IJHSR International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Review Article

Blood Pressure Measurement and Its Regulation

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Received: 22/08//2014 *Revised: 09/09/2014* *Accepted: 12/09/2014*

ABSTRACT

There are three methods of measurement and recording of blood pressure viz. Oscillatory, Palpatory and Auscultatory. In the normal individual the constancy of the internal environment is being a adjusted by the well-organised controlling system. Adjustment of blood pressure, according to the needs of the body, may be carried out by the several complex reflexes whose centres are lying in the cerebral cortex, formation reticularis, hypothalamus, medullary and spinal vasomotor centres. The (A) efferent and (B) afferent pathways constituting the above reflexes are lying within the sympathetic and parasympathetic nervous systems whose activities are modified by the hypothalamus and other centres.

Key words: blood pressure, blood pressure measurement, blood pressure regulation

INTRODUCTION

There are three methods of measurement and recording of blood pressure viz. Oscillatory, Palpatory and Auscultatory. [1]

Oscillatory method: Inspection of oscillation in spring gauge or mercury manometer is the basis of this method. In this method a pressure cuff is wrapped over the brachial artery and the oscillations that are produced by the pulsations, are observed. The instrument is always kept at the heart level. When the cuff pressure is increased and raised above the systolic pressure, the oscillations disappear, but on releasing the pressure gradually, the oscillations become larger and prominent. The pressure head, at which the larger oscillations are seen, is considered as systolic pressure. But on further release of pressure, the oscillations become smaller and disappeared. The pressure, at which the oscillation just becomes smaller or disappears, is known as diastolic pressure. [1]

Palpatory method: The instrument is kept at the level of the heart and the cuff is tied round the upper arm. Pressure is raised to 200 mm of Hg and then gradually released. When the pulse just appears at the wrist the pressure is noted. This is the systolic pressure. This method is not accurate. By this method the diastolic pressure cannot be determined. [1]

Auscultatory method: The instrument is kept at the level of the heart and the cuff is tied round the upper arm. Pressure is raised to 200 mm of Hg and then gradually released. When the first Korotkoff sound appears the pressure is noted it denotes the systolic pressure the pressure in the cuff is further decreased till the Korotkoff sound disappears, the point of disappearance is noted, it denotes the diastolic blood pressure. [1]

Regulation of blood pressure

In the normal individual the constancy of the internal environment is being a adjusted by the well-organised controlling system-which is called Milieu interieur after Claude Bernard and Homoeostasis after Cannon Adjustment of blood pressure, according to the needs of the body, may be carried out by the several complex reflexes whose centres are lying in the cerebral cortex, formation reticularis, hypothalamus, medullary and spinal vasomotor centres. [2] The (A) efferent and (B) afferent pathways constituting the above reflexes are lying within the sympathetic and parasympathetic nervous systems whose activities are modified by the hypothalamus and other centres. [3]

A. Efferent pathways for maintenance of blood pressure: are the vagi and the sympathetic nerves which control the blood pressure by (a) modifying the cardiac active (b) altering the cardiac output and (c) altering the lumen of the blood vessels. [5] The relative activities of the vagi and the sympathetic of the efferent pathways are under the control of vasomotor systems, which are described below:

Vasomotor system: This system consists of (1) vasomotor centre, (2) vasoconstrictor nerves, (3)vasodilator nerves.

Vasomotor centre: Vasomotor centre is situated on the floor of the fourth from lower part of the pons to the obex and forms a diffuse network of neurones. After section of the brain stem at the level of the calamus scriptorius there is fall of the blood pressure.There are practically two areas in reticular formation of the medulla.

(a) Pressor centre- which causes rise of blood pressure.

(b) Depressor centre- which causes fall of blood pressure.

The depressor centre is not the vasodilator centre. This centre causes inhibition of the vasoconstrictor tone. The depressor centre relays the inhibitory impulses to the pressor centre. Pressor and depressor centres form one functional unit and it is defined as the vasomotor centre. The vasomotor centre discharges impulses which pass down the lateral white column of the spinal cord in the cervical, thoracic and lumbar segments of spinal cord and form synaptic connections with the lateral horn cells of the spinal cord. [5]

Vasomotor reflexes : (1) Depressor reflex. (2) Pressor reflex.

Depressor reflex Blood pressure falls due to diffuse dilatation of the arterioles. Rise of blood pressure stimulates the baroreceptors of the carotid sinuses and aortic arch, and causes slowing of the heart and arteriolar dilatation. The vasodilatation is due to inhibition of vasoconstrictor effect of the sympathetic. [4]

Pressor reflex: Blood pressure rises due to diffuse constriction of the arterioles. Diminution of blood pressure fails to stimulate the barireceptors of the carotid sinuses and aortic arch, and the parasympathetic inhibitory tone over the heart and blood vessels is withdrawn. Blood pressure is raised reflexly through overactivity of the sympathetic. Vasoconstriction of the arterioles is due to activity of the vasoconstrictor centre. Reflex vasoconstriction also occur due to stmulation of chemoreceptors during the fall of blood pressure. [4]

