PHYSIOLOGY

Q13 – Blood Pressure & Short-Term Regulation
Ans : 13 – Answer

Introduction

Blood pressure is a vital physiological parameter that represents the force exerted by circulating blood on the walls of arteries. It is essential for maintaining adequate perfusion of all tissues and organs of the body, particularly the brain, heart, and kidneys. Regulation of blood pressure ensures continuity of circulation during rest, posture change, exercise, emotional stress, and pathological conditions. Even minor fluctuations in blood pressure can lead to dizziness, syncope, or organ damage, highlighting the importance of precise regulatory mechanisms.

Definition

Blood pressure is defined as the lateral pressure exerted by blood on the arterial walls during circulation and is expressed in millimeters of mercury (mm Hg).

Physiological Basis of Blood Pressure

Arterial blood pressure is the product of cardiac output and total peripheral resistance. Cardiac output depends on heart rate and stroke volume, whereas peripheral resistance is mainly determined by the tone of arterioles. The elastic nature of arteries helps in maintaining continuous blood flow and smoothening pulsatile output of the heart.

Normal Blood Pressure

In a healthy adult at rest, normal blood pressure is approximately 120/80 mm Hg. Systolic pressure represents ventricular systole and reflects the force of cardiac contraction, whereas diastolic pressure represents ventricular diastole and depends on peripheral resistance and arterial recoil.

Types of Blood Pressure

Systolic blood pressure is the maximum arterial pressure during ventricular contraction. Diastolic blood pressure is the minimum pressure during ventricular relaxation. Pulse pressure is the difference between systolic and diastolic pressures and reflects stroke volume and arterial compliance. Mean arterial pressure represents the average effective pressure driving blood to tissues.

Determinants of Blood Pressure

Blood pressure is influenced by cardiac output, peripheral resistance, blood volume, viscosity of blood, and elasticity of arterial walls. Any change in these factors results in alteration of arterial blood pressure.

Short-Term Regulation of Blood Pressure

Short-term regulation of blood pressure operates within seconds to minutes and plays a crucial role in rapid cardiovascular adjustments. These mechanisms are primarily neural and are essential during sudden posture changes, exercise, and acute blood loss.

Baroreceptor Reflex

Baroreceptors located in the carotid sinus and aortic arch act as stretch receptors that sense changes in arterial pressure. Increased blood pressure increases baroreceptor firing, leading to inhibition of sympathetic activity and stimulation of parasympathetic activity. This causes decreased heart rate, reduced contractility, vasodilation, and fall in blood pressure. Reduced blood pressure produces opposite effects.

Chemoreceptor Reflex

Chemoreceptors in carotid and aortic bodies respond to hypoxia, hypercapnia, and acidosis. Their stimulation activates the vasomotor center, increasing sympathetic discharge and raising blood pressure to improve oxygen delivery.

CNS Ischemic Response

During severe hypotension, cerebral ischemia stimulates the vasomotor center, producing a powerful sympathetic response and intense vasoconstriction. This mechanism acts as a last-resort defense to maintain cerebral perfusion.

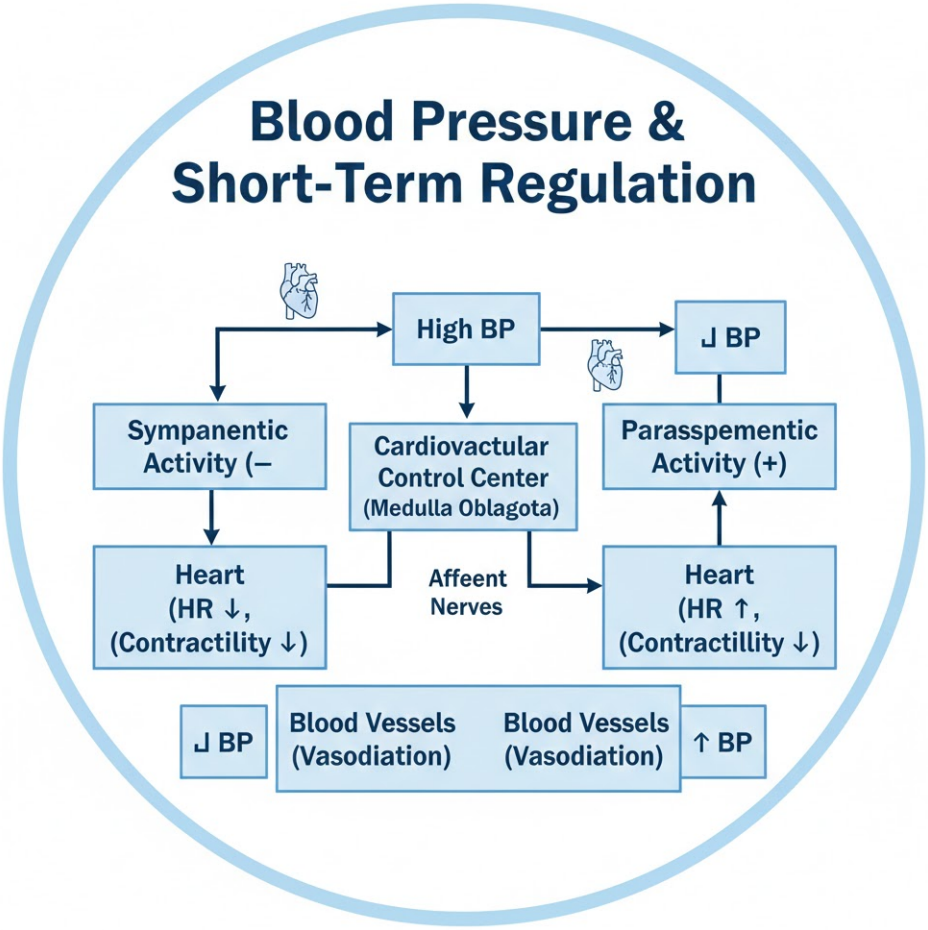
Bainbridge Reflex

Stretch receptors in the atria are stimulated by increased venous return, leading to increased heart rate. This reflex contributes modestly to short-term blood pressure control.

Clinical Importance

Failure of short-term regulatory mechanisms leads to postural hypotension, shock, and autonomic dysfunction. Knowledge of these mechanisms is essential for clinical management of cardiovascular disorders.

Diagram – Blood Pressure & Short-Term Regulation



Conclusion

Blood pressure regulation is essential for survival. Short-term neural mechanisms such as baroreceptor and chemoreceptor reflexes ensure rapid stabilization of arterial pressure and protection of vital organs under varying physiological conditions.