6. RENAL PHYSIOLOGY

David L. Mattson, Ph D.

BODY FLUIDS

1. How much of the body is composed of water? How much or the body is composed of 50-70% water. This percentage varies depending on the gweight, the body is composed of 50-70% water. This percentage varies depending on the By weight, the rooty services the water content of fat (approximately 20%) is much less than that the commitmately 70%). In general, an average person has a root body ishiridal body type to the control of the control o ignition (approximately 1/20). In general, an average person has a total body water (TBW) of dissist (approximately 60% of body weight. The average 70-kg man would then have approximately 42 specially 10 × 0.6 [1 L of water has a mass of 1 kg]). In contrast, an extremely 10 × 0.6 [1 L of water has a mass of 1 kg]). speciminately 60 to 61 L of water has a mass of 1 kg). In contrast, an extremely lean, muscular Lorent and a TBW that is close to 70% of total body weight, and a muscular leading to the second law a TBW that is close to 70% of total body weight, and a muscular leading to the second law a TBW that is close to 70% of total body weight, and a muscular leading to the second law as the second LOTBW (70 × 0.01)

LOTBW (70 × 0 istividial would be sold that is nearer to 50% of total body weight,

2. Where in the body is the TBW/located? Where in the usury is successful to the contract of the intracellular and the extracellu-TBW is distributed to consequence the second state of the cell membranes. The fluid volumes in these comis congartments, which are separated by and cent memoranes. The fluid volumes in these com-ing the known as the intracellular fluid (ICF) and the extracellular fluid (ECF). The ICF particults are known as the transfer of the ECF is the fluid outside of cells, including the intersti-she fluid found within the cells, and the ECF is the fluid outside of cells, including the interstisal fixed, lymph, and plasma.

1. What proportion of TBW is in the intracellular and extracellular compartments? What proportion of TBW, whereas the ECF constitutes one-third of Is general, the ICF comprises two-thirds of TBW, whereas the ECF constitutes one-third of

It general, the LCT companies and approximately 42 L of TBW would then have approximately 12 L of TBW would then have approximately 13 L of TBW would then have approximately 14 L of TBW would then have approximately 15 L of TBW would then h BW. 100 average in Ag. 32 Level and approximately 14 L (42 L × ½) in the ECF.

4. How is the ECF distributed?

The ECF is distributed into two major compartments, the interstitial fluid and the plasma. The buffer between these two compartments is composed of the highly permeable systemic capliers. The interstitial fluid volume is approximately four-fifths of ECF, and the plasma volume approximately one-fifth of ECF volume. The average 70-kg man with 14 L of ECF volume a approximately one-man or the state of the 28 L of plasma (14 L × 30).

Cakulate the normal blood volume.

The normal plasma volume is approximately 2.8 L, and the hematocrit (packed red blood cell factor of blood) averages 0.38 to 0.42; therefore, the average individual has a blood volume of approximately 4.7 L (plasma volume/[1 – Hct] = 2.8 L/[1-0.4]).

6. What is osmolarity?

Omedarity is a function of the total number of particles in solution, independent of mass, dame, or chemical composition. The dissolved particles (osmolytes) exert a force that tends to pil wars across semipermeable membranes (osmotic pressure). Dissolved particles in biologic whites are expressed in terms of milliosmoles (mOsm). For substances that do not dissociate Mossaler particles when dissolved (i.e., urea, glucose, inulin). I mole = 1 osmole and 1 mmole a lating periods when dissolved (i.e., urea, glucose, inulin), I mole = 1 bishoc and interest and including periods and including periods and interest and including periods and including periods and including periods and including periods and periods are periods and periods are periods and periods and periods and periods are periods and periods and periods and periods are periods and periods are periods and periods and periods are periods are periods are periods are periods and periods are per Assistant character that dissolve into two particles (sodium chloride [tract]) of mode NaCl = 20 km chloride [CaCl₂]), the osmolarity is double or triple the molarity (1 mode solution a concentration (CaCl₂)), the osmolarity is double or triple the motarity (1) in a concentration of osmotically active particles in solution where the concentration of osmotically active particles in solution and active. a segment of the concentration of osmotically active particles in segment of the ECF and ICF a в содел 280-300 mOsm/L.

7. What is amolality?

What is dimolality?

An alternative notation used to express the concentration of dissolved particles have been expressed in terms of mOsm/kg of water. In relatively diluge solutions, and accordance to the concentration of the concentration What is dimonitory.
 A alternative notation used to express the consensus or unsolved particle in a state of the consensus of months of water. In relatively dilute solition, the particle is expressed in terms of months of water. In relatively dilute solition, the particle is expressed in terms of months of water. As alternative recommendation of mOximizing or water, in consisting united solutions and symbol is expected in terms of mOximizing or water, in constantly in so, small constant in the body, the difference between cosmolarity and osmolality is so small find the constant in the body, the difference between cosmolarity and osmolality is so small find the constant in the body, the difference between cosmolarity and osmolality is so small find the cosmolarity and osmolarity and osmolarity and osmolarity and osmolarity is so small find the cosmolarity and osmolarity and osmolarity and osmolarity and osmolarity and osmolarity is so small find the cosmolarity and osmolarity and osmolarity

8. Define osmosis."

Define outnots."

Osmosis is the movement of water across a semipermeable membrane owing to define the control of the control 8. Deline demonstration of water across a semipatron continuorane owing to different consistency (an ownoic pressure gradient). Osmosis occurs from a fluid computing to different consistency (an ownoic pressure gradient). Osmosis occurs from a fluid computing to different consistency (an ownoic pressure of a second computation is lower to a second computation of the consistency of the consi Osmosis is no more considerable to the constraint of the constrain in combality (as usually the source of the s the solute consensation on each side of the internations is equal. A semipermental subject until the complainty on each side of the international subject with the complainty on that is permeable to water but not solute. It is this is each as a cell membrane) is one that is permeable to water but not solute. It is this is subject to the complainty of th higher unto the man and the membrane) is one that is pertureable to see that a dissolved particle can exert an osmotic force only if it is not permeable in the next in the man and the ma

What is tonicity? '
The total concentration of solutes in a solution that are not permeable in the cell broads are effective osmotic pressure in cells, the tonicity of a solution of the cell broads. The total concentration of souties in a sounce of the cell source of the cell source of the solution on water movement into or out of cells.

- 10. Explain the influence of hypotonic, isotonic, and hypertonic solutions on cell value is no isotonic solution, the cell volume will be included.
 - When a cell is placed in an isotonic solution, the cell volume will be unalired When a cell is placed in a hypotonic solution, the cell will swell.
 - When a cell is placed in a hypertonic solution, the cell will shrink

11. Is there a difference in the total osmolarity of the ICF and ECF?

Is there a difference in the conditions, the total concentration of dissolved pasters as No, under notinial sucasy-some partitions is equal because the cellular membranes as the intracellular and extracellular compartments is equal because the cellular membranes as the intracellular and expectations. See Ego. permeable to water, and any differences in osmolarity between these compartments in order. permeane to water, and any corrected due to osmosis. Because the total concentration of substances that are osmosis.) is the same in the ECF and ICF, the osmolarity of the ECF and ICF is equal (280-300 mOsale

12. Are there differences in the ionic composition of the fluid found in the ECF and NY Over 90% of the ions in the extracellular fluid are sodium, chloride, and bicarbons; the sa centration of other ionic species in the ECF is relatively low. In contrast, the intracellists fleir high in potassium and phosphate, whereas the ions abundant in the extracellular fluid (softened its anions) are relatively low within the cells.

Concentration of Selected Ions (mEq/L), pH, and Osmolarity (mOsm/L) in the ECF and ICF

	THE ECT WING ICF	
	ECF	ICF (MUSCLE)
Sodium Potassium	145	10
Calcium	4	155
Chloride	110	
Bicarbonate Phosphate	24	*
pH	2	140
Osmolality	7.4 290	7.15
		790

13. Why are there differences in the concentration of the individual ions in the ECF and IT.

The primary resources of the concentration of the individual ions in the ECF and IT. The primary reason for the difference observed in the ECF and ICF is the cell membras.

Na*, K*-ATP-sea recorded. the Na*, K*-ATP ase pump which is found in the cell membranes. Cell membranes are high P to warr but the permeasury a mean security is a relatively low. The Na*, K.*-ATPase war but warring to the regulation of intracellular concentration by actively transfer of page of cells (against this ion's electrochemical gradient) and pumping warring and page of cells (against this ion's electrochemical gradient) and pumping warring and page of the p to wear in the control of the contro so por of cells (agains una our o nextrochemical gradient) and pumping potassium and potal solution is diven by its electrochemical gradient into the cells, the sodium that gradient and the cells, the sodium that gradient and the cells of Although sodium is oriven or in concurrent and gradient into the cells, the sodium that of the cells of the cells of the sodium that of the cells of the cel grange and cells is accurate control of the cells to mainta

Ar there differences in the composition of the plasma and the interstitial fluid?

A return is slight difference in the ionic composition of plasma when one that the plasma is slight difference in the ionic composition of plasma when one is slight difference in the ionic composition of plasma when one is slight difference in the ionic composition of plasma when one is slight difference in the ionic composition of plasma when one is slightly a slight difference in the ionic composition of plasma and the interstitial fluid? the difference in the ionic composition of plasma when compared to the in-there is a slight difference is due to plasma protein (approximately 6 o/d1). It As we a slight difference in the source composition of plasma when compared to be inthere is a slight difference is due to plasma protein (approximately 6 g/dL), which is mostly

when the sum of albumin. The plasma proteins are effectively trapped in the plasma becomes

some of albumin. The plasma proteins are relatively improved. med. This difference is not a plasma protein (approximately 6 g/dL), which is mostly spirit fill of albumin. The plasma proteins are effectively trapped in the plasma because the same because the same because the same proteins are not plasma because the same plasma because the sam which is mostly trapped in the plasma because the base of the plasma because the base membranes in most tissues are relatively impermeable to protein. The albumin carries of the membranes in the plasma training training the plasma training gale New Arman sin most ussues are removery impermeable to protein. The albumin carries of the charge, which tends to hold extra amounts of cations in the plasma. This proper is sent to the charge, which tends to hold extra amounts of cations in the plasma. This propers is the Donnan effect, slightly alters the distribution of other ions have been applied to distribution of other ions. when seems to note that amounts of cations in the plasma. This paper are proposed as the Donan effect, slightly alters the distribution of other ions between the plasma this pace and leads to slightly greater concentration of other and the interstitial space and leads to slightly greater concentration of other and the interstitial space and leads to slightly greater concentration of other and the interstitial space and leads to slightly greater concentration of other and the interstitial space. | see of the interstitial space and reads to sugnify greater concentration of cations (3.4 pages) and the interstitial space and reads to sugnify greater concentration of anions in the plasma relative to the interstitial of the plasma relative to the plasma relati

Is Does water more from one body compartment to another? Does water more it can be a second of differences in hydrostatic pressure, osmotic pressure, or both.

ik Whit regulates the distribution of water between the plasma and the interstitial fluid? What regulates are used to the plasma and the interstitial fluid?

Hid exchange between the plasma and the interstitial fluid is governed by Starling's law

There is the net flux of fluid into or our flux of fluid into or our flux of fluid into or our flux or on the flux of fluid into or our flux or on the flux of fluid into or our flux or on the flux of fluid into or our flux or our flux or on the flux or our And exchange use the hydroctatic and osmotic forces on either hydroctatic and either hydroctatic and either hydroctatic and either hydroctatic and either hydroc

programy have exceed by the hydrostatic and osmotic forces on either side of the capillaries. As it is also receive a crime of the hydrostatic and systemic capillary have been designed by the capillaries. whe algebraic sum of use of the heart, a systemic capillary has a relatively high hydrosta. insid of the pumping section of the pumping sectin of the pumping section of the pumping section of the pumping se present (O mone)

general of fluid out of the capillaries include the plasma oncotic pressure (the osmotic presgoment of titud out or the control straint of titud by drostatic pressure. Without forces opposing are tented by proteins) and interstitial fluid hydrostatic pressure. Without forces opposing get curren of processors, primarily the plasma oncotic pressure, the plasma volume would oplary bytostatic pressure, apilest byterostate. Proceedings of the simple equa-

$$Flux = K_f [(P_{cap} + \Pi_{int}) - (\Pi_{cap} + \Pi_{int})]$$

- K, = Ultrafiltration coefficient
- P = Capillary hydrostatic pressure II = Interstitial oncotic pressure
- II. = Plasma oncotic pressure P_{in} = Interstitial hydrostatic pressure
- lagereal, the forces favoring filtration slightly exceed those opposing filtration. This leads to

antification out of the capillaries, which is collected as lymph and returned to the circulation. II. How is fluid exchanged between the ECF and ICF?

The movement of fluid between the ECF and ICF is governed by osmotic forces. The cell

tentraces are highly permeable to water and semipermeable to most solutes. Any change in her composition in one compartment is reflected in the osmolarity of that compartment (prowhich a the ion is not permeable in the cell membrane), and water quickly crosses the cell membrees until osmolarity is equal in both compartments.

it live can the different body fluid compartments be measured?

The volume of different body fluid compartments be measured?

The volume of different body compartments can be measured most easily by determining the late of data. water of different body compartments can be measured most easily by section of compounds known to be freely distribution of compounds known to be freely distributed within a certain comparting to the body fluid combeg. in this isolatique, a known quantity of a substance that is distributed in the body fluid com120

partment of interest is administered. After a sufficient amount of time is allowed for equipment of interest is administered. After a sufficient amount of time is allowed for equipment of the fluid from that compartment is taken. By dividing the original and the compartment of the fluid from the compartment of postment of interest is administered. After a sufficein amount of using its allowed for a supple of the fluid from that compartment is taken. By dividing the original analyse of the fluid from that compartment is taken. By dividing the original analyse is a supple of the fluid from the concentration of substance X at equilibrium (C_X) , the volume of distinct of substance X and the concentration of substance X at equilibrium (C_X) , the volume of distinct of substance X and X are the concentration of X and X are the conce partners of interest is some as a support of the first from that compartment is used. By such that the original angle of the first from that compartment is used. By support of the volume of discharge X at equilibrium (C_X) , the volume of discharge X and X by the concentration of substance X at equilibrium (C_X) , the volume of discharge X and X by the concentration of substance X and X by the concentration of substance X at equilibrium X by the volume of discharge X by the concentration of substance X and X by the concentration of substance X by the volume of X by the volume of

19. Describe the ideal substance for measuring volume of distribution.

- Nontoxic Nontoxic
 Mixes well in and is not removed from the targeted compartment
- Is not metabolized or synthesized in the body
- Rate of excretion easily quantified

 Ratio was accurately measurable
 Easily and accurately measurable
 Easily and accurately measurable
 Example: A 70-kg man is injected intravenously with 4 × 10⁶ cpm of tritiated was to the blood contains 100 cpm/mL 31,0 n 10,0 n 10 Estaty one Visual Research (A. 70-kg man is injected nurvernous)
 Example: A 70-kg man is injected nurvernous)
 Is minutes later, a blood sample is taken, and the blood contains 100 cpm/ml. 34,0. 38, 48, 15 minutes later, a blood sample is taken, and the blood contains 100 cpm/ml. 34,0. 38, 48, 15 minutes later, a blood sample is taken, and distribution of 44,0 in this individual is therefore 40.1 (4 × 106 cpm/ml). Example: ... So that sample is taken, and understanding the property of the p 15 minutes success
lated volume of distribution of ⁹H₂O in this mouvages are excreted, the amount but have a 40,000 mL = 40 L). In cases in which compounds are excreted, the amount but has been also as the second of the se lated votations are 40,000 mL = 40 L). In cases in which composition are 40,000 mL = 40 L). In cases in which composition are 40,000 mL = 40 L). In cases in which composition are 40,000 mL = 40,000

20. Name some compounds used to measure volume of distribution of different body for Compound

Body Fluid Compartment Total body water Extracellular volume

H,O (3H,O) Sodium (22Na) Inulin (3H-inulin)

Iothalamate (125I-iothalamate)

Albumin (125I-albumin) Plasma volume Evans blue dve

21. How can the volume of the interstitial fluid and ICF compartments be determined The ICF and interstitial fluid volumes can be calculated using the measured volumes of its ECF volume, and plasma volume:

The ICF volume can be determined by subtracting the ECF volume from TBW (ICF).

 Interstitial fluid volume can be calculated by subtracting plasma volume from cares. lular volume (ISF = ECF - PV).

22. What will happen to the different body volume compartments after the intake of its tonic saline solution?

Isotonic NaCl (0.9%, 290 mOsm/L) has an osmolarity equal to that found in the ECF at ICF. Both NaCl and water are freely permeable throughout plasma and the interstitial space. an isotonic NaCl load will be equally distributed throughout the ECF. Because sodiun care ter the cells but is actively excluded by the Na+, K+-ATPase, any added sodium will be else tively trapped in the ECF. Since isotonic saline has the same osmolarity as the ECF and ICF and will be no osmotic effect leading to a fluid shift between the ECF and ICF. The intake of issue NaCl will thus increase TBW and ECF but will not appreciably alter ICF volume; ourside ity of both the ECF and the ICF will be unaltered from the original value.

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A hypertonic NaCl load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also initially be distributed on the local load (osmolarity > 290 mOsm/L) will also on the local load (osmolarity > 290 mOsm/L) will also on the local load (osmolarity > 290 mOsm/L) will also on the local load (osmolarity > 290 mOsm/L) will also on the l throughout the ECF. The difference between the isotonic and hypertonic load is the final order ity that is attained in ity that is attained in the ECF and ICF. Because the osmolarity will initially be increased in the More to the hypertonic load is the final of the hypertonic load. owing to the hypertonic saline, water will move freely down its concentration gradient of the 126

After a sufficient amount of time is allowed for exhibition of the third from that compartment is taken. By dividing the original scale of the third from that compartment is taken. By dividing the original scale of the third from that compartment is taken. By dividing the original scale of the third from that compartment is taken. By dividing the original scale of the third from the compartment of the third from the compartment of the compa partment of interest is administered. After a sum of the many dividing the original angular as an ample of the fluid from that compartment is taken. By dividing the original angular as a sample of the fluid from that compartment of substance X at equilibrium (C_X) , the volume of dividing (C_X) and (C_X) and partners of interest is dominimated in the compartment is unknown, and the original and the sample of the fluid from that compartment is unknown, and the volume of discount in the constraint of the volume of discount in the volume of discount in the volume of discount in the volume of $A_{N}(x)$, by the consentration of $A_{N}(x)$.

