

# **THE HEART**

# **The localization of the heart**

- **Above the diaphragm, in the inferior middle mediastinum**
- **2/3 left, 1/3 right**

# The external shape of the heart

- **Unpaired, hollow, muscular organ of solid consistency, reddish brown colour**
- **4,5% of the body weight (fist-sized)**
- **Is of a cone shape**
- **The longitudinal axis of the heart (connector of vena cava superior and the apex)**

- basis - basis cordis - directs rightwards, up and backwards
- apex- apex cordis – directs for-, left- and downwards
- Facies anterior (sternocostalis)
- Facies posterior (diaphragmatica)
- Margo dexter (acutus)
- Margo sinister (obtusus)

# The chambers of the heart

- **Atrium dextrum**
- **Atrium sinistrum**
- **Ventriculus dexter**
- **Ventriculus sinister**

**Septum cordis**: divides the heart chamber into the right and left part

**Atrias**: at **basis cordis**

- The superficial border between the atrias and the ventricles is formed by transversally oriented groove – **sulcus coronarius**
- **auricula dextra et auricula sinistra**
- **septum interatriale**

## Ventricles : při apex cordis

- The border is sulcus interventricularis anterior et posterior, corresponding to the localization of septum interventriculare
- Right ventricle: truncus pulmonalis
- Left ventricle: aorta

**aorta**

**truncus  
pulmonalis**

# Atrium dextrum – cube with six walls

outcome: *vena cava superior et vena cava inferior*

*sinus coronarius* (the venous sinus of the heart)

- 1) Superior wall - *ostium venae cavae superioris*
- 2) Inferior wall - *ostium venae cavae inferioris, ostium sinus coronarii* and *ostia venae cordis anteriores*

*ostium  
venae cavae  
superioris*

*ostium sinus  
coronarii*

*ostium venae  
cavae inferioris*



4) Medial wall - septum interatriale s fossa ovalis with slightly raised edge (limbus fossae ovalis)

5) On the lateral wall - crista terminalis, which separates the posterior part – sinus venosus from the anterior one

*fossa ovalis*

*limbus fossae ovalis*

*crista terminalis*

3) Posterior wall – between openings of both venae  
cavae it vaults dorsally as torus intervenosus

6) Anterior wall corresponds to atrioventricular septum  
with ostium atrioventriculare dextrum (valva

tricuspidalis), right from the opening auricula

torus  
intervenosus

*ostium*  
*atrioventriculare*  
*dextrum*

# Atrium sinistrum - venae pulmonales (4 pulmonary veins)

**Septal wall:** fossa ovalis lined from behind with fold (falx septi), dorsocranially venae pulmonales

**Anterior wall:** ostium atrioventriculare sinistrum (valva bicuspidalis), auricula sinistra

- Smooth wall, has originated from pulmonary veins
- auricle (*auricula*) original atrium (plicated)

# **Ventriculus dexter**

***Triangular pyramid shape:***

***Widen upper part consists:***

***ostium atrioventriculare dextrum***

***ostium trunci pulmonalis***

***Ostium atrioventriculare dextrum***

***(valva tricuspidalis)***

***cuspidis anterior, posterior, septalis***

***Musculi papillares***

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***ostium trunci  
pulmonalis***

**ostium aortae**

***ostium  
atrioventriculare  
sinistrum***

***ostium  
atrioventriculare  
dextrum***

## **Ostium trunci pulmonalis**

- **valva trunci pulmonalis**
- ***valvula semilunaris anterior, dextra et sinistra***
- **Folds form together with the wall of *truncus pulmonalis* three semilunar pockets (*sinus trunci pulmonalis*)**

The medial wall is formed by septum interventriculare

Cavity of the right ventricle we can divide into inflow and outflow parts.

**Inflow part** (pars trabecularis) with trabeculae carnae, from ostium atrioventriculare dextrum till apex of the heart.

**Outflow part** (pars glabra) smooth walls from apex upwards and forward, towards to truncus pulmonalis, border between both parts presents transversely oriented muscular crest (crista supraventricularis).

