Auscultation of the heart. Functional and organic cardiac murmurs
Heart murmurs

Heart murmurs are rather long sounds arising at turbulent movement of a blood. Turbulence appears at the disorder of a normal correlation of three hemodynamic parameters:

1) A diameter of a valve aperture or a lumen of a vessel;
2) The rate of a bloodstream (linear or volumetric);
3) A viscosity of a blood.

Murmurs, auscultated above the cardiac area and large vessels, are divided into *intracardiac* and *extracardiac*. 
Intracardiac murmurs

- *Intracardiac murmurs are divided into:*
  1) **The organic murmurs**, arising due to serious organic lesion of valves and other anatomic frames of the heart (interventricular and interatrial septums);
  2) **Functional murmurs**, in which basis there are not serious infringements of the anatomic frames, but there are the infringement of function of the valves, increasing rate of blood flow through anatomically unchanged apertures or reducing of the viscosity of a blood.
The organic murmurs

- *All organic intracardiac murmurs are formed at* the occurrence of narrowing, dilation in the field of valval apertures, in cavities of the heart or initial parts of the main vessels or the occurrence of other obex, for example, as a mural thrombus, atherosclerotic plaques on a wall of an aorta. It is necessary to give the detailed characteristic of the murmur at the description of anyone murmur, including the organic murmur, *it is necessary to define:*

1) The relation of the murmur to **phases of the cardiac activity** (systolic, diastolic, etc.);
2) An area of the **maximal auscultation** of the murmur;
3) The **radiation** of the murmur;
4) **A timbre, loudness** of the murmur;
5) **A shape** of the murmur.
Organic **systolic** murmurs

- They arise in atrioventricular valves insufficiency, aortic and the pulmonary stenosis.

- **Systolic murmur at the heart apex** is listened in mitral valve insufficiency.

- Murmur is loud, rough, long, has decreasing character, radiates in the left axillary fossa, it is combined with weakened I sound, and not frequently with III tone. Murmur increases in the position of patient on the left side, in a delay of breath on an exhalation, after physical loading.
Systolic murmurs. Mitral regurgitation.

- Normal blood flow
- Normal closed valve
- Abnormal closed valve

The murmur of mitral regurgitation

- $S_1$
- $S_2$
• **Systolic murmur on an aorta is listened in:**

1. **Aortic stenosis - ejection murmur.** The characteristic finding is a rough, loud, low, long systolic murmur over the 2nd interspace transmitted into the neck on the carotids, with a corresponding thrill and a diminished or absent 2nd aortic sound;

2. **Systolic murmur connected with atherosclerotic changes of aortic valves** can be listened in older persons on an aorta.

• **Organic systolic murmur over pulmonary trunk** is listened rarely. The reasons of it can be: **pulmonic stenosis**, **atrial septal defect** (soft, short murmur), **patent ductus arteriosus** (systolodiastolic murmur, where systolic component is a rough, loud transmitted to all precordial area, neck vessels and axillary fossa).
Systolic murmurs. Aortic stenosis.
Systolic murmurs. Pulmonic stenosis.
• **Systolic murmur in tricuspid regurgitation** is best heard over tricuspid area, it has **decreasing character**, it is not always combined with the weakened first sound, transmitted to both sides from a sternum, and it may became louder with inspiration (**Carvallos sign**).

• The loudest and rough systolic murmur of ventricular septal defeat is heard best in the 3rd and 4th left intercostal spaces, transmitted to the axillary fossa and interscapular space.
Systolic murmurs. Tricuspid regurgitation.
Diastolic murmurs

- They are heard due to narrowing of atrioventricular orifices, aortic and pulmonic insufficiency.

- **Diastolic murmur at the heart apex** is heard in mitral stenosis. The murmur has a decrescendo quality through early and middiastole. During the latter third of diastole the gradient increases sharply due to atrial contraction causing a presystolic accentuation of the murmur. It is usually heard on the limited area with the patient rolled onto his left side, it is combined with a “triple rhythm”: an accentuated 1st sound, 2nd sound and mitral opening snap.
Diastolic murmurs. Mitral stenosis
• **Diastolic murmur in aortic insufficiency** is usually soft, *decreasing*, combined with weakened II tone. It is heard over the 2nd interspace to the right and transmitted to the Botkin-Erb point, in standing position of the patient with an inclination of a trunk forward or with the patient rolled onto his right side. In this case blood is delivered from an aorta into the left ventricle through not densely closed valves; blood turbulence is heard as murmur.

