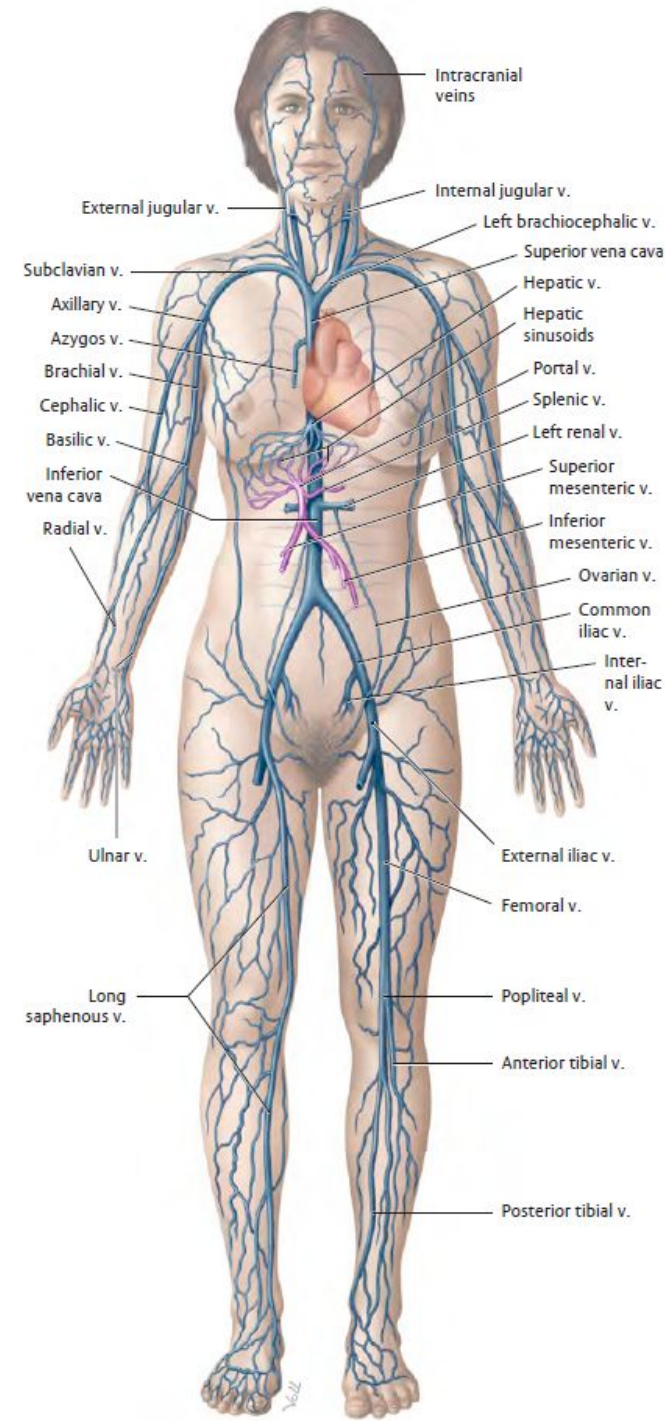


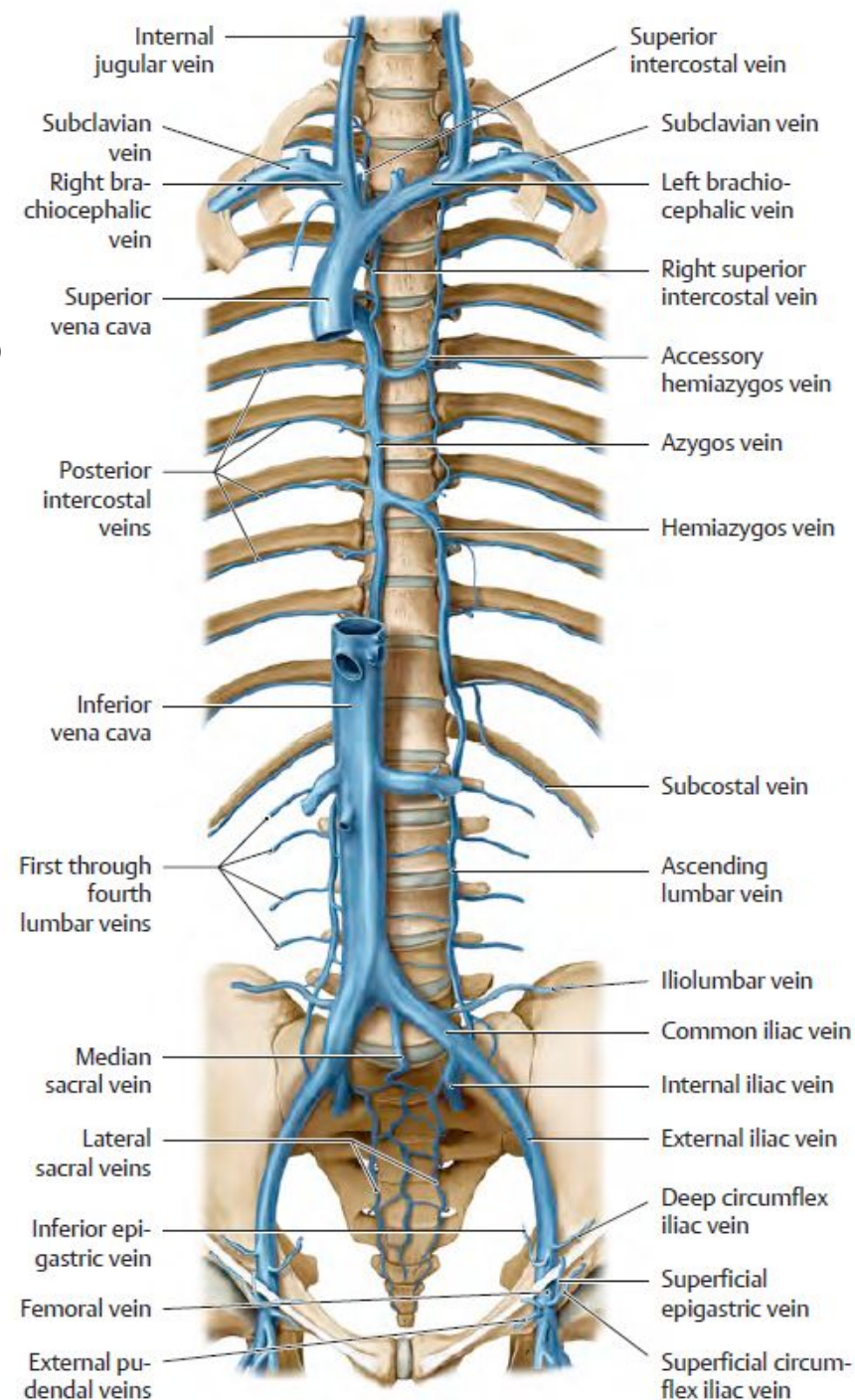
# VEINS OF THE SYSTEMIC CIRCULATION

- flow into the large trunks v. cava superior and v. cava inferior
- course independent of arteries: vv. cavae, collecting venous trunks, superficial veins
- veins accompanying arteries: so-called deep veins (sometimes doubled)
  - vv. perforantes – connections between the superficial and deep venous systems transfascially on the limbs



# SUPERIOR VENA CAVA

- thin-walled, reduced tunica media, without valves
- behind the right edge of the sternum at the level of the joint with the 2nd rib
- formed by the confluence of the right and left brachiocephalic veins
- opens after 6–7 cm into the right atrium at the level of the 3rd rib cartilage
- right and left brachiocephalic veins
- v. azygos
- small veins from the mediastinum
- v. thoracica interna dx. (or into v. brachiocephalica dx.)





