physiology lecture (9) part (1) and (2)

elastic arteries (large)(conduct blood to muscular arteries) → muscular arteries (medium size) (distributed blood to arterioles) → arterioles (Deliver blood to capillaries)(help regulate blood flow from arteries to capillaries.) → atrial capillaries (Permit exchange of nutrients and wastes between blood and interstitial fluid; distribute blood to postcapillary venules.) → Veinous capillaries (Pass blood into muscular venules) (permit exchange of nutrients and wastes between blood and interstitial fluid) (function in white blood cell emigration) → muscular venules (Pass blood into vein); (act as reservoirs for accumulating large volumes of blood) (along with postcapillary venules).) → veins (Return blood to heart, facilitated by valves in limb veins.)

arteries walls (stretch easily or expand without tearing) (due to their plentiful elastic fibers) (have three layers of a typical blood vessel)

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blood vessel

- tunica interna(intima)(direct contact with the blood)
  - endothelium
    - (thin layer of flattened cells that lines the inner surface of the cardiovascular system)
    - they have a group of functions:
      1. physical influences on blood flow
      2. secretion of locally acting chemical mediators(vasodilators and vasoconstrictors) that influence the contractile state of the vessel's overlying smooth muscle .
      3. facilitates efficient blood flow by reducing surface friction..
      4. Reduces inflammation and reduces clotting
  - basement membrane (physical support) (play a role in guiding cell movements during tissue repair of blood vessel walls.)
  - internal elastic lamina (thin sheet of elastic fibers with a variable number of windowlike openings that facilitate diffusion)
- tunica Media (displays the greatest variation) (relatively thick layer) (comprising mainly smooth muscle cells+ elastic fibers)
- tunica externa (adventitia) (consists of elastic and collagen fibers) (supplying the vessel wall with nerves and self-vessels) (helps anchor the vessels to

capillary exchange ways:

diffusion

(the most important method)
(O2 diffuse from blood into interstitial fluid)
(CO2 diffuse from interstitial fluid into blood)
(more importantfor solute exchange between blood and interstitial fluid)

transcytosis

(small quantity)
(enclosed within tiny pinocytic vesicles)
(first enter endothelial cells by endocytosis, then exit on the other side by exocytosis)

bulk flow

(large quantity , passive process, and the same direction)
(higher pressure to lower pressure)
(more important for regulation of the relative volumes of blood and interstitial fluid)

blood capillaries into interstitial fluid → filtration

interstitial fluid into blood capillaries → reabsorption

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blood flow → volume of blood that flows through any tissue in a given time period (in mL/min).

total blood flow= cardiac output

distribution of cardiac output depends on:
- the pressure difference
- the resistance

blood pressure (BP) determined by
- cardiac output
- blood volume
- vascular resistance

BP in young adult= $\frac{\text{systole}}{\text{diastole}} = \frac{\text{ventricular constriction}}{\text{ventricular dilation}} = \frac{110}{70}$

Mean arterial pressure (MAP): the average blood pressure in arteries, is roughly one-third of the way between the diastolic and systolic pressures. It can be estimated as follows:

MAP= diastolic BP +1/3 (systolic BP - diastolic BP)

pulse pressure = systolic BP - diastolic BP

CO = MAP/R → MAP = CO * R.

The normal volume of blood in an adult is about 5 liters → decrease in this volume, as from hemorrhage, decreases the amount of blood that is circulated through the arteries each minute

decrease blood volume(greater than 10%to20% of the total) blood pressure drops. Conversely, anything that increases blood volume, such as water retention in the body, tends to increase blood pressure.

