NEW LIFE FOUNDATION

SS.NAGAR.ARUPPUKOTTAI ROAD,

KALKURICHI,KARIYAPATTI,VIRUDHUNAGAR

TAMILNADU-INDIA

MB:+91 8438602500

REVIEW OF RENAL SYSTEM-1

ANATOMY AND PHYSIOLOGY

. Anatomy and physiology of the renal system

1. Write about the location and structure of the kidneys?

Ans: The kidneys are located dorsal abdominal cavity in retroperitoneal space in front of both sides of the vertebral column between twelfth thoracic and third lumbar vertebrae. The right kidney is positioned little lower than the left.

The kidneys are protected anteriorly by abdominal muscles, fascia, fat, and intestines; posteriorly by large back muscles and ribs. Right kidney protected superiorly by the liver and the left kidney by the spleen.

Each kidney measures approximately 11-13 cm in length, 5-7.5 cm in width, and 2.5-3.0 cm in thickness. The kidney weight in adult men is 125-170 grams and in adult women 115-155 grams.

2. What are the significant components of cortex and medulla of the kidney?

Ans: The kidney can be divided into cortex and medulla. Cortex is an outer and medulla is an inner part of the kidney. Cortex, approximately 1cm wide, is located immediately below the capsule, 85 % of nephrons and their blood vessels located in the cortex. The glomerulus, Bowman`s capsule and proximal and distal tubules of the juxtamedullary nephrons are located in the cortex.

Medulla is approximately 5cm wide. Medulla contains pyramids, renal columns and loop of henle, vasa recta, and collecting duct of juxtamedullary nephrons. Pyramids are triangular

structures composed of nephrons and their blood vessels. Renal columns are cortical tissue between the pyramids.

3. What are the major functions of the collecting duct system?

Ans: The collecting duct system can be divided into the cortical (CCD), outer medullary (OMCD) and inner medullary collecting duct (IMCD). The cortical collecting duct consists of the initial collecting tubule, and it`s epithelial cells composed of principal cells and intercalated cells. A main function of principal cells in the cortical collecting duct is potassium secretion.

Two types of intercalated cells have been identified; type A intercalated which is believed to be involved in hydrogen ion secretion and type B cells may secrets bicarbonate. The principal cells and the inner medullary collecting duct cells are responsive antidiuretic hormone. In the presence of ADH water is reabsorbed from the collecting duct which leads to the formation of a hypertonic urine. In the absence of ADH the collecting duct is relatively impermeable to water and hypotonic urine is formed.

4. What are the major functions of proximal convoluted tubule?

Ans: More than 65% of sodium, potassium and calcium are reabsorbed.100% of glucose and amino acids and 25% of magnesium are reabsorbed. Water reabsorbed passively with sodium. Phosphate reabsorbed if PTH absent or excreted if PTH present. Exogenous substances and hydrogen secreted and urea and bicarbonate reabsorbed. Filtrate leaves isotonic.

The luminal border of proximal tubule cells contains carbonic anhydrase that catalyzes the formation of carbonic acid (H_2CO_3) from carbon dioxide and water. Carbonic acid dissociates into hydrogen and bicarbonate.80-90% of filtered bicarbonate is reabsorbed.

Proximal convoluted tubule is composed of columnar cells with many mitochondria, which provide energy for active transport of solutes.

5. Describe the significant functions of loop of Henle?

Ans: The thin part of kidney tubules named after the German anatomist F.G.J.Henle. The loop of Henle has squamous cells, few organelles and microvilli. Countercurrent multiplying and exchange mechanism is established between long, thin loops of Henle and adjacent vasa recta.

Descending limb of loop of Henle is responsible for permeable to water and urea. Water moves from tubular lumen into hypertonic interstitium. Urea is secreted into tubular lumen increases osmolality and interstitium remains hypertonic because of sodium pumped into it from the ascending limb.

Thick ascending limb of loop of Henle is impermeable to urea and water; sodium and chloride are actively reabsorbed from the tubular lumen. Interstitium of the medulla becomes

hypertonic as its sodium concentration increases and hypotonic filtrate empties into distal convoluted tubule.

6. Write the important functions of distal convoluted tubule?

Ans: Distal convoluted tubules are impermeable to urea and slightly permeable to water. Sodium and water reabsorption occurs under the influence of ADH. Potassium secretion occurs in the presence of Aldosterone. Aldosterone enhances sodium in DCT; some water is reabsorbed with 6% of sodium; without aldosterone sodium is excreted in urine. Calcium and phosphate may be reabsorbed depending on PTH.

In DCT, hydrogen and bicarbonate ions are generated from carbonic acid. Bicarbonate is reabsorbed; hydrogen ions are actively secreted in exchange for active reabsorption of sodium and potassium. Hydrogen ion combines with filtered phosphate and forms titratable acids (monosodium phosphate).

7. What is aldosterone?

Ans: Aldosterone is a mineralocorticoid secreted by the adrenal cortex. It acts to increase reabsorption of sodium and water and secretion of potassium in the renal tubules. Aldosterone is essential to regulate total sodium, renin-angiotensin-aldosterone system, potassium level and adrenocortico trophic hormone.

8. Describe about Glomerulus?

The glomeruli are the located in the cortex. The human glomerular measures approximately 200microm in diameter and it includes a capillary tuft and the surrounding parietal epithelium of Bowman's capsule.

The glomerulus is responsible for the formation of an ultrafiltrate of plasma. It consists of a capillary network lined by thin endothelium, mesangium, and the visceral epithelium with its associated basement membrane.

The thin endothelium is perforated by pores measuring approximately 70 to 100nm in diameter. It contributes one initial barrier to the passage of blood constituents but is not believed to represent a significant barrier to the passage of macromolecules.

The GBM is located between the endothelium and the visceral epithelium and measures approximately 300nm in thickness. The GBM is believed to constitute the size selective as well as charge selective barrier to the passage of macromolecules.

It is composed of various glycoproteins, fibronectin and negatively charged glycosaminoglycans rich in a heparane sulfate. These anionic sites appear to be important in establishing the charge selective barrier.

The visceral epithelial cells have long cytoplasm process that divided in to foot process that are in close contact with the GBM. The space between adjacent foot processes is called the filtration slit and it is closed by a thin membrane.

The foot process is covered with negatively charged with sites which are riches in sialic acid and appear to be important for maintaining normal structure and function of the filtration barrier.

The removal these anionic sites causes the foot process to disappear and to be replaced by a continues band of cytoplasm along the GBM. Similar changes called foot process “fusion”

The mesangium is separated from the capillary lumen by the endothelium and consists of mesangial cells and surrounding mesangium matrix. These cells provide structural support for the capillary loops. They contain numerous filaments and have contractile as well as phagocytic properties.

Cell contraction is believed to limit filtration, perhaps by reducing the area of the glomerular filter. It is stimulated by Angiotensin11, Arginine, vasopressin and thromboxane, but is it is inhibited by prostaglandin 2.

The juxtaglomerular apparatus which is located at the vascular pole of the glomerulus, has vascular components and tubular component.

The vascular components include the terminal portion of the afferent arteriole, the initial portion of the efferent arteriole. The tubular component has a macula densa.

Some of the cells in the vascular portion of the JGA contain numerous granules. Granules of the JGA secretes rennin which, through the formation of angiotensin, is involved in the regulation of tubuloglomerular feedback and the control of aldosterone- stimulated sodium and potassium transport. Therefore the JGA is an important focal point for control of renal hemodynamic and salt excretion.

9. How does the kidney normally restrict the excretion of plasma proteins?

Ans: The glomerulus functions as a size and charge- selective ultrafilter that largely prevents filtration of plasma proteins into the tubules. Size- selective properties reflect poorly characterized pores in the glomerular capillary wall structure that prevent filtration of proteins above a specific molecular radius. Charge-selective properties arise from the presence of negatively charged sialoproteins and proteoglycans in the glomerulus. Because most of the plasma proteins are negatively charged, they are electrostatically repelled and fail to filter through the glomerulus. The glomerular capillary membrane is not a perfect filter. However, a large fraction of the plasma protein filtered through glomeruli is subsequently reabsorbed by renal tubular cells.

10. What is the clinical significance of glomerular filtration rate?

Ans: Glomerular filtration rate is the volume of plasma filtered from the glomerulus into Bowman`s capsule each minute, expressed in ml/minute. GFR most often refers to the sum filtration rate of all functioning nephrons. The most widely used clinical index of GFR is the serum creatinine. The normal values of GFR are Men: 115-125ml/mt, Women: 90-110ml/mt.

GFR is the valuable indicators of kidney function, identification of the stages of kidney failure, determine appropriate dosage of drugs and initiation of dialysis or transplantation.

11. What is the clinical relationship between creatinine and GFR?

Ans: Creatinine is a byproduct of the nonenzymatic conversion of creatinine and phosphocreatine in skeletal muscle. Production of creatinine by skeletal muscle is proportional to muscle mass and remains relatively constant. Once creatinine is filtered through the glomerular capillaries, it passes through the nephron with minimal change and is excreted, hence creatinine clearance is a measure of the glomerular filtration rate.

Creatinine clearance is an excellent clinical indicator of renal function. In healthy state, creatinine excretion equals creatinine production. Plasma creatinine creatinine= constant production/GFR. Therefore, diminished renal function decreases creatinine clearance.

12. How does the kidney normally maintain constant GFR?

Ans: The ability of the kidneys to maintain constant GFR is called renal autoregulation. The process responsible for renal autoregulation is called tubulo glomerulo feed back.The two mechanisms involved tubuloglomerulo feed back are afferent arteriolar vasodialator feedback and efferent arteriolar vasoconstrictor feedback controlled by juxtaglomerular apparatus.

The juxta glomerular apparatus consists of specialized cells called macula densa cells, which respond to ischemic changes and secret rennin. A decreased amount of glomerular filtrate decreases the sodium and chloride concentration in the area of macula densa, which causes dilatation of the afferent arteriole, as the afferent arteriole dialates blood flow and hydrostatic pressure in the glomerular capillary bed increase, thus maintaining the glomerular capillary pressure and GFR.

The decrease in sodium and chloride at the macula densa also causes rennin release, which causes efferent arteriole constriction also helps maintain the hydrostatic pressure in the glomerular capillary bed and helps GFR remains normal.

13. How does the kidney regulate the body water balance?

Ans: Glomeruluar filtration rate normally about 12oml/mt,approximately 180 liters are filtered from the glomerulus into bowman`s capsule every 24 hours.Under the influence of hormones

and countercurrent mechanisms,98-99% of this filtrate is reabsorbed by active and passive methods, excrete urine output of 1.5-2liters a day. Proximal tubule, ascending and descending limb of henle, distal tubule and collecting duct are responsible for reabsorption and secretion of glomerular filtrate under the influence of aldosterone and anti-diuretic hormone. However, the kidneys can make significant changes in the urine output depending on the state of hydration.

In conditions of fluid deficit, maximal amounts of tubular filtrate are reabsorbed and a small amount of urine is excreted under the influence of ADH and aldosterone hormone. Conversly,in conditions of fluid excess tubular reabsorption decreases and large volume of diluted urine is excreted by the absence of ADH.

14. Explain the consequences of clearance?

Ans: Volume of plasma that can be cleared of a specific solute by the kidneys per unit of time, expressed in ml/mt. The actual clearance depends on the rates of filtration, secretion and reabsorption. Clearance of a specific substance from the plasma depends on four factors.

- If a substance is filtered at the glomerulus and is not reabsorbed or secreted in the renal tubule, then the clearance of that substance equals the GFR of the substance.
- If a substance is filtered at the glomerulus and partially or completely reabsorbed in the tubule, then the clearance of that substance is less than the GFR of the substance.
- If a substance is filtered at the glomerulus and secreted in the tubule, then the clearance of that substance is greater than the GFR of the substance.
- If a substance is filtered at the glomerulus and reabsorbed and secreted in the tubule, the clearance of that substance may be less than, equal, or greater than the GFR of the substance.

15. What are the basic concepts involved in renal function?

Ans: Seven major concepts involved in renal functions, which include glomerular filtration, renal auto regulation, clearance, tubular reabsorption, action of ADH and aldosterone, tubular secretion, and maximum tubular transport.

