

Abstract

Sodium Chloride Addition to Cardiopulmonary Bypass Priming Effects on Electrolyte and Osmolality Homeostasis in a Randomized Controlled Trial

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Background

The use of cardiopulmonary bypass (CPB) is necessary in most types of cardiac surgery. The CPB circuit is primed with 1-2L of crystalloid solution prior to initiation. The priming solution affects several physiological parameters, such as electrolytes, osmolality and acid-base balance. The aim of this study was to assess the impact of different additions of sodium chloride (NaCl) to the priming fluid with regards to maintenance of electrolyte and osmolality homeostasis.

Methods

This multi-arm randomized controlled trial included patients scheduled for aortic valve replacement or coronary artery bypass grafting. The patients were randomized to one of three study solutions. The solutions were based on ringer's acetate. One group (n = 20) received no addition, one group (n = 20) received 80 mmol NaCl and one group (n = 20) received 160 mmol NaCl. Primary endpoints were changes in sodium, chloride and osmolality. Secondary endpoints were changes in acid-base status, renal parameters, fluid balance, S100-B, and cardiac rhythm after cross-clamp removal.

Results

Sodium, chloride and osmolality increased in a dose-dependent manner with NaCl addition ($p < 0.001$). The 80 NaCl and 160 NaCl groups had higher sodium levels, within normal range, from initiation of CPB to POD1, compared to the 0 NaCl group, which developed mild hyponatremia. All groups developed hyperchloremia during CPB. The NaCl groups developed hyperosmolality during CPB. All groups developed mild metabolic acidosis after CPB, most pronounced in the 160 NaCl group. Lower intraoperative fluid balance was observed in the 160 NaCl group, although post hoc comparisons were not significant. Renal parameters and incidence of acute kidney injury were similar between groups.

Conclusion

Ringer's acetate may be suboptimal as priming fluid due to its low sodium and high chloride content. The addition of NaCl to priming increases sodium, chloride and osmolality in a dose-dependent manner, mild hyperchloremic acidosis was observed. The highest-osmolality solution was associated with the lowest intraoperative fluid balance. We speculate that an optimal composition of priming fluid may involve a different proportion of sodium and chloride in order to preserve homeostasis in cardiac surgery patients.