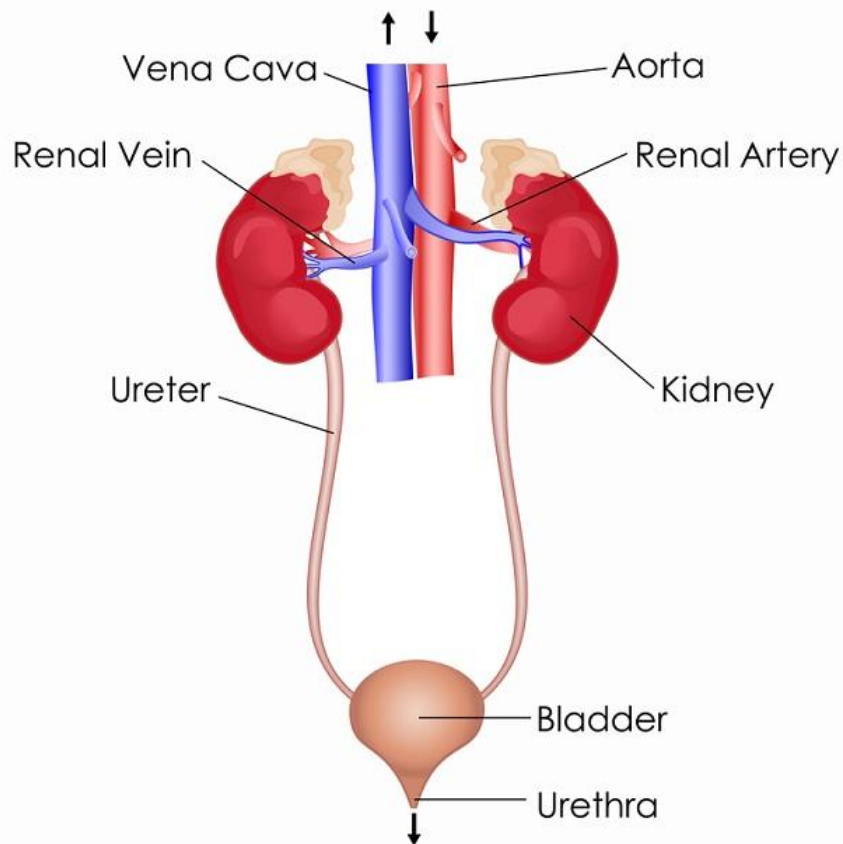


EXCRETORY SYSTEM & OSMOREGULATION

-By Newton Rain

EXCRETORY ORGANS:

- **Kidneys** – Principal excretory organs
- **Ureters** – Transport urine from kidneys to bladder
- **Urinary bladder** – Temporarily stores urine
- **Urethra** – Discharges urine from bladder to outside



✓ **MCQ Point:**

✓ Kidneys are the main organs of excretion in humans.