16. How does the renal tubule perform reabsorption function?

Ans: Renal tubular reabsorption involves active and passive mechanisms. Active transport requires energy to move substances against the concentration or electrochemical gradient. Sodium, glucose, calcium, phosphorus and amino-acids are actively reabsorbed. Passive transport requires no energy as it is based on concentration gradients. Urea, water, chloride, and some bicarbonate are passively reabsorbed.

Anti Diuretic hormone controls water reabsorption in the distal convoluted tubules and collecting ducts by increasing the permeability of the tubules and duct walls to water, thus promoting reabsorption. Aldosterone regulates sodium retention and potassium secretion by tubular epithelial cells.

17. What is the significant function of maximal tubular transport capacity?

Ans: Maximal tubular transport means the point at which the tubular membrane carrier that transports a substance become saturated with it and cannot accept more. Renal tubules have maximal tubular transport capacity for different substances. Once the maximal tubular transport capacity reached, substances normally reabsorbed are excreted. Substances normally excreted remain in the plasma.

18. What are the functions of Prostaglandins?

Ans: Renal medulla is major site of production of Prostaglandins, Prostacycline and Thromboxane. Prostaglandins play important roles in vascular tone and salt excretion. Prostaglandins and Prostacycline are acts as vasodilator and natriuretic whereas thromboxane act as vasoconstrictor and antinatriuretic. Prostaglandins regulate blood flow to the kidney and distribute blood in kidney.

19. How does the kidney excrete drugs and metabolic waste products?

Ans: Urea is a nitrogenous waste product of protein metabolism.Urea is filtered at glomerulus, reabsorbed from PCT, secreted into descending limb of loop of Henle, neither reabsorbed nor secreted in ascending limb of Henle, reabsorbed from collecting duct and variable amount excreted in urine. Under normal circumstances the kidneys excrete urea entirely by means of glomerular filtration.

Glucose and amino acids enter the glomerular filtrate from the blood stream, and completely reabsorbed by the tubules and do not appear in the urine at all. In contrast to this approximaly half the filtered urea is reabsorbed by the tubules while the others half appear in the urine.

If dietary protein intake is increased and urea production is high the blood urea level will rise slightly and are there will be corresponding increases in the amount of urea in the glomerular filtrate.

Only when the GFR is substantially reduced as a result of renal damage will there be a significant rising in blood. Dietary discretions have more serious effect in patients with renal failure.

CREATININE NORMAL 0.8-1.4MG/DL

Creatinine is a break down product of muscle metabolism, amount produced is proportional to muscle mass of the body and occurs in constant rate and excreted constantly. It is hardly affected by dietary protein intake.

Filtered creatinine is passing down the renal tubules without being significantly absorbed or secreted, creatinine is specially use full for making an stimulation of GFR and reliable indicator of renal function.

EXCRETION OF DRUGS AND POISON

The kidneys share with the liver the important job of disposing drugs and poisons that enter the body. Water soluble drugs tend to be excreted mainly in the urine while fat soluble drugs are usually deal with the liver.

Having entered the liver they may be excreted in the bile or changed in to water soluble in active components which are then excreted in the urine.

In drug overdose, the process of excretion involves concentrations of the poison in renal tubules severely high and damages tubules cells. This will cause acute renal failure.

20. Can measurement of blood urea serve as an index of GFR?

Ans: Blood urea is not a reliable index of GFR. The renal tubules reabsorb urea in quantities vary depending upon the state of hydration and it`s concentration also strongly affected by protein intake and catabolism.

21. What is renal tubular secretion?

Ans: Renal tubular secretion is a process by which substances move from peritubular capillary into the interstitial fluid and then into the tubular lumen.

22. What are the factors maintain normal GFR?

Ans: Three factors are essential to maintain normal GFR which includes permeability and surface area of the glomerular capillary wall, blood pressure and net filtration pressure.

23. Explain the vasculature of the kidney?

Ans: Each kidney has one renal artery that branches from the abdominal aorta and enters the kidney at hilum.Renal artery divides into interlobar arteries which travel alongside the pyramids into the cortex.At the junction of cortex and medulla, the interlobar artery bend at right angles, and are called arcuate arteries at this point.The arcuate arteries branch into interlobar arteries which travel into the cortex.In the cortex, the interlobar arteies divided into afferent arterioles.

The blood flow to the kidney is large amounting to approximately 1200ml/mt.Blood leaves the glomeruli through the efferent arterioles which continue on to form the peritubular capillary networks in the cortex.Blood from the capillaries drains into the interlobular,arcuate, and and interlolobar veins, and finally leaves the kidney through the renal vein.

24. What is the relationship between potassium and hydrogen?

Potassium and hydrogen ions are carrying positive electrical charge and has reciprocal relationship between them. If one of them enters the cells the other has to come out because electrical neutrality must be preserved.

If serum potassium becomes elevated due to excessive potassium administration, potassium enters the cell and hydrogen ions come out in to the plasma. This makes the plasma more acid.

If serum potassium is low, potassium come out of the cells in to the ECF and Hydrogen ions go in to the cells. The loss of H+ will make the plasma more alkaline.

25. How does the kidney regulate the electrolyte balance?

Sodium normal: 135-145meq/l

Sixty to eighty percent of the major electrolytes re absorbed in the proximal tubule with water. Selective re absorption and secretion of the reminder takes place in the distal tubules according to the needs of the body.

Sodium and water largely regulate blood volume and the osmolarity of the extra cellular fluid. It is therefore fortunate that healthy kidneys conserve very efficiently if there is a shortage and can excrete large amounts if an excess.

If sever deficiency, the blood flow to the kidney's will be reduced and renal function will become impaired.

Renal disease which damages the tubules may be associated with inability to conserve sodium normally.

Other factor such as aldosterone plasma potassium and ACTH helps to regulate sodium level.

POTASSIUM: NORMAL 3.5-5.5meq/L

Potassium is filtered at glomerulus and almost 90% of K+ eliminated in the urine is due to secretion in the cortical collection duct. Both high sodium diet and the administration of alkali will increase urinary potassium loss.

A low sodium diet and administration of acid tend to cause potassium retention. Potassium loss is also increased by ACTH.

Potassium and hydrogen ions are carrying positive electrical charge and has reciprocal relationship between them. If one of them enters the cells the other has to come out because electrical neutrality must be preserved.

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CALCIUM 8.5-10.5mg/dl

Calcium is filtered at glomeruls. 65% of filtered calcium is actively reabsorbed in PCT and 25% in loop of henle and 10% in DCT. Parathyroid hormone, low plasma calcium and decreased GFR may enhance calcium reabsorption.

PHOSPHATE: 3.0-4.5mg/dl

The major influence on phosphorus balance is renal 85-90%of the filtered load is reabsorbed in the PCT and the final 10% in the distal tubule. Decreased GFR, high PO4 intake and hyperparathyroidism may cause hyperphosphatemia.

26. What is the role of JGA in renal autoregulation action?

Some of the cells in the vascular portion of the JGA contain numerous granules. Granules of the JGA secretes rennin which, through the formation of angiotensin, is involved in the regulation of tubuloglomerular feedback and the control of aldosterone- stimulated sodium and potassium transport. Therefore, the JGA is an important focal point for control of renal homodynamic and salt excretion.

27. What is the significant function of principal cells?

A main function of principal cells in the cortical collecting duct is potassium secretion. The principal cells and inner medullary colleting duct cells are responsive to antidiuretic hormone, water is reabsorbed from the collecting duct which leads to the formation of a hypertonic urine in the absence of ADH.

II. Multiple choice questions

28. The major components of a nephron are

A. Cortex, hilum. B. Medulla, glomerulus. **C. Glomerulus, tubule**. D. Cortex and medulla.

29. The covering of the kidney is called

A. Medulla. **B. Fibrous capsule**. C. Adrenal gland. D. Juxta glomerulus.

30. Renal pyramid is

A. a triangular structure composed of nephrons and blood vessels

B. the cortical tissue between nephrons

C. major collection part of nephrons

D. site of rennin production

31. The vascular network surrounding the loop of Henle of a juxtamedullary nephron is called

A. Glomerulus. **B. Vasa recta.** C. Bowman`s capsule D.efferent arteriole

32. Erythropoeitin is secreted by

A. macula densa B.bowmans capsule **C.peritubular cells** D.cells in the liver

33. What percentage of glomerular fitrate is reabsorbed in tubules?

A.96% **B.99%** C.90% D.100%

34. Renin is secreted by the

A. glomerulus **B. Juxtaglomerulo apparatus** C. Pelvis D.Pappila.

35. Urine is transported through the ureters by

A . Peristalsis B.Diffusion C.Osmosis D.Ultrafitration

36. Which of the following affect urea production?

A. Protein intake B. Catabolism C. Steroid **D. All of them**

37. Creatinine is filtered at the glomerulus and

A. Reabsorbed in the proximal tubule

B. Neither reabsorbed nor secreted in the tubule

C. Secreted in the distal tubule

D. Influenced by hormones

38. Under normal circumstances, GFR does not contain which of the following substances?

A. Proteins, Red blood cells B. Amino-acids C. Uremic toxins D.All of them

39.WHICH SUBSTANCE IS 60 TIMES MORE CONCENTRATE IN URINE THAN IN PLASMA

A.glucose b.creatinine c.sodium **d.urea**

Glucose thresh hold for non-diabetes 180mg,normal serum glucose is 70-120mg and urine 0-0.8mg(For diabetes renal threshold is 54-300mg)

Creatinine normal in serum is 0.7-1.2mg/dl .creatinine in urine 955mg to 2936 for male and 601 t0 1689mg for female

Sodium 135 to 145 meq/l and urine sodium 20meq/l

Urea is 50% TO 60% HIGHER IN URINE BECAUSE the combination of water reabsorbtion,urea reabsorption, countercurrent exchange and urea cycling leads to increase concentration to initial glomerular filtrate(24 hrs urea in urine :200 to 600mmol/l)

40. REGARDING THE ANATOMY OF THE KIDNEY

a.the afferent arteriole is smaller than the efferent

b.the kidney contains 1.3 millions of nephrons

c.there are three layers separating the blood in the arteriole from the glomerular filtrate

d.podocytes are contractile and regulate GFR

Normal size of afferent arteriole is 21.5micrometer +_1.2 and efferent arteriole is 15.9 micrometer in diameter. normally afferent arteriole is bigger that efferent

There are three layers separating the blood in the arteriole from the glomerular capillaries

Podocytes are active contractile and prevent in plasma proteins enter the urinary ultrafiltrate

41. REGARDING GLOMERULUS FILTRATION

a.it allows the passage of molecules up to 4nm diameter freely, and up to 8nm with some depending on charge

b.positively charged molecules pass more easily than neutral

c.endothelial pores have greater diameter than podocyte filtration slits

d.the basal lamina contains irruption

Positively charged molecules are attracted to the negative charges and pass through more easily

Endothelial pores have a 60-80nm diameter and podocyte filtration slits are 30-40 nm in diameter

The basal lamina contains thin sheet layer and composed of type iv collegen, laminin and nidogen

42. WHICH CAUSES AN INCREASE IN GFR

a.endothelins **b.noradrenalin** **c. PGE2** **d.histamin**

Endothelins are vasoconstrictor effect on efferent arteriole and afferent arteriole to maintain GFR

Noradrenalin increases renal blood flow and perfusion to increase GFR

PGE-2 RLAXES AFFERENT ARTERIOLE AND INCREASE GFR

Histamine act as vasodilatation and increase GFR

43.THE RENAL TUBULE

a. all sections are lined with cuboidal epithelial cells with luminal microvilli

b. the thick loop of henle rises to lie adjacent to its glomerulus

c. there are a greater number of juxtamedullary nephrons than cortical

d. the lacis cells of the JGA secretes renin

JGA LACIS CELLS LOCATED BETWEEN THE AFF-EFF ARTERIOL AND SUPPORTING THE JGA TRANSMITTING SIGNALS

JGA MACULADENSA DENSE CELLS MONITOR SODIUM CONCENTRATION IN THE TUBULAR FLUID

JGA GRANULAR CELLS IN THE AFFERENT ARTERIOLE SECRETES RENIN -REGULATE BP

44. REGARDING GLOMERULAR BLOOD SUPPLY

a. the efferent arterioles are branches of the interlobar arterioles

b. the descending vasa recta vessels contains fenestrated endothelium to assist urea transport

c. the efferent arterioles empties in to the peritubular network

d. the glomerular capillaries drain into the efferent vein

THE EFFERENT ARTEROLES ARE BRANCHES OF RENAL ARTERY

THE DESCENDING VASA RECTA VESSELS CONTAIN FENESTRATED ENDOTHELIUM TO ASSIST URINE CONCENTRATION AND TRANSPORT

THE GLOMERULAR CAPPILLARIES DRAIN INTO THE EFFERENT ARTERIOLE

45. WHICH OF THE FOLLOWING WILL CAUSE AN INCREASE IN GFR

a. dehydration b. ureteral obstruction c. afferent arteriole constriction **d.**

hypoproteinaemia

DEHYDRATION, URETERAL OBSTRUCTION AND AFFERENT ARTERIOLE CONSTRICTION DECREASES GFR BUT HYPOPROTEINEMIA MAY INCREASE GFR DUE TO REDUCED COLLOIDAL OSMOTIC PRESSURE

