VITAL SIGNS
(PULSE & BLOOD PRESSURE)
CHAPTER 7

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LEARNING OUTCOMES

Upon the completion of “Pulse & Blood Pressure” lecture, the learners will be able to:

1. Discuss the importance of the vital signs in assessing the health status of the individual.
2. Identify the variations in pulse, and blood pressure that occur from infancy to old age.
3. Discuss the factors that affect the (P&BP) and accurate measurement of them using various methods.
4. Explain appropriate nursing care for alterations in P&BP.
5. Identify sites used to assess pulse, blood pressure and state the reasons for their use.
6. Explain how to measure the pulse, and blood pressure.
7. List the characteristics that should be included when assessing the pulse.
INTRODUCTION

- The vital signs are body temperature, pulse, respirations, and blood pressure. Recently, many agencies have designated pain as a fifth vital sign.
- These signs, which should be looked at together, are checked to monitor the functions of the body. The signs reflect changes in function that otherwise might not be observed. It should be evaluated with reference to the client’s present and prior health status, are compared to the client’s usual (if known) and accepted normal standards.
- When and how often to assess a specific client’s vital signs
- are chiefly nursing judgments, depending on the client’s health status.
COMMON TIMES TO ASSESS VITAL SIGNS

**BOX 7-1 Times to Assess Vital Signs**

- On admission to a health care agency to obtain baseline data
- When a client has a change in health status or reports symptoms such as chest pain or feeling hot or faint
- Before and after surgery or an invasive procedure
- Before and/or after the administration of a medication that could affect the respiratory or cardiovascular systems; for example, before giving a digitalis preparation
- Before and after any nursing intervention that could affect the vital signs (e.g., ambulating a client who has been on bed rest)
• is a wave of blood created by contraction of the left ventricle of the heart. It represents the stroke volume output or the amount of blood that enters the arteries with each ventricular contraction.

• **Compliance** of the arteries is their ability to contract and expand. When a person’s arteries lose their elasticity, as can happen in old age, greater pressure is required to pump the blood into the arteries.
Cardiac output is the volume of blood pumped into the arteries by the heart and equals the result of the stroke volume (SV; in mL) times the heart rate (HR) per minute (in beats per minute, or BPM).

**For example**: 65 mL * 70 BPM = 4.55 L per minute

- When an adult is resting, the heart pumps about 5 liters of blood each minute.
- In a healthy person, the pulse reflects the heartbeat.
The **peripheral pulse** is a pulse located away from the heart, for example, in the foot or wrist.

The **apical pulse** is a central pulse; that is, it is located at the apex of the heart. It is also referred to as the **point of maximal impulse (PMI)**.

The rate of the pulse is expressed in beats per minute (BPM).
FACTORS AFFECTING THE PULSE

1. **Age.** As age increases, the pulse rate gradually decreases overall. Table 7-2 page 122 (FYI).
2. **Gender.** After puberty, the average male’s pulse rate is slightly lower than the female’s.
3. **Exercise.** The pulse rate normally increases with activity.
4. **Fever.** The pulse rate increases (a) in response to the lowered blood pressure that results from peripheral vasodilatation associated with elevated body temperature and (b) because of the increased metabolic rate.
5. **Medications.** Some medications decrease the pulse rate, and others increase it.
FACTORS AFFECTING THE PULSE

6. **Hypovolemia.** Loss of blood from the vascular system normally increases pulse rate.

7. **Stress.** In response to stress, sympathetic nervous stimulation increases the overall activity of the heart.

8. **Position changes.** Pooling results in a graduate decrease in the venous blood return to the heart and a subsequent reduction in blood pressure and increase in heart rate.

