Assessment of Cardiovascular System

The nurse need especially to understand normal cardiovascular and other system function before you can identify abnormal findings.

The cardiovascular system is the lifeline of the body. Its primary function is to act as a transport system, delivering oxygen by way of the red blood cells and delivering nutrients, metabolites, and hormones to every cell in the body. At the same time, it transports metabolic wastes for detoxification and excretion. The cardiovascular system also contains white blood cells, whose main function is to fight infection.

Structures and Functions of the Cardiovascular System

The cardiovascular system is a closed system consisting of the heart and blood vessels.

Heart: The heart is a muscle about the size of a fist that beats 60 to 100 times a minute without rest, its pumps blood through a vast network of blood vessels extending over 60,000 miles through arteries, arterioles, capillaries, venules, and veins. And it's responding to both external and internal demands such as exercise, temperature changes, & stress (Table 1)(Fig. 1&2).

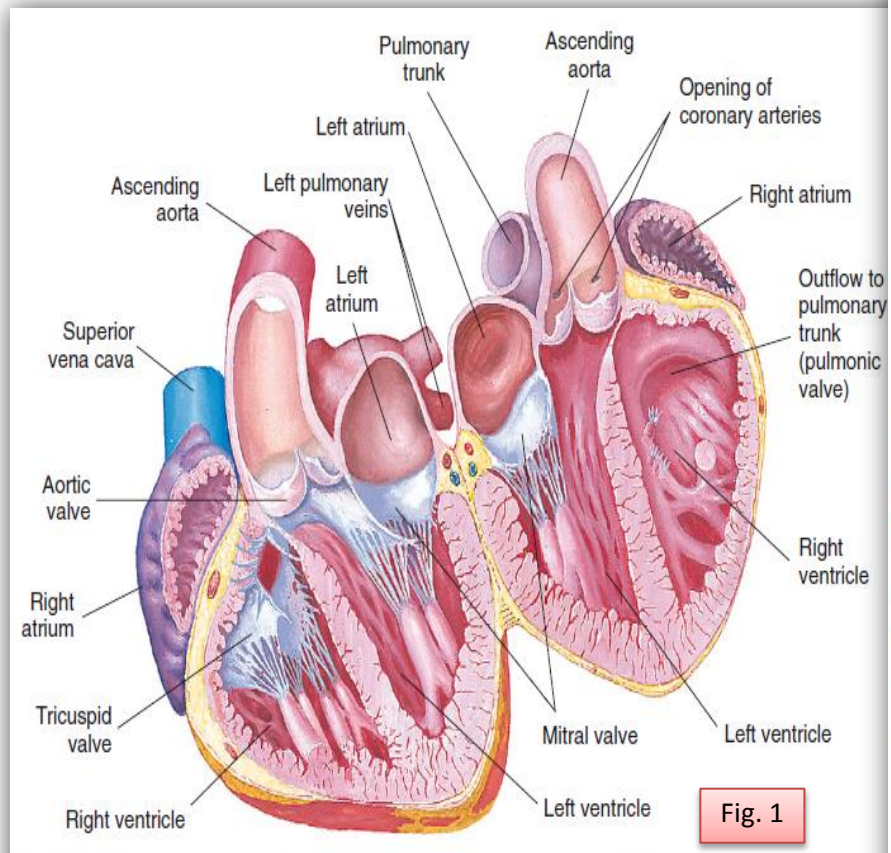


Fig. 1

IG. 12-3 Anterior cross-section showing valves and chambers of the heart. (From Seidel et a

