

# Nursing Assessment of Cardiovascular System: Importance of History Taking and Physical Examination

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## Abstract

Assessment of a patient's cardiovascular system is crucial in identifying potential problems, determining a diagnosis, and creating a care plan. The nursing assessment process involves both history taking and physical examination. History taking is important in obtaining information about the patient's past medical history, risk factors for cardiovascular disease, symptoms, and medication use. This information can help to identify potential problems, such as high blood pressure or heart disease, and provide a baseline for comparison during subsequent assessments. Physical examination includes evaluating the patient's vital signs, such as blood pressure, heart rate, and rhythm, and listening to the heart and lungs for sounds that may indicate problems, such as murmurs or crackles. The examination may also involve palpating for peripheral pulses, evaluating for edema, and assessing skin color and temperature. Together, the information gathered during history taking and physical examination forms a comprehensive picture of the patient's cardiovascular system and provides the foundation for an effective nursing care plan.

**Keywords:** congenital heart disease; pulmonary veins; blood; valves

## Introduction

A patient who presents with signs or symptoms of heart (cardiac) problems such as chest pain may be suffering a life-threatening condition requiring immediate attention. In this situation, you act quickly and perform the parts of the examination that are absolutely necessary (1). The history of cardiovascular provides physiological and psychosocial information that guides the physical assessment, the selection of diagnostic tests collection, and the choice of treatment options. During the process of taking a detailed history and performing a physical examination, the nurse has an opportunity to create consonance with the patient and to evaluate the general emotional status of patient (2).

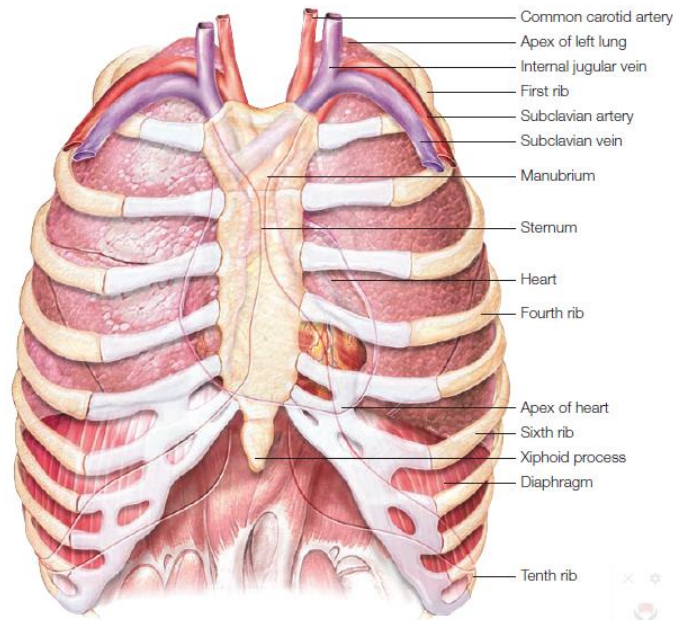
### The cardiovascular system:

The heart and the blood vessels are made up of the cardiovascular system. The heart is a muscle that pumps blood throughout the body. That is about

the size of a clenched fist in a healthy adult. The blood s, which makes up the vascular system, has two main networks: pulmonary circulation and systemic circulation (3). The cardiovascular system performs two basic functions: It delivers oxygenated blood to body tissues and removes waste substances through the action of the heart (4).

### Anatomy and physiology:

The heart is a hollow, muscular organ about the size of a closed fist. It is located between the lungs in the mediastinum, behind and to the left of the sternum. The heart extent is the area between the second and the fifth intercostal space. Its right border aligns with the right border of the sternum. The left border aligns with the left midclavicular line (5). Figure 1.



**Figure 1:** The heart's location

**Atria and ventricles**

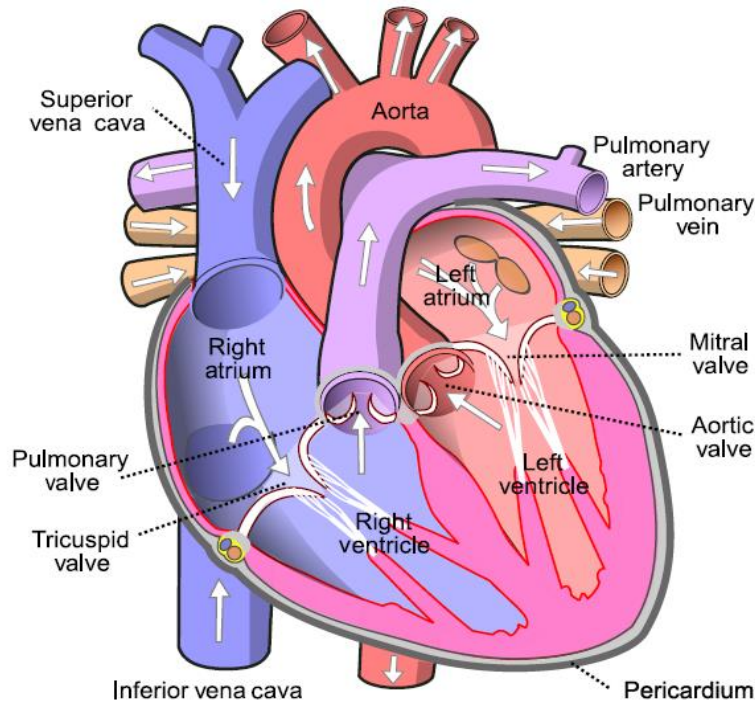
**The heart has four chambers**, two atria and two ventricles separated by a cardiac septum.

The upper atria have thin walls, which serve as blood reservoirs. They also promote the amount of blood that travels into the lower ventricles, which fill primarily by gravity. The left ventricle pumps blood against a much higher pressure than the right ventricle so that its wall is two and one-half times thicker (5).

The right side of the heart, made up of the right atrium and right ventricle, distributes venous blood (deoxygenated blood) to the lungs through the

pulmonary artery (pulmonary circulation) for oxygenation. The right atrium receives blood returning from the superior vena cava (head, neck, arms, and upper limbs), inferior vena cava (trunk and lower limbs), and coronary sinus (coronary circumference) (6).

The left side of the heart, composed of the left atrium and left ventricle, distributes oxygenated blood through the aorta (systemic circulation) to the remainder of the body. The left atrium receives oxygenated blood from the pulmonary circulation via the pulmonary veins. Besides that, the amount of pressure needed to pump the blood determines the thickness of a chamber wall (4).



**Figure 2:** Structures of the heart

## Cardiac Cycle

Is the rhythmic movement of blood through the heart. There are two phases of it, diastole and systole. In diastole, the ventricles relax and fill with blood. This takes up the cardiac cycle on two-thirds. The contraction of the heart in systole. During systole, blood is pumped out of the ventricles and fills the pulmonary and systemic arteries. This is one-third of the cardiac cycle (7).

