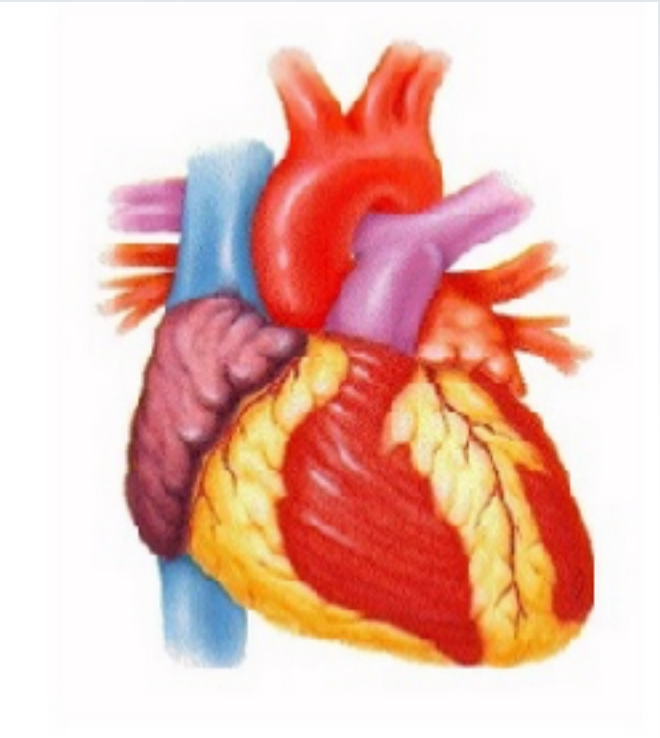
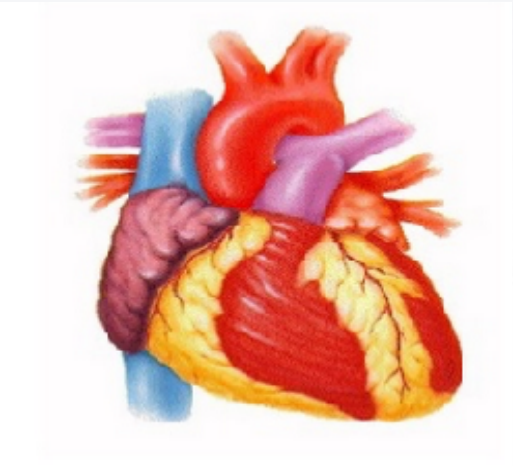
Peripheral vascular examination. Assessment of arterial pulse and blood pressure.

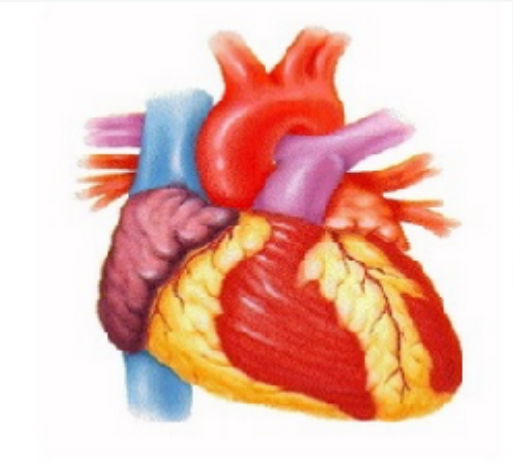


Diana Sasu
Assistant Professor, PhD

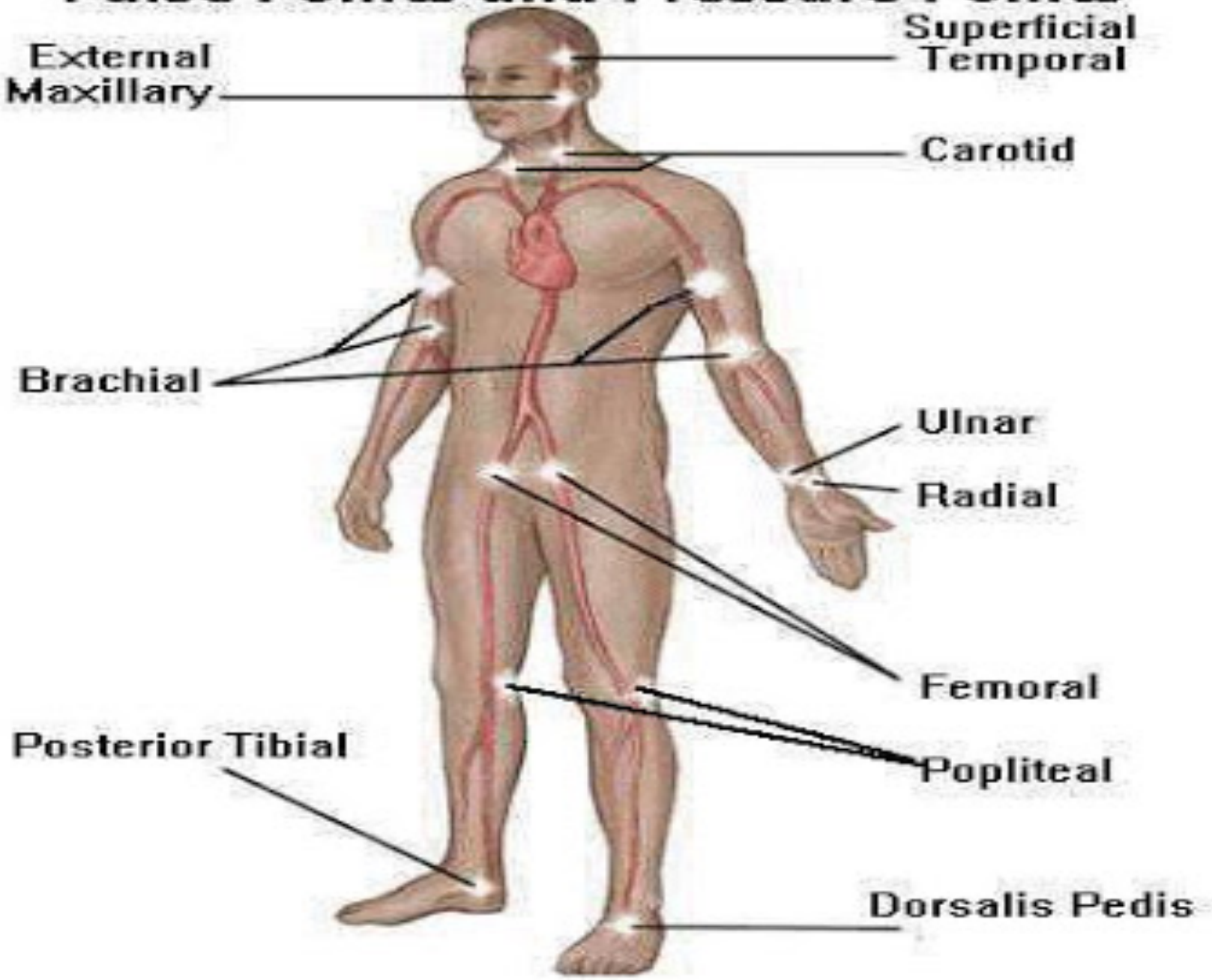
- The arterial pulse is a measurement of the heart's contraction rate because a pulse wave is created when the left ventricle contracts.
- The arteries expand in response to this contraction and increase in volume. Once expanded, the arteries will contract forcing blood to circulate to the capillaries and then to the veins.
- The carotid pulse is the most accurate reflection of central aortic pulse.



- All major pulses should be examined through palpation and auscultation: radial artery, temporal artery, carotid artery, brachial artery, femural artery, popliteal artery, posterior tibial artery and pedial artery (dorsalis pedis).
- *Palpating* peripheral arteries is the most important single maneuver in establishing whether or not chronic occlusive arterial disease is present.



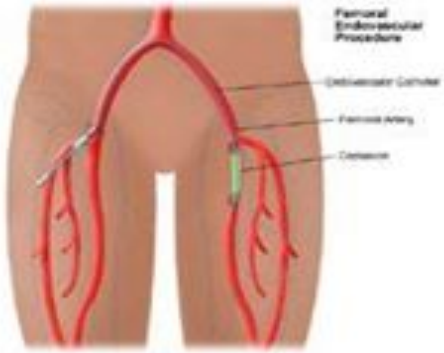
Pulse Points and Pressure Points



Palpation of arterial pulse

Radial

Brachial



Femoral

. Popliteal

Dorsalis pedis

Posterior tibial

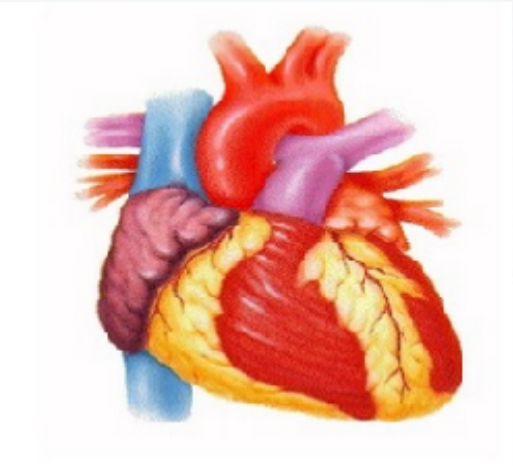
Normal pulse rate range, by age

Age	Pulse rate (beats per minute)
Newborn (resting)	100-180
Infant (resting)	80-150
Child 26 years	75-120
Child 6-12 years	70-110
Adolescent-adult	60-90

- Pulse palpated at the level of the main branches of the aorta (carotid artery, femural artery) is *the* ***central pulse***, by exploring any of the other sites we determine the ***peripheral pulse***.

Most frequently- palpation of the radial pulse.

- Pulse palpation should be done bilaterally, in the same time, determining the simmetricity and synchronicity of the pulse.



Radial pulse

- Palpate the radial pulse with the pads of your fingers on the flexor surface of the wrist laterally.
- Partially flexing the patient's wrist may help you feel this pulse.
- Compare the pulses in both arms

Brachial pulse

- Flex the patient's elbow slightly, and with the thumb of your opposite hand palpate the artery just medial to the biceps tendon at the antecubital crease.

- The brachial artery can also be felt higher in the arm in the groove between the biceps and triceps muscle.

Carotid pulse

- This is the best place to assess the pulse volume and waveform.
- Find the larynx, move a couple of centimetres laterally and press backwards medial to the sternomastoid muscle.
- Be sure not to compress both carotids at one this may decrease blood flow to the brain and induce syncope.
- Absence or diminuation of pulsation on one side can be caused by carotid artery occlusion, proving a clue to the diagnosis of cerebrovascular disease.

Temporal pulse

• The site is above and lateral to the eye where the temporal artery passes over the temporal bone of the head.

Femoral artery

•The patient should be lying on a bed.

• Ask them to lower their clothes a little more, exposing the groins.

• The femural pulsation can be felt midway between the pubic tubercle and the anterior superior iliac spine, below the inguinal ligament.

• Auscultation should be performed in this area as well.

Popliteal artery

- This lies deep in the popliteal fossa and is surrounded by strong tendons.
- With the patient lying flat and knees slightly flexed, press into the center of the popliteal fossa with tips of fingers of the left hand and use fingers of the right hand to add extra pressure to these.

Posterior tibial artery

• Palpate at the ankle just posterior and inferior to the medial malleous, it is felt most readily by curling the fingers of the examining hand around the ankle.

