CVVHF IN A PATIENT WITH SEPSIS, ACUTE RENAL INJURY AND SEVERE HYPERNATREMIA

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INTRODUCTION

Hypernatremia is one of the most common electrolyte complications in the intensive care unit. Its incidence increases with the indiscriminate use of crystalloid solutions in the shock resuscitation phase, as well as the use of sodium bicarbonate in patients with metabolic acidosis. It is often accompanied by acute kidney injury, and together they worsen the patient's survival prognosis.

OBJECTIVE

Describe the clinical case of an elderly woman with leukemia, acute kidney injury and severe hypernatremia that required CRRT with the need to adjust the concentration of sodium in the replacement solution to avoid serious variations in plasma sodium that could cause serious brain damage.

CASE REPORT

A 67-year-old woman with a diagnosis of acute myeloid leukemia in treatment with chemotherapy, complicated with urinary and pulmonary sepsis that developed hypernatremia secondary to the intense administration of crystalloid solutions and intravenous sodium bicarbonate. Nephrology assessment was requested for creatinine elevation consistent with acute kidney injury KDIGO 3 induced by sepsis, anuria, and serum sodium of 172 mEq / L.

The management of hypernatremia with hypotonic solutions was initiated, however, due to fluid overload greater than 10% and hemodynamic instability, it was decided to initiate renal replacement treatment with CVVHF.

The sodium concentration in the replacement solution for hemofiltration, according to the formula referred to by Yessayan et al, to obtain a concentration of 160 mEq / L or 800 mEq in 5 liters of replacement volume, with adjustment according to plasma sodium results; usually with a delta (plasma sodium - sodium in replacement liquid) of 10 mEq.

$$\text{Replacement fluid}\,[\mathrm{Na}^+] = \frac{\text{desired serum } \Delta\,[\mathrm{Na}^+]}{(1 - e^{(-\mathrm{Cl} \times 24\,\mathrm{h})/V})} + \text{initial serum } [\mathrm{Na}^+]$$

$$Cl\,\text{predilution} = \left(\frac{Q_b}{Q_b + Q_{rf}}\right) \times SC_{Na^+} \times (Q_{rf} + Q_{uf})$$

$$Cl\,\text{postdilution} = SC_{Na^+} \times (Q_{rf} + Q_{uf})$$

Where Qb is the blood flow rate (L/h), Qrf is the RF flow rate (L/h), Quf is the ultrafiltration rate (L/h) and SC_{Na} is the Na+ sieving coefficient (~1); e was 2.72 (constant).

The therapy was prescribed with Qb 250 ml / min, Qr-pre 1400cc, Quf 100 ml / hr, with the aim of correcting plasma sodium at approximately 6 mEq / L in 24 hours.

Day	-4	-3	-2	-1	0	1	2	3
Corrected sodium (mEq/L)	156	166	185	183	172 (CVVHF)	168	158	155
Potassium	2	2.4	2.3	2.2	3.7	3.6	3.7	4.2
BUN (mg/dL)	29	35	42	43	69	68	44	24
Creatinine (mg/dL)	1.52	1.44	2.04	2.32	4.97	4.5	3.1	1.68
Glucose (mg/dL)	138	128	228	310	364	234	190	95

In 72 hours the patient adequately tolerated the CRRT, with a decrease in plasma sodium to 155 mEq/L, however she presented bleeding, and progression of sepsis, and, unfortunately, died.

DISCUSSION AND CONCLUSION

The use of CRRT in severe dysnatremias, especially in patients with acute kidney injury or fluid overload, has been demonstrated by several authors. Severe hypernatremia is most important complication as acute neurological injury that may be irreversible. Using CVVHF is very useful for very complex cases and can improve the prognosis of the patient.

- Determine target correction for the next 24 hours (not to exceed 10 mEq/L)

$$\textit{initial serum } [\mathrm{Na}^+] = 98\ \mathrm{mEq/L},\ \textit{desired } \Delta\ \textit{serum}[\mathrm{Na}^+] = 10\ \mathrm{mEq/L}$$

- Determine minimum urea clearance (K) in L/h

Urea clearance for a 50-kg female: 25 mL/kg/h × 50 kg = 1.25 L/h

- Determine delivered K for a fixed blood flow rate (Q_b), replacement fluid (Q_{rf}), and ultrafiltration rate (Q_{uf})

$$\textit{Urea clearance}\left(\frac{L}{h}\right) = \left(\frac{Q_b}{Q_b + Q_{rf}}\right) \times (Q_{rf} + Q_{uf})$$

- Adjust replacement fluid rate for a fixed Q_b and Q_{uf} to achieve a desired K

K = 1.3 L/h with Q_b = 300 mL/min, Q_{rf} = 1.2 L/h, and Q_{uf} = 167 mL/h

- Assume Na^+ dialysance (D) = K
- To calculate delivered Dt/V over each 24-hour period, estimate total-body water (TBW) volume (V):

V ≈ TBW = 0.5* × estimated dry weight for females + estimated ECF expansion

V ≈ TBW = 0.6* × estimated dry weight for males + estimated ECF expansion

We estimated about 6 L of edema. Estimated dry weight ≈ 44 kg and 6 L of edema = 44 × 0.5 + 6 = 28 L.

- Determine replacement fluid [Na^+] needed to achieve desired [Na^+] change

$$\textit{Replacement fluid } [\mathrm{Na}^+] = \frac{\textit{desired } \Delta\ \textit{serum } [\mathrm{Na}^+]}{\left(1 - e^{-\frac{D \times 24\,h}{V}}\right)} + \textit{initial serum } [\mathrm{Na}^+]$$

Declining V with ultrafiltration will have minimal impact on $1 - e^{-\frac{D \times 24\,h}{V}}$. If desired, an average of time = 0 and time = 24-hour estimated V can be used to predict the replacement fluid with better accuracy.
It is ~0.66 with an estimated V = 28 L and 0.71 with an estimated V = 24 L by the end of the first 24 hours. The average of the 2 values can be used when estimating the replacement fluid [Na^+].

CVVHF with fluid customization (From: Yessayan L, Lee J, Frinak S, Szamosfalvi B. Am J Kidney Dis 2014; 64:305-310).