Renal replacement therapy in the ICU: continued controversy despite recent advances

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Approximately 50% of ICU patients experience an episode of acute kidney injury (AKI). The degree of AKI severity is nowadays determined by the *Kidney Disease Improving Global Outcomes* classification, based on urine output and creatinine levels [1]. In the most severe cases, renal replacement therapy (RRT) is initiated to support or 'replace' kidney function. RRT is part of daily activity for an intensivist as it concerns between 10 and 15% of ICU patients [2]. Importantly, this subgroup of ICU patients who receive RRT exhibits a high mortality rate (50–60%). If the patient survives, she/he may become dialysis independent after several days/weeks of RRT sessions. Although this evolution toward dialysis independence is regularly mentioned as 'renal recovery', one has to keep in mind that it does not necessarily mean kidney function has completely 'recovered' from that episode of AKI. Indeed, a certain degree of 'acute kidney disease' may persist, potentially leading to subsequent chronic kidney disease. Finally, in a significant number of cases (approximately 15%), she/he may remain 'dialysis dependent' after hospital discharge.

RRT in the ICU has been recently drastically modernized. Fast and constant technological progress coming from the industry, the advent of regional citrate anticoagulation, the release of large clinical studies bringing answers to crucial questions such as which dialysis dose for these patients [3], and the publication of international recommendations [1], are all together responsible for an easier management of RRT by the intensivist. However, a lot of work still needs to be done as many questions related to RRT are still considered today as unanswered or controversial. When should we start RRT? When should we terminate RRT? Should we administer intermittent RRT or continuous RRT (CRRT)? Should we make a particular prescription in case the patient suffers from septic shock? Should we systematically 'individualize' the RRT prescription? Which membrane should we use? Due to the absence of consensual answers to all these questions, practice varies a lot from one ICU to the other. In fact, RRT management is very heterogeneous, not only nationally and internationally but also locally within the same institution.

The current issue comprises nine important topics related to RRT administered to patients hospitalized in the ICU. The purpose of this series of overviews written by well known experts in the field is to summarize new advances regarding management of RRT in critically ill patients. In addition, RRT indications and specificities of RRT provided to subgroups of ICU patients such as sepsis and extracorporeal membrane oxygenation (ECMO) patients, all elements of the RRT prescription including modality, timing, dose, anticoagulation, membranes and catheters, are elegantly addressed in these review articles. Wang and Bellomo (pp. 000–000) discuss advantages and downsides of intermittent hemodialysis, sustained-low efficiency dialysis and CRRT, remind that no superiority of any RRT modality in terms of patient survival has been demonstrated so far, and mention that emerging evidence tends to show an association between CRRT and enhanced renal recovery after severe AKI. Haines from John Prowle's (pp. 000–000) team explains why precision medicine is not that easy to translate in the field of RRT. Kindgen-Milles *et al.* (pp. 000–000) nicely summarizes recent findings related to citrate anticoagulation for CRRT, notably in patients with liver failure, shock and lactic acidosis for whom regional citrate anticoagulation should nowadays be considered as doable but at the cost of increased caution. Michel from Lausanne's group led by Schneider (pp. 000–000) highlights the crucial importance of prompt and adequate resolution of circuit/membrane issues such as clogging and clotting. To reach this goal, this particular review insists on the mandatory need for ICU doctors of a clear understanding of extracorporeal circuit

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hemodynamics. Furthermore, Honoré *et al.* (pp. 000–000) provides a comprehensive overview on membranes and cartridges specifically designed for extracorporeal management of sepsis, whereas Girardot *et al.* (pp. 000–000) from Lyon focuses on the crucial role played by dialysis catheters and catheter locks for adequate RRT delivery. Importantly, Joannes-Boyau *et al.* (pp. 000–000) explains that correct management of RRT in the ICU necessarily requires a 'team strategy'. Finally, Romagnoli, Ricci and Ronco (pp. 000–000) exhibit the specificities of CRRT in septic patients, whereas Ostermann *et al.* (pp. 000–000) addresses CRRT in patients receiving ECMO, explaining that CRRT can be provided in these patients via an integrated approach or independently via parallel systems, both strategies having specific advantages and drawbacks.

When the reader goes through these overviews, she/he may easily realize how active and prolific this area of critical care research is. She/he may agree that much progress has been recently accomplished but, like all authors from this series of review articles, she/he may also admit that this area remains full of unanswered questions and controversies (e.g. early versus late RRT, heparin versus citrate, diffusion versus convection, continuous versus intermittent RRT), meaning that further research is still very warranted in the field of critical care nephrology.

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Conflicts of interest

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