



Renal Function

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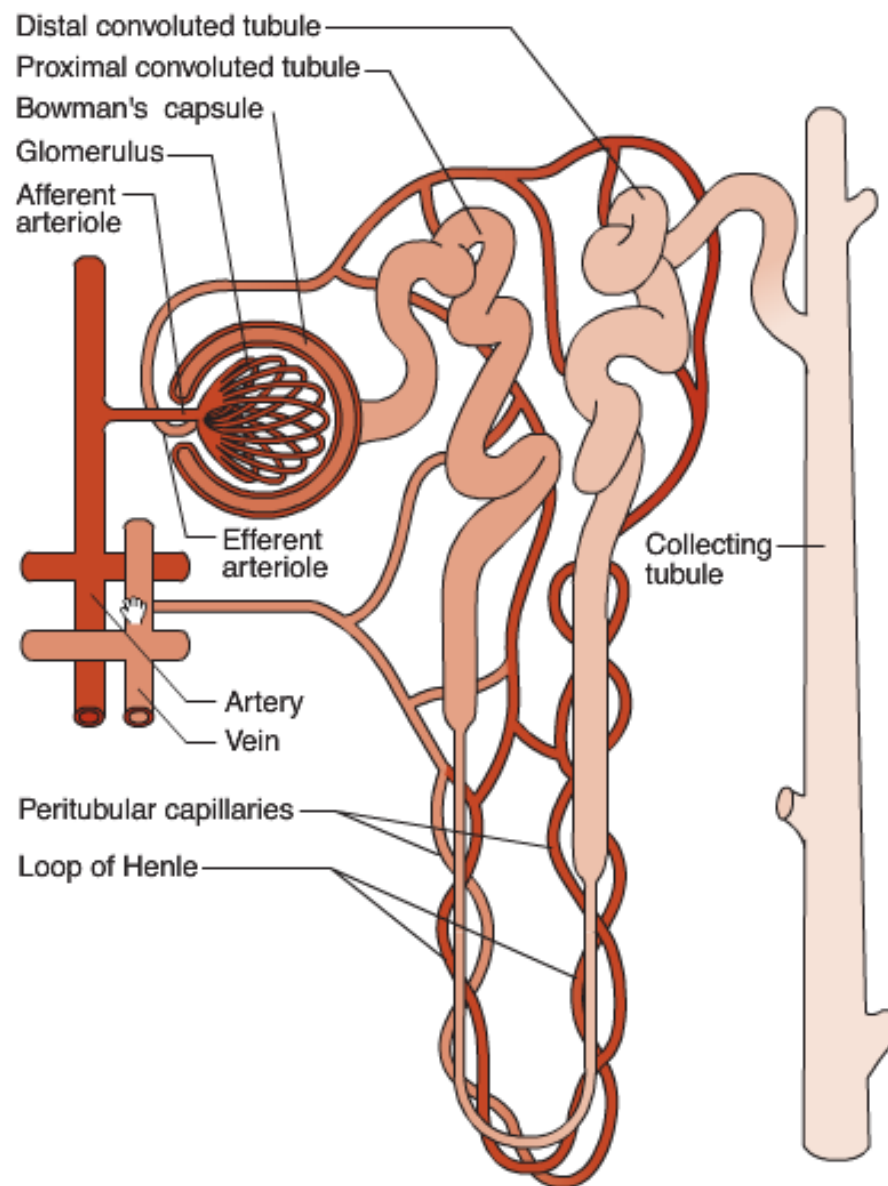
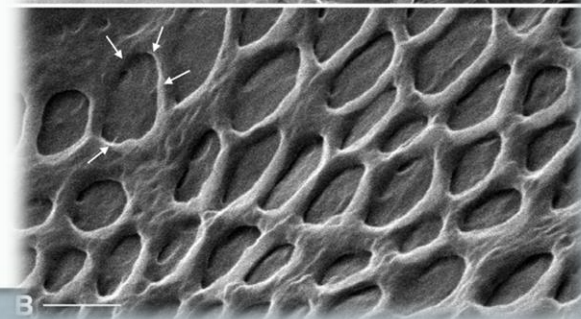
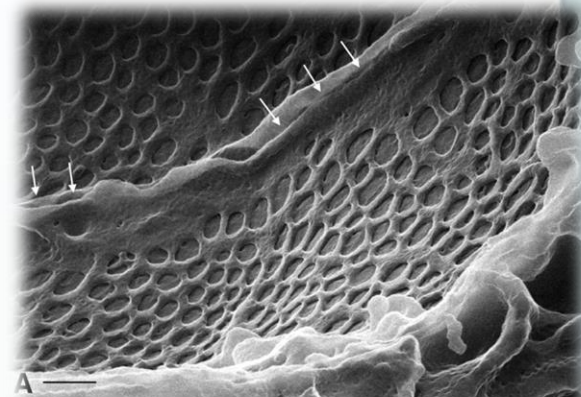
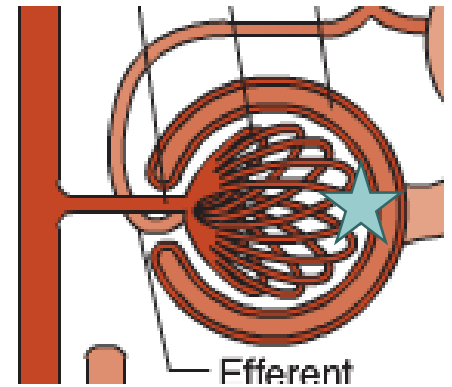