Vascular resistance → the opposition to blood flow due to friction between blood and the walls of blood vessels.

depends on:
- (1) size of the blood vessel lumen ↓
- (2) blood viscosity ↑
- (3) total blood vessel length ↑

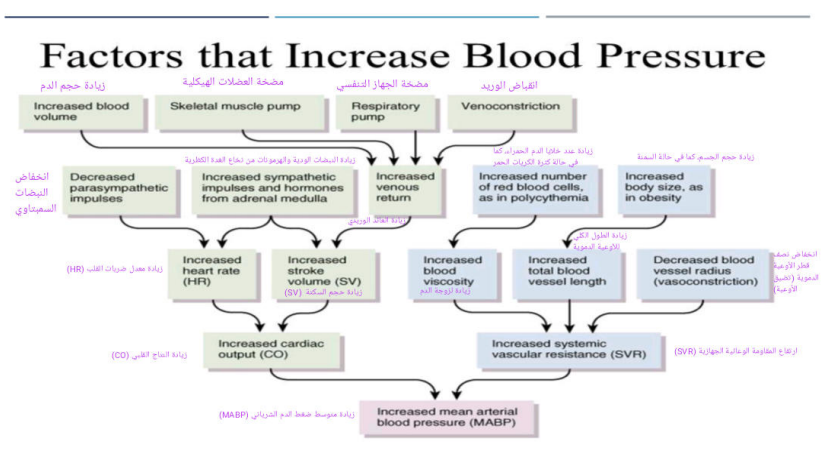
the blood viscosity → depends on:
- ratio of red blood cells to plasma (fluid) volume
- the concentration of proteins in plasma.

viscosity increase (dehydration) (polycythemia : unusually high number of red blood cells) → blood pressure increase

depletion of plasma proteins or red blood cells(viscosity decrease) (anemia) (hemorrhage) → blood pressure decrease

Systemic vascular resistance (SVR), (total peripheral resistance)(TPR) → all of the vascular resistances offered by systemic blood vessels.

↓ The speed or velocity of blood flow (in cm/sec) → inversely related to the cross-sectional area ↑



Role of the Cardiovascular Center in the medulla oblongata:

- helps regulate heart rate and stroke volume
- controls
  - neural negative feedback system
  - hormonal negative feedback system
  - local negative feedback systems
- receives input from
  - sensory receptors
  - higher brain regions

Nerve impulses descend from

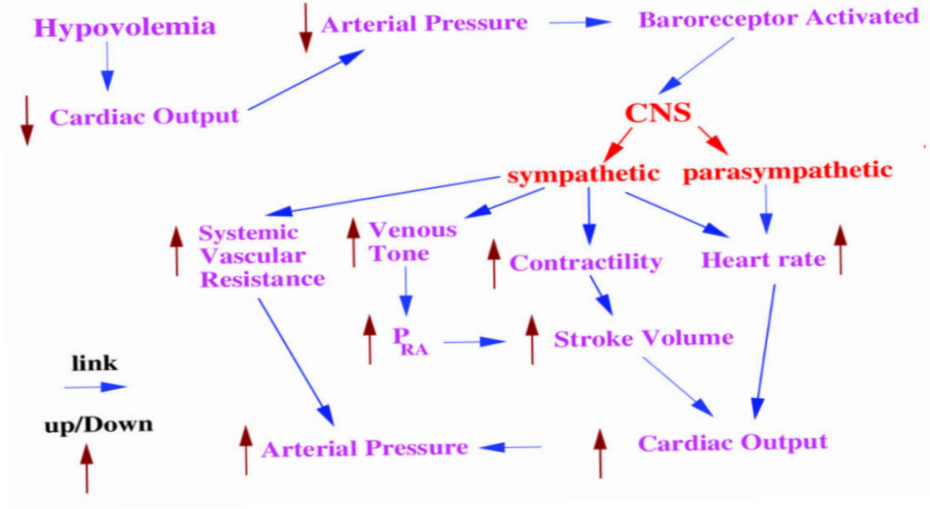
- cerebral cortex
- limbic system
- hypothalamus

