BLOOD PRESSURE &ITS REGULATION

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: OBJECTIVES :

1. DEFINITION
2. MEASUREMENT OF BLOOD PRESSURE
3. FACTORS CONTRIBUTING TO B.P
4. PERIPHERAL RESISTANCE
5. REGULATION OF BP
6. IMMEDIATE REGULATION
7. SHORT TERM REGULATION
8. LONG TERM REGULATION
9. APPLIED ASPECT OF HYPERTENSION AND HYPOTENSION
10. PHYSIOLOGY OF TREATMENT

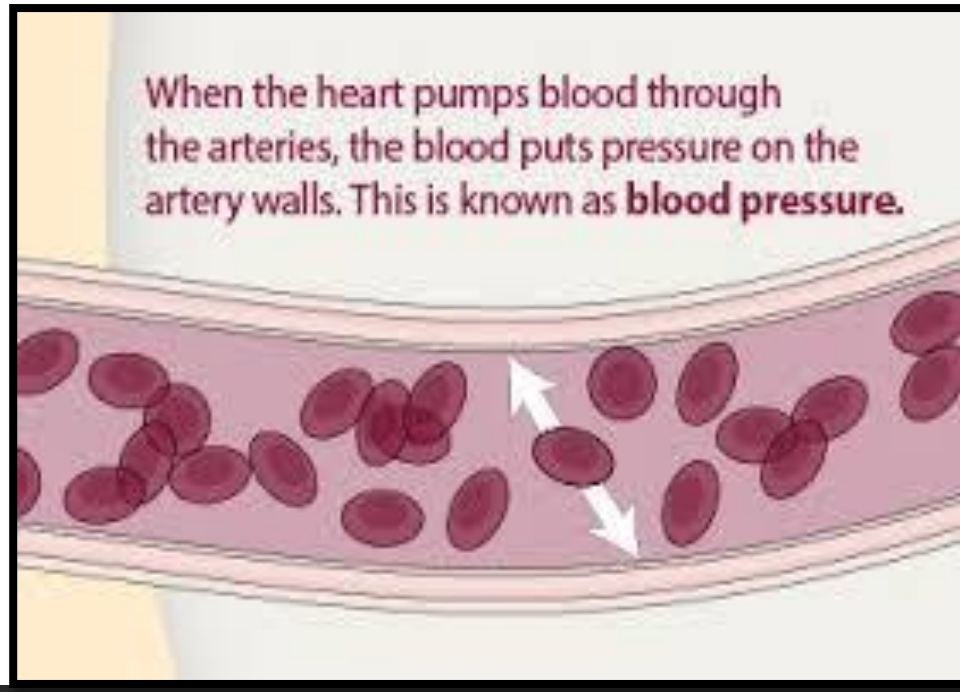
ARTERIAL BLOOD PRESSURE :

DEFINITION :

" Arterial blood pressure can be defined as the lateral pressure exerted by the moving column of blood against the walls of the arteries.

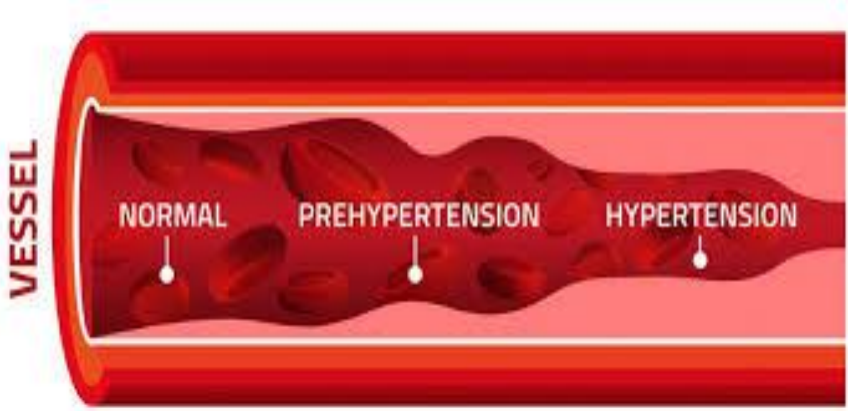
Arterial blood pressure is expressed in four different terms:

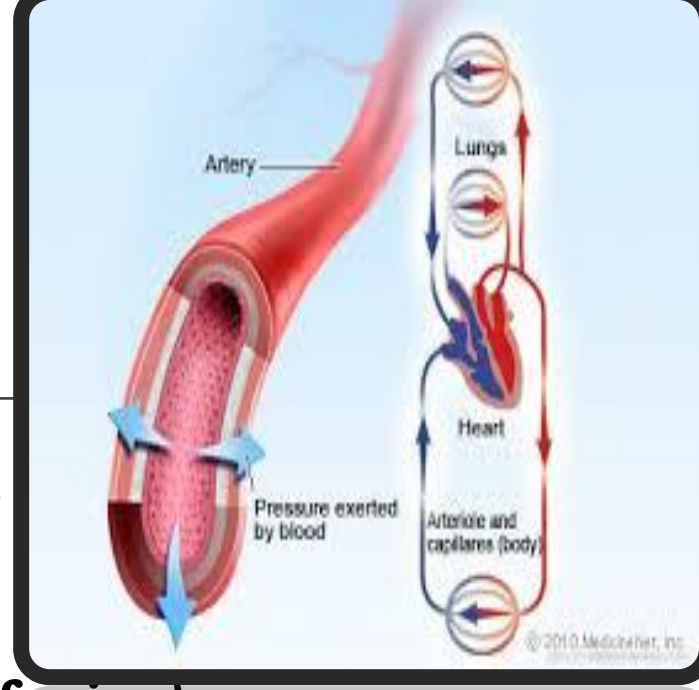
- ***1. Systolic blood pressure***
- ***2. Diastolic blood pressure***
- ***3. Pulse pressure***
- ***4. Mean arterial blood pressure.***



Significance of blood pressure :

- *It ensures the blood flow to various organs*
- *Plays an important role in exchange of nutrients and gases across the capillaries*
- *Blood pressure plays an important role in the formation of urine*
- *Essential in the formation of lymph.*
- *Systemic arterial blood pressure*
  *= cardiac output * total peripheral resistance*





- ***Intra-ventricular BP -for ejection of blood (stroke volume).***
- ***Systemic arterial BP -for blood flow to tissues (tissue perfusion)***
- ***Capillary hydrostatic BP -for filtration (tissue fluid formation).***
- ***Systemic venous BP is important for blood flow back from the organs to the heart (venous return)***

SYSTOLIC BLOOD PRESSURE

DEFINITION :

- ***systolic blood pressure or SBP is defined as the maximum pressure exerted in the arteries during the systole of the heart.***

The normal systolic pressure : 120 mmHg (110 mmHg to 140 mmHg)

DIASTOLIC BLOOD PRESSURE :

DEFINITION :

- ***Diastolic blood pressure or DBP is defined as the minimum pressure exerted in the arteries during the diastole of the heart.***

- ***Normal diastolic pressure : 80 mmHg (60mmHg to 80mmHg)***

PULSE PRESSURE (P.P)

- ***" Pulse pressure is defined as the difference between the systolic and the diastolic pressure "***

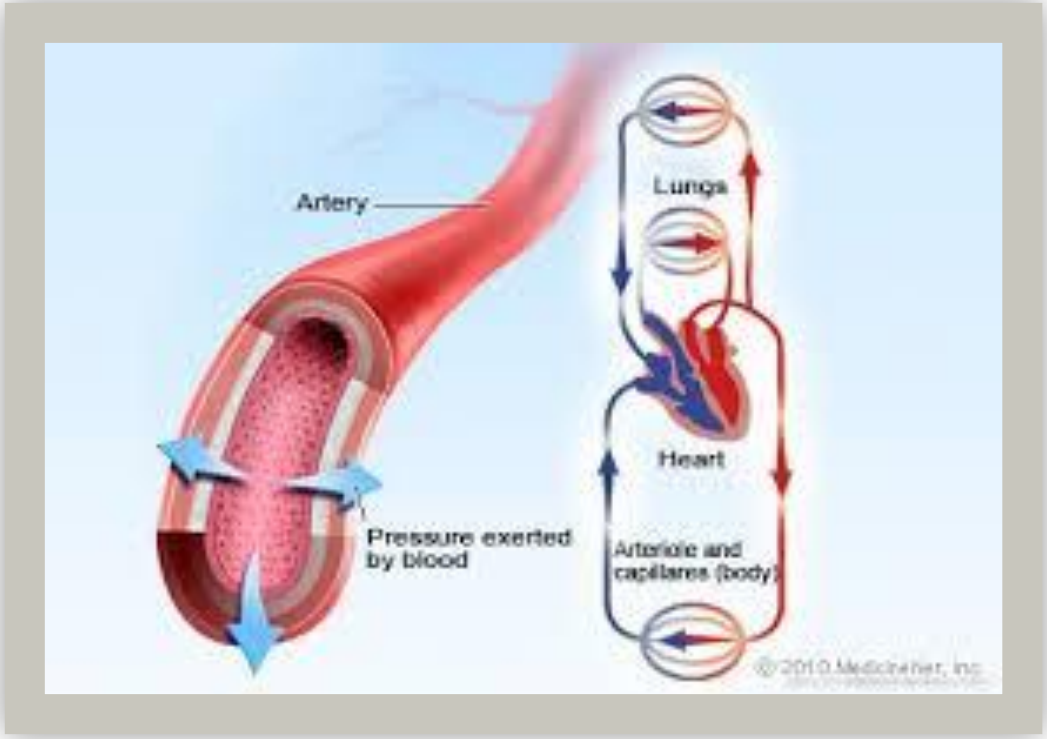
The normal pulse pressure is usually about 40 mmHg(120-80=40 mmHg)

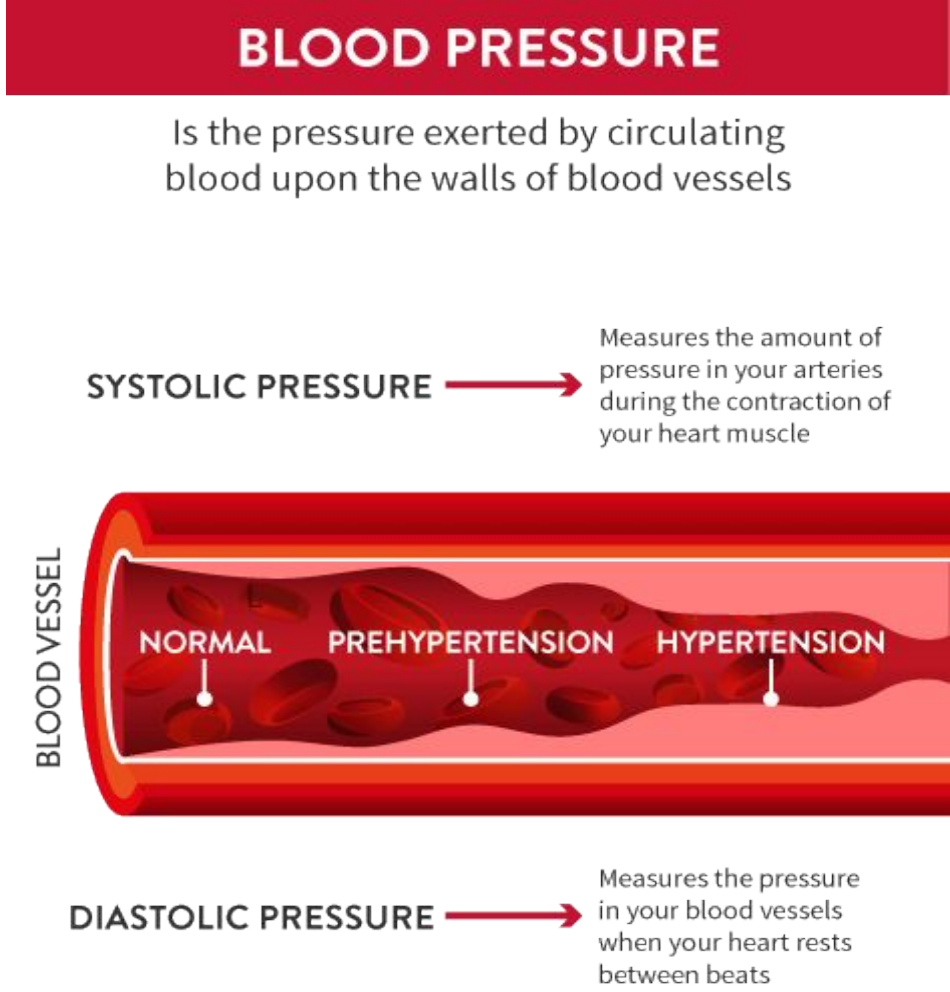
MEAN ARTERIAL PRESSURE :