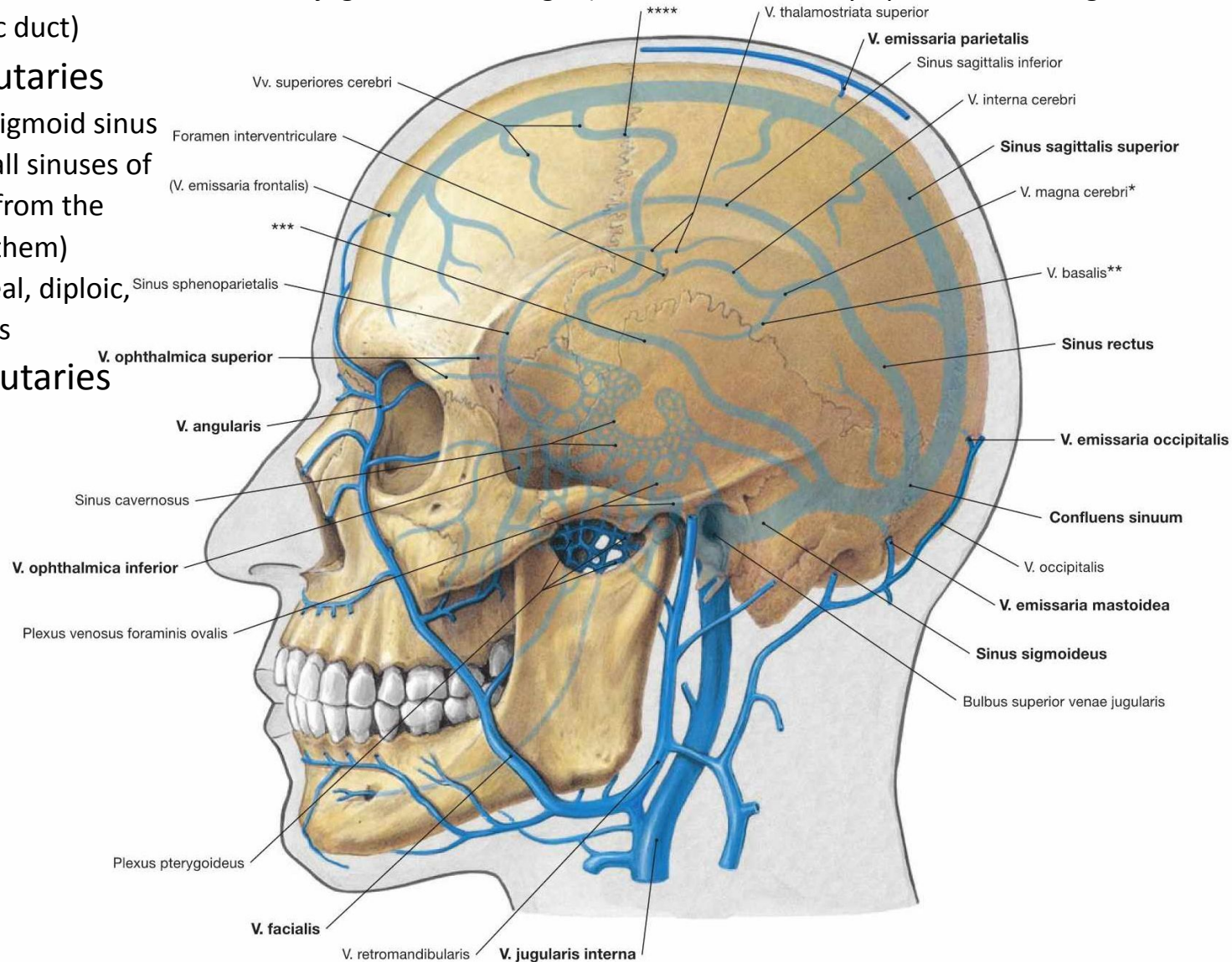
# INTERNAL JUGULAR VEIN

- begins at the basis cranii externa as the bulbus venae jugularis superior (continuation of the sinus sigmoideus, foramen jugulare)
- descends in the cervical neurovascular bundle to the inferior jugular vein bulb
- behind the clavicle, it joins the subclavian vein = jugular venous angle (mouth of the main lymphatic trunks: right lymphatic duct, thoracic duct)

## • 1. intracranial tributaries

- IJV connects to the sigmoid sinus (carries blood from all sinuses of the dura mater and from the veins that flow into them)
- encephalic, meningeal, diploic, and ophthalmic veins