• **Diastolic murmurs above the pulmonary trunk and near xiphoid process** are heard rarely and connected with **tricuspid stenosis** and **pulmonic insufficiency**, according.
Diastolic murmurs. Aortic regurgitation

Timing of diastolic murmurs

Aortic regurgitation

Valve closes after left ventricle pumps blood into aorta

Valve does not close completely, leaking blood into heart
Diastolic murmurs. Tricuspid stenosis. Pulmonary regurgitation
Functional murmurs

- All functional murmurs are conditionally divided into three groups:

1) Dynamic murmurs, the basis of which is substantial growth of the rate of a bloodstream at the absence of any organic diseases of the heart (for example, dynamic murmurs in a thyrotoxicosis, a neurosis of the heart, feverish conditions).

2) Anaemic murmurs, which reason is the decreasing of a viscosity of a blood and some acceleration of a bloodstream in patients with anaemia of different origin.

3) Murmurs of relative insufficiency of valves or relative stenosis of valval apertures are caused by various infringements of the function of the valval device, including in patients with organic diseases of the heart.
Remember:

1) *Dynamic and anaemic functional murmurs* appear at the absence of any organic diseases of the heart and consequently they have the name of “innocent” murmurs;

2) All “innocent” murmurs are systolic;

3) “Innocent” murmurs:

   – Are changeable, they are changed at change of position of a body and at respiration;
   – Are short;
   – Are not radiated far from a place of the maximal auscultation;
   – Not rasping, soft, blowing, gentle murmurs are more often;
   – Are not accompanied by a sharp hypertrophy of a myocardium, a dilatation of cavities and other signs of the organic disease of the heart.
• The special group is represented with functional murmurs of the relative insufficiency of valves or a relative stenosis of valval apertures.

• They can be caused by three groups of the reasons:

  l. The dilation of a fibrous ring of atrioventricular valves in expressive dilatation of ventricles results to incomplete closing of anatomically not changed cusps of atrioventricular valves and to development of relative insufficiency of these valves with a turbulent stream of a blood from a ventricle in an atrium. The characteristic of murmurs of relative insufficiency of mitral and tricuspid valves in these cases is similar those in corresponding organic defects.
Remember:

1) **The relative insufficiency of the mitral valve**, caused by dilation of fibrous ring, can develop at dilatation of the left ventricle in patients:
   - with arterial hypertension of any origin;
   - with aortal heart diseases, mainly in a stage of a decompenation (so-called the mitralization of an aortal defect);
   - with a heart failure of any origin (due to the myogenic dilatation of the left ventricle).

2) **The relative insufficiency of the tricuspid valve**, caused by the dilation of a fibrous ring, can develop in patients with appreciable dilatation of the right ventricle:
   - in late stages of a mitral stenosis;
   - in the decompenensive cor pulmonale (due to myogenic dilatation of a right ventricle).
II. The second reason of murmurs of the relative insufficiency is the **dysfunction of the valval device** (chordas and papillary muscles). The prolapse (a diverticulum, a caving) of one of cusps in a cavity of an atrium during a systole of ventricles develops in an infarct of the papillary muscle, congenital elongation or the acquired break of one of chords of atrioventricular valves. It leads to incomplete closing of cusps and to development of the relative insufficiency of the atrioventricular valve. Thus a short systolic murmur (more often meso- or late systolic) is heard. It is usual at the kept I sound.

