



MEASUREMENT OF BLOOD PRESSURE

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Theory

The heart supplies the organs and tissues of the body with blood. With every beat, it pumps blood into the large blood vessels of the circulatory system. As the blood moves around the body, it puts pressure on the walls of the vessels. Blood pressure readings are made up of two values:

- **Systolic blood pressure** is the pressure when the heart beats – while the heart muscle is contracting (squeezing) and pumping oxygen-rich blood into the blood vessels.
- **Diastolic blood pressure** is the pressure on the blood vessels when the heart muscle relaxes. The diastolic pressure is always lower than the systolic pressure.

Theory

- Blood pressure is measured in units of millimetres of mercury (mmHg). The readings are always given in pairs, with the upper (systolic) value first, and followed by the lower (diastolic) value.
- So, someone who has a reading of 132/88 mmHg (often spoken “132 over 88”) has a
 - **Systolic blood pressure** of 132 mmHg.
 - **Diastolic blood pressure** of 88 mmHg.
 - **Hypertension** – high blood pressure: consistently $>140/90$ mmHg
 - **Hypotension** – low blood pressure: typically, a systolic reading of <90 mmHg

Theory

- **Blood Pressure can be measured in two ways:**
 - Manually, using the auscultatory method – this involves listening to arterial sounds.
 - Automatically, using the oscillometer method – this detects variations in pressure oscillations due to arterial wall movement.
- Both methods use a measuring device attached to an inflatable cuff that is placed around the patient's upper arm, inflated to occlude the artery under the cuff, and then released in a controlled manner.
- BP is a variable haemodynamic phenomenon, and can be influenced by a range of factors

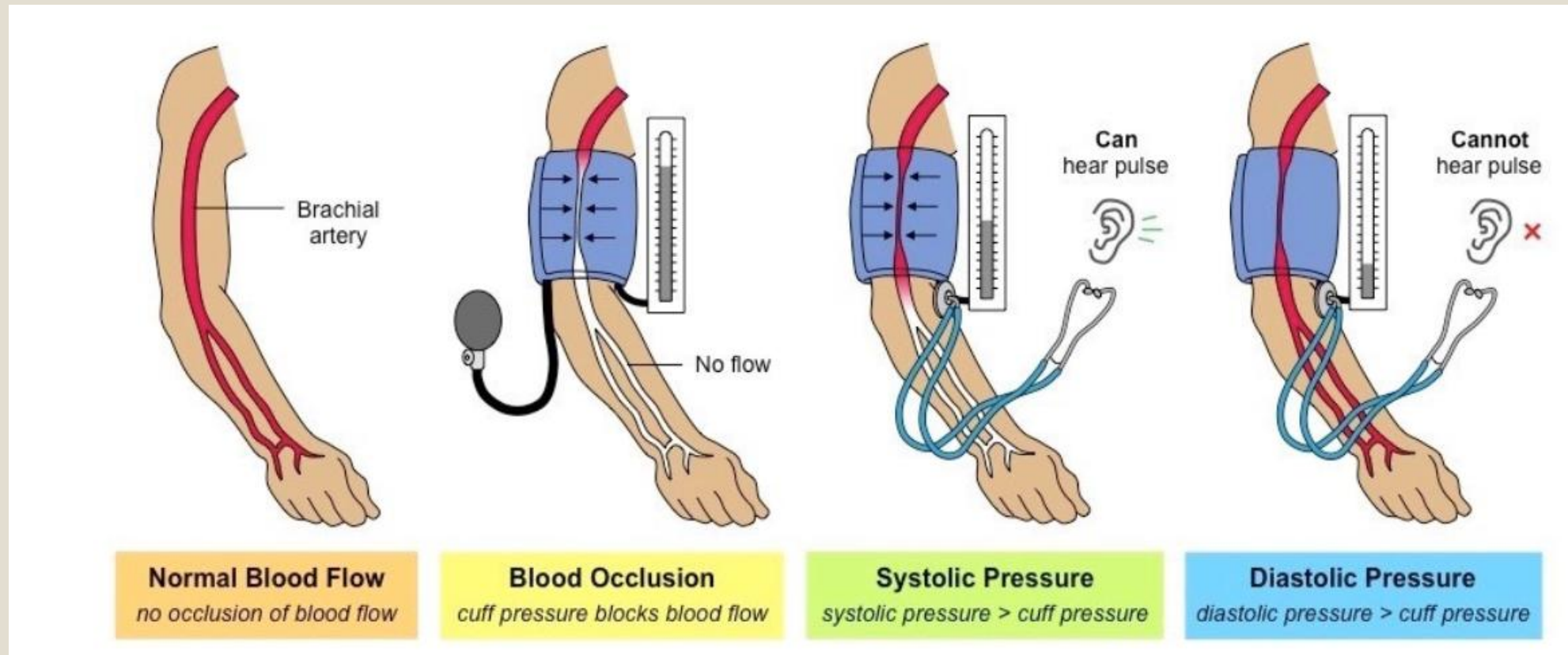
Theory

- Factors that can cause a variation in blood pressure
 - Emotional state
 - Temperature
 - Respiration
 - Bladder distension
 - Pain
 - Exercise
 - Sudden change in posture
 - Tobacco use

Manual Auscultatory Measurement

- Manual BP measurement devices require the user to inflate the upper-arm cuff to occlude the brachial artery, then listen to the Korotkoff sounds through a stethoscope while the cuff is slowly deflated.
- When the cuff is slowly deflated, five different sound phases can be heard:
 - Phase I – a thud;
 - Phase II – a blowing or swishing noise;
 - Auscultatory gap – in some patients, the sounds disappear for a short period;
 - Phase III – a softer thud than in phase I;
 - Phase IV – a disappearing blowing noise;
 - Phase V – silence: all sounds disappear.