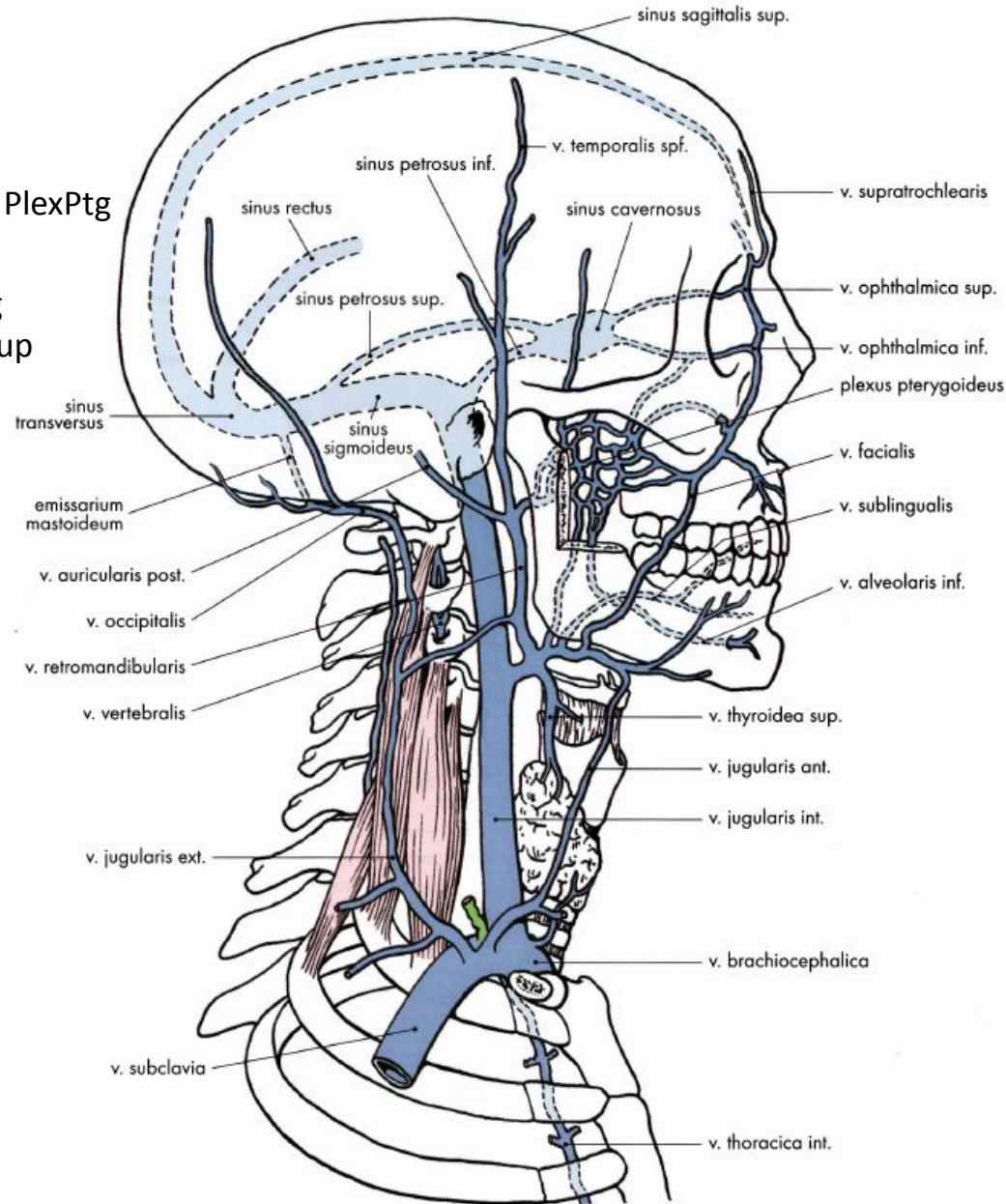
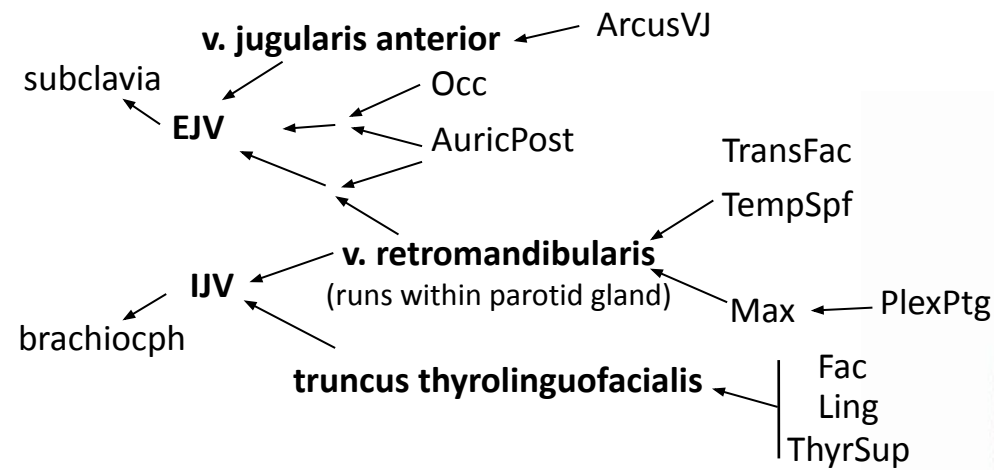
## • 2. extracranial tributaries



# INTERNAL JUGULAR VEIN – EXTRACRANIAL TRIBUTARIES

- **v. retromandibularis**
    - formed by the confluence of v. temporalis superficialis, media, and v. transversa faciei behind ramus mandibulae, descends behind angulus mandibulae, pierces the superficial cervical fascia, and enters v. jugularis interna
    - vv. maxillares from fossa infratemporalis
    - plexus pterygoideus – venous plexus in the infratemporal fossa; veins from the infratemporal fossa and pterygopalatine fossa, both jaws, orbit, from the cranial cavity; connections with veins of the orbit, face (superficial and deep), with vv. meningae and vv. emissariae of the middle cranial fossa (infection!!!)
  - **vv. pharyngeae**
    - smaller veins below the base of the skull, blood from the plexus pharyngeus
  - **v. facialis**
    - blood from the face, anastomosis with v. ophthalmica superior
  - **v. lingualis**
    - receives v. comitans nervi hypoglossi
  - **v. thyroidea superior**
    - from the larynx v. laryngea superior
  - **v. thyroidea media**
    - inconsistent, from the side of the thyroid gland in front of the a. carotis communis
  - **v. jugularis externa**
    - superficial vein on the outer side of the neck
    - begins below the mastoideus process confluence of v. auricularis posterior and v. occipitalis, descends caudally below m. platysma behind the posterior edge of m. sternocleidomastoideus, empties into bulbus inferior v. jugularis int./into v. subclavia
    - v. jugularis anterior – descends in the superficial cervical fascia (arcus venosus juguli – transverse connection of vv. jugulares anteriores in the fossa jugularis)
- opens into the internal jugular vein (at the level of the hyoid bone):
- a) separately
  - b) connected in various ways
  - c) thyrolingual trunk, thyrolinguofacial trunk

# VEINS OF THE NECK



# SUBCLAVIAN AND AXILLARY VEIN

- subclavian vein

- continues from the axillary vein, from the lateral edge of the first rib (in front of the anterior scalene muscle) behind the sternoclavicular joint, into the venous angle (there are valves in the vein in front of the venous angle), runs in front of the cupula pleurae, behind the subclavian muscle
- it receives only minor tributaries; most of the veins accompanying the branches of the subclavian artery drain into the brachiocephalic vein and internal jugular vein; it may receive:
  - the pectoral veins or the entire trunk of the thoracoacromial vein
  - the transverse vein of the neck