### Diastole.

In diastole, the ventricles are relaxed, and the AV valves (i.e., the tricuspid and mitral) are open. (Opening of the normal valve is acoustically silent.) The pressure in the atria is higher than that in the ventricles; therefore, blood pours rapidly into the ventricles. This first passive filling phase is called early or **protohistoric filling** (8).

Toward the end of diastole, the atria contract and push the last amount of blood (about 25% of stroke volume) into the ventricles. This active filling phase is called **presystolic, or atrial systole**, or sometimes the atrial kick. It causes a small rise in left ventricular pressure. (Note that atrial systole occurs during ventricular diastole, a confusing but important point) (7).

### Systole

The filling phases during diastole result in a large amount of blood in the ventricles, causing the pressure in the ventricles to be higher than in the atria. This causes the AV valves (mitral and tricuspid) to shut. Closure of the AV valves produces the first heart sound (S1), which is the beginning of **systole**. This valve closure also prevents blood from flowing backward (a process known as regurgitation) into the atria during ventricular contraction (9).

### Event of the cardiac cycle:

- ❖ **Isovolumetric ventricular contraction**, in response to the ventricular depolarization, mitral valve and the tricuspid valve closed, pulmonic and aortic valves still closed during this phase, Duration: 0.05 s.

- ❖ **Ventricular ejection**, when the ventricular pressure exceeds, the ventricles eject the blood through the pulmonic and aortic valves.
- ❖ **Isovolumetric relaxation**, the pulmonic and aortic valves closed when the pressure inside the ventricles becomes less than the pressure in the aorta and pulmonary artery, and all the valves still closed during this phase. Duration: 0.08 s (10)
- ❖ **Ventricular filling**, mitral, and tricuspid valves open and permit to 70% of the blood to flow into the ventricles when the pressure inside the ventricles becomes less than the pressure in the atria.
- ❖ **Atrial systole**, during this phase, the atria supply the ventricles with the remaining blood (30%). Duration: 0.3 s (11).

The autonomic nervous system controls the heart, which pumps blood through the entire body. The vascular network that carries blood throughout the body consists of high-pressure arteries, which deliver the blood, and low-pressure veins, which return it to the heart (10).

### Heart Sounds:

Events in the cardiac cycle generate sounds that can be heard through a stethoscope over the chest wall. These include normal heart sounds and occasionally extra heart sounds and murmurs Figure (3) (Jolobe and Vijay, 2015).

### Normal Heart Sounds

- **The first heart sound (S1)** occurs with the closure of the AV valves and thus signals the beginning of systole. The mitral component of the first sound (M1) slightly precedes the tricuspid component (T1), but you usually hear these two components fused as one sound. You can hear S1 over all the precordium, but usually, it is loudest at the apex.
- **The second heart sound (S2)**: occurs when the semilunar valves are closed and the systole end signals. The aortic component of the second sound (A2) slightly precedes the pulmonic component (P2). Although it is heard over all the precordium, S2 is the loudest at the base (7).

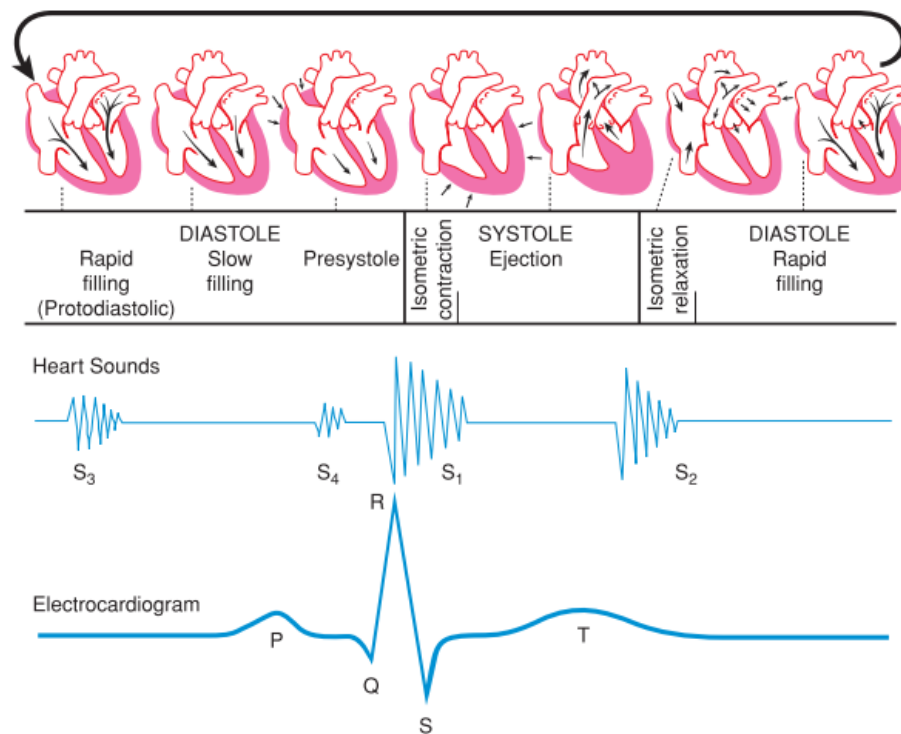


Figure 1: Cardiac Cycle

## General examination

The purpose of examining the cardiovascular system is to assess the function of the heart as a pump and arteries and veins throughout the body in transporting oxygen and nutrients to the tissues and transporting waste products and carbon dioxide from the tissues. Your assessment of the cardiovascular system is important because cardiovascular disease is the most prevalent health care problem in the United Kingdom. Over 250 000 deaths per year are attributed to cardiovascular disease (13).

## History Taking

The patient's history is his health status major subjective data source. Physiological, psychological, and psychosocial information (including family relationships and cultural influences) can be obtained which will inform you about the patient's perception of his current health status and lifestyle (14).

It will give insight into actual and potential problems as well as provide a guide for the physical examination. It is important to use open questioning to elicit the patient's presenting complaint (15).

Provides the diagnosis most often: history, physical, or diagnostic tests (16).

- History: 70%.
- Physical: 15% to 20%.
- Diagnostic tests: 10% to 15%.

## Components of the Health History

### 1. Biographical data:

Begin by asking the patient his name, address, telephone number, birth date, age, birthplace, Social Security number, race, nationality, religion, and marital status. Also, find out the names of anyone living with the patient, the name and telephone number of the person to call in an emergency, and the patient's usual source of health care (17).

### 2. Chief Complaint and History of Present Illness

The most common chief complaints of the cardiovascular system include chest pain, dyspnea, fatigue and weakness, irregular heartbeat, and peripheral changes (especially dry skin and extremity pain). In some patients, chest pain may radiate to other body parts, including the jaw, back, left arm, right arm, elbows, little fingers, teeth, and scrotum.

