

Arterial blood pressure measurement

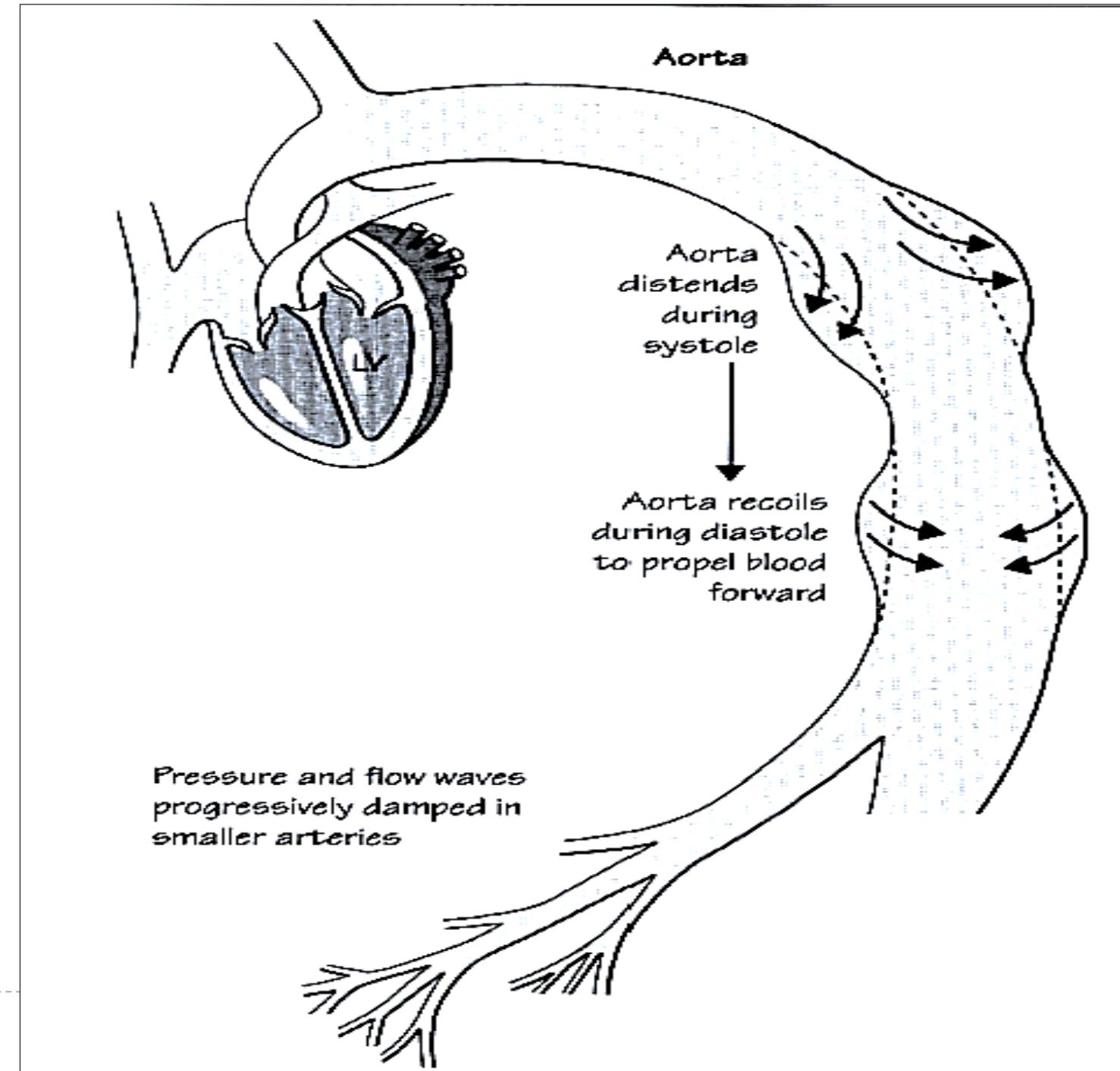


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Arterial Blood Pressure (ABP)

- It is the **P**ressure of **B**lood on **A**rterial wall.
- BP value is expressed as a fraction: The upper value is the **systolic** pressure, and the lower value is the **diastolic** pressure.