FIGURE 27-2 Representation of a nephron and its blood supply.

★ = You are here

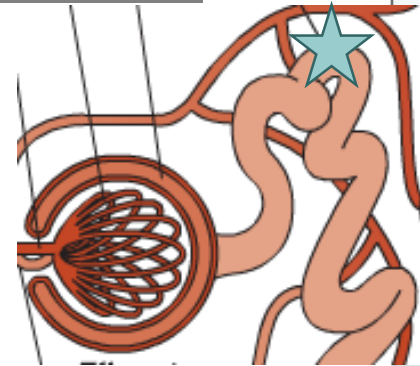
Renal Function

- Important for homeostasis, waste management, and endocrine function
- Glomerulus
 - The beginning of the nephron, a biological filter
 - Low molecular weight proteins, glucose, amino acids go through
 - Larger proteins, cells, lipids, are too large (neg charge too)
 - Kidneys get 1.2-1.5 L of blood per minute, ~10% goes to glomerular filtrate (protein and cell free liquid)
 - THIS IS THE GFR



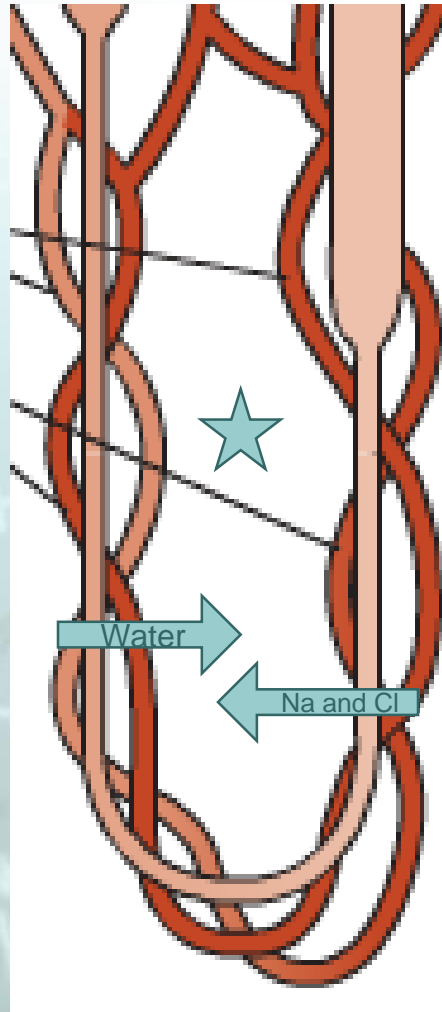
Proximal Convoluted Tubule

- At this point the filtrate is essentially trash water with some valuable things still stuck in it
- Reclaim the valuable things:
 - Water, sodium, chloride, glucose, A.A.s, Vitamins, Proteins
 - Little bit of urea, UA (this will be secreted again later!), bicarb, potassium, calcium and magnesium
 - If transport mechanisms are saturated it will come out in the urine
- Get rid of more trash:
 - Tubular cell metabolism products: H^+ , drugs, penicillin



Loop of Henle

- Highly permeable to water here, does not reabsorb Na or Cl
 - All the interstitial fluid being salty pulls water out of nephron here



