

Human Cardiovascular Physiology: Blood Pressure and Pulse Determinations

- The atria contract simultaneously, and as they start to relax, the ventricles contract simultaneously in a healthy heart.
- The cardiac cycle is equal to one complete heartbeat – where both atria and ventricles contract and relax.
- The **dicrotic notch** is a pressure fluctuation that results from the aortic semilunar valve snapping shut during the heart beat process. When this valve shuts, a momentary increase in the aortic pressure results from the elastic recoil of the aorta.
- The average heart beats approximately 75 beats per minute, so the cardiac cycle length is approximately 0.8 seconds.

Auscultation of Heart Sounds

Two distinct sounds are heard during each cardiac cycle – “**lub**” and “**dup**”. The sequence is designated lub-dup, pause, lub-dup, pause, etc.

- The first sound (lub) is called the S_1 and is associated with closure of the AV valves at the beginning of ventricular systole.
- The second sound (dup) is called S_2 and occurs as the semilunar valves close and corresponds with the end of systole.
- **Heart murmurs** are abnormal heart sounds and usually indicate valvular problems. Valves that don't close tightly are followed by a swishing sound due to the backflow of blood. High-pitched screeching sounds are associated with the tortuous flow of blood through constricted valves.

Palpation of the Pulse

Pulse refers to the alternating surges of pressure (expansion and recoil) in an artery that occur with each contraction and relaxation of the left ventricle.

- The **pulse pressure** is the difference between systolic and diastolic pressure.
- The nine superficial pulse points are: temporal artery, facial artery, common carotid artery, brachial artery, radial artery, femoral artery, popliteal artery, posterior tibial artery, and dorsalis pedis artery.

- Usually the pulse rate (pressure surges per minute) equals the heart rate (beats per minute). In resting state, the pulse averages 70-76 beats per minute.
- **Apical pulse** is the actual counting of heartbeats and it may be slightly faster than the radial because of a slight lag in time as the blood rushes from the heart into the large arteries where it can be palpated.
- The **pulse deficit** is the difference between the apical and radial valves. If this deficit is large, it may indicate cardiac impairment, low cardiac output, or abnormal heart rhythms.

Blood Pressure Determinations

The term **blood pressure (BP)** refers to the pressure the blood exerts against any unit area of the blood vessel walls, it is usually measured in the arteries. Blood pressure is taken in two readings: the systolic and the diastolic.

- The **systolic pressure** (ventricular contraction) is the pressure in the arteries at the peak of ventricular ejection.
- The **diastolic pressure** (ventricular relaxation) is the pressure during ventricular relaxation.
- When reporting BP, the systolic is reported first.
- BP is reported in millimeters of mercury (mm Hg).
- A **sphygmomanometer** is an instrument used to obtain blood pressure readings by the auscultatory method. It consists of an inflatable cuff and an attached pressure gauge.
 - As the cuff pressure is slowly released, the examiner listens with a stethoscope for characteristic sounds called the sounds of Korotkoff, which indicate the resumption of blood flow into the forearm.
 - The pressure at which the first soft tapping sounds can be detected is recorded as the systolic pressure.
 - As the pressure is further reduced, the sounds become louder. As the pressure is reduced below the diastolic pressure, the sounds stop because the blood flows freely. The sounds of Korotkoff can't be heard anymore at this point. The pressure at which the sounds disappear is recorded as the diastolic pressure.
- The **mean arterial pressure (MAP)** is computed as:

$$\text{MAP} = \text{diastolic pressure} + (\text{pulse pressure} / 3)$$