FREE NOTES · NCERT + NEET LEVEL

Excretory Products & Elimination

Ammonotelism, ureotelism, uricotelism, human excretory system, nephron, urine formation, counter-current mechanism, regulation (ADH, RAAS, ANF), micturition, role of other organs and disorders.

01 Modes of excretion
02 Human excretory system and nephron
03 Urine formation
04 Concentration of urine and regulation
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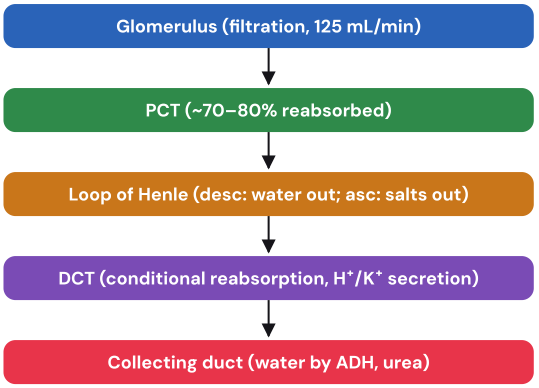
01 Modes of excretion

Mode	Product	Toxicity / water	Examples
Ammonotelic	Ammonia	Most toxic; needs lots of water	Bony fishes, aquatic amphibians, aquatic insects
Ureotelic	Urea (made in liver via ornithine cycle)	Less toxic	Mammals, terrestrial amphibians, marine fishes
Uricotelic	Uric acid (pellet/paste)	Least toxic, minimum water loss	Reptiles, birds, land snails, insects

Excretory structures: protonephridia/flame cells (Platyhelminthes, rotifers, some annelids, *Amphioxus*), nephridia (annelids), Malpighian tubules (insects), antennal/green glands (crustaceans like prawn), kidneys (vertebrates).

02 Human excretory system and nephron

- Pair of kidneys (10–12 cm × 5–7 cm × 2–3 cm, 120–170 g) between last thoracic and third lumbar vertebra; ureters, urinary bladder, urethra.
- Hilum (ureter, vessels, nerves), renal pelvis, calyces; outer cortex, inner medulla with pyramids; **columns of Bertini** = cortex between pyramids.
- Each kidney ~1 million **nephrons**. Nephron: glomerulus + Bowman's capsule (= Malpighian/renal corpuscle), PCT, Henle's loop, DCT, collecting duct.
- Afferent arteriole (wider) → glomerulus → efferent arteriole → peritubular capillaries; **vasa recta** runs parallel to Henle's loop (reduced in cortical nephrons).
- **Cortical** nephrons: short loop; **juxtamedullary**: long loop deep into medulla.



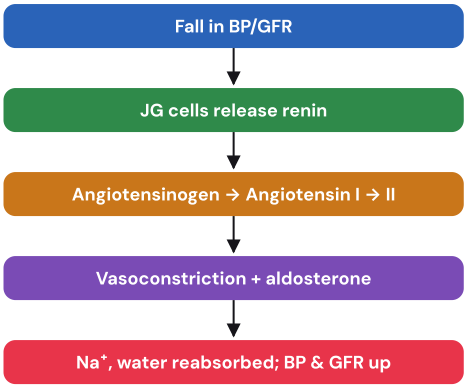
What each part of the nephron does

03 Urine formation

- **Glomerular filtration** (ultrafiltration): blood filtered through endothelium, basement membrane, podocyte filtration slits; all plasma constituents except proteins. Kidneys filter 1100–1200 mL blood/min (~1/5 of cardiac output). **GFR** ≈ 125 mL/min = 180 L/day.
- **Reabsorption**: ~99% of filtrate reabsorbed; only ~1.5 L urine/day. Active (glucose, amino acids, Na^+) and passive (nitrogenous wastes, water).
- **Secretion**: H^+, K^+, ammonia secreted into filtrate; maintains ionic and acid-base balance.
- PCT: simple cuboidal brush border epithelium; nearly all essential nutrients and 70–80% electrolytes and water reabsorbed; HCO_3^- reabsorbed.
- Henle's loop: **descending limb permeable to water only**; **ascending limb impermeable to water**, permeable to electrolytes. DCT: conditional Na^+ and water reabsorption.