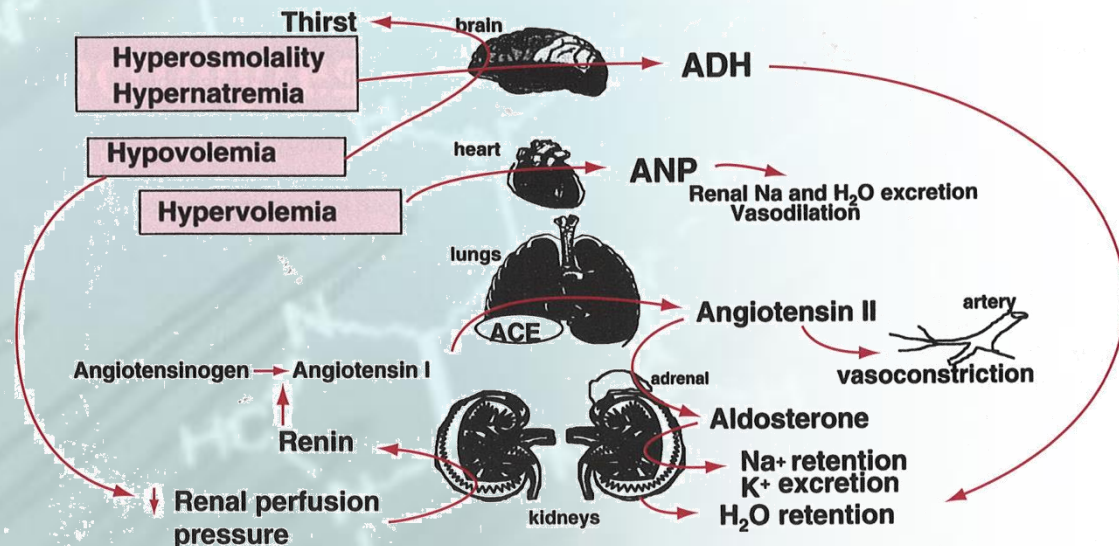
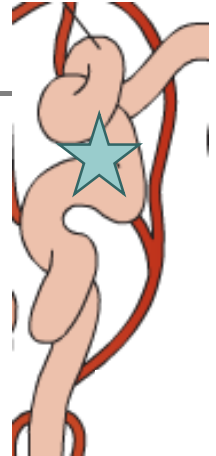
START HERE

- Sodium and chloride able to leave
 - Water cannot really follow it in this part
 - This makes the fluid in the nephron dilute at this point



Distal Convoluted Tubule

- Much shorter segment
 - Almost everything has already been reabsorbed at this point
 - This is the kidney's finishing move
 - Finishes up acid-base balance, electrolyte balance
 - Controlled by ADH and aldosterone

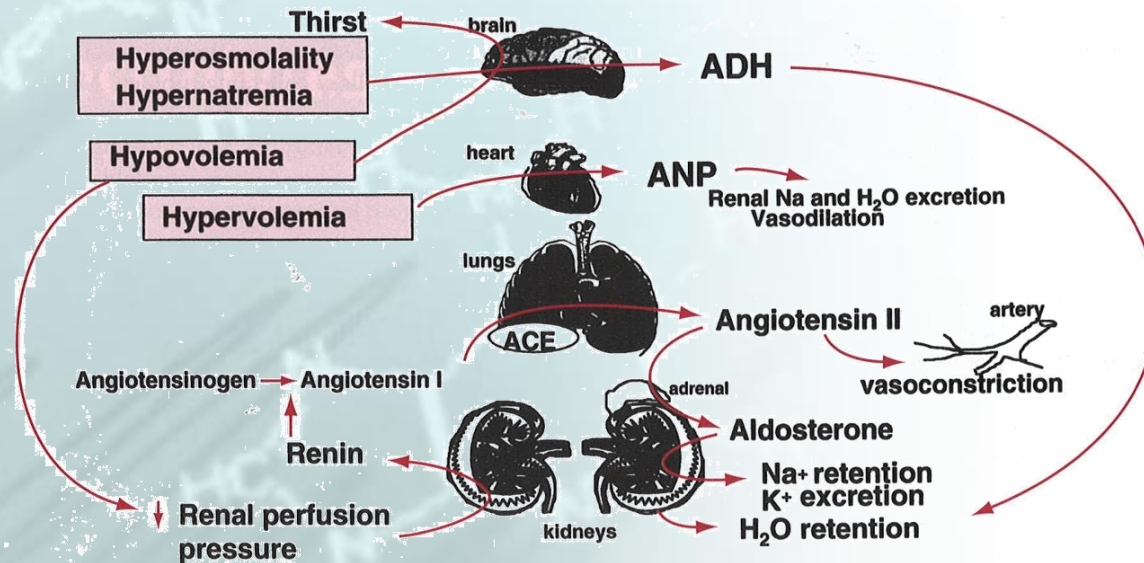


Eliminating Nitrogenous Waste

- Urea is $\frac{3}{4}$ of the waste NPNs
 - Protein catabolism
 - Detoxified Ammonia
 - Readily filtered
 - Some reabsorbed
- Creatinine
 - Waste product of muscles
 - Readily filtered
 - Not much reabsorbed
- Uric acid
 - Purine catabolism
 - Readily filtered, but a dance of reabsorption and secretion follows

