AMT
A CUT ABOVE

RENAL ANATOMY AND THE NEPHRON

Structure, Blood Supply, Functional Units and Clinical Correlates

Visual anatomy. Visual physiology, Better recall.

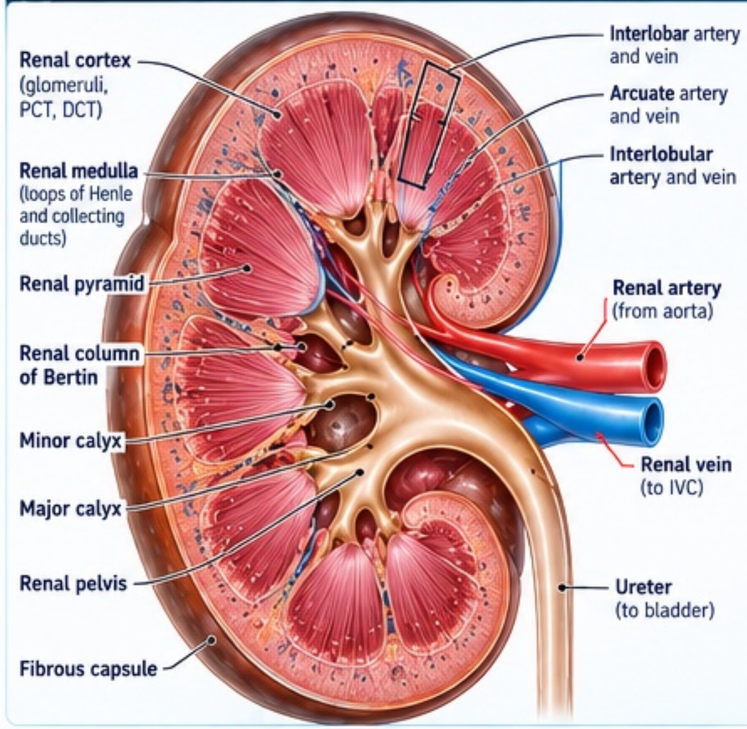
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AMT MRCP(UK) PARTS 1 & 2
RENAL MEDICINE

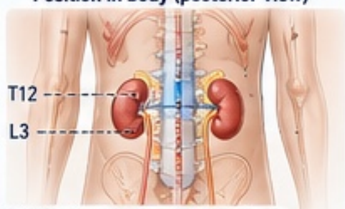
PART 1 CORE | HIGH-YIELD VISUAL CARD

KNOWLEDGE
CLINICAL SKILLS
BETTER PATIENT CARE

1 GROSS ANATOMY OF THE KIDNEY (ANTERIOR VIEW – SECTIONED)



Position in body (posterior view)

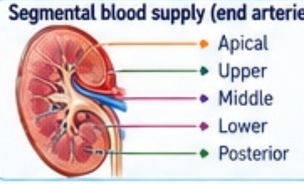


Right kidney lies slightly lower (liver)

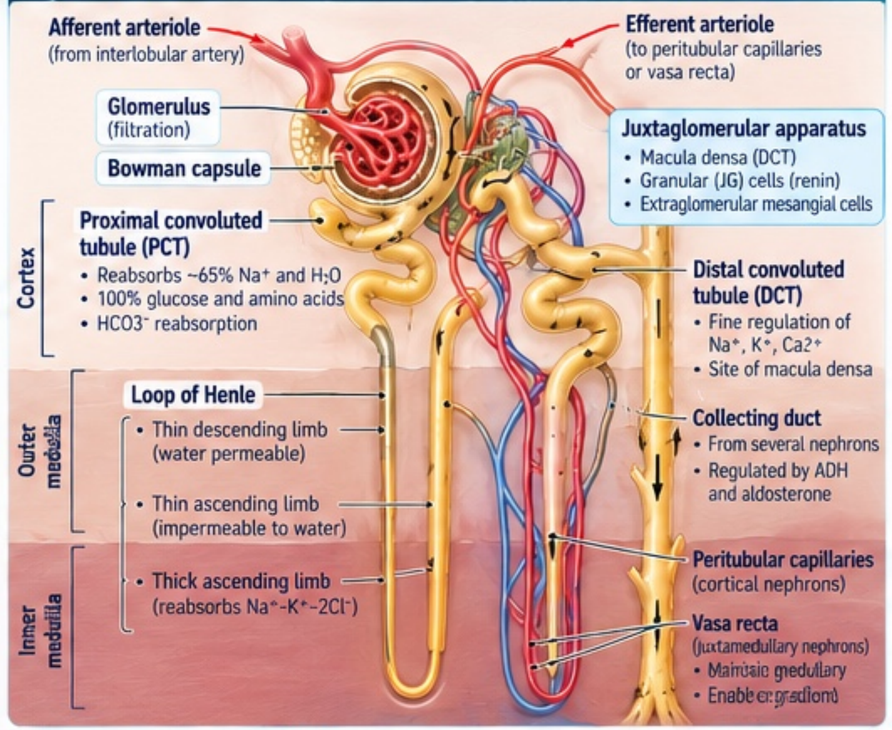
CLINICAL PEARLS

- Kidneys are retroperitoneal (T12–L3).
- Right kidney lower due to liver.
- Segmental arteries are end arteries → infarction risk.
- Column of Bertin can mimic a mass on imaging.
- Anatomy is crucial for interpreting — imaging, biopsy and surgical planning.

