

Anatomy and Physiology of the Kidneys

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(A concise, study-ready outline)

1. Overview

- **Location:** Retroperitoneal, one on each side of the vertebral column (T12–L3).
- **Size/Shape:** ~11cm long, 5cm wide, 3cm thick; bean-shaped.
- **Primary Functions**
 - **Excretory:** Remove metabolic waste, excess electrolytes, and water.
 - **Regulatory:** Maintain fluid/electrolyte balance, acid–base status, blood pressure, and erythropoiesis.

2. External Anatomy

Structure	Key Features	Clinical Relevance
Renal Capsule	Fibrous outer covering	Protects parenchyma; site of perinephric abscess
Renal Cortex	Outer renal tissue; contains glomeruli & proximal tubules	Site of many glomerular diseases
Renal Medulla	Inner pyramidal tissue; contains loops of Henle & collecting ducts	Medullary concentration gradient
Renal Pelvis	Funnel-shaped cavity → ureter	Obstruction → hydronephrosis
Renal Hilum	Entry/exit point for renal artery, vein, ureter, nerves, lymphatics	Vascular injuries often involve hilum

- **Renal Fascia (Gerota’s fascia):** Connective tissue envelope; separates kidney from surrounding fat.
- **Perirenal Fat:** Cushions kidney; source of fat stranding on CT in infection/inflammation.

3. Internal Gross Anatomy

3.1. Cortex vs. Medulla

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- **Cortex:**

- Contains renal corpuscles (glomerulus + Bowman's capsule).
- Proximal and distal convoluted tubules.

- **Medulla:**

- Organized into **renal pyramids** (conical structures).
- **Striated** appearance due to alternating **loops of Henle** (dark) and **vasa recta** (light).
- **Papillae** at pyramid tips drain into minor calyces.

3.2. Collecting System

1. **Minor calyces** ? converge into **major calyces**.
 2. **Major calyces** ? form the **renal pelvis**.
 3. **Renal pelvis** ? continues as the **ureter** (muscular tube).
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4. Microscopic Anatomy

4.1. Nephron (functional unit) – ~1?–?1.5?million per kidney

Segment	Main Functions	Histological Highlights
Glomerulus (capillary tuft)	Filtration of plasma (?180?L/day)	Fenestrated endothelium, basement membrane, podocyte foot processes
Bowman's capsule	Collects filtrate	Parietal epithelium (simple squamous)
Proximal convoluted tubule (PCT)	Reabsorption of ~65?% of filtered Na?, glucose, amino acids, HCO??, water	Brush border (microvilli) ? high surface area
Loop of Henle (descending & ascending limbs)	Generates medullary osmotic gradient; concentrates urine	Descending: permeable to water; Ascending: impermeable to water, active Na?/K?/Cl? transport

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