Definitions:

Systolic blood pressure

- Maximum pressure.
- During ventricular systole.
- 90 - 140 mmHg (average 120 mmHg).
- Due to Ejection of blood into aorta during systole
- Expansion of aorta prevents excessive ↑↑.

Diastolic blood pressure

- Minimal pressure.
- During diastole.
- 60 - 90 mmHg (average 80 mmHg).
- Due to Escape of blood to peripheral circulation during diastole.
- Elastic recoil of aorta prevents excessive ↓↓.



□ **Pulse pressure:** It is the difference between the SBP and the DBP.

- = **systolic BP - diastolic BP**
- ↑ **In hyperdynamic circulation as thyrotoxicosis, atherosclerosis, anemia & pregnancy.**
- ↓ **in aortic stenosis, cardiogenic shock, advanced HF.**

□ **Mean systemic blood pressure (Mean arterial pressure):**

- It is the average pressure in systemic arteries throughout cardiac cycle.
 - **MAP (at resting HR) = $\frac{2}{3} \text{ DBP} + \frac{1}{3} \text{ SBP}$**
 - = **diastolic blood pressure + $\frac{1}{3}$ Pulse pressure**
 - = **93 mmHg**
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Measurement of ABP

I. Direct Method

By cardiac catheter cannulated through a large artery, transmits the blood pressure to manometer.

2. Indirect Method: By sphygmomanometer + stethoscope.

-Principle: The pressure of blood in the artery (brachial artery) is balanced against the pressure of air in a rubber cuff surrounding the artery. The pressure of air in the cuff is then measured by means of a mercury manometer.

- Methods:

a) Palpatory step.

▶ b) Auscultatory step.





Mercurial
(the most accurate)



Digital
(the least accurate)