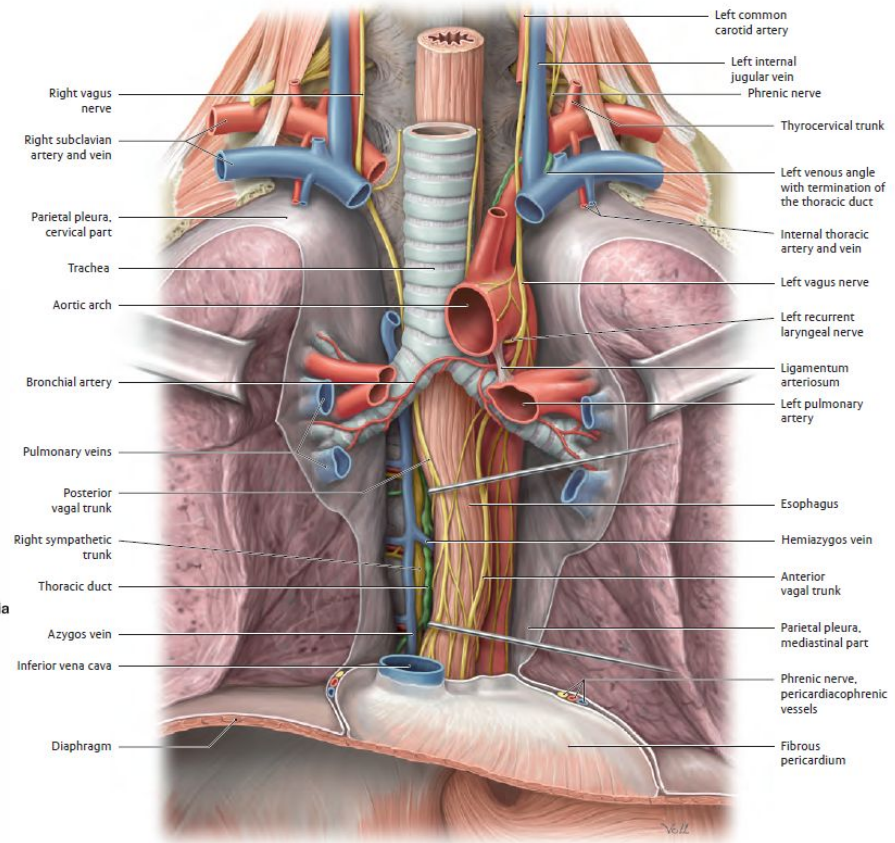
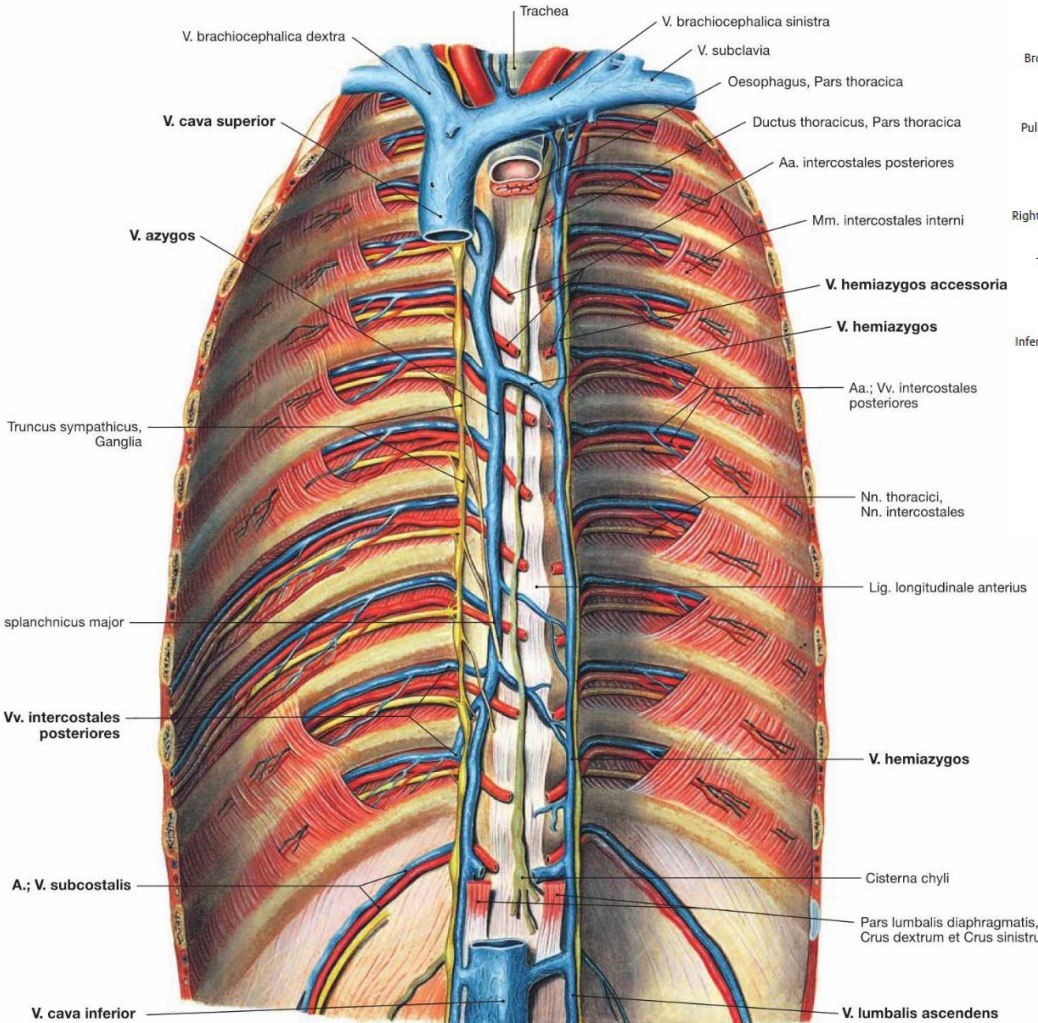
- axillary vein

- at the lower edge of the axilla from the brachial veins, at the outer edge of the first rib it transitions into the subclavian vein, runs along the axillary artery (ventrally), is not surrounded by the brachial plexus
- brachial veins – two, accompanying the brachial artery
- cephalic vein – subcutaneous vein of the upper limb
- thoracoepigastric veins – subcutaneous veins from the network on the front of the chest

# AZYGOS AND HEMIAZYGOS

- veins along the spine, tributaries from the wall of the lumbar region, in the chest approximately from the area supplied by the thoracic aorta
- collect blood from the wall of the lumbar region, from 8–10 caudal intercostal spaces, from the organs of the posterior mediastinum, from the nutritive circulation of the lungs, and from the venous plexuses of the spine
- have no valves (blood flows in both directions, part of the so-called cavocaval anastomoses)
- **azygos vein**
  - on the right, begins with the confluence of the right ascending lumbar vein and the right subcostal vein behind the cranial origins of the psoas major muscle under the diaphragm
  - passes through the diaphragm through the crus dextrum into the posterior mediastinum, at the level of Th4 arcus venae azygos into the superior vena cava (above the pericardium), above the pulmonary hilum leaves the sulcus venae azygos
  - posterior intercostal veins, esophageal veins, bronchial veins
- **hemiazygos vein**
  - on the left, extends to Th7–9, where it passes obliquely between the spine and the aorta and empties into the v. azygosv
  - v. intercostales posteriores sinistralae from the lower 6 intercostal spaces, vv. bronchiales, vv. oesophageae
  - accessory hemiazygos vein – on the left, originates from branches of v. intercostalis suprema, receives blood from vv. intercostales posteriores sinistralae, drains into the oblique section of v. hemiazygos
  - vv. oesophageae – in the lower part of the esophagus, connects the bloodstream of v. c. s. and v. portae

