Vital signs

(2) Pulse
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Learning objectives:-

At the end of this lecture the student should be able to:

1. Explain the anatomy and physiology of circulatory system.
2. Define pulse.
3. Define blood pressure.
4. Explain factors controlling blood pressure.
5. Mention the common sites for palpating pulse.
6. Describe assessment of normal and abnormal pulse rate, rhythm, volume and force.

7. Explain how to record and report pulse.
Anatomy and Physiology of the Circulatory System

The human heart is a four-chambered muscular organ, shaped and sized roughly like a man's closed fist with two-thirds of the mass to the left of midline.
The Heart

Superior Vena Cava (Blood comes from the head and arms.)

Aortic Arch (Blood goes to the body.)

Pulmonary Arteries (Blood goes to the lungs.)

Pulmonary Veins (Blood comes from lungs.)

Right Atrium

Mitral Valve

Left Atrium

Tricuspid Valve

Left Ventricle

Inferior Vena Cava (Blood comes from the body and legs.)

Semitunar Valves

Heart Muscle

Septum

Right Ventricle
The heart is enclosed in a pericardial sac that is lined with the parietal layers of a serous membrane.

The visceral layer of the serous membrane forms the epicardium.
Layers of the Heart Wall

Three layers of tissue form the heart wall.

1. Epicardium: the outer layer of the heart wall
2. The myocardium is the middle layer, and
3. The endocardium is the inner layer.
Chambers of the Heart

The internal cavity of the heart is divided into four chambers:

1. Right atrium
2. Right ventricle
3. Left atrium
4. Left ventricle
The two atria are thin-walled chambers that receive blood from the veins.

The two ventricles are thick-walled chambers that forcefully pump blood out of the heart.

Differences in thickness of the heart chamber walls are due to variations in the amount of myocardium present, which reflects the amount of force each chamber is required to generate.

The right atrium receives deoxygenated blood from systemic veins; the left atrium receives oxygenated blood from the pulmonary veins.
Valves of the Heart

- Pumps need a set of valves to keep the fluid flowing in one direction and the heart is no exception.

- The heart has two types of valves that keep the blood flowing in the correct direction.

- The valves between the atria and ventricles are called atrioventricular valves (also called cuspid valves), while those at the bases of the large vessels leaving the ventricles are called semilunar valves.
The right atrioventricular valve is the tricuspid valve.

The left atrioventricular valve is the bicuspid, or mitral, valve.

The valve between the right ventricle and pulmonary trunk is the pulmonary semilunar valve.

The valve between the left ventricle and the aorta is the aortic semilunar valve.
When the ventricles contract, atrioventricular valves close to prevent blood from flowing back into the atria.

When the ventricles relax, semilunar valves close to prevent blood from flowing back into the ventricles.
Pathway of Blood through the Heart

While it is convenient to describe the flow of blood through the right side of the heart and then through the left side, it is important to realize that both atria contract at the same time and both ventricles contract at the same time.

The heart works as two pumps, one on the right and one on the left, working simultaneously.

Blood flows from the right atrium to the right ventricle, and then is pumped to the lungs to receive oxygen.

From the lungs, the blood flows to the left atrium, then to the left ventricle. From there it is pumped to the systemic circulation.
Blood Supply to the Myocardium

The myocardium of the heart wall is a working muscle that needs a continuous supply of oxygen and nutrients to function with efficiency. For this reason, cardiac muscle has an extensive network of blood vessels to bring oxygen to the contracting cells and to remove waste products.

The right and left coronary arteries, branches of the ascending aorta, supply blood to the walls of the myocardium. After blood passes through the capillaries in the myocardium, it enters a system of cardiac (coronary) veins.

Most of the cardiac veins drain into the coronary sinus, which opens into the right atrium.
Physiology of the Heart

- The work of the heart is to pump blood to the lungs through pulmonary circulation and to the rest of the body through systemic circulation.

- This is accomplished by systematic contraction and relaxation of the cardiac muscle in the myocardium.
Conduction System

- An effective cycle for productive pumping of blood requires that the heart be synchronized accurately.

- Both atria need to contract simultaneously, followed by contraction of both ventricles.

- Specialized cardiac muscle cells that make up the conduction system of the heart coordinate contraction of the chambers.
The conduction system includes several components.

The first part of the conduction system is the sinoatrial node. Without any neural stimulation, the sinoatrial node rhythmically initiates impulses 70 to 80 times per minute.

Because it establishes the basic rhythm of the heartbeat, it is called the pacemaker of the heart.
Other parts of the conduction system include the atrioventricular node, atrioventricular bundle, bundle branches, and conduction myofibers.