Further elucidation of the symptom/complaint should establish the frequency, duration, exacerbation, and severity of symptoms; assessment tools provide a framework for assessment, and SOCRATES is a popular tool:

- **S - Site – where is the pain?** The pain of myocardial ischemia may be located in the jaw, throat, both arms, retrosternal, and in the back. The pain from pericarditis may be in the central chest, back, or shoulders. Aortic dissection pain is located retrosternal and radiates into the back and the abdomen.
- **O - Onset: when did it start? / Sudden vs gradual?** Angina may be precipitated by exercise, emotion, or cold weather. Pain associated with ACS may present at rest, on exertion, or in the early hours of the morning on waking. Pericardial pain may follow a period of flu-like symptoms or occur 3-6 weeks after acute MI.
- **C - Character: sharp/dull ache / burning** – myocardial ischemia is described as tight and crushing but may also be an ache or heaviness. Aortic dissection pain has a tearing quality, and pericardial pain is severe and constant.
- **R - Radiation: does the pain move anywhere else?** Cardiac pain tends to radiate; ischemic pain may radiate from the chest

to the arms, jaw, or back. The pain of aortic dissection often radiates into the back and occasionally the abdomen. Pericardial pain is frequently referred to as the trapezius ridge (shoulder).

- **A - Associations: other symptoms associated with the pain** – patients with myocardial infarction may present with dyspnea, diaphoresis, nausea, syncope, and extreme anxiety. Patients with ACS may present with one or several symptoms. In pericarditis, the pain is worse on inspiration. Aortic dissection may be associated with collapse and neurological involvement if the dissection compromises a major vessel to the head and neck (18).
- **T - Time course: worsening / improving/fluctuating / time of day dependent** – myocardial ischemia may have a sudden onset, and the pain may last for longer than 20 minutes without relief. Aortic dissection tends to be of sudden onset and remains constant. Pericarditis and myocarditis may be preceded by a history of viral or flu-like symptoms (18).
- **E - Exacerbating / Relieving factors: anything makes the pain worse or better?** – Angina may be exacerbated by exercise, emotion, following meals, or extreme weather temperatures. Pericardial pain is relieved by leaning forwards and made worse by deep inspiration (18).
- **S - Severity: on a scale of 0 to 10, how severe is the pain?** – whilst many patients with cardiac pain will describe the pain on the high end of a scale of 0–10, some patients, notably older patients and those with diabetes, may experience little or no pain (18).

### 3. Past Health History

The nurse asks for childhood diseases such as rheumatic fever as well as chronic illnesses such as pneumonia, tuberculosis, thrombophlebitis, pulmonary embolism, MI, diabetes mellitus, thyroid disease, or chest injury when determining the patient is past clinical history.

The nurse also asks about occupational exposures to cardiotoxic materials. Finally, the nurse seeks information about previous cardiac or vascular surgeries and any previous cardiac studies or interventions (19).

### 4. Risk factors

A significant part of history is the identification of risk factors for cardiovascular disease. Risk factors are categorized as major uncontrollable risk factors; major risk factors that can be modified, treated, or controlled; and contributing risk factors(2). An evaluation of lifestyle and risk factors pertinent to cardiac disease should be undertaken. It is important to be non-judgmental but to ask questions sensitively and objectively. Key lifestyle factors include cigarette smoking, misuse of alcohol, recreational drug use, lack of exercise and/or obesity. Cigarette smoking is the strongest modifiable risk factor for heart disease. Seek to evaluate if the patient has ever smoked and if so, how much and for how many years(18).

## Other Contributing Factors

- ❖ Stress.
- ❖ Sex hormones.
- ❖ Birth control pills
- ❖ Excessive alcohol intake.

### 5. Family history

The family history offers information about a potential predisposition to disease (e.g., heart attacks) and whether a patient may have cause to be especially concerned about a specific disease (e.g., mother died from cancer). Patients might be reluctant to talk about relatives' illnesses if they were mental

diseases, epilepsy, or cancer. Constructing a genogram of the patient's family history will be useful for quick referral(20).

The nurse also inquires about cardiovascular problems such as hypertension, elevated cholesterol, coronary artery disease, MI, stroke, and peripheral vascular disease(21).

#### 6. Social and personal history

Although the physical symptoms provide many clues regarding the origin and extent of cardiac disease, social and personal history also contribute to the patient's health status. The nurse inquires about the patient's family, spouse or significant other, and children. Information about the patient's living environment, daily routine, sexual activity, occupation, coping patterns, and cultural and spiritual beliefs contribute to the nurse's understanding of the patient as a person and guides interaction with the patient and family.

### Physical examination

The physical examination aims to gather objective data to confirm or refute any differential diagnoses identified from the focused history. An initial assessment should clarify if the patient is in pain or anxious, and any evidence of dyspnea, pallor, diaphoresis, or cyanosis would require urgent investigation. Examination of the cardiovascular system should include the whole circulatory system, not just the heart, and utilizes the following approach: inspection, palpation, and auscultation (19).

#### The general approach to heart assessment:

Appropriate patient preparation is essential to obtain accurate findings during the cardiovascular examination. The patient should be comfortable and calm, as anxiety may elevate the blood pressure or change the heart rate or rhythm [14].

- Explain to the patient what you are going to do.
- Ensure that the room is quiet, warm, and well-lit.
- Expose the patient's chest only as much as is needed for the assessment.
- Position the patient in a supine position or sitting position.
- Stand to the patient's right side, and the light should come from the opposite side of where you are standing so that shadows can be accentuated.

#### Equipment needed for examination:

- Stethoscope with a bell and diaphragm
- Sphygmomanometer
- Two 15-cm rulers
- Watch with second hand
- Examination light for tangential lighting
- Tape measure.

Cardiac assessment requires examination of all aspects of the patient to be evaluated, using the standard steps of inspection, palpation, and auscultation. A thorough and careful examination helps the nurse detect subtle abnormalities as well as obvious ones [7].

While taking the history and before inspecting the cardiovascular system, you must assess the general condition of the patient as a routine. The following points need to be examined from the cardiovascular point of view [9].

#### Dysmorphic features

1. Look for periorbital puffiness and loss of lateral eyebrows, which suggests hypothyroidism.
2. Depressed bridge of the nose—can occur with Down's syndrome or Elfin's face of supralvalvar stenosis.

3. Hypertelorism—the distance between the two inner canthi is increased, seen in pulmonary stenosis.
4. The webbing of the neck—coarctation of the aorta.
5. Polydactyly—atrial septal defect.
6. Short stature—coarctation of the aorta.

#### Hands:

Provide clear instructions to the patient and minimize the number of movements they need to make (don't have them turning their hands back and forth multiple times)

#### Hands out with palms downwards

**Splinter hemorrhages** – reddish/brown streaks on the nail bed – **bacterial endocarditis**

#### Hands out with palms facing upwards:

- **Colour:** dusky bluish discoloration (cyanosis) **suggests hypoxia**
- **Temperature:** cool peripheries may suggest **poor cardiac output/hypovolaemia**
- **Janeway lesions:** non-tender maculopapular erythematous palm pulp lesions – **bacterial endocarditis**
- **Osler's nodes:** tender red nodules on finger pulps/thenar eminence – **infective endocarditis**

**Cyanosis:** reflects the oxygenation and circulatory status of the patient. Cyanosis is a bluish skin and mucus membrane discoloration due to reduced hemoglobin [6].