• When taking the pulse on your own foot it is easier to use the thumb. In clinical practice the pulse is palpated using the pulps of the index and middle fingers.

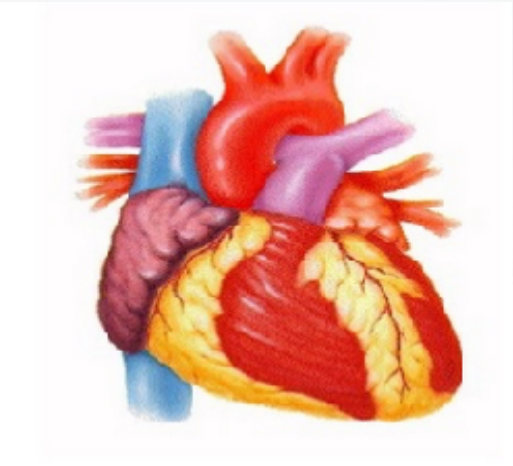
Dorsalis pedis pulse

- This runs lateral to the exterior hallucis longus tendon on the superior surface of the foot between the bases of the 1st and 2th metatarsals.
- This pulse often reguires some searching and is congenitally absent in approximately 10% of normal individuals.

Properties of arterial pulse

The following properties of pulse are examined:

- Rate
- Rhythm
- Character of the pulse (pulse volume and waveform)
- Simmetricity of the pulses
- Equality of the pulses



Pulse rate

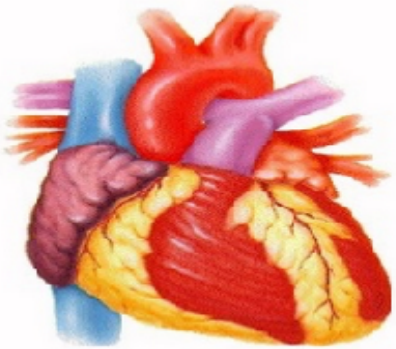
Pulse rate – expressed in beats per minute (b.p.m.)

A normal adult pulse rate is between 60-90 b.p.m.

- Tachycardia: >100 /min
- Bradycardia: < 60 /min

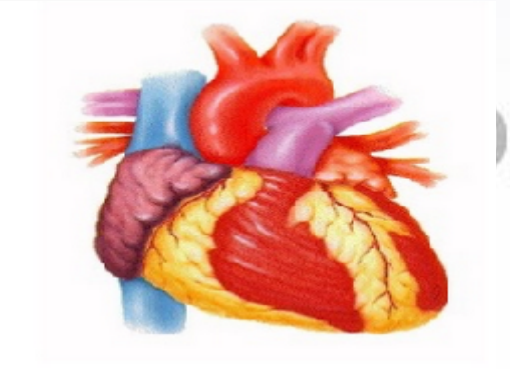
If the pulse is regular and strong, measure the pulse for 30 seconds. Double the number to give the beats per minute If it noticed changes in rhythm or strength, it must be measure the pulse for a full minute.

- Recording the pulse rate describe its strength and rhythm.
- Describe the pulse as ‘weak’, ‘faint’, ‘strong‘ or 'bounding‘.



Pulse deficit

- Difference between the apical (precordial) and radial pulse.
- It is found in atrial fibrilation, it is an irregularly irregular rhythm.
- During frequent and irregular contractions of the heart, some systoles of the left ventricle can be so weak that the blood is not ejected into the aorta or the amount of the discharged blood is very small and the pulse wave does nor reach the peripheral arteries.
- The rate should be evaluated by cardiac auscultation.

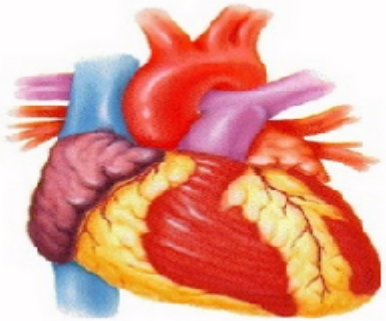


Puls rhythm

- The pulse can be either regular or irregular.
- It is important to identify any irregularity of the pulse rhythm, and whether this is permanent or intermittent.
- If there are any irregularities, check the rhythm again by listening with your stethoscope at the cardiac apex.

Pulse rhythm can be:

1. Irregularly irregular (in atrial fibrillation), the volume of the pulse is also variable.
2. Regularly irregular, *pulse bigeminus* will cause regular ectopic beats resulting in alternating brief gaps and long gaps between pulses. This may give the false impression of a very slow pulse.

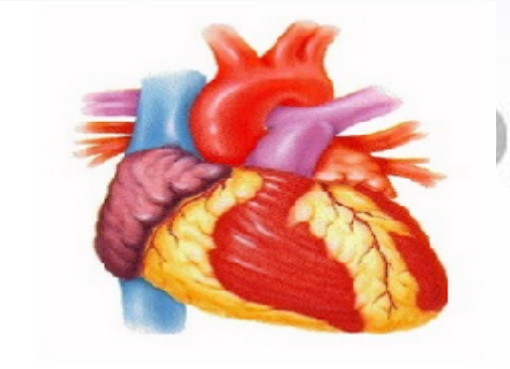


Puls rhythm

3. Regular with ectopics or extrasystoles from the atria or ventricles, a very difficult thing to feel and be sure of without an ECG.

- Often the pulse wave produced by the ectopic beat is too weak to be felt at the wrist. This produces a pulse deficit. Ectopic beats are followed by a compensatory diastolic pause which allows increased ventricular filling and produces a large stroke volume in the sinus beat following the ectopic beat, so this stronger beat is that is being felt by the patient.

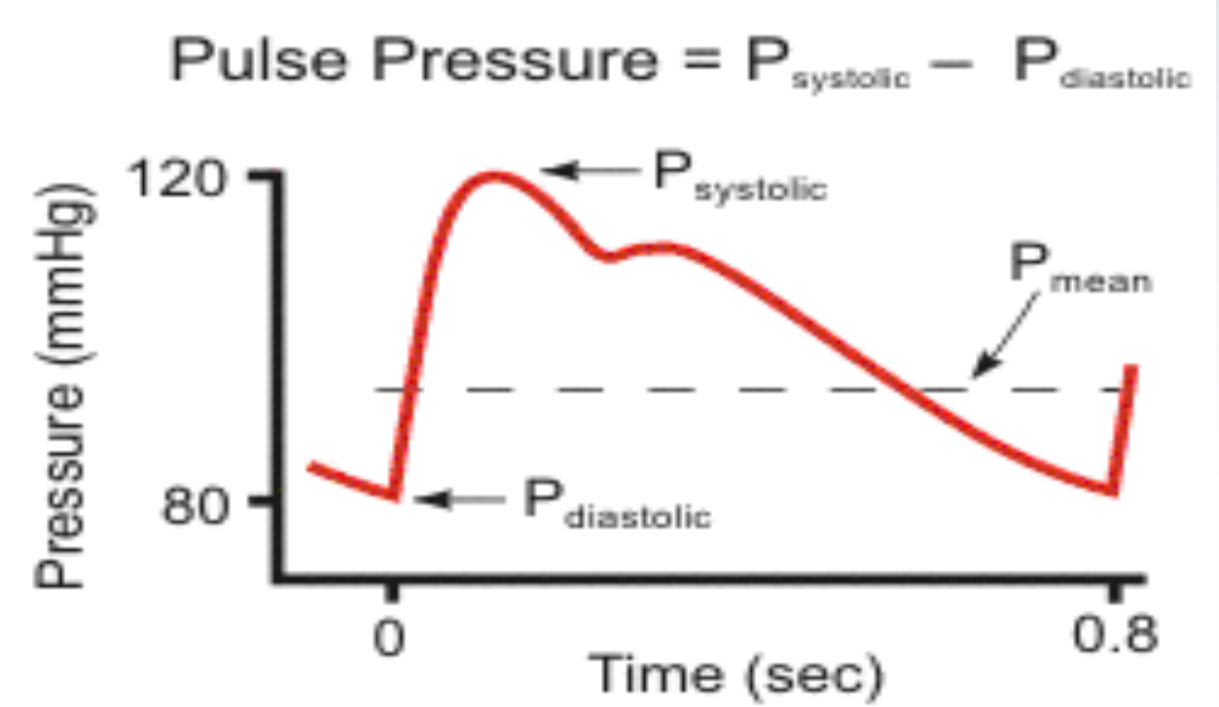
Causes of irregular rhythm: sinus arrhythmia, atrial extrasystoles, ventricular extrasystoles, atrial fibrillation, atrial fluter with variable response.



Character of the pulse (pulse volume and waveform)

Pulse volume- is the movement imparted to your fingers and reflects the pulse pressure.

Pulse pressure – the difference between systolic and diastolic blood pressure.



A large volume pulse may be due to:

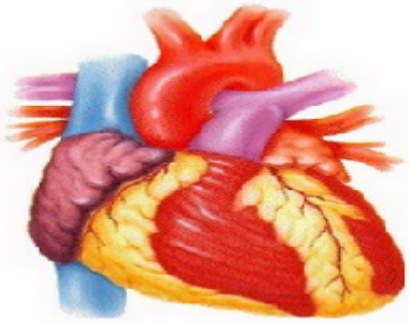
1. aortic regurgitation
2. a high cardiac output state:

- physiological factors: exercise, emotion, pregnacy
- pathological conditions causing increases cardiac output (hyperkinetic circulation): fever, severe anemia, bradycardia

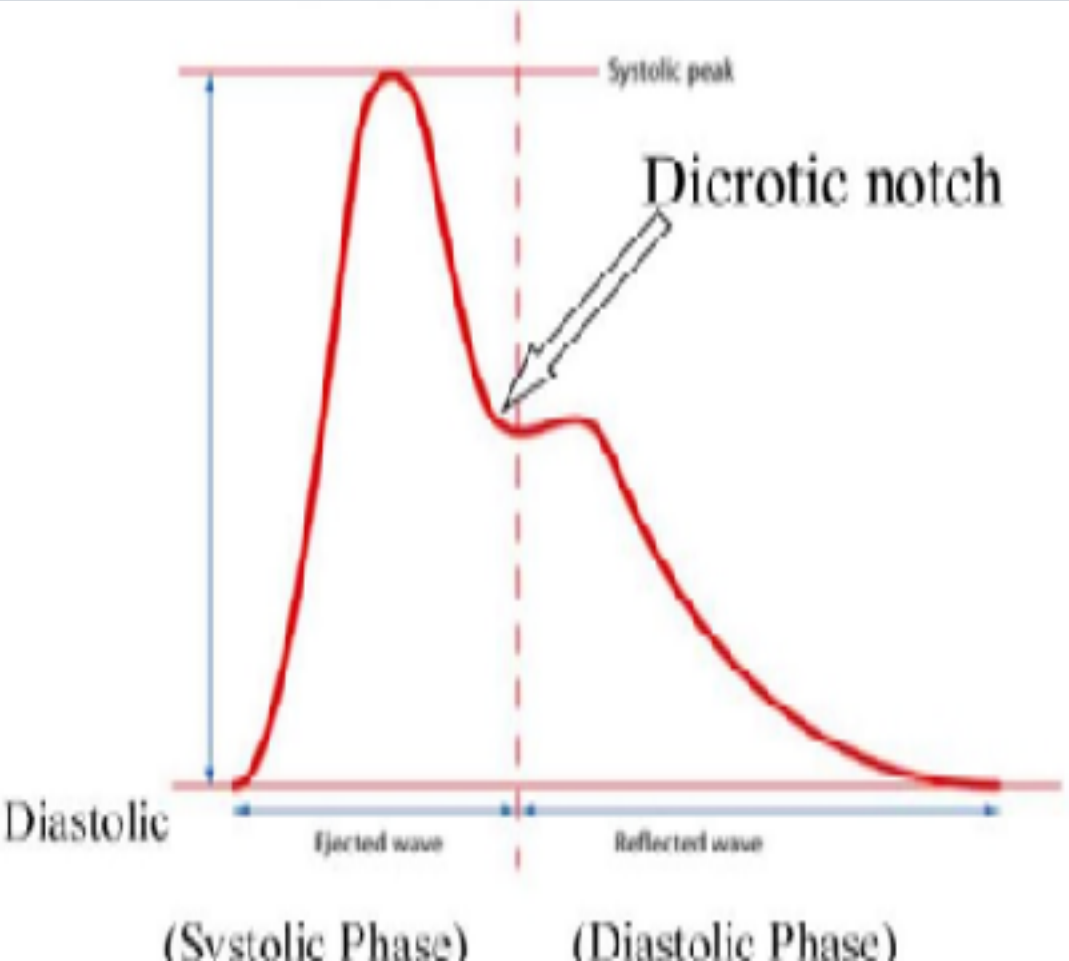
A low volume pulse is associated with:

- reduced stroke volume due to heart failure (poor cardiac contractility)
- aortic stenosis
- peripheral vascular disease

The pulse may be thin and "thready" in hypovolemia due to hemorrhage or dehydration.



