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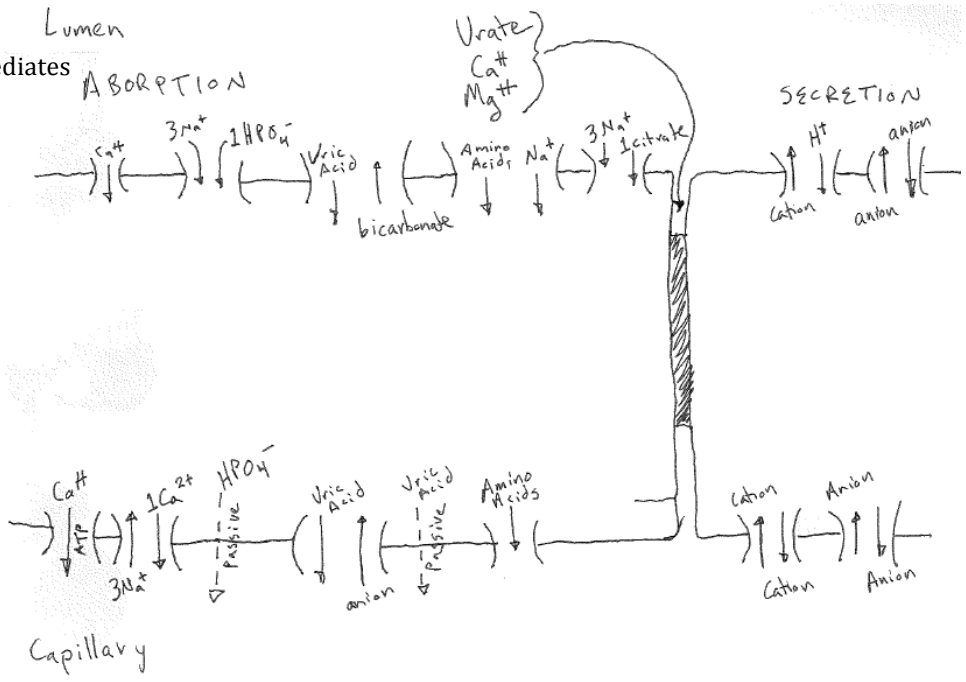
Proximal tubule solute reabsorption

- Urea:
  - Passive diffusion
  - [Urea] gradient due to H_2O reabsorption
- Calcium:
  - 80-85% filtered Ca^{++} reabsorbed in prox tubule/LOH
  - Predominantly passive, gradient from NaCl and H_2O reabsorption
  - Active reabsorption:
    - Enters cells through Ca^{++} channels on apical membrane
    - Down favorable electrochemical gradient
    - PTH increases Ca^{++} entry
    - Calcitriol stimulates production of calbindin, facilitating entry
    - Extrusion at basolateral:
      - Ca^{++}ATPase pump
      - $3Na^+$-$1Ca^{++}$ Exchanger
- Phosphate:
  - 80-95% filtered phosphate reabsorbed at prox tubule
  - Transcellular:
    - Luminal surface:
      - $3Na^+$:$1HPO_4^{2-}$ cotransporter
      - High affinity transporters in late prox tubule
    - Basolateral: passive diffusion
  - Regulation:
    - Plasma phosphate concentration
    - PTH-decreases phosphate absorption
    - Metabolic acidosis-decreased reabsorption
- Magnesium:
  - 20-30% of filtered reabsorbed in prox tubule
  - Predominantly paracellular, passive diffusion
    - Driven by electrochemical gradient from NaCl absorption

Proximal tubule solute secretion

- Organic cations:
  - Basolateral cation-cation countertransport and passive diffusion
  - Luminal exchange with H^+
- Organic anions:
  - Basolateral anion exchangers
  - Luminal membrane anion exchangers
    - Regulation by citric acid cycle intermediates

- Uric Acid:
  - Three processes result in prox tubule urate handling:
    - Near all filtered urate reabsorbed in prox tubule
    - Secretion in mid-proximal tubule
    - Postsecretory reabsorption in late prox tubule
    - Net effect=excretion of 6-12% filtered urate
  - Absorption:
    - Luminal urate:bicarbonate countertransporter
    - Driven by bicarbonate absorption by the Na^+-H^+ exchanger
  - Secretion:
    - Exchange at basolateral membrane exchanging for anion
    - Diffusion or Cl^- exchange across the luminal membrane
- Protein:
  - Amino acids:
    - Transcellular entry by cotransport with Na^+
    - Facilitated diffusion across basolateral membrane
    - Neutral amino acids cross with Na^+ independent transporters
  - Small peptides (angiotensin II):
    - Hydrolysed by brush-border peptidases before reabsorption
  - Larger compounds (insulin, lysozyme)
    - Carrier mediated endocytosis
    - Albumin by low-affinity, high-capacity endocytic process
- Citrate:
  - 80-90% of filtered is reabsorbed proximal tubule
  - Cellular entry by $3Na^+$:1 $citrate^{2-}$-cotransporter
  - Regulation:
    - Acidemia-increased reabsorption
      - Metabolism of 1 meq citration→3meq bicarbonate
    - Hypokalemia→increased reabsorption



Questions

1. Proximal tubule urea reabsorption is influenced predominantly by
    a. Intracellular organic anion availability for exchange across the luminal membrane
    b. Early proximal tubular water reabsorption
    c. Chloride concentration at the level of the macula densa
    d. Concentration gradient developed by basolateral urea transporters

2. In patients with hypercalcemia
    a. Increased calcitriol levels result in reduced renal reabsorption
    b. Treatment with furosemide directly inhibits reabsorption
    c. Reduced levels of PTH limit transcelluar calcium reabsorption
    d. Active secretion of calcium is achieved by luminal $3Na^{+}$-$1Ca^{++}$ exchangers

3. In regards to proximal tubule solute reabsorption
    a. Amino acids undergo sodium dependent and independent uptake
    b. The majority of filtered magnesium is resorbed passively in the proximal tubule
    c. The majority of filtered uric acid is eventually excreted following reabsorption, secretion and again reabsorption
    d. Renal phosphate reabsorption is regulated predominantly by the calcitrol concentrations

4. Citrate is reabsorbed in the proximal tubule in response to
    a. Alkalosis
    b. Acidosis
    c. Hyperkalemia
    d. Hyponatremia

5. Secretion of organic cations into the interstitium is achieved by
    a. Electrochemical gradients
    b. ATP mediated sodium channels
    c. Exchange for a complimentary anion
    d. Concentration gradients