

# CARDIOVASCULAR SYSTEM

## Overview

- Heart (cor)
- System of vessels: arteries (arteriae), veins (venae), capillaries

## COR

Position, size, shape, function.

Axis of a heart, auscultation points of valves - A, B, C, D.

Parts: basis et apex cordis

Facies: sternocostalis, diaphragmatica

Margins: dexter (acutus) et sinister (obtusus)

Surface: sulcus interventricularis ant. et post., sulcus coronarius

Septum cordis (interatriale, interventriculare); septum atrioventriculare

Cavities of a heart:

### **Atrium dextrum:**

shape, walls: *upper* (ostium venae cavae superioris), *lower* (ostium et valva venae cavae inf., ostium sinus coronarii, valvula sinus coronarii, venae cordis anteriores), *medial* (septum interatriale, fossa ovalis, limbus fossae ovalis), *lateral* (crista terminalis), *anterior* (ostium atrioventriculare dx., valva tricuspidalis: cuspis ant., post., septalis), *posterior* (torus intervenosus); auricula dextra

### **Ventriculus dexter:**

shape, *inflow part* (pars trabecularis): ostium atrioventriculare dx., valva tricuspidalis, (cuspis ant., post., septalis), chordae tendineae, mm. papillares (ant., post., septalis), crista supraventricularis

*outflow part* (pars glabra): ostium trunci pulmonalis, valva trunci pulmonalis (valvulae semilunaris ant., dx., sin.).

**Atrium sinistrum:** fossa ovalis, ostia venarum pulmonalium, auricula sinistra

**Ventriculus sinister:** shape, *inflow part* (pars trabecularis): ostium atrioventriculare sin., valva bicuspidalis (cuspis ant. et post.), chordae tendinae, mm. papillares (ant. et post.) *outflow part* (pars glabra): ostium aortae valva semilunaris aortae (valvula semilunaris post., dx., sin.)

Structure of wall: endocardium, myocardium (working, conductive), epicardium.

Pericard (perikardium): fibrosum, serosum; porta arteriarum et venarum; sinus obliquus et transversus.

Skeleton of heart (anulus fibrosus dx. et sin., anulus aorticus, anulus trunci pulmonalis, trigonum fibrosum dx. et sin., konusová šlacha).

Inervation: **Conductive system of heart:** nodus sinuatrialis et atrioventricularis, fasciculus atrioventricularis, crus dx. et sin. (branches of Tawar), fibres of Purkynje. Accessory connections. Modulation of heart labor: plexus cardiacus superficialis et prof. (sympathetic fibres - nn. cardiaci; parasympathetic fibres- rr. cardiaci)

Nourishment:

**aa. coronariae cordis:** leaving from aorta, position, region of blood supply. A. coronaria cordis sin.: r. interventricularis ant., r. circumflexus; a. coronaria cordis dx.: r. interventricularis post.

Branches from both aa. coronariae: r. coni arteriosi, rr. atriales, rr. ventriculares, rr. septales, rr. marginales, rr. nodi sinuatriales/atrioventriculares

**venae cordis:** localization, place of inflow, tributary regions. Sinus coronarius (vena cordis magna, media et parva); vv. cordis anteriores; vv. cordis minimae

Lymphatic vessels: lymphatic plexuses, truncus lymphaticus anterior dx. et sin.

X-ray:

- native X-ray of a thorax (posteroanterior projection, describe and show right and left border of a heart shade)
- contrast examination of coronary arteries - coronarography - PTCA

## ARTERIAE

Basic structure of wall: tunica intima, media, externa

In each artery briefly course and region of nourishment

### **Aorta ascendens**

Borders, bulbus aortae, sinus aortae

- Aa. coronariae cordis

### **Arcus aortae**

Borders

- Truncus brachiocephalicus (a. carotis communis dx, a. subclavia dx)
- A. carotis communis sin.
- A. subclavia sin.

### **A. carotis communis**

Course on a neck

### **A. carotis externa**

(detailed knowledge of passage!)

