CLASS EXAMINATION IN PHYSIOLOGY - SPRING TERM

MEDICAL STUDENTS

Thursday 11 March 1976 - 2 to 4 p.m.

(ALL Questions should be attempted)

The mark allowance is shown at the end of each question - total possible = [125]

Physiology of the Kidney

Section A - Calculations

1. A patient is suspected of having a functional tubular defect. Following intravenous glucose infusion glucose starts to appear in the urine at a concentration in plasma ($[glucose]_p$) = 135 mg/100 ml. Inulin is also infused intravenously at a rate sufficient to maintain a steady $[inulin]_p$ = 21 mg/100 ml. Concentration of inulin in urine ($[inulin]_u$) = 1.9 g/100 ml. Flow of urine ($\dot{V}_u$) = 1.5 ml/min.

   (a) Calculate the amount of glucose which is being reabsorbed per minute in the tubular system. [10]

   (b) The normal maximal transfer rate (T_m) $\approx$ 300-350 mg/min What is the diagnosis? [5]

2. pH of tubular fluid (pH_{TF}) = 7.0 in the most distal part of the proximal tubules. The corresponding $P_{CO_2\,TF}$ = 42 mm Hg. At the same site $\frac{[inulin]_{TF}}{[inulin]_p}$ = 3.1. Clearance of inulin = 125 ml/min. $[Na^+]_p$ = 142 mM, $[Cl^-]_p$ = 104 mM and $[HCO_3^-]_p$ = 24 mM. $[H_2CO_3]_{TF}$ (mM) = 0.03 x P_{CO_2} (mm Hg). pK = 6.1.

   (a) Calculate the percentage of filtered HCO_3^- which is being reabsorbed in the proximal tubules [25]

   (b) What is (approximately) $[Cl^-]_{TF}$ at the end of the proximal tubules? [5]

Section B - Short Answers

3. What are the consequences of administering a maximal dose of the carbonic anhydrase inhibitor acetazolamide with respect to $\dot{V}_u$, urinary excretion rate of Na^+, HCO_3^- and urinary pH? Explain! [10]

4. Describe the principle underlying an indirect determination of renal blood flow (RBF). Name a useful indicator substance. [10]

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Section B - Short Answers (contd.)

5. What is the approximate osmolarity of TF relative to that of plasma in the early distal tubule? Explain the mechanism responsible for this! [10]

6. What happens to urea transport in the collecting tubules during

   (a) antidiuresis

   (b) water diuresis? Explain! [10]

7. Explain how Na^+ and K^+ move across the distal tubular epithelium. Which hormone regulates these movements? [10]

8. Describe the fate of H^+ secreted in the distal tubule. What is the source of the H^+ secreted? [10]

9. Explain why the concentration of creatinine in plasma ($[creatinine]_p$) can be used as a rough measure of glomerular filtration rate (GFR). [10]

10. If a maximal dose of ADH is given to a man during water diuresis, how does the free water clearance (C_{H_2O}) change? Explain! [10]