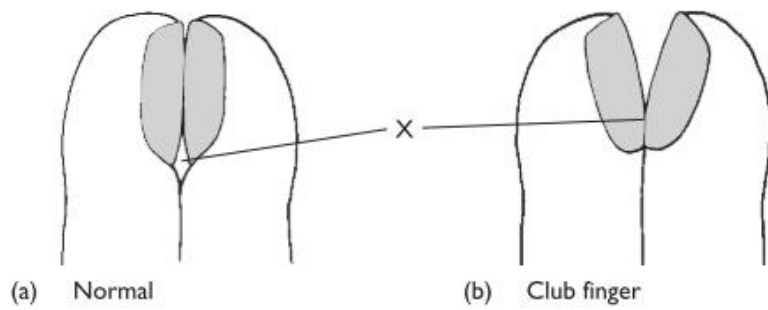
1. **Central cyanosis:** Cyanosis is seen in the skin and warm areas such as the oral cavity. This is observed in the right to left shunts in the heart, e.g., TOF. Central cyanosis manifests at a mean capillary concentration of 4 gm/dl of reduced hemoglobin. In general, when the systemic arterial saturation is less than 85%, cyanosis is manifest [12].
2. **Peripheral cyanosis:** Decreased capillary blood flow allows more oxygen extraction time. Seen in cardiac failure, shock, venous or arterial obstruction.
3. **Differential cyanosis:** Cyanosis is more marked in the legs than in the upper limb; in patients with patent ductus arteriosus with pulmonary hypertension, the blood gets shunted from the pulmonary artery to the aorta [6].

**Clubbing** loss of angle at the base of a nail. Clubbing of fingernails concerning the heart suggests cyanotic heart disease [9].

**Mechanism:** Platelet-derived growth factors are not inactivated in the lungs due to the right to left shunt. This results in the development of AV shunts in the distal phalanges, which results in swelling [20].

#### Testing

1. Keep the dorsal aspects of two fingers side by side with the nail touching normally; you should see a kite-shaped gap. If not, clubbing is present- Schamorth sign.
2. Lateral Profile: View the side of the flexed distal finger and look for a nail bed angle. If there is, no dip, there is clubbing. The hyponychial nail fold angle can also be measured; if this is more than 180 degrees, then clubbing is present.
3. Fluctuation: Place the finger's patient between the examiner's two thumbs. Next palpate the nail bed with the examiner's two index fingers and elicit fluctuation.
4. Phalangeal Depth Ratio: The vertical distance measured at the junction of the nail bed is more than the interphalangeal depth.



(a) Space seen at X is normal angle; (b) X is positive Schamroth's sign.

Figure 2:

**Cardiac Causes**

- Cyanotic congenital heart disease
- Infective endocarditis
- Atrial myxoma.

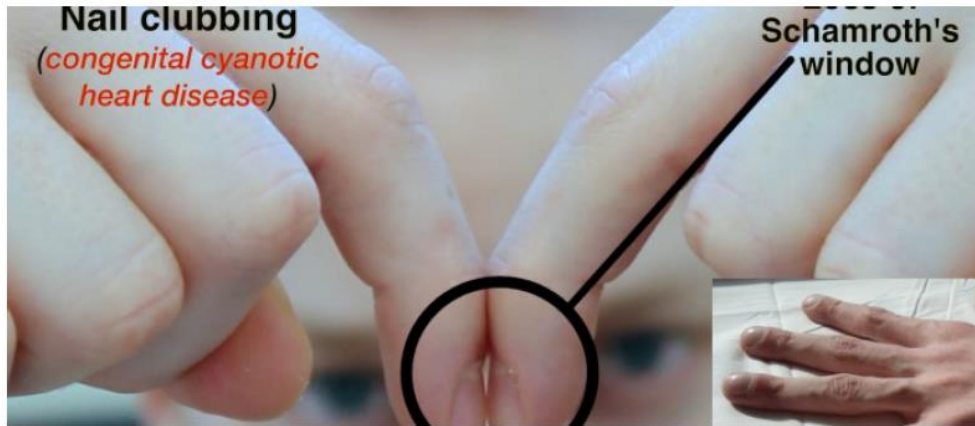


Figure 3:

**Edema:** is fluid accumulating in the interstitial spaces; it is not present normally.

brawny edema, this condition resists pitting but makes the skin appear distended [7].

**Evaluating edema:** When you detect edema, determine the degree using a scale of +1 to +4. Press your fingertip firmly for 5 to 10 seconds over a bony surface, such as the subcutaneous tissue over the patient's tibia, fibula, sacrum, or sternum. Then, note the depth of the imprint your fingertip leaves on the skin. A slight imprint indicates +1 edema. If the imprint is deep and the skin is slowly returning to its baseline shape, the edema is a +4. The skin swells so much with severe edema that fluid cannot be displaced. Called

**Causes**

- increased venous pressure—right heart failure, constrictive pericarditis
- Lower oncotic pressure—cirrhosis, nephrotic syndrome
- Lymphedema—filariasis, Milroy's syndrome [22].

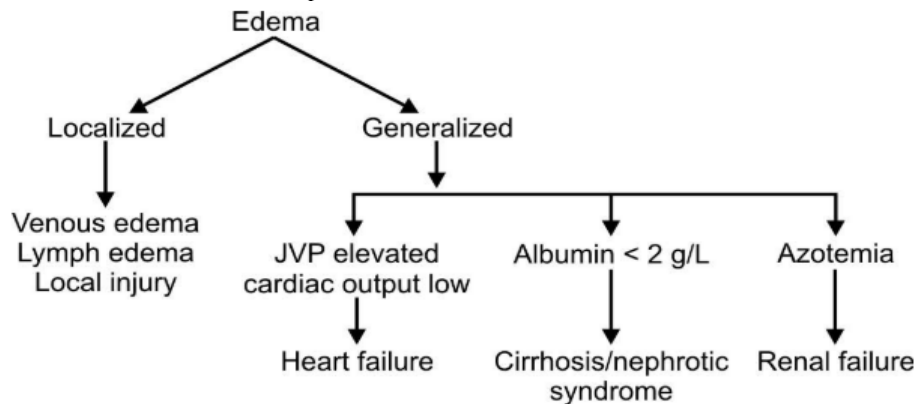


Figure 4:

## Inspection of the precordium

Inspection begins as soon as the patient and nurse interact. The general appearance and presentation of the patient are key elements of the initial inspection. It is necessary to note the ability of the patient to move and speak with or without distress. Consider the patient's posture, gait, and musculoskeletal coordination [23].

### 1. Inspection:

When assessing the pericardial, firstly, the examiner should be, observe the pericardial for symmetry, color, skin lesions, rash, and scars [12].

**Aortic area:** No pulsation should be visible. A pulsation at the aortic area is abnormal. A pulsation at the aortic area indicates an aortic root aneurysm.

**Pulmonic area:** No pulsation should be visible. A pulsation is an abnormal finding. A pulsation at the pulmonic area indicates pulmonary valve stenosis.

