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6

State-of-the-art fluid management in the operating room

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The underlying principles guiding fluid management in any setting are very simple: maintain central euvolemia, and avoid salt and water excess. However, these principles are frequently easier to state than to achieve. Evidence from recent literature suggests that avoidance of fluid excess is important, with excessive crystalloid use leading to perioperative weight gain and an increase in complications. A zero-balance approach aimed at avoiding fluid excess is recommended for all patients. For major surgery, there is a sizeable body of evidence that an individualized goal-directed fluid therapy (GDFT) improves outcomes. However, within an Enhanced Recovery program only a few studies have been published, yet so far GDFT has not achieved the same benefit. Balanced crystalloids are recommended for most patients. The use of colloids remains controversial; however, current evidence suggests they can be beneficial in intraoperative patients with objective evidence of hypovolemia.

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The underlying principles guiding fluid management in any setting are very simple: maintain central euvolemia, and avoid salt and water excess, in other words, maintain a full circulation to allow normal optimal cellular perfusion while avoiding any peripheral or interstitial edema, and associated increase in body weight. This, of course, is frequently easier to state than to achieve, particularly in the operating room (OR), where blood loss and fluid shifts can make fluid management challenging.

These principles have been displayed graphically as a U-shaped curve (Fig. 1) [1]. Episodes of hypovolemia, if undetected, can lead to hypoperfusion and organ dysfunction, with associated adverse outcomes [2]. Importantly, and perhaps not as readily acknowledged, excess fluid administration can result in tissue edema and adverse outcomes [3]. While both these processes can be extreme, more commonly, they are subtle with the splanchnic circulation particularly at risk.

One of the first responses to hypovolemia is recruitment of splanchnic reserves, potentially reducing flow in the splanchnic circulation to maintain core perfusion to vital organs. In healthy volunteers, normal core perfusion can be maintained after a controlled hemorrhage of 25% of blood volume, with no symptoms of hypovolemia and minimal change in heart rate or blood pressure [4]. However, at the same time, gastric tonometry shows evidence of splanchnic hypoperfusion once the circulating volume deficit exceeds 10% [5]. Other studies have also shown that the gut is the first area to suffer hypoperfusion as a result of acute hypovolemia [5,6].

Conversely, excess fluid administration will result in fluid shifting out of the circulation and into the interstitium [7]. Again, the gut is at risk, and the resulting interstitial edema can result in edema of the gut wall and prolonged postoperative ileus. Even a modest positive salt and water balance causing a weight gain of 3 kg after elective colonic resection has been shown to be associated with delayed recovery of gastrointestinal function, increased complications, and extended hospital stay [8].

Gastrointestinal (GI) dysfunction is thus the most common perioperative complication after abdominal surgery [9]. Any delay in gastrointestinal recovery correlates closely with the duration of hospital stay, with discharge from the hospital frequently possible the day following GI recovery [10].

Zero-balance approach to fluid therapy

A number of studies in the literature have examined whether a “restrictive” fluid regimen is associated with fewer complications then a “liberal” fluid regimen. However, the terminology is confusing with widespread variation between studies in fluid regimens making interpretation difficult [11]. The term “restriction” is commonly interpreted to imply hypovolemia, whereas it may simply represent avoidance of the fluid excess seen in the “liberal” group.

One of the most well-known and frequently cited “restrictive” studies is the study by Brandstrup et al. published in 2003. This multicenter trial randomized 172 mainly ASA I–II patients to either a

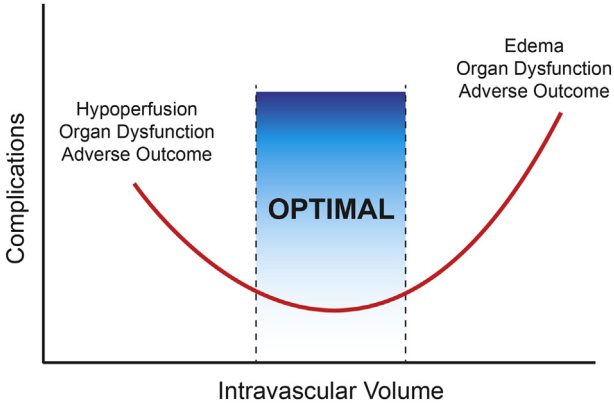

Fig. 1. Fluid load versus complications (modified from Bellamy) [1]. Both hypovolemia and hypervolemia can lead to organ dysfunction and adverse outcomes. The challenge is to keep patients at all times in the optimal zone.