Manual Auscultatory Measurement



Manual Auscultatory Measurement

- Devices that are generally used for manual BP measurement include:
 - **Aneroid sphygmomanometer** – this replaces the mercury manometer with an aneroid (liquid-free) gauge that registers pressure using a bellows and lever system (O'Brien, 2015), and requires use of a stethoscope;
 - **Electronic sphygmomanometer** – this battery-powered device replaces the mercury manometer with a pressure sensor and electronic display. The display may be numerical, or a circular or linear bargraph. No stethoscope is needed.

Automated measurement

Automated electronic BP devices

- Most automated BP measurement devices in current clinical practice use the oscillometric method.
- Each arterial pulse wave results in a small rise and fall in the volume of the limb which, in turn, causes an increase then a decrease in the pressure within the encircling cuff.
- The oscillometric method relies on detection of variations in pressure oscillations due to arterial wall movement beneath an occluding cuff to calculate the systolic and diastolic BP readings.

Direct Measurement

- Direct measurement of BP is usually obtained by one of three methods :
 - Percutaneous insertion.
 - Catheterization (vessel cut down)
 - Implantation of a transducer in a vessel or in the heart.

Figure below gives general idea of the direct method. Essentially, a long tube catheter is introduced into the heart of a major vessel by way of superficial vein. Then BP is measured either by introducing a saline solution and noting the pressure variation or by introduction the transducer into the catheter and measuring BP directly.

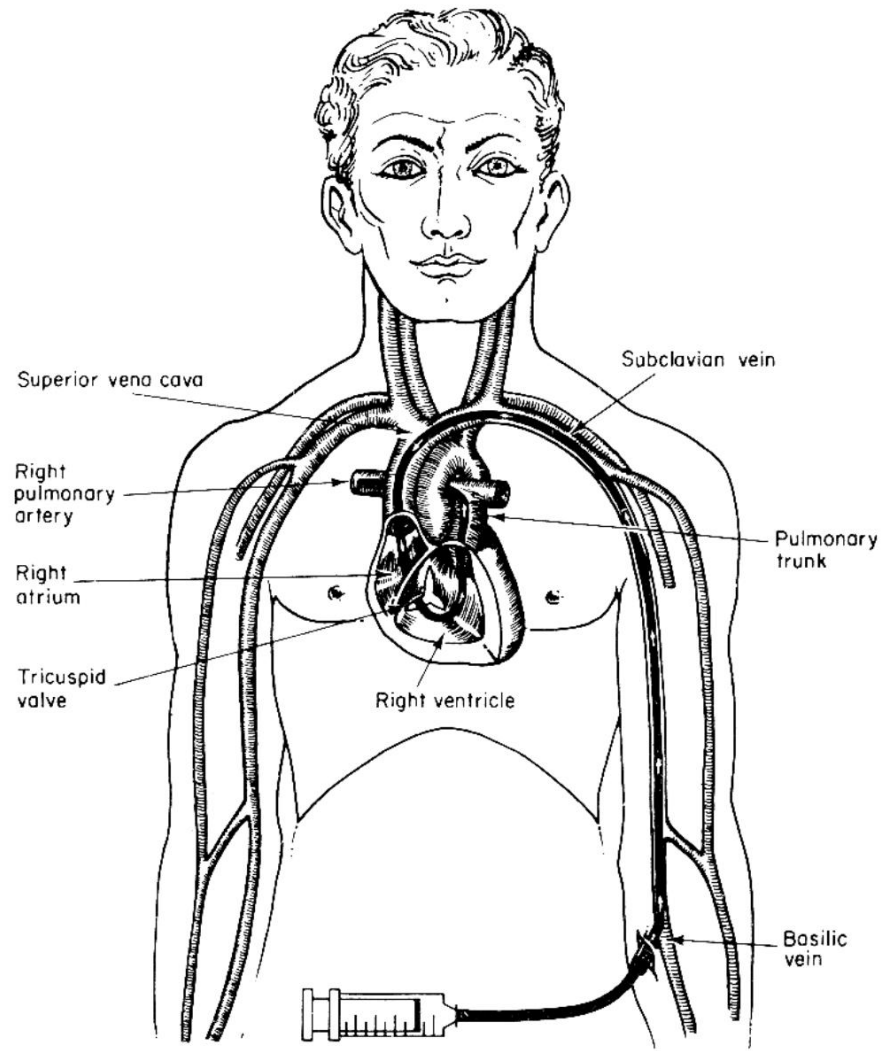


Figure-5

Cadiac catheterization. The tube is shown entering the basilic vein in this case.

Mean Arterial Pressure (MAP)

- Nowadays, along with the systolic and another parameter known as mean arterial pressure (MAP) has become very popular. Most electrical monitors now provide a single value of MAP indication along with the routine systolic and diastolic values.
- MAP is a weighted average of systolic and diastolic pressure. Generally MAP falls about one third of the way between diastolic low and systolic peak. A simple formula for calculating MAP is
 - $MAP = 1/3 (\text{systolic} - \text{diastolic}) + \text{diastolic}$
- It is now generally recognized that MAP is a direct indication of the pressure available for tissue perfusion and that a continuously increasing or decreasing MAP can ultimately result in a hypertensive crisis.