9. **Pathology.** Certain diseases such as some heart conditions or those that impair oxygenation can alter the resting pulse rate.
PULSE SITES
## REASONS FOR USING SPECIFIC PULSE SITE

<table>
<thead>
<tr>
<th>PULSE SITE</th>
<th>REASONS FOR USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radial</td>
<td>Readily accessible</td>
</tr>
<tr>
<td>Temporal</td>
<td>Used when radial pulse is not accessible</td>
</tr>
<tr>
<td>Carotid</td>
<td>Used during cardiac arrest/shock in adults</td>
</tr>
<tr>
<td></td>
<td>Used to determine circulation to the brain</td>
</tr>
<tr>
<td>Apical</td>
<td>Routinely used for infants and children up to 3 years of age</td>
</tr>
<tr>
<td></td>
<td>Used to determine discrepancies with radial pulse</td>
</tr>
<tr>
<td></td>
<td>Used in conjunction with some medications</td>
</tr>
<tr>
<td>Brachial</td>
<td>Used to measure blood pressure</td>
</tr>
<tr>
<td></td>
<td>Used during cardiac arrest for infants</td>
</tr>
<tr>
<td>Femoral</td>
<td>Used in cases of cardiac arrest/shock</td>
</tr>
<tr>
<td></td>
<td>Used to determine circulation to a leg</td>
</tr>
<tr>
<td>Popliteal</td>
<td>Used to determine circulation to the lower leg</td>
</tr>
<tr>
<td>Posterior tibial</td>
<td>Used to determine circulation to the foot</td>
</tr>
<tr>
<td>Dorsal pedal</td>
<td>Used to determine circulation to the foot</td>
</tr>
</tbody>
</table>
A pulse is commonly assessed by palpation (feeling) or auscultation (hearing).

The middle three fingertips are used for palpating all pulse sites except the apex of the heart. A stethoscope is used for assessing apical pulses.

A Doppler ultrasound stethoscope (DUS) is used for pulses that are difficult to assess.
ASSESSING THE PULSE

Figure 7-11 A Doppler ultrasound stethoscope (DUS).
A pulse is normally palpated by applying moderate pressure with the three middle fingers of the hand. The pads on the most distal aspects of the finger are the most sensitive areas for detecting a pulse.
NURSING CONSIDERATIONS WHEN ASSESSING PULSE

Before the nurse assesses the resting pulse, the client should assume a comfortable position.

The nurse should also be aware of the following:

1. Any medication that could affect the heart rate.
2. Whether the client has been physically active. If so, wait 10 to 15 minutes until the client has rested and the pulse has slowed to its usual rate.
3. Any baseline data about the normal heart rate for the client. For example, a physically fit athlete may have a heart rate below 60 BPM.
4. Whether the client should assume a particular position (e.g., sitting). In some clients, the rate changes with the position because of changes in blood flow volume and autonomic nervous system activity.
When assessing the pulse, the nurse collects the following data: the rate, rhythm, volume, arterial wall elasticity, and presence or absence of bilateral equality.

- An excessively fast heart rate (e.g., over 100 BPM in an adult) is referred to as **tachycardia**.
- A heart rate in an adult of less than 60 BPM is called **bradycardia**.
ASSESSING THE PULSE

- The **pulse rhythm** is the pattern of the beats and the intervals between the beats. Equal time elapses between beats of a normal pulse.
- A pulse with an irregular rhythm is referred to as a **dysrhythmia** or **arrhythmia**.
- **Pulse volume**, also called the pulse strength or amplitude refers to the force of blood with each beat.
- The **elasticity** of the arterial wall reflects its expansibility or its deformities.
- When assessing a peripheral pulse to determine the adequacy of blood flow to a particular area of the body (perfusion), nurse should assess pulses **bilaterally**.
APICAL PULSE ASSESSMENT (INDICATIONS)

• Assessment of the apical pulse is indicated for:

1. Clients whose peripheral pulse is irregular or unavailable.

2. Clients with known cardiovascular, pulmonary, and renal diseases.

3. Newborns, infants, and children up to 2 to 3 years old.
APICAL - RADIAL PULSE ASSESSMENT

• It need to be assessed for clients with certain cardiovascular disorders.

• Normally, the apical and radial rates are identical. An apical pulse rate greater than a radial pulse rate can indicate 1- that the thrust of the blood from the heart is too weak for the wave to be felt at the peripheral pulse site, or 2- indicate that vascular disease is preventing impulses from being transmitted.

• Any discrepancy between the two pulse rates is called a pulse deficit and needs to be reported promptly.