*Anterior branches:*

- A. thyroidea superior (a. laryngea sup.)
- A. lingualis (a. sublingualis, rr. dorsales linguae, a. profunda linguae)
- A. facialis (a. palatina ascendens, r. tonsillaris, a. submentalis, a. labialis sup. et inf., arcus labialis superior et inferior, a. alaris nasi, a. angularis)

*Lateral branches*

- A. sternocleidomastoidea

*Dorsal branches*

- A. occipitalis
- A. auricularis post. (rr. glandulares, r. auricularis, a. stylo-mastoidea, a. tympanica post.)

*Medial branches*

- A. pharyngea ascendens (a. meningea post., a. tympanica inf.)

*Terminal branches*

- A. temporalis superficialis (rr. parotidei, a. temporalis media, rr. auriculares ant., r. frontalis et parietalis)
- A. maxillaris
  - pars mandibularis (a. meningea media, a. alveolaris inf.)
  - pars pterygoidea (a. masseterica, aa. temporales profundae, rr. pterygoidei, a. buccalis)
  - pars pterygopalatina (a. infraorbitalis, a. palatina descendens, a. sphenopalatina)

### **A. carotis interna**

( 3. semester)

### **A. subclavia**

Boundaries; fissura scalenorum

- A. vertebralis (CNS – 3. semester)
- A. thoracica interna
  - rr. mediastinales
  - a. pericardiacophrenica
  - rr. intercostales ant.
  - a. musculophrenica
  - a. epigastrica superior
- Truncus thyrocervicalis
  - a. thyroidea inf. (a. laryngea inf., rr. tracheales, rr. pharyngeales, rr. oesophageales)
  - a. cervicalis ascendens
  - a. cervicalis superficialis
- Truncus costocervicalis (a. cervicalis prof., a. intercostalis suprema)

- A. transversa colli
- A. suprascapularis

### **A. axillaris**

Boundaries

- Rr. subscapulares
- A. thoracica suprema
- A. thoracoacromialis
- A. thoracica lateralis
- A. subscapularis (a. circumflexa scapulae, a. thoracodorsalis)
- A. circumflexa humeri ant. et post.

### **A. brachialis**

Boundaries, sulcus bicipitalis medialis

- A. profunda brachii - průběh (a. collateralis media, a. collateralis radialis)
- A. collateralis ulnaris sup. et inf.

### **A. radialis**

Relation to canalis carpi

- A. recurrens radialis
- R. carpeus dorsalis (rete carpi dorsale, aa. metacarpeae dorsales, aa. digitales dorsales)
- A. metacarpea dorsalis prima (aa. digitales dorsales)
- A. princeps pollicis (aa. digitales palmares)
- R. palmaris superficialis et profundus

### **A. ulnaris**

Relation to canalis carpi

- A. recurrens ulnaris
- A. interossea communis (a. interossea ant. et post.)
- R. carpeus dorsalis (rete carpi dorsale, aa. metacarpeae dorsales, aa. digitales dorsales)
- R. palmaris superficialis et profundus

Rete articulare cubiti (a. brachialis, a. radialis, a. ulnaris)

Arcus palmaris superficialis et profundus (aa. metacarpeae palmares, aa. digitales palmares)

### **Aorta thoracica**

Boundaries, position (posterior mediastinum)

*Parietal branches*

- Aa. intercostales post.
- Aa. phrenicae superiores

*Visceral branches*

- Rr. bronchiales, oesophagei, pericardiaci

### **Aorta abdominalis**

Boundaries, position (retroperitoneal)

*Parietal branches*

- Aa. phrenicae inf. (a. suprarenalis sup.)
- Aa. lumbales

*Visceral branches - paired*

- Aa. suprarenales mediae
- Aa. renales (rr. ureterici, a. suprarenalis inf.)
- Aa. testiculares / aa. ovaricae

*Visceral branches - unpaired*

- Truncus coeliacus
  - a. gastrica sin.
  - a. hepatica communis: hepatica propria (a. cystica), a. gastroduodenalis (a. gastroepiploica dx. et a. pancreaticoduodenalis sup.)
  - a. lienalis (rr. pancreatici, a. gastroepiploica sin., aa. gastricae breves, rr. lienales)
- A. mesenterica sup.
  - a. pancreaticoduodenalis inf.
  - aa. jejunales et ilei
  - a. ileocolica
  - a. colica dextra
  - a. colica media
- A. mesenterica inf.
  - a. colica sin. (ramus ascendens et descendens)
  - aa. sigmoideae
  - a. rectalis sup.

