

Functional organization of the kidney and GFR

MCQs

1. The functional unit of the kidney is which of the following?
A) Glomerulus
B) Nephron
C) Loop of Henle
D) Collecting duct
Answer: B
2. Each human kidney contains approximately how many nephrons?
A) 0.3 million
B) 0.8 million
C) 1.3 million
D) 3 million
Answer: C
3. Which part of the kidney appears granular due to glomeruli?
A) Medulla
B) Pelvis
C) Cortex
D) Calyx
Answer: C
4. Juxtamedullary nephrons constitute about what percentage?
A) 5%
B) 15%
C) 50%
D) 85%
Answer: B
5. The renal artery arises directly from the which of the following?
A) Renal vein
B) Inferior vena cava
C) Abdominal aorta
D) Femoral artery
Answer: C
6. What is the normal value of the Renal blood flow?
A) 300 ml/min
B) 600 ml/min
C) 900 ml/min
D) 1200 ml/min
Answer: D
7. Which capillaries are involved in urine concentration?
A) Peritubular
B) Glomerular
C) Vasa recta
D) Sinusoids
Answer: C

8. Glomerular capillaries are located between?

- A) Two veins
- B) Two arterioles
- C) Artery and vein
- D) Capillary and vein

Answer: B

9. GFR in a normal adult equals which of the following?

- A) 60 ml/min
- B) 90 ml/min
- C) 125 ml/min
- D) 180 ml/min

Answer: C

10. Daily glomerular filtrate volume is about?

- A) 18 L
- B) 80 L
- C) 125 L
- D) 180 L

Answer: D

11. Glomerular filtrate normally contains which of the following?

- A) Plasma proteins
- B) Blood cells
- C) Electrolytes
- D) Hemoglobin

Answer: C

12. Which layer of filtration barrier is negatively charged?

- A) Endothelium
- B) Basement membrane
- C) Podocytes
- D) Slit diaphragm

Answer: B

13. What is the size of endothelial pores ?

- A) 10 nm
- B) 25 nm
- C) 50 nm
- D) 70–90 nm

Answer: D

14. Which of the following is the main force favoring filtration ?

- A) COP GC
- B) HP BC
- C) HP GC
- D) COP BC

Answer: C

15. Glomerular capillary hydrostatic pressure equals?

- A) 18 mmHg
- B) 32 mmHg
- C) 45 mmHg

D) 60 mmHg

Answer: D

16. Hydrostatic pressure of Bowman's capsule equal which of the following?

A) 0 mmHg

B) 10 mmHg

C) 18 mmHg

D) 32 mmHg

Answer: C

17. Net filtration pressure normally equals which of the following?

A) 5 mmHg

B) 10 mmHg

C) 20 mmHg

D) 32 mmHg

Answer: B

18. Afferent arteriolar dilatation causes

A) ↓ GFR

B) No change

C) ↑ GFR

D) Renal ischemia

Answer: C

19. Severe efferent arteriolar constriction causes which of the following?

A) ↑ GFR

B) ↓ GFR

C) No effect

D) Renal failure

Answer: B

20. Increased plasma proteins will cause which of the following?

A) Increase GFR

B) Decrease GFR

C) No effect

D) Stop filtration

Answer: B

21. Urinary tract obstruction leads to which of the following?

A) ↑ HP GC

B) ↑ GFR

C) ↑ HP BC

D) ↓ OP GC

Answer: C

22. Mesangial cell contraction causes which of the following?

A) ↑ Surface area

B) ↓ GFR

C) ↑ K_f

D) ↑ Filtration

Answer: B

23. Autoregulation of GFR occurs between ABP of which of the following?

A) 50–100 mmHg

- B) 70–150 mmHg
- C) 90–200 mmHg
- D) 120–250 mmHg

Answer: C

24. Macula densa senses concentration of which of the following?

- A) Glucose
- B) Potassium
- C) Sodium chloride
- D) Urea

Answer: C

25. Renin is secreted by which of the following?

- A) Macula densa
- B) Podocytes
- C) Juxtaglomerular cells
- D) Lacis cells only

Answer: C

26. Substance best for measuring GFR is which of the following?

- A) Urea
- B) Creatinine
- C) PAH
- D) Inulin

Answer: D

27. Creatinine characterized by which of the following?

- A) Filtered and reabsorbed
- B) Filtered and secreted
- C) Only secreted
- D) Not filtered

Answer: B

28. A 45-year-old man presents with **severe dehydration** due to prolonged vomiting and diarrhea. Laboratory investigations show **elevated plasma protein concentration** and reduced urine output. Which of the following is the most likely effect on the patient's glomerular filtration rate (GFR)?

