Should "Normal" Saline Be Our Usual Choice in Normal Surgical Patients?

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For much of the past 20 years, anesthesiologists, intensivists, and surgeons have debated the merits of colloids versus crystalloids, "goal-directed" versus "conventional" fluid administration, "restricted" versus "conventional" fluid administration, and whether invasive monitoring added anything other than excess cost and risk to the care of the surgical patient. Notice that all of these "named" debates seemed to ignore the contents of crystalloid solutions. Meanwhile, abundant evidence appeared that 0.9% ("normal") saline led predictably to a greater incidence of hyperchloremia and acidosis than "balanced" salt solutions such as lactated Ringer's solution. It has been widely considered that saline-induced hyperchloremia is most often without consequence. However, in this issue of the journal, McCluskey et al.[1] use propensity matching to present us with relatively strong retrospective evidence that patients who developed hyperchloremia after noncardiac surgery had worse outcomes. Can it be that we have misdirected our attention to the style rather than the contents of our IV fluid therapy?

IV fluids were first administered "therapeutically" to treat cholera in the 19th century.[2] IV fluids began to be administered as a routine to surgical patients during the first half of the 20th century based on the clinical observations of surgeons Rudolph Matas and Frederick Coller. In the 1940s and 1950s, investigative work by Francis D. Moore, detailed in his *Metabolic Response to Surgery*[3] and *Metabolic Care of the Surgical Patient*,[4] characterized the hormonal basis for fluid retention after trauma or surgery and led to his recommendation that perioperative fluids be administered judiciously. Drawing seemingly an opposite conclusion were Thomas Shires and Curtis Artz, whose findings regarding "third space" fluid accumulation supported more lavish administration of crystalloid solutions to patients recovering from surgery or major trauma. Largely ignored in the discussions regarding volume was whether the choice of fluid might influence the outcome.

Curiously, the origins of normal saline are unclear, even as it is abundantly clear that there is nothing normal about 0.9% saline.[5] Saline 0.9% provides a small excess of sodium ions and a larger excess of chloride ions than are found in extracellular fluid. Saline 0.9% produces hyperchloremia in animals and patients in a dose-dependent fashion.[6] A Cochrane analysis of a relatively small number of clinical trials of surgical patients concluded that administration of buffered solutions (versus nonbuffered saline solutions) results in a reduced incidence of hyperchloremia and acidosis.[7] The data were not sufficient to determine whether there were differences in major morbidity or mortality. Now, McCluskey et al., studying patients in an institution where 0.9% saline was the operating room "crystalloid of choice," found that hyperchloremia was common (>20%) and associated with an increased incidence of morbid complications, an increased length of stay, and an increased likelihood of death.

But, what we really want to know is whether a switch from 0.9% saline to Normosol or to lactated Ringer's solution would reduce the likelihood of hyperchloremia and reduce the associated increased morbidity and mortality without resulting in some other offsetting complication. Shaw et al.[8] interrogated a multi-institutional database to determine whether there might be outcome differences between the relatively small number of patients receiving a calcium-free physiologically balanced crystalloid solution and the much larger cohort of patients receiving 0.9% saline.[8] Overall, mortality was reduced in the cohort receiving balanced crystalloid, and after propensity matching, the balanced crystalloid group had considerably less postoperative morbidity and fewer electrolyte disorders.

To us several things seem clear: (1) hyperchloremia is more common with 0.9% saline than with balanced crystalloid solutions; (2) hyperchloremia is associated with worse outcomes; (3) there are better alternatives to 0.9% saline in most clinical situations (excluding hypochloremic metabolic alkalosis); and (4) until an adequately powered randomized clinical trial proves us wrong, 0.9% saline will not be our crystalloid of choice for intravascular volume resuscitation in surgical patients.

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