- ***Mean arterial pressure is the average pressure existing in the arteries.***
- ***It is no the arithmetic mean of systolic and diastolic pressures.***
- ***It is the diastolic pressure plus 1/3rd of pulse pressure.***
- ***Normal mean arterial pressure : 93mmHg (80+13=93mmHg)***
- ***Formula to calculate the mean arterial pressure is***

MAP= DIASTOLIC PRESSURE =1/3RD OF PULSE PRESSURE

= 80+40 / 3 = 93.3 mmHg





VARIATIONS IN BLOOD PRESSURE :

Physiologic variations in blood pressure:

1. **AGE :**

BLOOD PRESURE CHART BY AGE			
Age	Min	Normal	Max
1 to 12 months	75/50	90/60	110/75
1 to 5 years	80/55	95/65	110/79
6 to 13 years	90/60	105/70	115/80
14 to 19 years	105/73	117/77	120/81
20 to 24 years	108/75	120/79	132/83
25 to 29 years	109/76	121/80	133/84
30 to 34 years	110/77	122/81	134/85
35 to 39 years	111/78	123/82	135/86
40 to 44 years	112/79	125/83	137/87
45 to 49 years	115/80	127/84	138/88
50 to 54 years	116/81	129/85	142/89
55 to 59 years	118/82	131/86	144/90
60 to 64 years	121/83	134/87	147/91

A. ***SEX :***

- In females , upto the period of menopause ,arterial pressure is 5mmHg less than the males . Post menopause the BP becomes same as that of the men.

B) *CIRCADIAN VARIATON (DIURAL VARIATION) :*

- In the early morning the bp is the slightly low and it gradually increases and reaches the maximum by noon.

C) *EFFECT OF GRAVITY :*

- When erect BP in any vessel varies in relation to the vertical distance from the heart level.

Increased transient during physical stress, mental stress, emotion excitement.

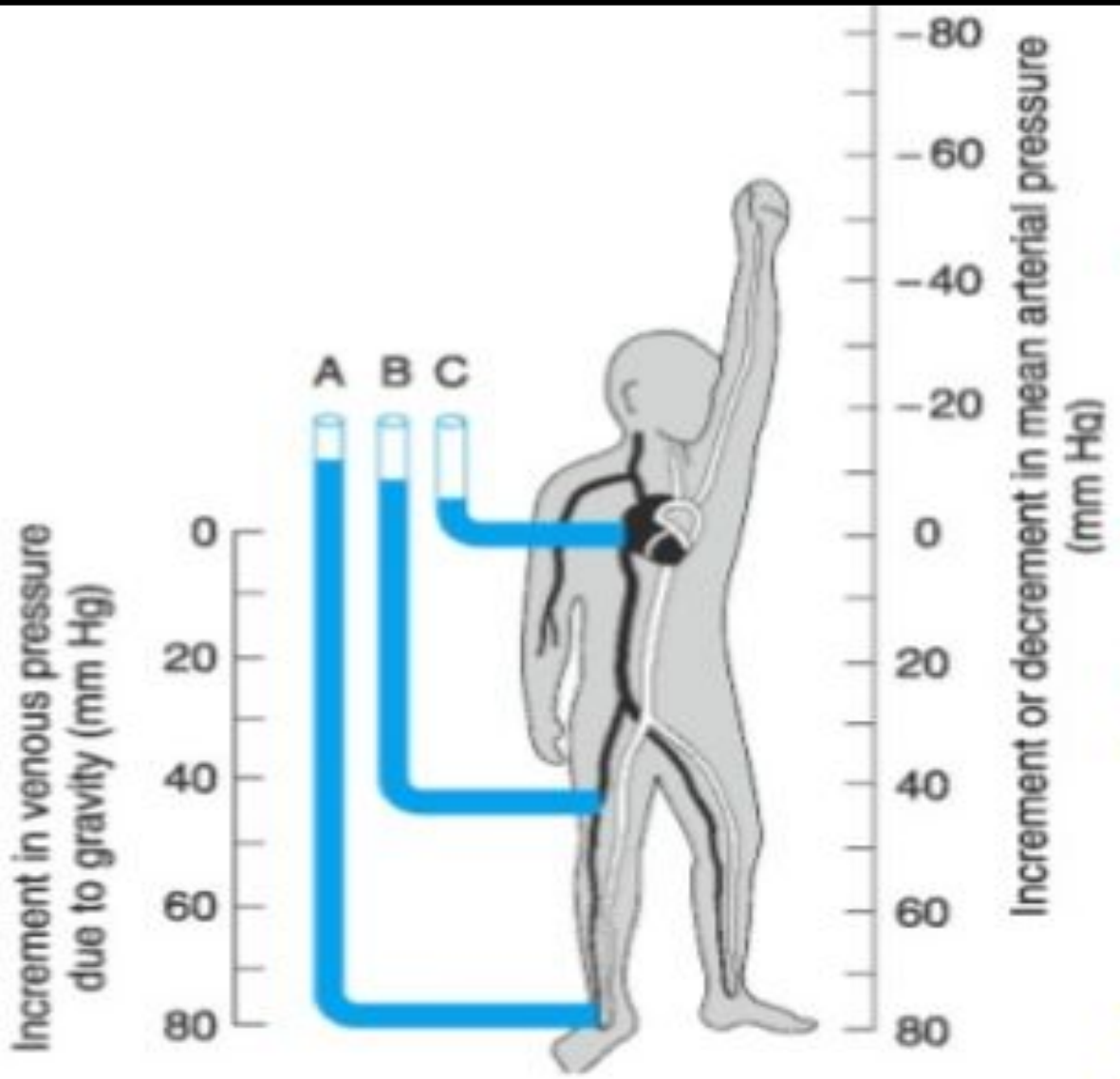
D) Body built : BP is more in an obese person

E) after meals : the BP is increased for a few hours after meals.

F) During sleep : the BP is reduced upto 15 to 20mmHg during sleep.

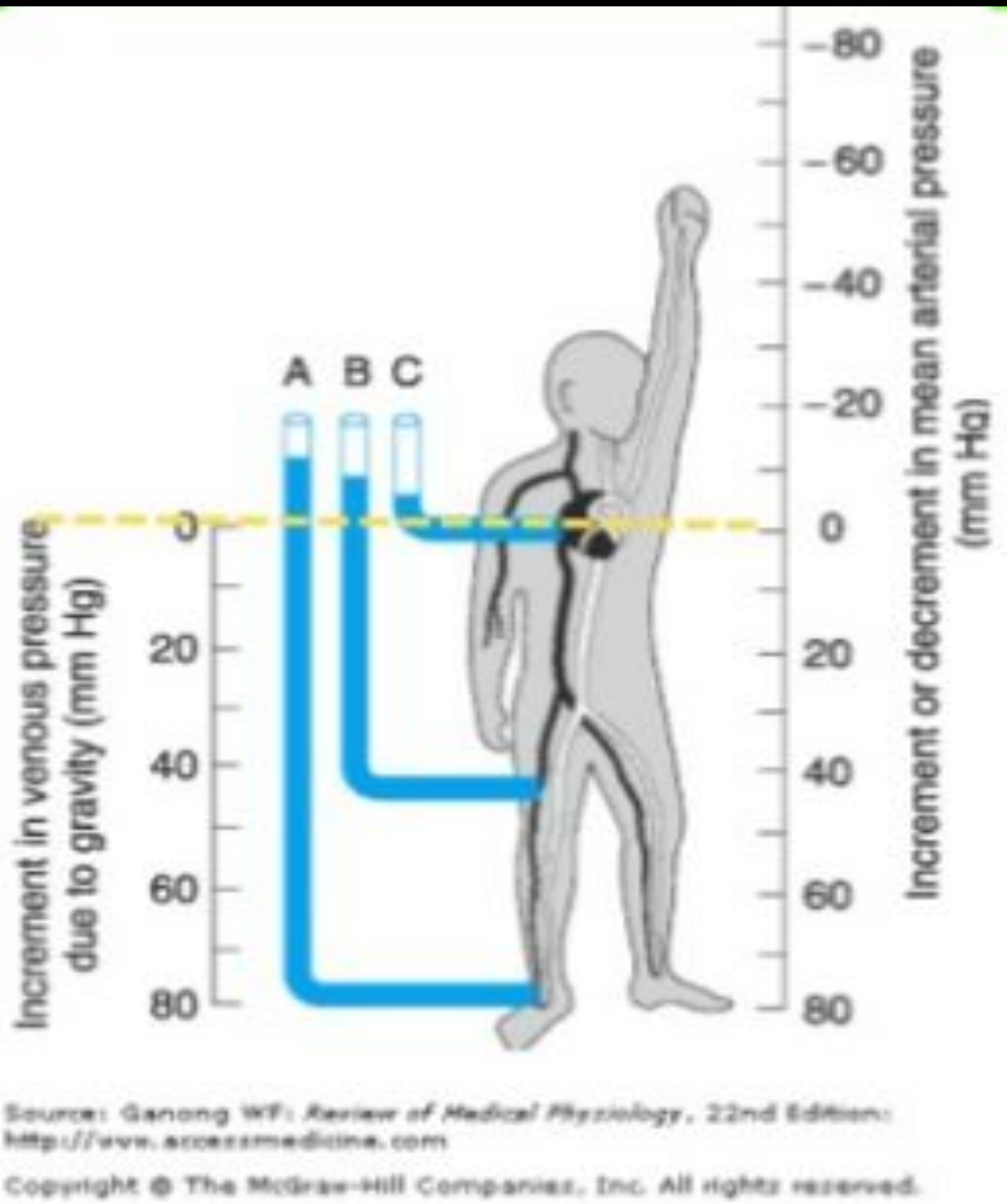
G) Emotional conditions and exercises : increased BP.

Effect of Gravity



- Pressure in large artery in the foot 105 cm below the heart = [0.77 mmHg/cm x 105 cm = 80 mm Hg)] +
- 100 mm Hg (Mean ABP at heart level)
- = 180 mm Hg
- Pressure in vein in the foot 105 cm below the heart = [0.77 mmHg/cm x 105 cm = 80 mm Hg)] +
- 4 mm Hg (right atrial pressure)
- = 84 mm Hg

Source: Ganong WF: *Review of Medical Physiology*, 22nd Edition: http://www.accessmedicine.com



Source: Ganong WF: *Review of Medical Physiology*, 22nd Edition: http://www.accessmedicine.com

- Gravity
  - In an upright position, BP in the arteries below the heart level is increased, and that in the arteries above the heart level is decreased by 0.77 mm Hg for each cm of vertical distance below or above the heart.
  - Thus, routine measurement of BP should be performed with the artery at the heart level.