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- Estily accurate

 Eastly ama some financial injected intravenously was 1 o 10 spin or tritiated was (18 family 18 famil Example: A color sample is taken, also use one to the property of the sample is taken, also use one of the sample is taken, also use one of the sample is taken, also use of the sample is taken, also 15 manuses asserting the first of the first laded volume to account of the hand of the second of the s

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and a sew composarity is achieved. A hypertonic NaCl load will therefore expand TBW, inthe set of decrease ICF volume. A new level of osmolarity will be attained that name.

Age of the composarity of the set of th where the second and the same section of the second second and the second secon the unit is and decrease ICF volume. Give we've of osmolarity will be attained that will be earlied that will be earlied that will be earlied that will be expended from the value before the hypertonic load.

Professional Line (Section 2) with happen to the different body volume compartments after the intake of hypo-

saline solution? Will also initially be distributed equally Aby me ECF. The mujor difference between the isotonic and hypotonic leads. ANY MORE TO BE CONTROLLED AND THE STATE OF THE MERCHANT OF THE A PAT THE ECF. The major universities convern the isotonic and hypotonic loads is the final angular that is attained in the ECF and ICF. Because the ECF esmolarity initially will be described in the ECF into the call.

A bornetonic NaCI lead will be seen the ECF into the call. goestic that is attained in one because the ECF osmolarity initially will be de-goestic will move down its concentration gradient out of the ECF into the cells until new gradient will move down its concentration gradient out of the ECF into the cells until new gradient is where the production of the new level of overshoots. will be described in the crisinal value. The new level of osmolarity will be equal throughout the color will be described in the crisinal value. erock. A hypoxome vact road will increfore expand TBW, increase ECP volmobility is crease ICF volume. The new level of osmolarity will be equal throughout the ECF
and all throughout the ECF
and will be decreased from the original value. are and increase the rename, the new level of osmoli

Has are clinical abnormalities in body fluid status evaluated? there are clinical noncommunication and the second The most commonly used that anions are the major ionic species of the ECF, plasma or serum and its anions are the major ionic species of the ECF, plasma sodium and its anions are the major ionic species of the ECF, plasma sodium and indication of volume status. Under normal condition Because socium and socium status. Under normal conditions, P_{No.} is 145 mEq.(...) fly is not day a chancer motion and the patient is said to be hypernatremic; when a patient's P_{N_k} is 145 mEq.(1), when a patient's P_{N_k} is less when P_{N_k} is less and individual is hypernatremic. the distribution and individual is hyponatremic.

% What conditions lead to hypernatremia?

What conditions read the which thirst is impaired (coma, neurologic abnormality, or drug effects) Situations with no access to drinking water Situations what has a water (increased ECF sodium concentration with decreased ECF volume)

Lossel etrusculum or excess sodium intake (increased ECF sodium concentration with normal or elevated ECF volume) material control of the second of the second

or the instillity of the kidneys to respond to ADH) or use installing a second-processive evaporative losses (such as those that occur in individuals with extensive second-

degree and third-degree burns) expectations in which excessive amounts of sodium-retaining hormones (such as aldosermac) are secreted into the blood

his interest to distinguish the cause of hypernatremia in patients to select the correct there ments measures to be taken.

If. Name some conditions that lead to hyponatremia. /

· Excess retention or intake of water (hyponatremia with increased ECF volume): Inapprotrials or uncontrolled secretion of ADH (kidney retains excess amounts of water and leads to expansion of extracellular water and hyponatremia) berased excretion or decreased intake of sodium (hyponatremia with reduced ECF volume)

Kidney disease Impropriate use of diuretics

Conditions in which there is decreased secretion of sodium-retaining hormones (aldosterone)

A What is edema?

Elema is a condition in which excess fluid accumulates in the body tissues, usually in the speces. This condition occurs when an alteration in Starling's forces for systemic capin cichange occurs.

It. List some causes of edema.

bonased systemic capillary hydrostatic pressure Bareased plasma oncotic pressure (owing to decreased plasma protein)

a Increased systemic capillary permeability

Blockade of lymphatic return to the venous circulation (lending to 6demanding bills bill bills interstitial spaces)

30. Why is the Ridney Important in regulating the body volumes?

Why is the Range Important in regumning in the Range Important in regumning in the Range Important in the Range Important in the most basic terms, the primary function of the kidneys is to maintain the constant the impact of altered remotion on body fluid for the kidneys of the Range Important in In the most basic natural of the impact or assetute tested tunction on body and the EOF and ICF outdents and the impact or assetute the kidneys operate, but also asset is critical to understand not only the processes by which the kidneys operate, but also extend the different body flower of excretion of various substance. The state of excretion of various substance are the state of excretion of various substance. is critical to Measurement of Herican Body Ruid comparaments. The Abuney's regulate body and the including the comparaments and composition by controlling the rate of excretion of various substances. This is a comparate and integrated relationship between the kidney, the endocrine symmetry and integrated relationship between the kidney, the endocrine symmetry and integrated relationship between the kidney. tionship between use and composition by controlling the rate of excretion or various substances. This is and composition by controlling the rate of excretion to the kidney, the endocrine state of the control is accomplete and integrated relationship between the kidney, the endocrine symmetry of the control is accomplete or the control is accomplete to the contro

List the first of the blood flow to the kidney is approximately 1200 ml/min or 76 at 1. Bulk filtration: The blood flow to the kidney is approximately 1200 ml/min or 76 at 100 ml/min) of the plasma that flows to the kidney is approximately 1200 ml/min or 76 at 100 ml/min). I. Bulk filtration: The blood how to the Anney to approximately 1 ANI mL/min or 3% or cardiac output. About 20% (100 mL/min) of the plasma that flows to the kidney is shorted and cardiac output. About 20% (100 mL/min) of the plasma that flows to the kidney is shorted and shorted an and a couple. About 20% (100 mL/min) or one present a couple six sharpers is sharpers in the glomerular capillaries into the renal tubules in the process known as glomerular capillaries in the formation of urine. is the initial step in the formation or urme.

is the initial step in the formation or urme.

2. Reabsorption: This is the mechanism whereby the renal tubules reabsorb the relative or the return of accommod to the return of ac

2. Reabsorption: This is use internally responsible for the return of approximately fluid that were filtered. This process is normally responsible for the return of approximately 89. ne glomerular filtrate to the cours.

3. Secretion: This is a subular transport process in which substances are transported by a life to the subular fluid and the subular fluid 3. Secretion: This is a tumular supported by a bedividual tubular fluid to be excreted in design.

(RENAL HEMODYNAMICS >

32. Briefly describe the gross anatomy of the kidney.

The kidneys are paired organs found against the dorsal wall of the abdomen just bereath. The Kameys are parted of the peritoneum. The renal tissue can be grossly divided into three min

33. What is a nephron?

A nephron is the basic unit of the kidney. Each normal human kidney has approximate million nephrons. (See top figure on next page.)

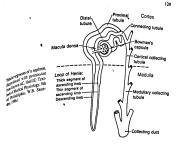
34. Describe the path blood travels as it passes from the renal artery to the renal ven. Blood enters the kidney through the renal artery; then flows through the interlobs step. arcuste artery, interlobular artery, afferent arteriole, glomerular capillaries, efferent arterist. peritubular capillaries, and interlobular, arcuate, and interlobar veins; and finally the real vein. Of note, glomerular ultrafiltration occurs in the glomerular capillaries, and upak of solute and water that has been reabsorbed by the epithelial cells occurs in the periutula of

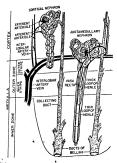
35. Are there different types of nephrons?

There are two general types of nephrons: cortical (superficial) and juxtamedulary nephrons. (See bottom figure on following page.)

36. How are different types of nephrons distinguished? Tubular structure

Location Vascular structure (See bottom figure on page 129.)





37. What are the distinguishing characteristics of a superficial nephron?

What are the distinguishing characteristics or a superior in HEPHTON'S
Superficial cortical replaces (see bottom figure, page 129) comprise approximately see
Superficial cortical replaces (see bottom figure, page 129) comprise approximately see

Local Country (see bottom figure)

Local Country (37. What are the distinguished the description of the surface of the kidney. The backet of the kidney. The backet of all nephrons and are located with the glomerulus near the surface of the kidney. The backet of all nephrons and are located with the scene partons have a short thin descending lively and all nephrons and resource in the medulla, where these nephrons have a short thin the scending lively. The backet of the scene and the scene and the scene are th Superficial corticus of the glomerium near one of the superficial corticus and a located with the glomerium near of the superficial polytosis and are located with the glomerium near of the superficial polytosis and a located with the medalla, where these nephrons have a short thin descending lands to the third scending limb. The good of the contract of the superficial polytosis of the superficial corticus and the super all nephrons and are IOCamo-all nephrons and are IOCamo-ure differs in the medulla, where these neparons mare a manufactured fifter in the medulla, where the second in the post of the which turns within the outer medulla and leads to the thick ascending limb. The post of the which turns within the outer medulla and leads to the thick ascending limb. The post of the which turns within the outer medulla and leads to the thick ascending limb. The post of the which turns within the post of the p ure differs in the uneure differs in the uneure differs in the uneure differs which graphed to the unewhich turns within the outer medulla and reason of an effected arteriole, which give in the
which turns within the outer medullar expension of the property of the
vasculature of the superficial nephron consists of an effected with the property of the prope which turns within unwhich turns within the properties of the superficial nephron consists of an expension of the superficial nephron consists of an expension of the superficial nephron consists of an expension of the superficial nephron consists of an expension of the superficial nephron consists of the superficial ne etex are taken up into the blood in these postglomerular capillaries.

nex are taxen up work.

38. What are the distinguishing characteristics of the deep or juxtamedullary nephrons (see bottom figure, page 129) make up 10% of all nephrons. What are the distinguishing characteristics of the context and medullary nephrons (see bottom figure, page 129) make up 10% of all sephrons Juxtamedullary nephrons (see bottom figure, page 129) make up 10% of all sephrons (see bottom figure, page 1 38. What are the property of the property of the cortex and medullar property of all neptodes as glomeruli found deep in the cortex near the junction of the cortex and medulla. Jundands, glomeruli found deep in the cortex near the junction of the medium of the property JustaneousJournal deep in the cortex near the junction of the descend deep into the internet in the property of the descending limbs of Henle, which descend deep into the internet i glomerul tours

rephrons have long thin descending limbs of returns, the seconding limb at the hotel field turn back at the thin ascending limb, and become the thick ascending limb at the boots as the hotel field turn back at the thin ascending limb, and become the deep nephrons is also neparons nave to the beat ascending limb, and occount are the beat and the board of a time back as the thin ascending limb, and occurred as a scalar of the deep nephrons is also at the couter and inner medulla. The postglomerular vasculature of the deep nephrons is also at the couter and inner medulla. The postglomerular vasculature of the deep nephrons is also at the machine. tum to a second of the postglomerurar vasconing of the properties as also are for a definition of the are found in the module after arteriole, but this vessel gives rise to the vasa recta capillaries, which are found in the module after the motake into the ECF of fluid absorbed by the nephron segment. arteriole, but this vessel gives use to use a second absorbed by the nephron segments in the are responsible for the uptake into the BCF of fluid absorbed by the nephron segments in the are responsible for the uptake into the BCF of fluid absorbed by the nephron segments in the are responsible for the uptake into the BCF of fluid absorbed by the nephron segments in the second s

39. How is the glomerular filtrate formed?

130

How is the glomerular filtrate is the total flux of fluid across the glomerular capillaries. The glomerular filtrate is the total flux of fluid across the glomerular capillaries. The glomerular filtrate is the budrostatic and oncotic pressures in the second The glomerular filtrate is une town room of the hydrostatic and one otic pressures in the glomerular filtrate is formed by the sum of the hydrostatic and one otic pressures in the glomerular particles of the hydraulic permeability. lar filtrate is formed by the sum of the control of the hydraulic permeability and surface and Bowman's space. These forces, along with the hydraulic permeability and surface the net flux of fluid known and surface the laries and Bowman's space. These contents are the net flux of fluid known as the glorents. And the glorents are the glorents.

40. What forces govern glomerular filtration?

The following equations express all the forces involved in determining GFR:

GFR = (ultrafiltration coefficient) × (forces opposing and favoring filtration)

GFR = (ultrafiltration coefficient) × [(forces favoring filtration) - (forces opposing filtration)

GFR =
$$K_t \times ((P_{co} + \Pi_{co})_{=}) = (\Pi_{co} + \Pi_{co})_{=} (\Pi_{$$

 $GFR = K_f \times [(P_{GC} + \Pi_{BS}) - (\Pi_{GC} + P_{BS})]$ Because $\Pi_{R^{q}}$ is negligible under normal conditions:

$$G_{FR} = K_f \times (P_{GC} - \Pi_{GC} - P_{BS})$$

Where:

 $K_f = \text{Ultrafiltration coefficient: the product of the hydraulic permeability (L_j) and the$ surface area (SA) of the glomerular capillary membranes

P_{OC} = Glomerular capillary hydrostatic pressure IIGC = Glomerular capillary oncotic pressure

P_{BS} = Bowman's space hydrostatic pressure

Π_{BS} = Bowman's space oncotic pressure

41. What are the pressures favoring and opposing filtration?

 Glomerular capillary hydrostatic pressure (P_{GC}) P_{GC} averages approximately in mmHe at the affactory and the state of the state mmHg at the afferent end of the glomerular capillaries and falls to 58 mmHg at the defendence of the second of ent end of the glomerular capillaries.

 Bowman's space oncotic pressure (II_{BS}); Normally, this force is negligible because simulations. imal amounts of protein are filtered.

 Hydrostatic pressure in Bowman's space (P_{RS}) I P_{RS} is approximately 20 mmHg and mains constant from the mains constant from the afferent to the efferent end of the glomerular capillaries

Renal Physiology

claumerular capillary oncotic pressure (Π_{QC}): Π_{QC} averages 25 mmHg at the afference of the glomerular capillaries. (donner glomerular capillaries,

District pressures favoring and opposing filtration change over the length of the glomeru-

ps under the state of the plasma in the glomerular capillaries while plasma pro-secured whind in the blood, the plasma protein concentration and constitution goding fluid is flue to blood, the plasma protein concentration and oncotic pressure in the blood proceeds from the afferent to the effect of the dod proceeds from the afferent to the receive as blood proceeds from the afferent to the goding process to blood proceeds from the afferent to the plasma protein process to blood proceeds from the afferent to the plasma protein process the plasma protein process the plasma protein process the plasma protein with the behind in the afferent to the efferent end of the gloomerular capillaries, and local plasma pro-where the filler is the glomerular capillaries, the sum of the forces for glomerular fillration. At the bethe fulfiller fillration of the fillration. The net pressure favoring glomerular ultrafillration favors net fillration. The net pressure favoring glomerular ultrafillration favors net fillration. The set (afterest easy) or filtration. The net pressure favoring glomerular ultrafiltration (P_{UP}) and $P_{UP} = \{(P_{CC} + \Pi_{BS}) - (\Pi_{CC} + P_{ac})\} = \{(P_{CC} + \Pi_{BC}) - (\Pi_{CC} + P_{ac})\} = \{(P_{CC} + \Pi_{CC}) - (\Pi_{CC} + \Pi_{CC})\}$ is a proper suppose that the state of the s where $P_{\text{max}} = P_{\text{max}} = P_{\text{max}}$ is greatly by a much as a market impact on the forces for filtration: $P_{ijr} = \frac{1}{18} \left[-(I_{0c} + P_{BS}) \right] = [(58 + 0) - (40 + 18)] = 0$ mmHg. The concentration of profess a right subset of the forces that Fur = 0 mmHg. The concentration of prolifer in the forces that favor glomerusels in glomerular blood therefore has a marked impact on the forces that favor glomerusels in glomerular blood therefore has a marked impact on the forces that favor glomeru-

ar filmation. A What is the GFR in a normal human?

120 nL/min (172.8 L/day) (average). # Explain the concept of clearance.

Explain the concept of the concept of substance X (C_) can be coloude. spec per unit manuscript attion of substance X by the urinary flow rate:

 $C_v = UF \times (U_v/P_v)$

Ur = Urine concentration of compound X (mg/dL) UF = Urine flow rate (mL/min)

P_v = Plasma concentration of compound X (mg/dL).

are vake will have the same dimensions (i.e., volume/time) as urinary flow rate.

8. How can GFR be measured?

ideally, substances that are freely filtered at the glomerulus and neither reabsorbed nor secould be the renal tubules are ideal markers for the measurement of glomerular filtration. One shase commonly used to measure GFR in experimental situations is inulin, a polysaccharide (notector weight = 5500), which is infused intravenously. Because the kidney removes inclin for the body by filtration and does not secrete, reabsorb, or metabolize this compound, the clearaccordinates (C____) equals GFR:

 $GFR = C_{inulin} = UF \times U_{inulin}/P_{inulin}$

C_{min} = Inulin clearance UF = Urinary flow rate

Unite = Unine inclin concentration

P_{mate} * Plasma inulin concentration

is this opasion, the plasma and urine inulin concentrations must be expressed in the same mak(i.e., mg/dL) and cancel each other out in the calculation. The units of GFR are then the same a te sub of uritary flow rate (i.e., mL/min).

4. Cas GFR be evaluated clinically?

Month tulin is the compound of choice for the measurement of GFR in experimental sit-Reading the compound of choice for the measurement of GPK in experimentation, the compound must be infused intravenously before any measurements can be made. In 132

the clinical setting, creatinine clearance is used to measure GFR. Creatinine is an endogeneous the clinical setting, creatine metabolism in skeletal muscle; it is produced at a relative metabolism in skeletal muscle; it is produced at a relative metabolism of the clinical setting.

The clinical setting creatine metabolism in skeletal muscle; it is produced at a relative metabolism of the clinical setting. the clinical setting, creatinine clearance is used to measure or a recovered at a relative to the clinical setting, creatine metabolism in skeletal muscle; it is produced at a relatively stace formed by creatine metabolism in skeletal muscle; it is produced at a relatively stace formed by creatine metabolism in skeletal muscle; it is produced by the state of the skeletal muscle; it is produced by the state of the skeletal muscle; it is produced at a relatively state of the skeletal muscle; it is produced at a relatively state of the skeletal muscle; it is produced at a relatively state of the skeletal muscle; it is produced at a relatively state of the skeletal muscle; it is produced at a relatively state of the skeletal muscle; it is produced at a relatively state of the skeletal muscle; it is produced at a relatively state of the skeletal muscle; it is produced at a relatively state of the skeletal muscle; it is produced at a relatively state of the skeletal muscle; it is produced at a relatively state of the skeletal muscle; it is produced at a relatively state of the skeletal muscle; it is produced at a relatively state of the skeletal muscle; it is produced at a relatively state of the skeletal muscle; it is not a skeletal muscle; it is n

47. How is creatinine clearance used to evaluate GFR clinically? How is Creatinine clearance (Corest) can be used as an index of GFR:

$$C_{creat} = GFR = UF \times (U_{creat}/P_{creat})$$

U_{crest} = Urine concentration of creatinine (mg/dL) UF = Urine flow rate (mL/min)

P_{cree} = Plasma concentration of creatinine (mg/dL)

UF = Olass a concentration of creatinine (mg/uL)

Port = Plasma concentration of creatinine production, urinary excretion of creatining true

If we assume a state of constant creatinine is excreted only by the process of glomenia. The content of the process of glomenia. If we assume a state of constant creatinine is excreted only by the process of glomenia fig.