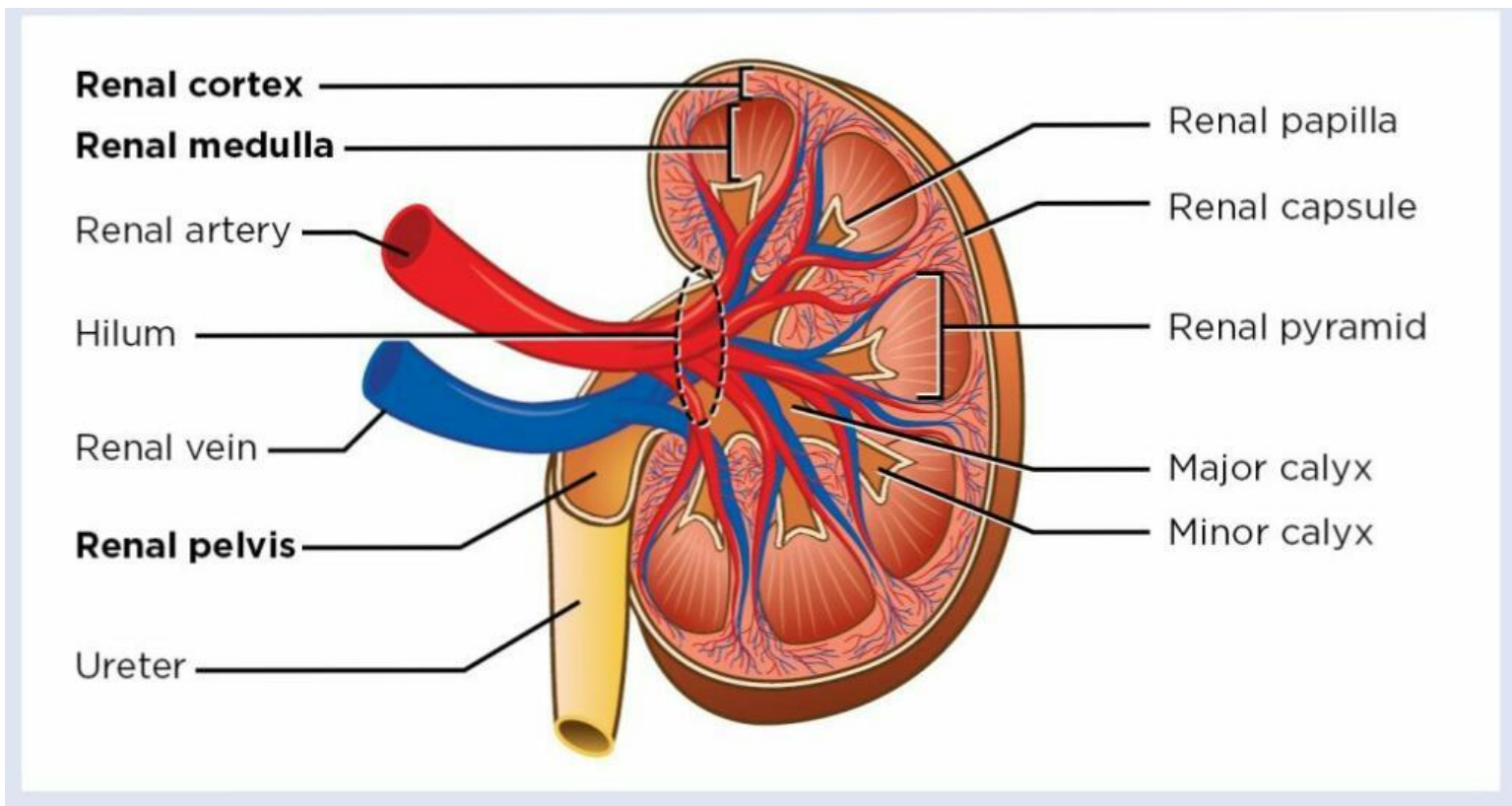
KIDNEY

Location: One on each side of vertebral column, in retroperitoneal space

Right kidney is slightly lower than the left
due to position of liver on right side

- Shape: Bean-shaped
- Size: ~10–12 cm long, ~5–7 cm wide

Internal Structure:



Cortex – Outer region

Medulla – Inner region; contains **renal pyramids (8–18)**

Renal papilla – Tip of pyramid, opens into minor calyx

Minor & Major calyces – Collect urine from pyramids

Renal pelvis – Funnel-shaped collecting region

Renal columns – Extensions of cortex between pyramids

◆ **Blood Supply:**

Renal artery: Brings oxygenated blood from abdominal aorta

Renal vein: Carries filtered blood to IVC (Inferior Vena Cava)

✓ **MCQ Points:**

- ✓ Right kidney is lower due to liver
- ✓ Renal pyramid ends at renal papilla
- ✓ Functional unit of kidney = Nephron



Renal artery originates from abdominal aorta

FUNCTIONS OF KIDNEY

A. Excretion of nitrogenous wastes

(urea, creatinine)