TABLE 103.1: Local factors determining arterial blood pressure

Arterial blood pressure	Factors
Arterial blood pressure is directly proportional to	1. Cardiac output 2. Heart rate 3. Peripheral resistance 4. Blood volume 5. Venous return 6. Velocity of blood flow 7. Viscosity of blood
Arterial blood pressure is inversely proportional to	1. Elasticity of blood vessel 2. Diameter of blood vessel

BLOOD PRESSURE REGULATION :

- ***SHORT TERM REGULATION / NERVOUS MECHANISM (seconds to minutes)***

  - **BARORECEPTOR MECHANISM / SINOAORTIC MECH**
  - **CHEMORECEPTOR MECHANISM**
  - **VASOMOTOR CENTER MECHANISM / CNS ISCHEMIC RESPONSE**

- ***INTERMEDIATE TERM REGULATION (minutes to hours)***

  - **STRESS RELAXATION**
  - **CAPILLARY FLUID SHIFT MECHANISM**
  - **RENIN ANGIOTENSIN MECHANISM**

LONG TERM REGULATION (days to years)

- **RENIN-ANGIOTENSIN-ALDOSTERONE MECHANISM**
- **RENAL BODY FLUID MECHANISM**

HORMONAL MECHANISM

LOCAL MECHANISM

- REGULATION OF BLOOD PRESSURE
  - **NERVOUS MECHANISM**
  - **BY VASOMOTOR CENTER AND IMPULSES FROM THE PERIPHERY**

  - **RENAL MECHANISM**
  - **BY REGULATION OF ECF VOLUME AND RENIN-ANGIOTENSIN MECHANISM**

  - **HORMONAL MECHANISM**
  - **BY THE HORMONES CAUSING VASOCONSTRICTION AND DILATION**

  - **LOCAL MECHANISM**
  - **BY LOCAL VASOCONSTRICTORS AND VASODILATORS**

- **MEDICAL PHYSIOLOGY**
- **BY SEMBULINGAM**

NERVOUS SYSTEM MECHANISM :

- **The nervous regulation is rapid among all the mechanisms involved in the regulation of arterial blood pressure**
- **when the blood pressure is altered the nervous system brings the pressure back to normal within few minutes.**
- **although the nervous system is quick in action, it operates only for a short period and then it adapts to the new pressure. Hence the term short term regulation.**
- **This mechanism operates through the vasomotor system.**

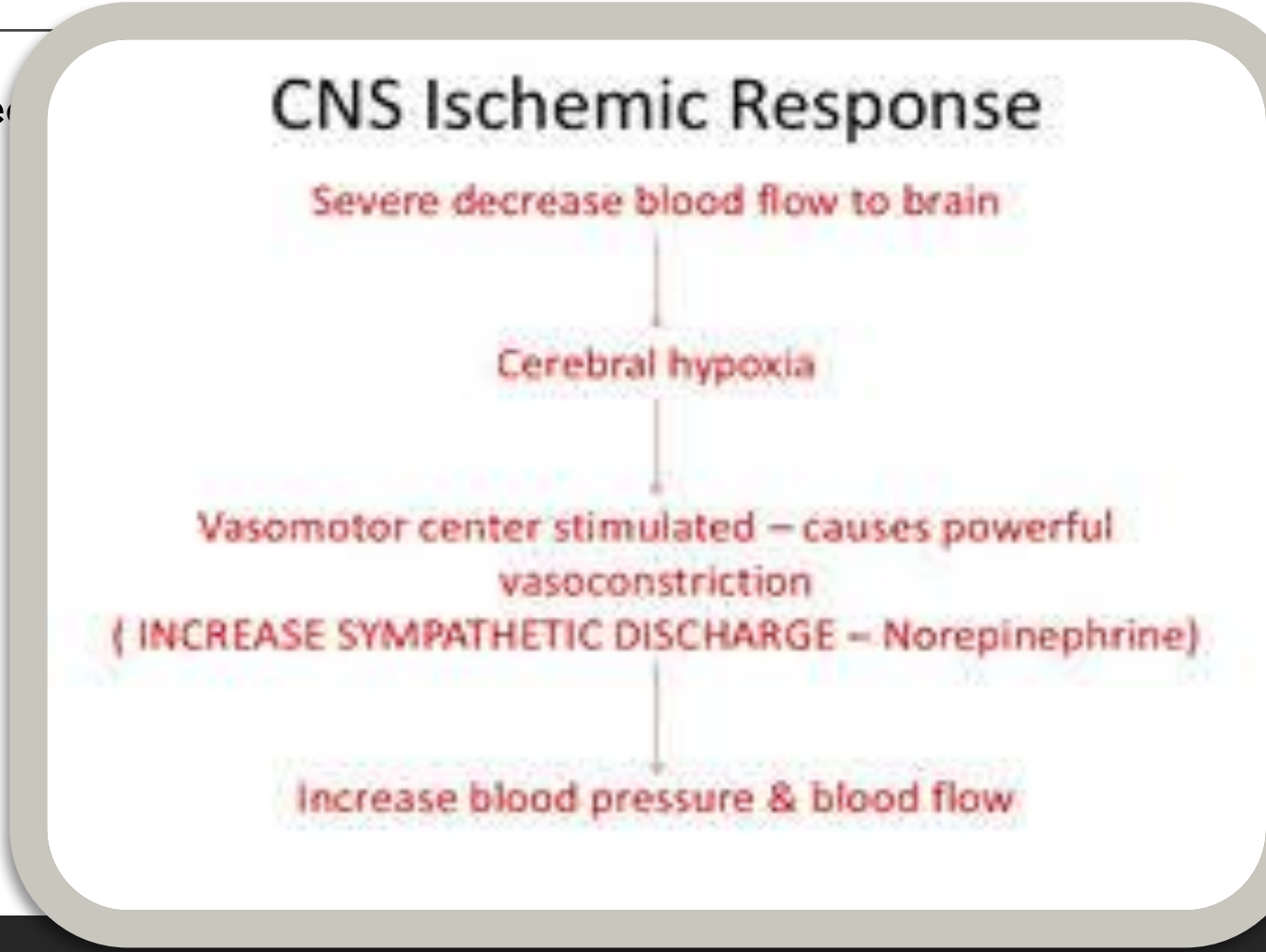
VASOMOTOR CENTER MECHANISM :

- **Reduced blood flow to VMC causes its ischemia.**
- **which causes stimulation VMC causing increase in heart rate and peripheral resistance.**
- **Net effect, causes increase or rise in blood pressure.**

VASOMOTOR SYSTEM :

The vasomotor system includes thre components :

1. **Vasomotor center**
2. **Vasoconstrictor fibers**
3. **Vasodilator fibers**



VASOMOTOR CENTER :

The vasomotor center is bilaterally situated in the reticular formation of medulla oblongata and the lower part of the pons

This consists of three areas :

A. **Vasoconstrictor area**

B. **Vasodilator area**

C. **Sensory area**

BARORECEPTORS :

- Baroreceptors are the receptors , which give response to change in blood pressure. Baroreceptors are also called presso-receptors.
- Baroreceptors are situated in the carotid sinus and the wall of the aorta.
- Baroreceptor mechanism is as follows :

❑Role of baroreceptors when blood pressure increases

Rise in B.P → activation of baroreceptors → impulses to nucleus of tractus solitarius → nucleus of tractus solitarius acts on vasomotor center → inhibition of vasoconstrictor area excites vasodilator area → Reduces vasomotor tone → Redution in peripheral resistance & Vasodilatation occur (force of contraction & Cardiac output decrease) → **Blood-pressure decreases**

❑Role of baro-receptors when blood pressure decreases

When blood pressure falls below normal

↓Carotid sinus and aortic arch receptor potential

↓Rate of firing in afferent nerves

Cardiovascular center

↑Sympathetic cardiac nerve activity

and

↑sympathetic vasoconstrictor nerve activity

and

↓parasympathetic nerve activity

↑Heart rate

and

↑stroke volume

and

arteriolar and venous vasoconstriction

↑Cardiac output

and

↑total peripheral resistance

Blood pressure increased toward normal

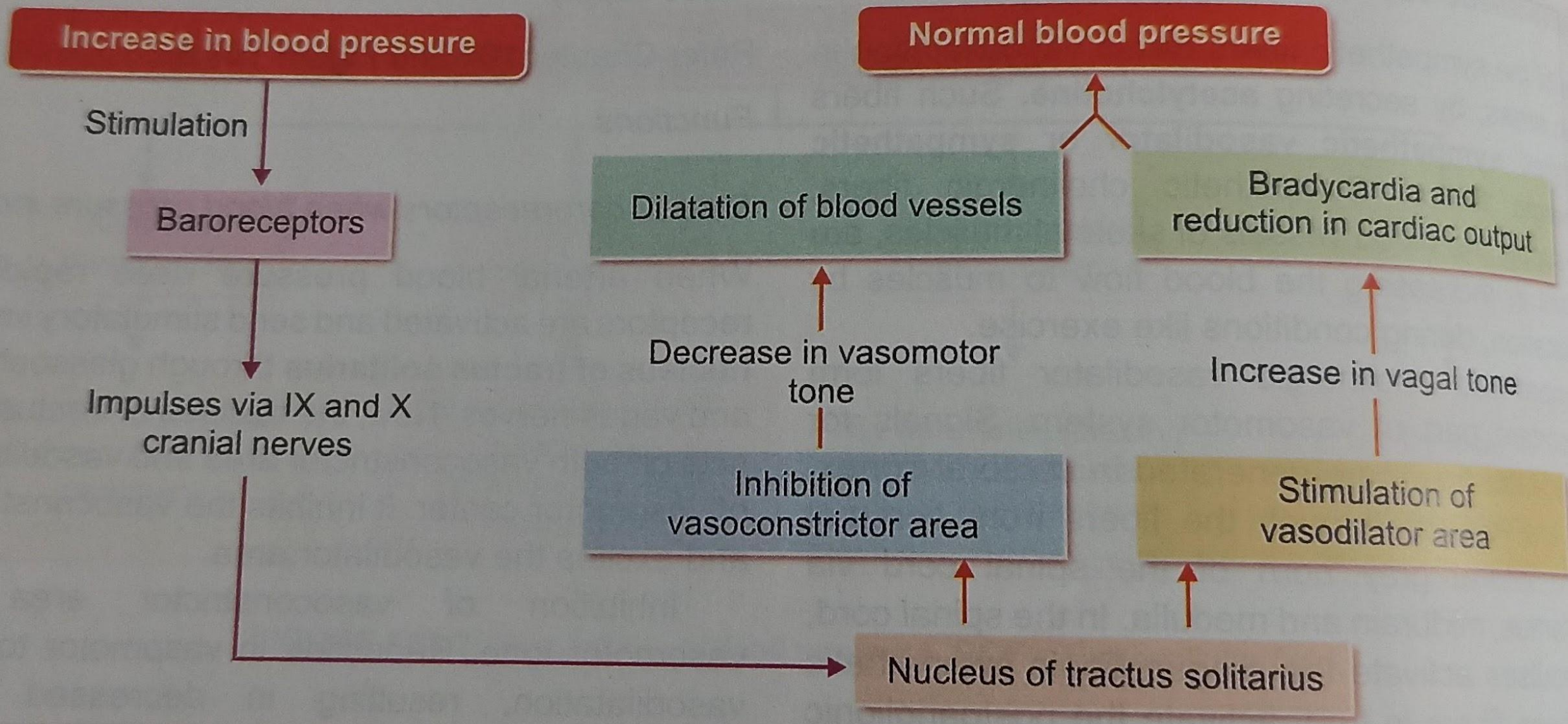


FIGURE 103.3: Regulation of blood pressure by baroreceptor mechanism

Chemoreceptors :