### **Arteria iliaca communis**

Boundaries, position (retroperitoneal)

- A. sacralis mediana

### **A. iliaca interna**

*Parietal branches*

- A. iliolumbalis
- A. sacralis lateralis
- A. obturatoria
- A. glutea sup. et inf.
- A. pudenda interna (canalis pudendalis)
  - a. rectalis inf.
  - a. perinealis
  - a. penis (a. bulbi penis, a. urethralis, a. dorsalis penis, a. profunda penis) nebo a. clitoridis (a. bulbi vestibuli, a. dorsalis clitoridis, a. profunda clitoridis)

*Visceral branches*

- A. umbilicalis (a. vesicalis sup.)
- A. vesicalis inf.
- A. rectalis media
- A. uterina - ♀ (r. uretericus, rr. uterini, r. tubarius, r. ovaricus, a. vaginalis) nebo a. ductus deferentis - ♂

### **A. iliaca externa**

Boundaries; lacuna vasorum

- A. epigastrica inf.
- A. circumflexa ilium prof.

### **A. femoralis**

Boundaries; fossa iliopectinea, canalis adductorius (lamina vastoadductoria), hiatus adductorius

- A. epigastrica superficialis
- A. circumflexa ilium superficialis
- Aa. pudendae externae
- A. profunda femoris
  - a. circumflexa femoris medialis
  - a. circumflexa femoris lateralis (r. ascendens et descendens)
  - aa. perforantes
- A. genus descendens

### **A. poplitea**

- Aa. surales
- Aa. genus sup., media et inf.

#### **A. tibialis anterior**

- Aa. recurrentes
- A. malleolaris anterior medialis et lateralis
- A. dorsalis pedis:
  - aa. tarseae mediales
  - a. tarsea lateralis (anastomosa s a. arcuata)
  - a. arcuata (aa. metatarsae dorsales, aa. digitales dorsales)
  - a. metatarsa dorsalis prima (aa. digitales dorsales)
  - r. plantaris profundus (napojení na arcus plantaris)

#### **A. tibialis posterior**

- R. circumflexus fibulae
- A. peronea (rr. malleolares laterales, rr. calcanei laterales)
- Rr. malleolares mediales
- Rr. calcanei mediales
- A. plantaris medialis (r. superficialis et prof.)
- A. plantaris lateralis (arcus plantaris, aa. metatarsae plantares, aa. digitales plantares)

Rete articulare genus (a. femoralis, a. poplitea, aa. tibiales)

## VENAE

Basic structure of wall (tunica intima, media, externa). In each vein tributary region, in large veins briefly course.

X-ray of vessels: angiography (arteries– arteriography, veins– phlebography)

**remark: by Origin is meant, from which vessels is formerly mentioned vein actually constituted**

#### **V. cava superior**

Origin, position, tributary region

- v. azygos

#### **Vv. brachiocephalicae**

Origin, position, tributary region, difference between left and right vein

- vv. thyroideae inf.
- v. vertebralis
- v. thoracica interna (v. epigastrica sup. a v. musculophrenica)
- mediastinal organs (vv. thymicae, tracheales, bronchiales, esophageales, pericardiacae)

#### **V. jugularis interna**

Origin, position, bulbus sup. et inf., tributary regions

- *Intracranial inflows:*
  - sinus durae matris
  - vv. cerebri
  - vv. diploicae
  - vv. meningae
  - vv. emissariae
  - vv. ophtalmicae
- *Extracranial inflows:*
  - v. retromandibularis (v. temporalis superf., v. maxillaris, plexus pterygoideus)

- v. facialis (v. profunda faciei)
- v. lingualis
- vv. thyroideae sup.
- vv. pharyngeae
- (v. transversa colli, v. suprascapularis)

### **V. jugularis externa**

Origin, position, tributary region

- v. auricularis post.
- v. occipitalis
- vv. jugulares ant. (arcus venosus juguli)