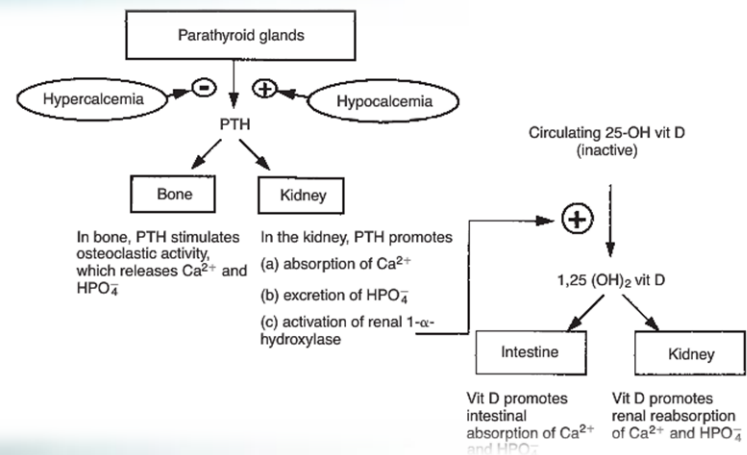
Water Balance

- ADH responding to changes in water balance
 - Primary: Osmolality and hypernatremia
 - Increased permeability of DCT allows more water to be reclaimed
 - Urine osmolality from 50 mOsm/kg – 1200 mOsm/kg lots of room for change



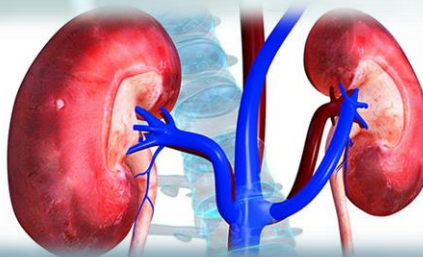
Electrolyte balance

- Been there, done that
 - Na^+ : renin-angiotensin-aldosterone controls secretion of sodium
 - K^+ : also controlled by aldosterone, compete with H^+ to be exchanged with Na^+
 - Cl^- : passively reabsorbed as counter to Na^+ movement
 - Ca^{2+} , PO_4^{3-} and Mg^{2+} : PTH makes Ca go up and PO_4^{3-} down, but GI changes are more important
 - Mg^{2+} : also reabsorbed due to PTH control



Endocrine Functions

- Renin: The beginning of the renin-angiotensin-aldosterone pathway
 - Secreted by JG apparatus when blood flow decreases
- EPO: Lance Armstrong's secret weapon
 - Produced in response to low O₂ delivery
 - Signals bone marrow to make more RBCs
 - Previously patients in renal failure often developed anemia
 - We can tell the difference between your EPO and manufactured EPO
- Vitamin D
 - It was a hormone all along!
 - Chronic renal insufficiency leads to osteomalacia because you don't have enough active D
- Prostaglandins
 - Counteract the renal vasoconstriction brought on by angiotensin and adrenaline



Non-NPN Kidney Tests

- Cystatin C: produced by most tissue, freely filters out the glomerulus then is reabsorbed BUT catabolized by the proximal tubule
 - More sensitive than creatinine, no diet impact, no muscle mass impact, no age impact, no gender impact, no race impact
 - Creatinine varies less in a single person from one day to the next
 - Cystatin C varies less from one person to another
 - Implications? If I know you have kidney disease I check creatinine
- β 2-M: increased cell turnover but also if the kidneys are no longer eliminating it, it will go up
- Myoglobin: rhabdomyolysis leads to acute kidney failure
 - Must treat it early and aggressively
- Microalbumin: small AMOUNTS of albumin in the urine, in particular with DMII pts.
 - If microalbumin is detected, you must very carefully manage your kidneys to prevent further issues.

Kidney Treatments

- Dialysis: an artificial filtering device, far from perfect but better than nothing
 - About 3 times a week you must go in for dialysis, for a standard of 4 hours
 - Peritoneal: draw all the toxins into the peritoneal space
- Transplant: if you can find a spare, you can be off dialysis
- Lasix aka furosemide
 - Loop diuretic: inhibits Na-K-Cl cotransporter in loop of Henle
 - Allows edema of CHF, kidney failure, nephrotic syndrome to go down

Dialyzable substances have following properties:

1. low molecular mass
2. high water solubility
3. low protein binding capacity
4. prolonged elimination (long half life)
5. small volume of distribution

