Deacon's Challenge No. 29 Answer

A male patient (weight 75 Kg) was in a high dependency unit after cardiac surgery. He developed a cardiac arrest just after he had received a bolus injection of an antibiotic through a central line. A junior nurse thought that he had flushed the injection port with Potassium Chloride Concentrate (15%) instead of heparinised saline as he had intended.

The following results were available:

	Serum potassium concentration
Immediately before injection	*5.0 mmol/L*
Five minutes after injection	*6.0 mmol/L*

Assuming that:

1) *the serum potassium concentration reached a peak one minute after injection and was distributed in the intra-vascular space only*
2) *by five minutes the potassium was distributed in the extra-cellular space only*
3) *there was no intra-cellular uptake of potassium:*

Estimate

a) *The volume of potassium chloride concentrate that was injected*
b) *The peak serum potassium concentration*
c) *Comment on the cause of the cardiac arrest.*

(Atomic weights: Potassium 39; Chloride 35.5)

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a) First calculate the amount (in mmol) of potassium given.

By 5 minutes the K^+ administered has become distributed throughout the extra-cellular volume (ECF). The ECF of an average 70 Kg man is approximately 14L (the ECF for this 75 Kg man will be slightly greater but this small difference may be ignored).

The plasma potassium concentration has increased from 5.0 mmol/L to 6.0 mmol/L i.e. has risen by 1 mmol/L. The plasma potassium concentration will be equal to that in the ECF. Therefore the administered K^+ is contained in 14L of ECF at a concentration of 1 mmol/L.

ECF K^+ from injected solution (mmol) = Plasma K^+ (mmol/L) x ECF vol (L)

= 1 x 14 = 14 mmol/L

Next calculate the potassium concentration (in mmol/L) in the KCl concentrate:

KCl concentration = 15% = 15 g/100mL = 150 g/L = 150,000 mg/L

MW of KCl = 39 + 35.5 = 74.5

K^+ concentration (mmol/L) = $\frac{\text{KCl (mg/L)}}{\text{MW KCl}} = \frac{150{,}000}{74.5}$ = 2000 mmol/L (2 sig figs)

To find the volume of KCl concentrate that contains 14 mmol K^+ (i.e. the volume administered), divide the increase in K^+ by the KCl concentration in the KCl concentrate:

Vol KCl injected = $\frac{14}{2000}$ = 7.0 mL

b) At 1 minute the plasma K^+ concentration is at its peak and is distributed only in the intravascular space (i.e. the blood plasma). The average 70 Kg man has a plasma volume of approx. 3.5 L. i.e. about a quarter of the ECF volume. Therefore the increased K^+ concentration in the plasma at 1min must be 4 times the rise in concentration in the ECF at 5 min (1 mmol/L).

Peak increase in plasma K^+ = 4 x 1 = 4 mmol/L

And, peak K^+ concentration = Pre-injection K^+ concentration + Rise due to injected K^+

= 5 + 4 = 9 mmol/L

c) The high potassium (9 mmol/L) was quite likely the cause of the patient's cardiac arrest.

Question No. 30

A standard has to be made up containing 100 mg dextropropoxyphene (Mol. Weight 339.5) per litre. How much dextropropoxyphene napsylate (Mol. Weight 565.7) must be weighed out to make 100 mL of standard solution?

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