# Deacon's Challenge

## No 142 - Answer

*A 24-year old man weighing 70 kg is admitted following ingestion of ethylene glycol. Calculate the volume of ethanol (10% w/v infusion) required to achieve a plasma ethanol concentration of 11 mmol/L, and the infusion rate required to maintain this once achieved. Assume the rate of elimination of ethanol follows zero-order kinetics with a rate of 2.2 mmol/L/h.*

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First convert the concentration of the ethanol infusion from % (i.e. g/100 mL) to mmol/L:

$$\text{Ethanol (mmol/L)} = \frac{\text{Ethanol (g/100 mL)} \times 10 \times 1{,}000}{\text{MW ethanol}}$$

MW ethanol ($C_2H_5OH$ = $C_2H_6O$) = (2 x 12) + (6 x 1) + 16 = 46

$$\text{Ethanol (mmol/L)} = \frac{10 \times 10 \times 1{,}000}{46} = 2174 \text{ mmol/L}$$

Absorbed ethanol is distributed throughout total body water (i.e. between all fluid compartments). Therefore the volume of distribution ($V_d$) is equal to total body water. Assuming an average body water content of 60% (quoted in most textbooks although a value of 68% may be more accurate) the $V_d$ for this patient can be calculated:

$V_d$ (L) = Body wt (Kg) x 60/100

= 70 x 0.6

= 42 L

Next calculate the total amount of ethanol required to achieve 42 L of 11 mmol/L:

Total ethanol (mmol) = Plasma ethanol (mmol/L) x $V_d$ (L)

= 11 x 42

= 462 mmol

Finally calculate the volume of the infusion solution which will contain 462 mmol ethanol:

$$\text{Vol of infusion solution (L)} = \frac{\text{Total ethanol required (mmol)}}{\text{Ethanol concentration in infusion solution (mmol/L)}}$$

$$= \frac{462}{2174}$$

= **0.213 L** (213 mL)

To calculate the infusion rate needed to maintain a steady state concentration of 11 mmol/L:

In a steady state:

Rate of infusion (mmol/h) = Rate of elimination (mmol/h)





Rate of infusion (mmol/h)

= Rate of fluid infusion (L/h) x Fluid ethanol concentration (mmol/L)

= Rate of fluid infusion (L/h) x 2174

Rate of elimination (mmol/h) = Rate of elimination (mmol/L/h) x Vd (L)

= 2.2 x 42

Therefore in a steady state:

Rate of fluid infusion (L/h) x 2174 = 2.2 x 42

$$\text{Rate of infusion} = \frac{2.2 \times 42}{2174} = \textbf{0.0425 L/h} \quad (= \textbf{42.5 mL/h})$$

# Question 143

The distribution of genotypes seen in Chemist's Disease is as shown. Calculate the frequency of the two alleles CCR-5 and ccr-5, and state whether these frequencies accord with the Hardy-Weinberg equilibrium.

| Genotype | Number of individuals |
|---|---|
| CCR-5/CCR-5 | 568 |
| CCR-5/ccr-5 | 134 |
| ccr-5/ccr-5 | 2 |
| Total | 704 |

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