COLLOIDS VS. CRYSTALLOIDS – AN INTENSIVE CARE REVIEW

The 2004 publication of the Saline Versus Albumin Fluid Evaluation (SAFE) study has assisted in guiding many health care professionals with selection of intravenous fluid administration in the critical care setting for hypovolemic patients. Nine years after SAFE, the debate still continues in the literature. The Society of Critical Care Medicine has taken an unspecified position on volume resuscitation by recommending that either crystalloids or colloids be given to achieve a target central venous pressure (CVP) of ≥ 8 – 12 mm Hg in patients with sepsis. This issue of CLIPS briefly summarizes an article that reviews and compares the safety and efficacy of colloids vs. crystalloids in specific intensive care populations and compares new trial data with previous recommendations. If you need further information, please contact the Samford University Drug Information Service at (205) 726-2659.


The SAFE trial

- Compared the effects of 4% albumin vs. 0.9% sodium chloride (normal saline) on mortality in a diverse population of intensive care unit (ICU) patients (n = 6997).
- More than 1/3 of the patients were treated for trauma (18%), severe sepsis (17%) or respiratory distress syndrome (2%).
- Overall mortality at day 28 was not significantly different between the albumin and saline treatment groups [RR, 0.99 (95% CI, 0.91-1.09); p=0.87].
- No significant differences were noted between the two treatment groups in rate of emergent organ failure (p=0.85), days in ICU (p=0.44), overall length of hospital stay (p=0.30), days of renal replacement therapy (p=0.41) and days on a ventilator (p=0.41).
- A subgroup analysis of the SAFE data noted no significant differences in mortality among trauma patients with the exception of patients suffering from traumatic brain injury (TBI). There was an increased risk of death in patients with TBI who received albumin compared with those who received saline [RR, 1.62 (95% CI, 1.12-2.34); p=0.009]. Although statistically insignificant, numerically more trauma patients died who were treated with albumin (81 of 596 vs. 59 of 590) and, conversely, numerically less severely septic patients died who were treated with albumin (185 of 603 patients) versus saline (271 of 615 patients).

Neurotrauma

- SAFE investigators conducted a post-hoc follow up study of TBI patients treated with albumin from the SAFE trial. At 24 months, an increase in mortality was noted in these patients compared with those treated with saline [RR, 1.63 (95% CI, 1.17-2.26); p = 0.003]. Additionally, the albumin-treated patients were less likely to show neurological improvement at 24 months [RR, 0.78 (95% CI, 0.65-0.94); p=0.007].
- This data combined with the trend of a higher mortality rate from the SAFE trial suggests that albumin, and perhaps all colloids, should be avoided for resuscitation in trauma patients, especially TBI patients.

Severe sepsis

- A SAFE follow-up study in septic patients noted no significant differences for ICU length of stay (LOS), general LOS, duration of mechanical ventilation, or duration of renal replacement therapy for patients treated with albumin vs. saline. However, in septic patients, treatment with albumin was associated with a reduced odds of death at 28 days [OR, 0.71 (95% CI, 0.52-0.97); p=0.03].
- The Crystalloids or Colloids Study Group (CRYCO) was a prospective, observational cohort study (n=1013) that noted a significant increase in the risk of renal failure with the use of 6% hydroxyethyl starch (HES)

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Severe sepsis (continued)

- [OR, 2.48 (95% CI, 1.24-4.97); p=0.0001] and 25% albumin [OR 5.99 (95% CI, 2.75-13.08); p=0.0001] vs. crystalloids in shock patients. Hyperoncotic albumin (25%) was also associated with an increased risk of death [OR, 2.79 (95% CI, 1.42-5.47); p=0.03].
- The Scandinavian Starch for Severe Sepsis/Septic Shock (6S) study noted an increased risk of death or dialysis dependence in patients receiving HES 130/0.42 vs. Ringer’s acetate solution [RR, 1.17 (95% CI, 1.01-1.36); p=0.03]. Patients receiving HES were at increased risk for temporary renal replacement therapy [RR, 1.35 (95% CI, 1.01-1.80); p = 0.04].
- Evidence suggests that there are little differences in mortality outcomes between hypotonic or isotonic albumin vs. crystalloid fluid resuscitation in severe septic patients. However, use of HES, pentastarch and 25% albumin are associated with an increased risk of mortality and morbidity in this population.

Patients with burns

- A Cochrane meta-analysis demonstrated that patients with burns who were treated with albumin as the first-line agent in fluid resuscitation were at increased risk of death [RR, 2.40 (95% CI, 1.11-5.19)] relative to other agents.
- In a retrospective cohort study, Cochran et al found that burn patients who received albumin were at increased risk for inhalation injury (p<0.001); had increased lactate dehydrogenase levels (p<0.001; and a longer resuscitation time (p<0.001)) compared with matched controls. Mortality rates were not significantly different.
- Vilachou et al. demonstrated a potential morbidity advantage in using colloids as adjunct treatment in burns patients when adequate urine output cannot be maintained using crystalloids only.

Patients undergoing cardiac surgery

- A retrospective database analysis (n=19,578) of patients who underwent coronary artery bypass grafting (CABG) noted a lower mortality rate in patients treated with albumin vs. nonprotein colloids (2.74% vs. 3.03%, p = 0.02). In addition, use of albumin was associated with a reduced risk of death [OR, 0.8 (95% CI, 0.67-0.96)].
- A 2001 meta-analysis reported that patients undergoing extracorporeal cardiopulmonary bypass (CPB), when primed with albumin, had a significantly reduced degree of CPB-related thrombocytopenia (weighted mean difference in platelet count reduction, -23.8 X 10^9/L (95% CI, -42.8 to -4.7)), post CPB hypervolemia (mean volume reduction, -584 mL (95% CI, -819 to -348 mL)) and postoperative colloid use (mean difference, -612 mL (95% CI, -983 to -241 mL)) vs. crystalloid priming.
- Wilkes et al. conducted a meta-analysis on the use of colloids intraoperatively, postoperatively and for CPB priming. Albumin was found to be superior to HES in post-operative bleeding (mean risk reduction, -0.24 (95% CI, -0.4 to 0.08)) and resulted in less blood loss (mean ± SD blood loss, 693 ± 350 mL versus 789 ± 487 mL).
- Two additional studies further supported that the use of HES intraoperatively after CPB showed a significant decrease in hematocrit and platelet counts as well as in increased prothrombin time compared to patients who did not receive HES or only received HES postoperatively.

Conclusion

- The debate continues about whether to use colloids or crystalloids for volume resuscitation in critical care.
- Current data is suggesting that recommendations are more conclusive when looking at specific subgroups of critical care and will vary between subgroups.
- Use of colloids should be avoided in patients treated for trauma and TBI.
- In patients with severe sepsis, there is little difference in outcomes when patients are treated with crystalloids or hypo or iso-oncotic albumin for fluid resuscitation. Hyperoncotic colloids should be avoided in this patient population.
- In burn patients, albumin should not be used during the resuscitation period due to increased fluid requirements. Albumin should only be used as adjunct treatment when adequate urine output cannot be maintained using crystalloids only.
- Albumin is the preferred colloid in patients undergoing coronary artery bypass grafting (CABG) or extracorporeal cardiopulmonary bypass (CPB).

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