vasomotor tone → moderate state of tonic contraction or vasoconstriction

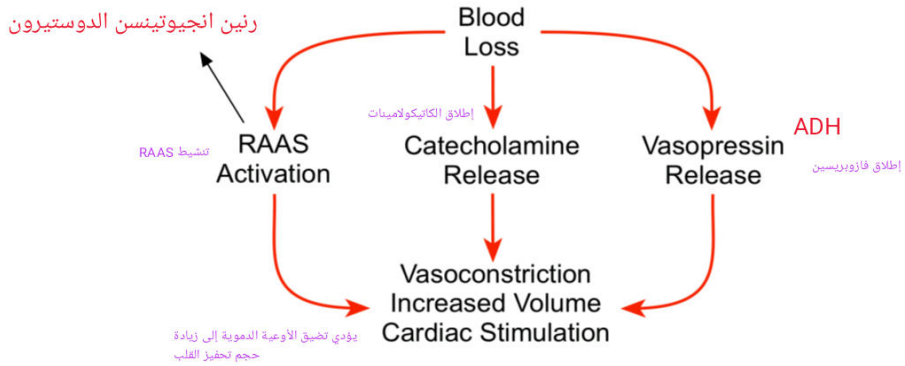
هسا الباقي حكيته بتلخيص ملف 8 بارت 2 عن ال short-term regulation

neural regulation

- baroreceptor reflexes(found in) (prone(lying down) to erect decrease blood pressure)
  - aorta
  - internal carotid arteries (in the neck supply the brain)
  - arteries in the neck and chest
- chemoreceptor reflexes. (found in)
  - carotid sinus → carotid bodies
  - arch of the aorta → aortic bodies



long term regulation



HORMONAL REGULATION OF BLOOD PRESSURE : long-term regulation

A. blood volume is low

1. Renin-angiotensin-aldosterone (RAA) system:

blood volume in kidneys decrease → juxtaglomerular cells in the kidneys secrete renin → angiotensin I —(angiotensin-converting enzyme (ACE))→ angiotensin II

angiotensin II → aldosterone → increases reabsorption → increase the blood pressure and blood volume

potent vasoconstrictor; it raises blood pressure by increasing systemic vascular resistance.

2. Epinephrine and norepinephrine:

sympathetic stimulation → adrenal medulla releases epinephrine and norepinephrine → increase rate and force of heart contractions → increase cardiac output → increase blood volume

3- Antidiuretic hormone (ADH)(Vasopressin):

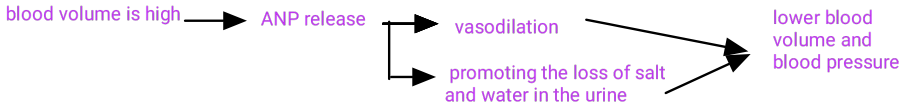
produced by the hypothalamus

released from the posterior pituitary

dehydration or decreased blood volume → ADH released → decrease in urine output → increase in blood volume

B. blood volume is high

- Atrial natriuretic peptide (ANP): Released by cells in the atria



Autoregulation → The ability of a tissue to automatically adjust its blood flow to match its metabolic demands

by → vasodilators / vasoconstrictors

control regional blood flow

it stimulated by → chemical changes / physical changes

physical changes → warming (vasodilation) / cooling (vasoconstriction)

two types of circulations → systemic circulation (low O2 vasodilation) / pulmonary circulation (low O2 vasoconstriction) → the important difference is the autoregulation when change in O2 occur

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checking circulation

pulse

(alternate expansion and recoil of elastic arteries after each systole of the left ventricle creates a traveling pressure wave)

(stronger nearer to the heart)

pulse rate ~=heart rate=70to 80 (beats/min) at rest

Tachycardia: rapid resting heart or pulse rate over 100 (beats/min)

Bradycardia: slow resting heart or pulse rate under 50 (beats/min).

measuring blood pressure

(pressure in arteries generated by the left ventricle during systole and the pressure remaining in the arteries when the ventricle is in diastole)

(measured in the brachial artery in the left arm)

the device used is (sphygmomanometer)