**Inflow part**

**Outflow part**

# Ventriculus sinister

- Cone shape
- ostium atrioventriculare sinistrum: *valva bicuspidalis (mitralis), cuspis anterior a posterior*
- ostium aortae
- *musculus papillaris anterior et posterior (papillary muscles)*



# Ostium aortae

- valva aortae
- valvula semilunaris dextra, sinistra et posterior form three semilunar folds (sinus aortae), on the surface of the artery vault as bulbus aortae
- from *sinus aortae* arise coronary arteries

## The cavity of the left ventricle:

- Inflow part contains *trabeculae carneae* and lies between *ostium atrioventriculare sinistrum* and the apex
- Outflow part directs from apex to aorta and has a smooth wall

**Inflow part**

**Outflow part**

## **Valves of the heart– derivatives of endocardium**

### **Cuspidal valves(*valvae atrioventriculares*)**

- *valva tricuspidalis* (right)
- *valva bicuspidalis* (left)

Tops of particular cusps head to hollow of the ventricle, the cusps are connected to *musculi papillares* through heart strings (*chordae tendineae*)

### **Semilunar valves (*valvae semilunares*)**

- *valva trunci pulmonalis*
- *valva aortae*

# **The structure of the heart**

- 1. Endocardium**
- 2. Myocardium**
  - A. working**
  - B. conductive**
- 3. Pericardium**

- 1. Endocardium**
  - Thin, smooth and glossy fibrous membrane**
  - Covers all cardiac chambers and surface of all the valves**

## 2. Myocardium

- **Main component of the cardiac wall**  
**working myocardium (contractions of cardiac compartments)**  
**conductive myocardium (conductive system of heart)**

A) Working myocardium: (muscles of atria and muscles of ventricles are separated)

a) Muscle of atria– 2 layers, spf. layer – common for both atria, deep layer- separate

b) Muscle of ventricles (thicker)

**3 layers:**

- Superficial layer: common, arranged into bands which create whirl (*vortex cordis*)
- middle layer is separate, band oriented circularly
- deep layer organized in reticular arrangement, forms underlay of mm. papillares and trabecular system

**muscles of atria and ventricles are separated by cardiac skeleton !**

# The fibrous skeleton of the heart

- Consists of fibrous connective tissue (form fibrous arches, anuli fibrosi), on borderline between atrias and ventricles
- *anulus fibrosus dexter*
- *anulus fibrosus sinister*
- *anulus aorticus*
- *anulus trunci pulmonalis*

*Trigonum fibrosum dextrum et sinistrum*

**B) Conductive myocardium (conductive system of the heart)**

- **Consists of an unique type of myocardium, its cells generate impulses which are stimuli for the muscular contractions**

**It consists of:**

- Nodus sinuatrialis in the right atrium– generates impulses (70/min)**
- Nodus atrioventricularis in the right ventricle under the endocardium of septum**
- Fasciculus atrioventricularis passes through aperture in *trigonum fibrosum dextrum* into *interventricular septum* and divides into two branches**
- Crus dextrum et crus sinistrum – head toward myocardium of right and left ventricle**
- Purkyně (Purkinje) fibres create large subendocardial net**



# 3. The Perikardium

The heart is stored in a firm fibrous sac, it has two layers:

external layer– pericardium fibrosum

internal layer– pericardium serosum

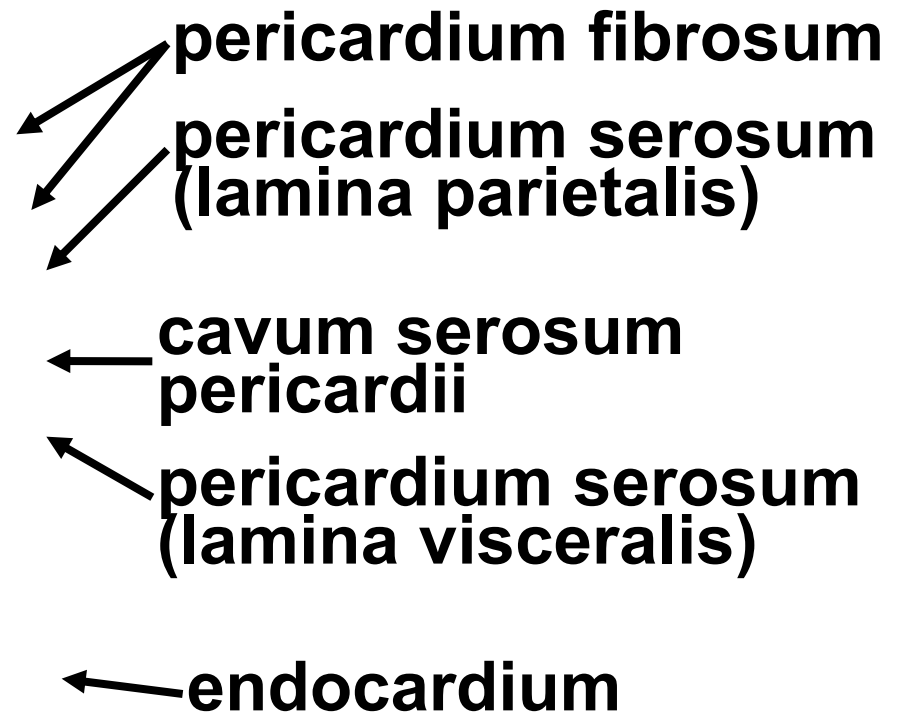
## 1) Pericardium fibrosum

- base-facies diaphragmatica-basis pericardii
- apex- cupula pericardii

## 2) Pericardium serosum

- External sheet (lamina parietalis)
- Internal sheet (lamina visceralis) or epicardium
- cavum serosum pericardii: cavity between the both sheets