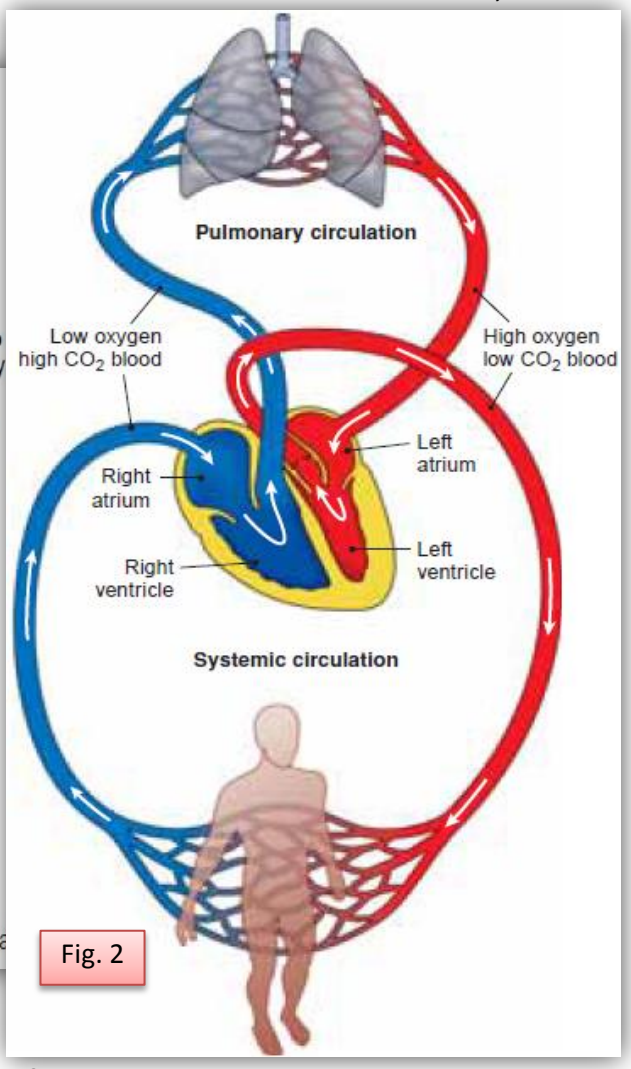


Fig. 2

STRUCTURE	DESCRIPTION/PRIMARY FUNCTION — Table 1
Heart	■ A cone-shaped muscle with four chambers; a double pump about the size of a clenched fist (12 cm long and 9 cm wide). Weighs 250–390 g (8.8–13.8 oz) in adult males and 200–275 g (7.0–9.7 oz) in adult females. ■ Pumps blood throughout circulatory system.
Right Side	
■ Right atrium	■ Upper chamber of right heart. ■ Receives unoxygenated blood from superior and inferior vena cava.
■ Tricuspid valve	■ Right AV valve with three cusps (tricuspid). Attached by chordae tendineae to papillary muscles, which are attached to inner heart muscle. ■ Valve between right atrium and right ventricle.
■ Right ventricle	■ Lower chamber of right heart. ■ Receives blood from right atrium and pumps it into pulmonary circuit.
■ Pulmonary semilunar valve	■ Composed of three cusps. ■ Valve between right ventricle and main pulmonary artery.
■ Main pulmonary artery	■ Artery leading from right ventricle to lungs. ■ Divides into right and left branches supplying respective lungs. ■ Carries unoxygenated blood from right ventricle to lungs.
■ Pulmonary veins	■ Veins leading from lungs to left atrium. ■ Carry oxygenated blood to left atrium.
Left Side	
■ Left atrium	■ Upper chamber of left heart. ■ Receives oxygenated blood from lungs through pulmonary veins.
■ Mitral valve	■ AV valve with two cusps (bicuspid) attached by chordae tendineae to papillary muscles, which are attached to inner heart muscle. ■ Valve between left atrium and left ventricle.
■ Left ventricle	■ Lower chamber of left half of heart. ■ Receives blood from left atrium and pumps oxygenated blood through systemic circulation.
■ Aortic valve	■ Composed of three cusps. ■ Valve between left ventricle and aorta.
■ Interventricular septum	■ Wall between left and right ventricles. ■ Vertically separates left and right sides of heart.

The Circulatory System

The circulatory system has two main networks, the pulmonary circulation and the systemic circulation (Fig. 2).The coronary circulation is part of the systemic circulation and supplies the heart itself. The pulmonary circulation involves blood vessels that circulate blood through the pulmonary arteries, the lungs, and the pulmonary veins. Unoxygenated blood enters the pulmonary circulation from the right and left pulmonary arteries. The unoxygenated blood then flows through the pulmonary arterioles to the lung capillaries, where the exchange of carbon dioxide and oxygen occurs. The oxygenated blood then enters the pulmonary venules that lead to the pulmonary veins. Oxygenated blood is then carried back to the left atrium through the right and left pulmonary veins.

