Kidney

المحاضرة الخامسة

Loop of Henle
&
Water Excretion

بتاريخ ٤ مارس ٢٠١٨

MCQs, choose the correct answer

1 Regarding Na reab at proximal tubule:
- a It is secondary active reabsorption.
- b It occurs in late part (2nd half).
- c Cl^- is reabsorbed by cotransport with Na^+.
- d nearly 2/3 of filtered Na is reab.

2 Regarding Na reab in thick ascending limb of loop of Henle.
- a It occurs by passive reabsorption.
- b It results in symport of K s Cl & antiport of H^+.
- c Only 5% of filtered Na^+ is reab.
- d All of the above are correct.

3 Na reab is increased by all except
- a Estrogens:
- b Angiotensin II.
- c Endothelins.
- d Cortisol therapy.

4 Regarding glucose reabsorption.
- a At basal border of proximal tubule, it occurs by facilitated diffusion.
- b At luminal border of proximal tubule, glucose carrier is Na^+ dependent.
- c TmG in adult ♂ = 375 mg/min.
- d All of the above.

5 Regarding glucose reabsorption
- a It occurs in all segments of nephron.
- b All nephrons have the same power of glucose reabsorption.
- c Renal threshold = 300 mg%.
- d Stops if Na reabsorption is stopped

p p ɔ q p

January

Excretion of H_2O

500 ml — 1200 - 1400 mOsm / L

23300 ml — 50 - 100 (75) mOsm / L

H_2O & Gas transport — Simple Diffusion (Passive)

Obligatory	H_2O reab	Facultative (Optional)
• Not controlled by ADH		• Controlled by ADH
• 87 % — 65 % PCT; 15 % Loop; 7 % Distal & Collecting		• < 13 %
• No change in tubular fluid osmolarity		• Changes Urine conc. (Osmolarity) 1/4 to 4 times that of blood.

Facultative H_2O reab.

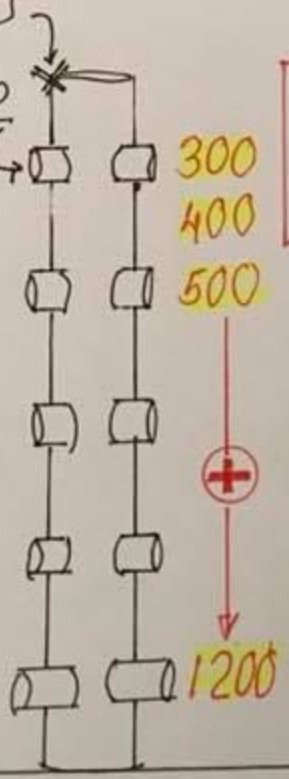
ADH "Vasopressin"

++ permeability of collecting tubules

cAMP

V_2 receptors

Aquaporin 2



2 Factors

- Hyperosmotic gradient of intestitial fluid
  - superficial layers of medulla 300 mOsm
  - deep " " 1200 - 1400

Caused by

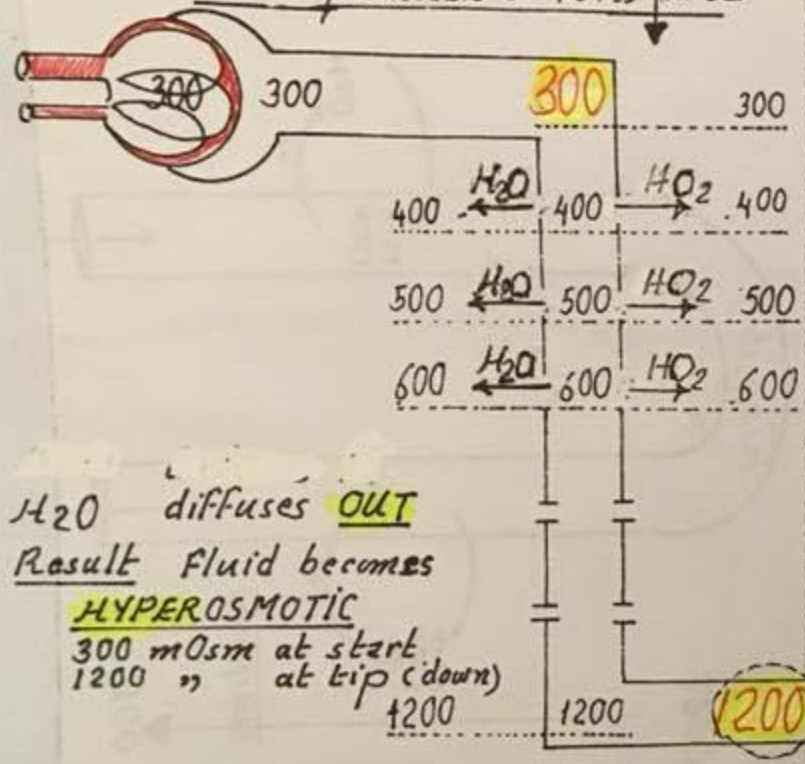
1. Loop of Henle creates gradient Counter current multiplier
2. Vasa recta maintain gradient Counter current exchanger
3. Diffusion of Urea from Medullarny Collecting T to Medullarny interstitium.
4. Sluggish medullary flow 1-2% keeps high salt conc.

