Deacon's Challenge

No 156 - Answer

A 62-year old woman has diabetes insipidus and loss of thirst sensation. Following a hot fortnight, she is admitted to the Emergency Department with dehydration. She is known normally to weigh 62 Kg. On admission, she is found to have a serum sodium concentration of 156 mmol/L. Estimate her water deficit.

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Assume that reduced fluid intake and increased urinary losses (due to decreased water reabsorption owing to ADH deficiency) results in pure water loss. Therefore:

Initial total sodium = final total sodium

The result is increased plasma (and ECF) sodium and osmolality which will shift water from the ICF to ECF. Therefore pure water loss is shared between all compartments. Sodium is the main determinant of ECF osmolality. Although sodium is mainly confined to the ECF, all compartments are in osmotic equilibrium so we can assume that plasma sodium reflects osmolality in all compartments. Therefore as an approximation:

Initial plasma Na concn x Initial total body H_2O = Final plasma Na concn x Final total body H_2O

Initial plasma Na concn is unknown so assume a "normal" value of 140 mmol/L

Since the average female is 55% water:

Initial total body H_2O = Body wt (Kg) x 55%

= 62 x 55/100 = 34.1 L

Final plasma Na is given as 156 mmol/L

Therefore:

$$140 \times 34.1 = \text{Final total body } H_2O \times 156$$

$$\text{Final total body } H_2O = \frac{140 \times 34.1}{156} = 30.6 \text{ L}$$

H_2O deficit = Initial total body H_2O - Final total body H_2O

= 34.1 - 30.6 = **3.5 L**

Question 157

A 70 kg man is admitted following a reported overdose of 14 g of Priadel (lithium carbonate) two hours previously. The concentration at admission is 3.7 mmol/L. Twelve hours later, a repeat value is 3.0 mmol/L. Calculate the volume of distribution and the elimination constant. Atomic masses: Lithium 6.94 Da, Carbon 12.01 Da, Oxygen16.00 Da.

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