Cuffs of different sizes

Apparatus

Sphygmomanometer .Which is composed of

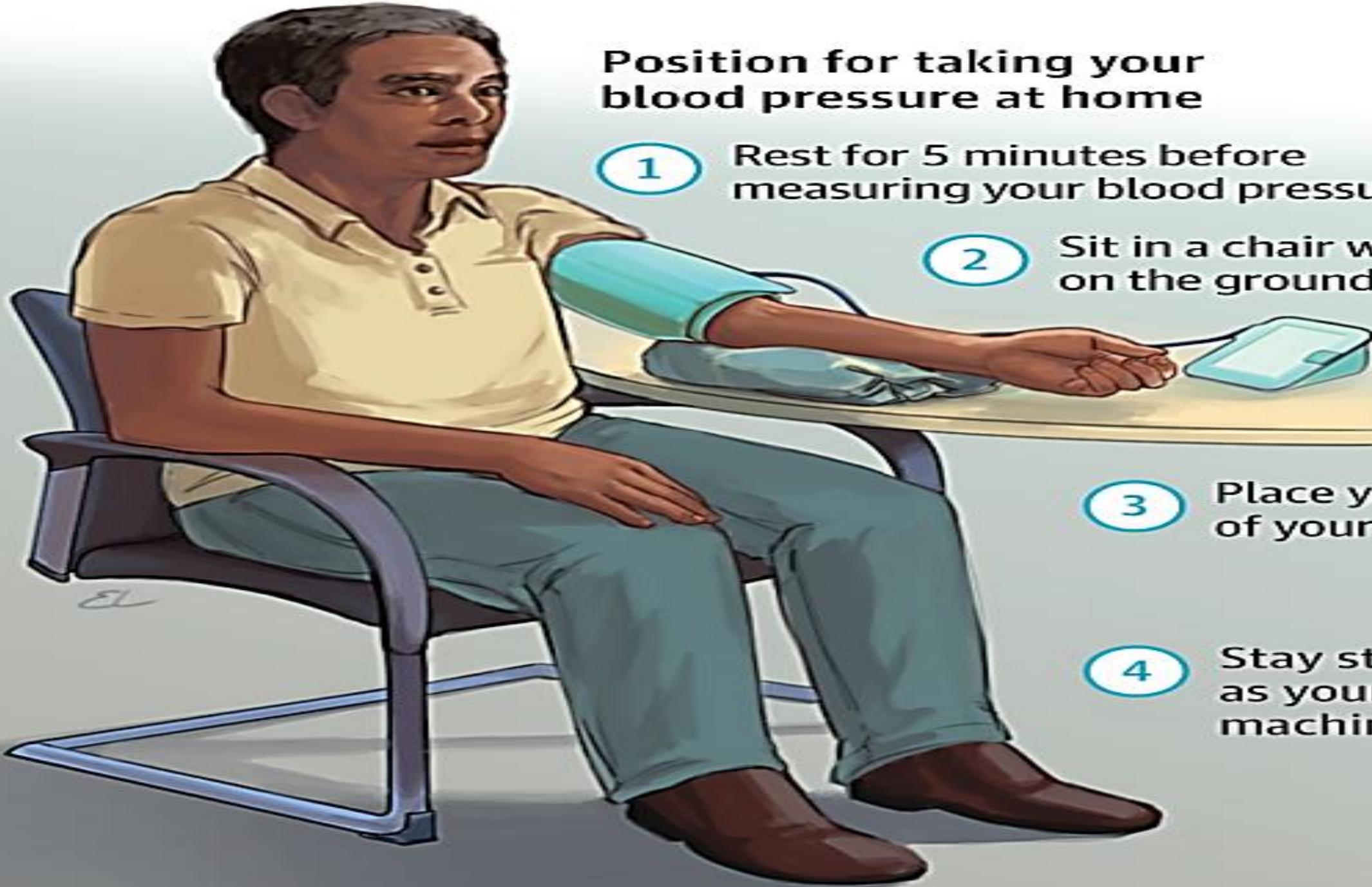
- ▶ Mercury Manometer,
- ▶ **Mercury Reservoir,**
- ▶ Rubber Tubes,
- ▶ Rubber Cuff
- ▶ **Air Pump.**



□ General Rules

Position for taking your blood pressure at home

- 1 Rest for 5 minutes before measuring your blood pressure.
- 2 Sit in a chair with both feet flat on the ground and back straight.
- 3 Place your arm at the level of your heart or chest.
- 4 Stay still and do not talk as your blood pressure machine operates.



How to measure?

