**Name: Adoga Deborah**

**18/mhs01/028**

**Level: 200**

**Department: Medicine and Surgery**

**Course name: PHYSIOLOGY**

**Long Term Regulation Of Mean Arterial Pressure**

Blood pressure is a measure of how well our cardiovascular system is functioning. We all require a blood pressure high enough to give our organs the blood and nutrients they need, but not so high our blood vessels become damaged.

As such, our bodies must maintain control over our blood pressure to keep it at a normal level. In this article, we will consider the short term and long term control of blood pressure, as well as some of the problems when control of blood pressure is lost.

**Blood Pressure**

The body’s blood pressure is a measure of the **pressures** within the cardiovascular system during the pumping cycle of the heart. It is influenced by a vast number of variables, and can alter in either direction for various reasons. Everyone’s blood pressure is slightly different and can change throughout the day depending on activity.

There is a range of normal blood pressures that we consider as acceptable. When blood pressure is outside of this normal range of values, people can start to have problems in both the long and short term. Our body tries to maintain a stable blood pressure in the process of **homeostasis**.

Blood pressure is measured using an automated blood pressure monitor, or manually using a stethoscope and sphygmomanometer. It is given as two values (e.g, **120/80 mmHg),** measured in “millimeters of mercury (mmHg)”:

* **Systolic pressure** – the first number (120 mmHg in the example) is the pressure of the blood during the heart contraction.
* **Diastolic** **pressure** – the second number (80 mmHg in the example) is the pressure of the blood after one contraction but before the next contraction.
* Blood pressure can be calculated as:
* Flow  x  Resistance
* Mean arterial blood pressure  = cardiac output  x  total peripheral resistance

## **Long-Term Regulation of Blood Pressure**

There are several physiological mechanisms that regulate blood pressure in the long-term, the first of which is the renin-angiotensin-aldosterone system **(RAAS)**.

### **Renin Renin-Angiotensin-Aldosterone System (RAAS)**

Renin is a peptide hormone released by the granular cells of the **juxtaglomerular apparatus** in the kidney. It is released in response to:

* Sympathetic stimulation
* Reduced sodium-chloride delivery to the distal convoluted tubule
* Decreased blood flow to the kidney

Renin facilitates the conversion of angiotensinogen to angiotensin I which is then converted to angiotensin II using angiotensin-converting enzyme **(ACE)**.

Angiotensin II is a potent vasoconstrictor. It acts directly on the kidney to increase sodium reabsorption in the proximal convoluted tubule. Sodium is reabsorbed via the sodium-hydrogen exchanger. Angiotensin II also promotes release of **aldosterone**.

ACE also breaks down a substance called **bradykinin** which is a potent vasodilator. Therefore, the breakdown of bradykinin potentiates the overall constricting effect.

Aldosterone promotes salt and water retention by acting at the distal convoluted tubule to increase expression of **epithelial** sodium channels. Furthermore, aldosterone increases the activity of the basolateral sodium-potassium ATP-ase, thus **i**ncreasing the electrochemical gradien**t** for movement of sodium ions.

More sodium collects in the kidney tissue and water then follows by osmosis. This results in decreased water excretion and therefore increased blood volume and thus blood pressure.

### Anti-Diuretic Hormone (ADH)

The second mechanism by which blood pressure is regulated is release of Anti Diuretic Hormone (ADH) from the OVLT of the hypothalamus in response to **thirst** or an increased plasma osmolarity.

ADH acts to increase the permeability of the collecting duct to water by inserting **aquaporin channels** (AQP2) into the apical membrane.

It also stimulates sodium reabsorption from the thick ascending limb of the loop of Henle. This increases water reabsorption thus increasing plasma volume and decreasing osmolarity.

Further Control of blood pressure.

Other factors that can affect long-term regulation of blood pressure are natriuretic peptides. These include:

* Atrial natriuretic peptide **(ANP)** is synthesised and stored in cardiac myocytes. It is released when the atria are stretched, indicating of high blood pressure.
* ANP acts to promote sodium excretion. It dilates the **afferent arteriole** of the glomerulus, increasing blood flow (GFR). Moreover, ANP inhibits sodium reabsorption along the nephron. Conversely, ANP secretion is low when blood pressure is low.
* **Prostaglandins** act as local vasodilators to increase GFR and reduce sodium reabsorption. They also act to prevent excessive vasoconstriction triggered by the sympathetic nervous and renin-angiotensin-aldosterone systems.

