PHA 5127 Dose Optimization I

Answers

Case Study II

1. **The plasma protein binding of drug A and drug B are 5% and 98% respectively but they have same tissue binding 80%.**

(1) Calculate the volume of distribution of each drug. (Assume V_p=3L, V_T=38L for both two drugs).

For drug A:

fu,A=1-5%=0.95, fu,T=1-80%=0.2,

$$V_{d,A} = V_P + V_T * \frac{f_{u,A}}{fu,T} = 3 + 38 * \frac{0.95}{0.2} = 3 + 180.5 = 183.5L$$

For drug B:

fu,B=1-98%=0.02, fu,T=0.2,

$$V_{d,B} = V_p + V_T * \frac{f_{u,B}}{f_{u,T}} = 3 + 38 * \frac{0.02}{0.2} = 3 + 3.8 = 6.8L$$

(2) Drug A and B are given as same IV bolus dose of 500mg, and at 4hr after dosing, plasma drug concentration is 1mg/L and 9.95mg/L for A and B respectively. Estimate clearance and AUC_∞ for each drug. (Assume both drugs follow first order elimination)

For drug A:

$$C_{0,A} = \frac{Dose}{V_{d,A}} = \frac{500}{183.5} \approx 2.725\text{mg/L}$$

$$K_{e,A} = -\frac{LnC_A - LnC_{0,A}}{4-0} \approx \frac{1.0025}{4} \approx 0.25\ h^{-1}$$

$$CL_A = K_{e,A} * V_{d,A} = 0.25 * 183.5 = 45.875\ L/h$$

$$AUC_{\infty,A} = \frac{Dose}{CL_A} = \frac{500}{45.875} \approx 10.899\ mg * h/L$$

For drug B:

$$C_{0,B} = \frac{Dose}{V_{d,B}} = \frac{500}{6.8} \approx 73.529\text{mg/L}$$

$$K_{e,B} = -\frac{LnC_B - LnC_{0,B}}{4-0} \approx \frac{2}{4} = 0.5\ h^{-1}$$
$$CL_B = K_{e,B} * V_{d,B} = 0.5 * 6.8 = 3.4L/h$$
$$AUC_{\infty,B} = \frac{Dose}{CL_B} = \frac{500}{3.4} \approx 147.059\ mg * h/L$$

(3) If the protein bindings of both drugs decreased 50% in one patient due to disease state, determine V_d of both drugs in this patient and compare the change of initial drug concentration between these two drugs. (Assume tissue binding does not change)

For drug A:

fu,A'=1-5%*0.5=97.5%,

$$V_{d,A}{}' = V_P + V_T * \frac{f_{u,A'}}{fu,T} = 3 + 38 * \frac{0.975}{0.2} = 3 + 185.25 = 188.25L$$

$$C_{0,A}{}' = \frac{Dose}{V_{d,A'}} = \frac{500}{188.25} \approx 2.656\text{mg/L}$$

$$\frac{C'_{0,A}}{C_{0,A}} = \frac{2.656}{2.725} \approx 0.975$$

Initial concentration of drug A has little change in this patient.

For drug B:

fu,B'=1-98%*0.5=51%,

$$V_{d,B}{}' = V_P + V_T * \frac{f_{u,B'}}{fu,T} = 3 + 38 * \frac{0.51}{0.2} = 3 + 96.9 = 99.9L$$

$$C_{0,B}{}' = \frac{Dose}{V_{d,B'}} = \frac{500}{99.9} \approx 5.005\text{mg/L}$$

$$\frac{V'_{d,B}}{V_{d,B}} = \frac{5.005}{73.529} \approx 0.068$$

Initial concentration of drug B has dramatic change in this patient.

So change in plasma protein binding is more important for drug with high protein binding.

2. TRUE (T) or FALSE (F)

1. Lipophilic drugs will be able to distribute throughout the body, so their volume of distribution cannot be smaller than total body volume.
   T F
2. If volume of distribution decreases, it will affect Ke.
   T F
3. Plasma protein binding only relates to what degree the drug gets into tissue, but does not relate to how fast drug gets into tissue.
   T F
4. Volume of distribution and clearance are independent parameters, but volume of distribution can affect AUC_{∞}.
   T F
5. If the drug has strong tissue binding, there must be a lot of drug accumulated in tissue.
   T F
6. Excretion rate of metabolite cannot be larger than that of parent drug.
   T F
7. Volume of distribution decreases as time because there will be less and less drug remaining in the body.
   T F