ARCHIVES OF HELLENIC MEDICINE: ISSN 11-05-3992

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ARCHIVES OF HELLENIC MEDICINE 2016, 33(4):573
ΑΡΧΕΙΑ ΕΛΛΗΝΙΚΗΣ ΙΑΤΡΙΚΗΣ 2016, 33(4):573

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Acid-Base Balance-Electrolyte Quiz – Case 56

A 70 kg male with serum sodium 115 mEq/L is given 1 L of isotonic sodium chloride solution (0.9%). Vurine is 500 mL and the concentration of urine sodium and potassium are 300 mEq/L and 80 mEq/L, respectively. Which is the change of serum sodium concentration?

- -2 mEq/L
- +2 mEq/L
- +4 mEq/L
- +6 mEq/L

The tonicity balance studies can be easily used to calculate the change in serum sodium levels. The estimated total body weight (TBW) is 42 L (60% of the total weight). Serum sodium levels can be calculated from the equation:

$$\text{Serum sodium levels} = \frac{\text{Total cation content}}{\text{Total body water}}$$

Thus, the patient's total cation content is 115 mEq/L×42 L. The change of the total cation content can be estimated by the equation: Change of cation content=infused (Na^++K^+) – excreted (Na^++K^+)=154–0.5 (300+80)=154–190=-36 mEq. The total body water will be increased by only 0.5 (1 L–0.5 L). Thus, the new total body water will be 42.5 L. Thus, the serum sodium concentration will be $= \frac{\text{Total cation content}}{\text{Total body water}} = \frac{(115\times42)-36}{42.5} = 113$ mEq/L (a small decrease of serum sodium by approximately 2 mEq/L).

Another view to predict the serum sodium concentration is the Adrogue-Madias equation, which projects the change in serum sodium levels after the administration of 1 L of any infusate:

$$\Delta Na^+ = \frac{(K^+ + Na^+) \text{ of the infusate} - (\text{serum sodium})}{\text{TBW}+1}$$

Thus, in the present case the ΔNa^+ is approximately <1 mEq/L. However, during treatment when the water losses are remarkable, the fluid-loss formula should be used for the correct evaluation of the change in serum sodium levels. In this case according to the fluid-loss formula the change in serum sodium can be estimated:

$$\Delta Na^+ = Vx \left[\frac{\text{Serum } Na^+ - (\text{urine } K^+ + Na^+)}{\text{TBW-Vurine}}\right] =$$

$$0.5 \left[\frac{115-380}{41.5}\right] = -3 \text{ mEq/L}$$

A small decrease of serum sodium is expected, as previously suggested.

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Answer: *A small decrease of serum sodium by approximately 2 mEq/L*