Creatine production = creatinine excretion =
$$K = (U_{creat} \times U_{P})$$

Because GFR = $(U_{creat} \times UF)/P_{creat}$ substituting K into the equation gives GFR = $K_{P_{creat}}$

Therefore, GFR a 112 count

Therefore, GFR a 112 count

Because P count normally equals 1 mg/dL, if we divide 100 by P crease we get an estimate of 5. percentage of normal GFR in this patient.

48. What are the possible concerns in the use of plasma creatinine to estimate GFR? What are the possible concern which leads to an overestimation of Gr.

I. Creatinine can be secreted by the renal tubules, which leads to an overestimation of Gr.

even if creatinine clearance is determined. if creatinine creatinine is a same as an index of GFR assumes that all individuals have the same nreduction rate of creatinine and therefore the same serum concentration

a. Although changes in serum creatinine can indicate alterations in renal function, and 3. Authorized the street of th crease in GFR from 100% (1/1 × 100) to 67% (1/1.5 × 100) of normal

49. What is contained in the glomerular ultrafiltrate?-The glomerulus is composed of the glomerular capillaries with endothelial cells covernily a basement membrane. The capillaries are surrounded by epithelial cells known as podocytes & though the endothelial layer contains fenestrations of approximately 1000 Å diameter for an freely permeable to water and most small solutes, the podocytes have foot processes that formilgration slits (approximately 40×140 Å), which retard the filtration of macromolecules baselon size. In addition, the surface of the endothelial cells, the basement membrane, and the polysis all contain negatively charged glycoproteins, which inhibit filtration of negatively charged reecules (such as plasma protein). In general, the largest molecules that can be effectively films are less than 25 Å in diameter, although positively charged molecules can still be filtered at sens as large as 40 Å.

50. Why isn't protein filtered in the glomerulus?

The glomerular ultrafiltrate is an ultrafiltrate of plasma excluding plasma protein and mysic stances bound to protein. Protein is excluded from the glomerular ultrafiltrate because of the protein. cialized structure of the glomerular membranes.

51. What is the level of renal blood flow (RBF) in a normal human? 4.0-1.25 L/min to both kidneys (average).

52. Can renal blood flow be measured?

In experimental animals, RBF can be measured directly using electromagnetic floaned

definition of RBF can be gained by determining the clearance of para-amino-hippuric acid of RB: can be used to quantitate renal plasma flow (RPF) because of policies, but a disks of like of the renal plasma flow (RPF) because this con-part of the renal plasma flow (RPF) because this con-part of the renal plasma flow (RPF) because this conand pAH clearance at the glomerulus and secreted by the organic acid transporter in the PAH: is freely filtered in the reabsorbed by any nephron segments. The clearance of PAH can be read to the control while, but it is not reabsorbed by any nephron segments. The clearance of PAH can be read to the control while th k akulated ac $C_{PAH} = RPF = UF \times (U_{PAH}/P_{PAH})$

$$C_{PAH} = RPF = UF \times (U_{PAH}/P)$$

Unine concentration of PAH (mg/dL) Ul = Plasma concentration of PAH (mg/dL)

Plasma contact for RPF can then be converted to RBF by dividing RPF by the fraction the rate obtained for RPF and then be converted to RBF by dividing RPF by the fraction The value of the result of the

G. What is the filtration fraction? that is used the glomerulus.

54 Her is the filtration fraction (FF) calculated?

FF = GFR/RPF.

S. How can RPF be calculated?

How can Ker 197.

The can Ker on the calculated as: RPF = RBF × (1 - Hct).

54 Describe what is meant by renal vascular resistance.

Describe man is a proportional to Reistance is generally defined by Poiseuille's law, in which resistance is proportional to Resistance is generally between the radius of the vessel, $\eta = \text{viscosity of the blood, and } l = \text{length of } f_{\text{blood}}$, where r = the radius of the vessel, $\eta = \text{viscosity of the blood, and } l = \text{length of } f_{\text{blood}}$. (HATTE X I'), where Poiseuille's law is applicable only to steady flow of an ideal fluid through the used. Although Poiseuille's law is applicable only to steady flow of an ideal fluid through the reset analogy of the state relation times and is the factors that can alter vascular resistance. Because the viscosity of the opage to uncertainty of the renal vessels can be considered constant, alterations in resistance are more are are reagant to the state of the sta min. and the fourth power, small changes in vessel radius can have profound effects on vasale resistance.

97. What are the preglomerular blood vessels?

Those found before the glomerulus:

• Renal arreny

· interlobar artery · Accuste artery

· Interlobular artery · Afferen arteriole

A What are the postglomerular blood vessels? Boe found after the glomerulus:

· Efferent arteriole

Pertubular (or vasa recta) capillaries Renal veza

N. Mich Mood venuels in the kidney provide for the greatest resistance to blood flow? Hornous in the kidney provide for the greatest resistance to blood flow?

in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the kidney provide for the greatest resistance to once in the greatest resistance to once the beginning to the end of these vessels, Intravascular hydrostatic pressure falls from approximately 100 mmHg to 60 mmHg from the beginning to the end of the affected arteriole, proximately 60 mmHg to 15 mmHg across the efferent arteriole. proximately 100 mining to 35 mmHg across the efferent arteriole.

from approximately

60. Do selective changes in preglomerular and postglomerular renal vascular real

61. Do selective changes in RBF? lead to similar changes in RBF?

Do selective changes in RBF?

to similar changes in RBF? lead to similar change—
RB is equal to the driving pressure (AF) unloss of the sequence of the driving pressure (AF) unloss of the sequence of the driving pressure of the sequence of the seq RBF is equal to uniformated renal vascular resistance at any account in the renal vascular resistance at any taken leave to a decrease in RBF. Conversely, decreased renal vascular resistance at any local work leads to a decrease in RBF. Increased RBF. Increases or decreases in preglomating work leads to a decrease in the renal blood flow.

61. How would selective changes in pregiomerular or postglomerular renal vascular tea.

cealter GFR?
In general, GFR increases when the driving force for filtration (glomerular capillary pressure is decreased to be seen In general, GFR increases when glomerular capillary pressure is decreased, Becque is increased, and GFR decreases when glomerular capillary pressure in all words for the society for the control of the is increased, and GFR decreases when good to a decrease in pressure in all vessels doubting a varied resistance in preglomerular vessels leads to a decrease in pressure in all vessels doubting varied resistance in preglomerular resistance decreases (Da. 1997). valed resistance in preglomerular vessels downstance in control of the glomerular capillaries), increased preglomerular resistance decreases GFR (as ref. (including the glomerular capitaness), increased preglomerular vascular resistance, increased grades as RBF). In contrast to the effects of increased preglomerular vascular resistance, increased participations of increased participations of increased participations. as RBF). In contrast to the effects of increased hydrostatic pressure in upstream segments (including to allowerular resistance leads to increased hydrostatic pressure in upstream segments (including to allowerular resistance leads to increase in GIFR desmite a decrease in DIF

62. How do selective changes in renal preglomerular and postglomerular resistance the -filtration fraction?

atton traction: In general, alterations in preglomerular resistance do not alter filtration fraction, whereas changes in postglomerular resistance do alter filtration fraction

63. Summarize the influence of changes in preglomerular and postglomerular renai vacular resistance on RBF, GFR, and filtration fraction.

PREGLOMERULAR RESISTANCE	POSTGLOMERULAR RESISTANCE	٠,	RRF		FILTRATION
1			RDF	GFR	FRACTION
-	ï		i i	Ü	
			ř		. 1
	1		î	i	7

64. Explain how fluid and solutes reabsorbed by the renal tubules are taken back up his

The uptake of reabsorbed solute and water into the ECF is the primary role of the posglomerular peritubular and was recta capillaries. These capillaries are extremely effective for the uptake of reabsorbed substances for two reasons;

1. Hydrostatic pressure in these capillaries is fairly low—on the order of 15 mmHg in the peritubular capillaries and 6-10 mmHg in the vasa recta capillaries.

Oncotic pressure in these capillaries is relatively high.

Because 20% of the plasma is filtered at the glomerulus, the blood entering the efferts and constitution of the plasma is filtered at the glomerulus, the blood entering the efferts and constitution of the plasma is filtered at the glomerulus. teriole and continuing to the postglomerular capillaries has an elevated protein concentrate and oncotic processor. and oncoic pressure (approximately 35-40 mmHg), which favors reabsorption. The balance Starling forces for continuous and cont Starling forces for capillary exchange in these vessels is in favor (low capillary bytonials pressure and high pressure and high capillary exchange in these vessels is in favor (low capillary available and the ECF.

griefy describe the physiologic regulators of GFR and RBE.

S author of different systems are involved in the physiologic flat constricted to the physiologic flat constricted to the co gridy describe the provided in the physiologic regulation of RBF and GFR.

A full provided that constricts the renal vasculature and decrease RBF and GFR.

Brieff of different systems are involved in the physiologic regulation of RBF and A new gradients that constrict the renal vasculature and decrease RBF and GFR.

Brieff of the renal control of the renal vasculature and decrease RBF and GFR.

Brieff of the renal control of the renal vasculature and decrease RBF and GFR. Propinging Prince (released by sympathetic nerve stimulation)
Nerspinging II

Asgotensin II February deal can increase GFR and RBF: , Nitric oxide

Bradykinin Prostaglandins

86 What is meant by autoregulation of GFR and RBF? What is meant by autoMarket is meant by auto Wife million of LFK and tools to 160 mmHg. To understand how autoregulation occurs, it is present in increased from 80 to 160 mmHg. To understand how autoregulation occurs, it is present in increased from 80 to 160 mmHg. To understand how autoregulation occurs, it is present to the second of the second to the second of the second to the second occurs, it is to the second to the second occurs of the second to the second occurs. is increased to the response of tubes with a fixed resistance and those that are distensible duris provided the response or town a taken resistance and those that are distensible dur-by the prefixion pressure. If the renal vasculature functioned as a set of rigid tubes (fixed with the prefixion pressure.) The renal vasculature functioned as a set of rigid tubes (fixed with the prefixion pressure.) The renal vasculature functioned as a set of rigid tubes (fixed with the renal vasculature) and the renal vasculature functioned as a set of rigid tubes (fixed with a renal vasculature). before the perfusion pressure. A successful distribution perfusion pressure as set of rigid tubes (fixed spines), 80F would be predicted to increase directly with arterial pressure. Recall that blood spines are directly proportional to perfusion pressure (P) and inversely proportional. RBF would be produced to perfusion pressure (P) and inversely proportional to resistance for a direct increase in pressure with no change in resistance would thus leave any A direct increase in pressure with no change in resistance would thus leave any A direct increase in pressure with no change in resistance would thus leave any A direct increase in pressure with no change in resistance would thus leave any any any any and a second secon see figured proportional to resistance with no change in resistance would thus lead to a pro-RF o RR. A direct interests to the circumstance with rigid tubes, if the renal vasculapost increase in now. In the many post increase in now in rigid tubes, if the renal vascula-post increase in now in the restance would discrease. Combined with the increased in factored as a set of the second decrease. Combined with the increased perfusion pressure would dilate the second set was all visual resistance would decrease. Combined with the increased perfusion pressure, seek and visual second and an increased perfusion pressure.

Media resistance would lead to even greater changes in flow than would be seen with rigid the list resistance would be seen with rigid the listed of either of these two types of responses, RBF and GFR are maintained constant as the listed of either of these two types of responses, RBF and GFR are maintained constant as prising pressure is increased.

g, Bow must vascular resistance change during autoregulation? How must vacuum Real vacuular resistance must increase (vessel diameter must decrease) as pressure is inand viscours reasonable RBF constant over the wide range of perfusion pressure.

g Describe the mechanisms that lead to the autoregulation of GFR and RBF. Appreciation of GFR and RBF is thought to be mediated by two mechanisms:

· Myogenic response Tebeloelomerular feedback

The appeale response is an intrinsic property of blood vessels whereby stretch of the vesgless to a reflex contraction of the vascular smooth muscle. The myogenic response can also behaved in many vascular beds in addition to the renal vasculature. In tubuloglomerular fethed, increased tubular flow rate and increased NaCl transport rate in the macula densa cells mine a feedback signal that is sent to the afferent arteriole to constrict in order to maintain a testan keel of GFR and therefore tubular flow rate. In combination, the myogenic response and this interest in feedback are capable of maintaining GFR and RBF fairly constant over a wide tage of arterial pressures.

8. Am GFR and RBF altered in pathologic conditions?

Any number of pathologic conditions can lead to alterations in GFR or RBF. GFR and RBF resuly decreased in both acute and chronic renal failure.

A Deine acute renal failure,

he shop impairment or interruption of renal function that is indicated by abnormally low Recent actions or interruption of renal function that is indicated by any conditions:

* Decreased blood supply to the kidney *Acta isjury to glomeruli or blood vessels

Renal Physiology

Damage to renal tubules or the renal interstitium

Obstruction of the lower urinary tract

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Define chronic renal failure. Define chronic renal failure.

An irreversible and progressive loss of nephrons over an extended period of sine

What are the changes in GFR and RBF unit occurs to the control failure with a set of the control failure is indicated by the rapid decrease in nephron function brought about acute renal failure is indicated by the rapid decreasing and the control failure is indicated by the control failure in indicated by the control failure is indicated by the control failure in the control failure in the control failure in the control failure is indicated by the control failure in the control failure in the control failure in the control failure in the control failure is indicated by the control failure in the control failure is indicated by the control failure in the control failure is indicated by the control failure is indintended by the control failure is indicated by the control failur 72. What are the changes in GFR and RBF that occur in acute renal failures The rapid decrease in nephron indically by increased serum or plasma creatining in GFR, which can be determined clinically by increased serum or plasma creatining.

in GFR, which can occur 73. List the types of renal vascular injury or abnormalities that can lead to acute the types of renal vascular injury or abnormalities that can lead to acute renal failure is vac-

List the type-or ure.

ure.

Decreased blood flow to the kidney that leads to acute renal failure is known as pretrail for the control of the following. Decreased blood flow to the Known as Pre ure or acute ischemic renal failure. Prerenal failure can be caused by the following: Hemorrhage

 Major surgery Diagnostic radiology techniques

Diagnostic radiology techniques
 Diagnostic radiology techniques
 Severe vomiting, diarrhea, or other conditions that lead to severe dehydration, by the conditions that lead to severe dehydration.

74. Describe glomerulonephrotic syndrome in acute renal failure,

Describe glomerulonephrous synus one.

Acute renal failure owing to glomerulonephrotic syndromes usually occurs 1-3 week to condition develors as a result of the condition develors. Acute renal failure owing to gonnection. This condition develops as a result of the day. a streptococcal or gram-negative in the glomerulus. These complexes, along with white too of antibody-antigen complexes in the glomerulus. These complexes, along with white too tion of antibody-antigen complexes in the growth of the first state of the cells, become entrapped in the glomeruli, reducing GFR and increasing the permeability of the cells, become entrapped in the glomeruli, reducing or the cells of the cells, become entrapped in the giomerulonephrotic syndrome is therefore associated with detread glomerulus to protein. Its grant survey glomerulonephrotic syndrome usually lasts 1-7 wed. and renal function gradually returns to normal in the next few weeks to months.

75. Is GFR altered in chronic renal failure?

Is Grant ancream. In chronic renal failure, the number of nephrons is progressively and irreversibly decread. Although the remaining nephrons hypertrophy in an attempt to compensate for the loss of on nephrons, chronic renal failure eventually is associated with a reduction in GFR. This condise can be detected clinically as a gradual increase in serum or plasma creatinine that occurs overing

TRANSPORT IN NEPHRON SEGMENTS

76. Name the different methods by which the kidney handles ions, nutrients, and water Normal renal function requires the movement of ions, essential nutrients, and water behind and out of the plasma compartment. These functions are accomplished by 3 major mechanism

1. Bulk filtration into the glomerulus 2. Reabsorption from the tubule into the plasma along nephron segments

3. Secretion from the plasma into the tubule at specific sites along the neptron

77. What different types of substances undergo these transport functions about the manhouse.

The major compounds that must be transported along the nephron after filtration includes cose, proteins, and amino acids. Because ions are freely soluble in plasma, they are also freely tered, All ions need to be reabsorbed along the nephron back into the plasma. The med of the control of the con

of these lons, however, include Na+, Cl-, K+, HCO₃-, Ca++, and Mg++. Other senses waste products must predominantly remain in the tubular fluid, such as urea, uric axid, steps

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Most of these nonessential waste products are filtered freely, which is one of the addition by which the kidneys clear the body of these compounds. In addition near the design of the addition of the second o Most of these compounds. In addition, organic acids if the specific transported (secreted) from the plasma into the tubular fluid as yet aminoration in the plasma into the tubular fluid as yet and the plasma into the tubular fluid as yet aminoration in the plasma into the tubular fluid as yet and the plasma into the tubular fluid as y by making by which me consequenced from the plasma into the tubular fluid as yet another mecha-state framported (secreted) from the plasma into the tubular fluid as yet another mecha-tion of the plasma of the plasma of the plasma of the plasma into the tubular fluid as yet another mecha-tion of the plasma remported in the particularly important for the urine. This function is particularly important for the reset best are certaing substances into the urine. This function is particularly important for the reset of the particular important for the reset of the particular important for the repure carried supsances may me arme. This function is particular flui-per for accreting supsances from the plasma. I

What is the filtered load of a substance? Wall is the filtered was substance that is filtered at the glomerulus per unit time. This filtered load the most of any substance that is filtered at the glomerulus per unit time. This filtered load the most of any substance that is filtered load. The mass of any Sussain transport functions and ultimate renal handling of ions and filtered load.

The mass of softe ubular transport functions and ultimate renal handling of ions and filtered solutes.

