BJA

British Journal of Anaesthesia, ■ (■): 1–8 (2017)

doi: 10.1016/j.bja.2017.10.011
Advance Access Publication Date: xxx
Review article

REVIEW ARTICLE

Current concepts of fluid management in enhanced recovery pathways

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Abstract

Perioperative fluid management impacts outcomes and plays a pivotal role in enhanced recovery pathways (ERPs). There have been major advances in understanding the effects of fluid therapy and administration during the perioperative period. Improving fluid management during this period leads to a decrease in complications, decrease in length of stay (LOS), and enhanced patient outcomes. It is important to consider preoperative and postoperative fluid management to be just as critical as intraoperative management given multiple associated benefits to the patients. Preoperative hydration with (complex) carbohydrate drinks up until 2 h before surgery is safe and should be encouraged, as this helps improve metabolism, decrease insulin resistance, reduce anxiety, and reduce nausea and vomiting. During the intraoperative period, the goals of fluid management are to maintain euvolemia using an individualized plan for fluid and haemodynamic management, matching the needs for monitoring with patient and surgical risk through goal-directed therapy (GDT). By combining the use of fluids and inotropes, GDT uses measurements and indicators of cardiac output and stroke volume to improve blood flow intraoperatively, and ultimately reduce LOS and complications. In the postoperative period, an early transition to oral hydration helps to enhance the conditions for healing and recovery from surgery. I.V. fluid therapy should be kept at a minimum, and urine output should not be the driving force for fluid administration. The optimization of perioperative fluid management is critical to ERPs as it helps improve pulmonary function, tissue oxygenation, gastrointestinal motility, and wound healing.

Keywords: fluid therapy; perioperative care; perioperative period

The practice of medicine seeks to continually improve the care that is provided to patients. Optimizing fluid therapy in the perioperative setting improves patient outcomes and reduces complications and length of stay (LOS).[1–4] The primary goal of any physician is to optimize patient health to prevent future disease and to treat existing diseases to improve outcomes. Surgery is a complex treatment method, where tissue insult is an expected part of patient care, with the idea that controlled short-term injury is an acceptable risk in the face of long-term health benefits. With a focus on improving patient outcomes and recovery, fluid management plays an important role in enhanced recovery pathways (ERPs) now being used in many hospitals.[5]

Perioperative physicians have multiple goals that can be divided into three categories. First, they seek to optimize the preoperative health status of the patient, including preexisting conditions and comorbid diseases, so as to maximally decrease the risk of perioperative complications.

Editorial decision: October 19, 2017; **Accepted:** October 19, 2017

Secondly, intraoperative management of patients is planned with the goals of improving patient recovery. Finally, postoperative care is designed to maximize recovery from the tissue injury. Similarly, perioperative fluid therapy can be divided into three components, namely, preoperative, intraoperative, and postoperative management, as represented in Figure 1.

Given the drive to improve patient care, ERPs have become an essential aspect of perioperative patient care, with fluid therapy playing a pivotal role. Fluid management and administration is an integral aspect of perioperative care. Historically, the focus has been on the intraoperative management of fluids; however, recently the focus has shifted to a more complete perioperative management of fluids, including preoperative hydration, intraoperative management, and postoperative outcomes. The goal of this review is to elucidate basic concepts used in perioperative fluid management and the application of these concepts to preoperative, intraoperative, and postoperative management of fluid therapy.

Goal-directed therapy

Management of intraoperative fluids has been the subject of much debate through the years. Early on, some recommended that patients be given very little fluids intraoperatively, as fluids were thought to increase the risk of postoperative complications.[6,7] As more patients were undergoing surgical procedures, it became clear that not providing intraoperative fluids had major adverse effects on the postoperative period, including complications such as prerenal acute tubular necrosis.[8] Given this knowledge, fluid administration during surgery became a standard of care for all operative procedures requiring anaesthesia.[9] Patients were given fluids liberally during surgery based on the concept that inadequate administration of fluids would result in poor outcomes. Even third-space loss, or oedema, was considered a fluid loss that needed to be replenished aggressively.[10] It became clear, however, that fluid overload in postoperative patients also caused rather severe complications, including pulmonary congestion,[11] decreased tissue oxygenation, decreased wound healing,[12,13] increased oedema,[14] and delayed recovery.[4] With this in mind, it is imperative that we define the treatment goals for management of perioperative fluid therapy.

