score).

Vitamin C serum levels were collected and recorded preoperatively (before CPB) and postoperatively (upon admission to the ICU, at 24 hours, and at 72 hours).

Pediatric patients undergoing cardiac surgery with CPB showed decreased vitamin C levels during the postoperative period.

The effects of hypovitaminosis C and vitamin C deficiency on patients outcomes remains unclear.

CONCLUSIONS

Pediatric patients with congenital heart disease undergoing surgical repair with cardiopulmonary bypass developed low circulating levels of vitamin C during the postoperative period.

The effects of hypovitaminosis C and vitamin C deficiency remains unclear.

Next steps:

- Upon completion of the final analysis, this study will provide data to help understand the relationship between low levels of vitamin C and patient outcomes.
- Expand to a multicenter study to help identify patients with a high risk of developing postoperative hypovitaminosis C and vitamin C deficiency.

ADDITIONAL KEY INFORMATION

CPB median duration was 117 (IQR, 82.8-162.3) minutes, and the hospital length of stay was 8 (IQR, 4-19) days.

Vitamin C levels median decreased from 82 (IQR, 64.8-99.5) $\mu\text{mol/L}$ before going on CPB to 48 (IQR, 39.8-69) $\mu\text{mol/L}$ upon admission to the ICU ($p < 0.001$).

Vitamin C remained low on post-op day one and day three, with serum levels of 52 (IQR, 40-77) $\mu\text{mol/L}$ ($p < 0.001$) and 62 (IQR, 33.3-93) $\mu\text{mol/L}$ ($p = 0.009$), respectively.

References:

Carr AC, Rosengrave PC, Bayer S, Chambers S, Mehrtens J, Shaw GM. Hypovitaminosis C and vitamin C deficiency in critically ill patients despite recommended enteral and parenteral intakes. Crit Care. 2017;21(1):300.

Marik PE. Vitamin C for the treatment of sepsis: The scientific rationale. Pharmacol Ther. 2018;189:63-70.

Tanaka H, Matsuda T, Miyagantani Y, Yukioka T, Matsuda H, Shimazaki S. Reduction of resuscitation fluid volumes in severely burned patients using ascorbic acid administration - A randomized, prospective study. Arch Surg-Chicago. 2000;135(3):326-331.

RESULTS

- 31 patients with a median age of 5 months (IQR range 7 months-4 years) were consented and enrolled in the study between October 2020 and February 2021.