Control of Vasomotor centre: Vasomotor centre is under the superior control of cerebral cortex and hypothalamus. Factors influencing V.M.C. have been described as follows:

1. Higher centre. Emotion generally stimulates, causing vasoconstriction .But shock may depress the centre –leading to a sudden fall of blood pressure and fainting.(Vasovagal attacks) [1]

2. Respiration. During inspiration systemic blood pressure is generally decreased but increased during expiration. This is due to the decrease of left ventricular cardiac output expiration. There is no evidence of direct respiratory centre– effect on vasomotor centre. [1]

3. CO_2 excess. Excess stimulates. The action is mainly on the centre but partly reflexly through the sino –aortic nerves. [1]

4. O_2 lack. Generally stimulates vasomotor centre. The effect is mainly reflex through the sino –aortic nerve and slightly direct on the centre. [1]

5. Sino-aortic nerves. Variation of blood pressure,CO2 tension, O2tension ,etc reflexly regulate the activity of the vasomotor centre through the sino – aortic nerves .Normally, stream of inhibitory impulses is carried up by these nerves depressing the vasomotor centre. When blood pressure rises, vasomotor centre is depressed , vasodilation occurs and further rise of blood pressure is checked .When blood pressure falls, the centre is released causing vasoconstriction and raising blood pressure. [1]

6. Other afferents. Local vasomotor tone is altered by afferent nerves originating from different baroreceptor and chemoreceptor areas, distributed all throughout the body. The baroreceptor are located in the right atrium, in the left atrium and left ventricle, in the pulmonary arch of aorto, in the junction of the superior thyroid artery and common carotid artery. The chemoreceptors are located in the ventricular cavity and all throughout the blood vessel. [2]

7. Vasoconstrictor nerves. The fibres pass along the sympathetic outflow of the first thoracic to the second lumber segments. The brief details are as follows:

1. To the skin and muscles – pass out through the grey rami communicants –to mixed spinal nerves – and finally distributed through ordinary and motor and sensory nerves. [1]

2. To the head and neck- Come from the first to the fourth thoracic segment-enter the superior cervical ganglion from which postganglionic fibres arise and pass along the carotid artery and its branches. [1]

3. To the fore limbs- arise from the fourth to tenth thoracic segments –enter the stellate ganglion from which the postganglionic fibres arise and pass along the spinal nerves and supply the blood vessel. [1]

4. To the hind limbs- arise from the eleventh thoracic to the second lumbar segments-relay in the lower lumbar and upper sacral ganglia, the postganglionic fibres accompany the nerves of the sacral plexus. [1]

5. To the abdominal viscera- from the lower thoracic and upper two lumbar segments-pass through the splanchnic nerves to celiac ganglion-the postganglionic fibres pass along the blood vessels[1].

6. To the thoracic viscera- Heart receives constrictor fibres through the vagus; lungs from the sympathetic. [1]

Vasodilator nerves: There are three types of vasodilator nerves:

1. Parasympathetic, 2. Sympathetic, 3. Antidromic fibres of the posterior spinal root.

1. Parasympathetic vasodilators:

(a) Cranial: (i) Chorda tympani-to the submaxillary or submandibular gland. (ii) Lesser superficial petrosal-to the parotid gland. (iii) Lingual-to the vessels of tongue. [1]

(b) Sacral: Nervi erigentes-to the vessels of genitalia. [1]

2. Sympathetic vasodilators: sympathetic fibres are mostly vasoconstrictor in nature. But some vasodilators are also present. For instance, (a) the dilator fibres of the coronary vessels come through the sympathetic. (b) sympathetic dilator fibres have been demonstrated in the peripheral nerves in human beings. (c) Stimulation of the last anterior thoracic root produces dilatation of the kidney vessels. (d) stimulation of the right splanchnic nerve some-times causes vasodilatation and fall of blood pressure. [2]

3. Antidromic vasodilators: in the posterior spinal root. When posterior spinal root is cut, distal to the ganglion and the peripheral end is stimulated- although the nerve is afferent, yet the vessels in the periphery- both skin and muscles-dilate (axon reflex). In the skin, it is due to liberation of histamine and as such produces the typical triple response: dilatation, flare and wheal. In the muscle it liberates acetylcholine and thereby causes vasodilatation. [2]

B. Afferent pathways: are lying in two sets of receptors that carry the information of the instantaneous circulatory status to e centre. These sensory receptors are (i) Chemoreceptors and (ii) baroreceptors distributed all throughout the cardiovascular system. The relative roles of the different afferent pathways have been described under separate headings, viz., (1) sino-aortic mechanisms controlling systemic blood pressure and flow, and (2) vascular receptors other than sino-aortic-controlling mostly the local blood pressure and flow. [2]

CONCLUSION

The blood pressure though appears to be a simple entity is controlled by various complex regulating mechanisms, which help in maintaining the proper perfusion of the vital organs for maintenance of their functions.

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How to cite this article: Sant SK, Hyder ANG. Blood pressure measurement and its regulation. Int J Health Sci Res. 2014;4(10):307-310.

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