



Cardiovascular Block

Physiology Team 430

13th Lecture

Regulation of blood pressure

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- The blood pressure is regulated by several cardiovascular mechanisms which can be rapid or intermediate term regulation:

- 1-Auto regulation.
- 2 - Neural mechanisms(by nerves)
- 3- endocrine response (by hormones)

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- Neural control mechanism: (it's consider to be rapid regulatory mechanism)

- Two centers in the medulla are responsible:

The cardiac centre :	The vasomotor centre (controls diameter of blood vessels) :
1-Cardiac acceleratory: ↑ H.R.& ↑ C.O. (sympathetic activation)	1-vasoconstrictor neurons
2- cardio inhibitory : ↓ H.R.& ↓ C.O (parasympathetic activation)	2-vasodilator neurons

The impulses are sent from the cerebral cortex, hypothalamus , chemoreceptor, and baroreceptors to the cardiac centre – then through the sympathetic and parasympathetic N.S to the heart – modify the heart rate and the force of contraction in response to any changes in the B.P

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- Reflex control of cardiovascular function: (This explains how the cardiac centre gets activated)

It's activated through detection of any changes in the blood pressure via set of receptors which are :

1- The baroreceptors (Pressure receptors):" the most important regulatory centre of blood pressure, they're very sensitive to any change in the B.P

- Respond to changes in B.P.

2- The chemoreceptors :-

Monitor changes of oxygen, carbon dioxide, and hydrogen ions.

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■ The baroreceptor reflexes :

Monitor the degree of stretch of expansible Organs

- Located in the :-

- 1- Carotid sinuses.
- 2- Aortic sinuses.
- 3- The wall of the right atrium.

If the carotid sinuses or aortic arch stretches – stimulate baroreceptor-send impulses through two nerves : the glossopharyngeal nerve to the cardiac center , and through the vagus nerve to the vasomotor centre – which send impulses to the blood vessels or the heart

When there is an increase in the blood pressure , the artery will be stretched , the baroreceptor will be stimulated leading to decrease sympathetic activity that result in decrease the heart rate and the cardiac output, and it will send impulses to vasomotor centre , leading to vasodilatation

Sudden decrease in B.P. → ↓ activity of the baroreceptors →

- 1- ↑ H.R. & ↑ C.O. due to ↑ sympathetic & ↓ parasympathetic activity.
- 2- Widespread peripheral vasoconstriction due to stimulation of the vasomotor center.

In Hyper tension there will be increase the HR and the C.O so, the left ventricle will become hypertrophic then heart will require more O₂-- this will lead to ischemic heart disease.

Atrial baroreceptors: "these baroreceptors are present on the right atrium "

Respond to stretch of the wall of the atrium

- \uparrow atrial pressure \rightarrow stimulate C.V. centre $\rightarrow \uparrow$ H.R. & \uparrow C.O (Bainbridge reflex) \rightarrow prevent damming of blood in veins, atria & pulmonary Circulation.
- Atrial stretch also \rightarrow dilate afferent arterioles $\rightarrow \uparrow$ GFR $\rightarrow \downarrow$ ADH & \uparrow atrial natriuretic peptide (ANP) hormone secretion $\rightarrow \uparrow$ urine output. $\rightarrow \downarrow$ B.P.

As a summary: Rapid control of arterial B.P is maintained by :