Softed to had is expressed simply as: Romer load is expressed simply as: Filtered load = GFR × [P].

$$d = GFR \times [P]$$

of CFR = glomerular filtration rate and {P}_x = the plasma concentration of any compound, when CFR = glomerular filtration should also factor a coefficient of filtration (A) (co...) WE GFR = glometrum in the compound, presents concentration of any compound, which compound, the compound, the compound, the compound, the compound in the comp (necessary, see an ignore this constant).

% Give an example using the filtered load of Na⁺ in humans.

Fitted load = GFR × $[P]_{N_B}$ + gd GFR = 0.125 L/min; $[P]_{N_B+}$ = 140 mM/L

Filtered Na⁺ load = (0.125 L/min) × 140 mM/L =17.5 mM/min or approximately 25,200 mM Na+/d

perfect, it becomes readily apparent that the nephrons of the kidneys must have a large ca-Bertice, it becomes some Na+ because the daily filtered Na+ load exceeds 10 times the to-

al body Na*g. Describe the filtered loads of some common plasma constituents and their percentages g perme an emission into the plasma before urinary excretion.

Ouantities Involved in Urine Formation in the Human*

Resil blood flow (RBF) = 1200 mL/min (20-25% of cardiac output)

Renal plasma flow (RPF) = 660 mL/min Glomerular filtration rate (GFR) = 125 mL/min

Fraction of plasma flow filtered (GFR/RPF) = 0.18-0.20 .

	CENTRATION	FILTERE	D/DAY		EXCRETED/DAY	
	(MM)	mmoles	g	mmoles	8	REABSORBEI
Section	140	25,200	570	103	2.3	99+
Cliente	105	18,900	660	103	3.7	99+
Scatorage	25	4.500	275	2	0.1	99+
hasian	4	720	30	100	4.2	86+
George	5	900	160	ti	ace	100
liez	5	900	50	360	20.0	60
ine Var	0.3	54	9	4	0.7	93
		18	OL.	1-1	.5 L	99+
Spanner vo	lau. f					

age values for a man weighing 70 kg.

 t_i t_{ibst} are the types of reabsorption that take place in the proximal convoluted tubules $\tau_{\rm tr}$

 $\frac{1}{4}$ Reparation of fluid and solutes are reabsorbed by both passive and active mechanisms. It se tages represt of the nephron where reabsorption occurs.

82. How much of the filtered load is reabsorbed in the PCT?

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How much of the filtered load is reabsorbed in the second of water and other second from the filtered water for th 82. How much of the replaced segment for bunk reasonaperor of water and other substances. The PCT is the neighbor segment reabsorbs approximately 67% of the filtered water. Na continue plasma. This segment reabsorbs approximately 67% of the filtered water. Na continue into the plasma. This segment reabsorbs such as glucose, amino acids, and small filteral. The PCT is the regions—The segment reabsorbs approximately 0.7 % or use intered water, Ne. 1. (in the plasm. This segment reabsorbs approximately 0.7 % or use intered water, Ne. 1. (in the plasm. This segment substances such as glucose, amino acids, and small filterable and uses. Other important substances by the PCT.

67% REABSORBED	100% REABSORBED*
Filtered water Na* CL- K*	Glucose Amino acids Small filterable protein

Urea *To achieve 100% reabsorption, both passive and active processes must be involved

83. If bulk reabsorption occurs in the PCT, is this nephron segment highly permedic

The PCT is often referred to as a leaky epithelium. In other words, both water and solute? The PCT is often referred to as a leaky epithelium. In other words, both water and solutions between PCT cells do not see the property of the prop

The PCT is often referred to as a teaky epitacinous. In ourse, words, both water and who easily cross this tubular segment, and the tight junctions between PCT cells do not afford to easily cross this tubular segment, and the apical or at the basolateral membranes.

84. If the PCT is a leaky epithelium, what is the osmolality of tubular fluid at the tod of the alar segment? The PCT undergoes isosmotic reabsorption, which is consistent with the leaky many of the alarm of the alarm

The PCT undergoes roosmoon. Thus, if the ultrafiltrate of the plasma at Bownin's copy tubular cells in this nephron region. Thus, if the ultrafiltrate of the plasma at Bownin's copy tubular cells in this nephron region. tubular cells in this nepimon region.

It is is isosmotic and provides tubular fluid with an osmolality of 290 mOsm/kg, the osmolality of 290 mOsm/kg. is isosmotic and province constitution of the PCT will also be 290 mOsm/kg. In other words, as some trabular fluid at the end of the PCT will also be 290 mOsm/kg. In other words, as some retubular nunc as the case of the solution of th

85. Is filtration the only way the nephron gets substances into the tubular fluid? Is mirrarous use usay use the subular fluid by active secretion from the basolateral cell re-

brane to the tubular lumen. These substances reach the basolateral membrane of the PCT to as sive movement at the peritubular capillaries into the interstitial fluid surrounding the RT at proximal straight tubules (PST). In addition to active secretion of substances, passive bad be of soluble ions is known to occur. This passive back leak from the basolateral to the spirel six of the PCT occurs only when either the concentration or electrochemical gradients favor noment in this direction. Because the PCT is leaky, water passively follows during ionic back isk thereby maintaining isosmotic fluid in the tubular lumen.

What are the major classes of compounds secreted into the PCT and PST?

The major transport systems in this tubule segment for secretion are specific to organic ions and organic cations. These are the same systems that function for the secretion of PAH## ganic acid). The active transport sites for these organic anions and cations are located or the solateral membranes of the late PCT and throughout the PST.

87. What are the major mechanisms for Na* reabsorption in the PCT? The most critical mechanisms for Na* reabsorption in the PC1? ATPACAL ATP

K*-ATPase located on the basolateral membrane of the tubular cell. This is the same and the same are the same active removal of Na⁺ from the cells establishes a low intracellular Na⁺ and a negative state lular electrical protection. lular electrical potential, which favors the facilitated movement of Na* down its electrical gradient from the rubular. gradient from the tubular lumen into the cells, Na* enters the PCT cell on the agical members

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By a sumber of facilitated transport processes. The PCT is particularly well suited for net reprocesses into the cell because of the large surface area on the brush border.

By a facility of the cell because of the large surface area on the brush border.

By a facility of the cell because of the large surface area on the brush border. processes. The PCT is particularly well suited transport processes. The PCT is particularly well suited for net reprocesses into the cell because of the large surface seen on the brush border membrane
produces for processes into the cell active Na¹. Ye. A-71 was extrassion of Na² from the cell into the
production of grants and grants the basedulareal membrane produces the second control of the cell into the cell per la summer de la companya del companya de la companya del companya de la companya del companya de la companya del companya de la companya del companya dela companya del companya del companya del companya del companya de print of the sective run in the sective run in the section of Na from the cell into the cell into the cell into the cell into the interactive run in the section of Na from the cell into the interthe section of the section of th or action of the submitted and the intracellular comparison. Thus, despite the isosolution of the cold in the interest of the interest of the cold in the interest of the interest of the interest o of comparison the unitial amount and one intracellular comparison. The contraction gradies is given by the FCT unbular fluid, active transport of Na+ out of the cell on the basolateral of the cell and the basolateral of the cell around the application of the cell of the basolateral of the cell around the application of Na+ z. of the PCT tunetter more, see the engineer of Na* out of the cell on the basolisteral of the pct tunetter concentration gradient for the movement of Na* from the basolisteral of the pct tunetter of Na* from the post tunetter of Na* from the post tunetter of Na* from the pct tunetter of Na* from tunetter of Na* f Section of the cell across the apical membrane,

in the reabsorption of Na⁺, Cl⁻, and water in the

He is a second of Na* out of the cell at the basolateral membrane is essential to the re-RT the rather transport of the control of the control of the transport of the transport of the PCT. In the absence of active Na*, K*-ATPase at the PCT, delivered to Na* from the PCT, delivered to Na* from the PCT, delivered to the transport of this rephron segment is approximately 65% of the filtered Na* to the transport of the The of Na from the Factor assumed to active Na*, K*-ATPase at the PCT, delivlike of the filtered Na* load is reabsorbed via mechanisms decended to the filtered Na* load. Thus, at the National Control of the filtered Na* load is reabsorbed via mechanisms decended to the filtered Na* load is reabsorbed via mechanisms decended to the filtered Na*. in of this septiment as a process of the filtered Na* load is reabsorbed via mechanisms dependent on the Na*, and the filtered Na* load is reabsorbed via mechanisms dependent on the Na*, and the filtered Na*, and the Na*, and gristing of the nucleon that is particularly important in clinical states in which severe K-ATps cause. This requirement is particularly important in clinical states in which severe K-ATps cause to the proximal tubule, and the Na*, K*-ATPs can longer function. before an in the posterior of posterior in protection in the interest in which save partial research in the protection of the protection o K.A. A. Pase to the proximal tundre, and the rat. A. A. Pase no longer functions efficiently, being a date to the proximal sections are observed in conditions of renal ischemia or following exponent and provident drugs that cause severe damage to PCT cells, Hade-to-min probrokotic drugs that cause severe damage to PCT cells, Hade-to-min probrokotic drugs that cause severe damage to PCT cells, Hade-to-min probrokotic drugs that cause severe damage to PCT cells. temporaries and the second of the PCT is greatly increased, and unless other modern of the second of the PCT is greatly increased, and unless other modern of the PCT is greatly increased, and unless other modern of the PCT is greatly increased, and unless other modern of the PCT is greatly increased, and unless other modern of the PCT is greatly increased. pro- min perhodoxic uses use a secret usuange to PCT cells. Under these circumstrates of normin perhodoxic uses a secret usuange to PCT cells. Under these circumstrates of normin perhodoxic uses a secret usuange to PCT cells. Under these circumstrates of the PCT are able to compensate in their reabsorption. ser, delivery of Na. our or use to a ground increased, and unless other tubular mecha-sers, delivery of Na. our or use to a ground increased, and unless other tubular mecha-sers, delivery of Na. our or use to a ground increased, and unless other tubular mecha-sers, delivery of Na. our or use to a ground increased, and unless other tubular mecha-sers, delivery of Na. our or use to a ground increased, and unless other tubular mecha-sers, delivery of Na. our or use to a ground increased, and unless other tubular mecha-sers, delivery of Na. our or use to a ground increased, and unless other tubular mecha-sers, delivery of Na. our or use to a ground increased, and unless other tubular mecha-sers, delivery of Na. our or use to a ground increased, and unless other tubular mecha-sers, delivery of Na. our or use to a ground increased, and unless other tubular mecha-sers, delivery of Na. our or use to a ground increased in their reabsorption of Na. our or use to a ground increased in the ground incr seriorsis and Nu+ loss occur.

g that are the major anions that get reabsorbed across the PCT?

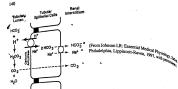
HCO. Agionic amino acids

a. By is the reabsorption of these anions critically dependent on the active transport of Sa', K'-ATPase?

When the PCT no longer possesses the ability to extrude Na+ from the inside of the cell, the then us relief to make the state of the control of the state of the central the centr asseption to major and the Na+, K+-ATPase activity is reduced, leading to grows as with the same of the Min. and Cl. These losses may lead to significant decreases in plasma oncotic pressure, byschlorenia, and alkalosis.

% How are Na+ and HCO1- reabsorption linked in the PCT?

The reabsorption of sodium bicarbonate (NaHCO₃) is critical to the net reabsorption of Na⁺ ate promal whole as well as to the understanding of the regulation of urinary acidification. basision to the Na+, K+-ATPase located on the basolateral membrane, the apical membrane PRODUCT No. 1 No. 1 H. Totransporter which utilizes the electrochemical gradient favoring the moveand Na* into the cell from the tubular lumen in exchange for secretion of H+ from inside the all as the laner. This electroneutral transporter is not only responsible for one-third of proxital their secum reabsorption in the PCT, but also provides the driving force for coupled to, ressorption (see figure). The lumenal brush border of the PCT contains large amounts dishore any drawn, which catalyze the production of carbonic acid (H₂CO₃). H₂CO₃ then diswas the CO₂ and water, and the CO₂ diffuses into the cell down its concentration gradient. lake to cill an abundance of carbonic anhydrase catalyzes the synthesis of carbonic acid in the bin entities abundance of carbonic anhydrase catalyzes the synthesis or carboned across the bin entities producing intracellular H* and HCO₃⁻¹. The HCO₃⁻¹ is readable to the Na*watton producing intracellular H* and HCO₃. The HCO₃ is reasonable to the Na*backed recibrate and into the interstitium while the free H* becomes available to the Na*backets. waterbrine and into the interstitium while the free H* becomes available to find the interstitium while the free H* becomes available to find the f is bashorn both Na. and HCO3 ...



92. Why is it necessary to reabsorb HCO₃⁻ In the form of CO₂ and water tyster (has been an anastive HCO₃⁻ diffusion across the apical membrane down its consequence. 92. Why is it necessary to reason across the apical membrane down its concept simply allowing passive HCO₃ diffusion across the apical membrane down its concept.

passive HCO₃ - reabsorption across the apical membrane would certainly be the single Passive HCO₃ - reassorption of NaHCO₃. To acidify the urine effectively be the sime mechanism for the dual reassorption of NaHCO₃. To acidify the urine effectively to HCO₃ - (This process in the big mechanism for the dual reassurption of the HCO₃-". (This process is been shown membrane must maintain a relative impermeability to HCO₃-". (This process is been shown membrane to HCO₃-".) All only membrane to HCO₃-".) membrane must maintain a reseave important membrane to HCO₃.) All cell membrane to HCO₃.) All cell membrane to HCO₃.) All cell membrane as the high reflection coefficient of the PCT apical membrane to HCO₃. the high reflection coefficient or uncertainty of the high reflection coefficient or uncertainty of the highly permeable to dissolved gases such as CO₂. Thus, the brush border of the apical members which helps catalyze the forms. highly permeable to dissorte a gases and the PCT cell contains carbonic anhydrase, which helps catalyze the formation of CO_1 and R_1

93. Does inhibition of HCO3- transport affect Na+ reabsorption in the PCT?

Inhibition of HCO₃ transport has been used as an effective "diuretic and naminesic" were for many years. Inhibition of carbonic anhydrase using acetazolamide (Diamox) effectively is for many years, mutouton of careful of the control nisms of altering the PCT Na⁺-H⁺ exchanger may also affect tubular NaHCO₃ reabscrping la hisms of aucting one Commission of the commissio of H+ in the PCT, whereas metabolic or respiratory alkalosis decreases the activity of the high H+ exchange mechanism and thereby decreases urinary acidification.

94. Is Na+ reabsorption linked to any other substances in the PCT?

A number of facilitated transport mechanisms are coupled with Na+ in the reabsence process of the PCT. These Na+-coupled transport mechanisms are located on the apical neebrane of the PCT and include:

- Na+-amino acid transporter Na⁺-PO₄⁻ transporter
- Na+-glucose transporter

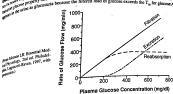
Coupled Na+-glucose Na+-amino acid transport accounts for the complete reasserption the filtered load of glucose and amino acids in the PCT under normal physiologic contines.

95. If glucose is 100% reabsorbed by the PCT, how does glucose get into the wine in the eases such as diabetes?

Because glucose undergoes a facilitated diffusion process, the glucose reabsorption is pendent on a fixed number of transport proteins located on the apical membrane. The religious among plasma glucose and the rates of glucose filtration, reabsorption (via the facilitated differ transporter), and urinary excretion is shown in the figure. Under normal conditions, plant and urinary excretion is shown in the figure. Under normal conditions, plant are cose concentrations are less than 200 mg/dL. As plasma glucose concentrations are less than 200 mg/dL. tration rate (or filtered load) of glucose also increases in a linear manner. The reabsorption cape

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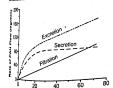
September 1 - 100 per construction and the filtered glucose load up to about 200 per conscious concentration. At that point, the reabsorptive capacity of the glucose from the filtered load per construction of the glucose. The september 200 per construction of the glucose from the filtered load per construction of the glucose. ransport mechanisms as some to match the filtered glucone load up to about 200, the process concentration. At that point, the readstorptive capacity of the glucone trans-tic and process concentration. At that point, the readstorptive capacity of the glucone trans-tic and process of the glucone transfer and the glucone transfer and process that at any other capacity of the glucone trans-tic and process of the glucone transfer and the glucone trans-tic and the glucone transof the plant of th R is the property of the decrease of the control of the careful of the ca property of the sum of use exerction rate and reabsorptive rate property of the sum of use exerction rate and reabsorptive rate of the sum of use and of glucose equals the reabsorptive rate of glucose is called the sum of the sum o we also there is no a process of the real sorptive rate of glucose is called the filtered the solid like in the solid like is a solid like in the solid like in the solid like is a solid like in the solid like in the solid like in the solid like is a solid like in the solid like in "The Parament (T_a) in passwords constructed an inability of cells throughout the beauty of an inability of cells throughout the beauty to parameter of the pa with places and the set regular even occase of an inability of cells throughout one of the comparison of the set of the s " a reserve to the body to a respect to the body to the body



g if transport maximum (T_m) exists for facilitated glucose reabsorption, do similar types g plantager maximum (1 m/s) and a constant of glucose reabsorption, do significant of the secretion of organic acids and bases into the tubular lumen?
d earlier of the secretion of organic acids and bases into the tubular lumen?

and for the secretion of $\sigma_{m,m}$ as any assessment the turbular lumen?

Alkiday transporters exhibit a T_m at a specific plasma concentration for their substrate, in-All takey transporters extration as $t_{\rm min}$ and a speciative phasmian concentration for their substrate, in-takey transporters that are located on the basical steral membrane of the PCT such as the organic acid takey transporters that are located on the basical steral membrane of the PCT such as the organic acid edge programs and are occurred on the constructed intention are of the PCT such as the organic acid intention but transporters. The relationships between plasma PAH concentrations (organic acid) at organic but transporters. adoptic base transported. The transmissions occurred pressure and consecutations (organic acid) as the figure. Similar to glucose, as the test of PAH excretion, secretion, and filtration are shown in the figure. Similar to glucose, note has at PAH extremus, secretors, and incurrence are shown in the figure, similar to guesses, plans concentrations of PAH are increased, the filtration rate or filtered load of PAH increases REMANDANCE TO THE PARTY OF PAH increases as plasma PAH concentration in-DEED REAL MALES AND A STREET THE dearting of PAH is rapid, and this excretion rate equals the sum of the secretion rate and the fil-



Plasma PAH Concentration (mg/dl)

(From Johnson LR: Essential Medical Physiology, 2nd ed. Philadelphia, Lippincott-Raven, 1997 with permission.)