- A) Increased GFR due to decreased Bowman's capsule pressure
- B) Decreased GFR due to increased glomerular colloidal osmotic pressure
- C) Increased GFR due to afferent arteriolar dilatation
- D) No change in GFR due to autoregulation

Answer: B

29. A 60-year-old male with a history of **benign prostatic hyperplasia** presents with **difficulty in urination and bladder distension**. Imaging shows **urinary tract obstruction**. The decrease in GFR in this patient is mainly due to which of the following?

- A) Decreased glomerular hydrostatic pressure
- B) Increased hydrostatic pressure in Bowman's capsule
- C) Decreased plasma oncotic pressure
- D) Constriction of efferent arteriole

Answer: B

Short Essay Questions (with answers)

1. **Define nephron.**
Functional unit of the kidney responsible for urine formation.
2. **Name parts of renal corpuscle.**
Glomerulus and Bowman's capsule.
3. **Mention kidney endocrine functions.**
Renin, erythropoietin, vitamin D activation.
4. **Define GFR.**
Volume of filtrate formed per minute by both kidneys.
5. **Normal value of GFR?**
125 ml/min.
6. **List layers of filtration membrane.**
Endothelium, basement membrane, podocytes.
7. **Why proteins are not filtered?**
Large size and negative charge.
8. **Define vasa recta.**
Medullary capillaries aiding urine concentration.
9. **What is juxtaglomerular apparatus?**
Specialized structure regulating GFR and BP.
10. **Function of macula densa?**
Senses NaCl concentration.
11. **What is net filtration pressure?**
Resultant pressure driving filtration.
12. **Effect of dehydration on GFR.**
Decreases GFR.
13. **Define plasma clearance.**
Volume of plasma cleared of a substance per minute.
14. **Why inulin is ideal for GFR?**
Filtered only, not reabsorbed or secreted.
15. **Creatinine source.**
Muscle metabolism.
16. **Define autoregulation.**
Maintenance of constant GFR despite BP changes.
17. **Name autoregulation mechanisms.**
Myogenic and tubuloglomerular.
18. **Effect of urinary obstruction on GFR.**
Decreases GFR.
19. **Role of mesangial cells.**
Regulate filtration surface area.

20. **Clearance of secreted substances compared to GFR.**
Greater than GFR.

Renal tubular function

- 1) **Which segment of the nephron reabsorbs about 65% of filtered Na⁺ and water?**
A) Loop of Henle
B) Distal convoluted tubule
C) Proximal convoluted tubule
D) Collecting duct

Answer: C

- 2) **The brush border in proximal tubules mainly increases which of the following?**
A) Secretion
B) Surface area for reabsorption
C) Filtration
D) Osmotic pressure

Answer: B

- 3) **Which substance is almost completely reabsorbed in the PCT?**
A) Urea
B) Glucose
C) Creatinine
D) Inulin

Answer: B

- 4) **Sodium reabsorption at the basal border of tubular cells occurs by which of the following?**
A) Passive diffusion
B) Facilitated diffusion
C) Primary active transport
D) Secondary active transport

Answer: C

- 5) **Which limb of loop of Henle is permeable to water?**
A) Thick ascending limb
B) Thin ascending limb
C) Thin descending limb
D) Distal convoluted tubule

Answer: C

- 6) **Fluid reaching the tip of loop of Henle is best described by which of the following?**
A) Isotonic
B) Hypotonic
C) Hypertonic
D) Alkaline

Answer: C

7) Reabsorption of Na^+ - K^+ - 2Cl^- occurs in which of the following?

- A) PCT
- B) Thin descending limb
- C) Thick ascending limb
- D) Collecting duct

Answer: C

8) The thick ascending limb is impermeable to which of the following?

- A) Na^+
- B) Cl^-
- C) Water
- D) K^+

Answer: C

9) The first half of DCT is best described as which of the following?

- A) Concentrating segment
- B) Secretory segment
- C) Diluting segment
- D) Exchange segment

Answer: C

10) Aldosterone mainly acts on which of the following?

- A) PCT
- B) Loop of Henle
- C) DCT and cortical collecting tubules
- D) Vasa recta

Answer: C

11) Aldosterone increases reabsorption of which of the following?

- A) K^+
- B) H^+
- C) Na^+
- D) Urea

Answer: C

12) Which cells secrete H^+ in DCT?

- A) Principal cells
- B) Intercalated cells
- C) Mesangial cells
- D) Endothelial cells

Answer: B

13) ADH increases water reabsorption mainly in which of the following?

- A) PCT
- B) Thin ascending limb
- C) DCT and collecting ducts
- D) Vasa recta

Answer: C

14) Calcium reabsorption in DCT is regulated by which of the following?

- A) Aldosterone
- B) ADH
- C) Parathormone

D) Cortisol

Answer: C

15) Urea recycling mainly occurs in which of the following?

A) PCT

B) DCT

C) Medullary collecting duct

D) Glomerulus

Answer: C

16) Which diuretic inhibits Na^+ reabsorption in PCT?