46. SODIUM RESORPTION DOESNOT OCCUR IN WHICH PART OF THE NEPHRON

a.PCT **b.thin descending loop of henle** c.thick ascending loop of henle

d.DCT e.collecting duct

sodium reabsorption occurs in proximal convoluted tubule 60%, thick ascending loop of henle 25%,DCT 5% and collecting duct 5-7%

THIN DESCENDING LOOP OF HENLE DOSENT REABSORB SODIUM

47.WHICH IS NOT RESORBED VIA COTRANSPORT WITH SODIUM IN THE PCT

a.lactate b.phosphate **c.hydrogen** d.aminoacids

48.FANCONI`S SYNDROME OF DECREASED LEVELS OF ATP IN THE TUBULAR EPITHELIUM OF THE PCT

a.decreases sodium extrusion from the cell into the interstitium

b.causes increased phosphate absorption

c.causes metabolic alkalosis

d.results in decreased aminoacid excretion

49.ANTI-DIURETIC HORMONE CONTROLS THE CONCENTRATION OF URINE

a.and can concentrate urine to upto 2500 mosm/kg H20

b.in its absence ,the collecting duct is impermeable to water

c.causing the ultimate resorption of upto 99.7% of the filtrate

d.by causing upregulation of aquaporin-1 channels

50.Regarding H+ RENAL EXCRETION

a.the distal convoluted tubule brush border contains carbonic anhydrase

b.H+ secretion occurs in all segments of the nephrons

c.H+NH3----NH4 is the most significant tubular buffering reaction

d.CO2 is recycled/ resorbed in the PCT to allow enhanced acid secretion

51.In the nervous control of the bladder which nerves do not play a role in micturtion

a. **sympathetic nerves from L2 in hypogastric nerve**
b. somatic motor bneurons in pudendal nerve
c. sensory neurons to S2/3 in pelvic nerve
d. parasympathetic supply in pelvic nerves

52.WHICH IS THE LEAST SIGNIFICANT BUFFERING SYSTEM IN THE BLOOD

a.H+ plasma protein----------HProt

b.H+HPO4-------H2PO4

c.H+ +HCO3---H2CO3

d.H+ =HB—HB

53.IN WHICH BODY COMPARTMENT IS THE BICARB BUFFERING SYSTEM LEAST IMPORTANT

a.intracellular b.interstitial c.CSF d.blood

54.IN WHICH STATE IS EXTRACELLULAR BUFFERING MORE IMPORTANT THAN INTRACELLULAR

a.respiratory acidosis b.respiratory alkalosis c.metabolic acidosis **d.metabolic alkalosis**

55.RENAL ACID SECRETION IS ENHANCED BY

a.respiratory acidosis b.respiratory alkalosis c.hyperkalemia d.carbonic anhydrase inhibition

56.CARBONIC ANHYDRASE IS NOT INHIBITED BY

a.cyanide **b.ZINC** c.azide d.sulphide

57.WHAT INCREASES GFR

a.moderate constriction of efferent arteriole b.moderate constriction of efferent arteriole

c.increased bowman`s capsule pressure d.increased glomerular capillary osmotic pressure

58.WHAT INCREASES THE ANION GAP

a.increased concentration of Mg b.decreased concentration of plasma proteins

c.decreased concentration of lactate **d.increased concentration of ketoacids**

KETOACID ANIONS ACETOACETATE AND BEYA-HYDROXYBUTYRATE INCREASES ANION GAP IN METABOLIC ACIDOSIS.BECAUSE THE ACCUMULATION OF THESE UNMEASURED ANIONS,COUPLED WITH DECREASE IN THE MEASURED ANION BICARBONATE LEADS TO HIGHER OVER ALL ANION GAP CALCULATION

59.WHICH IS CORRECT

a.humans have approximately 1.3 million nephrons **b.nephron length is 45-65mm**

c.glomereular membrane excludes substances greater than 4nm in diameter

d.total area of glomerular capillary endothelium is 8m2

GLOMERULAR MEMBRANE EXCLUDES SUBSTANCES VGREATER THAN 4 NM IN RADIUS

HUMANS HAVE APPROXIMATELY 1.3 MILLION NEPHRONS IN EACH KIDNEY

GLOMERULAR BASEMENT MEMBRANE EXCLUDES SUBSTANCES GREATER THAN 4NM RADIUS AND 8NM DIAMETER

TOTAL SURFACE AREA OF GLOMERULAR CAPPILLARY ENDOTHELIUM IS 6,000CM2 AND TOTAL FILTRATION SURFACE AREA IS 516.1CM2 .THE GM,GLOMERULAR CAPILLARIES IS ABOUT 0.8M2

A SINGLE GLOMERULUS LENGTH IS 0.95 AND TOTAL FOR 2 MILLION EQUAL TO 19KM

60.WHICH IS TRUE

a.U/P ratio for creatinine is 150mg/dl b.U/P ratio for glucose is 10

c.sodium concentration in the urine usually exceeds over 150mg/dl

d.the usual glucose excretion in the urine is 100mg/dl

U/P ratio for glucose is 0

Sodium concentration in the urine usually exceeds over 20meq/l in random or 40-220meq/ day

The usual glucose excretion in the urine is 0,normal threshold for glucose is 180mg

61.WHICH OF THE FOLLOWING IS FALSE

a.proximal convoluted tubular cells have lateral intracellular space -true

b.the cells in the descending loop of Henle have large numbers of mitochondria

c.the ascending loop of henle contributes to the formation of JGA (TRUE)

d.in humans only 15% of the nephrons have long loops are called JMN(true)

THE CELLS IN THE DESCENDING LOOP OF HENLE HAVE LARGE NUMBER OF AQUAPORIN-1

62.REGARDING TUBULAR FUNCTION

a.90% of the water is reabsorbed by the PCT

b.renal threshold for glucose is 300mg/dl

c.the main mechanism of the sodium reabsorption from the tubular fluid to proximal

d. the main mechanism of sodium reabsorption in the ascending loop of henle is via cotransport of Na/k/2cl

90% of the water is reabsorbed by the PCT

THE RENAL THRESHOLD FOR GLUCOSE IS 180

THE MAIN MECHANISM OF THE SODIUM REABSORPTION FROM THE GLOMERULAR CAPPILLARY

63.THE MAXIMUM EFFECT OF VASSOPRESSIN OCCURS AT

a.DCT b.PCT **C.cortical part of collecting duct** d.medullary part of collecting duct

VASOPRESSIN A HORMONES ACTS ON AQUAPORIN MOLECULES TO REMOVE MORE WATER FROM THE Ultrafiltrate, primarily acts on the distal convoluted tubule and cortical collecting duct, PROMOTING RESORBTION AND INCREASE VOLUME AND BP

64.REGARDING THE BUFFER SYSTEM IN THE TUBULAR FLUID,WHICH ONE IS TRUE

a.the main buffer system is H2PO4

b.the main mechanism of H+ secretion in the PCT is via proton pump

c.dibasic phosphate buffer is most effective at PCT

D.the H+ secretion at PCT tubule is mediated Na/K/ATP

THE LEAST BUFFER SYSTEM IS H2PO4

THE MAIN MECHANISM OF H= SECRETION IN THE PCT IS VIA Na/H+ATP-PUMP

DIBASIC PHOSPHTE BUFFER IS MOST EFFECTIVE AT DCT&CD

65.REGARDING THE RENIN -ANGIOTENSIN SYSTEM,WHICH IS CORRECT

a.renin has many functions including the formation of angiotensin I from angiotensinogen

b.after nephrectomy,circulating levels of protein fall

c.renin is formed in the juxtaglomerular cells of the kidney

d.active renin has a half-life in the circulation of 40 minutes less

e.protein is biologically active

ANGIOTENOGEN IS PRODUCED IN THE LIVER ,IT CONVERTS RENIN TO ANGIOTENSIN I

AFTER NEPHRECTOMY,CIRCULATING LEVELS OF PROTEIN FALL AND STABILIZE PRERENIN SYNTHESIS AND EXTRARENAL SITES

RENIN HALF-LIFE IN THE CIRCULATION IS 15 MINUTES FOR NORMAL PEOPLE BUT KIDNEY PATIENTS 1HOUR AND 22 MINUTES

PRORENIN IS BIOLOGICALLY INACTIVE OR EXIBIT SOME BIOLOGICAL ACTIVITY

66.ALL OF THE FOLLOWING INCREASE RENIN SECRETIONJ EXCEPT

a.sodium depletion b.diuretics c.cardiac failure **d.hypertension** e.chirrhosis

sodium depletion,diuretics,cardiac failure and chirrosis increases renin secretion

67.ALL OF THE FOLLOWING FACTORS INHIBIT RENIN SECRETION EXCEPT

a.prostaglandin b.angiotensin II c.vasopresin II D.increased afferent arteriole pressure

e.increased sodium and chloride reabsorption across the macular densa

PROSTAGLADINS DIRECTLY STIMULATE RENIN SECRETION

ANGIOTENSIN II,VASOPRESSIN INCREASED AFFERENT ARTERIOLE PRESSURE AND INCREASED SODIUM AND CHLORIDE REABSORPTION ACROSS MACULA DENSA CELLS INCREASE RENIN SECRETION.

68. WHICH OF THE FOLLOWING IS INCORRECT REGARDING REGULATION OF RENAL BLOOD FLOW

a.noradrenaline constricts the renal vessels

b.dopamine causes renal vasodilation and natriuresis

c.angiotensin II exerts a vasoconctor effect on the efferent arterioles

d.prostaglandins increase blood flow in the renal cortex and decrease BFR in the renal medulla

e.acetylcholine produces renal vasoconstriction

noeadrenaline constricts the renal vessels ,.dopamine causes renal vasodilation and natriuresis

.angiotensin II exerts a vasoconctor effect omn the efferent arterioles,

.prostaglandins increase blood flow in the renal cortex and decrease BFR in the renal medulla

ACETYLCHOLINE PRODUCES RENAL VASODILATION

69.ERYTHROPOIETIN

a.is produced in the juxtaglomerular apparatus

b.production is stimulated by theophylline

c.secretion is facilitated by the acidosis that develops at high attitude

d.has a half-life in the circulation of about 5 hours

e.is produced predominantly in the spleen in neonates

ERYTHROPOIETIN PRODUCED IN THE PERITUBULAR CELLS OF THE NEPHRON

ERYTHROPOIETIN PRODUCTION IS STIMULATED BY HYPOXIA

ERYTHROPOIETIN SECRETION IS FACILITATED BY THE HYPOXIA THAT DEVELOPS AT HIGH ALTITUDE

ERYTHROPOIETIN IS PRODUCED PREDOMINANTLY IN THE LIVER IN THE FETAL STAGE AND SHIFT TO THE KIDNEY IN THE FIRST MONTH OF LIFE.