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tered load. Once the organic acid secretory capacity of the PCT is saturated (i.e., the T to the secretion rate of the Companion is reached), there is no further increases in excellent the secretion rate of the Companion is reached. ered load. Once the organic acid secretory capacity or the secretion rate or the companies and secretion is reached), their is no further increase in the secretion rate or the companies acid secretion is reached), their is no further increases in the content of the companies acid secretion is reached, their particular particular acid particular aci tered load. Once the objective is no further increase in the secretion is necessful, there is no further increase in the increases in exceeding a property of the companies of t sered some metaboli, were mediated received in exception as revealed to describe in exception as revealed to describe in planta PAH concentration occur, use unaversace in exception as revealed to further elevations in planta PAH concentration occur, use unaversace in exception as revealed to further elevation in the further elevation in the example for the organic acid PAH, the T_e exists at a planta PAH to further elevation in this example for the organic acid PAH, the T_e exists at a planta PAH to further elevation in this example for the organic acid period a further elevatories. In this example for the organic and the secretion is approximately 80 mg/dL, and the T_m for PAH secretion is approximately 80 mg/dL, and the secretion of approximately 20 mg/dL, and the secretion of approximately 20 mg/dL.

97. What are the characteristics of the thin descending limb of the loop of Healt for th

What are the cussolute movement?

The thin descending loop of Henle is relatively impermeable to Na*, CI*, and we have
the independent of the second of th and solute movement and so The thin described to water. As the thin descending itsia solute concentration increases to as much as 1200 mOsm/L. There is, therefore, a least tial solute concentration increases to as much as 1200 mOsm/L. There is, therefore, a least tial solute concentration increases to as much as 1200 mOsm/L. There is, therefore, a least tial solute concentration increases to as much as 1200 mOsm/L. There is, therefore, a least tial solute concentration increases to as much as 1200 mOsm/L. There is, therefore, a least tial solute concentration increases to as much as 1200 mOsm/L. There is, therefore, a least tial solute concentration increases to as much as 1200 mOsm/L. There is, therefore, a least tial solute concentration increases to as much as 1200 mOsm/L. There is, therefore, a least tial solute concentration increases to as much as 1200 mOsm/L. There is, therefore, a least tial solute concentration increases to as much as 1200 mOsm/L. There is, therefore the least tial solute concentration increases to as much as 1200 mOsm/L. There is, therefore the least time as ily permeable to when the property of the prop tial solute concess.

mind driving force favoring the reabsorption or when the secondary line, the secondary line, the secondary line, the secondary of the long o motic driving too.

The polymer of t

98. How are water and solutes handled by the thin ascending limb of the loop of Heijo and the thin ascending limb are related to the value of Heijo

How are water and solutes manners of the changes in tubular fluid in the thin ascending limb are related to the relative important to the relative intermediate of NaCl. This is at a supercommand with that of NaCl. The changes in tubular num in the tubular number of NaCl. Thus, in this segment for water compared with that of NaCl. Thus, in this segment for water of NaCl out of the tubular lumen and into a segment for the segment of NaCl out of the tubular lumen and into a segment for the segment of NaCl out of the tubular lumen and into a segment for the segment of NaCl out of the tubular lumen and into a segment for the segment of NaCl out of the tubular lumen and into a segment for the segment of NaCl out of the tubular lumen and into a segment for the segment of NaCl out of the segment for t state of this nephron segment for water companion of the tubular lumen and into the interest of the property of the concentration profits of the concentration profits. nephron, there is a passive diffusion or reaction of the leaving water behind. This movement of NaCl occurs down its concentration gradient, which leaving water permeability in this down leaving water behind. Inits increasing limb (i.e., water permeability in thin descending limb to the created from the thin descending limb (i.e., water permeabilities are increased in the latest limbs.) been created from the turn descending into a ceeds that of NaCl). These differential permeabilities are important for helping to establishing ceeds that of tracts, the desired between the tubular lumen and renal medullary intentition, fective concentration gradient between the tubular lumen and renal medullary intentition.

99. Why are there no active transport mechanisms in the thin descending and across

The thin loops of Henle contain only simple squamous types of cells. These cells have in mitochondria, function primarily with anaerobic metabolism, and produce only small amound

100. What are the most important transport characteristics of the thick ascending logic

The medullary thick ascending limbs (MTAL) have two major functions in the reabsorption

- of water and solutes:
 - 1. These cells are quite impermeable to water? The cells contain a unique Na⁺-K⁺-2Cl⁻ transporter that is capable of transporting large.
- quantities of NaCl from the tubule lumen into the medullary interstitium. Because NaCl is being
- selectively reabsorbed in this segment with water remaining in the tubular lumen, the osnolally of the tubular fluid decreases and may even become hypotonic with respect to plasma by fixed of the MTAL.

101. How do the transport mechanisms in the early distal tubule contribute to the rob sorption of NaCl?

The early distal tubule is impermeable to water but contains an Na*/Cl- correspond is sensitive to thiazide diuretic agents. The selective reabsorption of solute (NaCl) in this xgast further dilutes the tubular fluid.

102. How does the late portion of the distal convoluted tubule contribute to the tubule. absorption of Na+?

Reabsorption of Na* in the principal cells of the late distal tubule is dependent on the form trochemical gradient for Na* established by the Na*, K*-ATPase in the basolateral merker. 143

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of the distal convoluted in the principal cells of the distal convoluted for k is certified collecting duct? Here is the reassorption controlled pt Here is the correct collecting duct?

he a man described convenience of the convenience o in the service of a service and a service an when me the headacean memora are not yet increasing the apical membrane permeability and in headacean with its specific receptor in the cell cytoplasm, adonourose moves to the first redshing with its specific receptor in the cell cytoplasm, adonourose moves to the production of the cell cytoplasm adonourose moves to the production of the cell cytoplasm adonourose moves to the production of the cell cytoplasm adonourose moves to the production of the cell cytoplasm adonourose moves to the production of the cell cytoplasm adonourose to the production of the cell cytoplasm. The Article Marie and the Specim receptor in the cell cytopiana, adorstone moves to the state of the speciments of the s where a war is not a consequence and translation of specific agricus to the consequence where a channels into the apical membrane allows increased flux of the specific form the colorist numerous down the concentration gradient, which is consequent to the specific form the colorist numerous down the concentration gradient, which is consequent to the specific form the spe when membrane allows increased flux of V same, cell from the through humen down the concentration gradient, which is continually V same, cell from the through the hasolateral Na., K. ~ ATPase. The increased outwhere the design of the following the concentration gradient, which is continually when it is continually to the spring of the baselsteral Na "K "A TPase. The increased substrate for the which is continually to the spring of t the artisty of the passenances are in AIPase. The increased substrate for the passenance in the passenance of the cells and into the interestium. out of the cells and into the interstitute of the cells and into the interstitute of the cells and into the interstitute of the cells and into the perindular capit.

The compare of a shum is completed by the movement of sodium into the perindular capit.

The compare of a shum is cells the principal cells of the late distal rubule and the cells are the cells and the cells are the cells and the cells are th processing of solution is compared to the MTAL cells the principal cells of the late distal tabule are was a process to the MTAL cells the principal cells of the late distal tabule are was a process of another the hormone, and the reabsorption of National Cells of the process of another the process of t to commend in contrast to the contrast of the and the reabsorption as well. Thus, water is reabsorbed in distal con-pressed a secretary with water reabsorption as well. Thus, water is reabsorbed in distal con-pressed a secretary with water reabsorption as well. Thus, water is reabsorbed in distal con-secution with the conditions when the body needs to conserve water. son and the second of the seco

M. 18 'M' the only critical ion controlled at the DCT? by the only cruses in the distal convoluted tubule is highly coupled to the Na*, we have a convinted with K* movement in ... No Recited Na reason plants associated with K- movement into the cell from the extracellu-fulfied Na reason from its associated with K- movement into the cell from the extracellu-FAIRs. As respective (K* movement from basolateral to apical membranes) is k par is the regard of the second traveless by the presence or absence of aidosterone. Thus, aland model in these convention of a reabsorption at the basolateral membrane, the concentrawe with the concentration of t as disperse, to summare Na " reabsorption, which is short effects to enhance K " removal from the plasma and excretion into the urine.

at that are the functions of the cortical collecting tubule (CCT) in determining the final agestion of the tubular fluid (urine)?

The CCT provides real-corption of small amounts of remaining Na+ in the tubular fluid. The pure function of the CCT is the reabsorption of water. These tubular cells specifically exmay joint of water channels called aquaporins at both the apical (aquaporin 2) and the bapostance (a ment) membranes. The insertion of the aquaporins in the apical membrane are air a count of ADH. The aquaporins are a unique family of proteins with selective and speat states that provide passive water movement across cell membranes. Water movement tone asserons channels occurs only as a function of osmotic gradients, and these channels lease a state or tional fashion.

In What are the primary purposes of the medullary collecting duct in the regulation of There composition?

- · Repaire the total unitary osmolality
- *Count water reabsorption and excretion See to the CCT, the medullary collecting duct promotes water reabsorption by expressing have sements express aquaporin 2 in the apical membranes in the presence of ADH, React a agence (acopressin (AVP). The medullary collecting duct cells are normally impertage visus is the process of ADH, these cells increase their expression and insertion of aqua-
- to us to presence of ADH, these cells increase their expression one of the partial membranes, thereby increasing the cells' permeability to water. During states of the partial membranes, thereby increasing the cells' permeability to water. as pass membranes, thereby increasing the cells' permeability to water.

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motic gradient for the movement of water across the cell membrane and into the intervision, by motic gradient for the movement of water ascending vasa recta and returned to the circulum, by water is then removed by the ascending vasa recta and returned to the circulum, by motic gradient for the movement of water across the second and returned to the intervillation reabsorbed water is then removed by the ascending vasa recta and returned to the circulation reabsorbed water is then removed by the ascending vasa recta and returned to the circulation. URINARY CONCENTRATION AND DILUTION

107. What are some of the different abilities of species to concentrate their unings concentrating capacity of different animals dependent unings. What are some of the different abilities or aperture and a second of the 107. What are some unitary concentrating capacity or universe manuals uppends on the white the relative unitary concentrating capacity or universe manual uppends on the diet of each some unitary unitary concentration where in their environments and habitats as well as the composition of the diet of each some unitary The relative automates and habitats as wen as an composition of the diet of each eye of water in their environment of plentiful water available, the species. For example, humans exist in an environment of plentiful water available, the species. For example, humans exist in an environment of plentiful water available to the species. For example, humans exist in an environment of the plentiful water available to the species. For example, humans exist in an environment of the plentiful water available, and the plentiful water available to the plentiful water of water in these contimes for example, humans exist in an environment of pictural water availability as
the species. For example, humans exist in an environment of pictural water availability as
therefore, concentrate their urine to a maximal level of only 1200 mOsm/kg. This object
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therefore, the third the transfer of the transfe therefore, Consciously, Consciously, and the state of the nary concentrate their urine from 5000 to //OUO INCOMING SOURCE THE ability to excrete large urine (i.e., excretion of water loads) is effective in all species. The ability to excrete large urine (i.e., excretion of water loads) is effective in all species. The ability to excrete large urine (i.e., excretion of animals to one to be a species of the

108. Is the excretion of a hypertonic or hypotonic urine necessary for the maintenance

neostasis?

The ability of the mammalian kidney to produce a dilute or concentrated urine study and the ability of the mammalian kidney to produce a dilute or concentrated urine study of the mammalian kidney to produce a dilute or concentrated urine study of the mammalian kidney to produce a dilute or concentrated urine study of the mammalian kidney to produce a dilute or concentrated urine study of the mammalian kidney to produce a dilute or concentrated urine study of the mammalian kidney to produce a dilute or concentrated urine study of the mammalian kidney to produce a dilute or concentrated urine study of the mammalian kidney to produce a dilute or concentrated urine study of the mammalian kidney to produce a dilute or concentrated urine study of the mammalian kidney to produce a dilute or concentrated urine study of the mammalian kidney to produce a dilute or concentrated urine study of the mammalian kidney to produce a dilute or concentrated urine study of the mammalian kidney to produce a dilute or concentrated urine study of the mammalian kidney of the mammali The ability of the mammana. Assure the state of the maintaining a relative constancy of solute exercises bodies to excrete or conserve water while maintaining a relative constancy of solute exercises because the kidney can form a district the kidne bodies to excrete or conserve was successful to the kidney can form a dilute or hypotonic and conditions when excess fluids have been ingested, the kidney can form a dilute or hypotonic and conditions when total body water must be conditions when excess thus have conditions when total body water must be construct to excrete excess water. In contrast, in conditions when total body water must be constructed to excrete excess water. to exercise excess water. In continuous to conservation that he mables the conservation of water to kidneys produce a concentrated or hypertonic urine, which enables the conservation of water to the conservation of wate kidneys produce a concentuated of the second of the second

SECONDARY TO NORMAL FUNCTIONS (INSENSIBLE WATER LOSSES)		SECONDARY TO EXCESS WATER LOST AFTER ENVIRONMENTAL REINTUBATIONS
Breathing Sweating		Excessive heat exposure Prolonged exercise Fever
	_	Diarrhea

109. Does the kidney have a constant interstitial fluid osmolality from the cortex to the papill. Interstitial osmolalities range from 290 mOsm/kg in the cortex (essentially equivalent plasma) to potentially high interstitial fluid osmolalities equivalent to the maximal unitary on centrating ability in the inner medulla. In humans, interstitial osmolality can increase to approimately 1200 mOsm/kg after 24 hours of water restriction.

110. How does the medullary interstitial concentration gradient contribute to the final are centration of the urine?

The concentration gradient found in the interstitial space from the cortex to the metallal the kidney is absolutely essential for the production of both a concentrated and a dilute urise. der normal circumstances, the body loses water because of respiration and sweat. This, de the ney is constantly being presented with a condition that requires the reabsorption and presented of water. The presence of a hypertonic renal interstitium allows the appropriate movement of the from the content of the front o ter from the tubular lumen to the interstitial fluid and back into the blood. Under their near conditions in which water reabsorption is of primary importance, the final concentration of the primary importance, the final concentration of the primary importance of of th urine is determined by the concentration of the renal interstitium within the deepest grow of the kidney (i.e., the inner medulla). As discussed below, the movement of water call of the distall librals and the distal tubule and the cortical and medullary collecting duct is entirely dependent of the entire

Does the PCT contribute to the final urinary concentration? not the PCT contribute to the man at many concentration?

Post the responsible for the bulk reabsorption of water via sisonoic transport mechanisms, the post present present the post present present the post present presen the first presponsible for the unan reasonable of water via sistence frameon mechanisms.

If the first the reasonable of water is an isosomotic bulk flow of fluid. If the reasonable of the tubulk flow of fluid is not changed and the first of the sistence of the first of the fluid is not changed and the first of the first of the fluid is not changed and the first of the fluid is not changed and the first of the fluid is not changed and the fluid is In perf. in the reabsorption of water is an assistantic bulk flow of fluid if the recharisms, in the first of the commodity of the tubular fluid is not changed and, therefore, as is assumed in the same of the first of the firs in the residence of the and a segment of arther above that or postina, tribs, shibough these nephron segments are ex-posting the bulk reaksorption of NaCl, water, and other ions, they do not commissing and other contracts of the bulk reaksorption of NaCl, water, and other ions, they do not commissing and other contracts of the bulk reaksorption of NaCl, water, and other ions, they do not commissing and other contracts of the bulk reaksorption of NaCl, water, and other ions, they do not commissing and the second of the bulk reaksorption of NaCl, water, and other ions, they do not commission and the second of the bulk reaksorption of NaCl, water, and other ions, they do not commission and the second of the bulk reaksorption of NaCl, water, and other ions, they do not commission and the second of the bulk reaksorption of NaCl, water, and other ions, they do not commission and the second of the bulk reaksorption of NaCl, water, and other ions, they do not commission and the second of the bulk reaksorption of NaCl, water, and other ions, they do not commission the second of the reach intention for one court reabsorption teach or producing a concentrated urine.

However provides ours reason, providing were uren get reabsorbed in the PCT as well?

The performance in the PCT in the same bulk manner as all other filtered substances. Apties grade of the filtered uren in the PCT is reabsorbed back into the intervision the PCT is reabsorbed in the CCT in the Source Dulk manner as all other filtered substant Uter 8 reabsorbed back into the interstitium.

Il is the PCT important in water reabsorption even though it does not participate in the first concentration of the urine?

III is the rule major take at water reabson the final concentration of the net reabsorption of water. Approximately two-thirds the first should be reabsorbed in the PCT along with the other balk water. Representation of water. Approximately two-thirds the PCT is absolutely essential of water is reabsorbed in the PCT along with the other bulk reabsorbed filtered set lief along of the pcT along with the other bulk reabsorbed filtered set lief along of the pcT. the blad of water is reasonable in use to a using with the other bulk reasonable filters and the purchase of t de me published continuous in winder une reassorptive processes of the PCT are damaged specific real failure), there may be water loss via lack of the necessary reabsorption in this personnel. The contribution of the PCT to overall water reabsorption is the second to the personnel. The contribution of the PCT to overall water reabsorption is the second to the personnel. water 1000 year not related to the necessary reabsorption in the perfect relationship of the PCT to overall water reabsorption in the reference critical segment. The committation of the PCT to overall water reabsorption is therefore critical segment and water balance of the organism, even though this nershrow. Remarkable for specifically changing the osmolality of the urine. positishing net water owners or gamestin, even though this neph

By Wast are the imajor ionic components responsible for generating hypertonic urine? (Wall are the major some components a sepanation for generating hypertonic urine?)

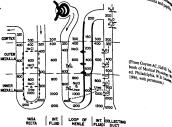
ACCOUNTED (A component from the lumen of the collection duet into the intention). Accordingled renal inner incurranty incurrants as required to create an osmotic gradient into the interstitial spaces. This interspection of water from the lumen of the collecting duct into the interstitial spaces. This interspection of water from the lumen of the excess concentration of North and account in the control of the collection of the collect international or water from the number of the consecuting duct into the interstitial spaces. This resembling patient is established by the excess concentration of NaCl and urea in the intersembling patient is intermediate. This creates a hyperfonic environment in the intersembling patient is a specific patient. metration gradent is established by the control of gai space on the name. The third space of the standard provides a driving force for water reabsorption in tese distril univolver segments.

