

## COMMENTARY

# Rational or rationalized choices in fluid resuscitation?

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See related research by Finfer *et al.*, <http://ccforum.com/content/14/5/R185>

### Abstract

The war between colloids and crystalloids wages on. In a large multinational survey of fluid prescribing practices in critically ill patients, we have a new and intriguing snapshot of global fluid resuscitation practices. Colloids are more often used for impaired perfusion or low cardiac output, and the choice of colloid or crystalloid varies enormously between countries. Why are some ICUs prescribing colloids more often than crystalloids when there is little convincing evidence that colloids are superior for fluid resuscitation? Are colloids advantageous in certain diseases, or in specific regional patient populations that have not yet been elucidated? Perhaps we should look inwards: the answer may not be more randomized clinical trials, but better adherence to current guidelines and treatment recommendations.

### Introduction

The war between colloids and crystalloids wages on. The most recent study of fluid prescribing practices in critically ill patients, in the previous issue of *Critical Care*, examined data from 5,274 patients in 391 ICUs across 25 countries [1]. In so doing, the authors have provided a snapshot of global fluid resuscitation prescribing practices. The observation that colloids were more frequently prescribed than crystalloids, both on the individual patient level and according to fluid resuscitation episodes, is novel and surprising [2]. More specifically, Finfer and colleagues [1] found colloids were more often used for impaired perfusion or low cardiac output, and geographically more often used in China, Great Britain and Sweden; crystalloids were more frequently used in the United States, New Zealand and Italy [1]. The

study raises a difficult question: why are some ICUs prescribing colloids more often than crystalloids when there is little convincing evidence that colloids are superior for fluid resuscitation? Asked differently, do colloids provide an advantage over crystalloids in certain regions or in specific patient populations that have not yet been elucidated?

### Is there a rationale for using colloids?

Following a spate of systematic reviews with conflicting conclusions about both the safety and efficacy of colloids, the American Thoracic Society released in 2004 a consensus statement on colloid use in the critically ill [3]. That guideline noted that colloids restore intravascular volume and tissue perfusion more rapidly than crystalloids in shock states. This is at least in part because colloids may be prescribed in volumes equivalent to whole blood loss, while crystalloids require 2 to 2.5 times greater volume infusion [4]. Does this translate into a clinically significant reduction in resuscitation time?

Perhaps there are specific patient subgroups where colloid use may confer an important benefit? Colloid use in cardiac surgical patients is reported to decrease pulmonary edema, pain and need for anti-emetics, with consequent faster return of bowel function due to decreased gut edema and preserved gut perfusion [5,6]. Also in cardiac surgical patients, albumin use has been associated with greater peri-operative survival [7]. There is also good clinical evidence for use of colloids in dialysis-related hypotension, spontaneous bacterial peritonitis and large volume paracentesis [3]. Colloids may also be considered in combination with diuretics in patients with acute lung injury or acute respiratory distress syndrome [8,9]. Finally, albumin administration to children with malaria and to adults with sepsis may improve survival [10,11]. If these latter two populations are confirmed to benefit from albumin resuscitation, a strong evidence-based recommendation could be made.

### Is there a rationale for using crystalloids?

Compared to crystalloids, there are substantial drug acquisition costs for colloids [12]. Given the ever-rising

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cost of healthcare internationally, it is noteworthy that among the countries with the highest colloid utilization are those with government managed or socialized health-care systems. Clinical indications aside, efforts to control healthcare expenditures based upon drug acquisition costs alone may lead to greater expenses and worse clinical outcomes [13].

Colloids have a combination of desirable and undesirable effects. Among their most common adverse reactions are general allergic responses, which are not easily predicted and may result in anaphylaxis [3]. In addition, their general anti-thrombotic properties may adversely affect blood coagulation [3]. Hydroxyethyl starch solutions increase the risk of acute kidney injury in sepsis and albumin may cause harm in traumatic brain injury [14-16].

Of course, there are detrimental effects of crystalloids as well. Depending on the specific fluid, they may cause hyperchloremic metabolic acidosis, hypocoagulable states, reduced renal blood flow and urine output, and neurologic and gastrointestinal disturbances [17]. However, the clinical implications of these potentially adverse effects are not fully understood.

### Why are we irrational?

Why do physicians behave irrationally in the face of clinical evidence that may guide appropriate decision-making? In this example, why do certain regions of the world utilize colloids preferentially despite the lack of evidence to prove their superiority [1,2]? Although unlikely, it is possible that genetic differences in patients or regional differences in disease result in true previously unrecognized superiority. Variations in local prescribing practices are far more likely. For example, in antibiotic prescription for bacteremia, the country of origin and infectious diseases specialist input were explanatory factors [18]. In patients with septic shock, low dose corticosteroids are used in more than half of patients in Europe but less than one-quarter in Asia [19]. As has been shown within and across healthcare systems for myriad clinical decisions, clinical practice for fluid choices varies despite available evidence.

According to the framework developed by Cabana and colleagues [20], barriers to optimum medical care exist in three major categories: knowledge, attitude and behavior. With globally available medical information, knowledge of evidence regarding fluid resuscitation is not the primary barrier to evidence-based practice. Physicians' practices are governed by attitudes that guideline recommendations may not produce the desired outcome, and cultural inertia restricting change in practice patterns. Attitude dictates prescribing behavior.

For all things clinical, the truth about fluid resuscitation is inevitably in the middle. Perhaps some colloid use

mixed with crystalloid use in certain patient populations is most beneficial [21]. Previous clinical trials have led to that supposition, but we must wonder: if the ideal randomized, controlled trial definitively reported that as truth, would clinical practice change? Perhaps the answer is not more randomized clinical trials but better adherence to current guidelines and treatment recommendations.