The cardiac cycle comprises all the physiological events needed for the heart to beat. The valves, the hemodynamic events within the heart and the conduction system work together in the cardiac cycle. The cardiac cycle comprises systolic and diastolic phases. The systolic phase is the contraction or emptying phase, and the diastolic phase is the resting or filling phase. The atria and ventricles alternate through the systolic and diastolic phases; while the atria are contracting, the ventricles are relaxing, and vice versa (see Fig. 14.4).

Mechanisms of Heart Sounds

Heart sounds are the result of events within the heart. The movement and pressure of the blood **(hemodynamics)**, the activity of the electrical conduction system (Fig. 4), and the movement of the valves affect the sounds that you hear (Fig. 3).

The most accepted theory concerning the origin of heart sounds relates primarily to the closure of the valves. The **"lub-dub"** sounds that are usually readily heard are referred to as **S1 (lub)** and **S2 (dub)**, the first and the second heart sounds, respectively. They result from valve closure.

The First Heart Sound (S1)

S1 (Fig. 3) marks the beginning of systole, and S2 marks the end of it. S1, the first heart sound, results from the closure of the mitral (M1) and tricuspid (T1) valves.M1 and T1 normally close within approximately 0.02 second or less. These valve sounds are often heard as a single sound.S1 is best heard at the apex or left lateral sternal border (LLSB) with the diaphragm of the stethoscope.

The Second Heart Sound (S2)

When the systolic pressure in the ventricles decreases below that of the aorta and the pulmonary artery (toward the end of systole), the aortic (A2) and pulmonic (P2) valves close producing the second heart sound (Fig. 3). Clinically, this sound marks the end of systole and the beginning of diastole.A2 and P2 normally close about 0.02 second from each other; consequently, they may occasionally be heard as a single sound.

Extra Heart Sounds

Additional sounds that may be heard during auscultation (Fig. 3) include early ejection click, mid-systolic ejection click, opening snap, S3, and S4.These sounds do not always indicate pathology.

The Physiological S3: The ventricles receive blood from the atria. As the blood flows torrentially from the atria into the ventricles in early diastole and forcefully impacts on the ventricular walls, it sets up vibrations that result in an audible sound the normal S3. A normal finding in children and young adults, S3 is a low-pitched, short, soft sound, occurring about 0.14 to 0.16 second after S2. It is heard best at the apex with the patient in the left lateral position using the bell portion of the stethoscope.

The S4 Gallop Rhythm (S4): At the end of diastole the atria contract and expel some of the residual blood within them to complete ventricular filling. This atrial contraction at the end of diastole is referred to as the **atrial kick** and is responsible for about 25 percent of the blood entering the ventricles. The sound is not normally heard. However, if the atria have to contract against ventricular resistance or decreased ventricular compliance, significant vibrations are generated, resulting in the audible S4 sound known as an **S4 gallop rhythm**. The S4 gallop sound is a low-pitched sound occurring 0.08 to 0.20 second before **S1**. The S4 of right-side origin is best heard at the left sternal border and the S4 of left-side origin is best heard at the apex with the patient in the left lateral position using the bell portion of the stethoscope.