1. Palpatory method



Less accurate

Only Systolic pressure

2. Auscultatory method



More accurate

Systolic and Diastolic pressure

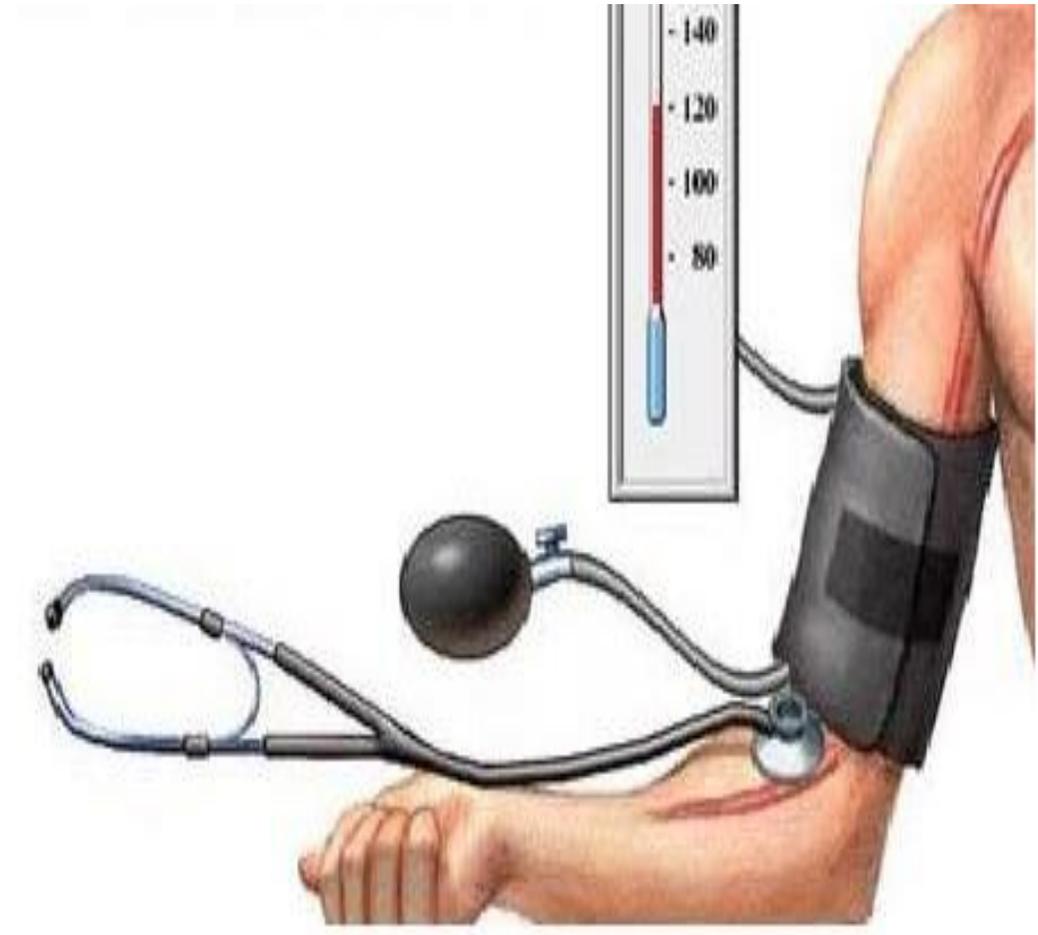
1. palpatory method

- A rubber inflatable cuff is placed over the **brachial artery**.
- Feel the subject's **radial artery** with the tip of 3 middle fingers, the pressure in the cuff is raised until the cuff pressure exceeds that of the pressure in the artery and at this point, the artery collapses and the radial pulse can no longer be felt .
- Then the pressure in the cuff is slowly released and the radial pulse reappears. The pressure at which the pulse reappears corresponds to the systolic pressure as it is the point at which the systolic pressure peaks in the brachial artery exceeding the occluding pressure in the cuff.