70.MESENGIAL CELLS CONTRACTION IS STIMULATED BY

a.ANP b.dopamin c.PGE2

D.c AMP **e.angiotensin II**

ANP INCREASES SODIUM AND WATER EXCRETION THUS DECREASE AND VOLUME

DOPAMIN CAUSES RENAL VASODILATATION AND NATRIURESIS

C AMP INVALVED IN FLUID REABSORPTION AND WATER BALANCE

ANGIOTENSIN II PLAYS A SIGNIFICANT ROLE IN STIMULATING CONTRACTION OF MESENGIAL CELLS

71.WITH REGARD DIURETICS

a.frusemide acts on the thick ascending limb of the henle

b.antagonists to v2 vasopressin receptors act on the eary portion of distal convoluted tubule

c.thiazides act primarily on the thick ascending limb of the loop of henle

d.loop diuretics act on the collecting ducts

e. aldosterone antagonists act on the early portion of the distal convoluted

ANTAGONISTS TO V2 VASOPRESSIN RECEPTORS ACT ON THE EARLY PORTION OF COLLECTING DUCT

THIAZIDE DIURETICS ACT PRIMARLY ON THE DISTAL CONVOLUTED TUBULE

LOOP DIURETIC ACT ON THICK ASCENDING LIMB OF HENLE

ALDOSTERONE ANTAGONISTS ACT ON THE LATE PORTION OF DCT AND COLLECTING DUCT

72. Questions 34&35 Use the following clinical laboratory test results for questions 34&35 and : Urine flow rate = 1 ml/min Urine inulin concentration = 100 mg/ml Plasma inulin concentration = 2 mg/ml Urine urea concentration = 50 mg/ml Plasma urea concentration = 2.5 mg/ml

73. What is the glomerular filtration rate (GFR)?

A. 25ml/min **B. 50 ml/min** C. 100 ml/min D. 125ml/min E. None of the above 2.

Ans.B) GFR is equal to inulin clearance, which is calculated as the urine inulin concentration (100 mg/ml)× urine flow rate (1 ml/min) ÷ plasma inulin concentration (2 mg/ml),which is equal to 50 ml/min

74.What is the net urea reabsorption rate?

A. 0 mg/min B. 25 mg/min C. 50 mg/min **D. 75 mg/min** E. 100 mg/min

D) The net urea reabsorption rate is equal to the filtered load of urea (GFR [50 ml/min] × plasma urea concentration [2.5 mg/ml]) − urinary excretion rate of urea (urine urea concentration [50 mg/ml] × urine flow rate [1 ml/min]). Therefore, net urea reabsorption = (50 ml/min × 2.5 mg/ml) − (50 mg/ml × 1ml/min) = 75 mg/min

75. Which of the following solutions when infused intravenously would result in an increase in extracellular fluid volume, a decrease in intracellular fluid volume, and an increase in total body water after osmotic equilibrium?

A. 1 L of 0.9% sodium chloride solution B. 1 L of 0.45% sodium chloride solution

C. 1 L of 3% sodium chloride solution D. 1 L of 5% dextrose solution E. 1 L of pure water

C) A 3% sodium chloride (NaCl) solution is hypertonic and when infused intravenously would increase extracellular fluid volume and osmolarity, thereby causing water to flow out of the cell. This would decrease intracellular fluid volume and further increase extracellular fluid volume. The 0.9% NaCl solution and 5% dextrose solution are isotonic, and therefore would not reduce intracellular fluid volume. Pure water and the 0.45% NaCl solution are hypotonic, and when infused would increase both intracellular and extracellular fluid volumes

76. A 65-year-old man has a heart attack and experiences cardiopulmonary arrest while being transported to the emergency room. The following laboratory values are obtained from arterial blood: A. plasma pH = 7.12, B. plasma PCO2 = 60mm Hg, and C. plasma HCO3 D. concentration = 19 mEq/L. A. Which of the following best describes his acid-base disorder?

A. Respiratory acidosis with partial renal compensation

B. Metabolic acidosis with partial respiratory compensation

C. Mixed acidosis: combined metabolic and respiratory acidosis

D. Mixed alkalosis: combined respiratory and metabolic alkalosis

Ans.C) Because the patient has a low plasma pH (normal = 7.4), he has acidosis. The fact that his plasma bicarbonate concentration is also low (normal = 24 mEq/L) indicates that he has metabolic acidosis. However, he also appears to have respiratory acidosis because his plasma Pco2 is high (normal = 40 mm Hg).The rise in Pco2 is due to his impaired breathing as a result of cardiopulmonary arrest. Therefore, the patient has a mixed acidosis with combined metabolic and respiratory acidosis

77. In normal kidneys, which of the following is true of the osmolarity of renal tubular fluid that flows through the early distal tubule in the region of the macula densa?

A. Usually isotonic compared with plasma **B. Usually hypotonic compared with plasma**

C. Usually hypertonic compared with plasma

D. Hypertonic, compared with plasma, in antidiuresis

Ans B) As water flows up the ascending limb of the loop of Henle, solutes are reabsorbed, but this segment is relatively impermeable to water; progressive dilution of the tubular fluid occurs so that the osmolarity decreases to approximately 100 mOsm/L by the time the fluid reaches the early distal tubule. Even during maximal antidiuresis, this portion of the renal tubule is relatively impermeable to water and is therefore called the diluting segment of the renal tubule

78. After receiving a renal transplant, a patient develops severe hypertension (170/110 mm Hg). A renal arteriogram indicates severe renal artery stenosis in his single remaining kidney, with a reduction in GFR to 25% of normal. Which of the following changes, compared with normal, would be expected in this patient, assuming steady-state conditions?

A. Large increase in plasma sodium concentration

B. Reduction in urinary sodium excretion to 25% of normal

C. Reduction in urinary creatinine excretion to 25% of normal

D. Increase in serum creatinine to about four times normal

E. Normal renal blood flow in the stenotic kidney due to autoregulation

Ans:D) A severe renal artery stenosis that reduces GFR to 25% of normal would also decrease renal blood flow but would cause only a transient decrease in urinary creatinine excretion. The transient decrease in creatinine excretion would increase serum creatinine (to about four times normal), which would restore the filtered creatinine load to normal and therefore return urinary creatinine excretion to normal levels under steady-state conditions. Urinary sodium secretion would also decrease transiently but would be restored to normal so that intake and excretion of sodium are balanced. Plasma sodium concentration would not change significantly because it is carefully regulated by the antidiuretic hormone thirst mechanism.

79. Which of the following tends to decrease potassium secretion by the cortical collecting tubule?

A. Increased plasma potassium concentration

B. A diuretic that decreases proximal tubule sodium reabsorption

C. A diuretic that inhibits the action of aldosterone (e.g., spironolactone)

D. Acute alkalosis

80. If a patient has a creatinine clearance of 90 ml/min, a urine flow rate of 1 ml/min, a plasma K+ concentration of 4 mEq/L, and a urine K+ concentration of 60 mEq/L, what is the approximate rate of K+ excretion?

A. 0.06 mEq/min B. 0.30 mEq/min C. 0.36 mEq/min D. 3.6 mEq/min E. 60 mEq/min

Ans. A) K+ excretion rate = urine K+ concentration (60 mEq/L) × urine flow rate (0.001 L/min) = 0.06 mEq/min

81. Which of the following changes would be expected in a patient with diabetes insipidus due to a lack of antidiuretic hormone (ADH) secretion?

A.POS-NORMAL,PNA NORMAL,PRENIN -DECREASED and Urine volume increased

B.POSM-NORMAL,PNA -NORMAL,P.RENIN INCREASED, and URINE VOLUME INCREASED

C.POSM,P.RENIN,PNA and URINE VOLUME INCREASED

D.POSM-INCREASED,PNA-INCREASED,RENIN-NORMAL and urine volume normal

Ans.C) In the absence of ADH secretion, there is a marked increase in urine volume because the late distal and collecting tubules are relatively impermeable to water. As a result of increased urine volume, there is dehydration and increased plasma osmolarity and high plasma sodium concentration. The resulting decrease in extracellular fluid volume stimulates renin secretion, resulting in an increase in plasma renin concentration

82. Which of the following changes would you expect to find after administering a vasodilator drug that caused a 50% decrease in afferent arteriolar resistance and no change in arterial pressure?

A. Decreased renal blood flow, decreased GFR, and decreased peritubular capillary hydrostatic pressure

B. Decreased renal blood flow, decreased GFR, and increased peritubular capillary hydrostatic pressure

C. Increased renal blood flow, increased GFR, and increased peritubular capillary hydrostatic pressure

D. Increased renal blood flow, increased GFR, and no change in peritubular capillary hydrostatic pressure E. Increased renal blood flow, increased GFR, and decreased peritubular capillary hydrostatic pressure

Ans. C) A 50% reduction in afferent arteriolar resistance with no change in arterial pressure would increase renal blood flow and glomerular hydrostatic pressure, thereby increasing GFR. At the same time, the reduction in afferent arteriolar resistance would raise peritubular capillary hydrostatic pressure

83. A 32-year-old man complains of frequent urination. He is overweight (102kg, 5 ft 10 in tall), and after measuring the 24-hr creatinine clearance, you estimate his GFR to be 150 ml/min. His plasma glucose is 300 mg/dL. Assuming that his renal transport maximum for glucose is normal, as shown in the figure, what would be this patient's approximate rate of urinary glucose excretion?

A. 0 mg/min B. 100 mg/min **C. 150 mg/min** D. 225 mg/min E. 300 mg/min
F. Information provided is inadequate

G. to estimate the glucose excretion rate.

Ans C) The filtered load of glucose in this example is determined as follows: GFR (150 ml/min) × plasma glucose (300 mg/dL) = 450 mg/min. The transport maximum for glucose in this example is 300 mg/min. Therefore, the maximum rate of glucose reabsorption is 300

mg/min.The urinary glucose excretion is equal to the filtered load (450 mg/min) minus the tubular reabsorption of glucose (300 mg/min),or 150 mg/min.

84.The clinical laboratory returned the following values for arterial blood taken from a patient: plasma pH = 7.28, plasma HCO_3^- = 32 mEq/L, and plasma P_{CO_2} = 70 mm Hg. What is this patient's acid–base disorder?

A) Acute respiratory acidosis without renal compensation

B) Respiratory acidosis with partial renal compensation

C) Acute metabolic acidosis without respiratory compensation

D) Metabolic acidosis with partial respiratory compensation

Ans.B) This patient has respiratory acidosis because the plasma pH is lower than the normal level of 7.4 and the plasma P_{CO_2} is higher than the normal level of 40 mm Hg. The elevation in plasma bicarbonate concentration above normal (~24 mEq/L) is due to partial renal compensation for the respiratory acidosis. Therefore, this patient has respiratory acidosis with partial renal compensation

85. Which of the following changes tends to increase peritubular capillary fluid reabsorption?

A. Increased blood pressure B. Decreased filtration fraction

C. Increased efferent arteriolar resistance D. Decreased angiotensin II

E. Increased renal blood flow

C) **Peritubular capillary fluid reabsorption is determined by the balance of hydrostatic and colloid osmotic forces in the peritubular capillaries. Increased efferent arteriolar resistance reduces peritubular capillary hydrostatic pressure and therefore increases the net force favoring fluid reabsorption. Increased blood pressure tends to raise peritubular capillary hydrostatic pressure and reduce fluid reabsorption. Decreased filtration fraction increases the peritubular capillary colloid osmotic pressure and tends to reduce peritubular capillary reabsorption. Decreased angiotensin II causes vasodilatation of efferent arterioles, raising peritubular capillary hydrostatic pressure, decreasing reabsorption, and decreasing tubular transport of water and electrolytes. Increased renal blood flow also tends to raise peritubular capillary hydrostatic pressure and decrease fluid reabsorption**

86. Which of the following would cause the greatest degree of hyperkalemia?

A) Increase in potassium intake from 60 to 180 mmol/day in a person with normal kidneys and a normal aldosterone system

B) Chronic treatment with a diuretic that inhibits the action of aldosterone

C) Decrease in sodium intake from 200 to 100 mmol/day

D) Chronic treatment with a diuretic that inhibits loop of Henle Na+-2Cl–-K+ co-transport

E) Chronic treatment with a diuretic that inhibits sodium reabsorption in the collecting ducts 8

B) Inhibition of aldosterone causes hyperkalemia by two mechanisms: (1) shifting potassium out of the cells into the extracellular fluid, and (2) decreasing cortical collecting tubular secretion of potassium. Increasing potassium intake from 60 to 180 mmol/day would cause only a very small increase in plasma potassium concentration in a person with normal kidneys and normal aldosterone feedback mechanisms. A reduction in sodium intake also has very little effect on plasma potassium concentration. Chronic treatment with a diuretic that inhibits loop of Henle Na+-2Cl–-K+ cotransport would tend to cause potassium loss in the urine and hypokalemia. However, chronic treatment with a diuretic that inhibits sodium reabsorption in the collecting ducts, such as a miloride, would have little effect on plasma potassium concentration

87. Which of the following is filtered most readily by the glomerular capillaries?

A) Albumin in plasma B) Neutral dextran with a molecular weight of 25,000

C) Polycationic dextran with a molecular weight of 25,000

D) Polyanionic dextran with a molecular weight of 25,000 E) Red blood cells

Ans. C) The filterability of solutes in the plasma is inversely related to the size of the solute (molecular weight). Also, positively charged molecules are filtered more readily than are neutral molecules or negatively charged molecules of equal molecular weight. Therefore, the positively charged polycationic dextran with a molecular weight of 25,000 would be the most readily filtered substance of the choices provided. Red blood cells are not filtered at all by the glomerular capillaries under normal conditions.