Loop of Henle — counter current multiplier

Discuss 1a, b then 2 then 3

(2) Descending limb

Very permeable to H_2O
Less permeable to ions urea

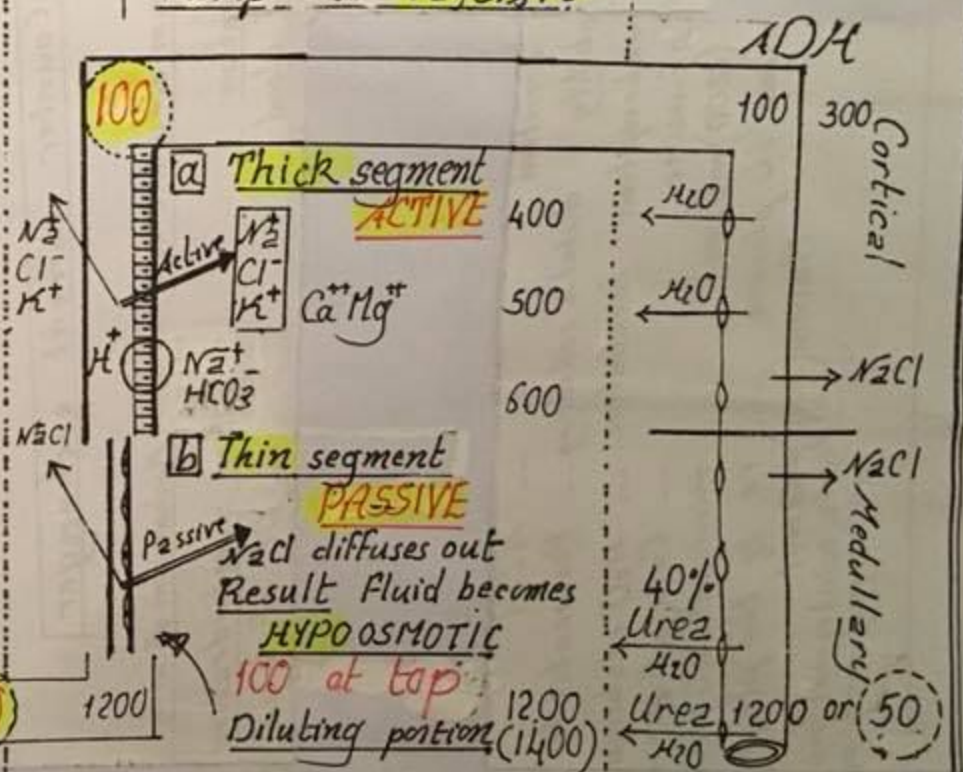


H_2O diffuses OUT
Result Fluid becomes HYPEROSMOTIC
300 mOsm at start
1200 " at tip (down)

(1) Ascending limb

(a) Thick segment

Impermeable to H_2O & urea
Pump of Na, Cl, K^+



(3) Interstizl Fluid equilibrates osmotically

- with descending limb being permeable to H_2O

Result. HYPEROSMOTIC gradient from 300 to 1200 mOsm (1400)