IK With the creation of a hypertonic inner medulla, how does water then get reabsorbed? light circumstances of water loading, the late distal tubule and collecting ducts are relatively increase to water. Therefore, the tubular fluid remaining within the nephron at the late distal which is curred into the urine with an osmolality that is hypotonic to plasma. In the presence of MR the list distal tubule and collecting ducts become permeable to water, under these circumsax, war will be realisorbed by osmosis from the tubular lumen into the interstitial space. Beuse the intensitial estmobility is hypertonic in the renal medulla, the urine excreted is hypertonic.

III. Bow does the kidney establish a differential concentration gradient from the cortex to triner medulla during water deprivation?

The listery generates a hypertonic inner medullary interstitium by both passive and active Repartments. The degree of hypertonicity achieved is directly proportional to the length the loop of Heale, such that the longer the loop of Heale, the greater the capacity to concentrate loop of Heale, the greater the capacity the loop of Heale, the greater the capacity the loop of Heale, the greater the loop The course in the inner medulla and consequently to concentrate the urine. The passive mechahas the intermedula and consequently to concentrate the transfer in the thin descending and ascending limbs of the loop of Henle. The thin tending into a relatively impermeable to NaCl and urea with respect to water, whereas the to water into a relatively impermeable to NaCl and urea with respect to water, when of NaCl. has a fe standescending limb, water is reabsorbed by osmosis leading to the concentration of wantescending limb, water is reabsorbed by osmosis leading to the control of the loop of Henle. In the thin as-lessed the formation of hypertonic tubular fluid at the tip of the loop of Henle. In the thin asadaption the formation of hypertonic tubular fluid at the tip of the loop of Heime. In the fluid at the tip of the loop of the lumen down its adaption the concentrated NaCl in the tubular lumen then moves out of the lumen down its adaption. herman grafien. The active mechanism for creating a concentration of solutes in the renal baddon to Na - X - Cl cotransporter of the thick ascending limb. The thick ascending limbs e market Na · K · Cl · cotransporter of the thick ascending limb. The

sence of water reabsorption, the tubular fluid becomes dilute with osmolalities decreasing of the thin descending decreasing to an anomaly of the thin descending decreasing to the close proximity of the thin descending decreasing to the control of the control o gence of water reabsorption, the tuonial most of the thin descending and decreasing as low as 100 mOsm/kg or less. The close proximity of the thin descending and decreasing as low as 100 mOsm/kg or less. The close proximity of the thin descending and decreasing as low as 100 mOsm/kg or less. sence of water resources as low as 100 mOsm/kg or less. The close proximity of a solution of mosm/kg or less. The close proximity of cestablishing a countercurrent provides the perfect juxtaposition of nephron segments for establishing a countercurrent provides the perfect juxtaposition of nephron segments for establishing a countercurrent provides the perfect juxtaposition of nephron segments for the provides the perfect juxtaposition of nephron segments for the provides the perfect juxtaposition of nephron segments for the perfect juxtaposition of nephron segments for the perfect juxtaposition of nephron segments for establishing a countercurrent perfect juxtaposition of nephron segments for establishing a countercurrent perfect juxtaposition of nephron segments for establishing a countercurrent perfect juxtaposition of nephron segments for establishing a countercurrent perfect juxtaposition of nephron segments for establishing a countercurrent perfect juxtaposition of nephron segments for establishing a countercurrent perfect juxtaposition of nephron segments for establishing a countercurrent perfect juxtaposition of nephron segments for the perfect juxtaposition of nephron segments for nephron as low as 10x mounts as for the perfect juxtaposition of neparon segments to make provides the perfect juxtaposition of neparon segments as the perfect juxtaposition of neparon segments as the provides the perfect juxtaposition of neparon segments as the provides the perfect juxtaposition of neparon segments as the provides the perfect juxtaposition of neparon segments as the provides the perfect juxtaposition of neparon segments as the provides the perfect juxtaposition of neparon segments as the provides the perfect juxtaposition of neparon segments as the provides the perfect juxtaposition of neparon segments as the provides the perfect juxtaposition of neparon segments as the perfect juxtaposition segm



117. What is the role of the vasa recta capillaries?

The function of the vasa recta capillaries is to deliver nutritire substances to the stratung the renal medulla and to reabsorb water and solutes reabsorbed in the loop of Heale and other ing ducts. The descending and ascending vasa recta are positioned within the inter models at papilla in close juxtaposition with the descending and ascending limbs of the loop of Hotes well as the medullary and papillary collecting ducts. These groups of tubules and capillars are closely associated into bundles called medullary rays.

The vasa recta are capillaries that allow free exchange between the blood and interstitation partments. In essence, they provide the conduit for returning reabsorbed water back to the real value. and central circulation. When water is reabsorbed from the collecting duct (in the presence of Alb down the concentration gradient that has been established in the hypertonic renal intestion to gradient may be lost because of dilution of the Na+, Cl-, and urea. Because the osmolarity of box within the vasa recta equilibrates with the interstitial space, the reabsorbed water equilibrates the blood in the ascending vasa recta. This is where the circuit of water reabsorption is ten or pleted with water moving into the ascending vasa recta and returning to the central circulate

118. Is urea absorption critical to the overall concentrating ability of the renal parith. Urea contributes to the medullary interstitial concentrating ability of the team probability from the tubular fluid in the collecting duct. Reabsorption at the collecting duct is while the dent on the presence of ADH; this nephron segment remains impermeable to urea is the segment of ADH. Rephrency of ADH. Reabsorption of urea is important to the overall ability of the kidney to produce of centrated urine. In the absence of urea reabsorption in the inner medulla, the ability of the last to reabsorb water and hence concentrate the urine is greatly impaired.

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The blood the MTAL contribute to the overall cortical-papillary concentration gradient the blood of the contribute to the overall cortical-papillary concentration gradient the blood of the contribute to the overall cortical-papillary concentration gradient the contribute to the cortical papillary concentration gradient the cortical-papillary concentration gradient graduent graduen how me thought of as the engine that drives the concentration of urine. The real-If M. can be thought or as one congenier mat drives the concentration of urine. The real-ing that M. can be thought of the concentration of urine The real-tion of the M. can be calculated by the M. a. K. A. Thase on the hasoluterout of the concentration of the M. can be the calculated that the can be calculated to the calculated to the calculated to the can be calculated to the calcul The part of the critical patients on the apreal membrane is driven by the electrochem-ber of the critical patients of th which is established to the season of the transporter in the generation of a concentrated arise is a far for the season of the transporter in the generation of a concentrated arise is a far for the season of the significant the critical matter or use sunsymmetr in the generation of a concentrated artise is a significant. The critical matter or use sunsymmetric such as furnosemble and bumenande, Those displayments by the use of loop distriction, where the readoutprist on of NaCl in these displayments are the contraction of the Clark of the Contraction of the cause mortisand national matter are the cause mortisan to the day of the second power of the second p or and MAL columbrates may prevent me reabsorption of NoCi in these segment of the segment of th is effectively abolished by these passes on the reason of the present the mediality interesting sometimes on increased beyond that of plasma, even in the present this the utility of sometimes of the present the contrast of the present Monator by these sections of the contract of t

the library by countercurrent multiplication? 1 that is meant by commerce and the physical juxtaposition of fluids flowing in close The Second physiologic term describes the physical juxtaposition of fluids flowing in close The Second physiologic term describes the physical juxtaposition of fluids flowing in close the second physiologic term describes the physical juxtaposition of fluids flowing in close the second physiologic term describes the physical juxtaposition of fluids flowing in close the second physiologic term describes the physical juxtaposition of fluids flowing in close the second physiologic term describes the physical juxtaposition of fluids flowing in close the second physiologic term describes the physical juxtaposition of fluids flowing in close the second physiologic term describes the physical juxtaposition of fluids flowing in close the second physiologic term describes the physical juxtaposition of the kidney that the second physiologic term describes the physical juxtaposition of the kidney that the second physiologic term describes the physical juxtaposition of the kidney that the second physiologic term describes the physical juxtaposition of the kidney that the second physiologic term describes the physical juxtaposition of the kidney that the second physiologic term describes the physical juxtaposition of the kidney that the second physiologic term describes the physical juxtaposition of the physiologic term describes the physiologic t The second physiotopy, serior was traces and physiotopy and physiotopy and the case of the kidney, countercurrent profits on the case of the kidney, countercurrent profits of the case of an ease of the kidney, countercurrent in the case of the kidney, countercurrent may be one such in both the loop of Henle segment of the nephron and in the was recta capable of the such of which descend deeply into the renal medulla. In each of these returns a seed in noon me nous or return segment or the nephron and in the was recta e-per-side and which descend deeply into the renal medulla. In each of these structures, there is is the structure, there is the structure, the st so dust in opposite directions and in cases proximity to one another. In the case of the loop

so dust in opposite directions and in cases proximity properties compared with the asspecific directions and in cases of the loop.

The allows the creation of different concentration gradients in another in the cases of the loop.

The allows the creation of different concentration gradients in another in the case of the loop. flash the descending amo manuams unrevent permeasuring properties compared with the as-flash the descending amount of different concentration gradients in each of these limbs inh. This allows me creation or unrecent concentration gradients in each of these limbs are the continual flow of ions out of the ascending limb, thereby effectively concentrations are the countercurrents of tubular fluid flow is a concentration of the countercurrents of tubular fluid flow is a concentration of the countercurrents of tubular fluid flow is a concentration of tubular fluid flow in a concentration of tubular fluid flow is a concentration of tubular fluid flow in a concentration of tubular fluid flow is a concentration of tubular fluid flow in a concentration of tubular fluid flow is a concentration of tubular fluid flow in a concentration of tubular fluid flow is a concentration of tubular fluid flow in a concentration of tubular fluid flow is a concentration of tubular fluid flow in a concentration of tubular fluid flow is a concentration of tubular fluid flow in a concentration of tubular fluid flow is a concentration of tubular fluid flow in a concentration of tubular fluid flow is a concentration of tubular fluid flow in a concentration of tubular fluid flow is a concentration of tubular fluid flow in a concentration of tubular fluid flow is a concentration of tubular fluid flow in a concentration of tubular fluid flow is a concentration of tubular fluid flow in a concentration of tubular fluid flow is a conce advance to continual now or runs our or time ascending time, thereby effectively concentrated with the secondary to the countercurrents of tubular fluid flow in close proximity to one with the countercurrent multiplier is essential for the maintenance of the countercurrent multiplier. whose ion secondary to the continuous or touchar much thow in close proximity to one whose the continuous multiplier is essential for the maintenance of an effective interpose. This is constructed between the cortex and possible man. 1910. When the cortex and papilla.

III. How does the kidney produce a dilute urine? Black of the urine is equally critical for the appropriate maintenance of plasma volume and DESIGNED BE USED. TO SPECIAL PROPERTY OF THE P discortical papillary concentration gradient.

Notice papers of the Control of the and the state of ADH, water reabsorpmant distal segments of the tubule is minimal, and the final urine will have an osmolality

subroths of the hypotonic tubular fluid found in the early distal tubule. 2 The lass of urea reabsorption at the collecting duct decreases the osmotic concentration *** metallary interstitium. The dilution of the plasma by the ingested water creates a gradient threensing vasa recta for movement of NaCl and urea into the blood and out of the medullary Tritum. This loss of osmotic activity in the inner medulla effectively washes out the cortical-

making concentration gradient. In the absence of a concentration gradient, any remaining per-Bibly of the collecting duct cells does not result in the reabsorption of water because the midery osnotic gradient has been diminished. that is the time frame for washout of the cortical-papillary concentration gradient

the dimination of a water load? Me negation of I L of water in a normal adult over a 30-minute period, the concentration

register of 1 L of water in a normal adult over a 30-minute period, the conand there of 600-1000 mOsm/kg to 300 or less. Within 1 hour after ingestion of this load. The contain can be as low as 50 mOsm/kg, which is significantly less than that of plasma.

The best low. he is they's comotic gradient is effectively removed, the urine osmolality is more dilute

and the body is effectively eliminating free water from the circulation.

EREGULATION OF PLASMA OSMOLALITY

123. What is the normal range of plasma osmolality (Posm) in humans?

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What is the normal range of plasma osmosom, which is the normal range of P_{max} in humans is 260–310 mOsm/kg. This range represents the normal range of P_{max} in humans is 260–310 mOsm/kg. This range represents the normal range of P_{max} in humans is 260–310 mOsm/kg. 123. What is the normal of P_{con} in humans is 200–310 inchange, a mis range representation of 10 mOnn/kg) to severe dehydration (310 mOnn/kg), Under the normal remains from overhydration (200 mOnn/kg) to severe dehydration (310 mOnn/kg), Under the normal remains on the P_{con} is approximately 290 mOsm/kg.

124. What is the primary hormone responsible for the control of P

What is the primary hormone responsive to unique control by ADH, which is not regulation of water balance and P_{ome} is under unique control by ADH. Which is not require regions of the brain by magnocellular neurons located rectains to located rectains to the regions of the brain by magnocellular neurons located rectains to the regions of the brain by magnocellular neurons located rectains the rectain the regions of the brain by magnocellular neurons located rectains the rectain the rectain the regions of the brain by magnocellular neurons located rectains the rectain the regions of the brain by magnocellular neurons located rectains the rectain 12.4. What is us. —

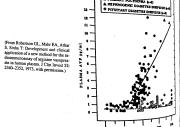
The regulation of water balance and P₁₀₈₁ is subset supported and only ADH, which is part in the hypothalamic regions of the brain by magnocellular neurons located predefining sized in the hypothalamic regions of the brain the nuclei These nuclei provide neural projections in the hypothalamic regions of the projection in the hypothalamic regions of the hypothalamic r The regussion.

The regussion of the brain by single provide neural probabilities are sized in the hypothalamic regions of the brain by sized in the supraoptic and paraventricular nuclei. These nuclei provide neural projections in the supraoptic and paraventricular nuclei. These nuclei provide neural projections in the supraoptic and paraventricular nuclei.

125. How is ADH release from the neurohypophysis controlled?

How is ADH release from the neurony property of ADH release remains under the exact cellular mechanisms responsible for the control of ADH release remains under the exact cellular mechanisms responsible for the control of ADH release remains under the exact cellular mechanisms responsible for the control of ADH release remains under the exact cellular mechanisms responsible for the control of ADH release remains under the exact cellular mechanisms responsible for the control of ADH release remains under the exact cellular mechanisms responsible for the control of ADH release remains under the exact cellular mechanisms responsible for the control of ADH release remains under the exact cellular mechanisms responsible for the control of ADH release remains under the exact cellular mechanisms responsible for the control of ADH release remains under the exact cellular mechanisms responsible for the control of ADH release remains under the exact cellular mechanisms responsible for the control of ADH release remains under the exact cellular mechanisms responsible for the control of ADH release remains under the exact cellular mechanisms responsible for the exac The exact cellular mechanisms responsive to the control of the case remains although the control of the brain that lacks the blood-brain barrier, sense the control of the brain that lacks the blood-brain barrier, sense the control of the brain that lacks the blood-brain barrier, sense the control of the brain that lacks the blood-brain barrier, sense the control of the brain that lacks the blood-brain barrier, sense the control of the brain that lacks the blood-brain barrier, sense the control of the brain that lacks the blood-brain barrier, sense the control of the brain that lacks the blood-brain barrier, sense the control of the brain that lacks the blood-brain barrier. What is known and well documented as unat speciments the blood-brain barrier, seen the appropriate the hypothalamus, a portion of the brain that lacks the blood-brain barrier, seen the chapter of the companies Pom and function as an osmoreceptor. When Pom is elevated, indicating relative dehydration of the supraoptic and paraventricular nuclei, resonance of the supraoptic and the supraoptic an The state of the state of the supraoptic and paraventricular nuclei, results and cells shrink and send neural signals to the supraoptic and paraventricular nuclei, results cells shrink and send neural signals to the supraoptic and paraventricular nuclei, results and cells shrink and send neural signals to the supraoptic and paraventricular nuclei, results and cells shrink and send neural signals to the supraoptic and paraventricular nuclei, results and cells shrink and send neural signals to the supraoptic and paraventricular nuclei, results and cells shrink and send neural signals to the supraoptic and paraventricular nuclei, results and cells shrink and send neural signals to the supraoptic and paraventricular nuclei, results and cells shrink and send neural signals to the supraoptic and paraventricular nuclei, results and cells shrink and send neural signals to the supraoptic and paraventricular nuclei, results and cells shrink and send neural signals to the supraoptic and paraventricular nuclei, results and cells shrink and send neural signals to the supraoptic and paraventricular nuclei, results and cells shrink and send neural signals to the supraoptic and paraventricular nuclei, results and cells shrink and send neural signals to the supraoptic and paraventricular nuclei, results and cells shrink and cel The second secon release of ADH from granulated nerve actions.

cell bodies of these neurons are thought to expand or swell and inhibit the release of ADH for the relationships between P_{non} and plasma ADH consumptions. cell bodies of these neurons are thought to expand on sweeth and mintors the release of ADH for their neuronal projections. The relationships between P_{com} and plasma ADH concentions their neuronal projections. The relationships between P_{com} and plasma ADH concentions as their neuronal projections. The relationshups between 1 of the auto plasting ADH concentrations as shown in the figure. These data show that the entire range of P one is essentially regulated our shown in the figure. These data show that the entire range of P one is essentially regulated our shown in the figure. shown in the figure. A fine of a shown in the figure, one of ADH (i.e., 0-12 pg/ml.). (See figure,)

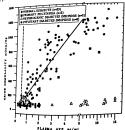


PLASMA OSMOLA

149

If regulation of total body water is critical for the maintenance of life, are there sense in the life, are there is a life, and life, are there is a life, are the life, are the life, are there is a life, and life, are the life if graduation or turns upony water is critical for the mainten is graduation of turns that may also affect ADH release? / is body fault volumes of body fluid volume are the if requirements that may associated ADM release? — on the, are there senye body major centors of body fluid volume are the low-pressure baroreceptors located in
the other paid and in the vena cava just outside the right arrium. These are called tothe did arria and in the vention in regions of the continue. Is the book major sensors of oway want voume are the low-pressure barrocceptors located in the state of the The size of the state of the st spit spin or because they more on an egrous of the cardiovascular years there they are the cardiovascular years they are the are they are the they are they are they are they are they are the are they are the "system where the vas-system is relatively jow and occasion of the value of blood entering the heart from the body and system is seen for relative stretch or volume of blood entering the heart from the body and stretch of the volume of the volume sensors or committee of the volume sensors or committee or volume sensors or volum and the result of the result o meetra continues of the body and the body an to the forms your vice raman nerve A (vague) and renextively regulate the release of ADH from the country of th and the second s by general myses and inhibitory reflex to decrease the land and the memohypophysis. Conversely, when plasma volume is reduced (i.e., de-land and the memohypophysis of the reduced stretch on these low-pressure volume and intreased P_{mph}, the reduced stretch on the cortest All from the neurotry payary 2000. Conversely, when plasma volume is reduced (i.e., de-most AlM from the neurotry payary 2000. Conversely, when plasma volume is reduced (i.e., de-pendent of the plant of the payary 2000. The plant of the research and increased P_{earch}, the reconcess assessed on these low-pressure — sourced (i.e., de-pendent and increased P_{earch}, the reconcess assessed on these low-pressure — sourced (i.e., de-pendent and increases ADH release,

The Hart does ADH increase or decrease plasma osmolality? Here does ADH increases the permeability of the collecting duct to water and therefore for the control of the collecting duct to water and therefore the collecting duct to water and the collecting duct to water and therefore the collecting duct to water and the collecting duct to w the relate of ADH increases use posture-around or use collecting duet to water and therefore the relate of a ADH increases use posture are related to the re and the second s asking their directly eners use to the control of the control of their interest and collecting duet. At the section, nearly all of the solutes and comotically active narriate. one and set or ALVI a major success one sate distal tubule and collecting duct. At girs, the seption, nearly all of the solutes and osmotically active particles have already the particles have already to the particles have already to the particles have already the in grant the acception, meany an acceptance of the acception, meany acceptance of the acception, meany acceptance of the ber February and Compared the Compared to the property which we will be a seen an investment of the seen and the set ex-milest and papillary collecting ducts remain relatively impermeable to water, and the set ex-milest and papillary collecting ducts remain relatively impermeable to water, and the set exgoldsy and papures control of the state of t orise of water is in a control of the water occurs. This process provides a critical pathway for inin perfore, a net ross or rice and osmotically active particles in the plasma compartsat thereby providing a net increase in Posses



The base R. Ressas TJ. Nelson AE, Robertson GL: The role of blood osmolality and volume in regu-**General TJ, Nelson AE, Robertson GL: The role of blood control——, the process acceptance in the rat. J Clin Invest 52:3212–3219, 1973, with permission.)