Carotid artery pulse wave



- The systolic phase corresponding to the opening of aortic valve. It's start with an upward trajectory (the *anacrotic wave or the percussion wave*)
- a descending wave (*dicrotic notch*)
- The diastolic phase includes the *dicrotic wave* (of reascension), caused by collison of the blood tending to flow back into the ventricle against the closed valve.

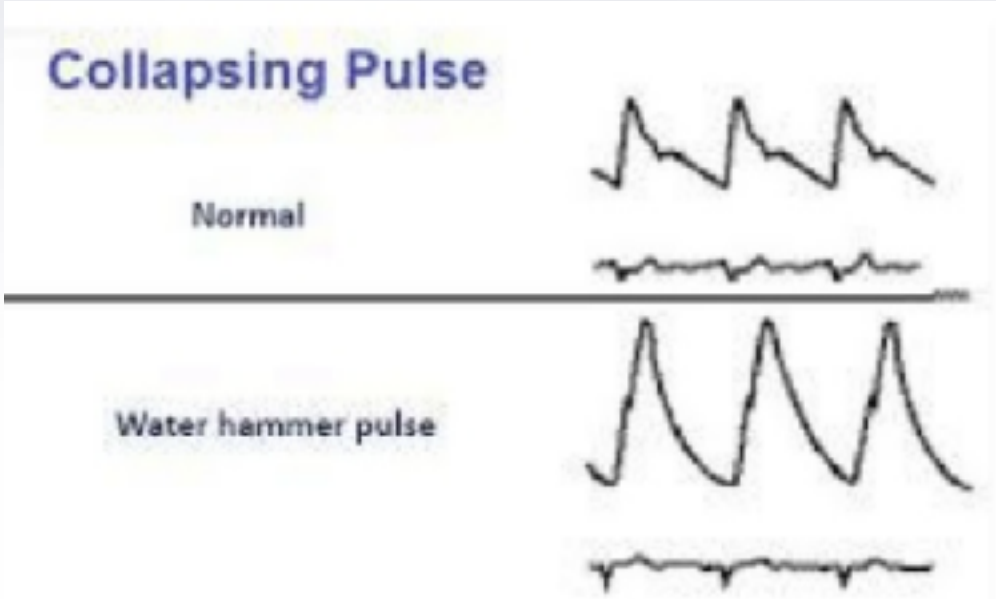
Pulsus parvus and tardus

- Best evaluated by palpating carotid pulse
- The pressure is diminished, the pulse feels weak and small, reflecting decreased stroke volume (pulse parvus)
- Slow rising pulse with delayed systolic peak and upstroke (pulse tardus)
- Frequently associated with thrill in carotids, caracteristic for aortic stenosis

Collapsing pulse/ Water-hammer pulse/ Corrigan's pulse

- Characterized by an abrupt, very rapid upstroke of the peripheral pulse (percussion wave), followed by rapid collapse.

- It is best appreciated by raising the arm abruptly and feeling for the characteristics in the radial pulse.

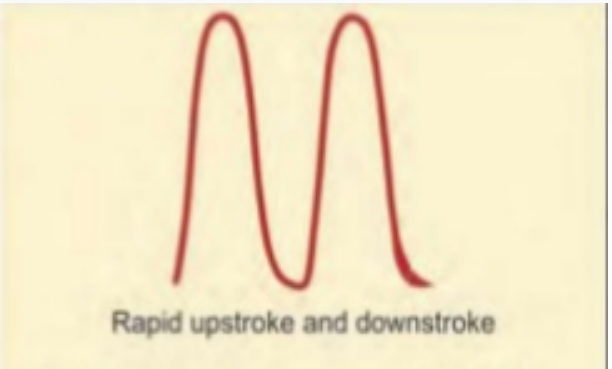


Collapsing pulse/ Water-hammer pulse/ Corrigan's pulse

Results from very rapid ejection of a large left ventricular stroke volume into a low resistance arterial system.

It occurs most commonly in chronic, hemodynamically significant aortic regurgitation;

- in many conditions associated with increased stroke volume: patent ductus arteriosus, large arteriovenous fistulas, hyperkinetic states, thyrotoxicosis, anemia, and extreme bradycardia.



Pulsus bisferans

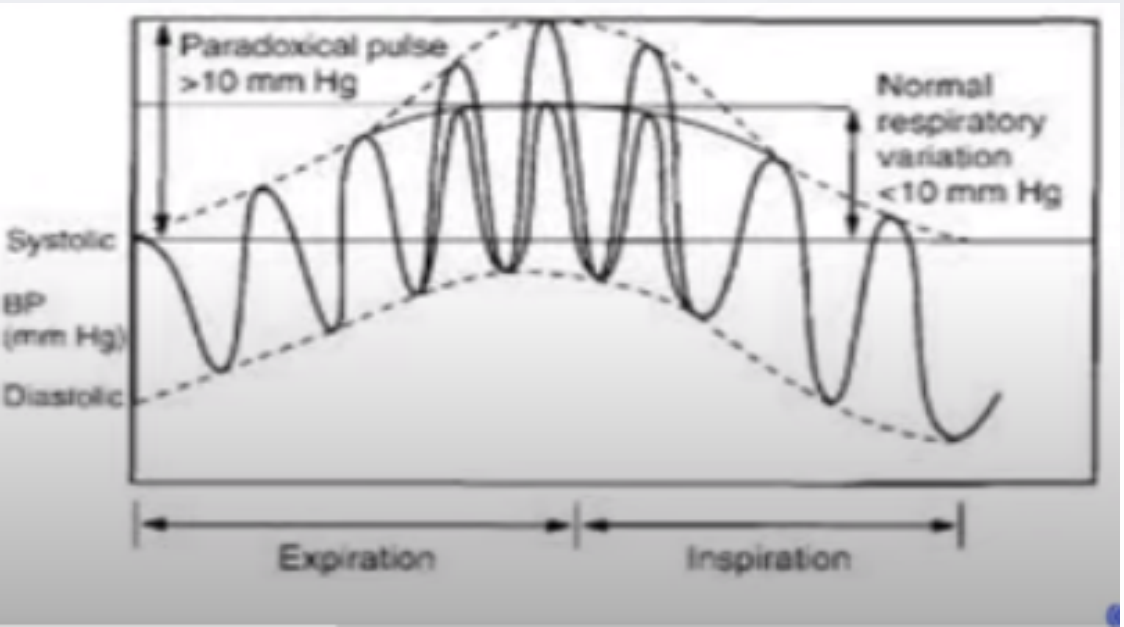
- Characterised by two systolic peaks sepearted by distinct midsystolic dip, best felt in brachial and femural artery.

Etiology:

- Occurs in mixed aortic stenosis and regurgitation, when the stenosis is moderate and the regurgitation is severe
- HOCM

Pulsus paradoxus

- A fall in the systolic blood pressure (SBP) of > 10 mmHg with inspiration
- Heart sounds are present but pulse may disappear during inspiration.



Pulsus Paradoxus

Inspiration

Increased venous return
(negative intrathoracic pressure)

Lung expansion

Right ventricle
enlarges

Pulmonary vasculature
expands

Septum pushes into left ventricle

Increased blood pools in pulmonary vasculature

Decreased filling of left ventricle

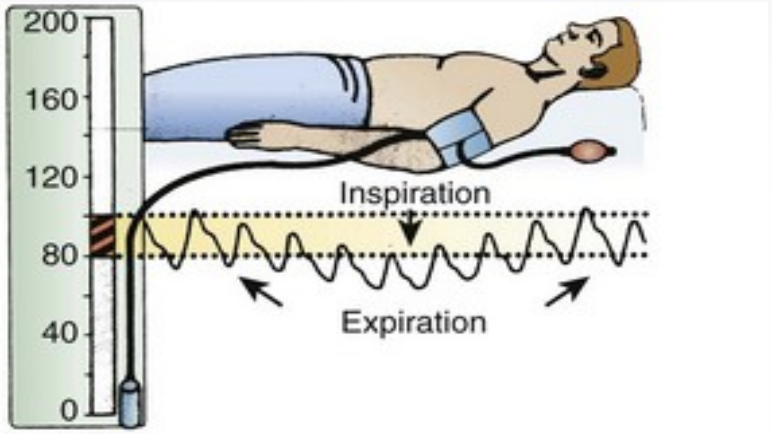
↓ **Stroke volume** ↓ **Pulse amplitude**

The Paradox

one can detect beats on cardiac auscultation during inspiration that cannot be palpated at the radial pulse

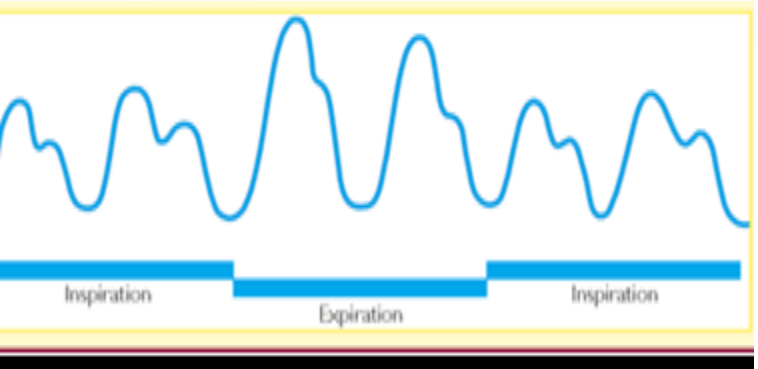
How to measure it?

1. Ask the patient to breath normally and inflate cuff ≥ 10 mmHg above the point at which no Korotkoff sound are heard
2. Slowly deflate cuff until the rest of Korotkoff sounds are heard (the sounds will be intermittent, only occuring during expiration)
3. Continue to deflate cuff until all Korotkoff sounds are heard (the sounds will be constant- now at the SBP where all inspiratory beats are audible as well)
4. The pulsus is the difference in SBP between step 2 and step 3, and if > 10 mmHg, then there is a pulsus paradoxus.