B. Osmoregulation (water-salt balance)

C. Acid-base balance

D. Hormonal secretion:

1. Erythropoietin: Stimulates RBC production

2. Renin: Regulates blood pressure

3. Calcitriol: Enhances calcium absorption from intestines

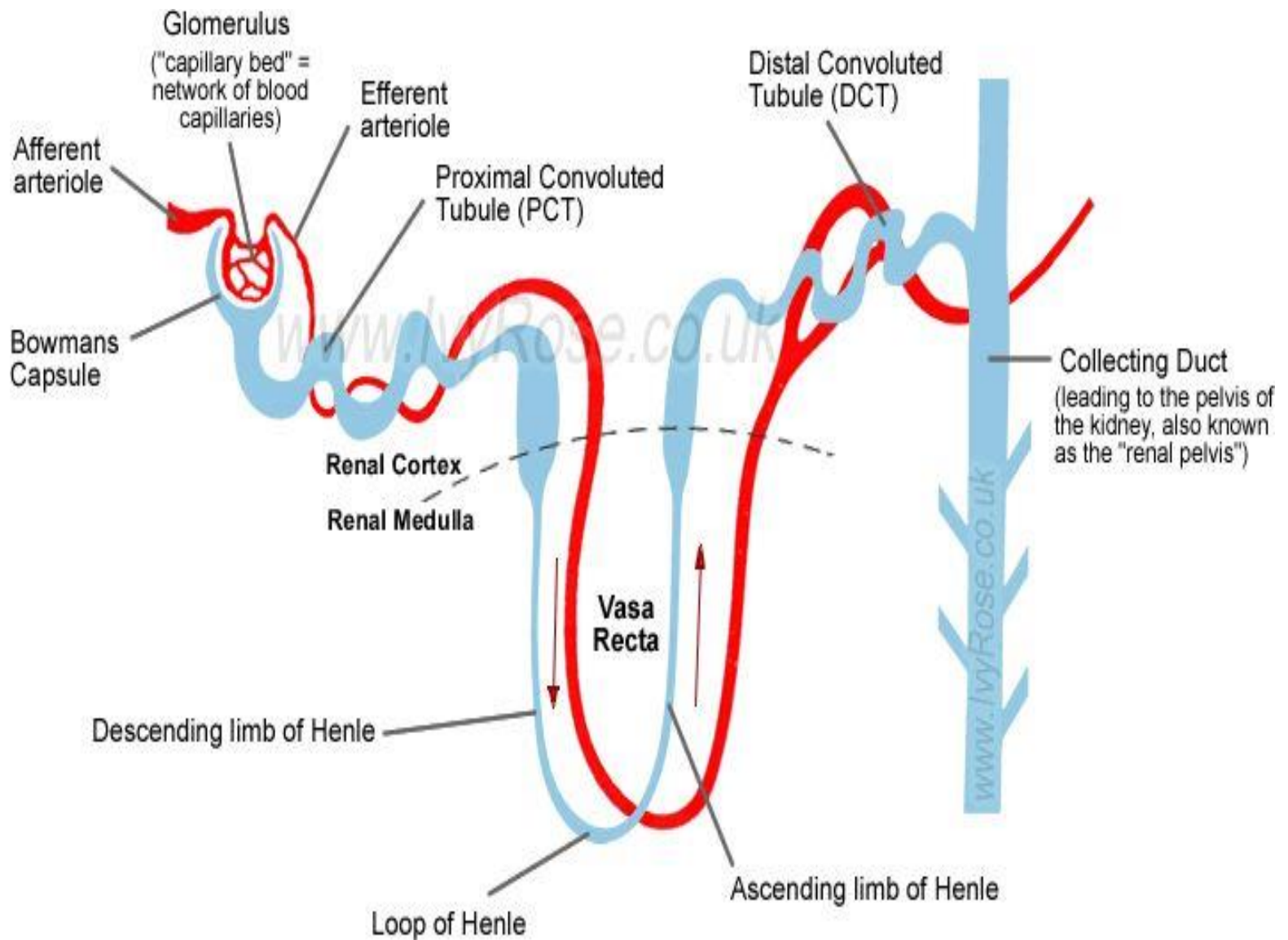
 MCQ Points:

 Erythropoietin stimulates RBC production

 Calcitriol helps calcium absorption

 Renin regulates blood pressure

NEPHRON (STRUCTURE & FUNCTION)



◆ Parts of Nephron:

- **Malpighian corpuscle** = Glomerulus + Bowman's capsule
- **Proximal convoluted tubule (PCT)**

- **Loop of Henle** – Descending & ascending limbs
- **Distal convoluted tubule (DCT)**
- **Collecting tubule/duct**

◆ **Malpighian Corpuscle**

Glomerulus: Ball of capillaries

Afferent arteriole – Brings blood to glomerulus

Efferent arteriole – Takes blood away (narrower)

Bowman's capsule: Double-walled structure around glomerulus and it has:

Parietal layer – Outer

Visceral layer – Inner (**podocytes**)

✓ MCQ Points:

✓ **Malpighian corpuscle = Glomerulus + Bowman's capsule**

✓ Afferent arteriole is wider than efferent arteriole

◆ Tubular Parts:

PCT: Cuboidal epithelium with microvilli
(brush border)