128. How is the relative clearance of water determined?

128. How is the relative summer than the control of water is termed free water customers. (Sh₂O₁O₁C₁, the water that he can be control of water is termed free water customers.) Ch₂O must be equal to be water than the control of plasma that is free of commotically active particles). Ch₂O must be equal to be water customers are controlled to the controlled than the controlled to the controlled t

$$C_{H_2O} = UF - C_{com}$$

Because $C_{com} = V \times U_{com}/P_{com}$, by simple substitution:

$$C_{H_2O} = UF - [V \times (U_{osm}/P_{osm})]$$

 $_{\rm H_2O}$. In most cases, the value for $C_{\rm H_2O}$ is a negative value. For example, during normal sacqu hydration:

UF = 1 mL/min

P_{som} = 290 mOsm/kg C_{HO} calculates to be -1.40 mL/min. This means that 1.40 mL/min of water that is fined to the controller is being reabsorbed or returned from the tubular fluid to the controller is being reabsorbed or returned from the tubular fluid to the controller is being reabsorbed. C_{60} calculates to be -1.40 mL/mm. c_{100} modern that is the d_{100} motically active particles is being reabsorbed or returned from the tubular fluid beta submotically active particles is being reabsorbed or returned from the tubular fluid beta submotically active particles in C_{600} is positive, the organism is in a state of overhydration. consider year title is being reasource or continued to the total art title beat to be plasma every minute. When Cy_{1,0} is positive, the organism is in a state of overhydration and the title of free water into the urine.

129. What is water balance?

. What is water balance:

The relationship between water intake and water loss. Although water loss is regularly between water intake and water loss is regularly between water intake and water loss. Although water loss is regularly between water intake and water loss. The relationship between water times with the urine, it also includes the removal of water has also just a state of the controlling water excretion into the urine, it also includes the removal of water has a state of the controlling water courses that are not easily regulated; respiration, twenty marily by controlling water excretion and one can be regulated: respiration, sweding, at the body as a result of other sources that are not easily regulated: respiration, sweding, at the

130. Why is water balance important for normal homeostasis?

When water balance does not equal 0, the organism is in a relative state of either dehydrin (net water loss) or overhydration (water gain). Because the body is approximately 65% wat & (net water 1998) of orterny and the overall regulation of cellular function. The control of Cook the body's feedback mechanism used to maintain normal watenbalance from the strepara

131. Is water balance also affected by water intake?

Thirst and drinking are the other factors used to maintain the balance between intaken excretion of fluids. When water loss exceeds water intake, the P_{ours} increases, and this ize P_{com} is sensed by the osmoreceptors, which signal the preoptic and paraventricular rackets the hypothalamus. The rise in P_{com} triggers the release of ADH from the neurohypotest which serves to help restore water balance to 0 by decreasing water excretion. At the use time, the hypothalamus maintains neural projections to the anterior regions, which spate desire and drive for thirst and drinking. Thus, the organism seeks the available war for solving negative water balance both by increasing water intake and by reducing water or

132. Does excess ADH release ever occur?

The syndrome of inappropriate ADH secretion (SIADH) is sometimes observed in particular to the syndrome of the for various reasons, including malignant (ectopic) neoplasms (e.g., bronchogenic carringal (Siandar) disorders (e.g., trauma), and pulmonary disorders (e.g., tuberculosis).

133. What effect does SIADH have on fluid and electrolyte homeostasis?

In this syndrome, excess ADH have on fluid and electrolyte homeostasis? mus no longer responds to normal changes in plasma osmolality. The elevated plasma osmolality. The elevated plasma osmolality. trations of ADH maintain the kidneys in a constant state of water reabsorption leading in the 151

A number of electrolyte disturbances result from this syndrome, including hyments of water. A number of electrolyte disturbances result from this syndrome, including hyments of water. A number of electrolyte disturbances result from this syndrome, including hyments of water. A number of electrolyte disturbances result from this syndrome, including hyments of water. A number of electrolyte disturbances result from this syndrome, including hyments of water. A number of electrolyte disturbances result from this syndrome, including hyments of water. A number of electrolyte disturbances result from this syndrome, including hyments of water. A number of electrolyte disturbances result from this syndrome, including hyments of water. A number of electrolyte disturbances result from this syndrome, including hyments of water. A number of electrolyte disturbances result from this syndrome, including hyments of water. A number of electrolyte disturbances result from this syndrome, including hyments of water. A number of electrolyte disturbances result from the syndrome of the syndrome o Bering of water. A number or erecurolyte disturbances result from the properties of water. A number of electrostic plasma oncode pressure, pagestal, hypomaternal announces.

Possession of the functional consequences of a lack of ADH release?

Was are the functional ADH is the form of diabetes termod

Like of circulating ADH is the form of diabetes termod what are the functional compounds as on a nack of ADH release?

What are containing ADH is the form of diabetes termed diabetes inslipidus. In the abties of circulating ADH is to have excess urine flow and water excretion betaken the organism tends to have excess urine flow and water excretion be
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with decidificating ducts are relatively impermable to water. Thus, individual
with the collecting ducts are relatively impermable to water. mappidus. In the operation is not never excess urine flow and water excercion. Recease with the objection of collecting ducts are relatively impermeable to water. Thus, individuals with discrete objections of the objecting ducts are relatively impermeable to water. Thus, individuals with discrete objections of the objection of of day. Secure with a contract of the contract and the second section of the section of the second section of the section of the second section of the section me screening from the individual continual thirst and drinking. These individuals the individual continual thirst and drinking. These individuals are maintain their normal water balance primarily through the metallic continual basis and maintain their normal water balance primarily through the metallic continual continuals.

see mechanism.

Bern mechanism may be caused by deficiencies in either hypothalamic or renal mechanisms and the majorithm may be caused by deficiencies in either hypothalamic or renal mechanisms and the majorithm and the majorit been insipidas may or cause of processors in either hypothalamic or renal mecha-bleses insipidas in the lack of ADH secretion and release from the neuro-sess. Hypothalamic diabetes insipidus can be treated easily with administra-Biplical mid diabets mapping to the mask of ADH secretion and release from the neurons. Biplical mid form of diabetes insipidus can be treated easily with administration of ADH on machine the modern diabetes insipidus, the hypothalamopituitary avivation of ADH on machine the machin This form or unaccess inspiration of Delton or the hypothalamopitulary axis secretes ADH spiration to the control of the contr Auth on Auth on Hardwest Control of the Control of are which distance and converge whose our not respond appropriately to the presence and the property of the presence of the pr REGULATION OF SODIUM EXCRETION AND PLASMA VOLUME

18. Why's the regulation of sodium intake and excretion important in plasma volume reg-

1000 Sodium intake and output is extremely important in the regulation and main-The regulation or sources from the major cation found in the ECP is sodium with its acmass of a normal pulsaria vocation.

The pulsaria stress (primarily chloride and bicarbonate). Together, these ions comprise greater of the pulsaria stress (primarily chloride and bicarbonate). Together, these ions comprise greater of the pulsaria or produce in the ECF. Recause plasma or modarity is taken. graphing amous (primarily and the ECF. Because plasma osmolarity is tightly controlled by ADH, the Smoothytes in the ECF. Because plasma osmolarity is tightly controlled by ADH, ag % d me ususopses.

and the distribution of APH and the accompanying changes in plasma volume.

136. Explain what is meant by sodium balance. Experience to the requirement that the intake and output of sodium (or any other thesen betwee refers to the requirement that the phenomenate countries and individual is in a steady state. For the body, dietary sodium intake magazi min ne copial se copial se copial se copial minus se copial medical losses. Because magazi de excepción of sodium plus any insensible losses, sweating, and fecal losses. Because notes take is largely dependent on behavior, and insensible losses generally are quite small and usually not under tight physiologic control, the renal handling of sodium is the critical link to our da the body remains in a steady state. If the normal adult human consumes 8-10 g of MOpriday, to remain in balance, 8-10 g of NaCl must be excreted per day.

137. How do the kidneys normally handle sodium?

tideys handle sodium through two basic mechanisms: filtration and reabsorption. Cases it neural, hormonal, and physical factors alter both filtration and reabsorption to detrace or increase sodium excretion to maintain sodium balance.

Us. How much of the filtered sodium is normally reabsorbed in each tubular segment? Processed automic 60-70% Loon of Heale

likal convoluted tubule 20_25% Coloring duct 3-5% 2-4%

B. By don real-corption of filtered sodium vary from normal values?

"foot problems of filtered sodium vary from normal values?

See Value of problems on the volume status of the individual. When excess sodium must be compared to the control of volume depletion." The contract of the individual. When excess soutum status of the individual. When excess soutum seasons to increase excretion. In contrast, in cases of volume depletion 152
in which sodium must be conserved, sodium reabsorption is increased in the individually by the conserved.

the depheno segmens.

It is the depheno segmens and plasma volume can be sensed by the body at three main sites.

140. Summarize how changes in sodium intake and plasma volume can be sensed by the body at three main sites.

Changes in plasma volume and states.

1. Low-pressure barracceptors on the venous side of the systemic circulation. Low-pressure baroreceptors on the arterial side of the systemic circulation
 High-pressure baroreceptors on the arterial side of the systemic circulation
 introduced harmaceutor and macula de-

Hign-pressure can be a surface can large can large

Where are the low-pressure baroreceptors a: Low-pressure baroreceptors are located within the great veins, the atria, and the pulpone, 141. Where are the low-pressure baroreceptors?

asculature.

142. How do the low-pressure baroreceptors affect renal function?

How do the low-pressure baroreceptors are term muccuum.

Because they are located on the low-pressure side of the circulation, low-pressure because they are located in fullness or central filling pressure by stretching and Because they are located on the row-passage of the contraction, low-pressure by stretching and staffs because they are to the cardiovascular control center in the hypotham-staff control center in the hypotham-staff. ceptors respond to changes in fullness or venues many product of sectioning and sending the entire signals via the vagus nerve to the cardiovascular control center in the hypodalamus reliance of the brain, the signals from the low-pressure and high-pressor reliance. etions with evagus nerve to the carurovascuna. Control cernet at the hypothalamic acids sem. In this region of the brain, the signals from the low-pressure and high pressure acids sem. In this region of the brain, the signals from the low-pressure and high pressure acids sem. In this region of the brain, the signals from the low-pressure and high pressure acids and on the signal services are set of the signal services. stem. In this region of the brain, the signates in renal nerve activity and arginine visopressing buttons are integrated, and reflex changes in renal nerve activity and arginine visopressin relations are integrated, and reflex changes in venous volume of 5–10% is usually required before tors are integrated, and reflex changes in venous volume of 5-10% is usually required before the key

143. Where are the high-pressure baroreceptors? I

High-pressure baroreceptors are found in the aortic arch and carotid artery.

144. How do the high-pressure baroreceptors affect renal function? These baroreceptors respond to changes in arterial pressure with afferent signals sex to be These parotectpouts response to the state of cardiovascular communication. These baroreceptors are fast acting and respond to a 5-108 chair pressin recesse are regularity of the arterial baroreceptors, much larger change in arterial pressure. Despite the sensitivity of the arterial baroreceptors, much larger change in arterna pressure.

you are the highly compliant venous circulation before systemic arterial pressure in the highly compliant venous circulation before systemic arterial pressure in the highly compliant venous circulation before systemic arterial pressure. votation to the high-pressure baroreceptors therefore are not as sensitive to changes in plant vated 5—10%. The high-pressure baroreceptors therefore are not as sensitive to changes in plant

145. What are the intrarenal mechanisms that sense changes in plasma volume? Intrarenal baroreceptor Macula densa

146. How do they function? 3

The intrarenal baroreceptor is a mechanism by which alterations in stretch of the affects arteriole lead to changes in renin release. If increased intrarenal arterial pressure is sensed, min release is inhibited. Conversely, renin release is stimulated when there is decreased stretch of the

afferent arteriole. The macula densa also alters renin release after changes in NaCl delivery. In response his creased NaCl delivery to this nephron segment, the macula densa signals the juxtualioneral of to release renin. When sodium chloride delivery to this segment is increased, the signal to the taglomerular cells is to decrease renin release.

147. Explain how the signals from the high-pressure and low-pressure barorespect to intrarenal baroreceptors, and the macula densa are integrated to regulate rend shandling handling.

The intrarenal and extrarenal mechanisms that sense the fullness of the extracellation of the concert to receive a method act in concert to regulate the renal handling of sodium. When volume is sensed in t ligit 153

Section 15 delivered to the macula densa, the systems involved in the conservation when the volume (pressure) is judged to be 1. special solutions is delivered to the manufacture. The systems involved in the conservation and water are suppressed or inactivated, depending on the degree of fullness of the degree of fullness of the system is the conservation of the degree of of the services and water are suppressed or macuvated, depending on the degree footness of the decimal orders, when the volume (pressure) is judged to be low and macula densa sodium demanders, when the volume (pressure) is judged to be low and macula densa sodium densa sodium demanders, and the conservation of sodium and water. description and the contrast, when the volunte (pressure) is judged to be low and macula densa sodium and water are actiserved to contrast, when the volunte (pressure) is judged to be low and macula densa sodium and water are actiserved to contrast, when the volunte (pressure) is decreased, the systems that favor the conservation of sodium and water are actiserved to contrast, when the volunte (pressure) is judged to be low and macula densa sodium

and water are actiserved to contrast, when the volunte (pressure) is judged to be low and macula densa sodium

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and the volunte (pressure) is judged to be low and the volunte (pressure) is judged to be low and the volunte (pressure) is j

List the systems primarily involved in sodium and plasma volume regulation.

Atrial natriuretic period-Renn-angiotensin Physical factors

Read sympathetic nerves

What is the Penin-angiotensin system? what is the rentin anguous is a cascade of biochemical reactions that leads to increased the rein angiotensin system is a cascade of biochemical reactions that leads to increased the rein anguous case of the results of the results of the results of the renting anguous case of the results of he rein angioensin system to a vascous or otocremical reactions that leads to increased the rein angiotesty active octapeptide angiotensin II. Renin is an enzyme found in the jux-left of the renal afferent arteriole; when this enzyme is released into the renal afferent arteriole; when this enzyme is released into the renal afferent arteriole; when this enzyme is released into the renal afferent arteriole; when this enzyme is released into the renal afferent arteriole; when this enzyme is released into the renal afferent arteriole; when this enzyme is released into the renal afferent arteriole; when this enzyme is released into the renal afferent arteriole; when this enzyme is released into the renal afferent arteriole; when this enzyme is released into the renal afferent arteriole; when this enzyme is released into the renal afferent arteriole; when this enzyme is released into the renal afferent arteriole; when this enzyme is released into the renal afferent arteriole; when this enzyme is released into the renal afferent arteriole; when the renal af me or universal of the feed of general resist of the rena attraction attractive, when this enzyme is released into the circulation, agencial recision of the released and the recival attractive agencial agencian agencian graph and agreement of the released to angiotensin II by angiotensin convention of the released to angiotensin II by angiotensin convention of the released to angiotensin II by angiotensin convention of the released to angiotensin II by angiotensin convention of the released and the released to the relea page agiotentinogen, a cucunsum party reputure produced by the liver, into the decaption, some and produced by the liver, into the decaption of the page of the pa agestini I. Angiotensin 1 is users reserved an argument in 10 y angiotensin-converting enzyme, agestini I. Angiotensin-converting enzyme, which is found in endothelial cells in the lung and the kiciney. By themselves, renin, angiotensin-converting enzyme have little to no historia. aggregation of medichelial cero in use rong area are aroney. By themselves, reain, anguler-gish found in endothelial cero in use rong enzyme have little to no biologic activity. The aggregation is an endotestin II, which is a potent vasoconstrictor, stimulator of see a spicersin I, and angunement on a rung outsyme nave intile to no biologic activity. The isother aspicersin II, which is a potent vasoconstrictor, stimulator of aldosterone restrictions are of unular sodium reabsorption.

stre pepase to the street of t

53. Name the stimuli that activate the renin-angiotensin system. Name the summus.

Reductions in renal perfusion pressure are sensed by intrarenal baroreceptors in the affeed anerole, which leads to renin release.

es unsciole, writes acoust to the macula densa also stimulates renin release from the 2. Decreased delivery of NaCl to the macula densa also stimulates renin release from the nunelomerator cells.

ngenerous 3. Stimulation of renal sympathetic nerves directly increases renin release. 2. Minuments is activated when the body needs to conserve or retain sodium. Each of these stimuli is activated when the body needs to conserve or retain sodium.

isi. What are the principal effects of the renin-angiotensin system on renal function? The overall effect of the renin-angiotensin system is to decrease sodium and water excrehe by feeresting filtered load and increasing tubular sodium reabsorption. Angiotensin II is a me of recessing among a supplemental and a suppleme conset that peripheral resistance, which tends to increase blood pressure by direct effects. The min angiotessin system is activated in conditions when sodium needs to be conserved.