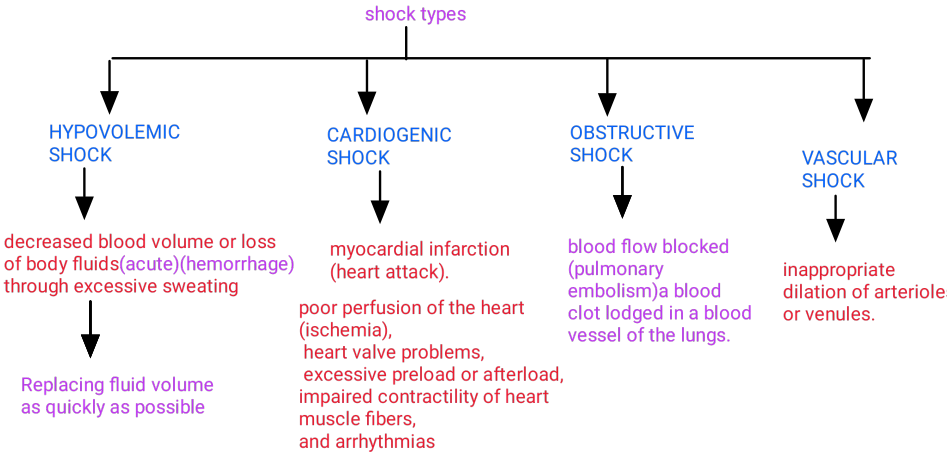
The normal blood pressure of an adult male= more than120 / less than 80

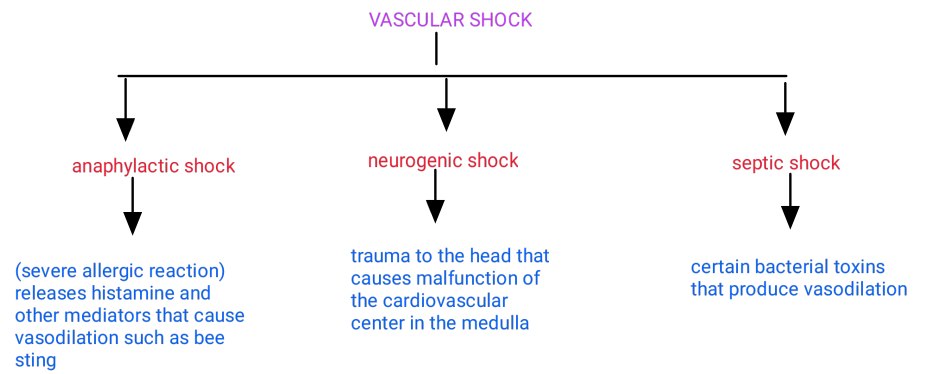
pulse pressure (providing information about cardiovascular condition)=normally 40mmHg

The normal ratio of systolic pressure to diastolic pressure to pulse pressure is about 3:2:1.

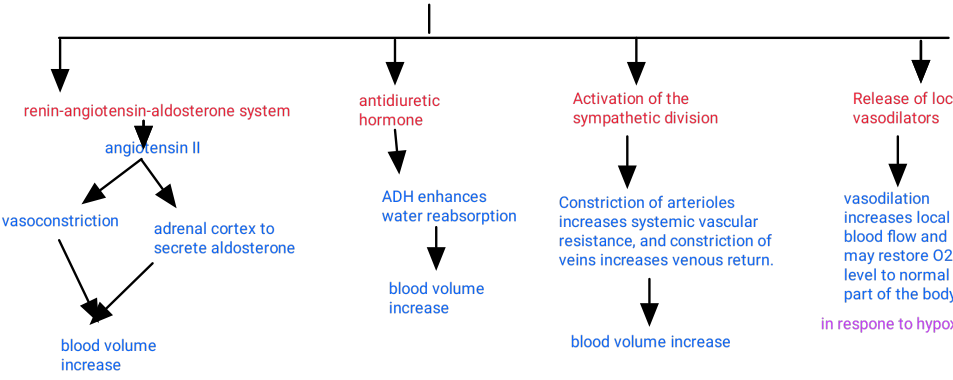
shock → failure of the cardiovascular system to deliver enough O2 and nutrients to meet cellular metabolic needs

hypoxemia → failure of the cardiovascular system to deliver enough O2 only to meet cellular metabolic needs





HOMEOSTATIC RESPONSES TO SHOCK
(major mechanisms of compensation in shock are negative feedback system)



If blood volume drops more than 10-20%, → shock becomes life-threatening as damaged cells start to die.