All these components coordinate the contraction and relaxation of the heart chambers.
Cardiac Cycle

- The cardiac cycle refers to the alternating contraction and relaxation of the myocardium in the walls of the heart chambers, coordinated by the conduction system, during one heartbeat.

- Systole is the contraction phase of the cardiac cycle, and diastole is the relaxation phase.

- At a normal heart rate, one cardiac cycle lasts for 0.8 second.
Heart Sounds

The sounds associated with the heartbeat are due to vibrations in the tissues and blood caused by closure of the valves.

Abnormal heart sounds are called murmurs.
Heart Rate

- The sinoatrial node, acting alone, produces a constant rhythmic heart rate.

- Regulating factors are reliant on the atrioventricular node to increase or decrease the heart rate to adjust cardiac output to meet the changing needs of the body.

- Most changes in the heart rate are mediated through the cardiac center in the medulla oblongata of the brain.

- The center has both sympathetic and parasympathetic components that adjust the heart rate to meet the changing needs of the body.

- Peripheral factors such as emotions, ion concentrations, and body temperature may affect heart rate.

- These are usually mediated through the cardiac center.
Definition of pulse

- An alternate expansion and recoil of an artery as the wave of blood is forced through it by the contraction of the left ventricle.

- It is felt by palpating a superficial artery that has a bone behind it.

- Counting pulse is an indirect measure to assess heart rate.

- Normally pulse rate is equal to heart rate.
Common sites for palpating the pulse

1. Radial Artery: At the wrist, is the most commonly used for palpating the pulse rate, because it is easily accessible and it can be pressed against the radius bone.

2. The superficial temporal artery, in the temporal region.

3. The external carotid artery, in the neck.

4. The subclavian artery behind the inner end of the clavicle against the first rib.
1. The facial artery, about an inch forward of the angle of the jaw.

1. The internal maxillary artery, in front of and slightly below the ear.

1. The brachial artery, on the inner aspect of the upper arm, about halfway between the shoulder and the elbow.

1. The femoral artery, in the mid-groin.

2. The popliteal artery, behind the knee.

3. The dorsalis pedis artery, below the ankle on the dorsum of the foot.
Apical Pulse

- A more accurate estimate of the heart beat, per minute.

- It is obtained by listening with a stethoscope over the apex of the heart, between fifth and sixth rib about 3 inches (8 cm) to the left of the median line and slightly below the nipple.
Assessment of Pulse;

1- Pulse is assessed according to rate 60 - 90 beat/minute, (b/m).
Abnormalities of Pulse Rate:

a- **Tachycardia**: The pulse rate is abnormally rapid.

An adult is considered to have tachycardia when his pulse rate is 100 beat/m. or more,

b- **Bradycardia**: The pulse rate is abnormally slow and below 60 beat/m.
Rhythm of pulse:

refers to the pattern of beats (the interval between each beat should be identical). Rhythm of pulse: means that beats are identical in force and separated by equal intervals.

Abnormalities in pulse Rhythm:-

An irregular pulse rhythm is called arrhythmias.

a- Intermittent pulse: a type of irregular pulse where a beat dropped either irregular or regular i.e. each 4 beats there is a dropped beat or in the form of periods of normal rhythm broken by periods of abnormal rhythm.

b- Bigeminal; It consists of two regular beats followed by a longer than normal pause with no beat, and then two regular beats again followed by a pause.
Common sites for palpating the pulse
1. **Axillary pulse**: located inferiorly of the lateral wall of the axilla

2. **Brachial pulse**: located on the inside of the upper arm near the elbow, frequently used in place of carotid pulse in infants (**brachial artery**)

3. **Radial pulse**: located on the lateral of the wrist (**radial artery**). It can also be found in the **anatomical snuff box**.
5. **Ulnar pulse**: located on the medial of the wrist (*ulnar artery*).

6. Front of right upper extremity: *Chinese* medicine has focused on the pulse in the upper limbs for several centuries.

7. The concept of **Pulse Diagnosis** is essentially a treatise based upon palpation and observations of the radial and ulnar volar pulses at the readily accessible wrist.
Lower limb

1. **Femoral pulse**: located in the inner thigh, at the mid-inguinal point, halfway between the pubic symphysis and anterior superior iliac spine (*femoral artery*).

2. **Popliteal pulse**: Above the knee in the popliteal fossa, found by holding the bent knee. The patient bends the knee at approximately 124°, and the physician holds it in both hands to find the popliteal artery in the pit behind the knee (*Popliteal artery*).