12. How does the renin-angiotensin system after renal vascular function?

Argonnish II increases renal vascular resistance. In the human kidney, this peptide appears to make the efferent arteriole preferentially at normal circulating levels. After hemorrhage or ther issues that lead to hypovolemia or lowering of renal perfusion pressure, elevated levels of minutes ill constrict the preglomerular vasculature as well as the postglomerular efferent artetok, leading to a decrease in GFR and RBF.

El Does the renin-angiotensin system influence tubular sodium transport?

Agoretsin II directly stimulates proximal tubule sodium reabsorption. Angiotensin II also to a fe level of the adrenal gland to increase aldosterone secretion; aldosterone then has poen description of the adrenal gland to increase aldosterone secretion; audosterone of the gland to timulate sodium reabsorption and potassium secretion in the distal portions of the tellar.

Is What is aldosterome?

Moderate additione?'

Analytic mixed produced in the zona glomerulosa of the adrenal gland. In response to Absolute control produced in the zona glomerulosa of the adrenal gland. In responsible appears if or increased extracellular potassium levels, the synthesis of aldosterone 154

and its release into the blood are increased. Of the two stimuli for addottenone release, the most potent.

"hadro possission are the most potent."

How does adoustrone affect renal function is to decrease sodium exercises to the net effect of adoustrone on renal function is to decrease sodium exercises.

The net effect of adoustrone on renal function is to decrease sodium exercises to the net effect of adoustrone or renal function without affecting renal hemodynamics (GFR, and RBF). The net of the connecting tubule and colleges, the net of the connecting tubule and colleges, the net of the connecting tubule and colleges. 155. Hor does address two—
The set effect of dolosterone on renal function as a constant and REF. The set of the of dolosterone on renal function are constant and REF. The set of the connecting tubble and collecting set of the connecting tubble and collecting set of the set of the connecting tubble and collecting set of the coll 150. It are effect of anosomore hinds to cytoplasmic exceptors. This binding length of
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change for polassium.

156. What is meant by physical factors, and how do physical factors affect road and the control of the

illaries and renal interstitial space.

This a term was the more than the state of t illaries ans tem
1. In the case of an expansion of ECF volutine, passiva protein is disuted (plasma orea),

1. In the case of an expansion of ECF volutine, passiva protein is disuted for the passiva orea, as sure decreases), and glomerular and peritubular capillary hydrostatic pressure increases the driving force for ultrafilitation when the passiva or another passiva o 1. In the words, and glomerular and permuonan caputary, trymostatic pressure the permuon is used decreased, and glomerular capillary pressure increases the driving force for ultrafiltration, the creased glomerular capillary pressure increases the forces opposing filtration; for these reasons, the seasons, the seasons, the seasons are sure uccommendar capillary pressure increases one only one or our durantitization, whereast glomental capillary pressure increase opposing filtration; for these reasons, de shared to it on of plasma protein decreases the forces opposing filtration; for these reasons, de shared to one of plasma protein decreases the forces opposing filtration; for these reasons, de shared to one of plasma protein decreases the forces opposing filtration; for these reasons, de shared to one of plasma protein decreases the forces opposing filtration; for these reasons, designed to one of plasma protein decreases the forces opposing filtration; for these reasons, designed to one of plasma protein decreases the forces opposing filtration; for these reasons, designed to one of plasma protein decreases the forces opposing filtration; for these reasons, designed to one of plasma protein decreases the forces opposing filtration; for these reasons, designed to one of plasma protein decreases the forces opposing filtration; for these reasons, designed to one of the forces of th

Of plasma productions of the plasma production of the plasma productions (elevated hydrostatic and reduced oncotic pressure) for not had 2. The increase in capillary hydrostatic and reduced oncotic pressure) for resource and vasa recta capillaries and tend to reduce the reabsorption of the reabsorption less favorable conditions (elevated nyurosante une control pressure) for reasonable in the peritubular and vasa recta capillaries and tend to reduce the reabsorption of fluid fine.

157. Explain how renal sympathetic nerves affect sodium handling. Explain how renar sympathy.

In response to decreased volume and stretch from the low-pressure and high-pressure by. In response to decrease the second of the renal sympathetic nerves are stimulated. The renal sympathetic nerves are stimulated. The renal sympathetic nerves are stimulated.

ceptors, renal sympausus and serve to retain sodium. Renal sympathetic stimulatio hashs · Decreasing filtered load

· Increasing tubular reabsorption

· Increasing renin release

158. What is atrial natriuretic factor? /

A neptide found in the atria and great veins that is released in response to increased and stretch (increased ECF volume); also known as atrial natriuretic peptide,

159. What does atrial natriuretic factor do to affect renal function? When atrial natriuretic factor is released, it increases sodium and water excretor by

creasing GFR and decreasing collecting duct sodium reabsorption. Atrial natriuretic peptit 58 leased in conditions of hypervolemia and acts to increase sodium excretion.

160. What is the pressure-natriuretic-diuretic mechanism?

The phenomenon by which increased renal perfusion pressure leads to an increase in xdan and water excretion owing to an intrinsic property of the kidney. The increased sodium and the ter excretion serves to decrease ECF volume and leads to a normalization of arterial Conversely, when arterial pressure is decreased, the pressure natriuretic mechanism is stated a lower operating point, and the kidney tends to decrease sodium and water excellent to accuse the state of t extracellular volume and return arterial pressure to control levels.

161. What is the importance of the pressure-natriuretic-diuretic mechanism? This intrinsic feedback mechanism of the kidney is hypothesized by some scientists as of the primary regulators of ECF volume and arterial blood pressure.

Nariuretic or Diuretic tanding. Prostaglandins

Endothelin

Nitric oxide Urodilatin

do all these systems act to regulate plasma volume?

164 How do all these systems and intrinsic mechanisms and intrinsic mechanisms. Bor do all three systems were no "Specime yourned volume?

Bor do all three systems me no speciment that regulate sodium and water exthree direction neural, hormonal, and intrinsic mechanisms that regulate sodium and water exthree directions are increased out on the speciment of the specime the flow of the state of the st bosonius processor process space is ex
Fig. 10 for expansion urgsus a minute of overity.

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The FUT expansion urgsus a minute of overity and vaso
the Fut of the pressure barroreceptors, which inhibits sympathetic activity and vaso
the fut of the pressure barroreceptors, which inhibits sympathetic activity and vaso
the fut of the pressure barroreceptors.

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A signal oracle of higher level of pressure

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residentials to a higher avec ou presente residentials to a higher avec ou presente residentials to a higher avec ou presente residentials are residentials and a constance of the residentials are residentials are residentials. habition of the reuln-migraceaum-unconstant outs by intrarenal mechanisms
which the constant of the content of maintain a constancy of the body's internal envifleet market the excess sodium. In contrast to the changes that occur when The mechanisms operate in content of meanman a constancy of the body's internal envi-fices mechanisms operate in contents to the changes that occur when sodium in-proved the excess sodium. In contrast to the changes that occur when sodium in-rorms by the systems (sympathetic nerves, renin-angiotensin, viscoprecional contents of the contents of t The control of the course sociation in visual east of the changes that occur when sodium in-properly exercising the experience (sympathetic nerves, renin-angiotensis, visopresia, adosterone, and the control of the c and the second s presure satriures (some constitutions in which the ECF is decreased, safeti inside or in other conditions in which the ECF is decreased.

164. How are these systems affected in disease states? I. Has are these systems assessed as the morrhage, shock, severe vomiting, or severe I. Palaologic conditions: In response to hemorrhage, shock, severe vomiting, or severe I. Palaologic conditions to conserve sodium and water are serioused to about Pathologic construence:

| Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic construence: | Pathologic constr fairtes, the mecuanisms of control of southing and water are activ.

page to decreased EUP vocume or observations are active, the inability of the heart to function ad-2. Pathophysiologic consecutions and account to majority of the heart to function ad-query as pump leads to a fall in cardiac output and mean arterial pressure. The fall in blood epairly as a pump least so a rain an amount of the renin-angiotensin system, vasopressin must leaf to activation of sympathetic nerves, the renin-angiotensin system, vasopressin great leafs to activation of opposition and the state of giore, and autoservous symmetries. A control condition by increasing the preload on the diseased at, which can actually exacerbate the heart condition by increasing the preload on the diseased

3. It is also not uncommon to observe patients in which an abnormality in one of the con-3. It is also not uncommon so consider pentrano an armon an armon manty m one of the con-nelling systems leads to afterations in renal sodium (and water) handling and the consequential reung ynamu see.

fiers on body fluids. In hypoaldosteronism, in which insufficient aldosterone is produced by the storal gland and large amounts of sodium are excreted, leading to decreased ECF volume, hypotension, and, if left untreated, circulatory shock and death.

ACID-BASE BALANCE AND EXCRETION OF POTASSIUM

16. Why is regulation of plasma K+ concentration important? The regulation of plasma K+ concentration is critical to the overall function of the body be-Take & K* concentration difference across cell membranes can dramatically influence the restin remains potential of all cells. This resting membrane potential is particularly important for nered connection of skeletal and cardiac muscle and function of nerve cells.

What is the normal range for plasma K+ concentration? 3.0-5.0 mM/L.

10. How does the kidney participate in the control of K+ balance? The kidney and adrenal cortex work in concert as the primary organs that regulate plasma K* 156

Recognition of renal K* exerction. This regulation is accomplished by the relationship of the regulation renal tubular K* handling.

To the access of the recognition of the relationship of the relation through me determs well described the determination of the determination

Does allosterone procercetion?

Aldosterone abould be considered a relatively long-term controller of Na* Technology

Aldosterone acts in the principal cells of the distal tubule and controller

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169. How does aldosterone affect K* excretion and K* balance?

How does aldosterone affect he exercises is to activate the tubular cell No. one mechanism by which aldosterone functions is to activate the tubular cell No. one mechanism of this basolateral cell enzyment on tony increases Na. readstranged to the contraction of the contraction of the contraction. 169. How does are the control of the One mechanism of this basolateral cell encyton hostory in the increased intracellular k* concentration. The increased intracellular k* interstitution, but also increases intracellular k* concentration ment through appeal due to the concentration of k* from inside the cell into the tubular lumen through appeal due to the concentration is under the concentration. ATPase, Summan, and the summan of the summan intensition, on the from inside the cent may be more secretion of K* from inside the cent may be more secretion of K* from inside the cent may be more secretion. This gradient is under the complete influence of the cent of thereby promotes overall h executive the executive thereby promotes overall h executive thereby promotes overall hereby promotes over a he

170. Does plasma K+ concentration affect the secretion of aldosterone?

Does plasma K* concentration attention to see the most potent controller of advance.

The concentration of K* in the plasma may be the most potent controller of advance.

Amount zona glomerulosa cells. These cells are highly influenced by the controller of the con The concentration of K* in the plasma may be a considered to the concentration of K* in the plasma may be cretion from the adrenal zona glomerulosa cells. These cells are highly influenced by the cretion from the adrenal zona glomerulosa cells. These cells are highly influenced by the cretion from the adrenal zona glomerulosa cells. These cells are highly influenced by the cretion from the adrenal zona glomerulosa cells. These cells are highly influenced by the cretion from the adrenal zona glomerulosa cells. These cells are highly influenced by the cretion from the adrenal zona glomerulosa cells. These cells are highly influenced by the cretion from the adrenal zona glomerulosa cells. These cells are highly influenced by the cretion from the adrenal zona glomerulosa cells. These cells are highly influenced by the cretion from the adrenal zona glomerulosa cells. These cells are highly influenced by the cretion from the adrenal zona glomerulosa cells. These cells are highly influenced by the cretion from the adrenal zona glomerulosa cells. cretion from the adrenal zona glomerutosa cens. These cents are mignry inhuenced by the cracking K* concentration. An elevation of plasma K* from 4.5 to 5.5 mEq.(1) provides near-national advantages and concentrations. Reduction of plasma K* below 3.0. ing K* concentration. An elevation of plasma K* below 30 mtsqt. elevation of circulating aldosterone concentrations. Reduction of plasma K* below 30 mtsqt.

171. Do any other ions in the plasma affect plasma K+?

. Do any other tons in the plasma acidification can have a pronounced influence on the company of acidosis and plasma acidification can have a pronounced influence on the company of acidosis and plasma acidification of acidosis and plasma acidification can have a pronounced influence on the company of acidosis and plasma acidification can have a pronounced influence on the company of acidosis and plasma acidification can have a pronounced influence on the company of acidosis and plasma acidification can have a pronounced influence on the company of acidosis and plasma acidification can have a pronounced influence on the company of acidosis and plasma acidification can have a pronounced influence on the company of acidosis and plasma acidification can have a pronounced influence on the company of acidosis and plasma acidification can have a pronounced influence on the company of acidosis and plasma acidosis acidos acido The level of acrossis and present the second of the second of the second of K* by the kidney. During chronic acidosis, elevation of extracellular H* is no second of the second of K* by the kidney. During the secon cretion of K * by the Numey, Johnson Both H * and K * are relatively permeable to moving fluences the plasma K * concentration. Both H * and K * are relatively permeable to moving fluences the plasma is to the presence of excess H+, the tendency is for H+ to diffuse as

172. How does acidosis affect plasma K+?

Acute acidosis tends to decrease Na+, K+-ATPase and decrease the K+ permeability d'a apical membrane and thereby decrease potassium secretion and excretion. Chronic netabole as dosis, however, induces hyperkalemia, which stimulates aldosterone release and has a are fin to increase potassium secretion and excretion.

173. What are the major mechanisms by which the kidney regulates acid-base blane? Renal regulation of acid-base occurs via H+ excretion and HCO3- reabsorption Comid either H+ excretion or the buffering capacity for H+ with HCO3- has the net effect of controller the overall state of extracellular fluid H+ concentration.

174. What are the nephron segments responsible for regulating H+ excretion? Excretion of fixed acid (H⁺) occurs in the proximal tubule, thick ascending limb and calated cells of the distal tubule and collecting duct. In the proximal tubule and thick senses

limb, H+ ion secretion occurs on the lumenal membrane in exchange for Na+ ion. The memlated cells contain specific proton pumps in the lumenal membrane that directly utilize ATPER crete H*. These proton pumps in the lumenal membrane that directly using the H*. These proton pumps secrete H* into the tubular lumen of the distal tubule and other ing duct and assist in acidifying the urine.

175. How does HCO3 reabsorption contribute to the urine acidification process The removal of HCO₃ reabsorption contribute to the urine acidification process: tions in which excess acid must be excreted from the body. The near complete reabsorption of tered HCO₃ is necessary to maintain the body's acid-base status since the CO₂/HCO₃ buffer tered to a sextremely important in acid-base regulation. The reabsorption of HCO₃ buffer tered HCO₃ is necessary important in acid-base regulation. The reabsorption of HCO₂/HCO₃ buffer system is extremely important in acid-base regulation. The reabsorption of HCO₃ from the tubusystem is extremely effective in the proximal tubule, thick ascending limb of Henle and included and under normal circumstances. system is extremely impossing the proximal tubule, thick ascending limb of HCO₃ from the tubular fine collecting duct and under normal circumstances 99.9% of the filtered local lar fluid is highly collecting duct and under normal circumstances 99.9% of the filtered load is reabsorbed.

176. How is HCO3 reabsorbed in the PCT? How is HCO₃ How is HCO₃ ions. Therefore, all the reabsorbed in the form of CO₂. H⁺ ion, which is secreted in an increase in the form of CO₂. The lumenal inclined in the form of CO₂. H⁺ ion, which is secreted in exchange for Na⁺, HCO₃ must be reabsorbed in the form of CO₂ and water, and this reaction is catalyzed by the HCO₃ must be readsolved from CO₂ and water, and this reaction is catalyzed by the presence of combines with HCO₃ to form CO₂ and water, and this reaction is catalyzed by the presence of combines with HCO₃ to form CO₂ and water, and this reaction is catalyzed by the presence of combines with news the PCT brush border membranes. CO₂ diffuses down its concentration carbonic anhydrase on the PCT cell because the lumenal membrane is permeable to this male carbonic anhydrase on the carbonic anhydrase of the concentration gradient into the PCT cell because the lumenal membrane is permeable to this molecule (similar than Incide the cell, the CO₂ combines with water, again catalyzed by the gradient into the relative the coll, the CO₂ combines with water, again catalyzed by the presence of into all cells). Inside the cell, the CO₂ combines with water, again catalyzed by the presence of into all cells). From the inside of the colling of the colling the tracellular carbonic anhydrase, forming H⁺ and HCO₃⁻. From the inside of the cell, the HCO₃⁻ tracellular carbonic annual concentration gradient into the blood and effectively complete the re-

177. How does acidosis increase the secretion of H⁺ from the interstitial spaces into the

tubular lumen?

absorptive process.

Acidosis or increased plasma H⁺ concentration is removed from the blood in a substratespecific manner. As plasma H+ concentration increases, the supply of substrate to the various special management processes in the kidneys also is increased. Therefore, H+ secretion in the PCT and collecting duct is increased because of elevated substrate availability to the specific transporters in those sites.

178. What are the other mechanisms that the kidney uses to excrete \mathbf{H}^+ ions and acidify the

Other mechanisms include the excretion of PO₄⁻, SO₄⁻, and NH₃/NH₄⁺. In the case of NH₃, acidosis increases ammoniagenesis through the deamination and metabolism of glutamine and glutamate. This deamination process in the PCT creates excess NH3, which diffuses into the tubular lumen and combines with filtered H+ ion to form NH₄+. The NH₄+ is then trapped in the tubular lumen and cannot diffuse back into the cell. Thus, the ammonia becomes an excellent carrier of excess H+ into the excreted urine.

BIBLIOGRAPHY

5. Windhager EE: Handbook of Physiology: Section 8. Renal Physiology, vol 1. Oxford, Oxford University Press, 1992

^{1.} Brenner BM: The Kidney, 5th ed. Philadelphia, W.B. Saunders, 1996.

² Guyton AC, Hall JE: Textbook of Medical Physiology, 9th ed. Philadelphia, W.B. Saunders, 1996.
3. Koepnen RW Co.

^{3.} Koeppen, BW, Stanton BA: Renal Physiology, 2nd ed. St. Louis, Mosby, 1997. 4. Navar LG, Inscho EW, Majid SA, et al: Paracrine regulation of the renal microcirculation. Physiol Rev