Best Practice & Research Clinical Anaesthesiology 28 (2014) 203–205

Contents lists available at ScienceDirect

Best Practice & Research Clinical Anaesthesiology

journal homepage: www.elsevier.com/locate/bean

Preface

# Fluid resuscitation in the 21st century: Don't try to run before you are able to walk

Every therapeutic intervention should have a rationale and – if possible – an evidence-based indication. Furthermore, the respective treatment effects should be carefully evaluated, for example, by using appropriate (laboratory) surrogate parameters and/or suitable techniques or monitoring devices. As highlighted in a recent editorial [1], however, fluid responsiveness may best be predicted by easy measures such as passive leg raising and fluid challenge [2,3]. Regardless of the applied technique, it is desirable to individualise the therapy as much as possible, taking into account the patients' specific (co)morbidities. In addition to the dictum 'primum non nocere' [4], the targeted therapeutic outcome is of course to improve the patients' health status whenever possible.

During the past years, it became evident that infusing any kind of fluid also represents a therapeutic measure, similar to administrating 'real' drugs. This is based on the fact that fluid and volume resuscitation may not only exert benefits but potentially also contribute to unwanted (side) effects that are often dose dependent [5]. This is especially true if the respective compounds are not used 'correctly', for example, when contraindications and dose restrictions are not adhered to.

As very nicely addressed in the first article of the present issue by Kampmeier et al., one of the greatest challenges in infusion therapy until today is to define the term 'correctly'. Reviewing the latest literature in this field, multiple approaches of fluid and volume resuscitation for different patient populations have been investigated in multicentre, randomised, controlled trials around the globe. However, the results are partly conflicting. Just one current example: The early goal-directed therapy for fluid resuscitation in patients with severe sepsis and septic shock has been widely adapted during the last decade [6] and represents a 'solid rock' in the current guidelines of the Surviving Sepsis Campaign [7]. Just recently, however, the results of a well-conducted multicentre, randomised, controlled ProCESS trial [8] did not support the benefit of this therapeutic concept.

If we are already struggling with basic questions like what kind of parameters in general, and, for example, which arterial blood pressure specifically [9] should be used to guide fluid therapy and what values for the individual parameters should be targeted, how can we believe to reliably test the influence of different solutions? Maybe, we sometimes act with precipitate haste and try to run before we are actually able to walk.

To answer these basic questions, current research increasingly focusses on organ perfusion instead of static pressures to guide fluid therapy. In this context, Veenstra and colleagues provide an excellent overview concerning the current knowledge on 'direct markers of organ perfusion' with a special focus on the microcirculation.

From a pathophysiological point of view, there is increasing awareness concerning the role of the glycocalyx with respect to a successful volume management in different disease entities. Two well-established experts in this field, namely Chappell and Jacob, explain this important concept in detail.

http://dx.doi.org/10.1016/j.bpa.2014.07.005

Besides the ongoing debate on crystalloids versus colloids for fluid resuscitation, there is another central question for every clinician, that is, should we use balanced or unbalanced solutions? While saline-based unbalanced solutions are still the most commonly used fluids around the world, there is increasing evidence – excellently summarised by Magder – that the use of 'normal' saline may dose-dependently contribute to metabolic acidosis, which in turn is prevented using solutions with a more plasma-adapted composition. From this point of view, balanced solutions might be advantageous as compared to solutions characterised by non-physiologically high concentrations of sodium and chloride. This assumption is supported by a recent cohort study in >54,000 critically ill patients with sepsis [10].

Considering these principles, Aditianingsih and George nicely compiled 'guiding principles of fluid and volume therapy'. They carefully discuss the advantages and pitfalls of available haemodynamic variables. Besides considering macrocirculatory parameters, the authors also emphasise the potential value of monitoring the microcirculation to guide fluid therapy.

The last four outstanding review articles of the current issue address the fact that different pathologies require different strategies with respect to fluid and volume resuscitation. In this context, Miller and colleagues focus on the management in the operating room. They recommend an individualised goal-directed fluid management using minimally invasive cardiac output monitoring to avoid perioperative weight gain, especially for major surgery. This is in harmony with the recently published OPTIMISE study demonstrating that using a cardiac output-guided haemodynamic algorithm reduces complication rates in patients undergoing major gastrointestinal surgery [11].

Zacharowski and van Haren focus on treatment concepts of critically ill patients and likewise emphasise the importance of using an algorithm-based approach and individualised therapy. As demonstrated by the recently published CRISTAL study, colloids may be advantageous in early shock treatment as compared to crystalloids alone [12]. In haemodynamically stabilised patients, however, (balanced) crystalloids should be used as 'maintenance fluid'.