3. **Dorsalis pedis pulse**: located on top of the foot, immediately lateral to the extensor of hallucis longus (*dorsalis pedis artery*).

4. **Tibialis posterior pulse**: located on the medial side of the ankle, 2 cm inferior and 2 cm posterior to the medial malleolus (*posterior tibial artery*). It is easily palpable over *Pimenta's Point*. 
Head/neck

- **Carotid pulse**: located in the neck (carotid artery). The carotid artery should be palpated gently and while the patient is sitting or lying down. Stimulating its baroreceptors with low palpitation can provoke severe bradycardia or even stop the heart in some sensitive persons. Also, a person's two carotid arteries should not be palpated at the same time. Doing so may limit the flow of blood to the head, possibly leading to fainting or brain ischemia. It can be felt between the anterior border of the sternocleidomastoid muscle, above the hyoid bone and lateral to the thyroid cartilage.

- **Facial pulse**: located on the mandible (lower jawbone) on a line with the corners of the mouth (facial artery).

- **Temporal pulse**: located on the temple directly in front of the ear (superficial temporal artery).
Pulse Rate

- Pulse rate is the number of contractions over a peripheral artery in 1 minute.

- Regulated by the autonomic nervous system through cardiac sinoatrial node

- Parasympathetic stimulation - decrease heart rate

- Sympathetic stimulation - increases heart rate
The normal heart rate in adult is (60 – 100 beat/min.)

- **Tachycardia**: is a rapid pulse rate, greater than 100 beats/min.

- **Bradycardia**: is a pulse rate below 60 beats/minute in adults.
Factors Contribute to Increase Pulse Rate

- Pain.
- Fever.
- Stress.
- Exercise.
- Bleeding.
- Decrease in blood pressure.
- Some medications as (adrenalin, aminophylline)
Age; as age increases, the pulse rate gradually decreases.

Exercise; the pulse rate normally increase with activity

Fever; the pulse rate increases in response to the lowered blood pressure that results from peripheral vasodilatation associated with elevated temperature and because of the increased metabolic rate.
Factors May Slow The Pulse

- Rest.
- Increasing age.
- People with thin body size.
- Medication as (digitalis).
- Thyroid gland disturbances.
Temporal pulse
Carotid pulse
Brachial pulse
Radial pulse
Femoral pulse
Popliteal pulse
Posterior tibial pulse
Dorsalis pulse.
Auscultation apical pulse with stethoscope
# Normal Pulse Per Minute At Various Age

<table>
<thead>
<tr>
<th>Age</th>
<th>Range</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn– 1 month</td>
<td>120 – 160</td>
<td>140</td>
</tr>
<tr>
<td>1 month - 12 months</td>
<td>80 – 140</td>
<td>120</td>
</tr>
<tr>
<td>12 months – 2 years</td>
<td>80 – 130</td>
<td>110</td>
</tr>
<tr>
<td>2 year - 6 year</td>
<td>75 – 120</td>
<td>100</td>
</tr>
<tr>
<td>6 year - 12 year</td>
<td>75 – 110</td>
<td>95</td>
</tr>
<tr>
<td>Adolescence to adult</td>
<td>60 - 100</td>
<td>80</td>
</tr>
</tbody>
</table>
Pulse Rate

The normal pulse for healthy adults ranges from 60 - 100 beats per minute.
The pulse rate may fluctuate and increase with exercise, illness, injury, and emotions. Girls ages 12 and older and women, in general, tend to have faster heart rates than do boys and men.
Pulse rate

Athletes, such as runners, may have heart rates in the 40's and experience no problems.
How to check your pulse

You feel the beats by firmly pressing on the arteries, which are located close to the surface of the skin at certain points of the body.
How to check your pulse

The pulse can be found on the side of the lower neck, on the inside of the elbow, or at the wrist.
Pulse

- Place the tips of your index and middle fingers just proximal to the patient's wrist on the thumb side, orienting them so that they are both over the length of the vessel.
Push lightly at first, adding pressure if there is a lot of subcutaneous fat or you are unable to detect a pulse. If you push too hard, you might occlude the vessel and mistake your own pulse for that of the patient.
Pulse: Quantity

- Measure the rate of the pulse (recorded in beats per minute). Count for **30 seconds** and multiply by 2 (or **15 seconds x 4**).
Pulse: Quantity

If the rate is particularly slow or fast, it is probably best to measure for a full 60 seconds in order to minimize the error.
Pulse: Regularity

Is the time between beats constant?. Irregular rhythms, are quite common.
Does the pulse volume feel normal? This reflects changes in stroke volume. In hypovolemia, the pulse volume is relatively low.
THANK YOU