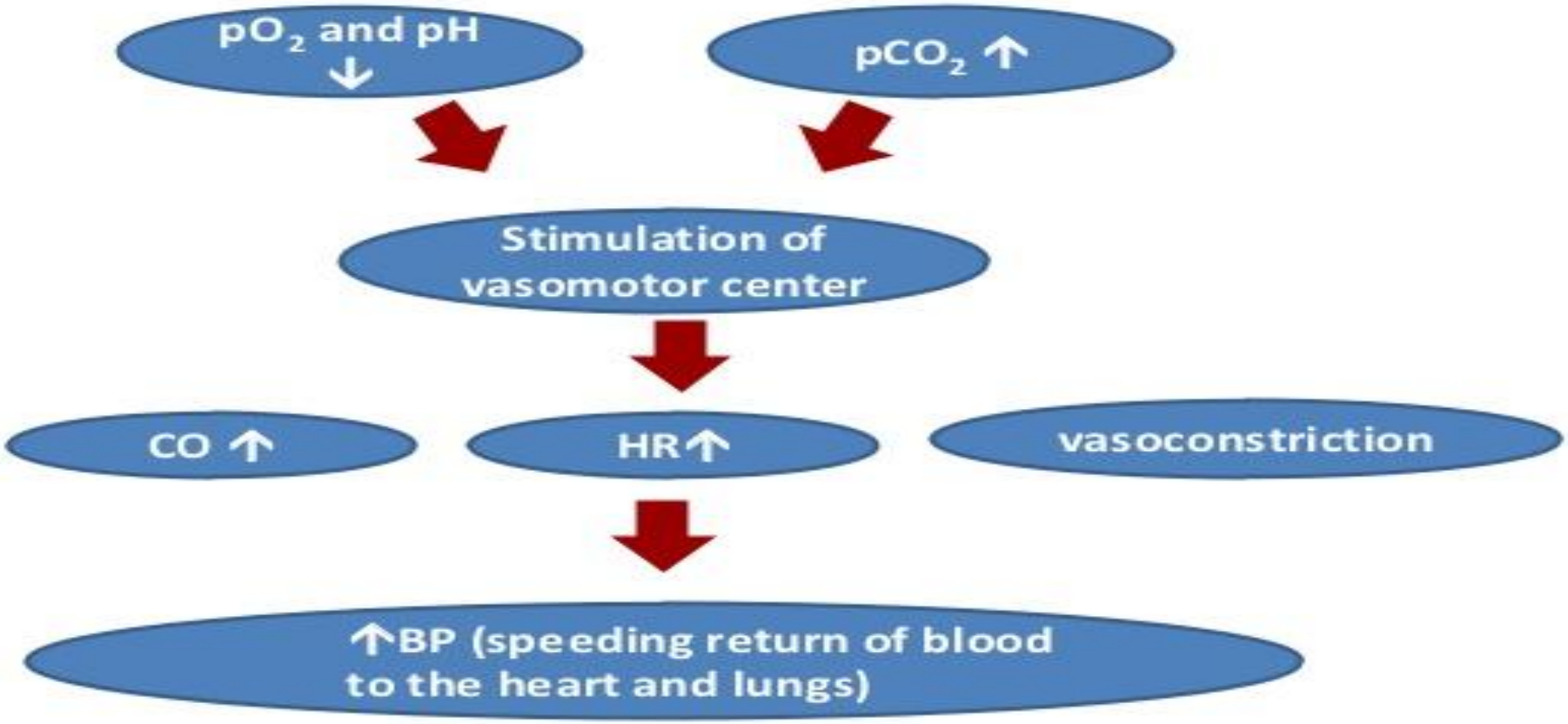
- **Chemoreceptors are those receptors giving response to change in chemical constituents of blood. Peripheral chemoreceptors influence the vaso-receptors.**

- ***Situation :***

- **peripheral chemoreceptors are situated in the carotid body and aortic body**
  - **Decrease in BP reduces blood flow to chemoreceptors present in the carotid body and arch of aorta.**
  - **Reduced oxygen supply stimulates the chemoreceptor.**
  - **Stimulate VMC increasing the heart rate and peripheral resistance by vaso constriction**
  - **Increase of blood pressure.**

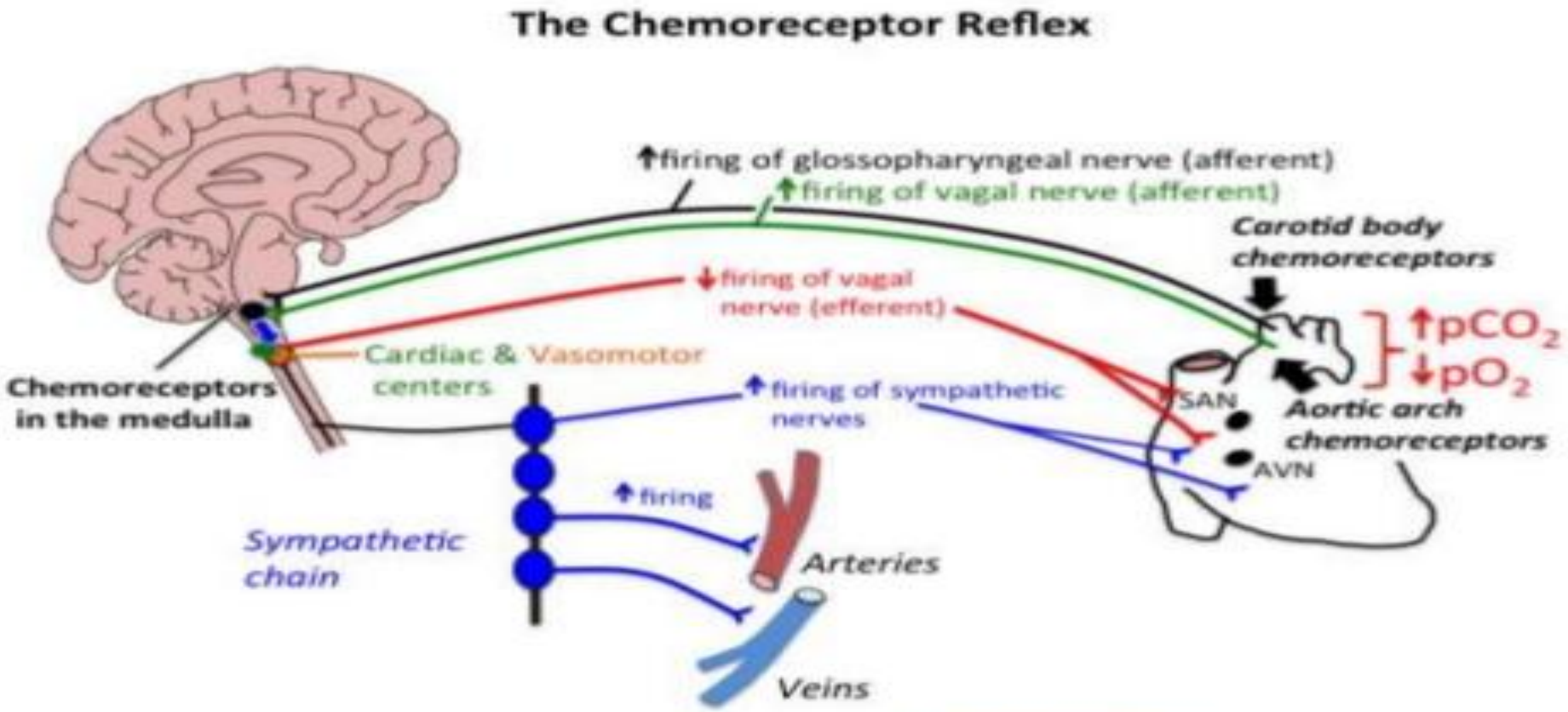
Chemoreceptor

- Chemosensitive cells that respond to changes in pCO_2 and pO_2 and pH levels (Hydrogen ion).



Mechanism Of Action Of Vasomotor Center In REGULATION OF BLOOD PRESSURE

Chemoreceptor Mechanisim



Intermediate term regulation :

It takes a few minutes to few hours to activate and alter the blood pressure.

Stress relaxation

- **Increased BP exerts a greater force on the walls of blood vessels.**
- **Stretching of the blood vessel initially causes contraction of the smooth muscles followed by relaxation.**
- **Relaxation of the vessel wall causes decrease in the blood pressure.**

Fluid shift mechanism :

- **Increased BP increases hydrostatic pressure.**
- **This pushes fluid out of blood vessels into interstitial space.**
- **hence there is loss of fluid from blood vessels which reduces blood volume.**
- **which in turn causes reduced venous return and hence decreases the blood pressure.**

RENIN ANGIOTENSIN MECHANISM

- **Also called as the renal mechanism for the regulation of blood pressure or long term regulation of blood pressure :**
  - **Reduced BP decreases blood flow to kidney.**
  - **Causes juxta glomerular apparatus of kidney to produce Renin.**
  - **Renin acts on plasma substrate, angiotensinogen, to form angiotensin I.**