88.Under conditions of normal renal function, which of the following is true of the concentration of urea in tubular fluid at the end of the proximal tubule?

A) It is higher than the concentration of urea in tubular fluid at the tip of the loop of Henle

B) It is higher than the concentration of urea in the plasma

C) It is higher than the concentration of urea in the final urine in antidiuresis

D) It is lower than plasma urea concentration because of active urea reabsorption along the proximal tubule

Ans B) **Approximately 30% to 40% of the filtered urea is reabsorbed in the proximal tubule. However, the tubular fluid urea concentration increases because urea is not nearly as permeant as water in this nephron segment. Urea concentration increases further in the tip of the loop of Henle because water is reabsorbed in the descending limb of the loop of Henle. Under conditions of antidiuresis, urea is further concentrated as water is reabsorbed and as fluid flows along the collecting ducts. Therefore, the final urine concentration of urea is substantially greater than the concentration in the proximal tubule or in the plasma.**

89. A patient's urine is collected for 2 hr, and the total volume is 600 ml during this time. Her urine osmolarity is 150 mOsm/L, and her plasma osmolarity is 300 mOsm/L. What is her "free water clearance"?

A) +5.0 ml/min **B) +2.5 ml/min** C) 0.0 ml/min D) −2.5 ml/min E) −5.0 ml/min

Ans B) Free water clearance is calculated as urine flow rate (600 ml/2 hr, or 5 ml/min) − osmolar clearance (urine osmolarity × urine flow rate/plasma osmolarity). Therefore, free water clearance is equal to +2.5 ml/min.

90.Which of the following changes tends to increase GFR?

A) Increased afferent arteriolar resistance

B) Decreased efferent arteriolar resistance

C) Increased glomerular capillary filtration coefficient

D) Increased Bowman's capsule hydrostatic pressure

E) Decreased glomerular capillary hydrostatic pressure

C) The glomerular capillary filtration coefficient is the product of the hydraulic conductivity and surface area of the glomerular capillaries. Therefore,increasing the glomerular capillary filtration coefficient tends to increase GFR. Increased afferent arteriolar resistance, decreased efferent arteriolar resistance, increased Bowman's capsule hydrostatic pressure, and decreased glomerular hydrostatic pressure tend to decrease GFR

91. The maximum clearance rate possible for a substance that is totally cleared from the plasma is equal to which of the following?

A) GFR B) Filtered load of that substance

C) Urinary excretion rate of that substance **D) Renal plasma flow** E) Filtration fraction

D) If a substance is completely cleared from the plasma, the clearance rate of that substance would equal the total renal plasma flow. In other words, the total amount of substance delivered to the kidneys in the blood (renal plasma flow × concentration of substance in the blood) would equal the amount of that substance excreted in the urine. Complete renal clearance of a substance would require both glomerular filtration and tubular secretion of that substance

92. A patient has the following laboratory values: arterial pH = 7.13, plasma HCO_3^- = 15 mEq/L, plasma chloride concentration = 118 mEq/L, arterial P_{CO_2} = 28 mm Hg, and plasma Na^+ concentration = 141 mEq/L. What is the most likely cause of his acidosis?

A) Salicylic acid poisoning B) Diabetes mellitus **C) Diarrhea** D) Emphysema

C) The patient has a lower-than-normal pH and is therefore acidotic. Because the plasma bicarbonate concentration is also lower than normal, the patient has metabolic acidosis with respiratory compensation (P_{CO_2} is lower than normal).The plasma anion gap (Na^+ Cl^--HCO_3^- = 10 mEq/L) is in the normal range, suggesting that the metabolic acidosis is not caused by excess nonvolatile acids such as salicylic acid or ketoacids caused by diabetes mellitus. Therefore, the most likely cause of the metabolic acidosis is diarrhea, which would cause a loss of HCO_3^- in the feces and would be associated with a normal anion gap and a hyperchloremic (increased chloride concentration) metabolic acidosis

93. A 26-year-old man develops glomerulonephritis, and his GFR decreases by 50% and remains at that level. For which of the following substances would you expect to find the greatest increase in plasma concentration?

A) Creatinine B) K^+ C) Glucose D) Na^+ E) Phosphate F) H^+ Answer:

A) A 50% reduction of GFR would approximately double the plasma creatinine concentration, because creatinine is not reabsorbed or secreted and its excretion depends largely on glomerular filtration. Therefore, when GFR decreases the plasma concentration of creatinine increases until the renal excretion of creatinine returns to normal. Plasma concentrations of glucose, potassium, sodium, and hydrogen ions are closely regulated by multiple mechanisms that keep them relatively constant even when GFR falls to very low levels. Plasma phosphate concentration is also maintained near normal until GFR falls to below 20% to 30% of normal

94.The most serious hypokalemia would occur in which of the following conditions?

A) Decrease in potassium intake from 150 to 60 mEq/day

B) Increase in sodium intake from 100 to 200 mEq/day

C) Fourfold increase in aldosterone secretion plus high sodium intake

D) Fourfold increase in aldosterone secretion plus low sodium intake

E) Addison's disease

C) A large increase in aldosterone secretion combined with a high sodium intake would cause severe hypokalemia. Aldosterone stimulates potassium secretion and causes a shift of potassium from the extracellular fluid into the cells, and a high sodium intake increases the collecting tubular flow rate, which also enhances potassium secretion. In normal persons, potassium intake can be reduced to as low as one fourth of normal with only a mild decrease in plasma potassium concentration. A low sodium intake would tend to oppose aldosterone's hypokalemic effect, because a low sodium intake would reduce the collecting tubular flow rate and thus tend to reduce potassium secretion. Patients with Addison's disease have a deficiency of aldosterone secretion and therefore tend to have hyperkalemia.

95. If the average hydrostatic pressure in the glomerular capillaries is 50 mm Hg, the hydrostatic pressure in the Bowman's space is 12 mm Hg, the average colloid osmotic pressure in the glomerular capillaries is 30 mm Hg, and there is no protein in the glomerular ultrafiltrate, what is the net pressure driving glomerular filtration?

A) 8 mm Hg B) 32 mm Hg C) 48 mm Hg D) 60 mm Hg E) 92 mm Hg

Ans.A) The net filtration pressure at the glomerular capillaries is equal to the sum of the forces favoring filtration (glomerular capillary hydrostatic pressure) minus the forces that oppose filtration (hydrostatic pressure in Bowman's space and glomerular colloid osmotic pressure). Therefore, the net pressure driving glomerular filtration is 50 − 12 − 30 = 8 mm Hg.

96.Which of the following tends to increase potassium secretion by the cortical collecting tubule?

A) A diuretic that inhibits the action of aldosterone (e.g., spironolactone)

B) A diuretic that decreases loop of Henle sodium reabsorption (e.g., furosemide)

C) Decreased plasma potassium concentration

D) Acute metabolic acidosis

E) Low sodium intake

B) Potassium secretion by the cortical collecting ducts is stimulated by (1) aldosterone, (2)increased plasma potassium concentration, (3) increased flow rate in the cortical collecting tubules, and (4) alkalosis. Therefore, a diuretic that inhibits aldosterone, decreased plasma potassium concentration, acute acidosis, and low sodium intake would all tend to decrease

potassium secretion by the cortical collecting tubules. A diuretic that decreases loop of Henle sodium reabsorption, however, would tend to increase the flow rate in the cortical collecting tubule and therefore stimulate potassium secretion.

. Answer: 39=B 40=B 41=C

97. A 48-year-old woman complains of severe polyuria (producing about 0.5 L of urine each hour) and polydipsia (drinking two to three glasses of water every hour). Her urine contains no glucose, and she is placed on overnight water restriction for further evaluation. The next morning, she is weak and confused, her sodium concentration is 160 mEq/L, and her urine osmolarity is 80 mOsm/L. Which of the following is the most likely diagnosis?

A) Diabetes mellitus **B) Diabetes insipidus** C) Primary aldosteronism

D) Renin-secreting tumor E) Syndrome of inappropriate antidiuretic hormone

Ans B) The most likely diagnosis for this patient is diabetes insipidus, which can account for the polyuria and the fact that her urine osmolarity is very low (80 mOsm/L) despite overnight water restriction. In many patients with diabetes insipidus, the plasma sodium concentration can be maintained relatively close to normal by increasing fluid intake (polydipsia). When water intake is restricted, however, the high urine flow rate leads to rapid depletion of extracellular fluid volume and severe hypernatremia, as occurred in this patient. The fact that she has no glucose in her urine rules out diabetes mellitus. Neither primary aldosteronism nor a renin-secreting tumor would lead to an inability to concentrate the urine after overnight water restriction. Syndrome of inappropriate antidiuretic hormone would cause excessive fluid retention and increased urine osmolarity.

98. Furosemide (Lasix) is a diuretic that also produces natriuresis. Which of the following is an undesirable side effect of furosemide due to its site of action on the renal tubule?

A) Edema B) Hyperkalemia C) Hypercalcemia

D) Decreased ability to concentrate the urine E) Heart failure

D) Furosemide (Lasix) inhibits the Na+-2Cl–-K+ co-transporter in the ascending limb of the loop of Henle. This not only causes marked natriuresis and diuresis but also reduces the urine concentrating ability. Furosemide does not cause edema; in fact, it is often used to treat severe edema and heart failure.Furosemide also increases the renal excretion of potassium and calcium and therefore tends to cause hypokalemia and hypocalcemia rather than increasing the plasma concentrations of potassium and calcium.

99. When the dietary intake of K+ increases, body K+ balance is maintained by an increase in K+ excretion primarily by which of the following?

A) Decreased glomerular filtration of K+

B) Decreased reabsorption of K+ by the proximal tubule

C) Decreased reabsorption of K+ by the thick ascending limb of the loop of Henle

D) Increased K+ secretion by the late distal and collecting tubules

E) Shift of K+ into the intracellular compartment

D) Most of the daily variation in potassium excretion is caused by changes in potassium secretion in the late distal tubules and collecting tubules. Therefore, when the dietary intake of potassium increases, the total body balance of potassium is maintained primarily by an increase in potassium secretion in these tubular segments. Increased potassium intake has little effect on GFR or on reabsorption of potassium in the proximal tubule and loop of Henle. Although high potassium intake may cause a slight shift of potassium into the intracellular compartment, a balance between intake and output must be achieved by increasing the excretion of potassium during high potassium intake.

100. A female patient has unexplained severe hypernatremia (plasma Na+ = 167 mmol/L) and complains of frequent urination and large urine volumes. A urine specimen reveals that the Na+ concentration is 15 mmol/L (very low) and the osmolarity is 155 mOsm/L (very low). Laboratory tests reveal: plasma renin activity = 3 ng angiotensin I/ml/hr (normal = 1.0), plasma antidiuretic hormone (ADH) = 30 pg/ml (normal = 3 pg/ml), and plasma aldosterone = 20 ng/dL (normal = 6 ng/dL). Which of the following is the most likely reason for her hypernatremia?

A) Simple dehydration due to decreased water intake **B) Nephrogenic diabetes insipidus**

C) Central diabetes insipidus D) Syndrome of inappropriate ADH

E) Primary aldosteronism F) Renin-secreting tumor

B) Hypernatremia can be caused by excessive sodium retention or water loss. The fact that the patient has large volumes of dilute urine suggests excessive urinary water excretion. Of the two possible disturbances listed that could cause excessive urinary water excretion (nephrogenic diabetes insipidus and central diabetes insipidus), nephrogenic diabetes insipidus is the most likely cause. Central diabetes insipidus (decreased ADH secretion) is not the correct answer because plasma ADH levels are markedly elevated. Simple dehydration

due to decreased water intake is unlikely because the patient is excreting large volumes of dilute urine

101. Juvenile (type I) diabetes mellitus is often diagnosed because of polyuria (high urine flow) and polydipsia (frequent drinking) that occur because of which of the following?