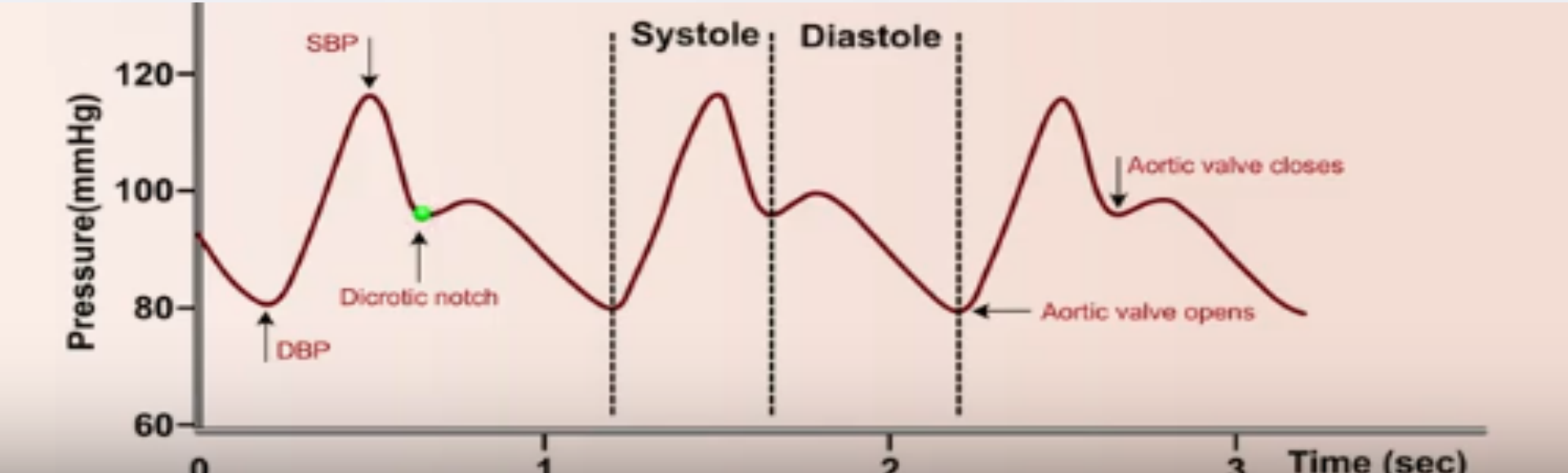
Causes of pulsus paradoxus

- Cardiac tamponade (commonly): due to a large pericardial effusion. In this case heart cannot expand because of the surrounding compressing pericardial fluid, due to what when blood is sucked into the right ventricle by inspiration, left- sided cardiac filling from the pulmonary circulation is reduced and the output from each beat during inspiration falls.
- Constrictive pericarditis, severe asthma, COPD (because of extreme changes in intrathoracic pressure)
- Restrictive cardiomyopathy, severe pulmonary embolism and hypovolemic schock (rarely).



Dicrotic pulse

- Results from accentuated diastolic dicrotic waves that follows dicrotic notch
- Tends to occur when dicrotic notch is low
- Patients with decrease systemic arterial pressure & vascular resistance (fever)



Dicrotic pulse

Present in patients with

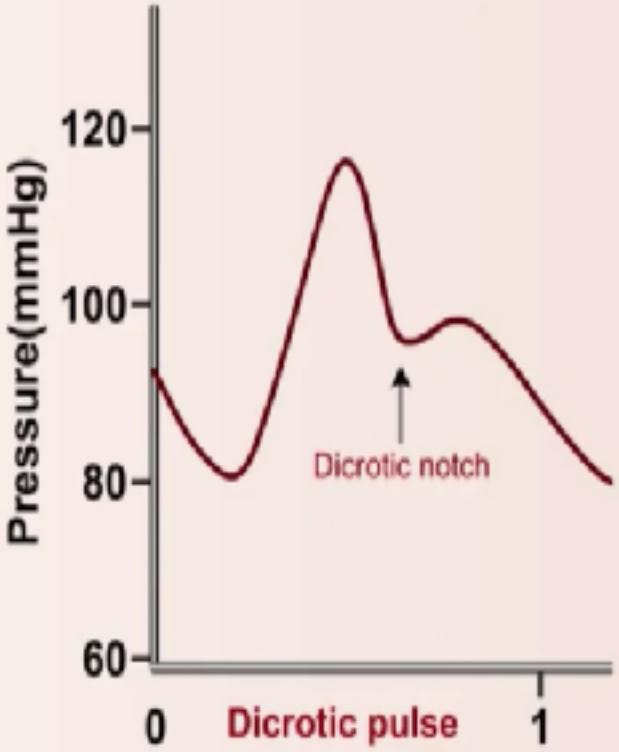
- Severe heart failure
- Hypovolemic shock
- Cardiac tamponade
- Conditions associated with
  - ↓ Stroke volume
  - ↑ Systemic vascular resistance
- Immediate postoperative period (aortic valve replacement)
  - Precise mechanism - Not clear
  - More frequently observed in patients with pump failure postoperatively

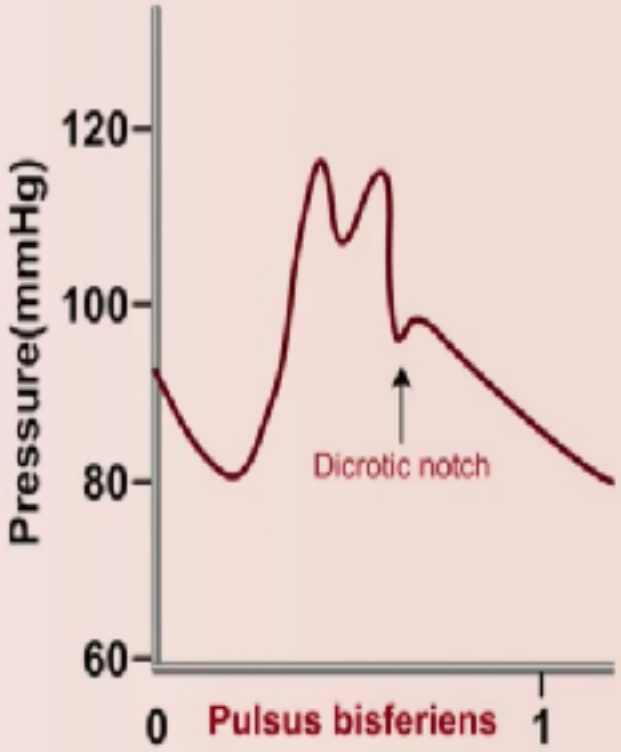
Dicrotic pulse

- Occasionally noted in normal individuals, particularly after exercise
- Frequently confused with **Pulsus bisferiens**

(aka **Biphasic pluse** : Aortic waveform with two peaks per cardic cycle)

- Impossible to distinguish between these 2 types of pulse configurations without pulse recording



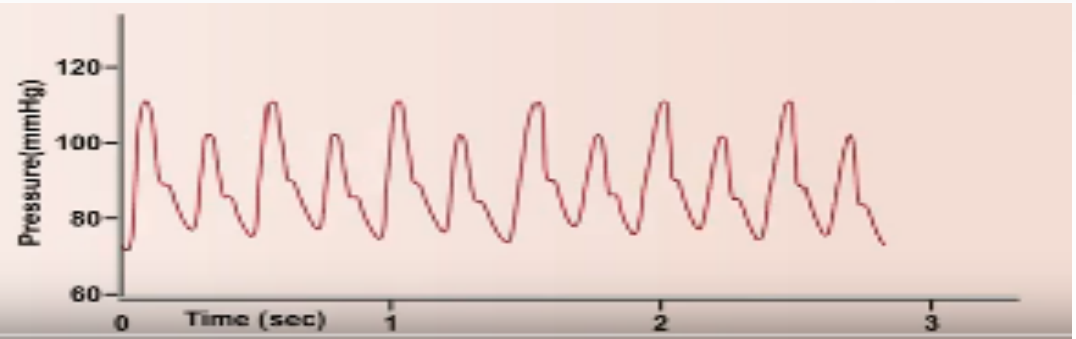


Pulsus alternans/Mechanical alternans

- Variation in pulse amplitude occuring with alternate beats due to changing systolic pressure
- Best appreciated- applying light pressure on peripheral pulse, can be confirmed by measuring blood pressure
- When cuff pressure

  - slowly released- Phase I Korotkoff sounds are intially heard only during alternate strong beats

  - further release, softer sounds of weak beats also appear
- Degree can be quantitated by measuring difference in systolic pressure between strong & weak beat



Pulsus alternans (Mechanical alternans)

Etiology

Most important cause	Left ventricular failure
Clinical practice	True pulsus alternans is rarely seen in absence of significant left ventricular myocardial failure
	Prompt further investigation to determine severity & cause of left ventricular myocardial dysfunction
Pulsus alternans occurs	Exclusively - Systolic heart failure (low left ventricular ejection fraction)
	Rarely - Diastolic heart failure (preserved ejection fraction)

Pulsus alternans (Mechanical alternans)

Evident in following situations:

- Left ventricular pulsus alterans without systemic arterial pulsus alternans: **hypertrophic cardiomyopathy**& significant rest/ provovable outflow gradient

  - mechanism is unclear
- Cardiac tamponade (rare)
- Tachypnea (respiratory rate is one- half rate due to an inspiratory decrease in pulse amplitude)
- Severe aortic regurgitation
- Freguently precipitated by ectopic beats (bigeminal rhythm)

Pulsus alternans (Mechanical alternans)

- Simultaneous auscultation of sequence of heart sound & palpation of arterial pulse can be differentiate between true pulsus alternans & apparent pulsus alternans due to bigeminy.
- Should not be dianosed when cardiac rhythm is irregular.
- More common with faster heart rate.