### **V. subclavia**

Origin, position, tributary region

- (v. transversa colli, v. suprascapularis)

### **V. axillaris**

Origin, position, tributary region

- v. thoracoepigastrica
- v. thoracica lateralis
- v. cephalica

### **Veins of upper extremity**

Profound and superficial system, differences

**Profound veins:** vv. digitales, radiales, ulnares, interosseae antebrachii, brachiales

**Superficial veins:** rete venosus dorsale manus, rete venosus palmare manus, vv. intercapitulares, v. basilica, v. cephalica (v. mediana cubiti, v. mediana antebrachii)

### **V. cava inferior**

Origin, position, tributary region

- *Parietal inflows:*
  - vv. iliacae communes
  - vv. lumbales
  - vv. phrenicae inf.
- *Visceral inflows:*
  - vv. testiculares / vv. ovaricae
  - vv. renales
  - vv. suprarenales
  - vv. hepaticae

### **Vv. iliacae communes**

Origin, position, tributary region

- v. sacralis mediana

### **V. iliaca interna**

Origin, position, tributary region

- *Parietal inflows:*
  - vv. iliolumbales
  - sacrales lat.
  - gluteae sup. et inf.
  - obturatoriae
  - pudendae int.
- *Visceral inflows:*

- plexus venosus vesicalis
- plexus venosus prostaticus
- plexus venosus uterinus, vaginalis
- plexus venosus rectalis (vv. rectales sup. mediae et inf.)

### V. iliaca externa

Origin, position, tributary region

- v. epigastrica inf.
- v. circumflexa ilium prof.

### Veins of lower extremity

Profound and superficial system, differences, perforators

Profound veins of LE: vv. digitales, metatarsales, vv. tibiales ant. et post., vv. peroneae, v. poplitea, v. femoralis (v. profunda femoris, vv. perforantes, v. circumflexa femoris medialis et lateralis)

Superficial veins of LE: rete venosum dorsale pedis, rete venosum plantare pedis, vv. intercapitulares, v. saphena parva (v. femoropoplitea), v. saphena magna (v. saphena accessoria, epigastrica superficialis, circumflexa ilium superficialis, vv. pudendae externae)

### Outflow of blood from vertebrae

- plexus venosi vertebrales int.
- plexus venosi vertebrales ext.

Position, course of blood flow

### V. portae

Origin, position, tributary region

- v. mesenterica sup.: head of pancreas, duodenum, stomach, small intestine, oral part of large intestine
- v. lienalis: body and tail of pancreas, stomach, spleen
  - v. mesenterica inf. (aboral part of large intestine)
- vv. cysticae

### Portocaval anastomoses and their importance

1. connections between vv. oesophageae (inflow to v. cava sup.) and vv. gastricae (inflow to v. portae)
2. connections around umbilicus: vv. paraumbilicales in lig. teres hepatis directs blood to umbilicus („caput Medusae“). Outflow to v. cava sup.: through v. thoracoepigastrica and v. epigastrica sup. Outflow to v. cava inf.: through v. epigastrica superficialis a v. epigastrica inf.
3. connections around rectum: v. rectalis sup. (inflow to v. portae); v. rectalis media a inf. (inflow to v. cava inf.)

### Cavocaval anastomoses

V. azygos, position, tributary region

- vv. lumbales
- vv. intercostales post.
- v. hemiazygos (v. hemiazygos accessoria)
- vv. phrenicae sup.
- veins for organs of mediastinum (vv. esophageae, bronchiales, pericardicae)

### Fetal blood circulation

Oxygenated blood from placenta: umbilical cord, v. umbilicalis, v. cava inf. (through ductus venosus or v. portae), atrium dx., foramen ovale, atrium sin., ventriculus sin., branches of arcus aortae

Deoxygenated blood from fetus:

- **v. cava sup.**, atrium dx., ventriculus dx., truncus pulmonalis, ductus arteriosus, aorta descendes
- **aa. iliacae internae:**
  - v. cava inf., atrium dx....
  - pupeční provazec, placenta

Condition after birth and interruption of umbilical cord:

V. umbilicalis = lig.teres hepatis, ductus venosus = lig. venosum, aa. umbilicales = ligg.umbilicalia medialis ( + non-obliterated aa.vesicales sup.), foramen ovale = septum secundum (fossa ovalis), ductus arteriosus = lig. arteriosum.