A) Increased delivery of glucose to the collecting duct interferes with the action of antidiuretic hormone

B) Increased glomerular filtration of glucose increases Na+ reabsorption via the sodium-glucose co-transporter

C) When the filtered load of glucose exceeds the renal threshold, a rising glucose concentration in the proximal tubule decreases the osmotic driving force for water reabsorption

D) High plasma glucose concentration decreases thirst

E) High plasma glucose concentration stimulates antidiuretic hormone release from the posterior pituitary

. C) High urine flow occurs in type I diabetes because the filtered load of glucose exceeds the renal threshold, resulting in an increase in glucose concentration in the tubule, which decreases the osmotic driving force for water reabsorption. Increased urine flow reduces extracellular fluid volume and stimulates the release of antidiuretic hormone

102.A 20-year-old college athlete has been in training for several months. As part of his regimen, he drinks milkshakes into which he adds protein supplements. The body metabolizes the protein to make muscle and, in the process, produces urea. You predict:

A. The kidney will filter more urea. B. The kidney will filter less urea.

C. There will be increased absorption of urea from the renal tubule.

D. The amount of urea in the urine will decrease

Ans A. As the amount of urea in the blood increases from metabo lism of protein, more urea is filtered through the glomerular capillary because the concentration gradient between the blood and the renal tubular space has increased; urea is a small molecule that easily passes through the endothelial lining. The amount of urea in the urine will also increase. Filtration of urea would only decrease if blood flow through or the pressure within the glomerular capillary has decreased. Absorption of urea from the tubule is increased only in conditions in which total body water is diminished.

103.Two Olympic marathoners are training together on a hot, summer afternoon. They decide to run for 15 miles today. Bob has taken salt tablets during the run whereas John has not. Assuming the two athletes are the same size and have the same total body water at the beginning of the run, and that both sweat the same amount and drink the same amount of water during the run, you predict:

A. John will filter more Na via his glomerulus than Bob.

B. Bob will filter more Na via his glomerulus than John.

C. They will filter the same amount of Na.

D. John will reabsorb more Na than Bob

Ans. B. Since Bob has ingested salt tablets prior to the run, he begins with a greater amount of Na in his system than does John. Thus, he will filter more Na throughout the run. Both runners will be trying to accommodate for the Na losses in the sweat by absorbing as much Na as possible from the renal tubule

104.An unfortunate animal eats a pesticide that poisons the cell membrane Na/K ATPases.

What will happen to the animal's cells?

A. They will shrink

B. They will swell

C. No change in cell size

Ans-B. The size of the cells is determined by osmotic forces. The NaK ATPases provide a net outward osmotic force across the cell membrane with respect to the major ions in the intracellular and the extracellular fluid since 3 Na ions move into the fluid surrounding the cell in exchange for 2 K ions; this outward force is balanced by the net inward force provided by intracellular proteins (this is the oncotic force, which is the term used for the osmotic force created by proteins). If the NaK ATPases are poisoned, the inward oncotic force is unbalanced, leading to cell swelling and death.

105.A 25-year-old man returns from vacation with profuse diarrhea for 2 days in duration. Due to the fluid loss, his weight decreases by 4 kgs. Which of his body compartments change in size?

A. IV

B. IC

C. IT

D. A and B

E. A and C

Ans.E. Diarrhea is usually isotonic, meaning that both Na and water are lost in similar concentrations to that of the body; consequently, there is no change in the osmolarity of the extracellular fluid and, thus, no movement of water into or out of cells (remember, movement of water into and out of the cells is dependent on osmotic forces). This Na and water loss will be reflected by a decrease in the sizes of the intravascular and the interstitial space, which are in equilibrium with each other. As salt and water leave the interstitial space into the intestinal lumen,hydrostatic pressure in the interstitial space decreases. The result is movement of salt and water from the vascular space into the interstitial space

106. A young woman develops frothy urine, and is found to be spilling large amounts of protein in her urine. (Protein is usually not filtered across the glomerulus in any appreciable amount.) Consequently, her serum protein levels are very low. What would you expect her blood pressure to be?

A. Higher than normal

B. Lower than normal

C. No different than normal

Ans. B. The blood pressure is determined, in part, by the volume of fluid within the vasculature. The vascular space is in equilibrium with the interstitial space; the volume of the two spaces is the consequence of the balance between the hydrostatic and oncotic forces in each space. Because of the loss of intravascular protein, the inward oncotic force in the blood vessel decreases, leading to a shift of fluid out of the vessel into the interstitium. Consequently, the young woman's blood pressure should be lower than her normal level

107.For the same patient in question , what (if any) abnormality might you find on chest x-ray?

A. Pulmonary edema B. Pleural effusions C. Edema of her ankles D. A and B **E. B and C**

Ans. E. As discussed in the chapter, the pulmonary vasculature is different from the capillaries in the rest of the body, in that it is relatively leaky to albumin. Thus, it does not rely on an inward oncotic force to maintain equilibrium with the interstitial space; rather, the pulmonary capillaries have a very low hydrostatic pressure, which prevents much loss of fluid to the interstitium. The loss of serum albumin will, therefore, not cause pulmonary edema. Pleural effusions, however, occur due to the extravasation of fluid out of thoracic blood vessels that perfuse the pleural tissue. These vessels are similar to systemic blood vessels,

and rely on inward oncotic pressure to balance the hydrostatic pressure of the vessel and prevent excessive loss of fluid to the interstitium. This patient is likely to develop edema (swelling) in her soft tissues, and she is likely to have pleural effusions, but not pulmonary edema.

108. In the presence of vasopressin, most filtered water is absorbed in the?

a) proximal tubule b) loop of Henle c) distal tubule **d) cortical collecting system** e) medullary collecting system

vasopressin increases water reabsorption in the cortical collecting system

109. On which of the following does aldosterone exert its greatest effect?

a) glomerulus b) proximal tubule c) thin portion of loop of Henle

d) thick portion of look of Henle e**) cortical collecting system**

Aldosterone exerts its greatest effect on cortical collecting duct

110. What is the clearance of a substance when its concentration in plasma is 1mg/ml, its concentration in urine is 10mg/ml and the urine flow is 2ml/min?

a) 2ml/min b) 10ml/min **c) 20ml/min** d) 200ml/min

e) clearance cannot be determined from the information given

CLEARANCE :C=U*V/P

URINE CONENTRATION,V-URINE VOLUME,P-PLASMA CONCENTRATION

10*2/1=20Ml/mt

111. Glucose reabsorption occurs in the:

a**) proximal tubule** b) loop of Henle c) distal tubule

d) cortical collecting system e) medullary collecting system

100% of glucose is reabsorbed in the PCT

73. As urine flow increases during osmotic diuresis:

a) the osmolality of urine falls b) the osmolality of urine increases

c) the osmolality of urine approaches that of plasma d) the osmolality of urine is unchanged e) the osmolality of urine depends primarily on other factors

112. Which of the following is NOT true regarding the voiding reflex?

a) it involves parasympathetic fibers

b) it remains intact in the period of spinal shock following transaction of the spinal cord

c) it occurs when the bladder volume reaches 300-400mls

d) it is integrated in the sacral segments of the spinal cord

e) its threshold is altered by inhibitory fibers from the brainstem

113. Which of the following substances is NOT actively secreted in to the tubular lumen by the proximal renal tubule?

a) urate b) para-amino hippuric acid c) catecholamines **d) sodium** e) creatinine

114. Angiotensin II causes:

a) greater constriction of efferent than afferent arterioles

b) greater construction of afferent than efferent arterioles

c) constriction of afferent arterioles only

d) constriction of efferent arterioles only

e) has no effect on arteriolar constriction

115. With regard to the effect of hormones on renal tubules, which is CORRECT?

a) aldosterone increases potassium reabsorption from the distal tubule

b) angiotensin II increases hydrogen ion secretion from the proximal tubules

c) ADH increases water reabsorption in the proximal tubule

d) atrial naturetic peptide decreases sodium reabsorption from the proximal tubules

e) parathyroid hormone increases phosphate reabsorption

116. With regard to tuboglomerular feedback:

a) the GFR increases when flow through the distal tubule increases

b) the macula densa on the afferent arteriole is the sensor

c) the afferent arteriole is constricted by thromboxane A2

d) it is designed to maintain sodium reabsorption

e) it does not operate in individual nephrons

117. The primary reason for the decreased medullary hypertonicity associated with osmotic diuresis is:

a) an associated increased urine volume

b) the limiting concentration gradient for sodium reabsorption is reached

c) tubular fluid has an increased sodium concentration

d) the total amount of sodium reaching the loop of Henle is increased

e) the associated maximal vasopressin secretion

118. With respect to renal handling of glucose:

a) glucose is reabsorbed from within the distal tubule by co-transport

b) glucose is reabsorbed from within the proximal tubule by facilitated diffusion

c) glucose is always completely reabsorbed

d) movement of glucose from tubular epithelial cells is by passive diffusion

e) none of the above

119. Creatinine:

a) is synthesised in the liver from methionine, glycine and anganine

b) is converted directly to creatine

c) has variable excretion from day to day

d) creatinuria occurs normally in the elderly and in pregnant women

e) all of the above

120. The thin ascending loop of Henle is:

a) relatively permeable to water

b) relatively impermeable to sodium ion

c) permeable to both water and sodium ion

d) relatively impermeable to water

e) relatively impermeable to both water and sodium ion

121. The primary effect of angiotensin II on renal vasculature is:

a) constriction of efferent arterioles

b) enhanced prostaglandin mediated increased blood flow to the renal cortex

c) enhanced catecholamine mediated afferent arteriolar vasoconstriction

d) enhanced catecholamine mediated afferent vasodilatation

e) constriction of interlobular arteries

122. With respect to the counter current system:

a) the loops of Henle act as counter current exchanges

b) solutes diffuse out of vessels conducting blood towards the cortex

c) water diffuses out of ascending vessels

d) water diffuses into the collecting ducts

e) counter current exchange is passive and can operate even if counter current multiplication ceases

123. What percentage of filtered sodium is reabsorbed by the kidney?

a) 1% b) 93% **c) 99%** d) 50% e) 100%

123. Tuboglomerular feedback refers to:

a) the process of increased sodium reabsorption associated with an increased glomerular filtration

b) changes in peri-tubular oncotic pressure associated with changes in glomerular filtration

c) decreased glomerular filtration associated with increased flow through the loop of Henle

d) increased glomerular filtration associated with decreased peri-tubular oncotic pressure

e) thromboxane A2 mediated increased sodium reabsorption associated with increased renal blood flow

124. Frusemide acts mainly at:

a) proximal tubule b) thin limb of loop of Henle **c) thick limb of loop of Henle**

d) distal tubule e) collecting duct

125. At which site does tubular fluid osmolality exceed that of plasma by the greatest amount?

a) proximal tubule **b) thin limb of loop of Henle**

c) thick limb of loop of Henle d) distal tubule e) collecting duct

126. At which site is sodium ion NOT actively reabsorbed?

a) proximal tubule **b) thin limb of loop of Henle** c) thick limb of loop of Henle

d) distal tubule e) collecting duct

127. At which site(s) is potassium ion secreted?

a**) distal tubule and collecting duct** b) proximal tubule and distal tubule

c) think limb of loop of Henle only d) thin limb and thick limb of loop of Henle

e) none of the above

128. At which site does chlorthiazide act?

a) proximal tubule b) thin limb of loop of Henle c) thick limb of loop of Henle

d) distal tubule e) collecting duct

129. The cortical portion of the collecting duct has the capacity to reabsorb approximately 10% of the filtered water. Which substance is most important in regulating this effect?