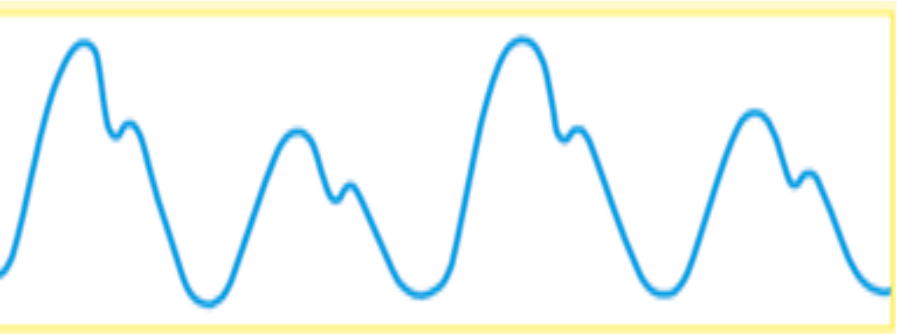
Pulsus alternans (Mechanical alternans)

Mechanism

- **Unclear**

- Alternating preload (Frank-Starling mechanism)
- Incomplete relaxation

- **Changes in afterload** (lower before strong beat) because of lower output during weak beat, may also contribute



Pulsus alternans

Mechanism

- **Primary mechanism** - Change in ventricular contractility

  ↓

  Mechanism - Changes in activity of sarcoplasmic calcium pump with alternate strong & weak beats

- **Experimental animals** - Acute myocardial ischemia is associated with regional pulsus alternans, leading to hypothesis that alternating potentiation & attenuation or deletion of contraction accounts for pulse abnormality
  - May result primarily from an alternating contractile state of ventricle
- Magnitude of alteration of pressure & stroke volume during pulsus alternans, indices of pump function, reflects interaction of an alternating contractile state with changes in preload & afterload

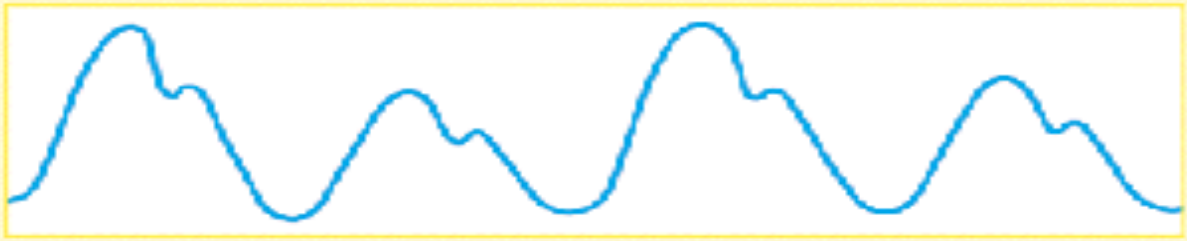
Comparing arterial pressure waves

This waveforms shown here help differentiate a normal arterial pulse from pulsus alternans, pulsus bisferiens, and pulsus paradoxus.

Normal arterial pulse

The percussion wave in a normal arterial pulse reflects ejection of blood into the aorta (early systole). The tidal wave is the peak of the pulse wave (later systole), and the dicrotic notch marks the beginning of diastole.

Pulsus alternans

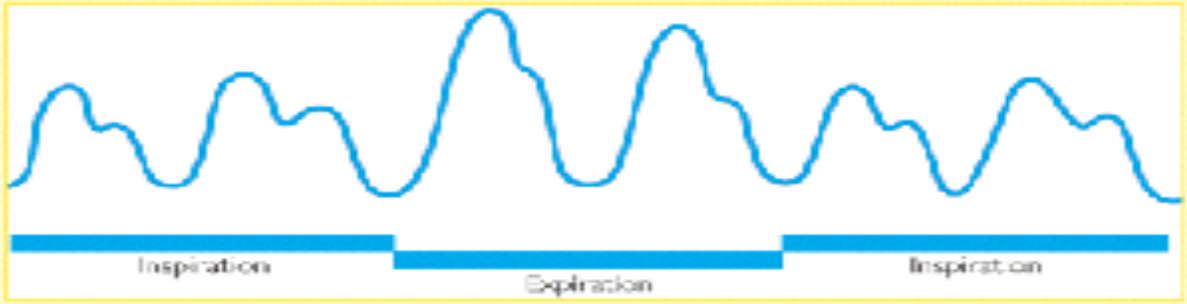


Pulsus alternans is a beat-to-beat alternation in pulse size and intensity. Although the rhythm of pulsus alternans is regular, the volume varies. If you take the blood pressure of a patient with this abnormality, you'll first hear a loud Korotkoff sound and then a soft sound. The two sounds will alternate continually. Pulsus alternans commonly accompanies states of poor contractility that occur with left-sided heart failure.

Pulsus bisferiens

Pulsus bisferiens is a double-beating pulse with two systolic peaks. The first beat reflects pulse pressure and the second reverberation from the periphery. Pulsus bisferiens commonly occurs with aortic insufficiency (pure bisferiens aortic regurgitation), hypertrophic cardiomyopathy, or high cardiac output states.

Pulsus paradoxus



Pulsus paradoxus is an exaggerated decline in blood pressure during inspiration, resulting from an increase in negative intrathoracic pressure. Pulsus paradoxus that exceeds 10 mm Hg is considered abnormal and may result from cardiac tamponade, constrictive pericarditis, or severe lung disease.

Other qualities of the pulse wave

- Pulse amplitude (***puls magnus-*** large amplitude **or *puls parvus-*** small amplitude***)***
- Pulse velocity (***puls celer-*** high velocity or *p**ulse tardus***- low velocity)
- Pulse tension – compressibility (**pulse mollis** – easily suppresive or **pulse durus-** hardly suppresive)

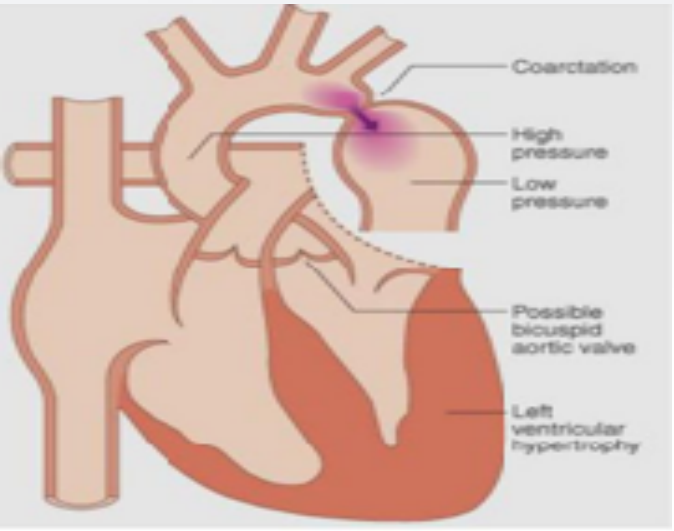
Simmetricity and equality of the pulses

- Information should be obtained by simultaneously palpating the two radial, the two femural arteries and then the radial and femural arteries
- Normally, the pulse arrives in these locations virtually simultaneously

Radio-femoral delay

- In children with *coarctation of the aorta*, the upper limb pulses are normal, while femoral pulses are usually palpable because of the development of collaterals, but are of low volume and delayed with respect to the radial pulse when you palpate them simultaneously on the same side.

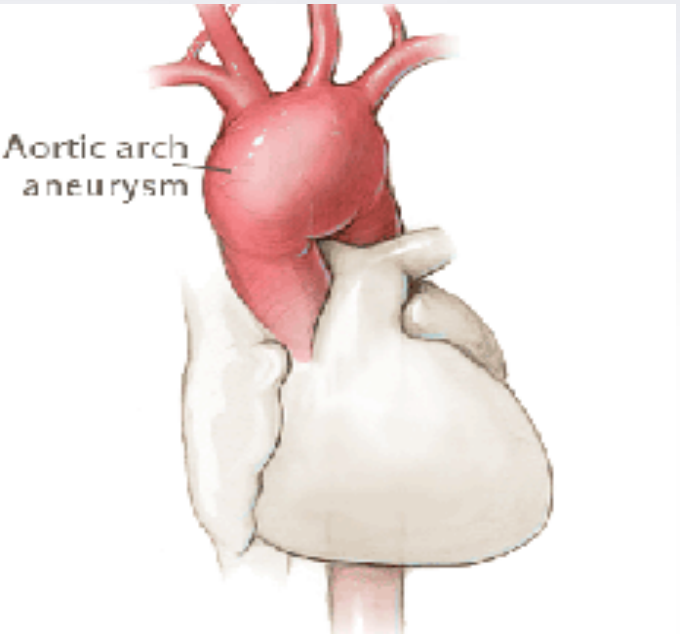
This delay can be also after *aortic dissection*.



Radio-radial delay

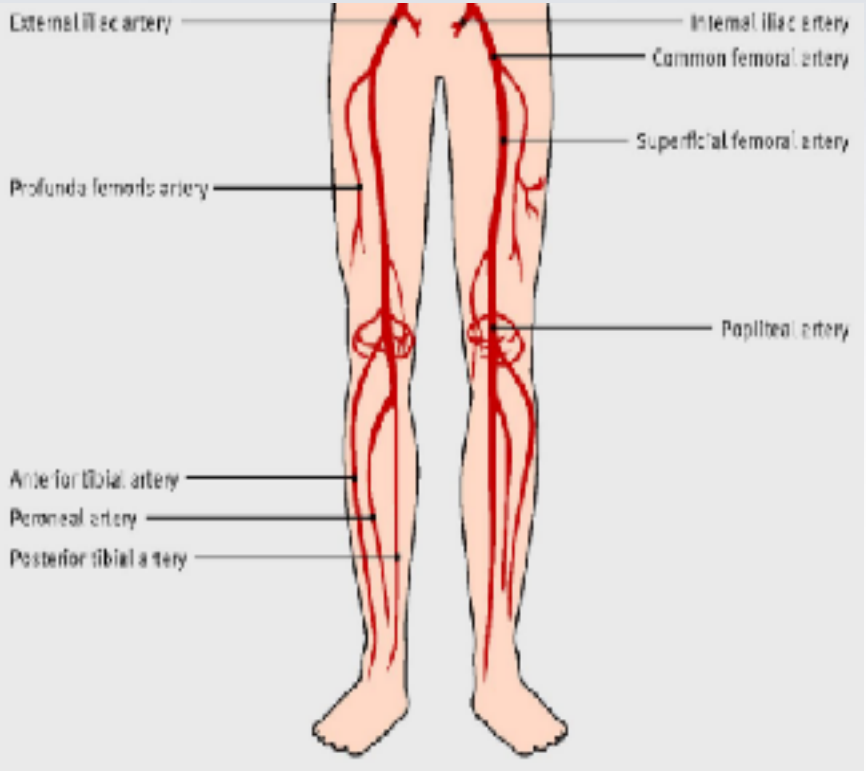
- It should feel both radial pulses simultaneously.

In the normal state, the pulses will occur together. Any delay in the pulsation reaching the radial artery on one side may point to pathology such as *aneurysm of the aortic arch* or *subclavian artery stenosis.*



Auscultation of peripheral arteries

- Bruits can be heard when blood flow is turbulent, may indicate partial occlusion, most frequently caused by atherosclerosis, but can be found normally in thin patients or hyperdinamic states.



Auscultation of carotid arteries

Should be performed along the course of the carotid artery.

- Lightly apply the bell of the stethoscope over the course of the carotid artery, from the base of the neck to angle of the jaw, during full expiration.
- It is necessary for the patient to stop breathing during auscultation to eliminate harsh sounds of traheal breathing that could mask o low pitched carotid bruit.