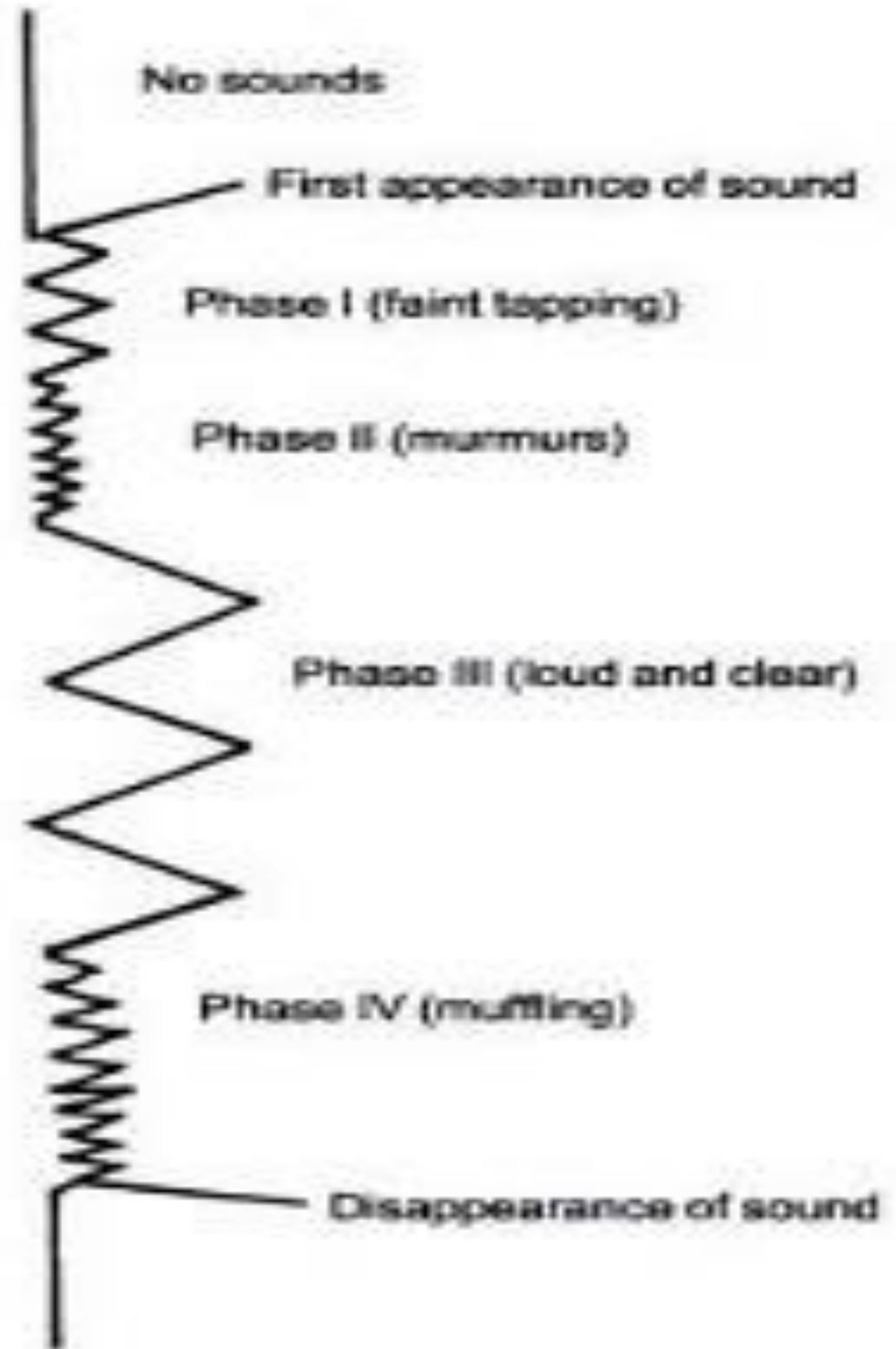


2. Auscultatory method.

- ❑ The cuff is inflated manually until the artery is completely occluded.
- ❑ Listening with the stethoscope over the brachial artery at the elbow, the examiner should then slowly release the pressure in the cuff.
- ❑ When blood just starts to flow in the artery, Korotkoff sound are heard which are:
 - I. **Sudden** appearance of faint clear sounds corresponds to SBP., heard as **tapping** sounds.
 - II. As the cuff pressure is lowered, the sounds become **murmur-like**.
 - III. With further lowering of the cuff pressure, the sounds become **louder**.
 - IV. When the cuff pressure approaches the diastolic pressure, turbulent flow becomes continuous and sounds become **dull** and **muffled**
 - V. At the diastolic pressure, the sounds **disappear**.

