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Conservative Fluid Management In Intensive Care Medicine



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Asserting the existence of a state of permanent controversy is a staple during presentations on the topic of resuscitation fluids. Clinical audiences recognise a cliché when they hear it, and may disengage. This is unfortunate, since there has been a steady crescendo in the quality and quantity of clinical fluid science in the last two decades. In particular, our understanding of *which* fluid to use has been greatly improved. Large-scale clinical trials are now providing high quality answers to questions of *how much* fluid we should use and *when* we should use it. There are at least nine reasons to believe that a programme of clinical research investigating conservative or restrictive fluid strategies may yield benefits for critically ill patients.

1. Traditional Paradigms Influencing Clinical Fluid Practices Are Broken

Small, underpowered studies are incapable of revealing what benefits and harms are really being experienced by patients who receive intravenous fluid. This is especially true where intervention effect sizes are small, and the use of surrogate physiological outcomes is widespread (Yudkin et al. 2011; Ioannidis 2005). Colloids, for example, do not deserve to be entrenched in widespread ICU practice, are not associated with improved survival, are expensive, and may be harmful in some cases (Perel et al. 2013). Almost every patient in hospital is exposed to intravenous fluid, and they are entitled to expect that the science guiding their use is constantly improving.

2. Bolus Fluid Administration is Guided by Weak Evidence

Clinical practice guidelines recommend a bolus fluid challenge of at least 2 litres in a 70kg patient with sepsis and hypoperfusion (Dellinger et al. 2013); smaller boluses of fluid are among the most common interventions in the ICU. There were no randomised controlled trials of fluid resuscitation in sepsis patients, which reported mortality, until 2008 (Hilton and Bellomo, 2012). Arguably, recent trials are undermining the usual practice of bolus fluid resuscitation, and constructive criticism of liberal fluid boluses should not be dismissed (Marik 2014).

3. We Need to Explain Unexpected Results Arising from Recent Large Clinical Trials

Bolus fluid was associated with increased mortality in the FEAST study (Maitland et al. 2011), a landmark trial of 3600 children with severe infection in resource-limited settings in Africa. It isn't clear if or how these results should be applied to our own practice, but the size and quality of this study demands that we should find out. The ProCESS (ProCESS Investigators et al. 2014) and ARISE (The ARISE Investigators and the ANZICS Clinical Trials Group 2014) trials have provided no additional support for current goal-directed fluid resuscitation, and are prompting reflection (Surviving Sepsis Campaign 2014).

4. Positive Fluid Balance is Associated with Increased Mortality in the ICU

Post-hoc analyses of large ICU trials have examined positive fluid balance as a risk factor for mortality. This association has been observed in patients with sepsis (Boyd et al. 2011) and renal failure (Payen et al. 2008), and raises unanswered questions about causality. It is unknown if fluid intake and/or fluid balance are valid therapeutic targets in most critically ill patients.

5. Conservative Fluid Strategies are Relevant in ICU Patients with Lung Injury

The FACTT study (National Heart Lung Blood Institute Acute Respiratory Distress Syndrome Clinical Trials Network et al. 2006) randomised 1000 patients with acute lung injury to a conservative or liberal fluid strategy. It is one of the highest quality studies of this intervention in critical illness. Conservative fluid management improved lung function, and shortened the duration of mechanical ventilation. In a different ARDSnet study (ARMA lower tidal volume), investigators followed up with a later report of an independent association between negative cumulative fluid

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balance and lower mortality (Rosenberg et al. 2009).

6. Conservative Fluid Strategies are Important in Surgical Patients

Fluid restriction is a common component of Early Recovery After Surgery (ERAS) and fast-track programmes (ERAS Society 2014), particularly in colonic surgery (Brandstrup et al. 2003). It is possible that trauma patients may also benefit from conservative fluid administration (Wang et al. 2014). These surgical patient groups are frequently managed in critical care areas, and there is no reason to think that the surgical benefits of fluid restriction would disappear when illness acuity is higher and ICU length of stay becomes longer.

7. Fluid Conservation may be Beneficial via Minimisation of Sodium and/or Chloride Exposure

If fluid conservation is demonstrated to be beneficial in more ICU patients, understanding the mechanism(s) of action will be required to maximise its efficacy and safety. It may be the dose of water that is most important, or the electrolyte composition of the fluid, or both. Unbuffered crystalloids that are relatively high in sodium and chloride cause more acid-base and metabolic derangement (Burdett et al. 2012), but we would be repeating mistakes of the past if we use this circumstantial evidence to make strong recommendations to change practice. Larger-scale, high quality clinical research can solve this puzzle too (Young et al. 2013).

8. There May Be Harms Associated with Conservative Fluid Strategies

Fluid restriction has been investigated most thoroughly in major abdominal surgical patients; intensive care medicine can learn from this. It is important to note, for example, that harm has been associated with fluid restriction in some surgical trials (Vermeulen et al. 2009). It is possible that harm may be avoided by tailoring fluid conservation to individual patients, an approach that is especially feasible during general anaesthesia (Pearse et al. 2014). In ICU patients, we must continue to insist that longer-term, patient-centred outcomes are included in trial design. In the FACTT study, an inconclusive but concerning association was observed between fluid conservation and decreased long-term neuropsychological function (Mikkelsen et al. 2012).

9. There is Probably a Secular Trend Toward Fluid Conservation Happening Already

In the study of early goal-directed therapy by Dr Rivers and coworkers (Rivers et al. 2001) the intervention group received around 5 litres of fluid in the first 6 hours of resuscitation (44.3% mortality at day 60). Around ten years later, the intervention group in the ProCESS study (ProCESS Investigators et al. 2014) received almost half this amount (21% mortality at day 60). This is only an association, but in the ARISE study (The ARISE Investigators and the ANZICS Clinical Trials Group 2014) even less fluid was administered in the first 6 hours (18.6% mortality at day 90). Anecdotal reports of international variation in fluid volume practice, as well as a trend to give less fluid to patients may soon be able to be confirmed (The George Institute for Global Health 2014).

ICU outcome does vary internationally, and may be improving over time for a variety of reasons (Bellomo et al. 2007; Prin and Wunsch 2012; Kaukonen et al. 2014). The hypothesis that fluid exposure may be responsible for a small part of this is an exciting and worthwhile area for intensive care medicine to investigate.

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