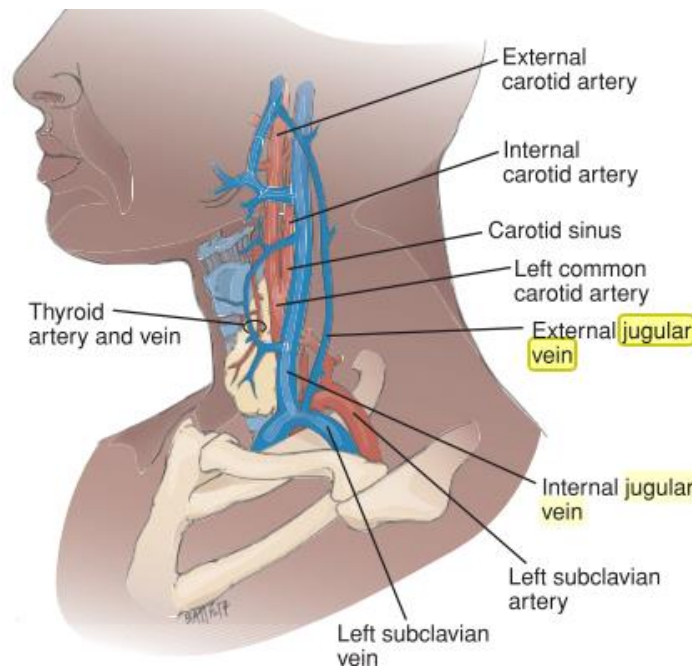
**Midprecordial area:** No pulsation should be visible. A pulsation or retraction at the Midprecordial area is considered abnormal findings. A left ventricular aneurysm causes mid-precordial pulsation. While precordial diseases may cause Midprecordial retraction [12].

**Tricuspid area:** No pulsation should be visible. A pulsation at the tricuspid area is considered an abnormal finding. A right ventricular enlargement can cause tricuspid pulsation.

**Mitral area:** Normally, there is a pulsation in the mitral area; this point is also known as a point of maximum impulse. A hypokinetic (decreased movement) pulsations at the mitral area are considered abnormal. Hypokinetic pulsation can be caused by certain conditions that put more fluids between the left ventricle and the chest wall, such as pericardial effusion and cardiac tamponade. Also, obesity, low-output states, and decreased myocardial contractility can cause this type of pulsation. Hyperkinetic pulsations (increased movement) are always abnormal when located in the mitral area. High-output states such as mitral regurgitation, thyrotoxicosis, severe anemia, and left-to-right shunt can cause this type of pulsation [24].

### The neck:

CV assessment includes the survey of vascular structures in the neck—the carotid artery and the jugular veins. The carotid artery and internal jugular vein lie beneath the sternomastoid muscle. The external jugular vein runs diagonally across the sternomastoid muscle [7].



**Figure 5:** Major neck vessels, including the carotid arteries and jugular veins.

### Jugular Venous Pulse and Pressure:

Pressure in the jugular veins reflects right atrial pressure (RAP) and provides the nurse with an indication of heart hemodynamics and cardiac function. The height of the blood level in the right internal jugular vein indicates RAP because there are no valves or obstructions between the vein and the right atrium [23].

Observe the height of the jugular venous pulsation (JVP). Position the patient lying at approximately 45° to the horizontal with his head on pillows. Shine a torch at an angle across the neck. Look at the veins in the neck. Use tangential lighting [20]. Next, the angle of Louis is located by palpating where the clavicle joins the sternum (suprasternal notch). The examining finger is slid down the sternum until a bony prominence is felt. This

prominence is known as the angle of Louis. A vertical ruler is placed on the angle of Louis. Another ruler is placed horizontally at the level of the pulsation. The intersection of the horizontal ruler with the vertical ruler is noted, and the intersection point on the vertical ruler is read [9].

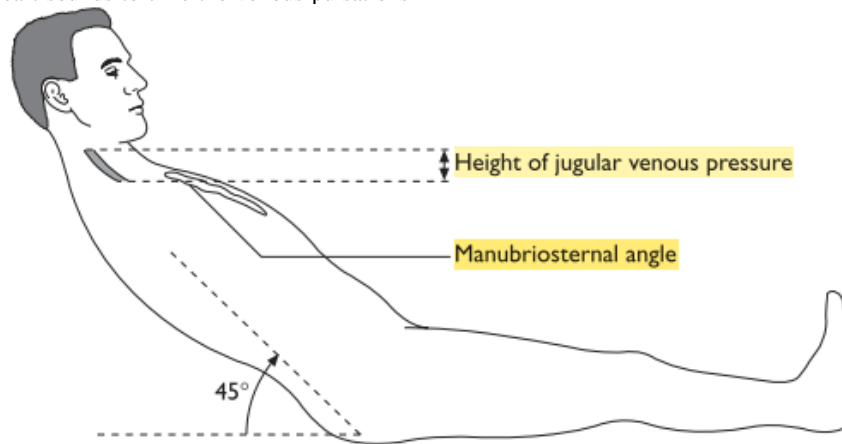
To estimate CVP, measure the vertical distance between the highest level of visible pulsation and the angle of Louis. Normally, this distance is less than 2.9 cm. Add 2" to this figure to estimate the total distance between the highest level of visible pulsation and the right atrium. A total distance that exceeds 4" (10 cm) may indicate elevated CVP and right ventricular failure [25].



**Figure 6:** Observe for a raised JVP

Suppose the patient has a central venous line connected to a hemodynamic monitoring system. In that case, you can observe jugular vein pulsations to obtain information about the dynamics of the right side of the heart. As you assess, use the carotid pulse or heart sounds to time the venous pulsations

with the cardiac cycle. Finally, inspect the carotid arteries, noting whether the pulsations are weak (hypokinetic) or strong and bounding (hyperkinetic). Figure 4 [2].



**Figure 7:** Assessment of jugular venous pressure. Place the patient supine in bed and gradually raise the head of the bed to 30, 45, 60, and 90 degrees.