reabsorption, resulting in increased

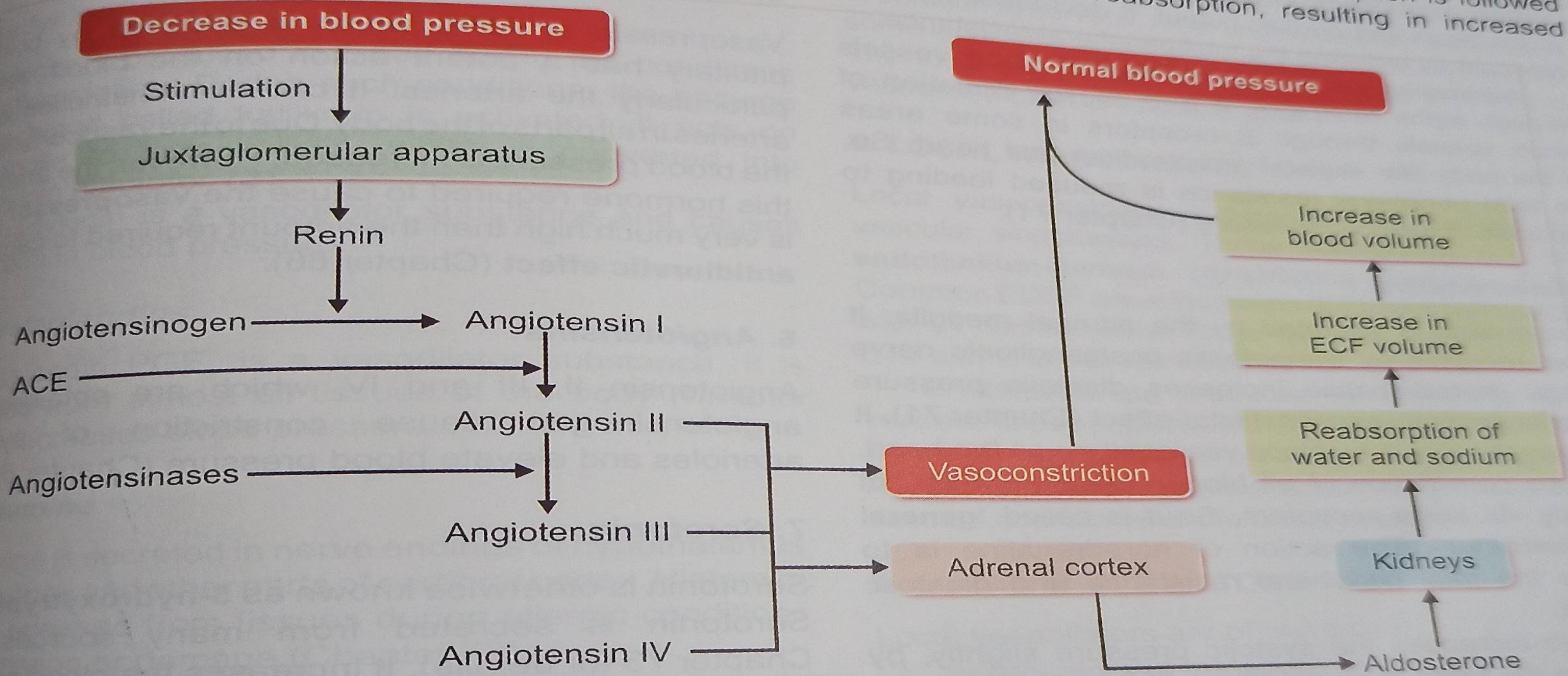
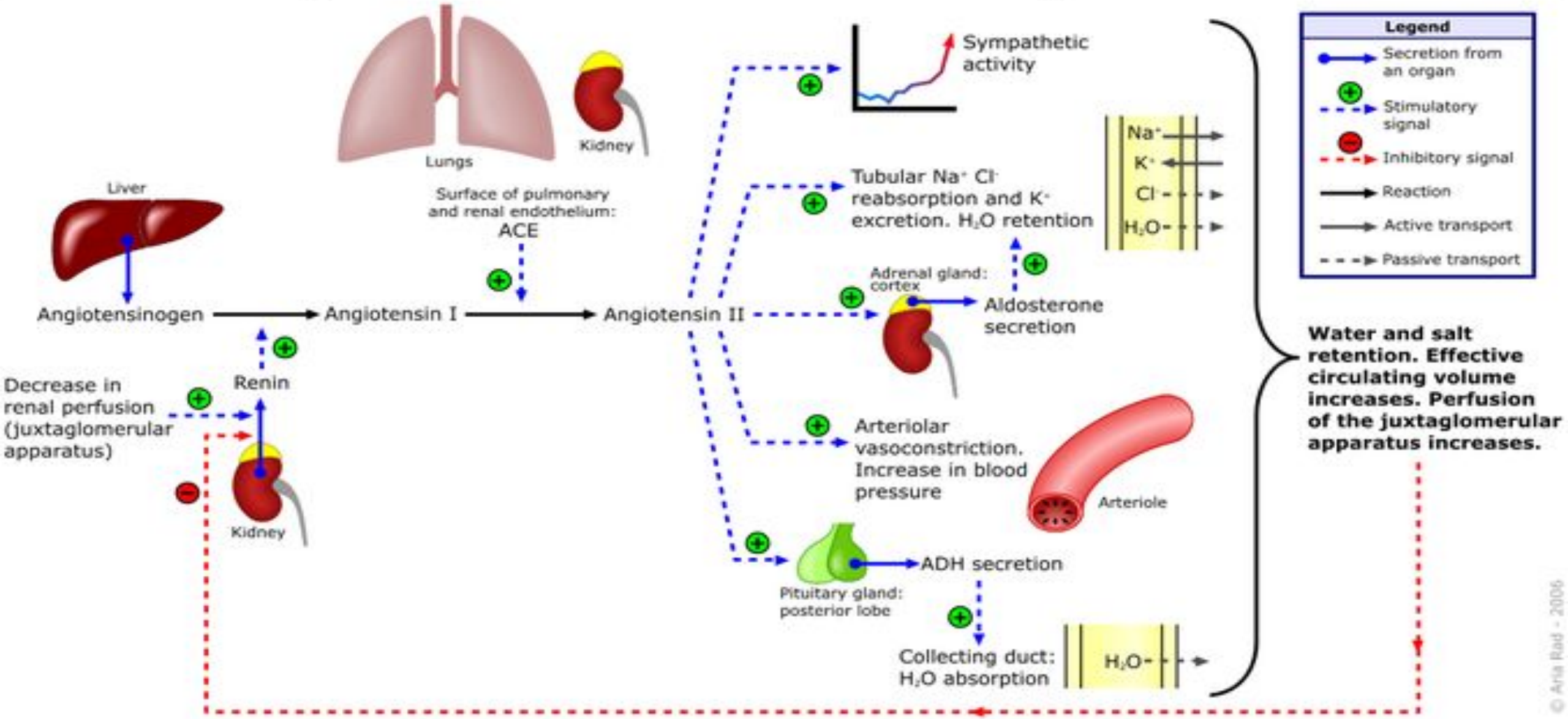


FIGURE 103.4: Regulation of blood pressure by renin-angiotensin mechanism. ACE = Angiotensin-converting e

Renin-angiotensin-aldosterone system



Hormonal mechanism :

- Many hormones are involved in the regulation of blood pressure.
- The hormones are listed below :

TABLE 103.2: Hormones involved in regulation of arterial blood pressure

Hormones which increase arterial blood pressure	Hormones which decrease arterial blood pressure
1. Adrenaline*	1. Vasoactive intestinal polypeptide (VIP)
2. Noradrenaline	2. Bradykinin
3. Thyroxine*	3. Prostaglandin
4. Aldosterone	4. Histamine
5. Vasopressin	5. Acetylcholine
6. Angiotensin	6. Atrial natriuretic peptide
7. Serotonin	7. Brain natriuretic peptide
	8. C-type natriuretic peptide

*Adrenaline and thyroxine increase systolic pressure but decrease diastolic pressure.

Adrenaline :

- **Adrenaline is secreted by the adrenal medulla. It is also released by the sympathetic postganglionic nerve endings.**
- **Adrenaline regulates the blood pressure by acting through heart and blood vessels.**
- **It increases the systolic pressure by increasing the force of contraction of the heart and cardiac output, and decreases the diastolic pressure by reducing the total peripheral resistance.**
- **It also acts as a vasoconstrictor that acts on the alpha receptors and also causes dilation of the blood vessels through the beta 2 receptors.**

Noradrenaline :

- Noradrenaline is also secreted by the adrenal medulla.
- It is also secreted by the sympathetic postganglionic nerve endings
- It increases the diastolic pressure by due to its general vasoconstrictor effect. (it has stronger effect on the blood vessels than on the heart)
- It causes constriction through out the body hence called as the “ general vasoconstrictor”

THYROXINE :

- **Thyroxine is secreted from the thyroid gland increases the systolic pressure but decreases the diastolic pressure .**
- **It increases the systolic pressure by increasing the cardiac output.**
  - Increased blood volume
  - Increased cardiac output
  - Increased systolic blood pressure
- **Thyroxine also has an indirect effect on the diastolic pressure- large quantities of metabolites are produced due to increased metabolic activity of thyroxine and these metabolites causes vasodilation leading to decreased peripheral resistance.**

Aldosterone :

- **Secreted from the adrenal cortex.**
- **It causes retention of sodium and water thereby increasing the ecf fluid volume and blood volume leading to the increase in blood pressure**

Conti…

- **<u>Vasopressin :</u> secreted by the postr pituitary has a potent action on the blood vessels. It causes constriction of all the arteries which leads to increased blood pressure**

- **<u>Angiotensins :</u> angiotensins 2, 3 and 4 causes constriction and increases the BP.**

- **<u>Serotinin</u> :It also increases the blood pressure by vasoconstriction.**

Hormones that decrease the blood pressure :

- ***Vasoactive intestinal polypeptide :*** **VIP is secreted in the stomach and the small intestine.**

  It is a vasodilator that causes dilation of the arteries and hence decreases the blood pressure.

- ***Bradykinin :*** **it is produced during the conditions like inflammation. During such conditions an enzyme called kallikrein is activated.**

  This is a vasodilator and causes reduction in the blood pressure.

- ***Prostaglandins :*** **vasodilator substance hence reduces the blood pressure.**

- ***Histamine :*** **secreted in the nerve endings of hypothalamus , it causes vasodilation and hence reduces the blood pressure.**

- ***Acetylcholine :***

- ***Atrial natriuretic peptides:***

- ***Brain natriuretic peptides:***

- ***Natriuretic peptides C- type :***

Local mechanism for the regulation of blood pressure :

Local vasoconstrictors :

- In additions to the renal mechanism , nervous and hormonal some local substances also regulate the blood pressure by two methods by vasoconstriction and by vasodilation.
- Local vasoconstrictor substances are derived from the vascular endothelium , they are called as the endothelium-derived constricting factors (EDCF).
- These produce endothelins ET1 ,ET2, ET3.
- These peptides act by activating the phospholipase which activates the thromboxane A2 and prostacyclin .
- These two substances together causes vasoconstriction and increases the BP.

Local vasodilators :

LOCAL VASODILATORS ARE OF TWO TYPES :

1. **Vasodilators of metabolic origin- carbon-di-oxide , lactate ,H ions.**
2. **Vasodilators of endothelial origin –(NO) Its synthesis is stimulated by acetylcholine and acts as a vasodilator and hence decreases the blood pressure**
3. **Deficiency of which leads to constant vasoconstriction and hypertension.**

Measurement of blood pressure :

- Blood pressure was first measured in a horse in 1733 by Stephen hales.
- Later sir Poiseuille reduced the length of the tube used and also used mercury to balance the column of blood.
- In 1847 ,sir Ludwig placed a float on top of the mercury column and made it possible for the recording of blood pressure.
- Initially called as the manometer later was said to be known as the sphygmomanometer.

BLOOD PRESSURE IS USUALLY RECORDED BY TWO METHODS :

1. DIRECT METHOD
2. INDIRECT METHOD

Direct method :

- **Direct method to measure the arterial blood pressure is employed only in animals.**
- **The carotid artery is cannulated and connected to a mercury manometer. By using a kymograph , the blood pressure can be recorded continuously in the form of a graph.**
- **The cannula can also be connected to an electronic pressure transducer which in turn is connected to a recording device like a polygraph to obtain the recordings of the BP.**

INDIRECT METHOD:

- **Indirect method is commonly used to measure the arterial blood pressure in man.**

- ***APPARATUS :***

- **The apparatus used to measure the blood pressure through this method is called as a sphygmomanometer. It is used alongside a stethoscope.**

- ***PRINCIPLE :***

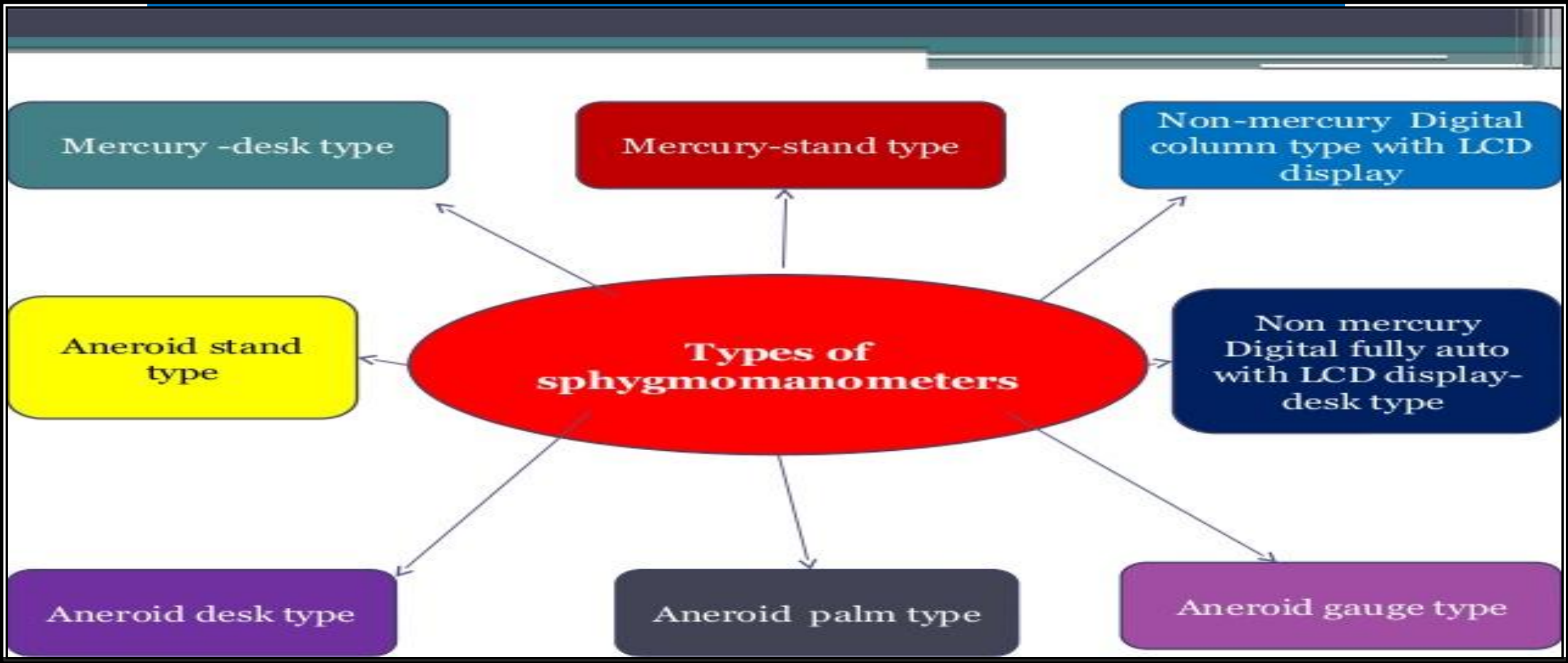
- **When an external pressure is applied over the artery the blood flow through it is obstructed and the pressure required to cause the occlusion of the blood flow indicates the pressure inside the vessel.**

