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CEREBRAL CIRCULATION AND LAWS OF HEMODYNAMICS

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Annotation:
Arterial system - blood supply to the brain. Microcirculation - blood circulation at the capillary level. Hemoencephalic barrier (HEB) - a protective filter for the brain. Mechanisms of cerebral circulation regulation.Arterial tizim (Miyani qon bilan ta’minlash)

Keyword: Microcirculation Diabetes Neyrogen Miogenik

Venous system (Venous blood flow from the brain)
The cerebral venous blood collection system differs significantly from the arterial system. The veins in the brain do not have a pairing in the traditional arterial system, and they are directed to the heart through the sinuses of the dura mater. Important veins and sinuses The superior sagittal sinus (Sinus sagittalis superior) collects blood from the frontal and parietal regions. The inferior sagittal sinus (Sinus sagittalis inferior) drains blood from the internal structures of the brain and the thalamus. Transverse sinus (Sinus transversus) - blood from the occipital region is directed through this sinus into the internal cervical vein.
Cavernous sinus (Sinus cavernosus) - blood from the pituitary gland and subbrain flows into this sinus. Venous blood eventually returns to the heart via the internal jugular vein (V. jugularis interna).
Microcirculation and capillary network
Capillaries are connecting structures between arteries and veins, which perform the following functions: Delivery of oxygen and nutrients to neurons. Removal of metabolic waste. Increasing the surface area for metabolism. The capillary system

is mainly controlled by pericytes, and their disruption can lead to neurodegenerative diseases.

Autoregulation of cerebral circulation

Self-regulation mechanisms work to keep the brain's blood supply constant:a) Miogenik

If arterial pressure increases, cerebral vessels constrict (vasoconstriction). If arterial pressure decreases, the vessels dilate (vasodilation).

b) Metabolic mechanism

When neurons' oxygen demand increases, blood flow also increases. When more carbon dioxide (CO2) is produced, blood vessels dilate and blood flow increases.c) Neyrogen

The sympathetic and parasympathetic nervous systems regulate blood flow by constricting or dilating blood vessels. Brain circulation is a complex and dynamic process, and for its normal functioning, the arterial and venous systems, microcirculation, BBB, and autoregulation mechanisms must work in coordination. Its disruption can lead to various neurodegenerative diseases and stroke. Therefore, it is very important to maintain the health of the cardiovascular system.

Hemodynamics is the science that studies the physical laws of blood movement in the circulatory system, which is a form of hydrodynamics adapted to the vascular system. Hemodynamics encompasses complex processes related to heart rate, blood pressure, vascular elasticity, and the physicochemical properties of blood.

The main sources of hemodynamics are:

Blood movement is based on the basic laws of hydrodynamics: The relationship between blood pressure and blood flow. Vascular resistance. Blood viscosity and rheology. Vascular elasticity and their dynamics. Pulse wave propagation.

Basic laws of hemodynamics:a) Poiseuille qonuni

Determines the speed of blood flow and resistance in blood vessels.

$Q = \triangle P\pi r^4/8nL$

Here:

Q– volumetric blood flow rate (L/min yoki m^3/s)

P– pressure difference (mmHg yoki Pa)

r– radius of a vessel (m)

n– dynamic blood viscosity (Pa·s)
L– vascular length (m)
Atherosclerosis
The accumulation of fat, cholesterol, and other substances on the inner surface of blood vessels increases the resistance of blood flow. This, according to the laws of hydrodynamics, reduces the flow velocity and hinders the normal movement of blood. As a result, the blood flow begins to move turbulently (irregularly), which leads to the formation of thrombi within the vessel. Blood pressure also increases, leading to oxygen deficiency in brain cells..
Diabetes
When blood sugar (glucose) levels increase, blood viscosity increases. This creates a risk of blood flow slowdown and blockage based on hydrodynamic rules. Blood viscosity increases, making it difficult to flow through capillaries and small blood vessels. The walls of blood vessels weaken and can be easily damaged.

Conclusion

Such various diseases arise as a result of violations of the laws of hemodynamics, which can lead to stroke, one of the dangerous diseases of the brain. We have already mentioned the occurrence of atherosclerosis as a result of a violation of Renold's law. Since the Reynolds number in this disease exceeds 3000, blood moves turbulently (unevenly) within the vessels, which leads to vascular damage. Every stroke can usually be caused by hypertension. As a result of increased blood pressure, blood vessels in the brain can rupture and damage the right and left hemispheres of the brain, which disables the hemispheres. This can lead to paralysis or failure of systems controlled by the hemispheres.

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