• In no instance is the radial pulse greater than the apical pulse.
**Arterial blood pressure** is a measure of the pressure exerted by the blood as it flows through the arteries.

The **systolic pressure** is the pressure of the blood as a result of contraction of the ventricles—highest pressure.

The **diastolic pressure** is the pressure when the ventricles are at rest—lower pressure.

The difference between the diastolic and the systolic pressures is called the **pulse pressure**. A normal pulse pressure is about 40 mmHg but can be as high as 100 mmHg during exercise.
Blood pressure is measured in **millimeters of mercury (mmHg)** and recorded as a **fraction**: systolic pressure over the diastolic pressure.

A typical blood pressure for a healthy adult is **120/80 mmHg** (pulse pressure of 40 mmHg).

A number of conditions are reflected by changes in blood pressure.

Blood pressure can vary considerably among individuals, it is important for the nurse to know a specific **client’s baseline** blood pressure (e.g., surgery).
DETERMINANTS OF BLOOD PRESSURE

1. Pumping Action of the Heart.
2. Peripheral Vascular Resistance.
1. PUMPING ACTION OF THE HEART

Weak

- less blood is pumped into arteries (lower cardiac output) >>> the blood pressure decreases.

Strong

- the volume of blood pumped into the circulation increases (higher cardiac output) >>> the blood pressure increases.
Peripheral resistance can increase blood pressure. The diastolic pressure especially is affected.

Some factors that create resistance in the arterial system are the capacity (internal diameter) of the arterioles and capillaries, the elasticity of the arteries, and the viscosity of the blood.
2. PERIPHERAL VASCULAR RESISTANCE

- **Normally**, the arterioles are in a state of partial constriction.
- **Increased vasoconstriction**, such as occurs with smoking raises the blood pressure.
- Decreased vasoconstriction lowers the blood pressure.
- If the elastic and muscular tissues of the arteries are replaced with fibrous tissue, the arteries lose much of their ability to constrict and dilate arteriosclerosis.
3. BLOOD VOLUME

Decreased
- e.g. as a result of a hemorrhage or dehydration>> the blood pressure decreases because of decreased fluid in the arteries.

Increased
- e.g. as a result of a rapid intravenous infusion>> the blood pressure increases because of the greater fluid volume within the circulatory system.
4. BLOOD VISCOSITY

- Blood pressure is **higher** when the blood is highly viscous (**thick**) >> when the proportion of red blood cells to the blood plasma is high. This proportion is referred to as the **hematocrit**.
FACTORS AFFECTING BLOOD PRESSURE

1. **Age.** The pressure rises with age, reaching a peak at the onset of puberty, and then tends to decline.

2. **Exercise.** Physical activity increases the cardiac output and hence the blood pressure.

3. **Stress.** Stimulation of the sympathetic nervous system increases cardiac output & vasoconstriction of the arterioles>>increasing the blood pressure. Severe pain >> decrease blood pressure by inhibiting the vasomotor center and producing vasodilatation.
4. **Gender.** After puberty, females usually have lower blood pressures than males of the same age; this difference is thought to be due to hormonal variations. After menopause, women generally have higher blood pressures than before.

5. **Medications.** Many medications, including caffeine, may increase or decrease the blood pressure.

6. **Obesity.** Both childhood and adult obesity predispose to hypertension.
7. **Diurnal variations**. Pressure is usually lowest early in the morning, when the metabolic rate is lowest, then rises throughout the day and peaks in the late afternoon or early evening.

8. **Disease process**. Any condition affecting the cardiac output, blood volume, blood viscosity, and/or compliance of the arteries has a direct effect on the blood pressure.
A blood pressure that is persistently above normal.

A single elevated blood pressure reading indicates the need for reassessment. Hypertension cannot be diagnosed unless an elevated blood pressure is found when measured twice at different times.

It is usually asymptomatic and is often a contributing factor to myocardial infarctions (heart attacks).
An elevated blood pressure of unknown cause is called primary hypertension.

An elevated blood pressure of known cause is called secondary hypertension.
An elevated blood pressure of unknown cause is called primary hypertension.

