Alexandre Toledo Maciel[1,2], Marcelo Park[2]

Urine assessment in the critically ill: a matter of both quantity and quality

Avaliação urinária no paciente crítico: uma questão tanto de quantidade como de qualidade

1. Intensimed Research Group, Intensive Care Unit, Hospital São Camilo Pompéia - São Paulo (SP), Brazil.
2. Intensive Care Unit, Department of Medical Emergencies, Hospital das Clínicas, Universidade de São Paulo - USP - São Paulo (SP), Brazil.

In this issue of Revista Brasileira de Terapia Intensiva, Masevicius et al.[1] reported on the behavior of the plasma chloride concentration ($[Cl^-]_{plasma}$) of 148 consecutive postoperative patients in the first 24 hours after their intensive care unit (ICU) admission. The authors' major finding was that, at the end of the first day in the ICU, the $[Cl^-]_{plasma}$ was primarily dependent upon the $[Cl^-]_{plasma}$ on ICU admission and on the urinary strong ion difference ($[SID]_{urine}$), also called the urinary anion gap. There were 3 patient groups: (1) increased, (2) decreased or (3) unaltered $[Cl^-]_{plasma}$ during the 24 hours period. The increased $[Cl^-]_{plasma}$ group had the lower $[Cl^-]_{plasma}$ on ICU admission and the higher strong ion gap (SIG), i.e., the higher concentration of unmeasured anions. The opposite was observed in this same group after 24 hours: the higher $[Cl^-]_{plasma}$ and the lower SIG. The volume of infused fluids and the SID of these fluids (only crystalloids) on the first ICU day were similar between groups, which led the authors to conclude that the fluids received during this period were not responsible for the distinct between-group $[Cl^-]_{plasma}$ behaviors.

These results must be carefully interpreted. First, it is intuitive that the $[Cl^-]_{plasma}$ on ICU admission is a determinant of the $[Cl^-]_{plasma}$ after 24 hours because the latter greatly depends on the former (which was different between groups) and the amount of $[Cl^-]$ received during this 24 hours period (which was similar between groups). Normal saline, which has a high $[Cl^-]$ content (154mEq/L, well above the initial $[Cl^-]_{plasma}$ in the 3 groups), was the primary fluid used; therefore, a decreased or even an unchanged $[Cl^-]_{plasma}$ would not be expected. On the contrary, an increase in the $[Cl^-]_{plasma}$ would be expected in all groups, particularly in the group with the lower initial $[Cl^-]_{plasma}$. At this point, the $[SID]_{urine}$ and the total urine volume play crucial roles. Because the kidneys are the major organs responsible for the SID regulation in plasma, it is expected that both the urine volume and $[SID]_{urine}$ are determinants of the final $[Cl^-]_{plasma}$. Diuresis volume in the 24 hours period was similar between groups, which directed our attention to the $[SID]_{urine}$. The urine is the main fluid by which we excrete $[Cl^-]$. Urinary $[Cl^-]$ excretion is of paramount relevance in acid-base equilibrium because it is usually the anion that follows ammonium (NH_4^+) excretion, the main form of acid excretion by the organism. In the Masevicius et al. study,[1] the increased $[Cl^-]_{plasma}$ group had the higher $[SID]_{urine}$, suggesting less capacity to excrete $[Cl^-]$ and manage saline-induced hyperchloremia. This finding could be an indirect sign of renal impairment,[2-4] although in the present study, few patients met an AKIN[5] stage 1 criterion for acute kidney injury (AKI), and the incidence of AKI was similar between groups.

Conflicts of interest: None.

Corresponding author:
Alexandre Toledo Maciel
Hospital São Camilo
Unidade de Terapia Intensiva - 4º andar
Avenida Pompéia, 1.178
Zip code: 05024-000 - São Paulo (SP), Brazil
E-mail: alexandre.toledo@intensimed.com

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Another between-group difference was the SIG value upon ICU admission. It is difficult to explain the reasons why SIG had distinct values based solely on the information provided by the authors. In addition, in terms of prognosis and therapeutic management of critically ill patients, the SIG utility remains to be determined. The opposite behaviors of $[Cl^-]$ and unmeasured anions (one increases, the other decreases and vice-versa) may be a physiological phenomenon, which has been suggested as an explanation for hypochloremia in untreated diabetic ketoacidosis[6] or for an increased SIG in the presence of hypoalbuminemia.[7] However, it may just be a mathematical coupling because until now, the SIG has been a calculated variable and not a directly measured variable. The fact that the increased $[Cl^-]_{plasma}$ group had the higher SIG upon admission may also influence our interpretation of $[SID]_{urine}$ in the present study. In the presence of a predominantly SIG acidosis, it is possible that unmeasured anions, not $[Cl^-]$, follow urinary NH_4^+ excretion, which results in less $[Cl^-]$ excretion and higher $[SID]_{urine}$ values.

In conclusion, this important paper by Masevicius et al.[1] brings some uncertainty about how to interpret the data: $[SID]_{urine}$ determines the changes in plasma $[Cl^-]$ or initial $[Cl^-]$ and SIG determine $[SID]_{urine}$? Anyway, one certainty this study brings: we must evaluate the electrolyte composition of urine for a full understanding of the acid-base equilibrium, and intensivists should perform this evaluation daily. The relevance of urine in the ICU extends well beyond its volume and flow.

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