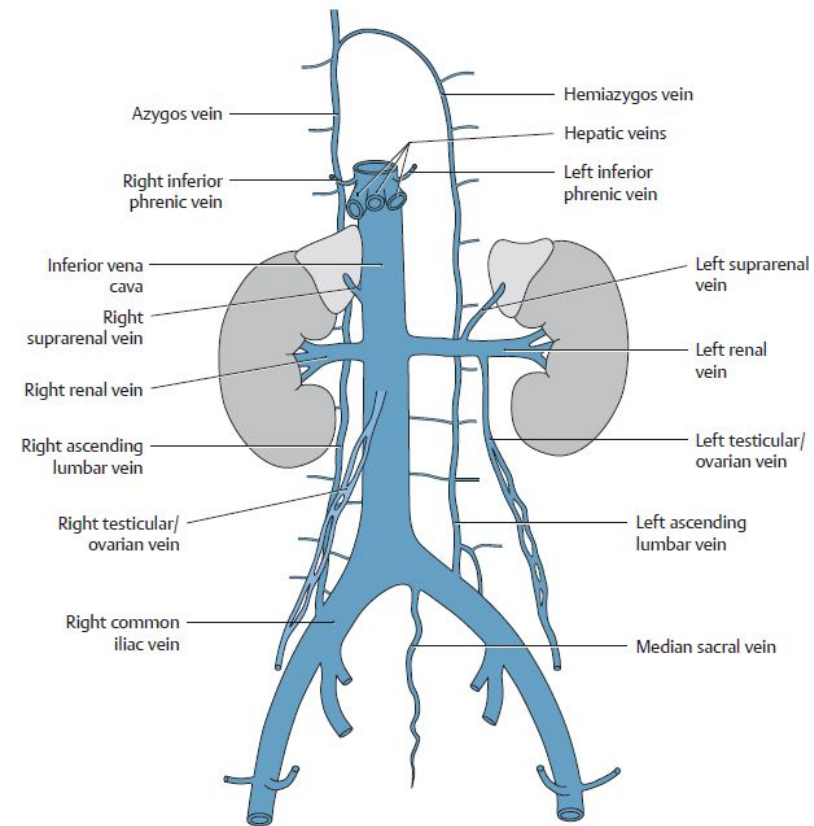
# RELATIONS IN THE THORACIC CAVITY



# INFERIOR VENA CAVA

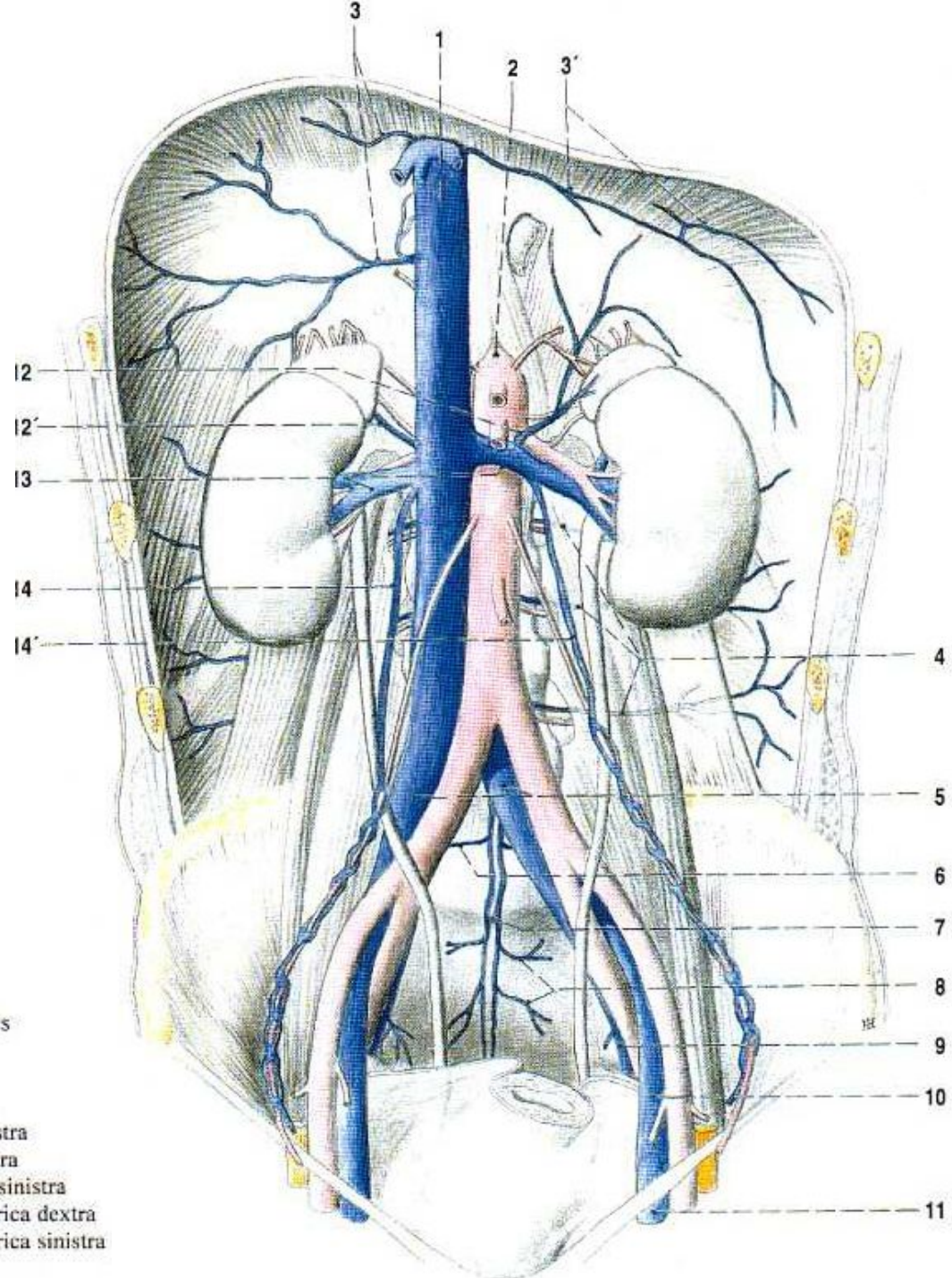
- retroperitoneally on the right along the abdominal aorta (behind the v. c. i. are the right-sided paired branches of the a. abdominis), cranially it moves away to the right, crossed from the front by the radix mesenterii, then more cranially by the pars horizontalis duodeni and caput pancreatis, then behind the foramen epiploicum, impressed into the liver (sulcus v. cavae), passes through the diaphragm (foramen v. cavae), enters the right atrium of the heart
- in wall, no valves, numerous varieties (due to complex development)
- **parietal tributaries**
  - vv. lumbales – usually 4 pairs, under m. psoas major, connected on the right and left v. lumbalis ascendens
  - v. phrenica inferior – from the lower surface of the diaphragm
  - v. sacralis mediana – into v. c. i. or into v. iliaca communis sin.
  - vv. iliaca communes – blood from the lower limbs and pelvis
- **visceral tributaries**
  - v. testicularis – venous drainage from the male gonad, begins as the pampiniform plexus, passes through the spermatic cord, separates from the cord after passing through the inguinal canal, ascends along the psoas major muscle and gradually reduces to a single vein, on the right it empties into the v. c. i., on the left into the v. renalis sin.
  - v. ovarica – in women, a similar pampiniform plexus from the ovary, gradually reducing and draining as v. testicularis in men
  - v. renalis – from the renal hilum, after entering v. c. i., v. c. i. is wider; the left v. renalis receives v. suprarenalis sin., vv. capsuloadiposae
  - v. suprarenalis dx.
  - vv. hepaticae – 2–3 unpaired veins (usually 2 from the right and 1 from the left hepatic lobe), after entering the v. c. i., the v. c. i. enlarges