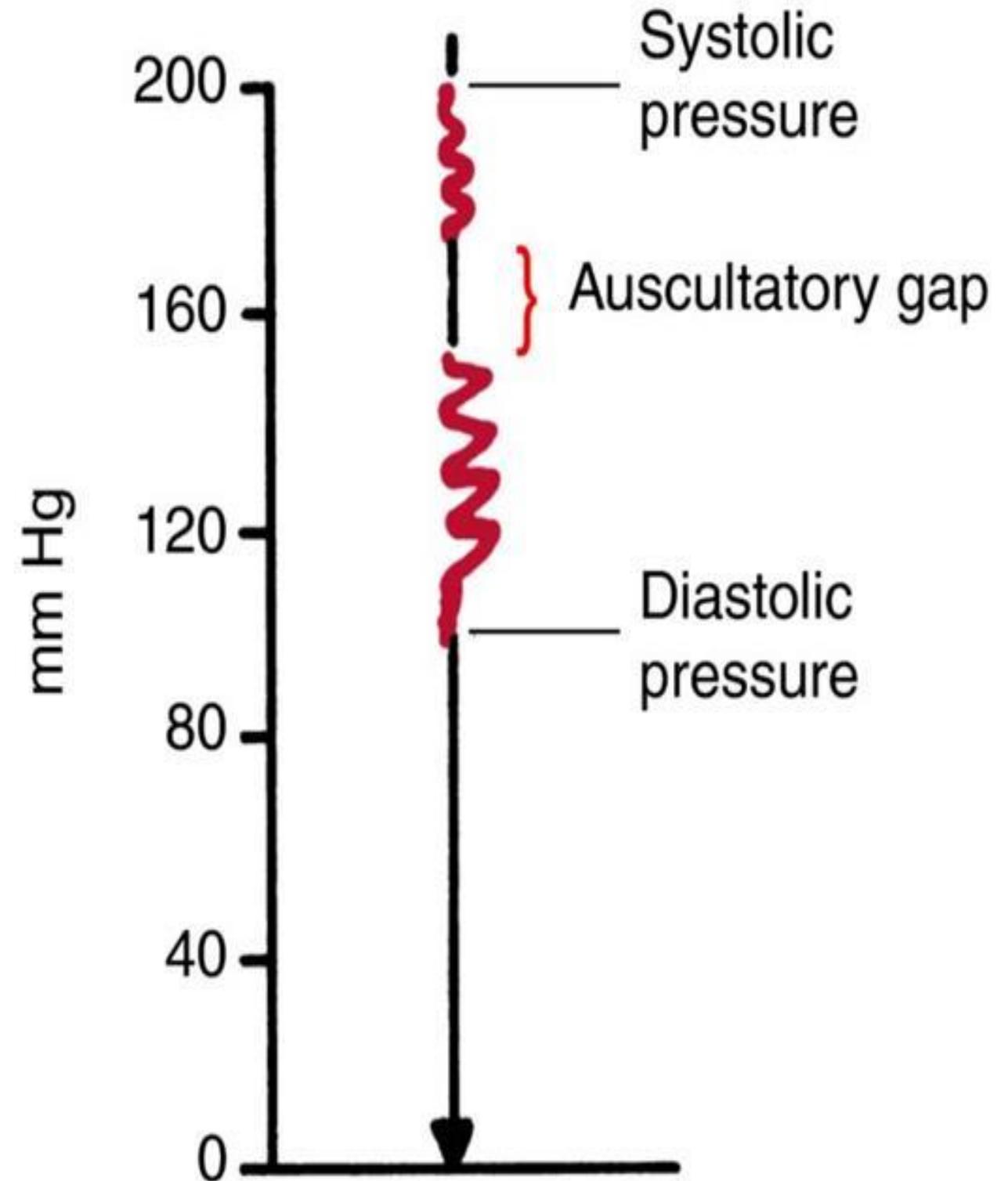


Korotkoff sounds



Auscultatory gap:

- ✓ During auscultation, sound **disappears** for short time (gap) between systolic and diastolic BP.
- ✓ in hypertensive atherosclerotic patients.



Physiological variations:

A. Age:

- In newly born infants the ABP = 80/40 mmHg.
- At 4 years old ABP = 100/60 mmHg.
- At 20 years old ABP = 120/80 mmHg.
- It increases gradually after the age of 20 years to reach 150/90 mmHg at the age of 60 years due to decrease the elasticity of arteries.

B. Body weight:

- ABP is usually higher in obese persons.

C. Sex:

- The ABP in adult male is higher than in adult female.
- After menopause, it is higher in female due to hormonal changes.

