Deacon's Challenge

No 190 - Answer

Recent European guidelines advise treatment with urea as a second-line treatment for the syndrome of inappropriate antidiuresis (SIADH), with the aim of inducing an osmotic diuresis. A 65-kg man with a stable serum sodium concentration (after fluid restriction) of 125 mmol/L is commenced on urea 15 g/day. Calculate the anticipated increase in serum osmolality, stating the assumptions made. NB: the formula of urea is $CO(NH_2)_2$.

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Urea is evenly distributed throughout body water.

Urea empirical formula = CH_4N_2O, calculate MW:

C	=			12
H_4	=	4 x 1	=	4
N_2	=	2 x 14	=	28
O	=			16
MW	=			60

$$\text{Number of mmol urea administered} = \frac{\text{wt urea (g)} \times 1000}{\text{MW urea}} = \frac{15 \times 1{,}000}{60} = 250 \text{ mmol}$$

Assume total body water is 60% of body weight:

$$\text{Total body water} = \text{Body wt (kg)} \times \frac{60}{100} = 65 \times \frac{60}{100} = 39 \text{ L}$$

$$\text{Urea concentration in body water} = \frac{\text{Urea load (mmol)}}{\text{Body water (L)}} = \frac{250}{39} = 6.4 \text{ mmol/L}$$

Since urea is undissociated and serum urea is in equilibrium with urea in other fluid compartments, the increase in serum osmolality due to 15 g urea administration is approximately **6 mmol/L.**

Assumptions:

- That all the administered urea is absorbed (if given orally) and evenly distributed throughout total body water without any excretion. In practice a steady state would eventually be achieved (half-life is probably about 2 h) but there would be fluctuations depending on dosing interval used. If given as a single bolus then the theoretical peak is 6 mmol/L but levels would fall rapidly before the next dose due to urinary excretion.
- That the patient has a normal total body water content for his weight. The low sodium suggests that this may not be the case.

Question 191

You need to make up a phosphate buffer with a pH of 7.4 and a total phosphate concentration of 40 mmol/L. Calculate the amounts of sodium dihydrogen phosphate and disodium monohydrogen phosphate that need to be weighed into 1 litre of water, given that the pKa is 6.82 (atomic weights: Na 23, P 31).

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