Auscultation of carotid arteries

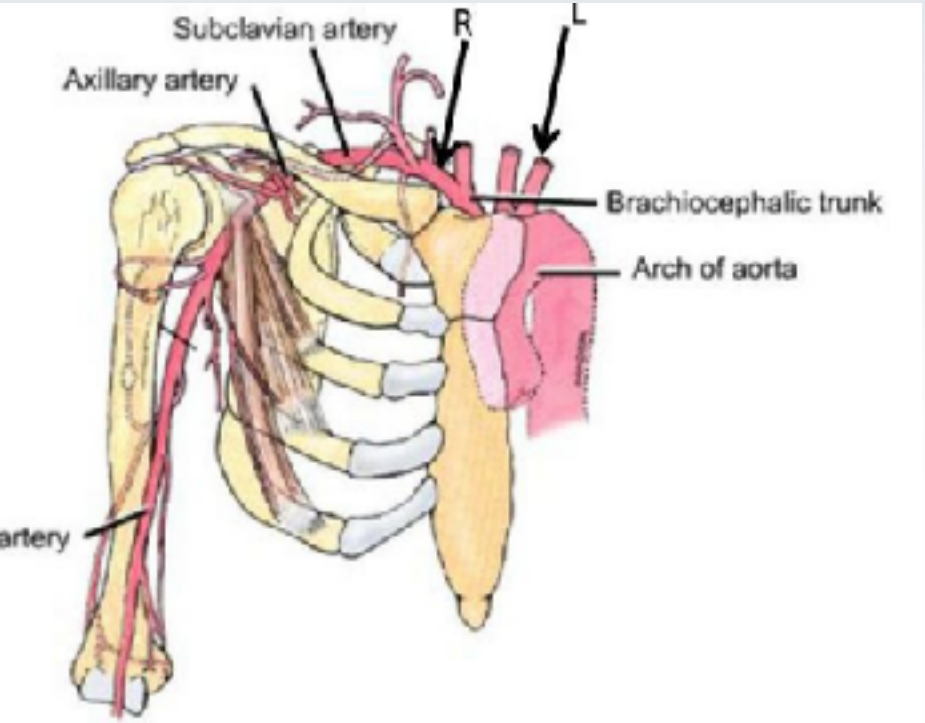
- Innocent murmur: children and adults with high cardiac output often have innocent cervical bruits related to high carotid flow.
- Functional: cervical bruit in thyrotoxicosis. In this condition, blood flow through the enlarged thyroid gland increases five- to ten fold, producing a systolic bruit directly over the thyroxic goiter.

Radiation from the aortic valve stenotic murmur, rarely anteriorly directed loud mitral murmurs may also got the neck, in this cases the same noise will be heard in neck and chest.

- Organic: can originate from disease in the carotid (stenosis) in which case it is only heard in the neck.

Subclavian arteries

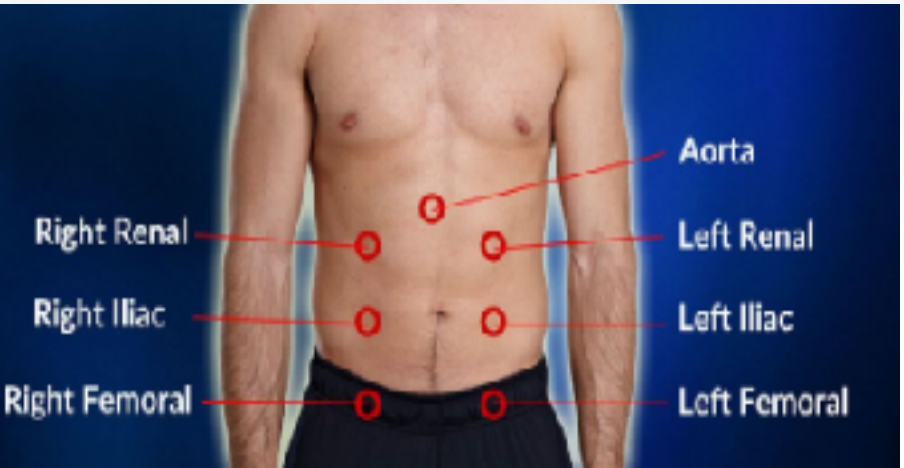
- Listen in the supraclavicular area
- Innocent supraclavicular systolic bruits are often heard in normal children or adolescents
- Supraclavicular murmurs in older persons may indicate significant vertebral or subclavian aretry stenosis.



Auscultation

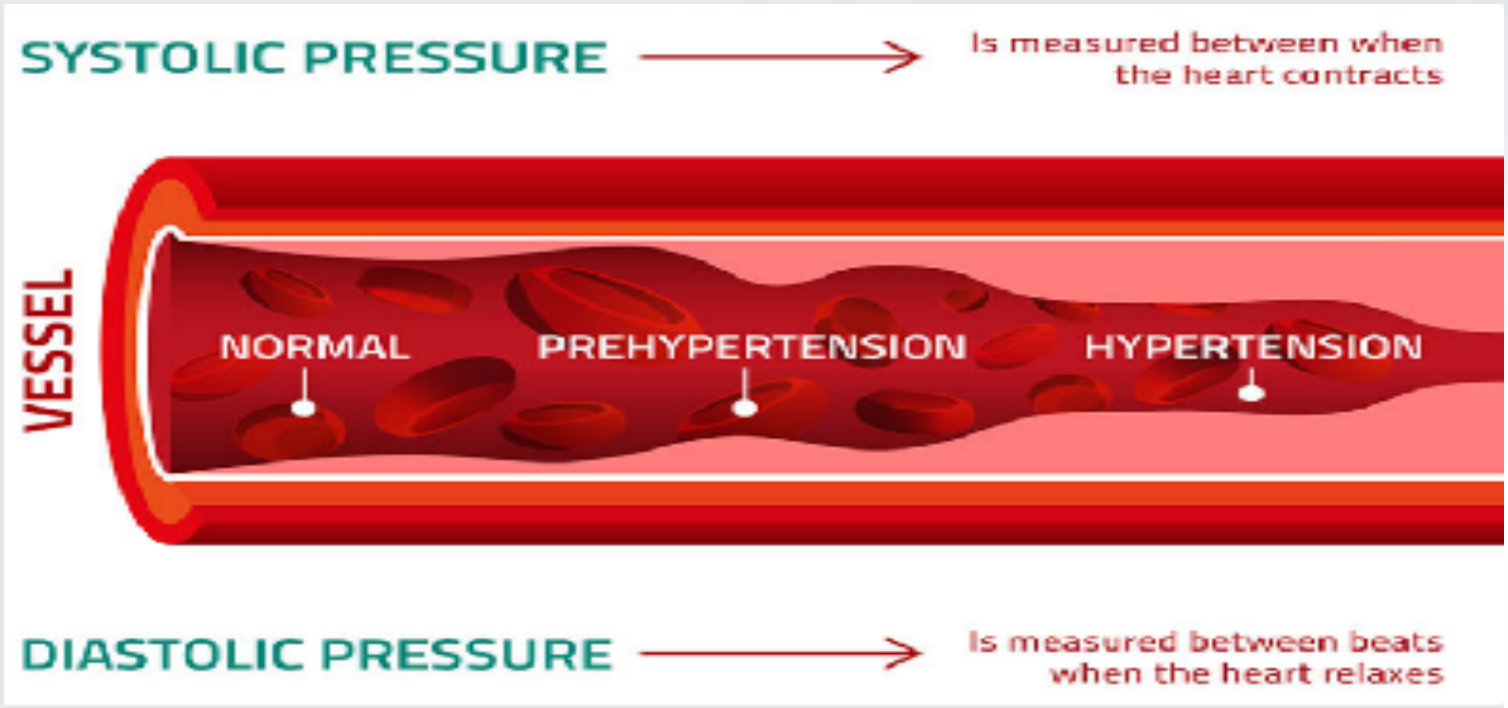
- **Abdominal aorta-** listen over and under umbilicus.
- **Iliac arteries-** along both iliac arteries into the lower abdominal quadrants
- **Femural arteries-** listen in the groin and over Hunter canal (supero-intern thigh)
- **Renal arteries-** on the 2 sides of ombilicus in the lumbar regions.

Loud systolic bruits are due to atherosclerotic plaques within arteries, producing turbulent flow. These plaques are common in the aorta and iliac arteries and less common in the renal arteries. Turbulent flow within an abdominal aortic aneurysm may create a bruit. Bruits that are present in both systole and diastole are strongly suggestive of an arteriovenous communication.

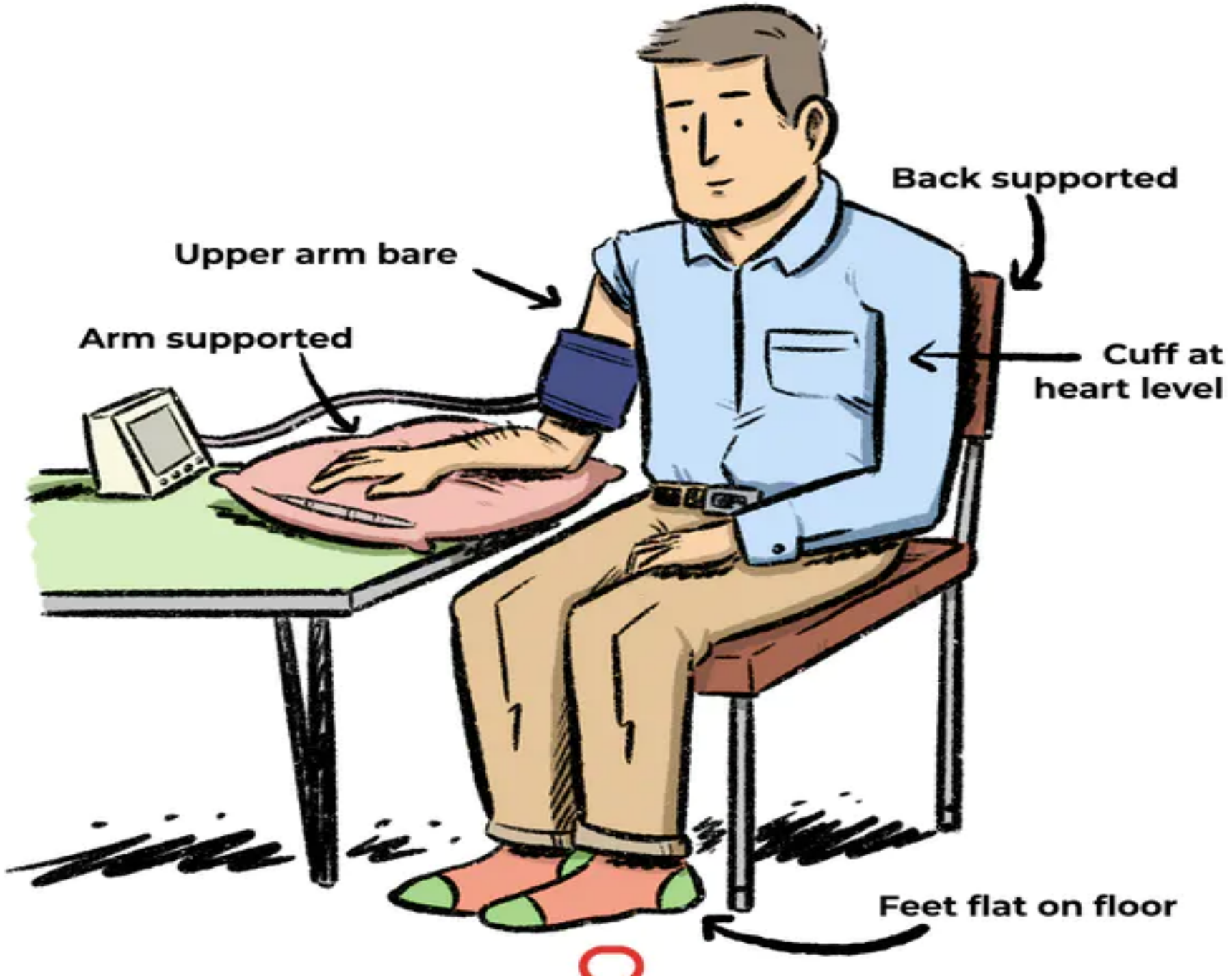


What is blood pressure?