Procedure of recording the BP:

- **Brachial artery is usually chosen because of its convenience. The arm cuff of the sphygmomanometer is tied around the upper arm , just above the cubital fossa.**
- **The cuff should not be too tight or too loose.**
- **it is then connected to a sphygmomanometer and then the blood pressure can be recorded by three different methods as follows :**

1. **Palpatory method**
2. **Auscultatory method**
3. **Oscillatory method**

TYPES OF SPHYGMOMANOMETERS



Palpatory Method (Rheographic Method)

- An occlusive cuff is placed on arm and inflated to P_{cuff} > SP. Then the cuff is deflated gradually and the measurement of blood flow is done
- The occlusive cuff should be of a correct size in order to transmit the pressure to the artery evenly and thus to obtain accurate results
- A short cuff requires special attention in placement. Longer cuff reduces this problem.
- The cuff should be placed at the heart level in order to minimize the hydrostatic effects
- When the cuff is deflated, there is a palpable pulse in the wrist. P_{cuff} = BP
- Several measurements should be done as the respiration and vasomotor waves modulate the blood pressure levels

Sfigmomanometro del Riva-Rocci (1896)

ADVANTAGES

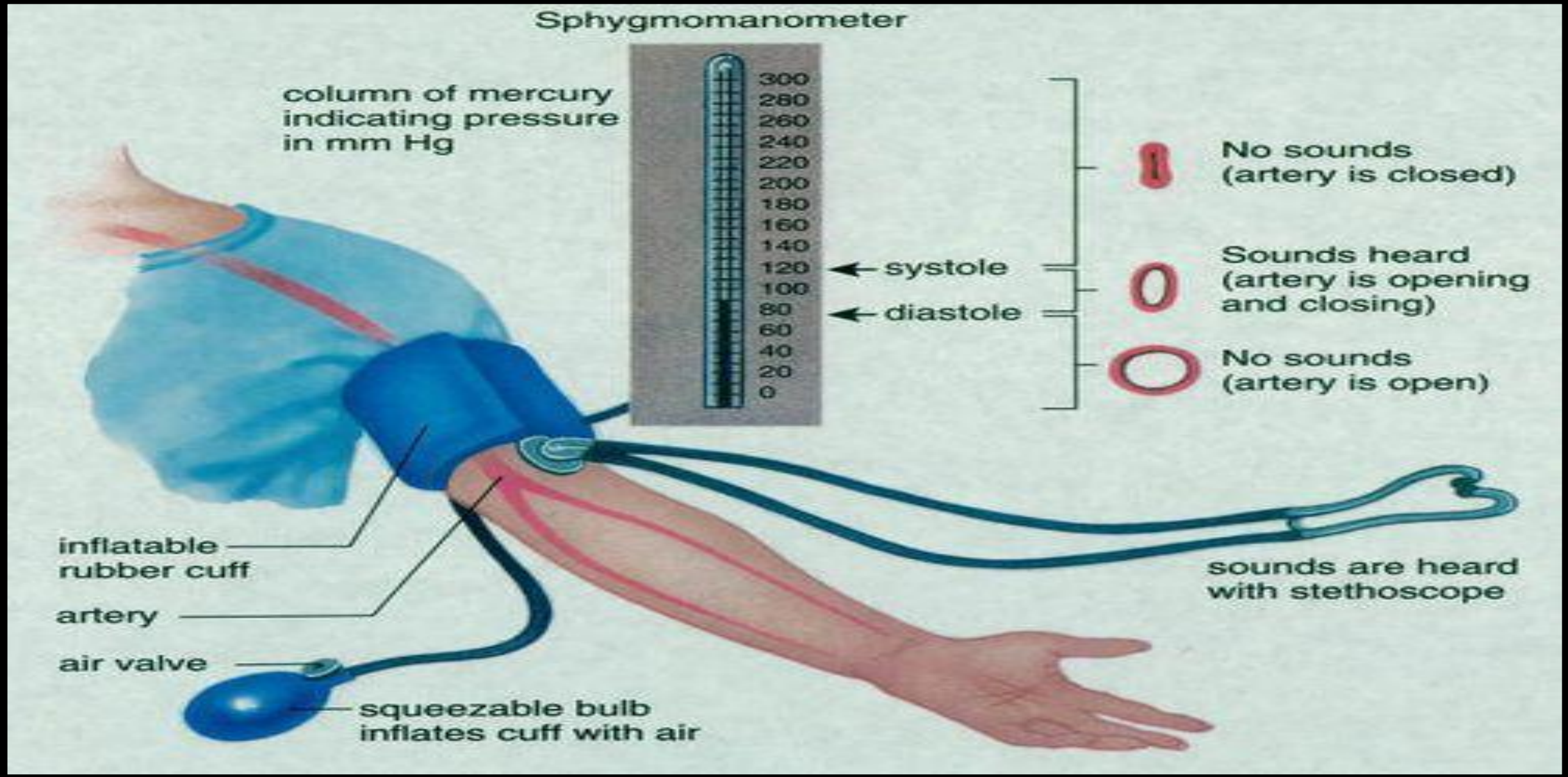
- The blood pressure can be measured in noisy environment too
- Technique does not require much equipment

DISADVANTAGES

- Only the systolic pressure can be measured (not DP)
- The technique does not give accurate results for infants and hypotensive patients

Auscultatory method :

- **It is the most accurate method to determine the arterial blood pressure.**
- **After determining the systolic pressure in the palpatory method , the pressure in the cuff is raised by about 20mmHg above that level so that the brachial artery is occluded.**
- **Now, the chest piece of the stethoscope is placed over the antecubital fossa and the arm cuff is slowly deflated. While doing so a series of sounds are heard. These sounds are called as the Korotkoff sounds, named after the person who discovered the sounds sir Korotkoff(1905).**
- **While reducing the pressure of while deflating the Korotkoff sounds have five phases :**


Sphygmomanometer
column of mercury indicating pressure in mm Hg
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
systole
diastole
No sounds (artery is closed)
Sounds heard (artery is opening and closing)
No sounds (artery is open)
inflatable rubber cuff
artery
air valve
squeezable bulb inflates cuff with air
sounds are heard with stethoscope

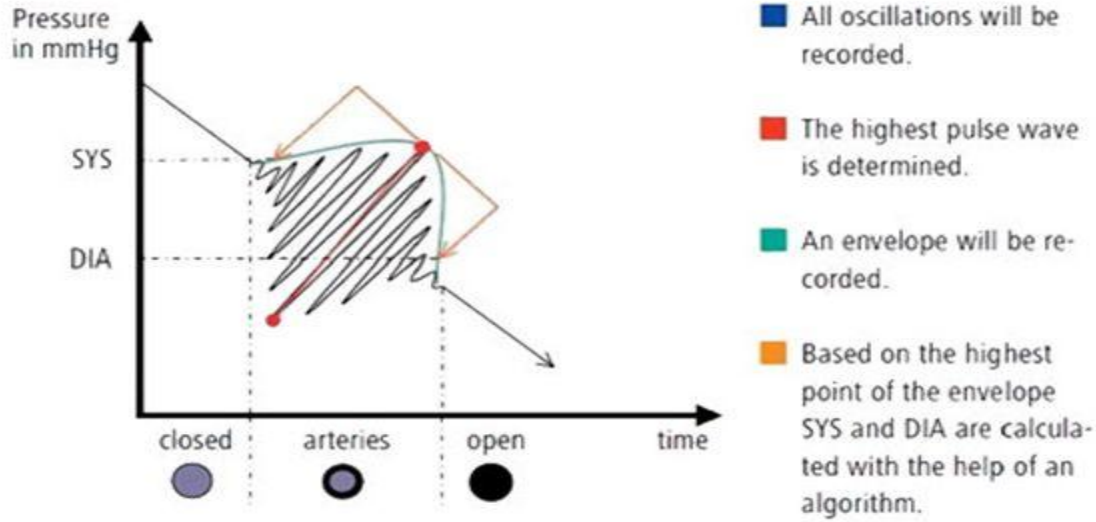
- **First phase: while decreasing the pressure from the arm cuff, the occlusion of the artery is relived and when the blood starts flowing through the artery , the first sound appears suddenly.**
- **In a normal person it appears when the pressure is reduced to about 120mmHg. It is then a clear tapping sound.**
- **Appearance of this tapping sound is referred to as the systolic pressure , when the pressure is later reduced by around 10mmHg the sound becomes louder and clearer.**
- **Second phase : appearance of murmuring sound**
- **Following the clear taping sound ,a murmuring sound is heard when the pressure is reduced further about 15mmHg.**

- **Third phase –appearance of the gong sound.**
- **After the murmuring sound , a very clear and louder sound is heard. It is gong in type .It is heard while reducing the pressure to about another 15mmHg.**
- **Fourth phase – appearance of a muffled sound**
- **Next to the gong type sound , a mild and muffled sound is heard when the pressure is decreased further by 5mmHg.**
- **Fifth phase- disappearance of the muffled sound :**
- **The muffling sound disappears. Disappearance of this sound indicates diastolic pressure.**

Oscillatoru method :

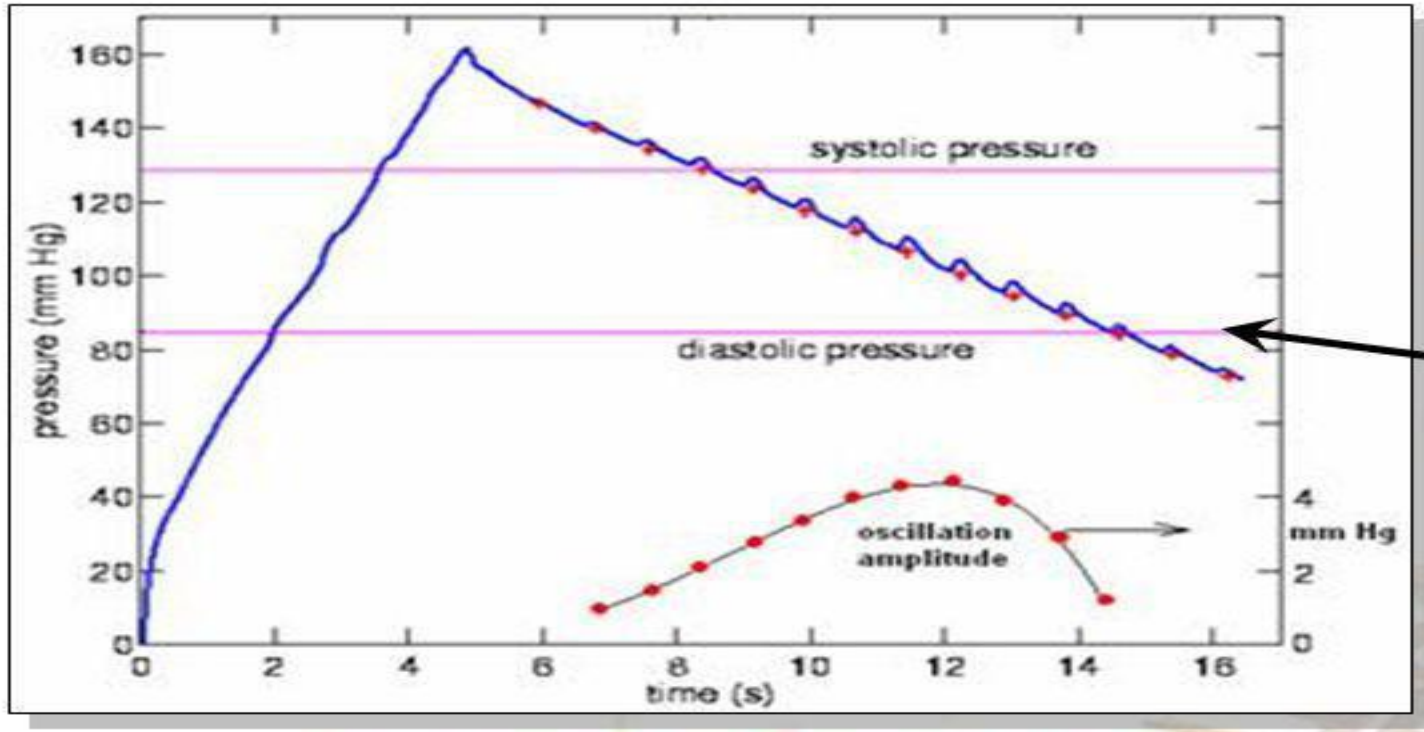
Oscillometric Method

- Measures pressure waves
- Can measure mean arterial pressure accurately
- Not as good of estimates for systolic and diastolic pressure



http://tensoval.com/oscillometric-measurement-devices.php

Oscillometric Method



The intra-arterial pulsation is transmitted via cuff to transducer (e.g. piezo-electric)

