

# PHA 5127 Dose Optimization I

## Homework II (10 points)

Due on Friday, 09/10/2010

Please do not forget the units of the results. 0.1 points will be deducted for each time an answer is provided without the appropriate unit.

1. A patient was given drug A by i.v. bolus at a dose of 400mg, and blood samples were taken at 1h and 4h following the first injection to monitor the drug blood level (See table below for these information). Assume first order elimination for this drug. (6 point)

Dose (mg)	C <sub>p</sub> at 1h (mg/L)	C <sub>p</sub> at 4h (mg/L)	C <sub>p</sub> at 8h (mg/L)	Plasma protein binding %
1000	5.706	3.227	1.509	95

- (1) Please estimate the initial free plasma concentration and tissue binding

$$(V_p=3L, V_T=38L)$$

$$K_e = -\frac{\ln C_{p,8h} - \ln C_{p,4h}}{8-4} = \frac{0.76}{4} = 0.19 \text{ h}^{-1}$$

$$\ln C_0 = \ln C_{p,1h} + K_e * 1 \approx 1.93, \quad C_0 \approx 6.89 \text{ mg/L (0.5 point)}$$

$$f_u = 1 - 95\% = 0.05,$$

$$C_{0,u} = C_0 * f_u = 6.89 * 0.05 = 0.3445 \text{ mg/L (0.5 point)}$$

$$V_d = \frac{\text{Dose}}{C_0} = \frac{1000}{6.89} \approx 145.14L \text{ (0.5 point)}$$

$$V_d = V_p + V_T * \frac{f_u}{f_{u,T}} = 3 + 38 * \frac{0.05}{f_{u,T}} = 3 + \frac{1.9}{f_{u,T}} = 145.14L$$

$$f_{u,T} \approx 0.013, \text{ so the tissue binding is } 98.7\% \text{ (0.5 point)}$$

- (2) Please calculate  $AUC_\infty$

$$CL = K_e * V_d = 0.19 * 145.14 \approx 27.58 \text{ L/h (1 point)}$$

$$AUC_\infty = \frac{\text{Dose}}{CL} = \frac{1000}{27.58} \approx 36.258 \text{ mg*h/L (1 point)}$$

- (3) If the plasma protein binding of this drug decrease by 20%, predict the dose that should be administered to reach the same initial concentration.

$$f'_u = 1 - 95\% * 80\% = 0.24,$$

$$V'_d = V_p + V_T * \frac{f'_u}{f_{u,T}} = 3 + 38 * \frac{0.24}{0.013} \approx 704.54 \text{ L (1 point)}$$

$$\text{Dose}' = V'_d * C_0 = 704.54 * 6.89 \approx 4854.28 \text{ mg (1 point)}$$

2. TRUE (T) or FALSE (F) (4 points, 0.5 each)

1. If volume of distribution decreases, this will affect the drug clearance as well since this means less volume of drug to be cleared.

T F

2. For low affinity, high capacity binding proteins, fraction unbound ( $f_u$ ) of drug is usually constant.

T F

3. Concentration gradient is an important factor affecting rate of drug uptake when a drug has difficulty to cross the membrane.

T F

4. Increase in plasma protein binding will increase the volume of distribution of a lipophilic drug.

T F

5. The volume of distribution of a drug in a 60kg female patient is 100L, it means this drug has strong tissue binding.

T F

6. It is important to figure out if drug is one or two compartment drug before we determine drug clearance.

T F

7. Drug A has 98% protein binding and has a narrow therapeutic index. Any change in the protein binding is not of significance since already 98% drug is bound and very less is available for receptors.

T F

8. Clearance tells us the amount of drug eliminated from body per unit time.

T F