a) angiotensin II b) histamine **c) vasopressin** d) sodium e) prostaglandins

130. With respect to GFR:

a) clearance of p-amino hippuric acid is used to determine GFR

b) inulin cannot be used to measure GFR

c) GFR is usually reduced in ureteric obstruction

d) filtration pressure changes with change in blood pressure

e) contraction of mesangial cells increases GFR

131. With respect to the loop of Henle:

a) the ascending limb is highly permeable to water

b) the descending limb is impermeable to water

c) the thick ascending limb co-transports sodium, potassium and chloride out of the lumen

d) tubular fluid becomes concentrated as it passes through the ascending limb

e) the ascending limb removes approximately 15% of filtered water

132. Mesangial cells:

a) are specialized cells that are characterized by numerous pseudopodia

b) are made to contract by dopamine

c) are made to contract by angiotensin II

d) lie within the renal medulla

e) decrease the area for filtration when they relax

133. Regarding the proximal tubule, the following statements are true EXCEPT:

a) sodium is co-transported out of the tubule with glucose

b) sodium is actively transported into the intercellular spaces by Na-K-ATPase

c) the cells are characterized by a brush border and tight junctions

d) vasopressin increases the permeability to water by causing the rapid insertion of water channels into the luminal membrane

e) water moves passively out of the tubule along osmotic gradients

134. Renal autoregulation of GFR helps prevent large fluctuations in GFR despite wide variations in arterial blood pressure. With regard to autoregulation, which is TRUE?

a) the macula densa cells sense change in afferent arteriolar pressure

b) falling GFR results in a feedback to decrease efferent arteriolar pressure

c) falling GFR results in an increase in renin secretion from macula densa cells

d) decreased macula densa concentration of NaCl results in dilatation of afferent arterioles

e) decreased GFR decreases NaCl reabsorption in the ascending loop of Henle

135. Aldosterone has its principle effect in the:

a) proximal convoluted tubule b) descending loop of Henle

c) thick ascending loop of Henle d) distal convoluted tubule **e) collecting ducts**

136. 85% of $NaHCO_3$ in the filtrate is reabsorbed in the:

a) proximal convoluted tubule b) descending loop of Henle

c) thick ascending loop of Henle d) distal convoluted tubule e) collecting ducts

137.Thiazide diuretics exert their main effect in the:

a) proximal convoluted tubule b) descending loop of Henle

c) thick ascending loop of Henle **d) distal convoluted tubule** e) collecting ducts

138. Ethacrynic acid exerts its principle effect in the:

a) proximal convoluted tubule b) descending loop of Henle

c) thick ascending loop of Henle d) distal convoluted tubule e) collecting ducts

139. When considering fluid balance, which of the following is INCORRECT?

a) the minimum daily fluid output may normally be estimated by measuring the urine output and adding 500ml

b) urine output is always the single largest contributor to fluid output

c) fluid intake and output may be altered in response to a change in extracellular osmolarity

d) fluid intake and output may be altered in response to a change in extracellular volume

e) the hypothalamus is an important regulator of fluid intake

140. Which of the following does NOT stimulate erythropoietin secretion?

a) cobalt salts **b) thromboxanes** c) androgens d) adenosine e) prostaglandins

141. Glomerular filtration rate is best measured using:

a) inulin b) glucose c) PAH d) urea e) creatinine

142. “Renal dose” dopamine increases glomerular filtration rate by:

a) dilating the renal arteries b) dilating the vasa recta

c) constricting the efferent arteriole **d) relaxing glomerular perivascular mesangial cells**
e) all of the above

143. Regarding the kidney:

a) the glomerular filtration rate is 125mls/hr

b) the renal threshold for glucose 300mg/dL

c) glucose transport is an example of secondary active transport

d) the blood flow in the renal medulla is greater than in renal cortex

e) a high protein diet decreases renal blood flow

144. Which of the following substances is not excreted by the kidney in a normal adult on an average diet?

a) K+ b) uric acid c) creatinine **d) glucose** e) urea

145. Which of the following statements regarding erythropoietin is I**NCORRECT** in an adult?

a) half-life of about 5 hours b) hypoxia can increase secretion within minutes

c) is secreted by spleen and salivary glands

d) is secreted in adequate amounts by liver in absence of kidneys

e) is a glycoprotein

146. "Renal dose" dopamine is:

a) 1-2 mcg/kg/min b) 1-5 mcg/kg/min c) 1-10 mcg/kg/min

d) 1-20 mcg/kg/min e) greater than 20 mcg/kg/min

147. Frusemide acts as a diuretic primarily by:

a) inhibiting Na+/K+/Cl- co-transport in loop of Henle

b) inhibiting action of vasopressin on collecting duct

c) decreasing H+ secretion with resultant increase in Na+/K+ excretion

d) inhibiting vasopressin secretion

e) inhibiting Na+/K+ exchange in collecting ducts by inhibiting the action of aldosterone

148. Regarding the osmolality of renal tubular fluid, is it?

a) hypotonic in loop of Henle **b) isotonic in proximal tubule**

c) hypertonic in distal tubule d) hypotonic in collecting duct

e) hypotonic in proximal tubule

149. Which of the following statements regarding renal tubular glucose absorption is INCORRECT?

a) binds to SGLT-2 in luminal membrane

b) example of secondary active transport

c) transported out of luminal cell by GLUT-2

d) about 100% reabsorption in proximal tubule if less than transport maximum

e) linked to sodium reabsorption

150. Which of the following does NOT increase renal tubular sodium reabsorption?

a) cortisol b) oestrogen c) growth hormone d) insulin **e) glucagon**

151. Regarding renal handling of glucose, which is INCORRECT?

a) transport maximum varies depending on sex

b) proximal tubular absorption is an example of a symport mechanism

c) not all nephrons handle glucose filtration and reabsorption equally

d) phlorhizin inhibits distal tubular reabsorption

e) GLUT-2 transports glucose into interstitial fluid

151. Regarding renal handling of sodium, which is INCORRECT?

a) more than 95% of filtered sodium is reabsorbed

b) proximal tubular reabsorption is an example of secondary active transport

c) aldosterone increases reabsorption despite increasing GFR

d) glucocorticoids may increase or decrease urinary excretion

e) renal oxygen consumption is directly proportional to sodium reabsorption

152. Which of the following agents cause relaxation of mesangial cells of the glomerulus?

a) angiotensin II **b) dopamine** c) endothelins

d) vasopressin e) noradrenaline

153. Regarding renal handling of bicarbonate ion, which is INCORRECT?

a) small size of bicarbonate ion affects reabsorption

b) reabsorption is reciprocally related to chloride ion reabsorption in proximal tubule

c) most reabsorption occurs in proximal tubule

d) reabsorption requires carbonic anhydrase

e) reabsorption is decreased by ECF expansion

154. Regarding renal handling of ammonia, which is INCORRECT?

a) ammonia is not filtered at the glomerulus

b) ammonia is synthesised in proximal and distal tubules

c) glutaminase plays a role in ammonia excretion

d) non-ionic diffusion of ammonia maintains a concentration gradient for further diffusion

e) ammonia diffusion can increase up to 30 fold

155. Regarding renal handling of calcium, which is INCORRECT?

a) metabolic acidosis decreases reabsorption

b) growth hormone increases reabsorption

c) calcium is actively reabsorbed

d) about 60% of filtered calcium load is reabsorbed in proximal tubules

e) glucocorticoids increase calcium reabsorption

156. Regarding renal handling of chloride, which is INCORRECT?

a) about 25% of filtered load is actively reabsorbed in thick ascending limb

b) proximal tubular reabsorption is reciprocally related to bicarbonate reabsorption

c) it is actively secreted in distal tubule

d) two chloride per sodium are reabsorbed in thick ascending limb

e) chloride-hydroxide antiport are present in the kidney

157. Regarding glomerular filtration:

a) the glomerular filtration rate varies les than the renal plasma flow

b) inulin is stored in the kidney

c) sialoproteins in the glomerular capillary wall are positively charged

d) dopamine causes contraction of mesangial cells

e) changes in renal blood flow do not affect glomerular filtration rate

158. Regarding renal handling of phosphate, which is INCORRECT?

a) no tubular secretion occurs

b) most reabsorption occurs actively in proximal tubule

c) parathyroid hormone inhibits tubular reabsorption

d) less than 5% of filtered load is excreted

e) phosphate is a much more powerful buffer in tubular fluid than in blood

159. Regarding renal handling of hydrogen ion, which is INCORRECT?

a) acetazolamide decreases tubular secretion

b) aldosterone increases distal tubular secretion

c) much more acid secretion occurs in proximal than distal tubule

d) lowest tubular fluid pH achievable is 4.5

e) secondary active transport mechanism operates in distal tubule

160. In diabetes insipidis:

a) percentage of filtered water reabsorbed is increased compared to normal

b) there is a net gain of water in excess of solute (L/day)

c) urine volume (L/day) is decreased

d) urine concentration (msom/L) is markedly reduced

e) glomerular flow (ml/min) is increased

161. Which site of diuretic action is INCORRECT?

a) antidiuretic hormone antagonists act in collecting duct

b) loop agents act in thin ascending limb

c) carbonic anhydrase inhibitors act in proximal tubule

d) thiazides act in early distal tubule

e) aldosterone antagonists act in cortical collecting tubule

162. Which of the following statements regarding angiotensin is INCORRECT?

a) angiotensin II has a half-life of about 1-2 minutes

b) angiotensin I is physiologically inactive

c) angiotensin III has equivalent pressor activity to angiotensin II

d) angiotensinogen mainly comes from the liver

e) angiotensin converting enzyme is a dipeptidyl carboxypeptidase angiotensin converting enzyme

163. Regarding renal tubular function:

a) Na+ is actively transported out of the thin portions of the loop of Henle

b) Na+-K+ ATPase pumps Na+ out of the renal tubule

c) Cl- is transported only by co-transport

d) glucose is reabsorbed mainly in the distal tubule

e) penicillin is not actively secreted into tubular fluid

164. Regarding the actions of angiotensin II, which is INCORRECT?

a) selective renal efferent arteriolar constriction

b) acts on CNS without crossing blood-brain barrier

c) contract mesangial cells

d) direct positive chronotropic action on heart

e) increases conversion of cholesterol to pregnenelone

165. Normal values for renal function include all of the following EXCEPT:

a) filtration fraction =0.2 b) 22% of cardiac output c) GFR = 180 litres/day

d) RPF = 900 litres/day **e) Tm glucose = 450 mg/minute**

166. Regarding renal handling of potassium, which is INCORRECT?

a) 10 to 15% of filtered load may be excreted in urine

b) two potassium per sodium are reabsorbed in thick ascending limb

c) excretion decreased in acidosis

d) distal tubular secretion is capable of "adaptation" depending on demand

e) aldosterone increases distal tubular secretion in exchange for sodium

167. Normal urinary values include all of the following EXCEPT:

a) albumin ≤ 150mg/day b) pH = 4.5 to 8.0 c) volume = 0.5 to 2.4 litres/day

d) specific gravity = 1.010 to 1.035 e) osmolality = 3 to 1400 millismol/litres

168. Regarding the kidney:

a) prostaglandins decrease blood flow in renal cortex

b) acetylcholine produces renal vasoconstriction

c) angiotensin II causes constriction of efferent arterioles

d) angiotensin II causes constriction of afferent arterioles

e) glomerular capillary pressure normally is about 100mmHg

169. Glucose reabsorption is most marked in which segment of the glomerulus?

a) the proximal convoluted tubule

b) the distal convoluted tubule

c) the descending loop of Henle

d) the ascending loop of Henle

e) the collecting system

170. Why is NSAIDs use a relative contraindication in patients with chronic renal failure?

a) direct toxic effects on proximal tubule

b) direct toxic effects on collecting ducts

c) indirect toxic effects on loop of Henle

d) inhibition of prostaglandin synthesis which is an important regulator of renal blood flow in arterioles

e) inhibition of prostaglandin synthesis which is an important regulator of renal blood flow in main renal arteries

171. Characteristics of a substance suitable for measuring GFR do NOT include:

a) freely filtered b) not toxic c) no effect on filtration rate

d) not metabolised **e) of low molecular weight**

172. Amino acid reabsorption is most marked in which segment of the glomerulus?

a) the proximal convoluted tubule b) the distal convoluted tubule

c) the descending loop of Henle

d) the ascending loop of Henle e) the collecting duct

173.. Which of the following substances would NOT cause contraction of mesangial cells?