## LYMPHATIC SYSTEM

### Overview

- Lymph (lymph)
- lymphatic vessels (vasa lymphatica), lymphatic stems (truncus lymphaticus dx., ductus thoracicus),
- Lymphatic follicles, lymphatic nodes (nodi lymphatici), tonsils (tonsillae), spleen (lien), thymus (thymus)

Function of lymphatic system

X-ray exam.: lymphography

### Lymph

Formation, amount, qualities, daily production, circulation

### Lymphatic vessels

profound and superficial; structure; valves; tissues without lymphatic vessels

### Trunci lymphatici

- **Ductus thoracicus:** drained region, length, place of formation, parts(truncus lumbalis dx. et sin., truncus intestinalis; cisterna chyli). Pars: abdominalis, thoracica, cervicalis. Inflows: truncus jugularis sin., truncus subclavius sin., truncus bronchomediastinalis sin.
- **Ductus lymphaticus dexter:** drained region, place of formation, parts (truncus jugularis dx., truncus subclavius dx., truncus bronchomediastinalis dx.)

### Lymphatic follicles

Localization, function

### Tonsillae

Localization, function. Tonsilla: palatina, tubaria, lingualis, pharyngea, abdominalis

### Nodi lymphatici

Shape, size, color, function (filtration, immunobiological), regional lymph nodes.

Structure: capsula, trabeculae, cortex, medulla, sinusy, vasa afferentia, vas efferens, hilus

**In each group of lymph nodes is necessary to know: tributary region (drained region) and outflow to more distant lymph nodes!**

### **Lymph nodes of head.**

Nodi lymphatici: occipitales, retroauriculares, parotidei, submandibulares, submentales, retropharyngei. More forwarded lymph nodes (nll. faciales).

### **Lymph nodes of neck**

Nodi lymphatici cervicales superficiales: localization, concomitant veins

Nodi lymphatici cervicales profundi: localization, concomitant structures. Nodus jugulodigastricus, juguloomochoideus, tonsillaris (lymph node of Wood)

### **Lymph nodes and vessels of upper extremity**

Superficial lymph vessels: lateral, medial and anterior collectors

Profound vessels

Nodi lymphatici:

- cubitales: superficiales et profundi
- axillares: laterales, subscapulares, pectorales, interpectorales, centrales, apicales (infraclaviculares)

### **Lymph nodes of thorax**

Visceral – nodi lymphatici: pulmonales, bronchopulmonales, bronchiales, tracheobronchiales, paratracheales, mediastinales ant. et post.

Parietal – nodi lymphatici: phrenici sup., parasternales, intercostales

### **Lymph nodes of abdomen and pelvis**

- Nodi lymphatici coeliaci (stomach, liver, pancreas, duodenum, spleen, small and large intestine) → **truncus intestinalis**
  
- Nodi lymphatici:
  - iliaci externi
  - iliaci interni (paravesicales, paravaginales, parauterini, pararectales)
  - iliaci communes
  - lumbales
  - sacrales→ **trunci lumbales**

### **Lymph nodes and vessels of lower extremity**

Superficial vessels (lateral, medial and posterior collectors)

Profound vessels

Nodi lymphatici:

- poplitei superficialis et profundi
- inguinales superficiales et profundi

### **Lien**

Position, shape, size, function

Margo: superius et inferius

Facies: diaphragmatica et visceralis

Extremitas: ant. et post.

Hilus lienis

Structure: tunica fibrosa, trabeculae lienis, pulpa lienis alba et rubra.

Blood supply: a. et v. lienalis

### **Thymus**

Size, color, position, function, involution

Lobus: dexter et sinister

Structure: capsula thymi, septa, lobuli, cortex, medulla thymi, reticulum thymi

Blood supply: branches of a. subclavia, inflow to vv. brachiocephalicae