The cuff pressure is deflated either linearly or stepwise

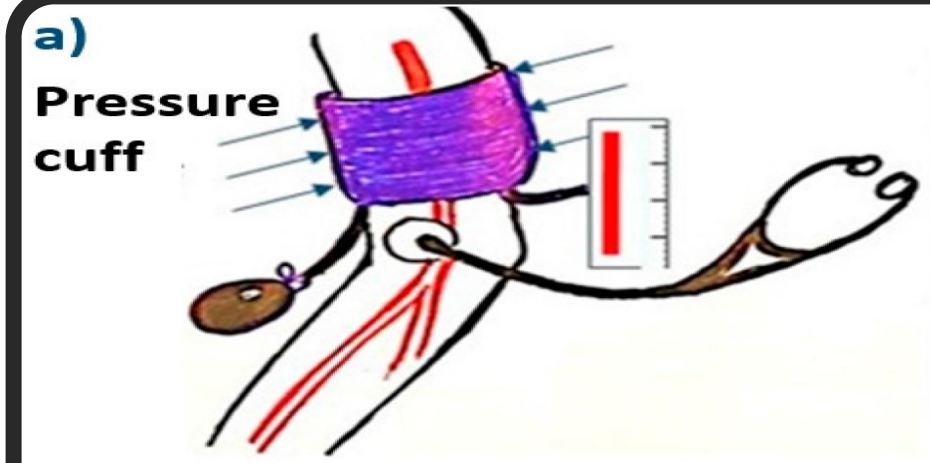
The arterial pressure oscillations (which can be detected throughout the measurement i.e. when $P_{cuff} > SP$ and $P_{cuff} < DP$) are superimposed on the cuff pressure

http://colin-europe.com/docpdfdemos/oscillo0104.wmv

SP and **DP** are estimated from the amplitudes of the oscillation by using a (proprietary) empirical algorithm.

Automatic blood pressure instrument :

a)



Type of Sound	Inference
No sound	Artery occluded
K-1 (clear tapping)	Systolic Pressure
K-5 (sound ceases)	Diastolic Pressure

b)

Pressure sensor → MAP determined by analysis of oscillometric pulse → SBP and DBP estimated → Electronic Display

Applied physiology of blood pressure :

A. ***HYPERTENSION***
B. ***HYPOTENSION***

Blood Pressure Categories

American Heart Association | American Stroke Association

BLOOD PRESSURE CATEGORY	SYSTOLIC mm Hg (upper number)		DIASTOLIC mm Hg (lower number)
NORMAL	LESS THAN 120	and	LESS THAN 80
ELEVATED	120 – 129	and	LESS THAN 80
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 1	130 – 139	or	80 – 89
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 2	140 OR HIGHER	or	90 OR HIGHER
HYPERTENSIVE CRISIS (consult your doctor immediately)	HIGHER THAN 180	and/or	HIGHER THAN 120

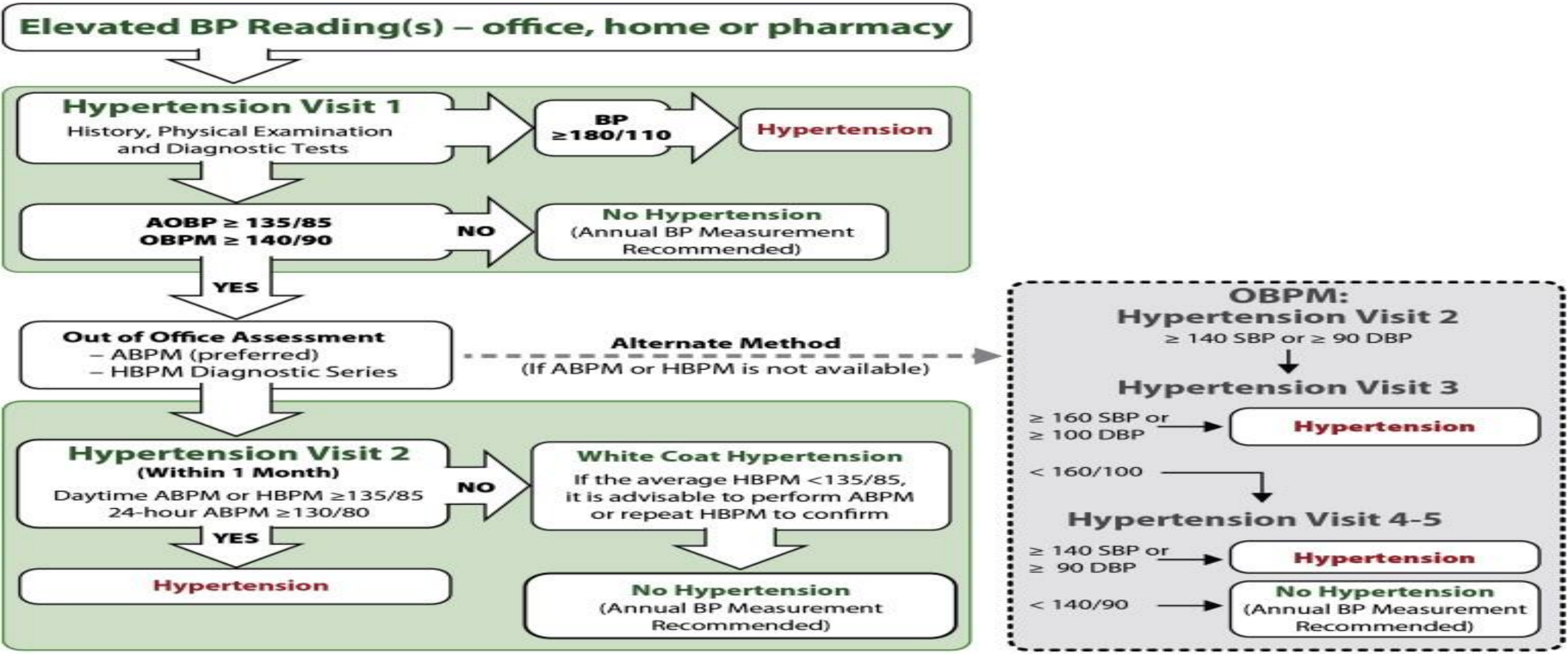
heart.org/bplevels

TABLE 2: RECOMMENDED BLOOD PRESSURE LEVELS

Category	Systolic BP (mm Hg)	Diastolic BP (mm Hg)
Normal	<120	<80
Prehypertension	120-139	80-89
Hypertension stage 1	140-159	90-99
Hypertension stage 2	≥160	≥100

BP = blood pressure. Adapted from references 2 and 9.

Diagnosis of Hypertension



Measurement using electronic (oscillometric) upper arm devices is preferred over auscultation

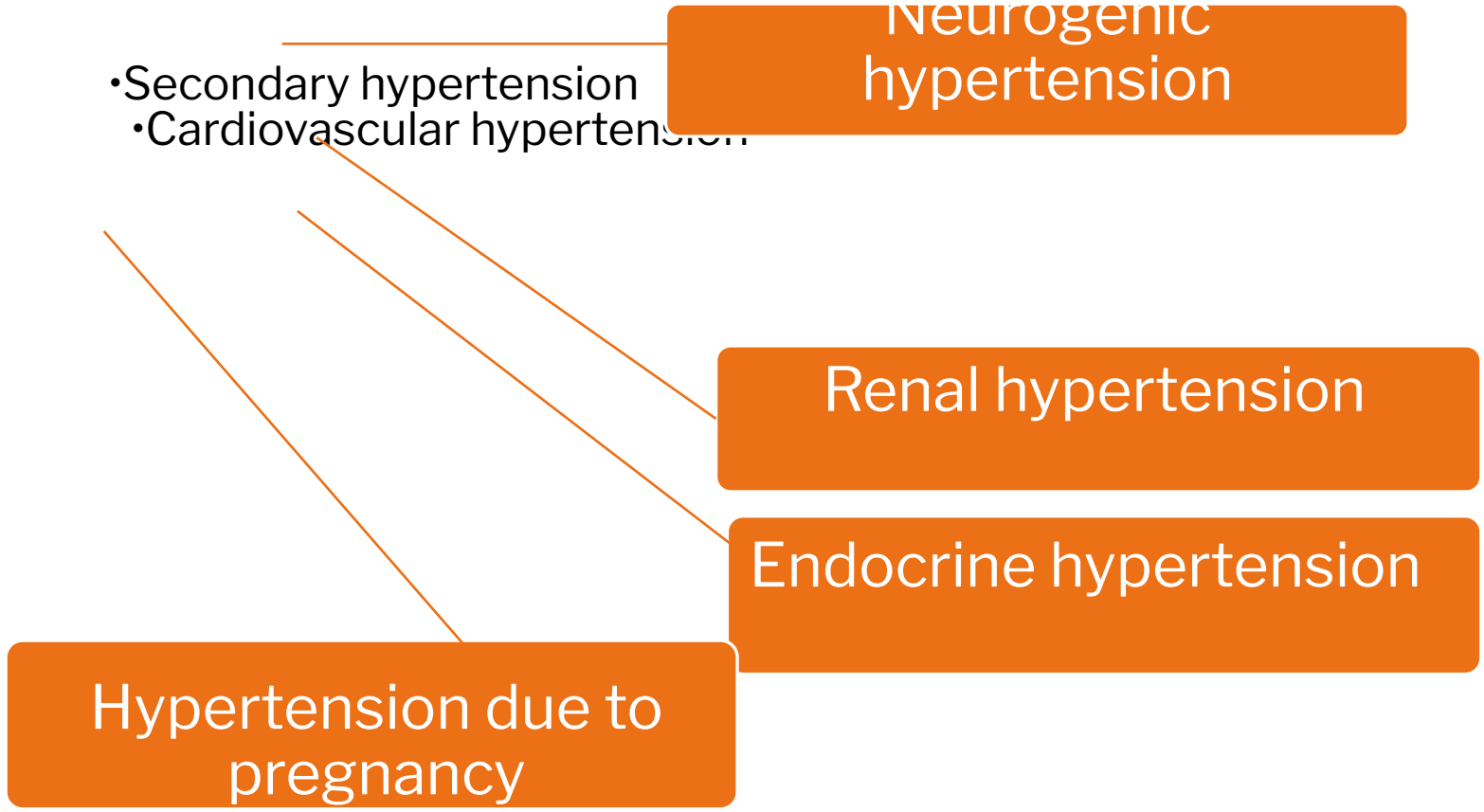
ABPM: Ambulatory Blood Pressure Measurement
AOBP: Automated Office Blood Pressure
HBPM: Home Blood Pressure Measurement
OBPM: Office Blood Pressure Measurement

HYPERTENSION :

Definition – " it is defined as the persistent high blood pressure, clinically when the systolic pressure remains elevated above 150mmHg and the diastolic pressure remains elevated above 90mmHg , it is considered as hypertension.

