

Fluid management in renal transplantation: Is it time to move towards goal-directed directed therapy?

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Achieving optimal fluid balance for a patient undergoing major surgery, especially transplant surgery, has always been the lofty goal of peri-operative care,¹ which often proves to be an elusive target. While keeping the patient well hydrated improves organ perfusion, being too generous with fluids can result in morbidity, such as venous congestion and tissue oedema. On the flip side, keeping the patient less than well hydrated may potentially reduce blood loss, but water deprivation exposes organs to the risk of injury. The complex process of achieving optimal fluid management is further amplified in renal transplantation, where the interplay of different factors such as tissue oedema leading to vascular anastomotic failure against acute tubular necrosis from intraoperative hypotension and dehydration, creates a convoluted puzzle waiting to unfold. One can no longer rely on the traditional goal of achieving an adequate urine output but rather, depend on other markers to gauge the patient's fluid status.

Over the years, a longstanding and widely accepted goal for fluid management for renal transplant was to maintain the central venous pressure (CVP)² at a range of 8–12 mmHg, and this was thought to be a marker of adequate fluid management in order to provide adequate perfusion to renal graft. It is believed that more fluid is required for transplant surgery than for non-transplant surgery. This subsequently contributed to the practice where a large volume of fluids administered is considered beneficial for renal transplantation.³ However, in the past few decades, most physicians have shown and widely accepted that CVP has poor association with fluid responsiveness.⁴ Neither is it an accurate and reliable estimate of the preload to the heart, which one hopes will predict perfusion to the kidney graft. Static reading of the CVP is no longer considered a good predictor of fluid responsiveness.⁵

Several physiologic parameters measured by cardiac output monitors have shown promising data in predicting fluid responsiveness in non-transplant surgeries as well as in intensive care units. The non-

invasive cardiac output measurement technologies include pulse contour analysis, pulse wave transit time, thoracic electrical bioimpedance/bioreactance and transoesophageal doppler.⁶ Among these newer technologies, pulse contour analysis has gained traction as a simple, non-invasive cardiac output monitor for frequent clinical use. The pulse contour analysis system measures the area under the curve from the systolic phase of the arterial waveform to derive the stroke volume. Dynamic variations of the systolic pressure, stroke volume and pulse pressure in mechanically ventilated patients give an index that predicts the probability of fluid responsiveness reliably. Based on these promising data, several studies have been performed to explore the use of these physiologic monitoring technologies for renal transplantation.

In this issue of the Annals, a meta-analysis by Choo et al. on the effect of goal-directed fluid therapy on postoperative outcomes in renal transplantation was published.⁷ It aims to explore if goal-directed therapy (GDT) improves outcomes in terms of graft function and requirements for dialysis. The authors of this meta-analysis have done a comprehensive search on the available evidence of GDT for renal transplant, but the main limitation of this analysis is the insufficient quality of studies included. The studies consist of small randomised controlled trials and are also heterogenous to each other in terms of the type of renal transplantation, patient characteristics and goal-directed and control protocols. However, the studies that can significantly affect the outcome of fluids used have yet to be analysed or performed. Hence, finding no significant difference in the primary outcome is not unexpected.

However, it is interesting to note that the likelihood of postoperative tissue oedema and respiratory complications was significantly lower in the GDT group, which may suggest the beneficial effect of GDT. A lower likelihood of tissue oedema could be beneficial in ensuring graft function. One study demonstrated an association between the fluid volume administered and endothelial

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glycocalyx degradation.⁸ Fluid overload may induce endothelial injury.

Other factors can affect delayed graft functions, which are predictors of subsequent clinical courses.⁹ These factors include immunological processes, haemodynamic parameters, prolonged ischaemic time and manner of graft preservation, which will influence the development of acute tubular necrosis—the most common cause of delayed graft function.¹⁰ With a myriad of factors that can influence the outcome of graft function, it will be challenging to have a universal algorithm that will fit every individual in the study design. However, this should not deter further extensive studies from being performed.

The Consensus Statement of the Committee on Transplant Anaesthesia of the American Society of Anesthesiologists¹¹ states there is low-quality evidence for a more significant volume of fluid administration targeting a higher CVP during renal transplantation. They also concluded that using CVP as a guide to fluid administration is only weakly supported. Using stroke volume variation, oesophageal Doppler and Pleth Variability Index (PViR) to guide administration is promising but limited in evidence.

Fluid management for renal transplants is akin to walking on a tightrope. Too much of it will result in tissue oedema, and too little will result in tissue ischaemia; both situations will affect graft function. While there is limited evidence to support the GDT, this meta-analysis suggests that postoperative renal function is better with GDT as demonstrated by a lower creatinine and reduced incidence of dialysis for mainly cadaveric graft patients. The signal favouring the use of GDT being stronger with cadaveric renal transplants may be due to a longer ischaemic time and this is associated with increased risk of delayed graft function. GDT may have a beneficial effect in this group of patients.

Fluid management, in addition to blood pressure, should be individualised to the specific patient, and guidance from physiologic goals may help achieve that.

Keywords: *fluid management, goal-directed therapy, nephrology, renal failure, renal transplantation*

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