Patients with traumatic injuries and parturients represent special patient populations requiring a very careful fluid and volume therapy. The recent evidence concerning the treatment of trauma and neurotrauma patients is elegantly addressed by James. In addition to highlighting the importance of fluid balance and normalising coagulation disorders, the role of balanced crystalloids and colloids is critically reviewed to provide goal-oriented treatment concepts with a focus on key physiological considerations. In this regard, the different characteristics of the available solutions should be critically considered. Among them, osmolality plays a major role and is of special importance for patients with traumatic brain injury [13].

Current practice for obstetric patients with a special focus on caesarean delivery is excellently summarised by Teoh and colleagues. The authors point out that vasopressors and fluid therapy remain the standard of care to minimise hypotension in women undergoing caesarean section. Current data suggest that preloading with colloids might be superior to crystalloids [14]. However, the potential side effects of available colloidal solutions need to be carefully considered.

Taking into account the conflicting evidence for multiple aspects of fluid and volume therapy (e.g., early goal-directed therapy), as well as the numerous aspects that still need to be defined (haemodynamic variables and surrogate parameters, start and end points, etc.), these 'basic aspects' should be carefully evaluated to enable us not only to walk but also to have the ability to run (without stumbling).

## References


*[1] Marik PE, Lemson J. Fluid responsiveness: an evolution of our understanding. Br J Anaesth 2014;112:617–20.
[2] Marik PE, Monnet X, Teboul JL. Hemodynamic parameters to guide fluid therapy. Ann Crit Care 2011;1:1.
[3] Muller L, Toumi M, Bousquet PJ, et al. An increase in aortic blood flow after an infusion of 100 ml colloid over 1 minute can predict fluid responsiveness: the mini-fluid challenge study. Anesthesiology 2011;115:541–7.
[4] Gillon R. "Primum non nocere" and the principle of non-maleficence. Br Med J (Clin Res Ed) 1985;291:130–1.
[5] Boyd JH, Forbes J, Nakada TA, et al. Fluid resuscitation in septic shock: a positive fluid balance and elevated central venous pressure are associated with increased mortality. Crit Care Med 2011;39(2):259–65.
[6] Rivers E, Nguyen B, Havstad S, et al. Early goal-directed therapy in the treatment of severe sepsis and septic shock. N Engl J Med 2001;345(19):1368–77.
*[7] Dellinger RP, Levy MM, Rhodes A, et al. Surviving sepsis campaign: international guidelines for management of severe sepsis and septic shock: 2012. Crit Care Med 2013;41(2):580–637.

*[8] ProCESS Investigators, Yealy DM, Kellum JA, et al. A randomized trial of protocol-based care for early septic shock. N Engl J Med 2014;370(1):1683–93.
*[9] Asfar P, Meziani F, Hamel JF, et al. High versus low blood-pressure target in patients with septic shock. N Engl J Med 2014 24;370(17):1583–93.
*[10] Raghunathan K, Shaw A, Nathanson B, et al. Association between the choice of iv crystalloid and in-hospital mortality among critically ill adults with sepsis. Crit Care Med 2014;42:1586–91.
*[11] Pearse RM, Harrison DA, MacDonald N, et al. Effect of a perioperative, cardiac output-guided hemodynamic therapy algorithm on outcomes following major gastrointestinal surgery. A randomized clinical trial and systematic review. JAMA 2014;311(21):2181–90.
[12] Annane D, Siami S, Jaber S, et al. Effects of fluid resuscitation with colloids vs crystalloids on mortality in critically ill patients presenting with hypovolemic shock: the CRISTAL randomized trial. JAMA 2013;310:1809–17.
*[13] Ertmer C, Van Aken H. Fluid therapy in patients with brain injury: what does physiology tell us? Crit Care 2014;18:119.
*[14] Mercier FJ, Diemunsch P, Ducloy-Bouthors AS, et al. 6% Hydroxyethyl starch (130/0.4) vs Ringer's lactate preloading before spinal anaesthesia for Caesarean delivery: the randomized, double-blind, multicenter CAESAR trial. Br J Anaesth 2014 Jun 26. pii: aeu103 [Epub ahead of print].

Sebastian Rehberg, M.D., Ph.D.*, Hugo Van Aken, M.D., Ph.D.
*Department of Anaesthesiology, Intensive Care and Pain Medicine, University Hospital of Muenster, Muenster, Germany*

Martin Westphal, M.D., Ph.D.
*Department of Anaesthesiology, Intensive Care and Pain Medicine, University Hospital of Muenster, Muenster, Germany*
Fresenius Kabi AG, Bad Homburg, Germany
*E-mail address:* westphal2006@gmx.net

* Corresponding author.
*E-mail address:* Sebastian.Rehberg@ukmuenster.de (S. Rehberg)