Fig 3

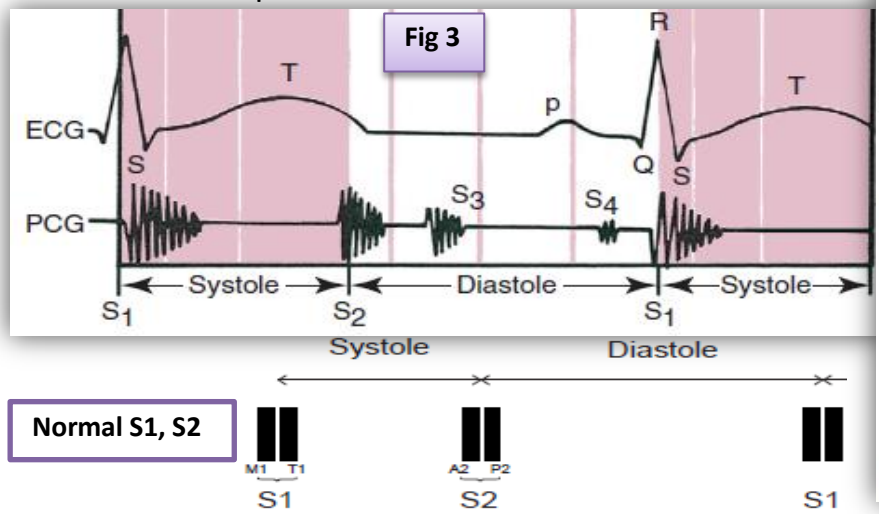


Fig 4

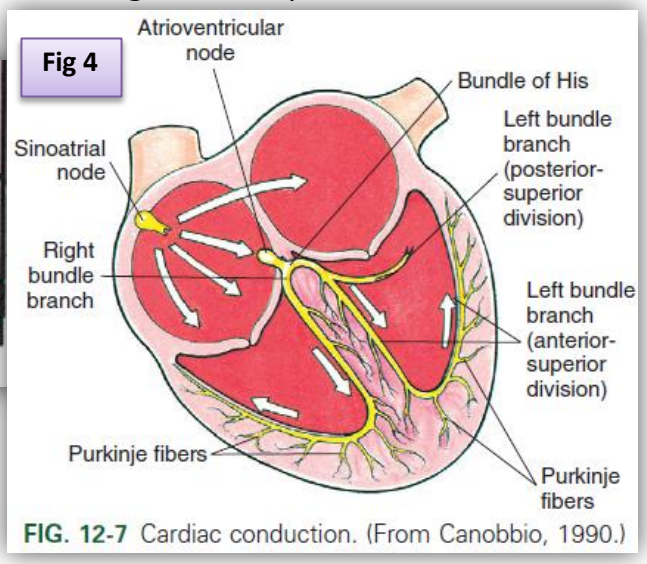


FIG. 12-7 Cardiac conduction. (From Canobbio, 1990.)

<u>Murmurs</u>: are defined as a series of audible, prolonged sounds resulting from turbulence created within the vascular system. Causes of turbulent flow include:

- Increased flow through normal blood vessels, creating frictional, audible sounds.
- Flow through constricted blood vessels (e.g., aortic stenosis).
- Flow into a dilated blood vessel from one of normal size.
- Combination of the preceding causes.

(Figure 5) is a graphic depiction of the causes of turbulent flow.