**truncus pulmonalis**



**myocardium**

- Both sheets pass into each other in two places:

*porta arteriarum*

*porta venarum*

*sinus transversus pericardii*: between *porta arteriarum*  
and *porta venarum*

*sinus obliquus pericardii*: below the transverse arm of  
*porta venarum*

# The cardiac arteries (Arteriae coronariae cordis)

The heart is supported by two arteries  
(subepicardially):

arteria coronaria cordis sinistra

arteria coronaria cordis dextra

Arteria coronaria cordis sinistra

a) ramus interventricularis anterior

b) ramus circumflexus

- Supports of wall of left ventricle (including its papillary muscles), anterior part of wall of right ventricle (including *musculus papillaris anterior*) and anterior part of interventricular septum

## **Arteria coronaria cordis dextra**

### **a) ramus interventricularis posterior**

- Supports majority of wall of right atrium and ventricle (including its papillary muscles), part of posterior wall of left ventricle (including *musculus papillaris posterior*) and posterior part of interventricular septum

A.c.c. dextra

A.c.c. sinistra

**anterior**

**posterior**

# Venae cordis

1) sinus coronarius cordis (60% of the blood), confluence of:

a) vena cordis magna

b) vena cordis media

c) vena cordis parva

2) venae cordis anteriores – 2 till 4 veins, which collect blood from anterior wall of right ventricle

3) venae cordis minimae – open into cardiac cavities through separate apertures (foramina venarum minimarum)

*Venae cordis anteriores at minimae* (40% of the blood).

# **The lymphatic vessels of the heart**

**They form three lymphatic nets in the cardiac wall:**

- **subendocardial**
- **myocardial**
- **subepicardial**

**There are two lymphatic trunks draining out the lymph from these nets:**

**1) Truncus lymphaticus cordis dexter – *nodus lymphaticus praeaoorticus - nodi lymphatici mediastinales anteriores***

**2) Truncus lymphaticus cordis sinister- *nodus lymphaticus retroaorticus - nodi lymphatici tracheobronchiales***



# The innervation of the heart

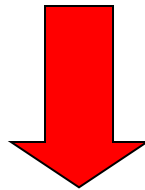
- autonomic nervous (sympathetic and parasympathetic nerve fibres), which influences conduction system (changes of cardiac rhythm) and wall of coronary vessels

**Sympathetic fibres (truncus sympathicus): nn. cardiaci cervicales (superior, medius, inferior) a nn. cardiaci thoracici**

**symp. fibres - nervi accelerantes (acceleration of heart activity + vasodilatation of the cardiac arteries)**

**Parasympathetic fibres (nn. vagi): rami cardiaci superiores, medii, inferiores**

**parasymp. fibres - nervi retardantes (deceleration of heart activity, vasoconstriction of coronary arteries)**



**Symp. and parasymp. fibres form compound plexuses**

- 1) Plexus cardiacus superficialis: ganglion cardiacum
- 2) Plexus cardiacus profundus
- 3) Plexus coronarius sinister et dexter

# The projection of the heart

The heart is located in the middle inferior mediastinum. The projection of the heart on the anterior thoracic wall – it is bordered with 4 auscultation points – heart field.

- 1) Point A – 2nd intercostal space, circa 1 cm on the right from the sternal margin – Auscultation Point of valva aortae.
- 2) Point B – 5th intercostal space, at left edge of sternum- AP of valva tricuspidalis.
- 3) Point C – 5th intercostal space, left, medially from medioclavicular line – AP of valva bicuspidalis.
- 4) Point D – 2nd intercostal space, left, circa 2 cm from sternal margin - AP of valva trunci pulmonalis.

**A**

**Valva aortae**

**D**

**Valva trunci  
pulmonalis**

**B**

**Valva tricuspidalis**

**C**

**Valva bicuspidalis**

# **X – ray (anteroposterior imaging)**

- **Images:**
- **Atlas der Anatomie des Menschen/Sobotta.**
- **Putz,R., und Pabst,R. 20. Auflage. München: Urban & Schwarzenberg, 1993**
- **Netter: Interactive Atlas of Human Anatomy.**
- **Naňka, Elišková: Přehled anatomie. Galén, Praha 2009.**
- **Čihák: Anatomie I, II, III.**
- **Drake et al: Gray's Anatomy for Students. 2010**