III. The third reason of functional murmurs of the relative insufficiency of valves or a relative stenosis of valval apertures is **hemodynamic displacements of cusps of valves, dilatation of aorta or pulmonary artery** and some other reasons.
Graham-Still’s murmur is the functional diastolic murmur of the relative insufficiency of the valve of the pulmonary artery, arising at long increasing of the pressure in a pulmonary artery (for example, in patients with a mitral stenosis, primary pulmonary hypertension, cor pulmonale). In the II intercostal space to the left of the sternum and by a left edge of a sternum it is auscultated thus the silent, decreasing diastolic murmur beginning at once with the II sound.
Graham-Still’s murmur

Murmur

PCG

Pulmonary artery

Localization of murmur
• **Flint’s murmur** is presystolic murmur of relative (functional) stenosis of the left atrioventricular aperture arising sometimes (it is rare) in patients with organic insufficiency of the aortal valve owing to the raising of cusps of the mitral valve by a strong jet of a blood, regurgitating during a diastole from an aorta to the left ventricle. It results to difficulty of a bloodstream from the left atrium to the left ventricle during an active systole of an atrium. Thus at a heart apex, besides conducted organic diastolic murmur of aortal insufficiency, presystolic intensifying of the murmur - Flint’s murmur is heard also.
Flint’s murmur

Systole of an atrium

Flint’s murmur

Organic murmur of aortic regurgitation
• **Coombs murmur** is functional mesodiastolic murmur caused by a relative stenosis of the left atrioventricular aperture, arising in patients with the expressed organic insufficiency of the mitral valve under condition of the appreciable dilatation of the LV and LA and the absence of the dilation of the fibrous ring of the valve. Under these conditions the heart (LV and LA) reminds under the form a sand-glass with rather narrow intersection in the field of the left atrioventricular aperture. This aperture for the short time becomes rather narrow for the enlarged volume of a blood in the LA during the moment of the emptiness of the LA atrium in the phase of the fast filling and there is a relative stenosis of the left atrioventricular aperture with a turbulent stream of a blood from the LA to the LV. At a heart apex, besides organic systolic murmur of mitral insufficiency it is possible to listen to the short and silent mesodiastolic murmur caused by a functional mitral stenosis.
Coombs murmur

Organic murmur

Coombs murmur
• **Functional systolic murmur** of relative aortic ostium stenosis at organic aortic valve incompetence appears due to significant increase systolic blood volume passed in aorta from the left ventricle during ejection period. Normal, unchanged aperture of aortal valve becomes rather narrow for the left ventricle and relative (functional) aortic ostium stenosis with turbulent blood flow in aorta from the left ventricle is formed. Besides organic diastolic murmur of aortic insufficiency functional systolic murmur of relative aortic ostium stenosis is heard over aorta and in Botkin-Erb’ point during ejection period. It is radiated into cervical vessels.
Functional systolic murmur of relative aortic ostium stenosis
The extracardiac murmurs

- **Pericardial friction murmur** appears when the layers of a pericardium becomes rough. It is observed in:
  a) a dry (fibrinous) pericarditis;
  b) an aseptic pericarditis in patients with an acute myocardial infarction;
  c) an uremic pericarditis in patients with the renal failure.

- Pericardial friction murmur is auscultated during systole and diastole and resembles a crunch of a snow, a rustle of a paper or a gnash, scratching.

- **Remember:**
  - Pericardial friction murmur differs from the endocardiac murmurs by the following signs:
    1) it is auscultated on the circumscribed site more often, it is usual in a zone of the absolute cardiac dullness, and it is not irradiated anywhere;
    2) it amplifies at pressing by a phonendoscope on anterior thoracic wall;
    3) it is very changeable sound phenomenon;
    4) it is auscultated in both phases of a cardiac activity.
• **Pleuropericardial friction murmur** appears in an inflammation of pleura, immediately adjoining to the heart, due to the friction of layers of pleura with each other synchronously with cardiac contractions. As a matter of fact the pleuropericardial friction sound represents a pleural friction sound, auscultated on the circumscribed site.

• **Remember:**

• Pleuropericardial friction murmur should be distinguished from a pericardial friction murmur by the following signs:
  1) it is auscultated usually by a left border of relative cardiac dullness;
  2) it amplifies at the height of a deep inspiration;
  3) it is weakened or disappears at the maximal exhalation and a breath holding.
Thank you for attention