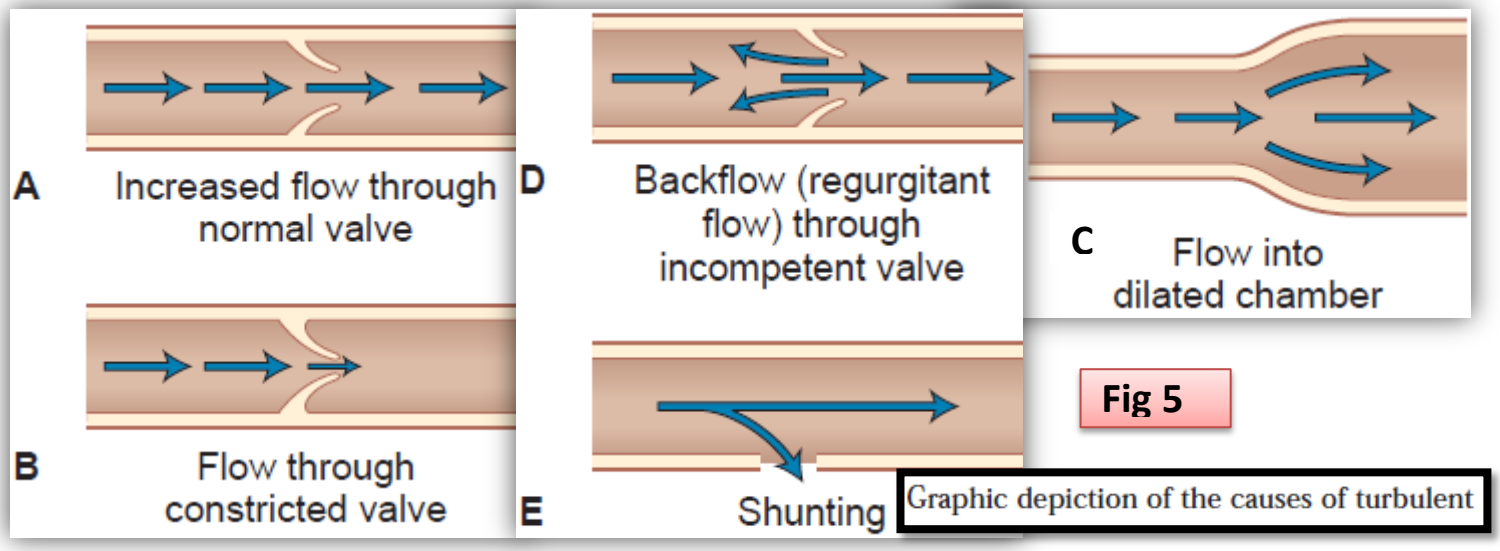


Fig 5

Graphic depiction of the causes of turbulent

GENERAL HEALTH HISTORY

1- **Present Health Status**:
2- **Past Health History:** (medical & surgical)
3- **Family History:**
4- **Personal and Psychosocial History**:

Physical examination (Cardiovascular)

The cardiovascular system affects every other system, so look for changes from head to toe in each system that might signal a respiratory problem.

Skin assessment findings such as temperature, color, mottling, evidence of trauma, and bruising, etc. correlate with cardiovascular function. Note nail beds for cyanosis, clubbing and capillary refill. Normal refill of 3 seconds or less fits with good arterial perfusion. Presence/absence of edema should be determined. Assess the depth (mm) of depression for pitting edema and the rapidity of skin recoil (seconds).

Physical Exam	Normal finding	Abnormal finding
• **INSPECT** the patient for general appearance, skin color, and breathing effort. **Heart:** **Inspect precordium:** Have patient supine, and keep light source tangential. **1- Apical impulse**	•patients ease and relaxed with skin color appropriate for race and regular, unlabored respirations. 1- Visible about midclavicular line in fifth left intercostal space. Sometimes visible only with patient sitting.	•Dyspnea, cyanosis, pallor, and use of accessory muscles to breathe. 1- Visible in more than one intercostal space; exaggerated lifts or heaves.

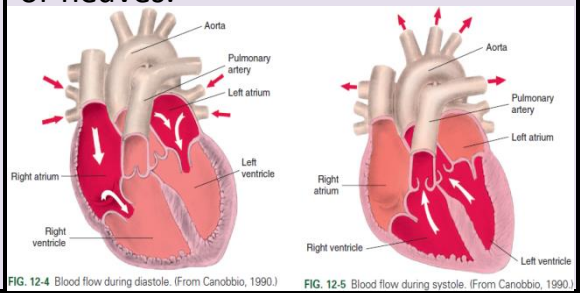
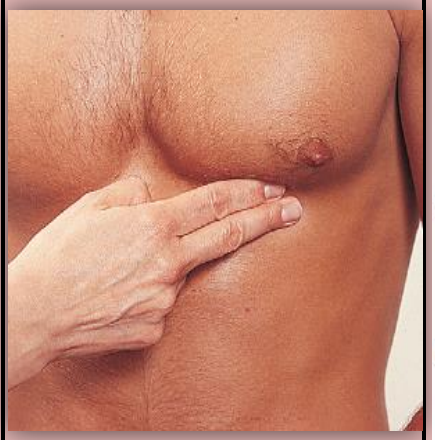
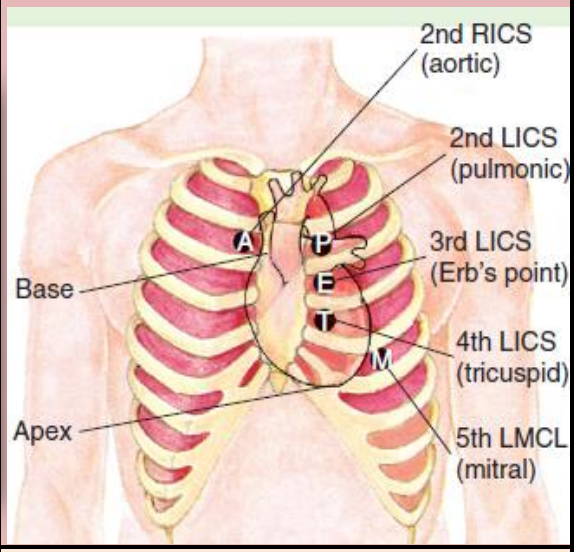


