PHA 5127
Case Study 3 - answer key
Fall 2002

1.   Is it possible that the renal clearance can exceed the hepatic clearance in a patient
        with normal kidney and liver function?

        (In this case, we only consider the physiological capacity of the body. If we are
        dealing with specific drugs, it will be different).
        No. When there is no plasma protein binding, the maximum renal clearance
        equals kidney blood flow (1100 mL/min) (by filtration and active secretion), and
        the maximum hepatic clearance equals liver blood flow (1450 mL/min).

2.   Which of the following factors significantly affect the renal clearance of an
        unionized drug that shows complete passive renal reabsorption from the "urine"
        back into the blood:

        a)   plasma protein binding   True
        b)   activity of cationic transporters in the tubuli.
        c)   urine flow   True
        d)   pH of urine   True
        e)   liver blood flow

3.   Why do we use IBW (ideal body weight) for the calculation of CrCL (creatinine
        clearance) in Cockcroft-Gault equation?

        Creatinine is produced by the muscle in the body.

4.   Describe two methods which can be used to calculate the CrCL.

        Method 1 (slide 181): if we know urinary and plasma creatinine levels and the
        volume of 24 h urine, CrCL can be calculated by this equation

        $\text{CrCL} = \dfrac{C_{urine} \cdot V}{60 \cdot 24} \cdot \dfrac{1}{C_{plasma}}$ (derived from $CL = \dfrac{rate\ of\ excretion}{plasma\ concentration}$)

        Method 2 (slide 184): close estimation using Cockcroft-Gault equation if we
        know the plasma creatinine level only.

5.   A 24-year-old female patient Noel Christmas (72 kg, 66 inches), is admitted to the
        hospital after sustaining multiple traumatic injuries. Her recovery is complicated
        by the onset of moderate renal failure and she also experienced a spiking fever,
        gram-positive bacilli, and the physician decides to begin a course of gentamicin.
        The serum creatinine level of this patient is 1.6 mg/dL. [k_e (h^{-1})= 0.00293
        [CrCL(mL/min)]+0.014].

a) Calculate the creatinine clearance of this patient using Cockcroft-Gault equation.

$IBW_{female} = 45.5 + 2.3*(66\text{-}60) = 59.3 \text{ kg}$

$CrCL_{female} = 0.85 \cdot \dfrac{(140 - 24) \cdot 59.3}{72 \cdot 1.6} = \textbf{50.8 mL/min}$

b) After the first iv dose of gentamicin (2 mg/kg), the blood sample was taken at 1 hr and the plasma concentration was 7.5 mg/L. How long will it take for plasma level to reach 2 mg/L?

$k_e = 0.00293 \ 50.8 + 0.014 = 0.16 \text{ h}^{-1}$

$C_t = C_0 \cdot e^{-ke \cdot t}$

$2 = 7.5 \cdot e^{-0.16 \cdot t}$

$\textbf{t = 8.3 hrs}$