### Competing interests

Emory University has received provision of albumin from Baxter Healthcare for the conduct of a randomized, clinical trial. The authors declare no other competing interests.

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### References

1. Finfer S, Liu B, Taylor C, Bellomo R, Billot L, Cook D, Du B, McArthur C, Myburgh J, for SAFE TRIPS Investigators: **Resuscitation fluid use in critically ill adults: an international cross-sectional study in 391 intensive care units.** *Crit Care* 2010, **14**:R185.
2. Schortgen F, Deye N, Brochard L; CRYCO Study Group: **Preferred plasma volume expanders for critically ill patients: results of an international survey.** *Intensive Care Med* 2004, **30**:2222-2229.
3. Martin GS, Matthay MA, ATS Colloid Consensus Working Group: **Evidence-based colloid use in the critically ill: American Thoracic Society Consensus Statement.** *Am J Respir Crit Care Med* 2004, **170**:1247-1259.
4. Grocott M, Mythen M, Gan T: **Perioperative fluid management and clinical outcomes in adults.** *Anesth Analg* 2005, **100**:1093-1106.
5. Stephens R, Mythen M: **Optimizing intraoperative fluid therapy.** *Curr Opin Anaesthesiol* 2003, **16**:385-392.
6. Mythen M: **Postoperative gastrointestinal tract dysfunction: an overview of causes and management strategies.** *Cleve Clin J Med* 2009, **76** Suppl 4:S66-71.
7. Sedrakyan A, Gondek K, Paltiel D, Eleftheriades JA: **Volume expansion with albumin decreases mortality after coronary artery bypass graft surgery.** *Chest* 2003, **123**:1853-1857.
8. Martin GS, Mangialardi RJ, Wheeler AP, Dupont WD, Morris JA, Bernard GR: **A randomized controlled clinical trial of albumin and furosemide therapy in hypoproteinemic patients with acute lung injury.** *Crit Care Med* 2002, **30**:2175-2182.
9. Martin GS, Moss M, Wheeler AP, Mealer M, Morris JA, Bernard GR: **A randomized controlled trial of furosemide with or without albumin in hypoproteinemic acute lung injury patients.** *Crit Care Med* 2005, **33**:1681-1687.
10. Maitland K, Pamba A, English M, Peshu N, Marsh K, Newton C, Levin M: **Randomized trial of volume expansion with albumin or saline in children with severe malaria: preliminary evidence of albumin benefit.** *Clin Infect Dis* 2005, **40**:538-545.
11. The SAFE Study Investigators: **Impact of albumin compared to saline on organ function and mortality of patients with severe sepsis.** *Intensive Care Med* 2010 [Epub ahead of print].
12. Vincent JL: **Fluid management: the pharmacoeconomic dimension.** *Crit Care* 2000, **4** Suppl 2:S33-35.
13. Herwaldt LA, Swartzendruber SK, Edmond MB, Embrey RP, Wilkerson KR, Wenzel RP, Perl TM: **The epidemiology of hemorrhage related to cardiothoracic operations.** *Infect Control Hosp Epidemiol* 1998, **19**:9-16.
14. The SAFE Study Investigators: **Saline or albumin for fluid resuscitation in patients with traumatic brain injury.** *N Engl J Med* 2007, **357**:874-884.
15. Schortgen F, Lacherade JC: **Effects of hydroxyethylstarch and gelatin on renal function in severe sepsis: a multicenter randomized study.** *Lancet* 2001, **357**:911-916.
16. Brunkhorst FM, Engel C, Bloos F, Meier-Hellmann A, Ragaller M, Weiler N, Moerer O, Gruendling M, Oppert M, Grond S, Olthoff D, Jaschinski U, John S, Rossaint R, Welte T, Schaefer M, Kern P, Kuhnt E, Kiehntopf M, Hartog C, Natanson C, Loeffler M, Reinhart K; German Competence Network Sepsis (SepNet): **Intensive insulin therapy and pentastarch resuscitation in severe sepsis.** *N Engl J Med* 2008, **358**:125-139.

17. Roche A, James M, Bennett-Guerrero E, Mythen M: **A head-to-head comparison of the In Vitro coagulation effects of saline-based and balanced electrolyte crystalloid and colloid intravenous fluids.** *Anesth Analg* 2006, **102**:1274-1279.
18. Corona A, Bertolini G, Ricotta AM, Wilson A, Singer M: **Variability of treatment duration for bacteraemia in the critically ill: a multinational survey.** *J Antimicrob Chemother* 2003, **52**:849-852.
19. Beale R, Janes JM, Brunkhorst FM, Dobb G, Levy MM, Martin GS, Ramsay G, Silva E, Sprung CL, Vallet B, Vincent JL, Costigan TM, Leishman AG, Williams MD, Reinhart K: **Global utilization of low-dose corticosteroids in severe sepsis and septic shock: a report from the PROGRESS registry.** *Crit Care* 2010, **14**:R102.
20. Cabana M, Rand C, Powe Neil, Albert W, Wilson M, Abboud P, Rubin H: **Why don't physicians follow clinical practice guidelines? A framework for improvement.** *JAMA* 1999, **282**:1458-1465.
21. Wilkes N, Woolf R, Mutch M: **The Effects of balanced versus saline-based Hetastarch and crystalloid solutions on acid-base and electrolyte status and gastric mucosal perfusion in elderly surgical patients.** *Anesth Analg* 2001, **93**:811-816.

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