EDITORIAL

Goal-directed Fluid Therapy in Neurosurgery: Three Feet from Gold?

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Perioperative goal-directed fluid therapy (GDT) focuses on optimizing advanced hemodynamic parameters like stroke volume or cardiac output to improve tissue end-organ perfusion. Goal-directed fluid therapy uses dynamic indices of fluid-responsiveness like stroke volume variation (SVV) or pulse pressure variation (PPV) to identify fluid responsive patients. This strategy helps in tailoring fluid therapy to patients needs and has the potential to reduce the deleterious side effects of fluids by avoiding fluid in non-responsive patients. A recent meta-analysis has shown reduction in postoperative complications with perioperative goal-directed therapy across various surgeries.[1] Globally, there is a demographic shift towards the elderly population accompanied by an increasing prevalence of multiple comorbidities. Also, there is an increased prevalence of left ventricular diastolic dysfunction (LVDD) in the elderly.[2] The presence of LVDD has the potential to reduce fluid tolerance.

Fluid management in neurosurgical patients, in particular, is a delicate equilibrium, requiring careful avoidance of both hyper or hypovolemia to prevent cerebral edema or brain hypoperfusion respectively. Concerning neurosurgical procedures, significant benefit from GDT (odds ratio 0.40, 95% confidence interval 0.21–0.78, $p = 0.008$) from limited evidence in the meta-analysis by Giglio et al. ignites further interest in perioperative GDT in neurosurgical patients.[1]

In this issue of the Indian Journal of Critical Care Medicine, Vorrachai et al. have explored this research question with an randomised controlled trial (RCT) in elderly (age >60 years) patients undergoing elective craniotomy (duration >2 hours).[3] Length of stay in the intensive care unit (ICU), a clinically relevant surrogate parameter was selected as the primary endpoint. Patients were randomized to either the GDT group or the conventional group with 50 patients in each arm. The two groups look well matched in terms of important baseline characteristics like the nature of the surgery, underlying comorbidities and frailty and preoperative Glasgow Coma Scale (GCS), and preoperative fluid therapy.

Patients in GDT group were treated with either fluids or vasopressors when SVV was more than 12% as described further. Patents received acetate Ringer's solution 100 mL bolus every 5 minutes when high SVV was associated with low cardiac index (2.5 L/min/m^2). On the other hand, they received vasopressors if high SVV was associated with a cardiac index of more than 2.5 L/min/m^2 along with hypotension (mean arterial pressure >65 mm Hg). Inotropes were recommended for the treatment of hypotension when low SVV was associated with low cardiac index.

The study by Vorrachai et al. could not find a difference in the primary endpoint, i.e., ICU length of stay between the two groups.

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As rightly mentioned by the authors, a shorter observed ICU stay (14–15 hours) compared to assumptions (6 days or 144 hours) used for sample size calculations, has grossly reduced the statistical power of the study. Minimal blood loss is another limitation of the study identified by the authors. No significant differences were observed in terms of blood loss, urine output, lactate levels, post-operative complications, and mortality between the two groups. The significant difference in the volume of crystalloids received by the patients between the two groups rekindles interest in this GDT protocol. Goal-directed fluid therapy group received a significantly less amount of crystalloid compared to the control group: 1311.5 (823–2018) mL vs 2080 (1420–2690) mL (p < 19 0.001).

In our opinion, it may be worth testing this hypothesis further in the elderly undergoing complicated neurosurgery with anticipated major blood loss.

The goals of fluid management in general anesthesia and critical care focus on optimizing intravascular volume and maintaining organ perfusion pressure. Neurosurgical patients differ slightly from another specialty due to the addition of an important goal of avoiding hypotonic fluids causing hypo-osmolality cerebral oedema. Regarding the choice of isotonic fluid, normal saline carries a risk of hyper chloremic acidosis while lactated Ringer's solution can cause hyponatremia and hypo-osmolality due to its low 'measured' osmolality (254 mOsmol/kg).[4] Volume of acetate Ringer's solution in the study is unlikely to cause hypo-osmolality however it may be worth monitoring serum sodium and osmolarity in neurosurgical patients.[5]

Causes of low cardiac output and hypotension in neurosurgical patients differ from critically ill septic patients. Preoperatively these patients can have dehydration due to possible indiscriminate starvation. Intraoperatively drugs and rapid blood loss are implicated. This is in contrast to the causes of low cardiac output and hypotension in septic patients. Passive leg raising (PLR), one of the commonly used tests for fluid responsiveness in ICU may not be practical in an operating room (OR). Dynamic arterial elastance (Eadyn), a ratio of PPV and SVV has been demonstrated as an accurate predictor of arterial pressure response to fluid administration.[6] It may be worth exploring Eadyn in this population.

In conclusion, the present study could not demonstrate the beneficial effects of goal-directed therapy in high-risk patients posted for elective craniotomy in terms of incidence of postoperative complications and length of ICU stay. However, decreased intraoperative fluid requirement due to GDT protocol in the study arouses further research in this area.

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