# Deacon's Challenge

## No 157 - Answer

*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*
*Oxygen 16.00 Da*

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Assuming that the elimination of lithium follows first order kinetics, the relevant integrated form of the rate equation is:

$$\ln Cp_t = \ln Cp_0 - k_d.t$$

Where $Cp_t$ is the plasma concentration at time $t$, $Cp_0$ is the initial plasma concentration and $k_d$ the elimination rate constant.

Therefore a pair of equations can be set up at the two sampling times:

At admission (2 h post dose, $t$ = 2 h): $\ln 3.7 = \ln Cp_0 - 2\,k_d$

12 h after admission (14 h post dose, $t$ = 14 h): $\ln 3.0 = \ln Cp_0 - 14\,k_d$

Subtraction of the second equation from the first eliminates the $\ln Cp_0$ term:

$$\ln 3.7 - \ln 3.0 = 12\,k_d$$

which can then be solved for $k_d$:

$$k_d = \frac{(\ln 3.7 - \ln 3.0)}{12} = \frac{(1.308 - 1.099)}{12} = \frac{0.209}{12} = \mathbf{0.017\ h^{-1}}\ \text{(to 2 sig figs)}$$

Substitution of this value for $k_d$ into either of the two rate equations enables calculation of $Cp_0$. Using the 14 h equation:

$$\ln 3.0 = \ln Cp_0 - (14 \times 0.017)$$

$$1.099 = \ln Cp_0 - 0.238$$

$$\ln Cp_0 = 1.099 + 0.238 = 1.337$$

$$Cp_0 = \text{anti ln } 1.337 = 3.8\ \text{mmol/L (to 2 sig figs)}$$

Next calculate the dose of lithium carbonate in mmol:

$$MW\ LiCO_3 = 6.94 + 12.01 + (3 \times 16) = 66.95$$





$$\text{Therefore dose (mmol)} = \frac{\text{Dose (g)} \times 1{,}000}{MW} = \frac{14 \times 1{,}000}{66.95} = 209\ \text{mmol (to 3 sig figs)}$$

Division by the initial plasma concentration gives the volume of distribution $V_d$:

$$V_d = \frac{\text{Dose (mmol)}}{Cp_0\ \text{(mmol/L)}} = \frac{209}{3.8} = \mathbf{55\ L}$$

# Question 158

Your laboratory is considering a change in creatinine method from a kinetic Jaffe to an enzymatic method. You are provided with the results obtained on a serum sample from a patient in Intensive Care, using the new method and your current method. Assess the probability of an interfering substance being present in this specimen.

| | | |
|---|---|---|
| Results: Creatinine | (Jaffe) | 157 mmol/L |
| | (enzymatic) | 172 mmol/L |
| Analytical CV: | (Jaffe) | 3.0% |
| | (enzymatic) | 2.3% |
| Regression equation: | Jaffe = 0.9539 (enzymatic) + 11.375 | |

Table of *z*-distribution:

| *P*(%) | 10 | 5 | 2 | 1 | 0.2 | 0.1 |
|---|---|---|---|---|---|---|
| *z* | 1.65 | 1.96 | 2.33 | 2.58 | 3.09 | 3.29 |

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