# INFERIOR VENA CAVA



- 1 v. cava inferior
- 2 aorta abdominalis
- 3 vv. phrenicae inferiores dextrae
- 3' vv. phrenicae inferiores sinistrae
- 4 vv. lumbales
- 5 v. iliaca communis dextra et sinistra
- 6 v. lumbalis ima dextra
- 7 vv. sacrales medianae s a. sacralis mediana

- 8 vv. sacrales laterales
- 9 v. iliaca interna
- 10 v. iliaca externa
- 11 v. femoralis
- 12 v. suprarenalis sinistra
- 12' v. suprarenalis dextra
- 13 v. renalis dextra et sinistra
- 14 v. testicularis / ovarica dextra
- 14' v. testicularis / ovarica sinistra



# COMMON ILIAC VEIN

- formed by the confluence of the internal and external iliac veins at the level of the sacroiliac joint
- the left common iliac vein is longer, runs along the medial side of the left common iliac artery, passes under the right common iliac artery, and empties into the internal iliac vein
- the right common iliac vein runs behind the right common iliac artery
- **v. iliaca interna**

- accompanies the course of the a. iliaca interna on the ventromedial side and receives tributaries along the main branches of this artery

parietal tributaries – correspond to the respective arteries

- v. glutea superior et inferior – foramen supra-/infrapiriforme
  - v. obturatoria – canalis obturatorius
  - v. sacralis lateralisv. iliolumbalis – below m. psoas major
  - v. pudenda interna – formed by the confluence of parietal and visceral veins, encircles spina ischiadica, foramen infrapiriforme

visceral tributaries – originate from venous organ plexuses

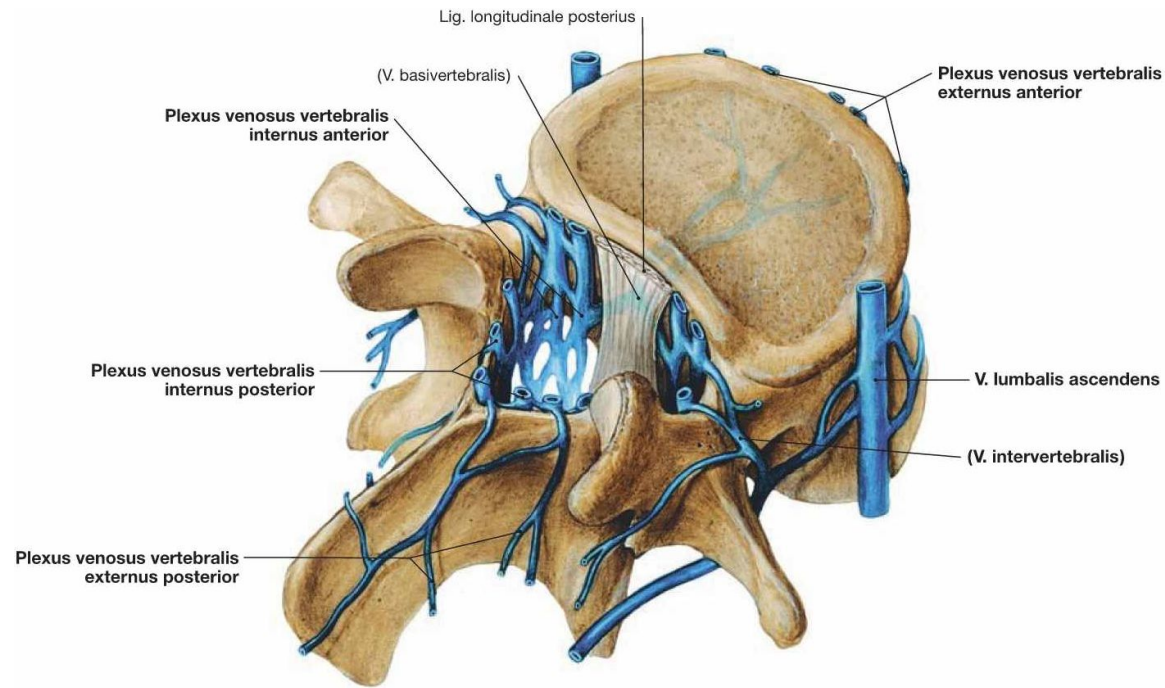
- plexus venosus vesicalis – at the base of the urinary bladder
  - p. v. prostaticus – from the erectile bodies of the penis via v. dorsalis penis profunda
  - p. v. uterinus – connects to p. v. vaginalis and p. v. ovaricus
  - p. v. vaginalisp. v. ovaricus – in lig. latum uteri
  - p. v. rectalis – submucosal into v. rectalis superior, perirectal into v. rectalis media et inferiorp. v. sacralis – in front of facies pelvina ossis sacri

- **v. iliaca externa**

- in continuation of v. femoralis into lacuna vasorum, medially from the artery
  - v. epigastrica inferior
  - v. circumflexa ilium profunda