FIG. 12-4 Blood flow during diastole. (From Canobbio, 1990.)

FIG. 12-5 Blood flow during systole. (From Canobbio, 1990.)

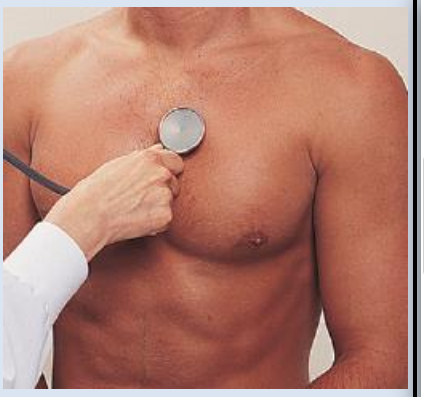
Palpate precordium • **Apical impulse**: Have patient supine. With warm hands, gently feel precordium, using proximal halves of fingers held together or whole hand, Methodically move from apex to left sternal border, base, right sternal border, epigastrium, axillae.	• Gentle, brief impulse, palpable within radius of ≤1 cm, although often not felt. 	• Heave or lift, loss of thrust, displacement to right or left; thrill. 
Percuss precordium: Begin by tapping at anterior axillary line, moving medially along intercostal spaces toward sternal borders until tone changes from resonance to dullness. Mark skin with marking pen.	• No change in tone before right sternal border; on left, loss of resonance generally close to point of maximal impulse at fifth intercostal space. Loss of resonance may outline left border of heart at second to fifth intercostal spaces.	
Auscultate heart: Make certain patient is warm and relaxed. Isolate each sound and each pause in cycle, and then inch along with stethoscope. Systematically approach each of the five precordial areas, base to apex, using each position as on rigth. Use diaphragm of stethoscope first, with firm pressure, then bell, with light pressure. **1-Rate and rhythm** Assess overall rate and rhythm. **2- S1:** Ask patient to breathe comfortably, and	 1-Rate 60-90 beats/min, regular rhythm. 2-S1 usually heard as one sound and coincides with rise of carotid pulse. 3-S2 to become two components during inspiration. S2 to become an apparent single sound as breath is exhaled.	 1- Bradycardia, tachycardia, dysrhythmia. 2-Extra sounds or murmurs.

then hold breath in expiration. Listen for S1 (best heard toward apex) while palpating carotid pulse. Note intensity, variations, effect of respiration, splitting. Concentrate on systole, then diastole.

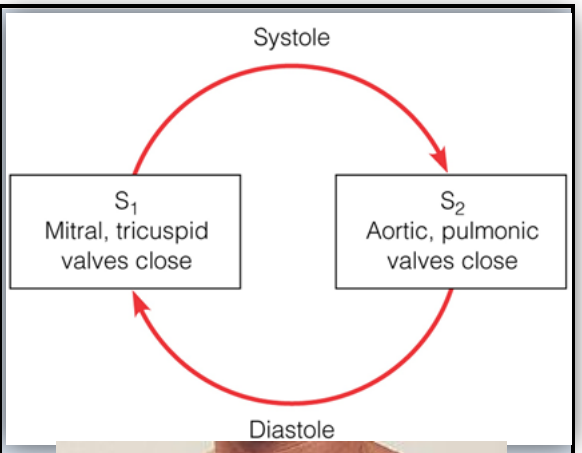
3-<u>S2:</u> Ask patient to breathe comfortably as you listen for S2 (best heard in aortic and pulmonic areas) to become two components during inspiration. Ask patient to inhale and hold breath.

