Mini Review

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Treatment with Continuous Renal Replacement

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Abstract

For critically sick patients with acute kidney damage, continuous renal replacement therapy (CRRT) is frequently utilised to provide renal support, especially for patients who are hemodynamically unstable. Continuous venovenous hemofiltration, which primarily uses convective solute clearance, continuous venovenous hemodialysis, which primarily uses diffusive solute clearance, and continuous venovenous hemodiafiltration, which combines both dialysis and hemofiltration, are just a few of the techniques that can be used.

The current paper discusses the indications for beginning renal replacement therapy, as well as dose and technical elements in the administration of CRRT, and compares CRRT with alternative modalities of renal support.

Keywords: Acute kidney injury • Continuous renal replacement therapy • Dialysis • Hemodialysis • Hemofiltration

Introduction

Acute kidney damage (AKI), a frequent complication in critically sick patients, is linked to significant morbidity and a high risk of mortality. Renal replacement treatment (RRT) is necessary for 5% to 10% of AKI patients throughout their ICU stay, with death rates ranging from 30% to 70%. The incidence of RRT-requiring AKI has grown by around 10% annually during the last 20 years. Older age, male sex, African-American race, higher disease severity, sepsis, decompensated heart failure, cardiac surgery, liver failure, and use of mechanical ventilation are risk factors for RRT-required AKI [1].

Although it was originally thought to be an unusual intervention, it is now commonplace to administer RRT even in the presence of obvious hemodynamic instability. The ideal timing for beginning and termination, as well as the choice of modality, are among the many essential components of RRT therapy that still face significant ambiguity. The current paper gives a summary of important difficulties in the administration of RRT to critically sick patients, with a particular emphasis on the use of continuous renal replacement therapy (CRRT).

Blood flow rate

The recommended blood flow rate varies by modality. To maximize the plasma to dialysate concentration gradient in CVVHD, the blood flow rate should be at least twice that of the dialysate. Blood flow rate needs to be adjusted for CVVH to avoid a filtration fraction (plasma water removal to plasma flow ratio) of more than 25%. This formula must be modified for pre-filter replacement fluid delivery. We gradually increase (over the course of 10-15 minutes) from 25 mL/min to our goal blood flow rate. Once established, the hemodynamics are unaffected by average blood flow rates (150–250 mL/min). We recommend a lower blood flow rate of 120 mL/min for citrate CVVHDF since greater rates call for higher citrate

doses, which raise the possibility of citrate toxicity. Despite changes in solute clearance efficiency, we do not alter blood flow rate in response to fluid delivery before vs after filter replacement [2].

CRRT modality

There are three essential CRRT comparable modalities. The terms continuous venovenous haemodialysis (CVVHD), continuous venovenous haemofltration (CVVH), and continuous venovenous hemofltration are all used interchangeably (CVVHDF).

Consequently, local expertise informs the choice of modality. Because CVVHDF has been the subject of the greatest research and because diffusion could lengthen circuit life, we choose to recommend it [3].

Discontinuation of CRRT

There are no set standards for stopping CRRT due to improved renal function or switching to other RRT modalities. Although there are few exact requirements, higher urine production is a first sign of recovering kidney function. A urine output > 400 mL/d without concurrent diuretic medication was a predictor of effective CRRT termination in the observational Beginning and Ending Supportive Therapy for the Kidney (Best Kidney) research. Patients in this observational cohort who were able to effectively stop receiving CRRT without needing to restart it had a higher chance of surviving until hospital release than those who needed to restart it [4].

In another research, it was suggested that a threshold of 500 mL/d or more of urine output be reached before RRT is stopped for patients with AKI. The relevance of this criterion is questionable, though, as the treating doctors maintained RRT almost two thirds of the time despite this prescription, citing continuing volume overload as the main justification.

When the urine production was greater than 750 mL/d, a 6-h timed urine sample was taken for the ATN trial. RRT was continued if the measured creatinine clearance was below 12 mL/min, stopped if it was over 20 mL/min, and left to the clinician's discretion if it was in the range of 12 to 20 mL/min. Although these tactics can aid in clinical decision-making, there aren't any clear standards for stopping RRT [5].