Anaesthesiologists often consider fluids as a carrying device or a vehicle through which other medications can be given. However, it is important that we consider fluids as medications in and of themselves. Thus, fluids should be accurately calculated and dosed in a more specific way. Intraoperative management of fluids during surgery should be guided by goal-directed therapy (GDT) rather than predetermined calculations. Just as with any perioperative medication given, fluids should be titrated to the desired effect.

Routes of fluid administration

Fluid administration has only been considered via one method, which is directly into the intravascular space, specifically by the i.v. route. As we start to learn more about fluid management, intravascular volume, intracellular volume, and fluid volume in the interstitial space, it is becoming more and more clear that i.v. fluid administration does not necessarily lead to a direct increase in intravascular volume.[15] Particularly after surgery and as a result of tissue injury, much of the fluids administered i.v. accumulate in the interstitial space causing unwanted oedema. The best method to improve hydration is by increasing *per os* (PO) fluid intake. Although this is not practical in the anaesthetized patient, it should still be an important consideration in perioperative patient care. While following nil *per os* (NPO) guidelines, preoperative as well as early postoperative PO hydration is very important and can have significant benefits in the recovery period.

Most often, fluid management is about which fluid is given and how the provider administers or withholds it. There is, however, a rather important role that the patients themselves can play in optimizing their own fluid status. It is becoming more apparent that PO hydration is superior to i.v. fluid therapy. For example, children who are being treated for gastroenteritis historically received i.v. fluids as a first line therapy. This has been challenged with new data demonstrating that those being treated with PO hydration or hydration through nasogastric tubes tend to fare better than those who receive i.v. fluids.[16] This is postulated to be due to much of what is given i.v. not remaining intravascular, possibly resulting in unwanted oedema. Similarly, in perioperative patient care, it is becoming more apparent that PO hydration, both preoperatively and postoperatively, can improve patient experience and outcomes. Thus, it is crucial for the provider to empower patients to take control over aspects of their preoperative management that they can improve, such as PO hydration prior to surgery.

Preoperative fluid management

NPO guidelines

The ASA provides well-defined guidelines about how long a patient should be NPO prior to procedures requiring anaesthesia. While patients are required to refrain from eating solid foods, particularly fatty meals, for at least 8 h prior to surgery, the requirement for refraining from clear liquids is only 2 h prior to surgery.[17] Given these guidelines, patients should be encouraged to continue PO hydration up until 2 h before surgery.

The goal of NPO guidelines is to reduce the risk for pulmonary aspiration by giving the appropriate time needed for gastric emptying. There is now increasing evidence that increasing PO hydration with clear liquids ending 2 h prior to surgery does not increase gastric volumes, and may even reduce the acidity of stomach fluids.[17] The recommended preoperative use of clear carbohydrate beverages prior to surgery has not been associated with any increase in the risk of aspiration or other pulmonary complications.[18] Recent magnetic resonance imaging studies have shown that the time needed for sufficient gastric emptying in healthy adult volunteers after the ingestion of clear carbohydrate beverages is 120 min.[19] This has also been corroborated in a more recent study that sought to compare morbidly obese to average weight patients.[20] Residual gastric volumes after oral rehydration in the morbidly obese were not greater than those who had fasted overnight, as determined by magnetic resonance imaging.[20] These findings support the rationale for the recommended 2 h of NPO time for clear liquids prior to surgical procedures. The European and Canadian guidelines not only allow fluids up until 2 h prior to surgery, but they encourage it.[21]

Advantages of carbohydrate drinks

The advantages of preoperative hydration go beyond simply optimizing the volume status of patients prior to surgery, it