An elevated blood pressure of known cause is called secondary hypertension.
# Classification of Blood Pressure

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>SYSTOLIC BP (MMHG)</th>
<th>DIASTOLIC BP (MMHG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&lt;120</td>
<td>&lt;80</td>
</tr>
<tr>
<td>Prehypertension</td>
<td>120–139</td>
<td>80–89</td>
</tr>
<tr>
<td>Hypertension, stage 1</td>
<td>140–159</td>
<td>90–99</td>
</tr>
<tr>
<td>Hypertension, stage 2</td>
<td>&gt;160</td>
<td>&gt;100</td>
</tr>
</tbody>
</table>
1. Thickening of the arterial walls, which reduces the size of the arterial lumen.

2. Inelasticity of the arteries (arteriosclerosis).

3. Lifestyle factors as cigarette smoking, obesity, heavy alcohol consumption, lack of physical exercise, high blood cholesterol levels, and continued exposure to stress.
1. Follow-up care should include lifestyle changes (dietary modifications, exercise) conducive to lowering the blood pressure.

2. Monitoring the pressure itself.

3. Compliance with care plan, e.g. medications.
HYPOTENSION

• blood pressure that is below normal, meaning a systolic reading consistently between 85 and 110 mmHg in an adult whose normal pressure is higher than this.

• Orthostatic hypotension is a blood pressure that falls when the client sits or stands (position change). It is usually the result of peripheral vasodilatation in which blood leaves the central body organs, especially the brain, and moves to the periphery, often causing the person to feel faint.
CAUSES OF HYPOTENSION

1. Analgesics such as meperidine hydrochloride (Demerol).
2. Bleeding
3. Severe burns.
4. Dehydration.
HYPOTENSION CARE

- It is important to monitor hypotensive clients carefully to prevent falls.
- **When assessing for orthostatic hypotension:**
  1. Place the client in a supine position for 10 minutes.
  2. Record the client’s pulse and blood pressure.
  3. Assist the client to slowly sit or stand. Support the client in case of faintness.
  4. Immediately recheck the pulse and blood pressure in the same sites as previously.
  5. Repeat the pulse and blood pressure after 3 minutes.
  6. Record the results. A rise in pulse of 15–30 BPM or a drop in blood pressure of 20 mmHg systolic or 10 mmHg diastolic indicates orthostatic hypotension.
ASSESSING BLOOD PRESSURE

• Blood pressure is measured with a blood pressure cuff, a sphygmomanometer, and a stethoscope.
• There are three types of sphygmomanometers: mercury, aneroid, and digital.
ASSESSING BLOOD PRESSURE
The blood pressure is usually assessed in the client’s upper arm using the brachial artery and a standard stethoscope.

**Indications of assessing blood pressure on client’s thigh:**

1. The blood pressure cannot be measured on either arm (e.g., because of burns or other trauma).
2. The blood pressure in one thigh is to be compared with the blood pressure in the other thigh.
Contraindications of the use of particular arm to assess blood pressure:

1. The shoulder, arm, or hand (or the hip, knee, or ankle) is injured or diseased.
2. A cast or bulky bandage is on any part of the limb.
3. The client has had surgical removal of axilla (or hip) lymph nodes on that side, such as for cancer.
4. The client has an intravenous infusion in that limb.
5. The client has an arteriovenous fistula (e.g., for renal dialysis) in that limb.
• When taking a blood pressure using a stethoscope, the nurse identifies phases in the series of sounds called Korotkoff sounds. Box 7-6 page 135 (FYI).
ASSESSING BLOOD PRESSURE (METHOD)

Measuring Arterial Blood Pressure

- Blood pressure: 120 systolic, 70 diastolic (to be measured)
- Pressure in cuff: above 120; no sounds audible
- Pressure in cuff: below 120, but above 70
- Pressure in cuff: below 70; no sounds audible

(a) Brachial artery
(b) Brachial artery closed
(c) Sounds audible in stethoscope
(d)
ASSESSING BLOOD PRESSURE

- Inappropriate cuff size and/or poor techniques would result in wrong blood pressure reading.

Table 7-5 page 135 (FYI).
PRACTICE QUESTIONS