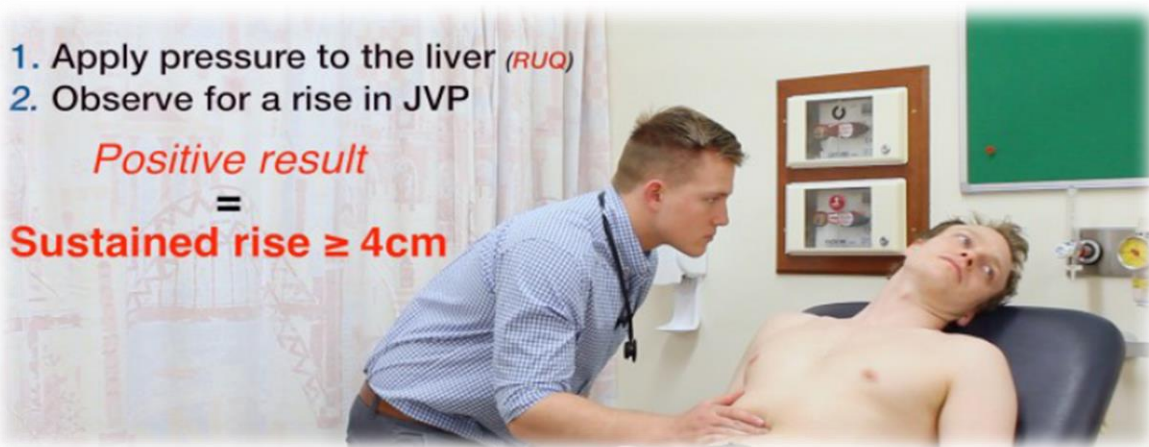
**Inspect the hepatojugular reflux**

**Hepatojugular** (Abdominojugular) reflux occurs in right ventricular failure. It can be demonstrated by pressing the periumbilical area firmly for 30 to 60 seconds and observing the jugular venous pressure. If there is a rise in the jugular venous pressure by 1 cm or more that is sustained throughout pressure application, abdominojugular reflux is present. Kussmaul's sign is a

paradoxical elevation of jugular venous pressure during inspiration and may occur in patients with chronic constrictive pericarditis, heart failure, or tricuspid stenosis(22).

A positive hepatojugular reflux sign is suggestive of **right-sided heart failure/tricuspid regurgitation**

1. Apply pressure to the liver (RUQ)
  2. Observe for a rise in JVP
- Positive result*  
= **Sustained rise  $\geq$  4cm**



**Figure 8:** Assess for hepatojugular reflux



## 2. Palpation:

Cardiovascular assessment continues with palpation and involves the use of the pads of the finger and balls of the hand. Using the pads of the fingers, the carotid, brachial, radial, femoral, popliteal, posterior tibia, and dorsalis pedis pulses are palpated. The peripheral pulses are compared bilaterally to determine rate, rhythm, strength, and symmetry. The 0-to-3 scale is used to rate the strength of the pulse. The carotid pulses should never be assessed simultaneously because this can obstruct flow to the brain [22].

**Carotid pulse:** Lightly place your fingers just medial to the trachea and below the jaw angle. Carotid pulse assesses character & volume e.g., the slow rising character in aortic stenosis [26].

**Femoral pulse:** Press relatively hard at a point inferior to the inguinal ligament. For an obese patient, palpate in the crease of the groin halfway between the pubic bone and the hipbone [27].

**Popliteal pulse:** Press firmly against the popliteal fossa at the back of the knee.

**Posterior tibia pulse:** Apply pressure behind and slightly below the malleolus of the ankle [7].

**Dorsalis pedis pulse:** Place your fingers on the medial dorsum of the foot while the patient points the toes down. In this site, the pulse is difficult to palpate and may seem to be absent in healthy people.

**Brachial pulse:** Position your fingers medial to the biceps tendon.

**Radial pulse:** Apply gentle pressure to the medial and ventral de of the wrist just below the thumb [25].

### Radial pulse – assess rate & rhythm

Palpate both radial pulses simultaneously. They should occur at the same time in a healthy adult. A delay may suggest **aortic coarctation**.

### Collapsing pulse: associated with aortic regurgitation

1. First, ensure the patient has no shoulder pain
2. Palpate the radial pulse with your hand wrapped around the wrist
3. Raise the arm above the head briskly

You should feel a tapping impulse through the muscle bulk of the arm as the blood empties from the arm very quickly in diastole, resulting in a palpable sensation(20).

This is a Water hammer pulse and can occur in normal physiological states (fever/pregnancy), or in cardiac lesions (e.g., AR / PDA), or in high output states (e.g., **anaemia / AV fistula/thyrotoxicosis**)



**Figure 9:** Collapsing pulse

**Arterial pulses:** Weak pulses indicate low cardiac output or increased peripheral vascular resistance, as occurs in arterial atherosclerotic disease. Weak pedal pulses are common in elderly patients. A strong bounding pulse occurs in patients with hypertension and in high cardiac output states, such as exercise, pregnancy, anemia, and thyrotoxicosis [9].

Rating Scale Used for Assessing Strength of Pulses:

- 0 Absent pulse
- 1+ Present but diminished pulse
- 2+ Average normal pulse
- 3+ Moderately increased
- 4+ Markedly increased pulse

**Rate:** The resting heart rate shows considerable variation ranging between 60 to 100 beats/min. The rate should be counted for at least 30 seconds. When the rhythm is irregular, count for a full one minute [25].

**Rhythm:** The normal rhythm is initiated from the sinus node, and this follows a regular cycle within physiological variations. The rhythm can be

intermittently irregular or can be continuously irregular. The common causes for an intermittently irregular pulse are either ventricular premature beats or supraventricular premature beats [6].

### Palpation of precordium

The nurse may feel a thrill (vibrations that feel similar to what one feels when a hand is placed on a purring cat), heaves (lifting of the cardiac area secondary to an increased workload and force of the left ventricle contraction, or pulsation. The patient should be in a supine position for this portion of the assessment [24].

### Palpate the cardiac landmarks for:

- 1- **Pulsation:** using the fingers pads, locate the cardiac landmarks and palpate the area for pulsation.
- 2- **Thrills:** using the hand's palmar surface at the base of the fingers, locate the cardiac landmarks and palpate the area for thrills.
- 3- **Heaves:** follow step 2 and palpate the area for heaves.

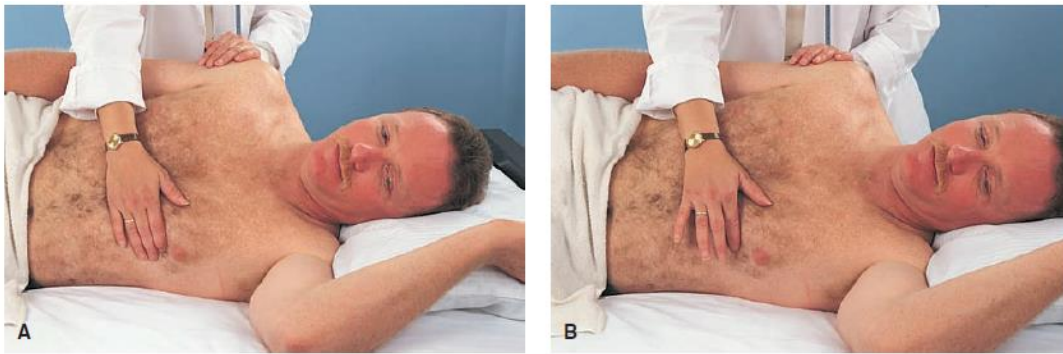


Figure 10:

**Aortic area:** No pulsation, thrills or heaves should be palpated. Aortic regurgitation or stenosis can cause a turbulent blood flow in the left ventricle, which may be palpated as a thrill [28].

**Pulmonic area:** No pulsation thrills or heaves should be palpated. Pulmonic regurgitation or stenosis can cause a turbulent blood flow in the right ventricle, which may be palpated as thrills.

