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NEPHROLOGY - LETTER TO THE EDITOR

Solute-free water excretion and electrolyte-free water excretion are better terms than solute-free water clearance and electrolyte-free water clearance

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Editor,

Renal solute and water excretion determines the direction and magnitude of the change in serum sodium concentration resulting from renal losses [1–8]. The rates of renal solute and water excretion are expressed as osmolal clearance (C_{Osm}), solute-free water clearance (C_{H2O}), electrolyte (monovalent cation) clearance ($C_{(e)}$), and electrolyte-free water clearance ($C_{H2O(e)}$). These clearances consider that the volume of the urine consists of two virtual parts: C_{Osm} and $C_{(e)}$ have osmolality or sodium plus potassium concentrations equal to those of plasma, respectively; C_{H2O} is solute-free (pure water) water clearance; $C_{H2O(e)}$ is electrolyte-free (sodium plus potassium-free) water clearance. Table 1 shows the formulas for these clearances [6, 7].

The main components of urine solute are sodium and potassium salts and urea. $C_{(e)}$ and $C_{H_2O(e)}$ are expressions of the relationship between urine volume, urine sodium concentration (U_{Na}), urine potassium concentration (U_K) and plasma sodium concentration (P_{Na}), but not urea. $C_{(e)}$ is defined as the virtual volume of plasma completely cleared of sodium and potassium by the kidney per unit time (e.g., a minute). $C_{H_2O(e)}$ is defined as the volume of pure water to be subtracted from or added to a urine volume to produce a concentration of sodium and potassium in this modified urine equal to plasma concentrations of either sodium or sodium plus potassium. With this definition of $C_{H_2O(e)}$, it should be noted that the volume of plasma needed to provide the amount of electrolyte-free water to the urine is slightly higher than the volume of electrolyte-free water obtained. Thus, 100 mL of plasma can generate maximally only 93 mL of electrolyte-free water to the urine due to the presence of 7 g of proteins in 100 mL of plasma. These plasma proteins cannot be filtered into the urine under normal protein handling by the kidney.

If $U_{Na} + U_K < P_{Na}$, then $C_{H_2O(e)}$ is positive, a process that will increase plasma sodium level. If $U_{Na} + U_K > P_{Na}$, then $C_{H_2O(e)}$ is negative, a process that tends to reduce plasma sodium level [9]. $C_{(e)}$ and $CC_{H_2O(e)}$ were introduced in medical practice because they provide an accurate characterization of the pathophysiology of dysnatremias produced by various diuretic states, while C_{Osm} and $C_{H_2O(e)}$ do not [1–8].

C_{Osm} and $C_{(e)}$ are computed by the general formula expressing steady-state renal clearances of solutes, UV/P, where U and P are urine and plasma concentrations of the solute studied, respectively, and V is urine volume formed per unit time. The word "clearance" in solute-free or electrolyte-free water clearance does not correspond with the conventionally recognized nephrological meaning of "clearance" (expressed as a formula "UV/P" or narratively, "the volume of plasma from which a substance is entirely removed by the kidney per unit time"). Therefore, we propose that the term solute-free water clearance is replaced by "solute-free water excretion" abbreviated as E_{H_2O} and the term electrolyte-free water clearance excretion be replaced by "electrolyte-free water excretion" abbreviated as $E_{H_2O(e)}$ [10].

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Table 1 Clearance formulas expressing the relation between the rates of urinary solute and water excretion

Clearance	Formula
Osmolal clearance	$C_{Osm} = V \times \frac{U_{Osm}}{P_{Osm}}$
Solute-free water clearance	$C_{H2O} = V - C_{Osm} = V \times (1 - \frac{U_{Osm}}{P_{Osm}})$
Electrolyte clearance*	$C_{(e)} = V \times \frac{U_{Na}+U_K}{P_{Na}}$
Electrolyte-free water clearance*	$C_{H20(e)} = V - C_{(e)} = V \times (1 - \frac{U_{Na}+U_K}{P_{Na}})$

V urine volume per unit time, U_{Osm} urine osmolality, U_{Na} urinary sodium concentration, U_K urinary potassium concentration, P_{Na} plasma sodium concentration

*Plasma potassium concentration (P_K) was not included in the formulas of electrolyte clearance and electrolyte-free water clearance because its magnitude is small compared to P_{Na}. However, some authors include P_K in these formulas, which results in $C_{(e)} = V \times (U_{Na}+U_K) / (P_{Na}+P_K)$, and $C_{H2O(e)} = V \times (1 - (U_{Na}+U_K)/(P_{Na}+P_K)$ [2, 8]

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Compliance with ethical standards

Conflict of interest The authors declare that there is no conflicts of interest or competing interests.

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