

Perioperative Fluid Administration

Another Form of “Work-Life Balance”

So divinely is the world organized that every one of us, in our place and time, is in balance with everything else.

Johann Wolfgang von Goethe

“KEEPING the balance” is a traditional, yet still modern, intention of human beings—as well as a central target of perioperative fluid administration. While the triumphal procession of balanced solutions appears unstoppable, quantitative perioperative fluid balance, which is the focus of the study by Kiefer *et al.*¹ in this issue of *ANESTHESIOLOGY*, remains one of the most difficult challenges in the operating theater.

In our clinical routine, only a few forms of fluid losses out of the circulation are measurable. Although imperceptible, perspiration, deficits caused by preoperative fasting and bowel preparation, and fluid shifts below the body surface remain a dark horse.^{2–4} For decades, it has been well-established clinical practice to liberally infuse fluid in the face of hypotension during or after induction of general and/or neuraxial anesthesia—and to replace fluid deficits caused by overnight fasting and bowel preparation.^{2,3} This practice was believed to be not too much of a problem because fluid compartments were grasped as a dynamic equilibrium where the kidneys handle any potential overload. The nevertheless frequently well-recognized accompanying interstitial edema was considered the inevitable price of cardiovascular stability.

The new millennium, however, has brought important physiologic insights indicating that this concept might cause patients to pay a heavy price. Fluid overload has been shown to negatively affect vascular barrier competence,⁵ increase cardiopulmonary complications,⁶ and prolong recovery of bowel function^{7,8} and hospital stay^{7,9} and should, therefore, most probably be avoided in certain patient collectives.¹⁰

Unfortunately, despite several promising recent studies, perioperative fluid management remains a field where evidence-based medicine leaves us out in the rain. The reason is quite simple. To create reliable evidence, prospective randomized trials have to compare the traditional approach to a new therapeutic idea in a sufficiently high number of patients. If the “study” group shows a better outcome than the “control,” the study treatment is what has to be done in the future. If not, everything remains unaffected.

Indeed, perioperative fluid therapy followed a transnational common principle during the past decades that is best described as “liberal.” Unfortunately, there is not only no worldwide standardized approach. In addition, national and regional differences have led to a wild freestyle mix of crystalloids, colloids, and vasoactive drugs.² This lack of agreement has punched itself through to the literature and has led to sometimes even irrational debates as well inconsistent terminology in various study groups. The “restrictive” treatment in one study is called the “liberal” control in the next.^{2,3} This reflection of local strategies within the control groups—instead of general practice—produced data of limited significance, causing misinterpretations and preventing data pooling. Despite of the *results* from individual studies, the generally much less recognized *methodology* is questionable. Accordingly, it is currently impossible to formulate evidence-based guidelines for optimal procedure-specific perioperative fixed-volume regimes.¹¹

Lack of evidence, however, should not be misused as a justification for continuing current therapeutic arbitrariness. Rather, as long as evidence is not available, we must “get back to basics” and medical practice should be guided by physiologic principles and scientific facts. In the long history of human life, the body’s ability to maintain intravascular normovolemia is an essential prerequisite and obviously very important for survival. Conclusively, it is not astonishing that the human body is well adapted to overnight sleeping without fluid supply, which normally does not lead to intravascular hypovolemia.¹² Maintaining this fine-tuned, balanced physiologic state perioperatively by causally treating actual problems seems to be the most logical and “rational” approach. This would implicate to treat intravascular deficits caused by acute bleeding with isooncotic preparations and restoring anesthesia-related vasodilation with a vasopressor.² Crystalloids, from this physiological standpoint, should be used to replace ongoing extracellular loss that is the result of urinary output and a realistically calculated rate of insensible perspiration which is, at most 1 ml/kg/h, far below common perception.²

To those who still believe in basic physiology, it is not surprising that the results of the few available studies on outcomes in this field point in the same direction. It has been indicated repeatedly that a too-positive perioperative volume balance causes a significant perioperative body weight gain by interstitial

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◆ This Editorial View accompanies the following article: Kiefer N, Theis J, Putensen-Himmer G, Hoeffel A, Zenker S: Peristaltic pneumatic compression of the legs reduces fluid demand and improves hemodynamic stability during surgery: A randomized, prospective study. *ANESTHESIOLOGY* 2011; 114:536–44.

edema and might be negative for patient outcomes, at least for those undergoing major abdominal surgery.¹⁰

In this issue of ANESTHESIOLOGY, Kiefer *et al.*¹ bring forward the idea that hemodynamic depression of the cardiopulmonary healthy patient related to anesthesia is not undoubtedly a sign for absolute hypovolemia—which, for its part, should be treated causally by volume administration—but more likely for vasodilation. They provide a further important scientific fact concerning perioperative fluid therapy, taking us another step forward on our way to a rational approach. Peristaltic pneumatic compression of the legs in the perioperative setting partly restores peripheral vasodilation and, consequently, resolves a relative hypovolemia by venous pooling. The authors clearly show this technique to be an easy and effective way to temporarily counteract the negative effects of anesthetics and positive pressure ventilation on hemodynamic stability, simultaneously preventing edema formation. In some way, this method imitates actions of vasopressors on the peripheral vascular system (*i.e.*, increases cardiac preload by recruiting peripherally pooled volume, without active vasoconstriction of the supplying arteries in vital organs). This process could indeed be an advantage *versus* vasopressors—in addition to avoiding an interstitial load of the patient by volume, which unnecessarily endangers the vascular barrier. Moreover, an important contrast to volume loading is that the action of this external device is quickly reversible when patients wake up at the end of surgery and the physiologic vasotonus returns.

A potential beneficial effect on patient outcomes, however, still needs to be shown as it was not the target of the present investigation. For this, the low-numbered collective of patients undergoing minor surgery chosen in this study would have been suboptimal anyway. It has previously been demonstrated that a more liberal fluid approach seems beneficial during minor interventions, causing a greater hemodynamic stability and reducing postoperative nausea, vomiting,^{13,14} and pain scores.¹⁴ Especially in outpatients, this practice might have a cost-saving effect and should by far outweigh the theoretical advantage of maintained physiologic conditions in detail.

Current concepts about perioperative fluid therapy are heading in the right direction.^{2,4} The small pilot study performed by Kiefer *et al.*¹ has provided another step that improves our factual knowledge. Small steps can be equally important to the large jumps concerning patient outcomes that we expect will follow. In the near future, the real impact of peristaltic pneumatic compression of the legs during major surgery, which might be the original domain in which a too-positive fluid balance is suspected to be harmful, is eagerly expected. There is still a lot of procedure-specific out-

come-based evidence to create to really understand our patients perioperative “work-life balance.” Let’s play up!

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