**Midprecordial area:** No pulsation thrills or heaves should be palpated. Both left ventricular aneurysm, and right ventricular enlargement can produce a pulsation in the midprecordial area [19].

**Tricuspid area:** No pulsation thrills or heaves should be palpated. Tricuspid regurgitation or stenosis can cause a turbulent blood flow in the right atrium,

which may be palpated as thrills. Right ventricular enlargement can produce heaves at the tricuspid area, secondary to increased ventricular workload [19].

**Mitral area:** Palpate the mitral area for pulsation, thrills, or heaves. If a pulsation (apical impulses) is not palpable, turn the patient to the left side and palpate in this position.

The apical impulse can be palpated at approximately half of the adult population, 1-2 cm in diameter, and the amplitude is small and can be felt directly after the first heart sounds. Mitral stenosis or mitral regurgitation may produce thrills from the turbulent of blood at the left atrium [29].

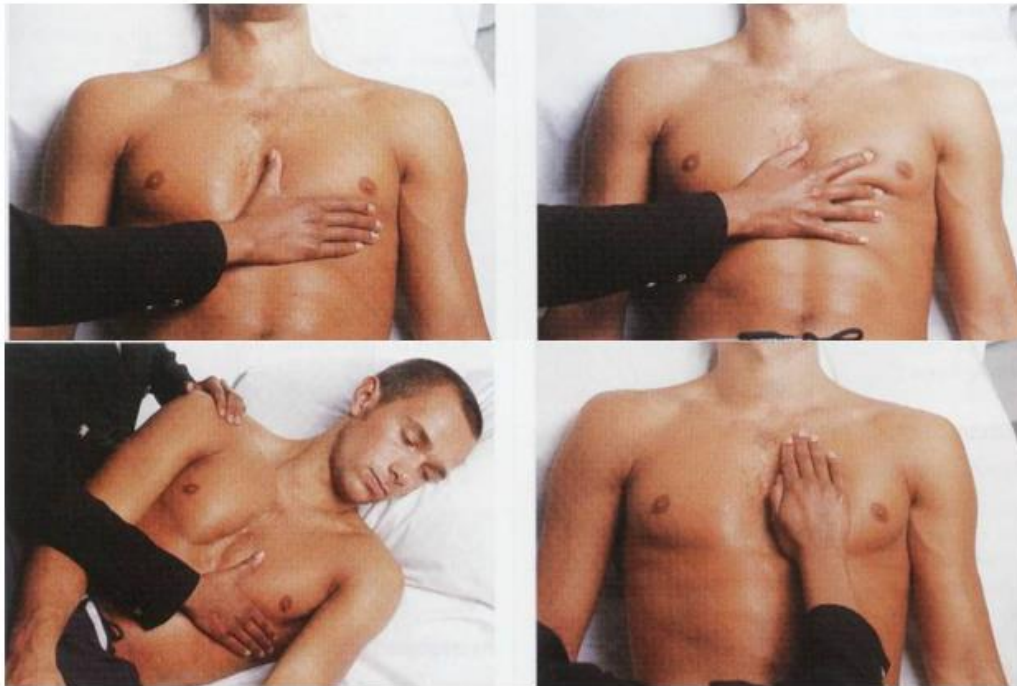


Figure 11:

Left ventricular hypertrophy produced a laterally displaced apical impulse to the sixth intercostal space. In addition, the hypertrophied muscles work harder during a contraction to produce a heave or sustained apical beats. This occurs in many cases, such as aortic stenosis, systemic hypertension, sub-aortic stenosis, and hypertrophied cardiomyopathy.

A hypokinetic pulsation less than 1-2 cm in diameter can be caused by the same cause listed under the hypokinetic pulsation in the inspection of the mitral area [30].

### 3. Percussion

With the advent of radiological means of evaluating cardiac size, percussion is not significantly contributing to cardiac assessment. However, a gross determination of heart size can be made by percussing for the dullness that reflects the cardiac borders [31].

### 4. Auscultation of Precordium:

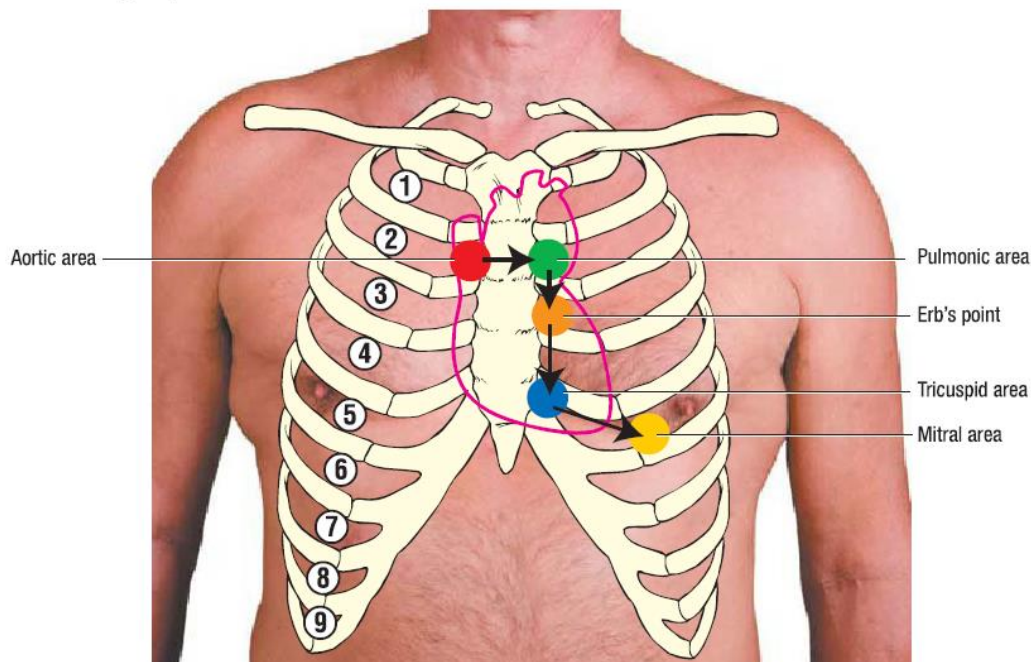
Data obtained by careful and thorough auscultation of the heart are essential in planning and evaluating care of the critically ill patient [23].

Listen with the stethoscope over all five auscultatory areas during auscultation, first with the diaphragm and then with the bell. Be sure to listen through several cardiac cycles to allow yourself enough time to become oriented to the sounds and to hear any subtle changes [31].

The examination should be done in a quiet, well-lighted, comfortable room, and the patient should be relaxed and comfortable properly gowned, and adequately exposed to the waist. Usually, the examination is initiated from the right side [12].

The patient is placed in a recumbent position with the trunk elevated 30 to 45 degrees. To help here abnormal sounds, the patient may be asked to roll partly onto the left side (left lateral decubitus position). This position helps bring the left ventricle closer to the chest wall [23].

