Deacon's Challenge

No 127 - Answer

A patient after returning from holiday presents his GP with a set of laboratory results obtained during a brief hospital admission in the USA. The GP asks you to convert the following data to "SI units" commonly used in the UK:

Plasma glucose	=	*270 mg/dL*
Plasma creatinine	=	*2.3 mg/dL*
Plasma BUN	=	*50 mg/dL*
Urine albumin:creatinine ratio	=	*40 mg/g*

(Molecular weights: glucose = 180, creatinine = 113)

Mass and "SI" units are related by the expression:

$$\text{Concentration (mol/L)} = \frac{\text{Concentration (g/L)}}{\text{MW}}$$

which must be adapted to the particular units being used i.e. if mass units are mg/L then SI units will be mmol/L.

Glucose: Mass units = mg/dL. Since SI units are mmol/L the mass units must be multiplied by 10 (to convert from mg/dL to mg/L).

$$\text{Therefore, glucose (mmol/L)} = \frac{\text{glucose (mg/dL) x 10}}{\text{MW glucose}} = \frac{270 \times 10}{180} = \textbf{15 mmol/L}$$

Creatinine: Mass units = mg/dL. Since SI units are µmol/L the mass units must first be multiplied by 10 (to convert from mg/dL to mg/L) then by 1,000 (to convert from mg/L to µg/L).

$$\text{Therefore creatinine (µmol/L)} = \frac{\text{Creatinine (mg/dL) x 10 x 1,000}}{\text{MW creatinine}} = \frac{2.3 \times 10 \times 1{,}000}{113} = \textbf{204 µmol/L}$$

BUN: BUN is blood urea nitrogen. Urea (formula $CO(NH_2)_2$) contains 2 atoms of nitrogen (equivalent to one molecule of nitrogen, N_2). Mass units = mg *nitrogen*/dL, required units = mmol *urea*/L. The mass units are first multiplied by 10 (to convert from mg/dL to mg/L) then divided by the molecular weight of N_2 (i.e. 2 x 14):

$$\text{Urea (mmol/L)} = \frac{\text{Nitrogen (mg/dL) x 10}}{2 \times 14} = \frac{50 \times 10}{2 \times 14} = \textbf{17.9 mmol/L}$$

Albumin:creatinine ratio: Mass units = mg/g. In the UK it is common practice to convert the creatinine component to SI units but retain albumin in mass units, expressing the ratio as mg/mmol. The creatinine component is therefore divided by its molecular weight. Since creatinine appears in the denominator this means that the numerator must be multiplied by the molecular weight of creatinine so as to give the ratio in mg/mol. Further division by 1,000 converts this to mg/mmol:

$$\text{Albumin:creatinine (mg/mmol)} = \frac{\text{Albumin:creatinine (mg/g) x MW creatinine}}{1{,}000} = \frac{40 \times 113}{1{,}000} = \textbf{4.5 mg/mmol}$$

Question 128

A newly diagnosed epileptic commenced treatment with a daily oral phenytoin dose of 150 mg. After 2 months of treatment his average steady state plasma phenytoin concentration was 4.1 mg/L. Since there had been little clinical improvement the dose was increased to 200 mg per day and after a further 2 month period the new plasma phenytoin concentration was 7.5 mg/L. However, seizure control was still not ideal and the neurologist has asked you to calculate the expected plasma phenytoin concentration if the dose is further increased to 250 mg.

Assume that phenytoin clearance follows saturation kinetics and bioavailability, F = 1, salt conversion factor, S = 0.92 and the dosing interval, τ = 24h.