Vasa recta

Counter current exchanger

Capillaries supplying renal medulla
1 - 2% of RBF

Descending limb

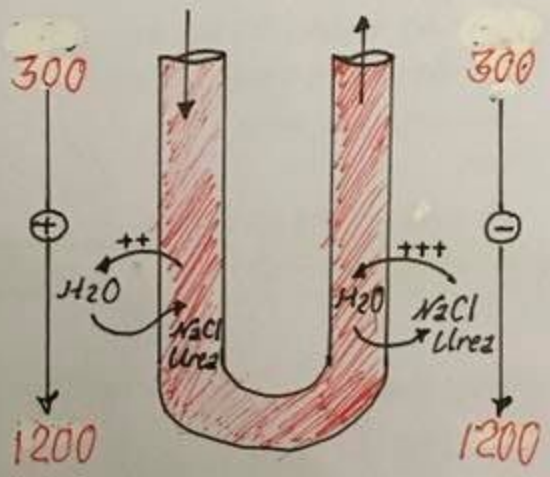
- $NaCl$ & urea diffuse IN
- H_2O diffuses OUT of bl

Result at tip osmolality 1200 mOsm.

Ascending limb

- $NaCl$ & urea diffuse OUT
- H_2O diffuses IN blood

Result opposes & prevents changes produced by descending limb



Function:

Maintains hyperosmotic gradient viz

1 Trapping solutes in medulla
$NaCl$ 60% Urea 40%

2 Removal of reabsorbed H_2O to general circulation

Mechanism of urine conc

In dehydration

++ OP of blood
++ ADH secretion
++ Permeability of distal & Collecting t — Facultative
++ H_2O reabsorp.
++ Conc. of urine

Maximal 1200 to 1400 mOsmol

i.e > 4 times that of plasma

Mech. of urine dilution

In overhydration

-- OP of blood
-- ADH secretion
-- Permeability
-- H_2O reabsorption
-- Conc of urine

Minimal 50 - 75 mOsmol
i.e 1/4 - 1/6 the plasma
Its solutes reabsorption is strong and active.

Plasma (300 / 290) mOsm

Renal mechanism for excreting diluted urine

Solutes are reabsorbed to a greater extent in

1 Diluting segment — 100 mOsm. Ascending limb
2 Distal and collecting T. — 50 mOsm.

Role of ADH

++ permeability to H_2O
via insertion of aquaporin 2 H_2O channels into the Luminal border of principal cells of:

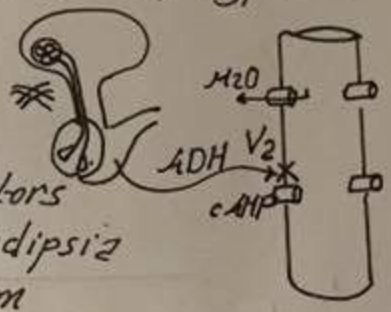
a late distal & cortical collecting T: 8% of H_2O → fluid isoosmotic
b Inner medullary collecting tubules: 4.7% of H_2O → " hyperosmotic

Disorders of urinary concentration

Diabetes insipidus DI

Types: 1 Central DI -- ADH
2 Nephrogenic DI -- V_2 receptors

Effects Polyuria with low sp.gr Polydipsia
If no thirst → fatal dehydration



Diuresis and diuretics

	1 H_2O diuresis	2 Osmotic diuresis
Cause	++ H_2O intake	++ unreabsorbable solute
Solute excretion	not ++	++
ADH secretion	inhibited	normal or ++
-- H_2O reab	Facultative	Obligatory & facultative
Maximal urine flow	16 ml/min	Large urine volume
Urine osmolarity	Hypotonic	Isotonic or hypotonic

3 Pressure diuresis

4 Diuretic drugs 1, 2, 3

1 Loop diuretic: Lasix (frusemide) inhibits Na^+-K^+-2 Cl^- cotransporter
2 Ethanol (alcoholics) -- ADH
3 Caffeine ++ GFR -- Na^+ reab
4 Antagonists of V_2 receptor
5 Aldosterone inhibitors e.g aldactone
6 Carbonic anhydrase inhibitor e.g diamox -- H secretion → Na^+, K^+ & H_2O lo

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