If there is increase only is the systolic pressure then it is called the systolic hypertension.

- hypertension
  - Primary hypertension
    - Benign hypertension
    - Malignant hypertension
  - Secondary hypertension
    - Cardiovascular hypertension



Type of hypertension	Description	Blood pressure range
Essential hypertension (major type)	Chronic elevation in blood pressure with no underlying disease	Both systolic and diastolic blood pressure are elevated more than 140/ 90 mmHg
Secondary hypertension (second common type)	Chronic elevation in blood pressure due to underlying pathology (mostly due to renal problems)	Both systolic and diastolic blood pressure are elevated more than 140/ 90 mmHg
Malignant hypertension	When blood pressure is severely elevated and causes an organ damage	Both systolic and diastolic blood pressure are elevated but the diagnosis made mainly when the diastolic blood pressure is higher than 130 mmHg
Isolated systolic hypertension	Common in elderly due to the loss of elasticity of major blood arteries	The systolic blood pressure is higher than 140 mmHg while the diastolic blood pressure is close to the normal range
Resistant hypertension	When more than three different antihypertensive agents are prescribed and blood pressure is still elevated	Both systolic and diastolic blood pressure are elevated more than 140/90 mmHg

Primary hypertension or essential hypertension :

- **Primary hypertension is the elevated blood pressure in the absence of any underlying disease. It is also called as essential hypertension. Arterial blood pressure is increased because of increased peripheral resistance which occurs due to unknown cause.**
- ***Benign hypertension :***
- **It is high blood pressure that does not cause any problem.**
- **It is defined as the essential hypertension that runs relatively long and usually symptomless.**
- **In the early stages it is usually moderate increase in the BP , the pressure reduces normally during the resting or sleeping phase.**
- **In the later conditions the rise in the BP does not normally reduce even during the resting phase.**

Malignant hypertension :

- **It is a severe form of hypertension with a rapid course leading to progressive cardiac and renal diseases. It is also called as the accelerated hypertension.**
- **The BP is elevated the SBP rises to about 250mmHg and the diastolic pressure 150 mmHg.**
- **Occurs always due to combined effects of both primary and the secondary hypertension.**
- **This type of hypertension causes severe damage to the tunica intima of small vessels and retina of the eye, heart , brain.**

Secondary hypertension :

It is the high blood pressure caused due to some underlying disorders. The different forms are :

a. ***Cardiovascular hypertension :*** **caused due to any underlying cardio disorders like :**

I. **Artherosclerosis**

II. **Coarctation of the aorta**

III. **Ischemic heart disease or coronary artery diseases**

a. ***Endocrine hypertension :*** **developed due to hyperactivity of the endocrine glands**

I. **Pheochromacytoma**

II. **Hyperaldosteronism**

III. **Cushing's syndrome**

a) ***Renal hypertension :***

1. **Stenosis of the renal artery**
2. **Tumor of the juxtaglomerular cells**
3. **Glomerulonephritis**

I. ***Neurogenic hypertension :*** **due to increased intracranial pressure , lesions in the tractus solitarius**

II. ***Hypertension due to pregnancy :*** **occurs due to toxemia of pregnancy**

Resistant hypertension :

Blood pressure that cannot be reduced below 140/90mmHg or sometimes below 160mmHg in patients who are complying with adequate triple drug regimens in appropriate doses.

50-70% of these patients are usually treated but fail to achieve the target BP.

CAUSES:

- ***DRUG –INDUCED***
- ***OBESITY***
- ***ETHANOL***
- ***TOBACCO***
- ***EXCESSIVE Na intake***
- ***VOLUME RETENSION SECONDARY TO KIDNEY DISEASES.***

HYPERTENSIVE CRISIS :

Hypertensive urgency :

- Increased in the diastolic BP.
- >120-130mmHg.
- There is no end organ damage.
- The BP usually lowers down within the next 24hrs.

Hypertensive emergency :

- **Condition in which the systolic pressure is exceeding 210mmHg and the diastolic is >130mmHg.**
- **Usually ends with <u>END ORGAN FAILURE.</u>**
- **Requires immediate reduction in BP within an hour (IV medications).**

Manifestations of hypertension :

1. *Renal failure*
2. *Left ventricular failure*
3. *Myocardial infarction*
4. *Cerebral hemorrhage*
5. *Retinal hemorrhage*

Treatment of hypertension :

- **Secondary hypertension is used cured by treating the disease causing the hypertension.**
- **The primary hypertension cannot be cured but can be controlled.**

Following drugs can be administered to treat hypertension :

1. ***Beta blockers :***
2. ***Alpha blockers :***
3. ***Calcium channel blockers :***
4. ***Vasodilators :***
5. ***Diuretics :***

ACE inhibitors :

Depressors of the vasomotor center :

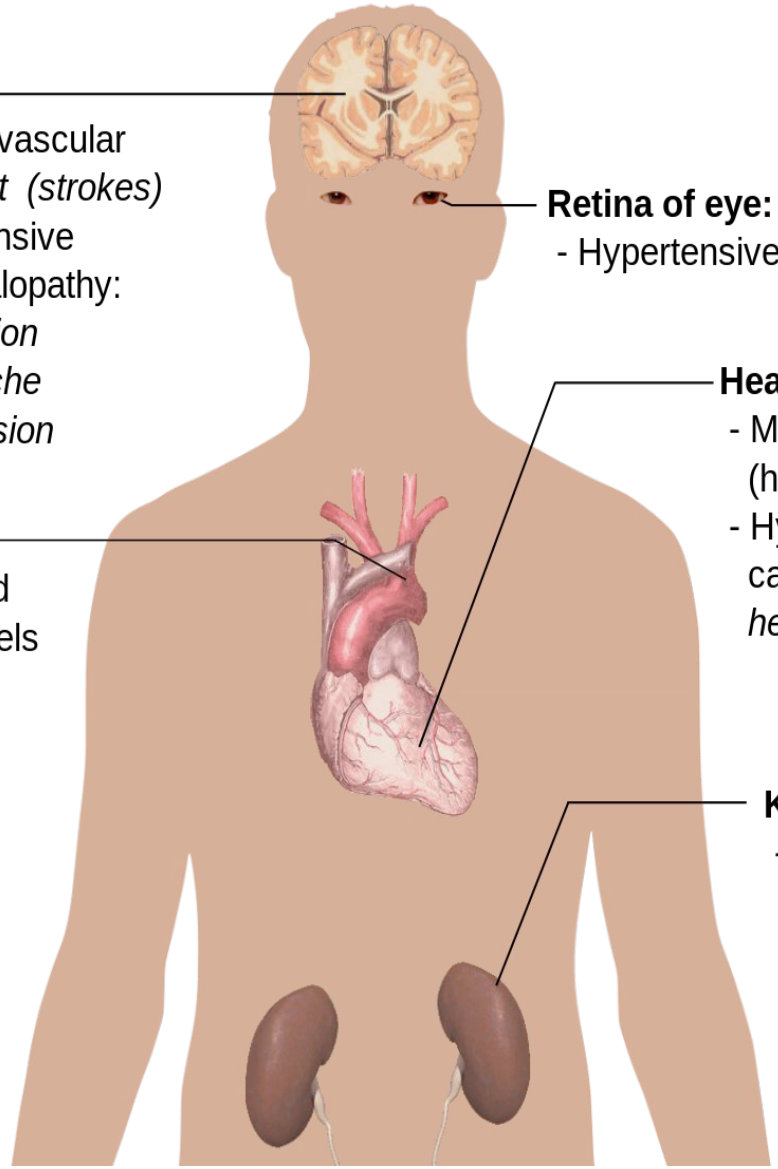
Angiotensin 2 receptor blockers :

Classification of Drugs Used in Hypertension

- Diuretics
  - Osmotic
  - Thiazide
  - Loop
  - K^+ sparing
- Cardioinhibitory drugs
  - β-blockers
  - Ca^{++}channel blockers
- Centrally Acting Sympatholytics
- Vasodilators
  - α-blockers
  - ACEi
  - ARB
  - Ca^{++}channel blockers
  - Direct acting arterial dilators
  - Ganglionic blockers
  - Nitrodilators
  - K^+ channel openers

Main complications of persistent

High blood pressure



TREATMENT FOR HYPERTENSION

Non-pharmacological measures
- Head-up tilt during sleep
- Increase salt intake
- Exercise
- Physical manoeuvres (e.g. leg crossing, bending forward)
- Thigh-length elastic stockings
- Abdominal binders
- Avoid
  - Sudden head-up postural change
  - Prolonged recumbency
  - Warm environments
  - Drugs with hypotensive side effects

Pharmacological interventions
- Fludrocortisone
- Midodrine
- Ephedrine
- Potassium supplements
- Dihydroergotamine
- Indomethacin
- Fluriprofen
- Desmopressin
- Metoclopramide, domperidone
- Erythropoietin

HYPOTENSION :

"It is defined as the low blood pressure when the systolic pressure is less than 90mmHg ."

Types :

Primary hypotension : **it is the low BP that develops in the absence of any underlying disease and develops due to an unknown cause. Hence also called as the essential h**

Signs and symptoms are : **fatigue , weakness , vertigo.**

Secondary hypotension : **it usually occurs due to some underlying diseases**

Myocardial infarction

Hypoactivity of the pituitary gland

Hypoactivity of the adrenal gland

Tuberculosis

Table 1. Symptoms of Hypotension

- Dizziness or lightheadedness
- Fainting
- Dehydration and unusual thirst
- Lack of concentration
- Blurred vision
- Nausea
- Cold, clammy, pale skin
- Rapid, shallow breathing
- Fatigue
- Depression

Source: Reference 4.

ORTHOSTATIC HYPOTENSION :

- It is the sudden fall in the blood pressure while in the standing position.
- Etiology is due to the effect of gravity.
- Usually seen In patients with myasthenia gravis and patients with nervous disorders. Like tabes dorsalis , syringomyelia and diabetic neuropathy
- The associated symptoms include orthostatic syncope

: Dental implications of hypertension :

- *Patients with hypertension should be treated with care.*
- *Risks of heart failure / heart attacks are common.*
- *Such patients should be continuously monitored through out the procedure.*
- *It is very common for dental anxiety to elevate the blood pressure which should be taken care of during treatment.*

TABLE 4 — DENTAL TREATMENT RECOMMENDATIONS ACCORDING TO THE MEASUREMENT OF HIGH BLOOD PRESSURE

Dental treatment Recommendations According to the Measurement of High Blood Pressure			
SBP	DBP	ORF	Recommendations
120-139	80-89	Yes/No	Routine dental care OK; discuss BP guidelines
140-159	90-99	Yes/No	Routine dental care OK; consider stress reduction, refer for medical consult
160-179	100-109	No	Routine dental care OK; consider stress reduction, refer for medical consult
160-179	100-109	Yes	Urgent dental care OK; consider stress reduction, refer for medical consult
180-209	110-119	No	No dental treatment without medical consult; refer for prompt medical consult
180-209	110-119	Yes	No dental treatment; refer for emergency medical treatment
>210	>120	Yes/No	No dental treatment; refer for emergency medical treatment
Other Risk Factors: History of myocardial infarction, angina pectoris, high coronary disease risk, recurrent stroke, diabetes mellitus, renal disease			
(Adapted from Yagiela et al[10]; Merin et al[11]; Herman et al)[12]			


Thank
You