#### Auscultatory sequence



**Figure 12:** Area of auscultation

**Capillary refill:** Capillary refill time provides an estimate of the rate of peripheral blood flow. When the tip of the fingernail is depressed, the nail bed blanches. When the pressure is released quickly, the area is reperused and becomes pink. Normally, reperfusion occurs almost instantaneously. More sluggish reperfusion indicates a slower peripheral circulation, such as in heart failure. Normal is <2 seconds – if prolonged may suggest **hypovolemia**. More sluggish reperfusion indicates a slower peripheral circulation, such as in heart failure [33].

#### Blood pressure:

Measure blood pressure and note any abnormalities – **hypertension/hypotension**

Narrow pulse pressure is associated with **Aortic Stenosis**

Wide pulse pressure is associated with **Aortic Regurgitation**

You will often not be expected to carry this out (due to time restraints), but make sure to mention that you'd ideally like to measure blood pressure in both arms [19].

**Temperature:** Temperature and moistness are controlled by the autonomic nervous system. Normally, hands and feet are warm and dry. Under stress,

The key is to use a systematic approach to listening and describing what is heard. There are four valves (mitral, tricuspid, pulmonary and aortic), and each has an auscultatory area. These areas reflect sounds transmitted in the direction of blood flow as it passes through the valves, not surface markings of the valves. For this reason, there are five key listening areas [32]:

- **Aortic valve area** – 2nd right intercostal space, right sternal border
- **Pulmonary valve area** – 2nd left intercostal space, left sternal border
- **Second pulmonic area (Erb's point)** – 3rd intercostal space, left sternal border
- **Tricuspid area** – 4th left intercostal space, lower left sternal border
- **Mitral (apical) area** – the apex of the heart, 5th left intercostal space, midclavicular line.

the periphery may be cool and moist. In cardiogenic shock, skin becomes cold and clammy.

**Temperature:** cool peripheries may suggest **poor cardiac output/hypovolemia** [20].

#### Pulse oximetry

Pulse oximetry provides a noninvasive method of monitoring SpO<sub>2</sub> levels, either continuously or intermittently. It is widely used in both pre-hospital and hospital settings. The normal SpO<sub>2</sub> is >95%. Indications for use include the following [27]:

- Critical illness
- Hypoxia
- Post-surgery
- Sedation

Place the probe on the patient's finger or earlobe. If SpO<sub>2</sub> is monitored continuously, the nurse must change the probe's position regularly to prevent the formation of pressure ulcers and finger stiffness. If the fingers are used, remove nail polish or anything else that may cause problems with the analysis, such as blood, paint, or grime. Set the monitor alarms. Avoid

placing the BP cuff on the same arm as the probe, as this will interrupt the readings. The following can lead to inaccurate readings [34]:

- Anemia
- Poor peripheral perfusion
- Hypothermia
- Rhythm problems
- Nail polish and extensions
- Carbon monoxide poisoning

Do not consider SpO<sub>2</sub> levels in isolation, but also consider the clinical presentation. In some cases, ABG will need to be obtained [35].

**Varicose Veins:** Are tortuous dilations of the superficial veins that result from defective venous valves, intrinsic weakness of the vein wall, high intraluminal pressure, or arteriovenous fistulas.

### Diagnostic Evaluation

Diagnostic tests and procedures are used to confirm the data obtained by the history and physical assessment. Some tests are easy to interpret, but expert clinicians must interpret others. All tests should be explained to the patient. Some necessitate special preparation before they are performed and special monitoring by the nurse after the procedure [36].

### Laboratory tests may be performed for the following reasons:

1. To assist in identifying the cause of cardiovascular signs and symptoms
2. To identify abnormalities in the blood that affect the prognosis of a patient with CVD
3. To assess the degree of inflammation
4. To screen for risk factors associated with CAD
5. To determine baseline values before initiating therapeutic interventions
6. To ensure that therapeutic levels of medications (e.g., antiarrhythmic agents and warfarin) are maintained
7. To assess the effects of medications (e.g., effects of diuretics on potassium levels)

### Cardiac Biomarker Analysis

Plasma levels of cardiac biomarkers are used to diagnose acute MI in conjunction with the history, physical examination, and ECG. These substances leak into the bloodstream after injured myocardial cells rupture their cell membranes. Biomarkers have a specific timeline for when they first rise, peak, and then return to normal. This timeline helps the clinician decide which test to order based on the timing of patient's symptom onset [34].

- ❖ **Creatine kinase (CK)/CK-MB:** CK is released from three types of damaged tissue (myocardium, skeletal muscle, brain). CK-MB is the cardiac-specific isoenzyme that rises within 4 to 8 hours after myocardial injury, peaks in 12 to 24 hours, and returns to normal within 3 to 4 days [22].
- ❖ **Myoglobin:** This hemeprotein transports oxygen. Its small molecular structure allows it to be released rapidly from damaged myocardial tissue and accounts for its early rise. Myoglobin is not used alone to diagnose MI because elevations can also occur in patients with renal or musculoskeletal disease. However, negative results help rule out acute MI. Myoglobin rises within 1 to 3 hours of tissue injury, peaks in 4 to 12 hours, and returns to normal in 24 hours [28].
- ❖ **Troponin T and I:** These hemeproteins regulate the contractile function of the myocardium. After a myocardial injury, these biomarkers rise early (within 3 to 4 hours), peak in 4 to 24 hours, and remain elevated for 1 to 3 weeks. These early and prolonged elevations make a very early diagnosis of acute MI possible and allow for late diagnosis in patients who have delayed seeking care for several days after the onset of acute MI symptoms [36].

### Reading a rhythm strip

#### 12-lead electrocardiogram (ECG)

The Electrocardiogram (ECG) is a graphic record of the electrical activity generated by the heart's cells, recorded at the body surface by electrodes and displayed on a cardiac monitor or ECG paper as a visual record. The electrodes detect the electrical current generated by depolarization and repolarization of the atria and ventricles during each cardiac cycle [18]. The largest electrical current flows from the base to the apex of the heart in a right to left direction [34].

**Analyzing a Rhythm Strip:** the analyzing should always be given in the same sequence:

- 1- Rhythm
- 2- Rate and conduction problems
- 3- Cardiac axis
- 4- P wave evaluation
- 5- QRS evaluation
- 6- ST segment evaluation
- 7- T wave evaluation

Finally, you need to pull together all your ECG findings and draw a conclusion about what the ECG shows, placing your findings in the context of the clinical information provided. This is where you apply your knowledge of the ECG and what each ECG feature can indicate in order to draw conclusions about the patient's condition [37].

Finally, the purpose of examining the cardiovascular system is to assess the function of the heart as a pump and arteries and veins throughout the body in transporting oxygen and nutrients to the tissues and transporting waste products and carbon dioxide from the tissues. A patient with signs or symptoms of heart (cardiac) problems, such as chest pain, may suffer a life-threatening condition requiring immediate attention. The history of cardiovascular provides physiological and psychosocial information that guides the physical assessment, the selection of diagnostic tests collection, and the choice of treatment options.

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