The transfer of patients to alternative RRT modalities with a better hemodynamic state but persisting AKI is likewise quite varied. Depending on the clinical situation, patients may either go from PIRRT to IHD or vice versa. Moving from CRRT to PIRRT or IHD may make it easier to start physical therapy and get out of bed. Patients with chronic RRT-dependent AKI must often switch to IHD before being released from the ICU [6].

RRT Modality

The therapy of the critically sick patient with kidney failure may involve using a variety of renal support techniques. These include prolonged intermittent renal replacement treatments (PIRRTs), which are a combination of CRRT and IHD, traditional intermittent hemodialysis (IHD), and CRRT. All of them make use of quite comparable extracorporeal blood circuits; the main differences are in the length of therapy and, as a result, in the speed of net ultrafiltration and solute clearance. Additionally, solute clearance during hemofiltration happens through convection, whereas dialysis treatments primarily rely on diffusive solute clearance [7].

While continuous therapies provide more gradual fluid removal and solute clearance over extended treatment times (ideally, 24 hours per day but frequently interrupted due to system clotting or diagnostic or therapeutic procedures), IHD offers rapid solute clearance and ultrafiltration during relatively brief (3- to 5-h) treatments. Treatments for the various subtypes of PIRRT typically last 8 to 16 hours, and they have slower solute clearance and ultrafiltration rates than IHD but faster than CRRT. The equipment used to provide PIRRT most frequently has lower blood and dialysate flow rates than that used for IHD. A comparable administered treatment can also be achieved over a shorter period of time by employing equipment made for CRRT but with enhanced dialysate and/or ultrafiltration rates. The extracorporeal modalities of RRT can be effectively replaced by peritoneal dialysis; however a thorough examination of this procedure is outside the purview of this paper [8].

Timing of initiation

The definition of "early" differs among research, and early CRRT beginning may not enhance results.

As a result, clinical judgment directs the start of CRRT. To satisfy metabolic and fluid demands that residual renal function cannot meet, as well as to avoid or quickly cure life-threatening derangements in fluid status, electrolytes, and/or acid-base balance [9].

Catheter selection

In order to supply the appropriate blood flow rate without creating significant negative pressure, catheters should be of sufficient gauge (13 Fr or 13.5 Fr). Clinical discretion will determine the implantation place. Right internal jugular vein has the highest catheter function, followed by femoral vein and left internal jugular vein. Due to the possibility of thrombosis or stenosis, we avoid placing any more lines in the same channel and using the sub-clavian vein. Maximizing circuit life involves aiming for soft tip positions in the right atrium or the proximal inferior vena cava. Calcium administration is much easier when using triple lumen catheters (13 Fr) for citrate anticoagulation. Blood, however, for ionized calcium [10].

Conclusion

In critically sick patients, CRRT has established itself as a cornerstone in the therapy of AKI. The best time to start RRT in patients who don't have measurable reasons to start renal support immediately is still up for debate. Despite the fact that continuous therapies may make it easier to manage patients who are hemo-dynamically unstable, the data currently available do not indicate that using CRRT leads to an improvement in survival or kidney function restoration when compared to alternatives like traditional IHD and PIRRT. The majority of patients do not benefit from increasing solute clearance with effluent flow rates greater than 20 to 25 mL/kg per hour, according to large, well-planned clinical trials; nonetheless, the best volume management techniques still need to be determined. Similar to how an anticoagulation method, another part of managing CRRT, is prone to wide variability in practice. Finally, it is important to take into account how CRRT fits into the overall goals of care and the utilization of other life-sustaining procedures.

We recommend using a triple lumen catheter to deliver CVVHDF with local citrate anticoagulation into the right internal jugular vein or right femoral vein. Clinical discretion is used to choose when to start and stop CRRT.

With citrate anticoagulation, we recommend a blood flow rate of 120 mL/min and an effluent flow rate of 25 mL/kg/h. Acute NUF is avoided unless clinically necessary. To target ammonia clearance, we modify the effluent flow rate for certain individuals. We promote the use of protocolized treatment and keep an eye on the safety and effectiveness of CRRT. Although in our unit intensivists are the ones who prescribe CRRT, we realise that collaborative and interdisciplinary prescribing is widespread globally.

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