

Theoretical part

Apex beat and heart sounds

Basic evaluation of heart status done during each total patient's examination includes examination of external manifestations of heart function. According to the various senses employed this examination is divided into four groups:

- **Visual (inspection):** in meagre students an apex beat can be observed;
- **Touch (palpation):** an apex beat is palpable in the 4th to 5th intercostals space on the left medioclavicular line, in healthy people it can be covered by fingertip;
- **Tapping (percussion):** tapping of heart borders is not a routine examination since it is inaccurate; exact information on heart size can be obtained by X-ray or echocardiographic examinations;
- **Listening (auscultation):** the most important physical method of examination the heart; the presence and quality of particular heart sounds can be considered, and pathological heart sounds (murmurs) can be examined and their cause identified (based on the place and time of their audibility).

The examiner usually approaches the patient from the latter's right side and examines him/her in the following positions: supine position, lying on the left side with the patient's left hand the below head and in sitting position, possibly in bending forward. This examination is performed in a silent room and the patient must be in comfortable position and undressed. In healthy adults, there are two normal heart sounds, often described as a lub and a dup, that occur in sequence with each heartbeat. The first and second heart sounds are separated by a brief systolic pause, and second and first heart sounds are separated by longer diastolic pause. In addition to these sounds, a variety of other sounds may be present including heart murmurs, adventitious sounds, and gallop rhythms, third and fourth heart sounds.

The first heart sound is initiated at the onset of ventricular systole and reflects closure of the AV valves. It is the loudest and longest of the heart sounds, and is heard best over the apical region of the heart. The tricuspid valve sounds are heard best in the fifth intercostal space just to the left of the sternum; the mitral sounds are heard best in the fifth intercostal space at the cardiac apex.

The second heart sound, which occurs with abrupt closure of the semilunar valves, is composed of higher frequency vibrations (higher pitch) and is of shorter duration and lower intensity than is the first heart sound. The portion of the second sound caused by closure of the pulmonic valve is heard best in the second thoracic interspace just to the left of the sternum, whereas that caused by closure of the aortic valve is heard best in the same intercostal space but to the right of the sternum. The aortic valve sound is generally louder than the pulmonic valve, but in cases of pulmonary hypertension, the reverse is true. The nature of the second heart sound changes with respiration. During expiration, a single heart sound is heard that reflects simultaneous closing of the pulmonic and aortic valves. However, during inspiration, closure of the pulmonic valve is delayed, mainly as a result of increased blood flow from an inspiration-induced increase in venous return. With this delayed closure of the pulmonic valve, the second heart sound can be heard as two components; this is termed physiological splitting of the second heart sound.

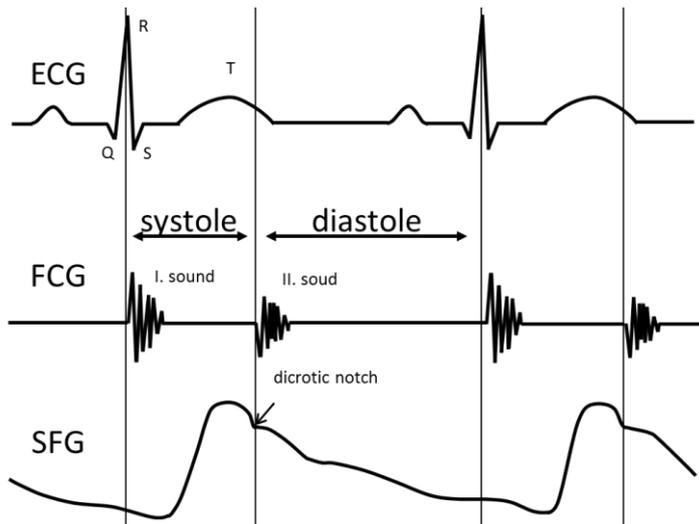


Figure: Heart sounds (FCG, fonocardiography) in context of ECG and sphygmography (SFG)

A third heart sound is sometimes heard in children with thin chest walls or in patients with left ventricular failure. It consists of a few low-intensity, low-frequency vibrations heard best in the region of the cardiac apex. The vibrations occur in early diastole and are caused by the abrupt cessation of ventricular distention and by the deceleration of blood entering the ventricles.

A fourth, or atrial, sound consists of a few low-frequency oscillations. It is caused by the oscillation of blood and cardiac chambers as a result of atrial contraction.

Heart murmurs are generated by turbulent flow of blood. Murmurs may be physiological (benign) or pathological (abnormal). Abnormal murmurs can be caused by stenosis restricting the opening of a heart valve, resulting in turbulence as blood flows through it.

Mitral stenosis	diastolic murmurs
Tricuspid stenosis	diastolic murmurs
Aortic stenosis	systolic murmurs
Pulmonic stenosis	systolic murmurs

Abnormal murmurs may also occur with valvular insufficiency (regurgitation), which allows backflow of blood when the incompetent valve closes with only partial effectiveness.

Mitral insufficiency	systolic murmurs
Tricuspid insufficiency	systolic murmurs
Aortic insufficiency	diastolic murmurs
Pulmonic insufficiency	diastolic murmurs

The systolic murmurs occur during systolic pauses, diastolic murmurs occur during diastolic pauses.

Apex beat

The apex beat is a mechanical manifestation of heart activity generated by impact of cardiac apex during ventricular systole to the chest wall. Apex beat can be viewed or palpated in the 4th or 5th intercostal space under the left mammilla and it is better observable in a skinny person. The apex beat can pathologically shift to the 6th intercostal space in patients with left ventricular dilatation.