D. Diurnal variation: During sleep ABP is decreased due to decreased sympathetic activity.

▶ (highest value in afternoon & lowest value in early morning)

E.

Exercise:

-In the isometric (static) exercise:

Both the DBP & SBP rise sharply.

Then, return immediately to normal after stoppage of exercise.

-Due to reflex action by impulses originate in the contracting muscles proprioceptors to stimulate vasomotor center (VMC).

-In the isotonic (dynamic) exercise:

The SBP increases, while the DBP decreases.

Then, this effect remains for a time after stoppage of exercise.

Due to vasodilator effect of accumulated metabolites in the skeletal muscle.

Emotions:

e.g. anger, ABP increases (especially systolic) due to increased sympathetic activity.



Eating (meals):

After meals the ABP increases (especially systolic) due to:

Vasodilatation (VD) in the splanchnic area due to increased venous return (VR) & cardiac output (COP).

GIT wall contraction with blood vessels compression that leads to increased VR & COP.

F. Familial & Race:

ABP in orientals is less than in europeans & americans due to:

Genetic & Environment & Less cholesterol in diet & Less stressful life.



G. Gravity:

During standing, the blood pressure increases in all vessels below the heart and decreases in vessels above the heart level. The rise or decrease in ABP is equal to 0.77 mmHg per 1 cm.

R. Respiration:

The ABP shows rhythmic fluctuations during the respiratory cycle called **Traube-Herring waves**.



- Fluctuations in blood pressure synchronized with respiration

Early part of Inspiration	Late part of Inspiration	Early part of Expiration	Late part of Expiration
<p>Expansion of chest \Rightarrow dilatation of pulmonary vessels $\Rightarrow \downarrow$ blood return to left ventricle $\Rightarrow \downarrow$ COP & ABP.</p>	<p>Due to \uparrow the VR $\Rightarrow \uparrow$ blood return to left ventricle $\Rightarrow \uparrow$ COP & ABP. Active inspiratory centre send excitatory impulses to VMC \Rightarrow VC $\Rightarrow \uparrow$ ABP.</p>	<p>Narrowing of the chest \Rightarrow compression of pulmonary vessels $\Rightarrow \uparrow$ blood return to left ventricle $\Rightarrow \uparrow$ COP & ABP.</p>	<p>Due to \downarrow the VR $\Rightarrow \downarrow$ blood return to left ventricle $\Rightarrow \downarrow$ COP & ABP.</p>



Factors affecting ABP:

1) Blood volume

- \uparrow Blood volume \rightarrow \uparrow blood pressure.
- Blood is incompressible—the molecules cannot be forced to come closer together by external force. However, the impact of changes in blood volume are partially damped out by the fact that **arteries are compliant**—the walls are able to stretch to accommodate more fluid without a proportional increase in pressure.



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- With age, our arteries stiffen (become less compliant)
 - **Arteriosclerosis** is a factor that contributes to the gradual increase in blood pressure that we experience with age.
 - **The kidney** controls the blood volume by modulating the amount of salt and, consequently, water that is reabsorbed in the distal tubule.