A) Loop diuretics

B) Osmotic diuretics

C) Thiazides

D) Aldosterone antagonists

Answer: B

17) Na^+ accounts for more than 90% of osmotically active particles in which of the following?

A) ICF

B) Plasma

C) ECF

D) Urine

Answer: C

18) Pressure natriuresis occurs due to increased which of the following?

A) ADH

B) Aldosterone

C) Arterial blood pressure

D) Renin

Answer: C

19) Which hormone increases Na^+ excretion?

A) Aldosterone

B) Angiotensin II

C) ANP

D) Cortisol

Answer: C

20) Sympathetic stimulation causes which of the following?

A) Decreased Na^+ reabsorption

B) Increased Na^+ reabsorption

C) Increased GFR

D) Decreased ADH

Answer: B

21) Which of the following is the main function of vasa recta ?

A) Filter blood

B) Secrete hormones

C) Maintain medullary hyperosmolarity

D) Produce urine

Answer: C

22) Countercurrent exchanger is performed by which of the following?

- A) Loop of Henle
- B) Collecting duct
- C) Vasa recta
- D) PCT

Answer: C

23) Which substance is secreted in PCT?

- A) Glucose
- B) Amino acids
- C) Creatinine
- D) Sodium

Answer: C

24) Ammonium is synthesized mainly from which of the following?

- A) Glycine
- B) Glutamine
- C) Alanine
- D) Tyrosine

Answer: B

25) Na^+ reabsorption in DCT occurs under control of which of the following?

- A) ADH
- B) Aldosterone
- C) PTH
- D) ANP

Answer: B

26) Which prostaglandin increases Na^+ excretion?

- A) PGE_2
- B) PGF_2
- C) PGL_2
- D) TXA_2

Answer: A

27) The main site of urine concentration is:

- A) PCT
- B) DCT
- C) Medullary collecting duct
- D) Loop of Henle

Answer: C

28) A 45-year-old man receives furosemide for treatment of pulmonary edema. After therapy, his urine output increases markedly. Which part of the nephron is primarily affected by this drug?

- A) Proximal convoluted tubule
- B) Thin descending limb
- C) Thick ascending limb of loop of Henle
- D) Collecting duct

Answer: C

29) A 30-year-old woman has excessive urination and dilute urine due to **deficiency of ADH. Which nephron segment normally responds to ADH?**

- A) Proximal convoluted tubule
- B) Thin ascending limb
- C) Distal convoluted tubule and collecting duct
- D) Glomerulus

Answer: C

30) A patient with **hyperaldosteronism** presents with hypertension and hypokalemia.

Which renal effect explains the hypokalemia?

- A) Decreased Na^+ reabsorption
- B) Increased K^+ secretion in distal tubules
- C) Decreased H^+ secretion
- D) Reduced GFR

Answer: B

31) A patient has damage to the **proximal convoluted tubule** and develops glucose in urine despite normal blood glucose levels. **Which function is most likely impaired?**

- A) Passive diffusion of water
- B) Active reabsorption of glucose
- C) Urea secretion
- D) ADH-dependent water reabsorption

Answer: B

32) A dehydrated patient produces **highly concentrated urine. Which mechanism is mainly responsible for this concentration?**

- A) Na^+ reabsorption in PCT
- B) Countercurrent mechanism with ADH action
- C) Glomerulotubular balance
- D) Pressure natriuresis

Answer: B

Short Essay Questions with Answers

1. **State one function of thin descending limb.**
Water reabsorption.
2. **Why is fluid hypertonic at loop tip?**
Due to water reabsorption without solute.
3. **Name the diluting segment of nephron.**
First half of distal convoluted tubule.
4. **Role of aldosterone in kidney.**
Increases Na^+ reabsorption and K^+ secretion.
5. **Function of intercalated cells.**
 H^+ secretion and HCO_3^- reabsorption.
6. **Effect of ADH on kidney.**
Increases water reabsorption.
7. **One function of medullary collecting duct.**
Concentration of urine.
8. **Define osmotic diuretics.**
Diuretics that reduce water reabsorption by osmotic effect.
9. **What is pressure natriuresis?**
Increased Na^+ excretion due to high blood pressure.
10. **Mention Hormone that increases GFR and Na^+ excretion.**
Atrial natriuretic peptide.
11. **Role of vasa recta.**
Maintains medullary osmotic gradient.
12. **Main mechanism of Na^+ transport at basal border .**
 $\text{Na}^+ - \text{K}^+$ ATPase pump.
13. **Substance completely reabsorbed normally.**
Glucose.
14. **One function of thick ascending limb.**
Reabsorption of Na^+ , K^+ , Cl^- .
15. **Hormone regulating Ca^{2+} reabsorption.**
Parathormone.
16. **Define countercurrent mechanism.**
Mechanism that creates medullary hyperosmolarity.
17. **Source of ammonia in tubules.**
Glutamine.