Segmental blood supply (end arteries)



2 THE NEPHRON AND ITS BLOOD SUPPLY



3 CORTICAL vs JUXTAMEDULLARY NEPHRONS

Cortical nephron (~85%)

- Short loop of Henle
- Peritubular capillaries
- Main role: filtration and reabsorption



Juxtamedullary nephron (~15%)

- Long loop of Henle
- Vasa recta
- Essential for urine concentration (countercurrent multiplier)



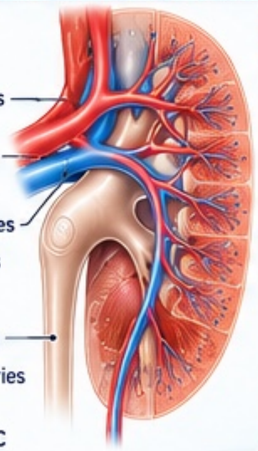
AMT MEMORY AID

"CORTEX FILTRATES, MEDULLA CONCENTRATES"

- **C** – Cortex = glomeruli, PCT, DCT
- **F** – Filtration happens in the cortex
- **M** – Medulla = loops of Henle, collecting ducts
- **C** – Concentration of urine in the medulla

4 RENAL VASCULATURE (FROM AORTA TO GLOMERULUS)

Abdominal aorta
↓
Renal artery
↓
Segmental arteries (end arteries)
↓
Interlobar arteries
↓
Arcuate arteries
↓
Interlobular arteries
↓
Afferent arterioles
↓
Glomerulus
↓
Efferent arterioles
↓
Peritubular capillaries or Vasa recta
↓
Renal vein → IVC



MRCP TRAP

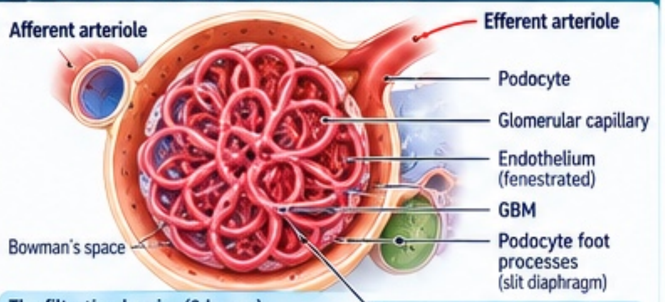
- Renal arteries are end arteries.
- Segmental infarction can occur with thrombosis, embolism or trauma.
- Wedge-shaped area on imaging. Medulla is more vulnerable to ischaemia (lower oxygen tension).

CLINICAL CORRELATE



Wedge-shaped renal infarct on CT (educational image)

5 KEY STRUCTURES: MICROANATOMY



The filtration barrier (3 layers)

1. Fenestrated endothelium
2. Glomerular basement membrane
3. Podocyte foot processes (slit diaphragm)



Filtration barrier (magnified)

6 FUNCTIONS BY NEPHRON SEGMENT (SUMMARY)

Segment	Key functions
Glomerulus	Filtration of plasma (cell-free ultrafiltrate)
PCT	Reabsorbs ~65% Na^+ and H_2O, 100% glucose, amino acids, HCO_3^-
Thin descending limb	Water reabsorption
Thin ascending limb	Impermeable to water
Thick ascending limb	Reabsorbs Na^+-K^+-$2Cl^-$ (NKCC2)
DCT	Fine regulation of Na^+, K^+, Ca^{2+} (NCC)
Collecting duct	Regulated by ADH (water) and aldosterone (Na^+, K^+)

7 HIGH-YIELD FACTS

- ~1 million nephrons per kidney.
- Cortex: glomeruli, PCT, DCT.
- Medulla: loops of Henle, collecting ducts.
- Juxtamedullary nephrons essential for urine concentration.
- Renal blood flow ~20–25% of cardiac output.
- Renal artery stenosis → activate RAAS.
- Urine flow: collecting duct → papilla → minor calyx → major calyx → pelvis → ureter.
- Functional unit of the kidney = nephron.

8 CLINICAL APPLICATIONS

- Interpret imaging (mass vs column of Bertin).
- Localise pathology (cortex vs medulla).
- Understand effects of ischaemia, obstruction and systemic disease.
- Guide interpretation of biopsy and urine findings.
- Essential for transplantation and surgical planning.

AMT 60-SECOND RECALL

1. Kidneys retroperitoneal (T12–L3), right lower.
2. Cortex = glomeruli, PCT, DCT; medulla = loops, collecting ducts.
3. Nephron = functional unit (~1 million per kidney).
4. Three filtration barriers: endothelium, GBM, podocyte slit diaphragm.
5. Cortical nephrons (85%) vs juxtamedullary (15%) → urine concentration.
6. Renal arteries are end arteries → infarction risk.
7. Collecting duct regulated by ADH and aldosterone.
8. Medulla more vulnerable to ischaemia.

10 EXAM-FOCUSED QUESTIONS

Which part of the nephron is most important for urine concentration?

A. PCT B. Thin descending limb C. Thick ascending limb
D. Collecting duct E. DCT

Answer: D (Collecting duct)

KEY TAKE-HOME MESSAGE

"Structure explains function, and function explains the clinical consequences."

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