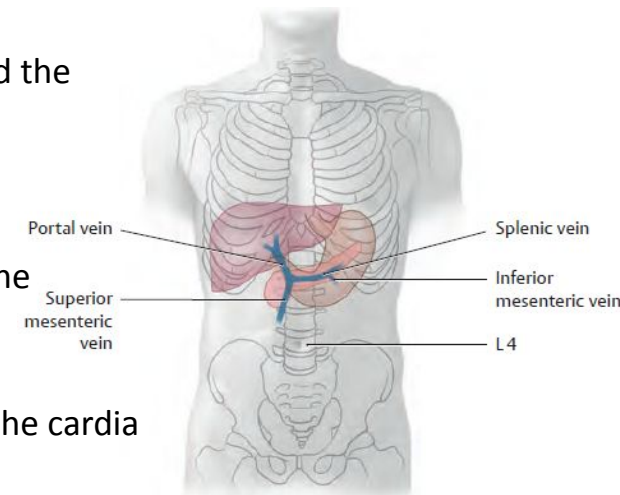
# VEINS OF THE SPINE

- emerge from the plexus venosi vertebrales along the entire length of the spine
- plexus venosi vertebrales interni
  - between the saccus durae matris spinalis and endorhachis (position corresponds to intracranial sinuses in terms of development)
  - anteriores et posteriores
  - receive veins from the vertebral bodies (vv. basivertebrales) and from the spinal cord (vv. spinales)
  - drainage – a) through the foramina vertebralia posteriorly, b) via connections through the vertebral bodies to the external plexuses on the anterior side of the spine, c) via connections between the vertebral arches to the external plexuses on the posterior side of the spine
- external vertebral venous plexus
  - along the spine anteriorly and posteriorly (anteriores et posteriores)
  - drainage – a) in the cervical region into the vertebral vein and deep cervical vein, b) in the thoracic region into the intercostal veins, c) in the lumbar region into the lumbar veins, d) in the sacral region into the lateral sacral veins

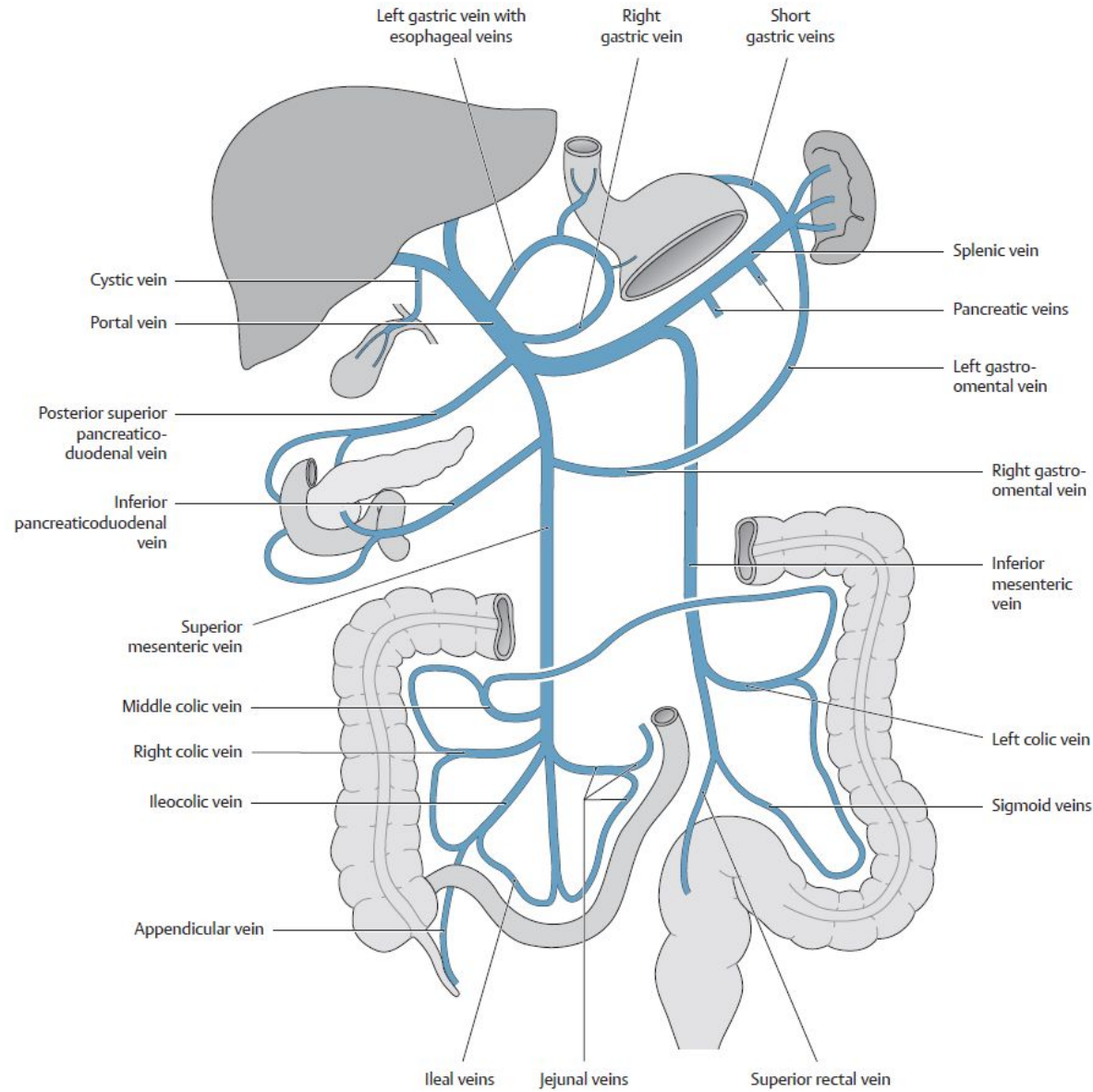
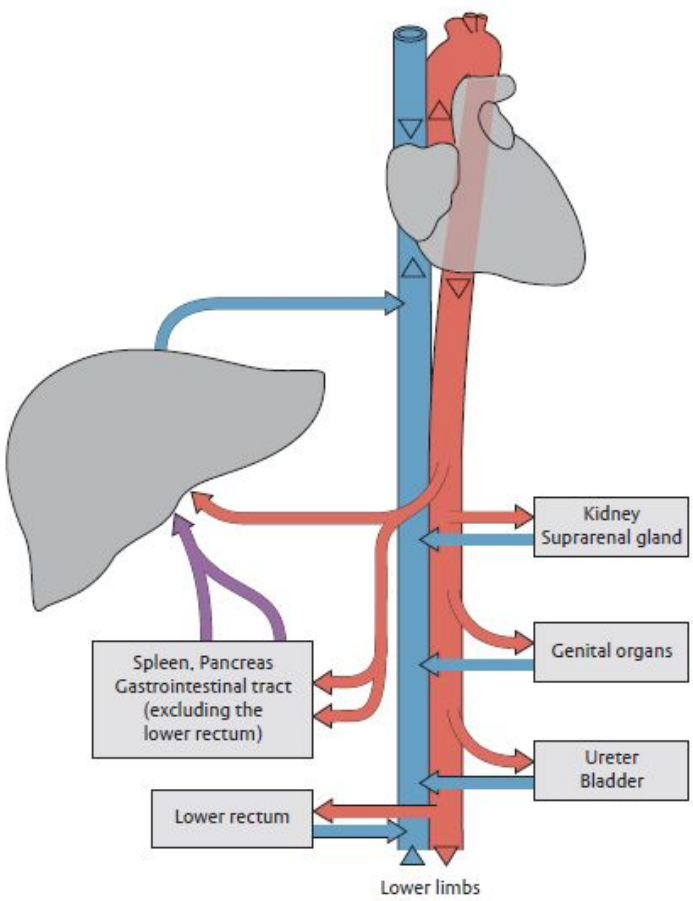