2a)

**Splanchnic Circulati**on: The term ‘splanchnic circulation’ describes the blood flow to the abdominal gastrointestinal organs including the stomach, liver, spleen, pancreas, small intestine, and large intestine. It comprises three major branches of the abdominal aorta; the coeliac artery; superior mesenteric artery (SMA); and inferior mesenteric artery.

**Pulmonary Circulation:** Pulmonary circulation is the system of transportation that shunts de-oxygenated blood from the heart to the lungs to be re-saturated with oxygen before being dispersed into systemic circulation. Deoxygenated blood from the lower half of the body enters the heart from the inferior vena cava while deoxygenated blood from the upper body is delivered to the heart via the superior vena cava. Both the superior vena cava and inferior vena cava empty blood into the right atrium. Blood flows through the tricuspid valve into the right ventricle. It then flows through the pulmonic valve into the pulmonary artery before being delivered to the lungs. While in the lungs, blood diverges into the numerous pulmonary capillaries where it releases carbon dioxide and is replenished with oxygen. Once fully saturated with oxygen, the blood is transported via the pulmonary vein into the left atrium which pumps blood through the mitral valve and into the left ventricle. With a powerful contraction, the left ventricle expels oxygen-rich blood through the aortic valve and into the aorta: This is the beginning of systemic circulation

**Circle of Willis:** The **circle of Willis** is a ring of interconnecting arteries located at the base of the brain around the optic chiasm or chiasma (partial crossing of the optic nerve – CNII; this crossing is important for binocular vision), infundibulum of the pituitary stalk and the hypothalamus

This arterial ring provides blood to the brain and neighbouring structures. Polygonal anastomotic shape offers the possibility of alternate pathways for the blood flow, which is essential for the brain functioning, since it is the structure that is mostly sensitive to hypoxia. Hypoxia of the brain tissue that lasts longer than 6 minutes results with the irreversible changes in the brain parenchyma, and depending on the location of the lesion, the functional damages vary widely.

**Coronary Circulation:** Part of the systemic circulatory system that supplies blood to and provides drainage from the tissues of the heart. In the human heart, two coronary arteries arise from the aorta just beyond the semilunar valves; during diastole, the increased aortic pressure above the valves forces blood into the coronary arteries and thence into the musculature of the heart. Deoxygenated blood is returned to the chambers of the heart via coronary veins; most of these converge to form the coronary venous sinus, which drains into the right atrium**.**

**Cutaneous Circulation:** The cutaneous circulation is the circulation and blood supply of the skin. The skin is not a very metabolically active tissue and has relatively small energy requirements, so its blood supply is different to that of other tissues.

Some of the circulating blood volume in the skin will flow through will flow through **arteriovenous anastomoses (AVAs)** instead of capillaries. AVAs serve a role in temperature regulation. In this article we shall consider the different adaptations of the cutaneous circulation, and its role in body temperature control.

## Arteriovenous Anastomoses

AVAs are low-resistance connections between the small arteries and small veins that supply and drain the skin. These allow the shunt of blood directly into the **venous plexus** of the skin, without it passing through capillaries. Since AVAs contain no capillary section, they are not involved in transport of nutrients to/from the tissues, but instead play a major role in temperature regulation.

## Temperature Regulation

The skin is the body’s main heat dissipating surface: the amount of blood flow to the skin determines the degree of heat loss and therefore the core body temperature. The blood flow through AVAs is heavily influenced by the **sympathetic nervous system.**  At rest, the sympathetic nervous system dominates and acts to constrict AVAs.

Any changes in core temperature are detected by the thermoregulatory centre in the **hypothalamus**. It regulates temperature by altering the level of sympathetic outflow to the cutaneous vessels, to return temperature to its normal range:

In high core temperatures:

* Sympathetic innervation is decreased, reducing the vasomotor tone in the AVAs.
* More blood flows through the AVAs and reaches the venous plexus (close to the surface of the skin), increasing heat loss to reduce core temperature.

In low core temperatures:

* Sympathetic innervation is increased, increasing the vasomotor tone in the AVAs.
* Less blood flows to the apical skin (of nose, lips, ears, hands and feet), reducing heat loss to increase the core temperature

**Cardiovascular adjustments during exercising**