- BP is a measure of the pressure exerted by the blood as it flows through the arteries. It is measured in millimetres of mercury (mmHg). Blood pressure measurements take into account:
- **Systolic** measurements (the contraction of the ventricles) and
- **Diastolic** measurements (the ventricles are at rest and filling).



How to sit to have your blood pressure taken



Korotkoff sounds are generated when a blood pressure cuff changes the flow of blood through the artery. These sounds are heard through either a stethoscope or a doppler that is placed distal to the blood pressure cuff.

There are five distinct phases of Korotkoff sounds:

Phase 1: A sharp tapping.	This is the first sound heard as the cuff pressure is released. This sound provides the systolic pressure reading.
Phase 2: A swishing/whooshing sound.	Swishing sounds as the blood flows through blood vessels as the cuff is deflated.
Phase 3: A thump (softer than phase 1).	Intense thumping sounds that are softer than phase 1 as the blood flows through the artery but the cuff pressure is still inflated to occlude flow during diastole.
Phase 4: A softer, blowing, muffled sound that fades.	Softer and muffled sounds as the cuff pressure is released. The change from the thump of phase 3 to the muffled sound of phase 4 is known as the first diastolic reading.
Phase 5: Silence.	Silence that occurs when the cuff pressure is released enough to allow normal blood flow. This is known as the second diastolic reading.

How to Take a Blood Pressure Measurement

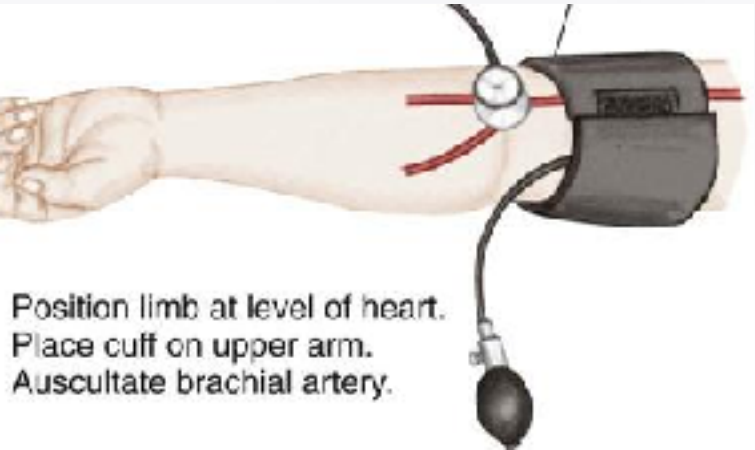
Step 1

- Obtain consent from the patient for the assessment and explain the procedure.
- Ensure that the patient has not had caffeine or tobacco in the last 30 minutes.
- The patient should be allowed to rest for 5 minutes following activity.
- Prepare the environment by making the room quiet, ensure patient privacy and equipment is intact and clean. BP is measured indirectly with a stethoscope and a sphygmomanometer. A sphygmomanometer includes the blood pressure cuff, connection tubes, air pump and manometer.

Step 2

Choose a measurement site:

- The preferred site is the brachial pulse site where the brachial artery runs across the antecubital fossa.
- Another site is the posterior thigh, where the popliteal artery runs behind the knee joint.
- A site should be free from pain, injury, surgical incisions, intravenous cannulas, central venous or arterial lines, areas with poor perfusion, arteriovenous fistulas or AV shunts. This reduces the risk of patient harm and helps to ensure result accuracy.



How to Take a Blood Pressure Measurement

Step 3

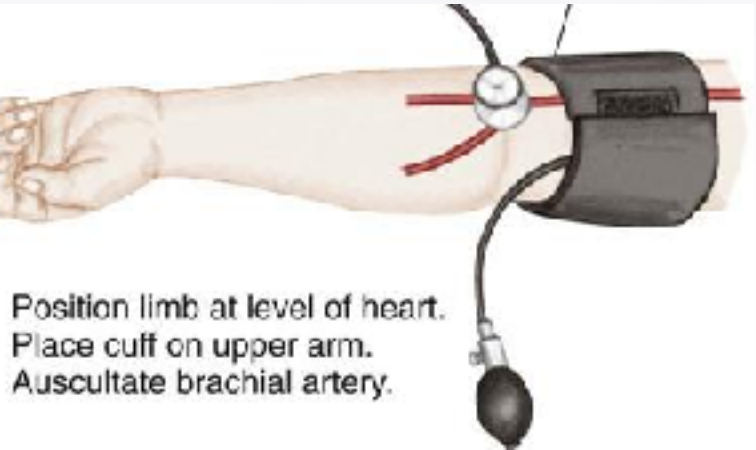
- If sitting, their feet should be flat on the floor.
- The limb should be fully exposed so the cuff can be correctly applied - don't apply the cuff over clothing.
- If using the arm: Patients should be supported so that the midpoint of the upper arm is level with the heart with the elbow extended and palm facing upward. Then palpate the brachial artery to identify location and apply the cuff directly over the brachial artery. There is usually an arrow to indicate the centre of the cuff, which should be directly above the brachial artery. Wrap the fully deflated cuff snugly about 2.5cm above the antecubital fossa and secure.
- If using the leg: Position the leg so that it is at an equal level to the heart then wrap the cuff around the thigh with the bottom of the cuff slightly above the knee. The popliteal artery will be used for BP measurement.

How to Take a Blood Pressure Measurement

Step 4

Palpate the artery to determine the systolic BP

- This ensures that the auscultatory gap does not interfere with accurate reading of the BP.
- Inflate the BP cuff and note when the pulsation is no longer palpable.
- Release the cuff and wait 1 to 2 minutes.



How to Take a Blood Pressure Measurement

Step 5

Auscultate the BP:

- Pump up to 30 mmHg above the palpated systolic BP.
- Slowly release the pressure so that it falls by 2-3 mmHg per second.
- Note the manometer reading at Korotkoff phases 1, 4 and 5.
- Continue to listen for another 30 mmHg.
- Deflate the cuff rapidly.

How to Take a Blood Pressure Measurement

- Blood pressure should be taken in both arms at least once. Normally, there may be a difference in pressure of 5 mmHg and sometimes up to 10 mmHg.
- Subsequent readings should be made on the arm with the higher pressure
- Pressure difference of more than 10-15 mmHg suggests arterial compression or obstruction on the side with the lower pressure.

Classification of office blood pressure[a] and definitions of hypertension grade[b]

Category	Systolic (mmHg)		Diastolic (mmHg)
Optimal	<120	and	<80
Normal	120–129	and/or	80–84
High normal	130–139	and/or	85–89
Grade 1 hypertension	140–159	and/or	90–99
Grade 2 hypertension	160–179	and/or	100–109
Grade 3 hypertension	≥180	and/or	≥110
Isolated systolic hypertension[b]	≥140	and	<90

Clinical significance of BP changes

- Hypertension is defined as office SBP ≥ 140 mmHg and/or DBP ≥ 90mmHg.
- Hypotension: lower than 90/60 mmHg can be caused by low cardiac output, acute cardiac tamponade, low circulating blood volume (due to hemorrhage, dehydration, loss of vascular tone (septicemia, anaphylaxis).
- Difference between upper and lower limb: lower limb BP is 20-40 higher than upper one normally.

  Pathological: aortic coarctation, acute thrombosis in atheromatous artery, aneurysm or dissection of descending thoracic or abdominal aorta

Common Blood Pressure Measurement Errors

- Bladder cuff too narrow or wide;
- Limb being assessed is unsupported;
- Insufficient rest before the assessment;
- Repeating the assessment too quickly;
- Cuff not wrapped tightly and evenly;
- Deflating the cuff to quickly;
- Deflating the cuff too slowly.

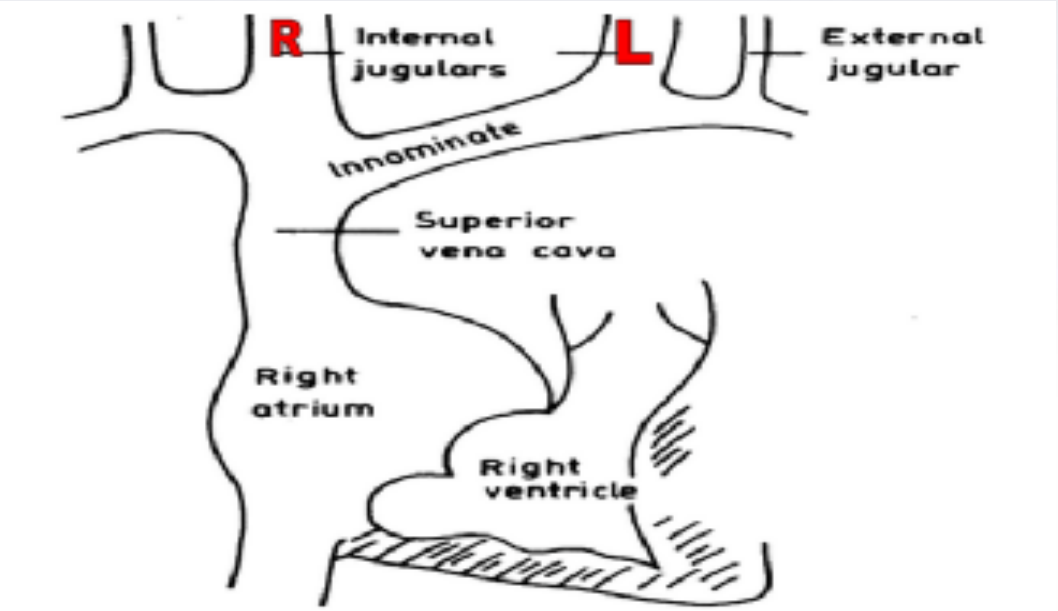
Jugular Venous Pulse and Pressure Examination

Jugular venous pulse is defined - the oscillating top of vertical column of blood in the right Internal Jugular Vein (IJV) that reflects the pressure changes in the right atrium in cardiac cycle.

Jugular venous pressure (JVP) is the vertical height of oscillating column of blood.

Why is Internal Jugular Vein preferred?

- IJV is anatomicallty closer to and has a direct course to right atrium while EJV does not directly drain into Superior vena cava.
- It is valveless and pulsations can be seen. Due to presence of valves in EJV, pulsations cannot be seen.
- Vasoconstriction secondary to hypotension (as in congestive heart failure) can make EJV small and barely visible.
- EJV is superficial and prone to kinking.