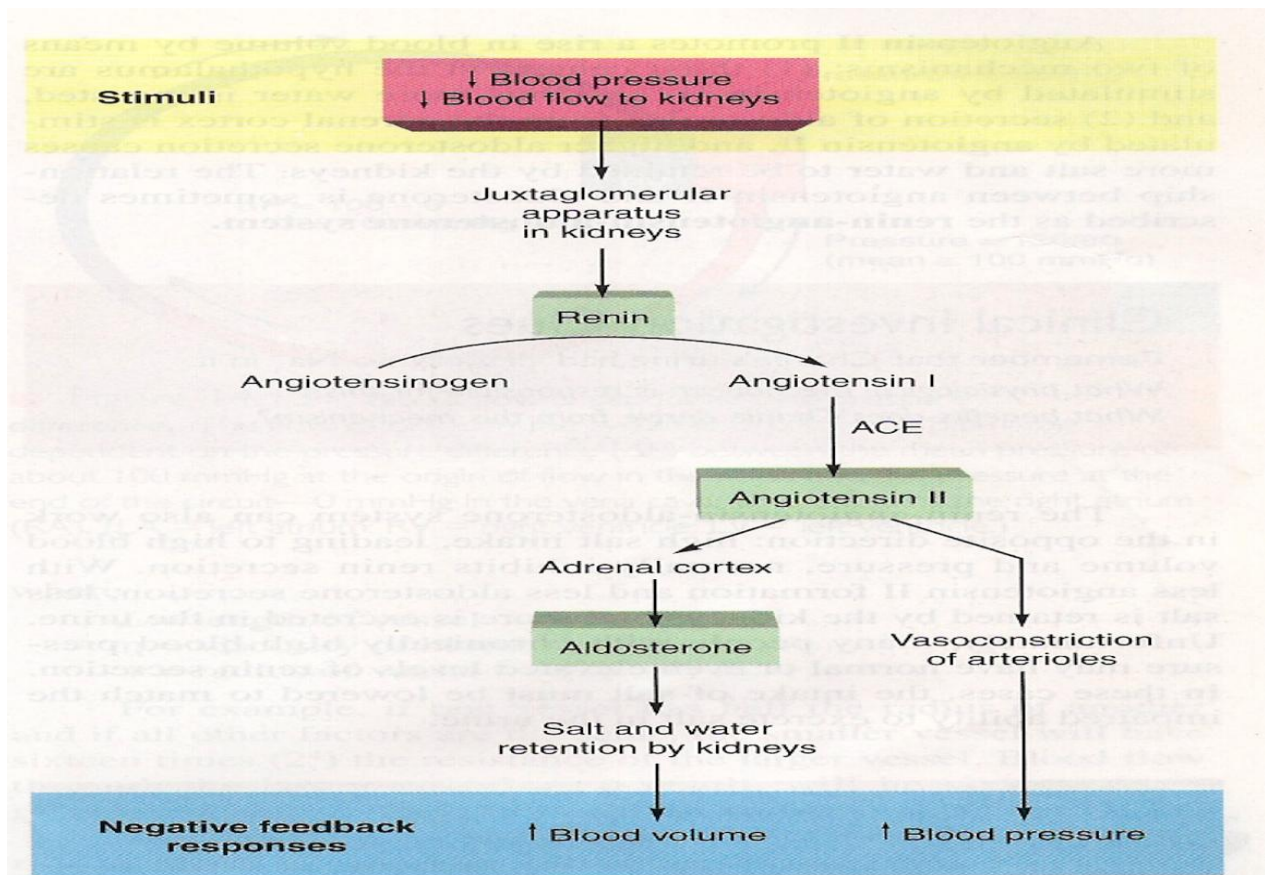
- 1- Baroreceptors
- 2- CNS effects: sympathetic and parasympathetic
- 3- Chemoreceptor

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INTERMEDIATE TERM REGULATION OF BLOOD PRESSURE (Respond from 30 minutes to several hours):

1. Renin – Angiotensin system.(when this system gets activated , it leads to salt and water retention – so increase B.P)
2. Capillary shift mechanism (Fluid shift from the interstitial spaces into blood capillaries) $\rightarrow \uparrow$ Blood volume.
3. Stress relaxation of vessels.(when there is accumulation of metabolites like lactic acid—it will lead to vasodilatation)

Explanation of how the rennin angiotensin system works :



Functions of the angiotensin 2 :

- 1- causes salt & water retention directly when acting on the kidney in addition to vasoconstriction
- 2- by releasing aldosterone by the adrenal cortex that causes reabsorption of Na and water – increase blood volume – restore the normal B.P

Hormonal regulation of CVS :

The endocrine system provides both **short-term** and **long-term** regulation of CVS:

Short term regulation:

- epinephrine
- norepinephrine

Long term regulation

- **1-Antidiuretic hormone (ADH)** " this hormone will be inhibited if the person has hypertension
- **2-Angiotensin II**
- **3- erythropoietin** : " this hormone will stimulate the bone marrow - increase RBC production-- increase blood volume " in case of hypotension
- **4- Natriuretic peptides (ANP&BNP)**
- **in hypertension , they increase the loss of urine -- decrease Blood volume**

If the person has polyuria " Excessive passage of urine" and he is not diabetic , we should check his blood pressure to make sure he is not suffering from hypertension