Objectives:

1. Describe the pressure profiles in the left atrium, left ventricle and the aorta for a single cardiac cycle.
2. Explain the origin and indicate the positions of the 1st and 2nd heart sounds.
3. Draw the profile of pressure changes in the external jugular vein, labeling the three component waves.
4. Draw a classical ECG waveform on the time-base schedule.
Cardiac cycle

**Systole:** time during which cardiac muscle contracts.

**Diastole:** time during which cardiac muscle relaxes.
Cardiac cycle

- The cardiac events that occur from the beginning of one heart beat to the beginning of the next.

- At a normal heart rate of 72 beats/minute:
  For the ventricles, the duration of each cardiac cycle lasts about 0.8 second (0.3 sec. in systole, 0.5 sec. in diastole).

  For the atria, the cycle lasts for about 0.15 sec. in systole and 0.65 second in diastole.
Phases of the cardiac cycle:
atrial systole, ventricular systole, diastole of the whole heart.
Atrial systole

atria as a pump:

Blood normally flows continually (passively) from the veins into the atria.

- About 75% of the blood in the atria flow directly into the ventricles even before the atrial contraction.
- Then, atrial contraction usually causes an additional 25% filling of the ventricles.
Pressure changes in the atria during cardiac cycle

3 major atrial pressure elevations (a, c and v waves):

- **a wave** (atrial contraction).
- **C wave** ventricular contraction (bulging of the tricuspid valve).
- **V wave** veins (atrial filling).
Clinical importance of atrial waves

- Jugular venous pulsations reflect changes in right atrial pressure (the central venous pressure).
- The person has to be supine with his back at an angle of 45 degrees.
- The a and v waves can be seen in the jugular veins.
- When the venous pressure is raised as in heart failure disease, the jugular veins become more prominent with visible pulsations.
Ventricular cardiac cycle

Phase one: Ventricular filling.

Phase two: Ventricular systole.
   a) isovolumetric contraction.
   b) Ventricular ejection.

Phase three: Isovolumic, isometric relaxation.
Ventricular filling

- the accumulated large amounts of blood in the atria push the AV valves open and allow blood to flow rapidly into the ventricles (75%).
- During atrial contraction, an additional amount of blood (25%) flows into the ventricles complete the filling of the ventricles.
Ventricular systole:

Isovolumetric contraction:

- It is ventricular contraction but without blood ejection (no emptying) just to close the AV valves and to open semilunar valves by the rise in intraventricular pressure (from 0 to 80 mmHg in the left ventricle).
- only the tension is increasing in the ventricular muscle without shortening of the muscle and with no change in blood volume.
Ventricular systole:

Ventricular ejection:

- The blood ejected from the ventricles into pulmonary trunk and aorta when the ventricular pressure rises to open the semilunar valves.
- Left ventricular pressure rises from 0 to above 80 mmHg.
- Right ventricular pressure rises above 8 mmHg.
Aortic pressure curve:

- When the left ventricle contracts, blood immediately flows into the aorta, causes the wall of this artery to stretch and the pressure rise (systolic pressure = 120 mmHg).

- Then, at the end of the systole, the elastic recoil of the arteries maintains a high pressure even during diastole (diastolic pressure = 80 mmHg).

- **Incisura**: is caused by a short period of backward flow of blood from the ventricle immediately before closure of the valve.
Relationship of the Heart Sounds to Heart Pumping

- **the first heart sound** is caused by closure of the A-V valves at the beginning of systole.
- **the second heart sound** is caused by closure of the aortic and pulmonary valves at the end of systole.
Thank you