2) COP

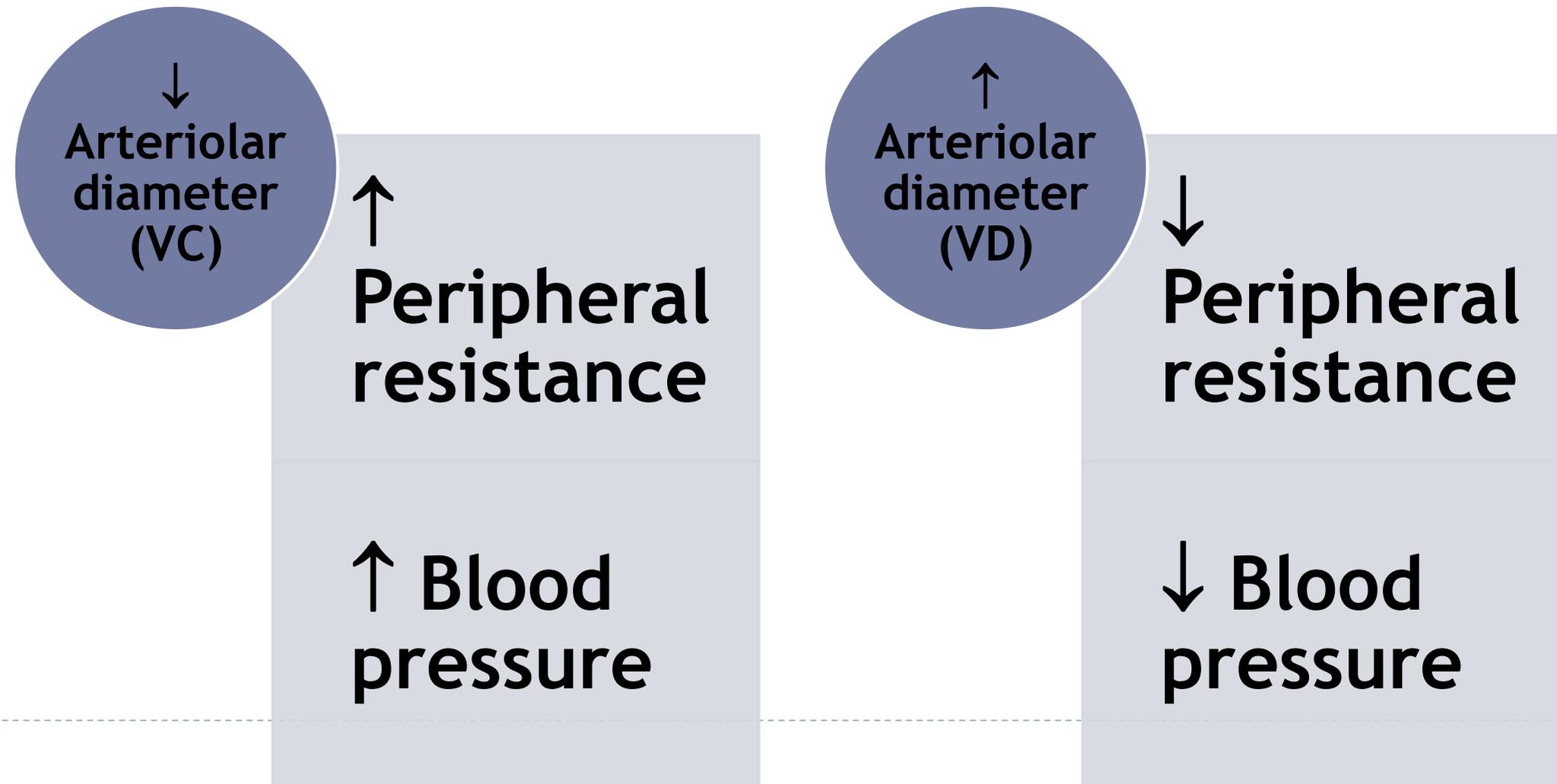
▶ **COP = SV x HR**

- ▶ The relationship between **cardiac output** and **blood pressure** is a proportional: if all other parameters remain unchanged, doubling cardiac output would double blood pressure.



3) Total peripheral resistance (TPR)

- ▶ It is the resistance that opposes the blood flow, it is present mainly in the arterioles (contain more smooth muscles).
- ▶ It is mainly controlled by the **diameter of arterioles** (As blood vessel length & blood viscosity kept constant).



Comment on pulse

▶ **Pulse:**

The impulse transmitted to the arteries by contraction of the left ventricle of the heart.

Provides information concerning the number of cardiac contractions per minute (rate) and the overall regularity of the contractions (rhythm).

▶ **A full comment on (Patient's pulse) should include a comment on:**

- Rate
- Rhythm
- Volume
- Equality on both sides





Thank you!