a) angiotensin II **b) dopamine** c) vasopressin

d) histamine e) platelet activating factor

174. Chloride may be reabsorbed in the nephron by:

a) passive reabsorption b) active co-transport with K+ and Na+

c) OH-/Cl- antiport **d) all of the above** e) none of the above

175. Which of these factors do NOT affect GFR?

a) renal blood flow b) ureteral obstruction c) dehydration

d) a neutral molecule measuring 4 manometer

e) angiotensin II effects on mesangial cells

176. The collecting duct is the main site of action for which of the following drugs?

a) ethanol **b) demeclocycline** c) thiazide diuretics

d) ethacrynic acid e) caffeine

177. Which is NOT true of osmotic diuresis?

a) osmotic diuresis is due to the quantity of unreabsorbed solutes

b) decreased water reabsorption in proximal tubules and loops

c) reduced Na+ reabsorption as the limiting concentration gradient is exceeded

d) net loss of Na+ in urine

e) normal water reabsorption in proximal portion of tubules

178. Which of these is NOT a factor affecting acid secretion?

a) intracellular PCO2 b) carbonic anhydrase level c) K+ concentration

d) aldosterone concentration **e) none of the above**

179. Regarding the kidney:

a) glucose is reabsorbed mainly in distal tubule

b) normal GFR is 125ml/hour

c) glomeruli filter 180L fluid per day

d) Na+ is actively transported out of think loop of Henle

e) ethanol promotes vasopressin secretion

180. Regarding renal blood flow:

a) blood flow greatest to medulla

b) pressure in renal vein is about 20mmHg

c) angiotensin II constricts efferent arterioles

d) prostaglandins increase blood flow in cortex and medulla

e) renal blood flow = renal plasma flow x 1 haematocrit

181. Osmolality of tubular fluid:

a) isotonic in proximal tubule b) isotonic in loop of Henle

c) hypertonic in ascending limb loop of Henle

d) hypotonic in collecting duct

e) hypotonic in proximal tubule

182. Regarding the kidney and urine formation:

a) specific gravity is measure of osmolality

b) thin ascending limb relatively impermeable to water

c) thin ascending limb relatively impermeable to Na+ Cl-

d) water diuresis begins about 1 hour after ingestion of a water load

e) high protein diet does not affect concentrating ability of kidney

183. Regarding tubular reabsorption in kidney:

a) glucose and amino acids passively reabsorbed

b) Cl- mainly actively reabsorbed

c) only passive reabsorption occurs in proximal tubule

d) urea is not passively reabsorbed

e) Na+ actively reabsorbed in most parts of tubule

184. Which part of the renal tubule is Na+ NOT actively transported out of?

a) proximal convoluted tubule

b) thin portions of the loop of Henle

c) thick ascending limb of loop of Henle

d) distal convoluted tubule

e) collecting duct

185. Where is the macula densa located?

a) afferent arteriole b) efferent arteriole c) proximal convoluted tubule

d) thick ascending limb of loop of Henle e) distal convoluted tubule

It is part of the distal convoluted tubule and is located in the terminal portion of thick ascending limb of loop of Henle

186. What percentage of cardiac output goes to the kidneys at rest?

a) 10% b) 15% **c) 25%** d) 35% e) 45%

187. Which factor increases renal blood flow?

a) α1 adrenergic stimulation b) α2 adrenergic stimulation

c) reduced systemic blood pressure d) exercise **e) lying down**

188. Angiotensin II:

a) constricts afferent arterioles only b) constricts efferent arterioles only

c) constricts afferent and efferent arterioles d) dilates afferent arterioles

e) dilates efferent arterioles

189. Regarding nephrons permeability:

a) glomerular capillaries are 100 times more permeable than skeletal muscle capillaries

b) anionic substances are more permeable than neutral substances

c) N (?normal) glomerular concentration of albumin is 0.2% of plasma concentration

d) neutral substances are freely filtered with diameters < 8nm

e) 100mg/d of protein is filtered at the glomerulus

190 Where does glucose reabsorption occur?

a) proximal convoluted tubule

b) thin descending limb of loop of Henle

c) thick ascending limb of loop of Henle

d) distal convoluted tubule

e) collecting duct

191.Vasopressin acts as the:

a) proximal convoluted tubule b) loop of Henle c) distal convoluted tubule

d) cortical portion of the collecting duct e) medullary portion of the collecting duct

192. Regarding the bladder:

a) the external urethral sphincter is made up of smooth muscle cells

b) the internal urethral sphincter does not encircle the urethra

c) pelvic nerves (S2-S4) supply the external sphincter

d) when the bladder is stretched, tension is maintained

e) relaxation of the internal urethral sphincter assists micturition

193. Which substance relaxes mesangial cells?

a) angiotensin II b) ADH c) noradrenaline d) thromboxane A2 **e) ANP**

194. Concerning the kidneys:

a) normal glomerular filtration rate is 250ml/minute (120ML/MT)

b) normal renal plasma flow is 125ml/minute (600ML/MT)

c) normal filtration fraction is 0.19 or 20%

d) blood flow is normally higher in the medulla than the cortex (BFR higher in cortex)

e) normal blood volume in the kidneys at any one time is 250ml (1.2-1.3 ltrs/mt)

195. Regarding renal handling of substances:

a) urea is filtered, but not secreted b) most sodium is resorbed in the loop of Henle

c) creatinine is not filtered, but is resorbed

d) potassium is filtered, but not secreted e) chloride is secreted and resorbed

196. Which of the following is transported via active transport?

a) chloride **b) hydrogen** c) glucose d) urea e) bicarbonate

197. Concerning the respiratory exchange ration (R)

a) it falls during exercise b) it falls in metabolic acidosis

c) the stomach has a positive R during secretion of acid

d) it rises after ingestion of alkali

e) at steady state, it equals the respiratory quotient

198. Regarding fat metabolism, all are true EXCEPT:

a) brown fat is characterised by a H+ short circuit protein in the mitochondria

b) heparin is a cofactor for lipoprotein lipase

c) ketone bodies accumulate in diabetic ketoacidosis due to reduced removal from the circulation

d) the essential fatty acids are used to produce autocoids

e) there is no major pathway for converting fat to carbohydrate

199. Triiodothyronine:

a) is less potent than thyroxine

b) deficiency causes yellow skin due to keratin buildup

c) acts via a tyrosine kinase predominantly

d) causes an increase in Na+/K+ ATPase activity

e) in both, deficiency but no excess leads to muscle weakness

200. Mesangial cells:

a) have a role in the control of GFR

b) are similar to other endothelial cells in the vascular tree

c) are responsible for tubuloglomerular balance

d) contract in response to dopamine

e) relax in response to vasopressin

201. With regard to water excretion:

a) 280 l is filtered per day b) it is impossible to excrete more than 23 l/day

c) most regulation is via manipulation of the gradients along the loop of Henle

d) vasopressin acts to insert water channels into the basolateral cell membrane of the collecting ducts

e) water reabsorption in the collecting ducts can alter by a factor of 2.5 dependent on the presence of vasopressin

202. All of the following are transported across renal tubular cell membranes by secondary active transport, using the energy of the active transport of Na+, EXCEPT:

a) glucose b) lactate c) citrate d) H+ **e) K+**

203. Regarding the control of GFR:

a) increasing ANP causes contraction of mesangial cells

b) glomerular cap are less permeable than skeletal

c) oedema of kidney causes increase in renal intent po????

d) efferent arterioles have low reninlard

e) hypoproteinaemia increases GFR

204. Regarding osmotic diuresis:

a) is secondary to decreased ADH b) results in hypertonic urine

c) increased water reabsorption in PCT

d) may be seen in patients with diabetes ketoacidosis

e) may be seen in patients with diabetes insipidis

205. Effective renal plasma flow is best measured using:

a) inulin b) glucose **c) PAH** d) urea e) creatinine:

Write TRUE or FALSE following statements

206. Renal pelvis is a functional unit of the kidneys

FALSE

207. The volume of plasma that is cleared of un- dissolved substance by the kidneys in one hour is called filtration.

FALSE

208. Anti diuretic hormone influences water reabsorption by increasing permeability of renal tubules and ducts to water.

TRUE

209. In the presence of aldosterone, potassium is reabsorbed. FALSE

210. If antidiuretic hormone is not present in the collecting duct, dilute urine is excreted.

TRUE

211. In the absence of aldosterone, sodium is excreted.

TRUE

212. The normal adult GFR is approximately 125ltr/min.

FALSE

213. Countercurrent mechanism occurs at glomerulus.

FALSE

214. The descending limb of the loop of Henle is impermeable to both urea and water.

FALSE

215. In the distal tubule, aldosterone acts to reabsorb urea.

FALSE

216. Renal columns also called as Bertin`s column.

TRUE

217. Efferent arteriole divides into tuft capillaries called the glomerulus.

FALSE

218. In glomeruls, endothelium works as a sieve to retain large substances in the capillary.

TRUE

219.In the proximal tubule, acid-base balance is regulated by bicarbonate re-absorption and hydrogen ion secretion.

TRUE

220. Capillary oncotic pressure is the pressure inside the capillary caused by blood sugar.

FALSE

221. Passive transport requires no energy as it is based on concentration gradients.

TRUE

222. Renal auto-regulation is controlled by collecting duct.

FALSE

223. Angiotensin II causes afferent arteriolar constriction.

FALSE

224. In the distal tubule, hydrogen ions are buffered by formation of titrable acids and ammonia synthesis.

TRUE

225. In response to acidosis, the kidneys increase ammonia production and ammonium excretion.

TRUE

226. Tubular reabsorption is a process by which substances move from the tubular lumen into the interstitial fluid and then into the plasma of peritubular capillaries.

TRUE

227. The renomedullary interstitial cells are important sites of prostaglandin production.

TRUE

228. A main function of principal cells in the cortical collecting duct is hydrogen ion secretion.

FALSE

229. The thin ascending limb of loop of henle is the site of action of the loop diuretics, where as thiazide diuretics their effect mainly on the distal convoluted tubules.

TRUE

230. Variable tubular secretion of creatinine makes creatinine clearance is a perfect marker of GFR.

FALSE

231. Left kidney is little lower than right kidney.

FALSE

232. Adrenal gland located on top of each kidney.

TRUE

233. The blood supply to the kidney is approximately 1200ml/mt

TRUE

234. Proximal convoluted tubule is composed of columnar cells with many mitochondria, which is essential for passive transport of solutes.

FALSE

235. Kidneys are fully matured during the second year of life.

TRUE

236. Adrenal insufficiency impairs potassium excretion and causes sodium wasting, while hyperaldosteronism causes sodium reabsorption and hypokalemia.

TRUE

237. All patients with hyperpara thyroidism have decreased ionized calcium.

238. The anatomical barrier to protein in the kidney is the glomerulo epithelial cells.

239. Chronic urinary loss of vitamin D metabolites can cause bone disease.

TRUE

240. Metabolic acidosis represents a primary decrease in plasma bicarbonate and increase blood pH. F

241. Metabolic alkalosis represents primary increase pH and decrease bicarbonate.F

242. Acid-base regulation process involves hydrogen ion secretion, bicarbonate reabsorption, ammonia synthesis and secretion and ammonium excretion.

TRUE

243. Countercurrent blood flow in vasa recta enhances sodium chloride and urea concentration in interstitum, thus maintaining hypotonic interstitum.F

244. Thromboxane act as a vasodilator F

245. Prostacycline and prostaglandin are act as vasoconstrictor. F

246. Type A intercalated cells which are believed to involved in hydrogen ion secretion and type B cells that may secrete bicarbonate.

TRUE

247. GFR normally remains quite constant even wide variations in arterial blood pressure. This ability of the kidneys to maintain a constant GFR is called compensatory mechanism. F

248. Hypertension produces glomerular damage in the cortex and tubular damage in the medulla

TRUE

249. Angiotengin ll has a vasoconstrictor effect on renal tubules thereby increasing the resistance to flow and causing high BP. F

250. The manufacture of RBC takes place in the bone narrow especially the vertebrae and flat bones in human adults.

TRUE

251. Each kidney has one renal artery that branches from the abdominal aorta and enters the kidney at the Pelvis.F

252.The renal cortex lies inside the medulla -FALSE

253.The left kidney lies lower than the right-FALSE

254.The renal veins drain directly into the inferior venacava--TRUE

255.The link between the kidney and bladder is the urethra--- FALSE

256.THE renal cortex contains all the glomeruli-TRUE

MR.DAVID BALU

FOUNDER

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