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Letter to the Editor

Is continuous renal replacement therapy an option for hyperkalemic cardiocirculatory arrest?

To the Editor,

During advanced life support, potentially reversible causes should be actively pursued using the "4Hs and 4Ts" approach.[1] If the serum potassium is ≥6.5 mmol/L early in the resuscitation, hyperkaliemia should be considered as the potential cause.[2] Guidelines recommend the administration of intravenous calcium chloride, insulin/glucose and bicarbonate.[1,2] However, these are frequently ineffective and renal replacement therapy (RRT) in combination with high-quality cardiopulmonary resuscitation (HQ-CPR) should be considered. This is especially true if return of spontaneous circulation is not achieved within 15 minutes or with an initial serum potassium ≥9.5 mmol/L.[2]

Both conventional hemodialysis (cHD) and continuous renal replacement therapy (CRRT) have been described with safety and efficiency in hyperkalemic cardiocirculatory arrest (HCA).[2,3] However, in all case reports describing CRRT it was associated with veno-arterial extracorporeal life support (V-A ECLS) for augmented systemic perfusion.[2] In hospitals there is great heterogeneity in the availability of either V-A ECLS or cHD equipment, and there may be a tendency to use CRRT because of defibrillation compatibility.[4] Indeed, most cHD equipment is not defibrillation-proof contrary to CRRT.[2] Published case reports and guidelines only give generic prescribing indications for RRT.[2,3]

Using a previously published two-compartment model,[5] we simulated potassium kinetics during a cHD session with a potassium concentration of 9.5 mmol/L at dialysis initiation. For dialysis parameterization we used: (1) blood flow rate (Qb) of 200 cc/min, the average blood flow obtainable in patient in HCA during HQ-CPR with a conventional provisory catheter[2]; (2) dialysate flow rate (Qd) of 500 mL/min, the normal dialysate flow; and (3) potassium dialysate concentration of 2 mmoL/L, the lowest readily available concentration.

We then simulated potassium kinetics during CRRT sessions. We considered a multiFiltratePRO machine with an AV1000 filter in continuous venovenous hemodialysis (CVVHD) mode with: (1) Qb of 200 cc/min; (2) Qd of 4.800 cc/h, the maximum flow rate of the equipment maintaining a Qb/Qd ratio of 2.5 which allows a near-complete saturation of the dialysate; and (3) potassium dialysate concentration of 0 mmoL/L which is the lowest commercially available concentration. Finally, we tested a continuous venovenous hemodiafiltration (CVVHDF) by adding a replacement fluid with a 0 mmoL/L potassium dialysate concentration at a flow rate (Qf) of 1.440 cc/h, the maximum value for a filtration fraction of ≤20%.

The results of the simulation (Fig. 1) were overlapping with the published data referring to patients with HCA with cHD during HQ-CPR.[2,3] CRRT is less efficient than cHD with the need for an additional 23 minutes in CVVHDF and 38 minutes in CVVHD to reach a potassium concentration of 6.5 mmol/L, even with optimized parameters.

This simulation provides evidence to support the fact that cHD remains the standard RRT in HCA. CRRT should only be used when cHD is not available and CVVHDF (using the above optimized parameters) should be the preferred mode of therapy.

Conflicts of Interest Statement

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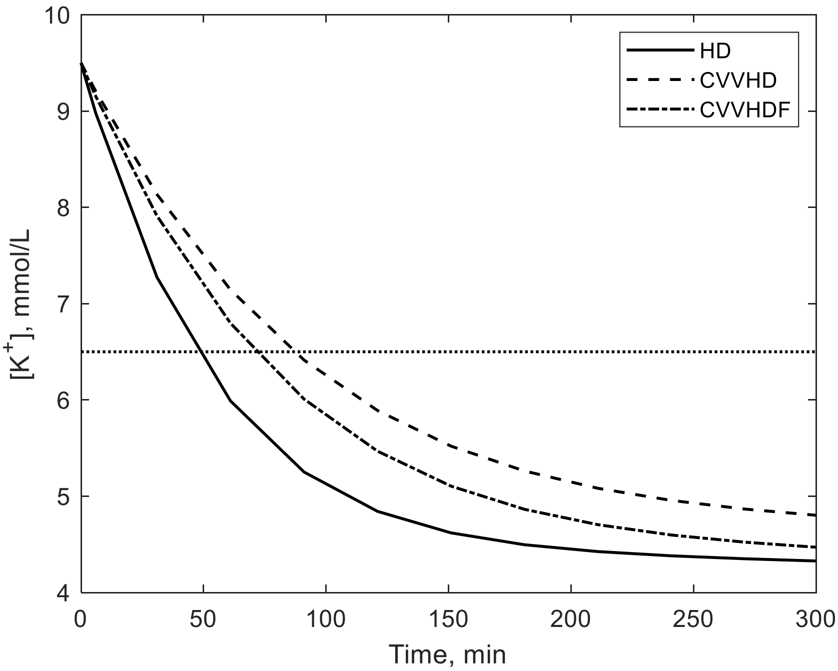

Fig. 1 – Predicted potassium concentration profile in the extracellular compartment with conventional hemodialysis (HD), continuous venovenous hemodiafiltration (CVVHDF) and continuous venovenous hemodialysis (CVVHD). The intersection with the dotted line represents the instant when the threshold of 6.5 mmol/L is reached with each treatment.

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