Bio390 **Glucose and the Kidney ANSWERS**

thanks to Dr. J.F. Anderson,
Dept Zoology
Univ of Florida, Gainesville

USE THE FOLLOWING DATA TO ANSWER THE SUBSEQUENT QUESTIONS

Inulin clearance: $\frac{125\ ml}{min}$

rate of urine formation: $\frac{1.0\ ml}{min}$

plasma glucose concentration: $\frac{80\ mg}{100\ ml\ plasma}$

urine glucose concentration: $\frac{0\ mg}{ml}$

CALCULATE:
the reabsorption rate for glucose

ANS: 100 mg glucose / min

Since glucose is freely filterable the amount that is filtered is a function of the GFR and its concentration in the blood (obviously, the higher the rate of plasma flow or higher the plasma concentration of glucose, the more glucose that will be filtered). Since no glucose is in the urine, we know that whatever is filtered is reabsorbed. So, for this case:

the rate of glucose filtration
= rate of glucose reabsorption

Thus, rate of filtration = GFR * $[glucose]_{plasma}$

and since GFR = clearance of inulin, then:

Rate of reabsorption = rate of filtration

= 125 ml / min * 0.80 mg glucose/ ml

= 100 mg glucose / min

Calculate the glucose clearance

ANS: 0 ml/ min

No need to calculate this; since there is no glucose in the urine, the renal clearance is zero.

Calculate the glucose filtration rate

ANS:100 mg glucose / min

-- see the first question

Assume you administer a drug that completely blocks renal reabsorption of glucose. What would be the clearance of glucose resulting from this procedure?

ANS: 125 ml / min

Recall that clearance is calculated as:

$C = U_x * V / P_X$

where V is the rate of urine production (vol. per time) and U_x is the concentration of the substance in the urine (given as amount/vol.). Thus, $U_x * V$ has units of amount per time -- it is the rate at which a substance is excreted.

Now, if reabsorption was blocked, then glucose would be lost at the rate at which it is filtered. This would be equal to $U_x * V$. There is no secretion of glucose (we

want to hold onto it since it is an excellent energy storage molecule) and so no need to worry about secretion.
So, the previous problem showed the amount filtered was 100 mg glucose/ min; that is also $U_x * V$.

Thus, the clearance of glucose would be:

$C_{glucose} = U_{glucose} * V / P_{glucose}$ = (100 mg glucose / min) / (0.8 mg glucose / ml plasma)

= 125 ml/min

Before you yell "Eureka" -- yes, the answer you just got does equal the GFR (as it should) but please don't get too excited because the method we used to get this result is clearly circular. Confirming that the GFR does equal the clearance of glucose when the reabsorption mechanism is shut down would have required a truly independent measurement of $U_{glucose}$ which we did not have! But such parameters can be easily obtained in real experiments.