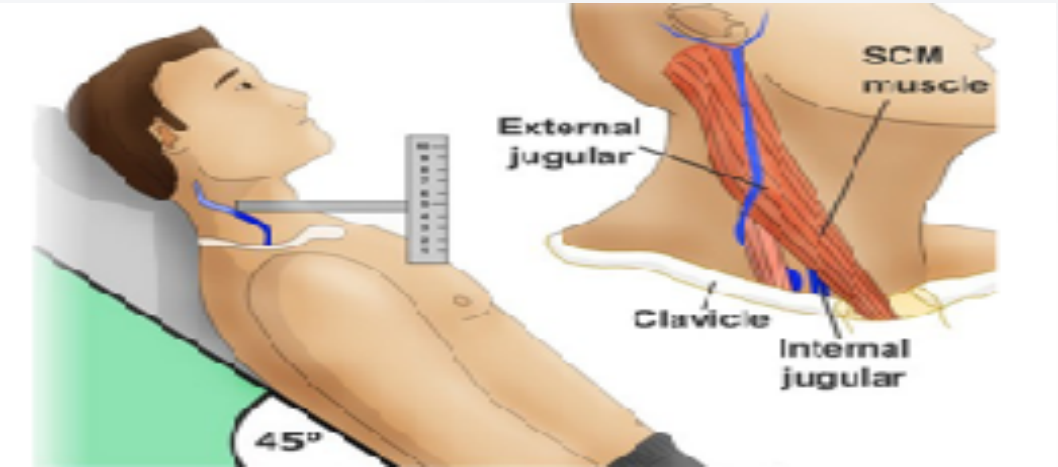


Evaluation of JVP

Evaluation of JVP

- Level
- Waveform
- Respiratory variation in level and wave pattern
- Hepatojugular reflux
- Venous hum
- Liver size and pulsations

- Patient should lie comfortably and trunk is inclined by 45 º position
- Elevate and slightly rotate head to the left;
- Inclination angle should be subtended between trunk and bed , while neck and trunk should be in same line;
- When neck muscles are relaxed, shining the light tangentially over the skin and see pulsations,
- In patients with low jugular pressure, a lesser (<30‘) inclination is desirable;
- In patients with high jugular pressure , a greater (60-90‘) inclination is required to obtain visible pulsations;
- Simultaneous palpation of the left carotid artery and or apical impulse aids in timing of the venous pulsations in cardiac cycle .

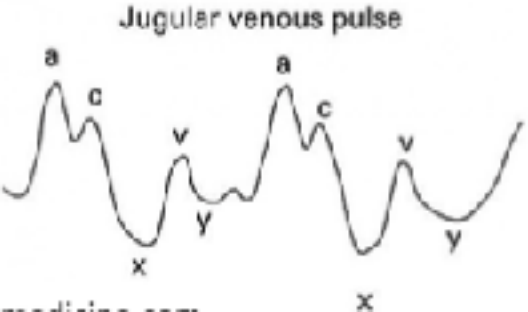


Differences between IJV and Carotid pulses

• Superficial and lateral in the neck	Deeper and medial in the neck
• Better seen than felt	Better felt than seen
• Has two peaks and two troughs	Has single upstroke only
• Descents >obvious than crests	Upstroke brisker and visible
• Digital compression abolishes venous pulse	Digital compression has no effect
• Jugular venous pressure falls during inspiration	Do not change with respiration
• Abdominal compression elevates jugular pressure	Abdominal compression has no effect on carotid pulse
• Mean jugular venous pressure falls during standing	Carotid pulse do not change when standing .

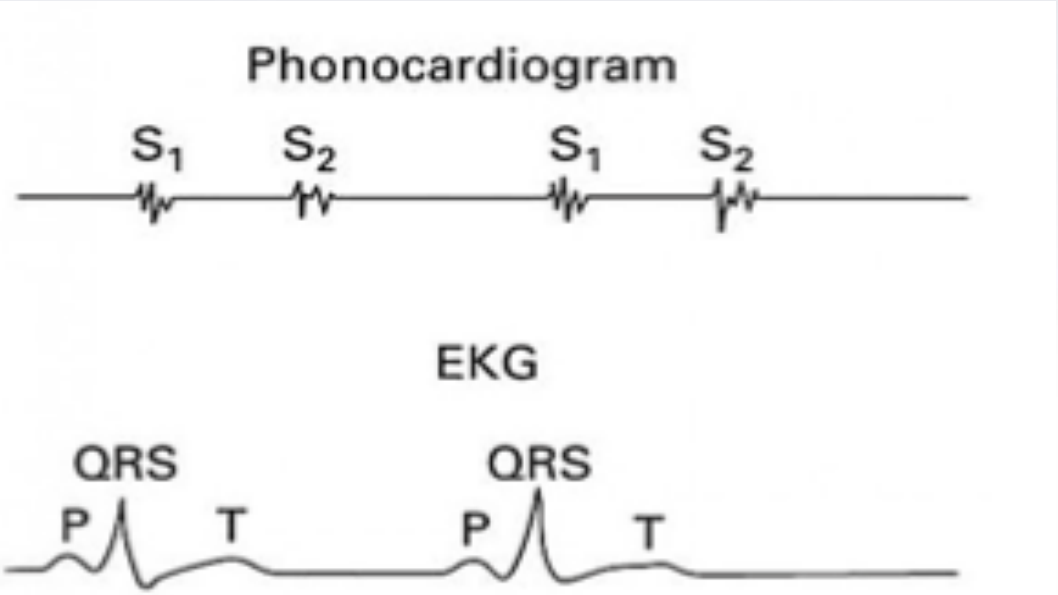
The normal JVP consists of 3 ascents or positive waves (a,c and v) and 2 descents or negative waves (x,x' and y):

- **a** wave (ascent): due to **a**ctive atrial contraction leading to retrograde blood flow into neck veins
- x wave (descent)- due to continued atrial relaxation
- **c** wave- to impact of the **c**arotid artery adjacent to the jugular vein and retrograde transmission of a positive wave in the right atrium produced by the right ventricular systole and the bulging of the tricuspid valve into the right atrium.
- x' wave (descent)- to descent of floor of right atrium (tricuspid valve) during right ventricular systole and continued atrial relaxation
- **v** wave (ascent)- to passive atrial filling (**v**enous filling)
- y wave (descent)- due to opening of tricupsid valve and subsequent rapid inflow of blood from right atrium into the right ventricle leading to a sudden fall in right atrial pressure.



The best way to identify the waves (ascents and descents) would be to simultaneously auscultate and observe the wave pattern.

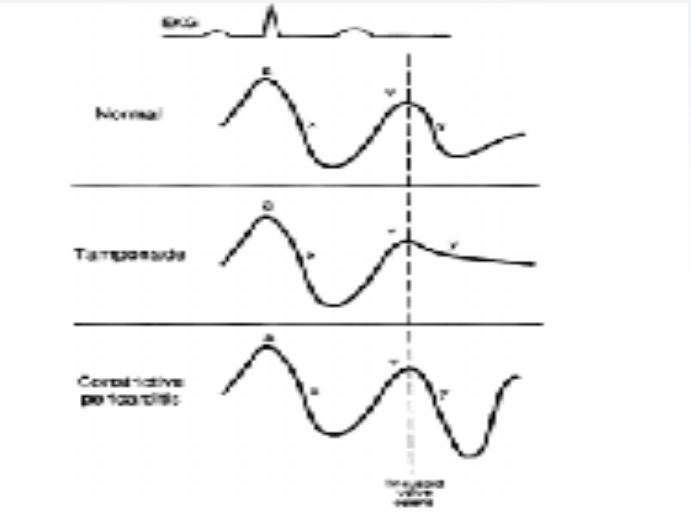
- ‘a’ ascent: clinically corresponds to S1 (though it actually occurs before S1); sharper and more prominent than ‘v’ wave
- ‘x’ descent: follows S1; less prominent than ‘y’ descent
- ‘c’ ascent: occurs simultaneously with carotid pulse; but never seen normally
- ‘v’ ascent: coincides with S2; less prominent than ‘a’ ascent
- ‘y’ descent: follows S2; more prominent than ‘x’ ascent.



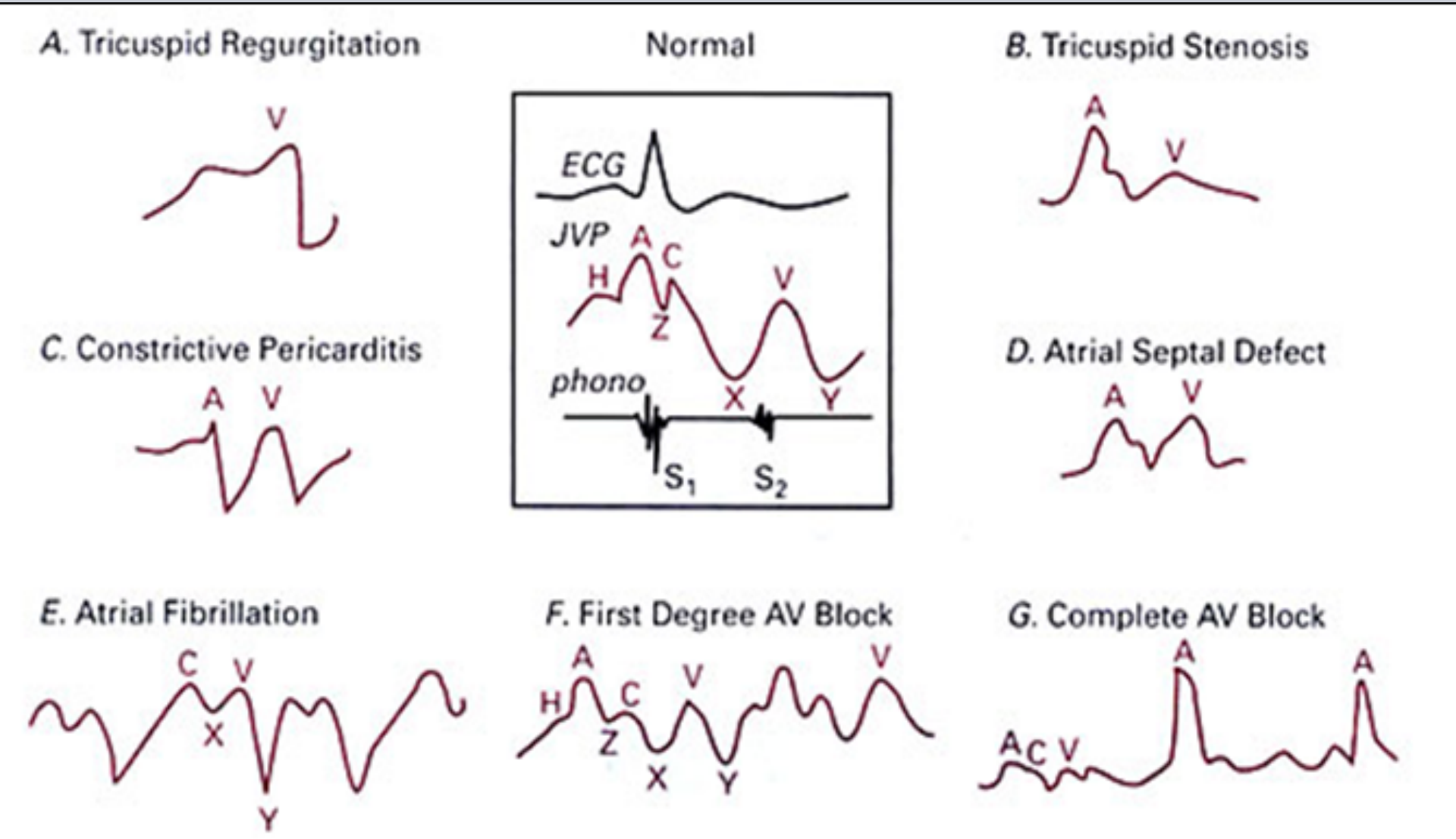
Causes of elevated JVP (Jugular venous distension):

- Right ventricular failure
- Pericardial compression (constriction/tamponade) – little or no pulsations when severe
- Tricuspid stenosis
- Superior vena cava obstruction – no pulsations
- Circulatory overload
- Renal failure
- Excessive fluid administration
- Atrial septal defect with mitral valve disease

Causes of lowered JVP: Dehydration, Hypovolemia



Representations of the normal and abnormal JVP




Thank
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