04 Concentration of urine and regulation

- **Counter-current mechanism**: opposite flows in two limbs of Henle's loop and vasa recta; NaCl and urea keep medullary interstitium hyperosmotic: 300 mOsmol/L in cortex → **1200 mOsmol/L** in inner medulla. Urine can become ~4 times more concentrated than filtrate.
- **ADH** (vasopressin) from posterior pituitary: when body loses water, osmoreceptors trigger ADH ⇒ more water reabsorbed from DCT and collecting duct; also constricts vessels.
- **RAAS** (right). **ANF** (atrial natriuretic factor) from atria when BP rises: vasodilation, lowers BP; checks RAAS.



Renin–angiotensin–aldosterone system

05 Micturition and other excretory organs

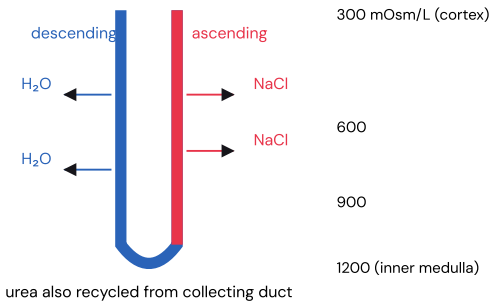
- Urine stored in bladder; stretch receptors send signals to CNS; motor messages contract bladder smooth muscles and relax urethral sphincter: **micturition reflex**.
- Adult passes 1–1.5 L urine/day, slightly acidic (pH 6.0), ~25–30 g urea/day. Glucose in urine = **glycosuria**, ketone bodies = **ketonuria** (indicate diabetes mellitus).
- Lungs remove CO_2 (~200 mL/min) and water. Liver secretes bilirubin, biliverdin, cholesterol, steroid hormone breakdown products, vitamins, drugs in bile. Skin: sweat (NaCl, small urea, lactic acid; mainly cooling) and sebum (sterols, hydrocarbons, waxes). Saliva removes small amounts of nitrogenous wastes.

06 Disorders

Disorder	What happens / treatment
Uraemia	Urea accumulates in blood; harmful; treated by **haemodialysis** (artificial kidney: blood with heparin through cellophane tube in dialysing fluid without nitrogenous wastes; anti-heparin added back)
Kidney transplant	Ultimate method for acute renal failure; donor preferably a close relative to reduce rejection
Renal calculi	Stones of crystallised salts (oxalates etc.) in kidney
Glomerulonephritis	Inflammation of glomeruli

07 Extra + tricks

- **Renal failure**: kidneys stop filtering; treated by dialysis or transplant. **Nephritis** (glomerulonephritis): inflammation of glomeruli.
- **Diabetes insipidus**: low ADH ⇒ large volumes of dilute urine (polyuria), thirst.
- Normal urine: ~1–1.5 L/day, pH ~6, contains urea 25–30 g/day; colour from urochrome.
- Trick: **"Descending drinks, ascending salts"**: descending limb loses water, ascending loses salts.
- Juxtaglomerular apparatus (JGA) = JG cells of afferent arteriole + macula densa of DCT; senses BP/GFR.



Counter-current mechanism in Henle's loop

08 Important Q&A

Q1. Why does the descending limb of Henle's loop concentrate the filtrate?

It is permeable to water but almost impermeable to electrolytes, so water leaves into hyperosmotic medulla and filtrate becomes concentrated.

Q2. Calculate daily filtrate from GFR 125 mL/min.

125 × 60 × 24 = 180,000 mL = 180 L/day.

Q3. What is the role of ANF?

Released from atrial walls when BP rises; causes vasodilation and lowers BP, acting as a check on RAAS.

09 Common mistakes

- Saying ascending limb is permeable to water (it is impermeable).
- Writing birds as ureotelic (uricotelic).
- Thinking ADH comes from anterior pituitary (posterior).
- Forgetting columns of Bertini are cortical tissue.

10 Practice (NEET style)

1. Normal GFR?
2. Excretory structure of insects?
3. Hormone released by JG cells?
4. Maximum osmolarity of inner medulla?
5. Glucose in urine is called?

ANSWERS

1) 125 mL/min · 2) Malpighian tubules · 3) Renin · 4) 1200 mOsmol/L · 5) Glycosuria

11 Quick revision: 5 minutes before the exam

MODES

- Ammonia: fish
- Urea: mammals
- Uric acid: birds, reptiles

NEPHRON

- GFR 125 mL/min, 180 L/day
- PCT max reabsorption
- Desc water, asc salts

REGULATION

- ADH: water back
- RAAS: BP up
- ANF: BP down

DISORDERS

- Uraemia → dialysis
- Calculi, glomerulonephritis

Have a doubt? Ask the AI Doubt Solver at padhaiadda.netlify.app, or take the mock test on this chapter.