Reabsorbs glucose, amino acids, Na^+ , water

Loop of Henle:

Descending: Permeable to water

Ascending: Permeable to salts

DCT: Cuboidal epithelium,

Secretes H^+ , K^+ , ammonia,

Regulates Na^+/K^+ balance

Collecting Duct:

Responsive to ADH, reabsorbs water

MCQ Points:

-  PCT has brush border epithelium
-  Most reabsorption occurs in PCT
-  Loop of Henle forms countercurrent system

Types of Nephron:

Cortical nephron (85%)

- Maximum in number in kidney
- Short loop of Henle

Juxtamedullary nephron (15%) – Long loop, deep into medulla

✓ MCQ Point:

✓ Juxtamedullary nephron concentrates urine

URETER

- Muscular tube **~25–30 cm long**
- Conducts urine by peristalsis from kidney to bladder

✓ MCQ Point:

✓ Ureter conducts urine by peristaltic movement

URINARY BLADDER

- Hollow, muscular sac
- Lined by **transitional epithelium**
- **Detrusor muscle – Contracts to expel urine**
- **Capacity: 300–500 mL**

MCQ Points:

-  Lining = Transitional epithelium
-  Detrusor muscle helps in micturition
-  Normal urine volume = 1.5 L/day

MICTURITION (Urination)

- Spinal reflex involving stretch receptors in bladder wall

- Controlled by **in**ternal sphincter (**in**voluntary) and external sphincter (voluntary)

MCQ Points:

 **Micturition is a reflex process**

 **External sphincter is under voluntary control**

URETHRA

Conducts urine from bladder to outside

Length:

- **Male: ~20 cm**
- **Female: ~4 cm**

External urethral sphincter provides voluntary control

✓ MCQ Point:

✓ Female urethra is shorter than male

URINE FORMATION

◆ Glomerular Filtration:

Blood plasma filters into Bowman's capsule

GFR = 125 ml/min $\approx$ 180 L/day

Net Filtration Pressure: $\sim$ 10 mm Hg

✓ MCQ Points:

✓ GFR = 125 ml/min or 180 L/day

✓ Net Filtration Pressure = 10 mm Hg

◆ Selective Reabsorption:

Useful substances reabsorbed (glucose, Na^+ , water)

◆ Tubular Secretion:

Secretion of H^+ , K^+ , NH_3 , drugs into tubules

RENAL THRESHOLD

Definition: Maximum plasma concentration that can be reabsorbed

Glucose threshold: 180 mg/dL

✓ MCQ Point:

✓ Renal threshold for glucose = 180 mg/dL

HORMONAL REGULATION OF BP BY KIDNEY

Aldosterone:

↑ Na⁺ reabsorption → ↑ Water retention
→ ↑ Blood volume → ↑ BP

ADH (Antidiuretic Hormone):

↑ Water reabsorption in DCT/CD → ↓
Urine → ↑ Blood volume → ↑ BP

(↑ means increase and ↓ means decrease)

→ Flowchart:

- How Aldosterone works:

Low BP → Renin → Angiotensin II →
Adrenal cortex → ↑ Aldosterone → ↑
Na⁺/H₂O retention → ↑ BP

- **How ADH works:**

Dehydration → Hypothalamus →
Posterior pituitary → ↑ ADH → ↑
Water reabsorption → ↑ BP

✓ **MCQ Points:**

✓ **Aldosterone: secreted by adrenal cortex**

✓ **ADH: secreted by posterior pituitary**

✓ **Both hormones help raise BP**

URINE COMPOSITION & ABNORMALITIES

- Normal volume: ~1.5 L/day

- **pH: ~6** (slightly acidic) **but can vary from about 4.5 to 8** according to changes in food and diet intake
- **Composition: Water (~95%), urea, creatinine, uric acid, ions**

◆ **Abnormal Conditions:**

- **Glycosuria – Glucose in urine (diabetes)**
- **Proteinuria/Albuminuria – Proteins in urines**
- **Hematuria – Blood in urine**
- **Pyuria – Pus cells in urine (infection)**

- Bilirubinuria – Bile pigments in urine (jaundice)
- Oliguria – Less urine (<400 ml/day)

✓ MCQ Points:

✓ Normal urine pH $\approx$ 6

✓ Normal urine volume = 1.5 L/day

✓ Oliguria = urine output < 400 ml/day

✓ Glycosuria in diabetes,

hematuria = blood in urine