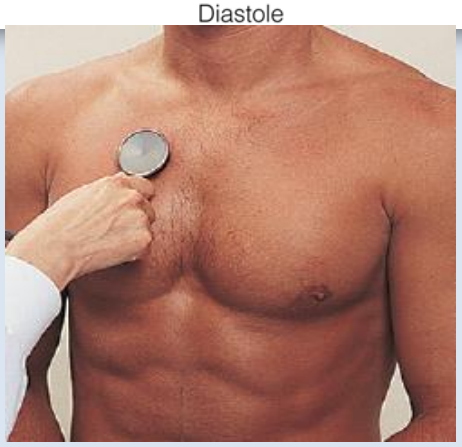
4- <u>S3 and S4</u>: If needed, ask patient to raise a leg to increase venous return or to grip your hand vigorously and repeatedly to increase venous return.

5-<u>Extra heart sounds</u>



4-Both S3 and S4 quiet and difficult to hear.





4- Increased intensity (and ease of hearing) of either.

5-Extra heart sounds—snaps, clicks, friction rubs, murmurs (Table 3).

Vascular assessment

<u>Peripheral Arteries</u>

<u>Palpate</u>: arterial pulses in neck and extremities:

Palpate (carotid, brachial, radial, femoral, popliteal, dorsalis Pedi's, and posterior tibial arteries) using distal pads of second and third fingers

1-Characteristics: Compare characteristics bilaterally, as well as between upper and lower extremities.

2-Rate:

3-Rhythm:

4-Contour:

1-Femoral pulse as strong as or stronger than radial pulse.

2-60-90 beats/min.

3- Regular.

4- Smooth, rounded, or dome-shaped.

:0 Assessing capillary refill. (From

1-Femoral pulse weaker than radial pulse or absent.

2- Rate different from that observed during cardiac examination.

3-Irregular, either in a pattern or patternless.

Auscultate: (carotid and subclavian arteries; abdominal aorta; and renal, iliac, and femoral arteries) for bruits. When auscultating the carotid vessels, you may at times need to ask patient to hold breath for a few heartbeats. Auscultate with **bell** of stethoscope.

Assess for arterial occlusion and insufficiency

1-Site: Assess for pain distal to possible occlusion.

2- Degree of occlusion: Ask patient to lie supine. Elevate extremity, note degree of blanching, then ask patient to sit on edge of table or bed to lower extremity. Note time for maximal return of color when extremity is lowered.

3- Measure blood pressure:

Measure in both arms at least once. Patient's arm should be slightly flexed and comfortably supported on table, pillow, or your hand.

4- Edema: Press index finger over bony prominence of tibia or medial malleolus for several seconds.

5- Varicose veins: If suspected, have patient stand on toes 10 times in succession.

2- Slight pallor on elevation and return to full color as soon as leg becomes dependent.

3- <120 mm Hg systolic and <80 mm Hg diastolic, with pulse pressure of 30-40 mm Hg (sometimes to 50 mm Hg). Reading between arms may vary by as much as 10 mm Hg. Prehypertension is now defined as a blood pressure between 120 and 139 mm Hg systolic or 80 and 89 mm Hg diastolic.

5- Pressure from toe standing disappears in seconds.

12-40 Chronic venous stasis

1-Dull ache accompanied by fatigue and often cramping; possible constant or excruciating pain. Weak, thready, or absent pulses; systolic bruits over arteries; loss of body warmth; localized pallor or cyanosis; delay in venous filling; or thin, atrophied skin, muscle atrophy, and loss of hair.

2- Delay of >2 sec.

3- Hypertension

4- Orthostatic (pitting) edema; thickening and ulceration of skin possible. Grade edema from 1+ to 4+ see (table 2).

5- Veins dilated and swollen; often tortuous when extremities are dependent and pressure does not quickly disappear.

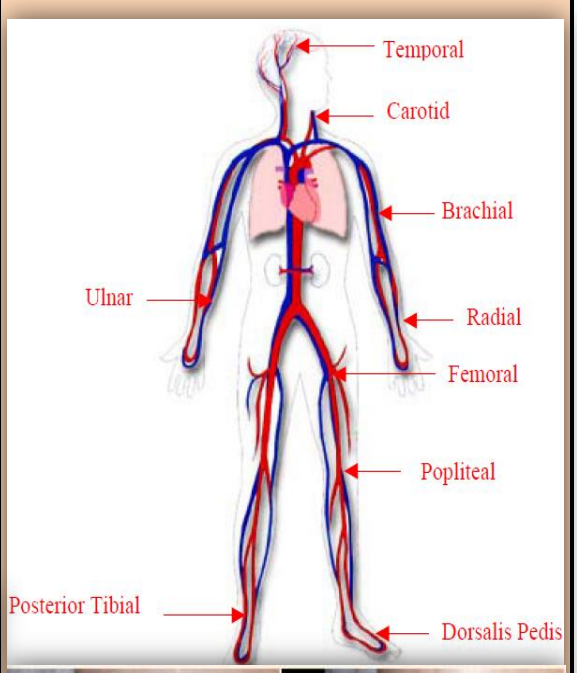


TABLE 2 PITTING EDEMA SCALE

SCALE	DESCRIPTION	"MEASUREMENT"*
1+	Barely perceptible pit	2 mm (3/32 in)
2+	Deeper pit, rebounds in a few seconds	4 mm (5/32 in)
3+	Deep pit, rebounds in 10-20 seconds	6 mm (1/4 in)
4+	Deeper pit, rebounds in >30 seconds	8 mm (5/16 in)

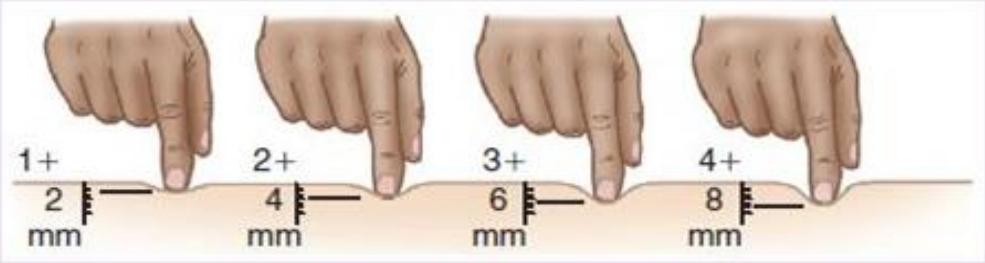
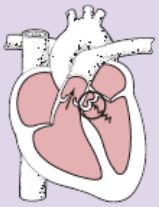
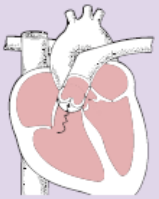
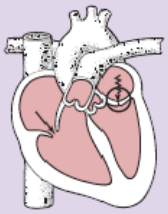
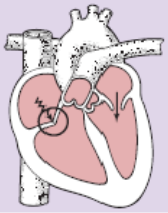


TABLE 3 MURMURS CAUSED BY VALVULAR DEFECTS

TYPE		DETECTION	QUALITY/PITCH
Aortic stenosis		Heard over aortic valve area; ejection sound at second right intercostal border Radiates to neck, down left sternal border	Medium pitch, coarse, with crescendo-decrescendo pattern Pitch low
Pulmonic stenosis		Heard over pulmonic valve; radiates left to neck; thrill at second and third left intercostal spaces	Same as for aortic stenosis Pitch medium
Mitral stenosis		Bell at apex with patient in left lateral decubitus position	Low rumble more intense in early and late diastole Pitch low
Tricuspid stenosis		Bell over tricuspid area.	Similar to mitral stenosis but louder on inspiration Pitch low