# PORTAL VENOUS SYSTEM

- blood from the veins of the unpaired organs of the abdominal cavity to the liver
- in the porta hepatis, it divides into the right and left branches
- it begins behind the head of the pancreas with the confluence (90°) of the superior mesenteric vein and the splenic vein (L2)
- rises behind the pars superior duodena dorsally from the gastroduodenal artery and the common bile duct
- enters the hepatoduodenal ligament (runs behind the common hepatic artery and the common bile duct)
- cystic vein, paraumbilical veins
- right gastric vein
  - blood from the right half of the lesser curvature of the stomach and from the pylorus
- left gastric vein
  - blood from the venous plexuses in the lower third of the esophagus, from the cardia and from the left half of the curv. minor ventriculi
- superior mesenteric vein
  - comes from the radix mesenterii through the pars horizontalis duodeni behind the head of the pancreas
  - in the mesentery, it is to the right of the a. mes. sup.
  - vv. pancreaticoduodenales, vv. pancreaticae, v. gastroepiploica dx., vv. jejunales et ileales, v. ileocolica, v. appendicularis, v. colica dx., v. colica media
- splenic vein
  - formed by the confluence of several branches in the hilum of the spleen and passes behind the pancreas
  - vv. gastricae breves, vv. pancreaticae, v. gastroepiploica sin.
  - inferior mesenteric vein (may flow into the confluence of v. lienalis and v. mes. sup.), confluence of v. colica sin., vv. sigmoideae, v. rectalis superior



# PORTAL VENOUS SYSTEM



# PORTOCAVAL ANASTOMOSES

① Through veins of the stomach and distal esophagus (dilation of these veins may lead to esophageal varices, with risk of life-threatening hemorrhage):

**Portal vein** ← gastric veins ← *esophageal veins* → azygos/hemiazygos vein → **superior vena cava**.

② Through veins of the anterior abdominal wall:

**Portal vein** ← umbilical vein (patent part) ← *paraumbilical veins* → periumbilical veins → superior epigastric vein → internal thoracic vein → subclavian vein → **superior vena cava** or

**Portal vein** ← umbilical vein (patent part) → *paraumbilical veins* → periumbilical veins → inferior epigastric vein → external iliac vein → **inferior vena cava**.

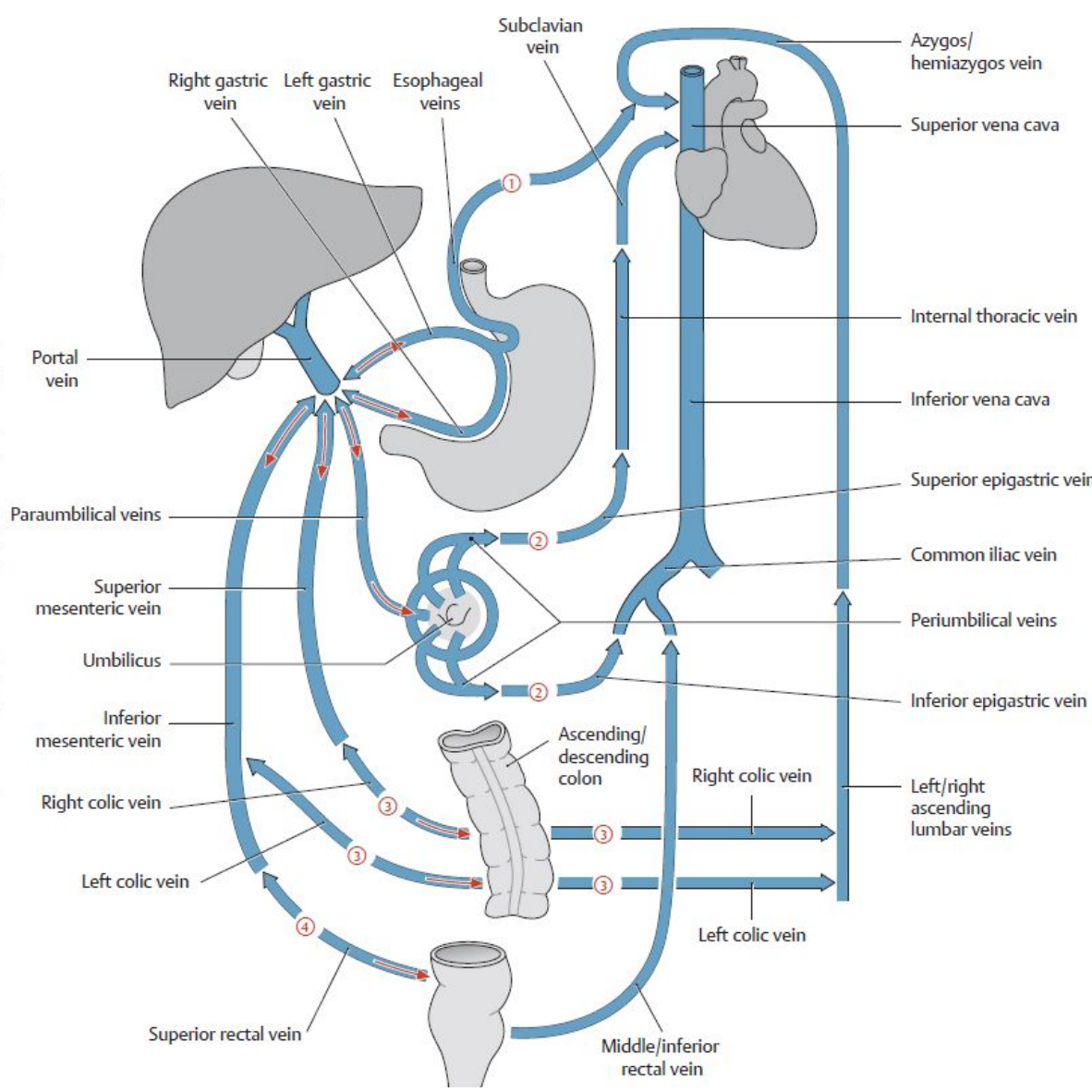
Note: Drainage from paraumbilical veins into the superficial veins (rare) of the anterior abdominal wall (thoracoepigastric vein, lateral thoracic vein, superficial epigastric vein, see A) leads to dilation of these tortuous veins (Medusa head, caput medusae).

③ Through veins of the posterior abdominal wall:

**Portal vein** ← superior and inferior mesenteric vein ← left and right *colic veins* → left and right ascending lumbar veins → azygos/hemiazygos vein → **superior vena cava**. The ascending lumbar veins may also divert blood to the inferior vena cava.

④ Through the rectal venous plexus (with dilation):

**Portal vein** ← inferior mesenteric vein ← superior rectal vein ← middle/*inferior rectal veins* → internal iliac vein → **inferior vena cava**.



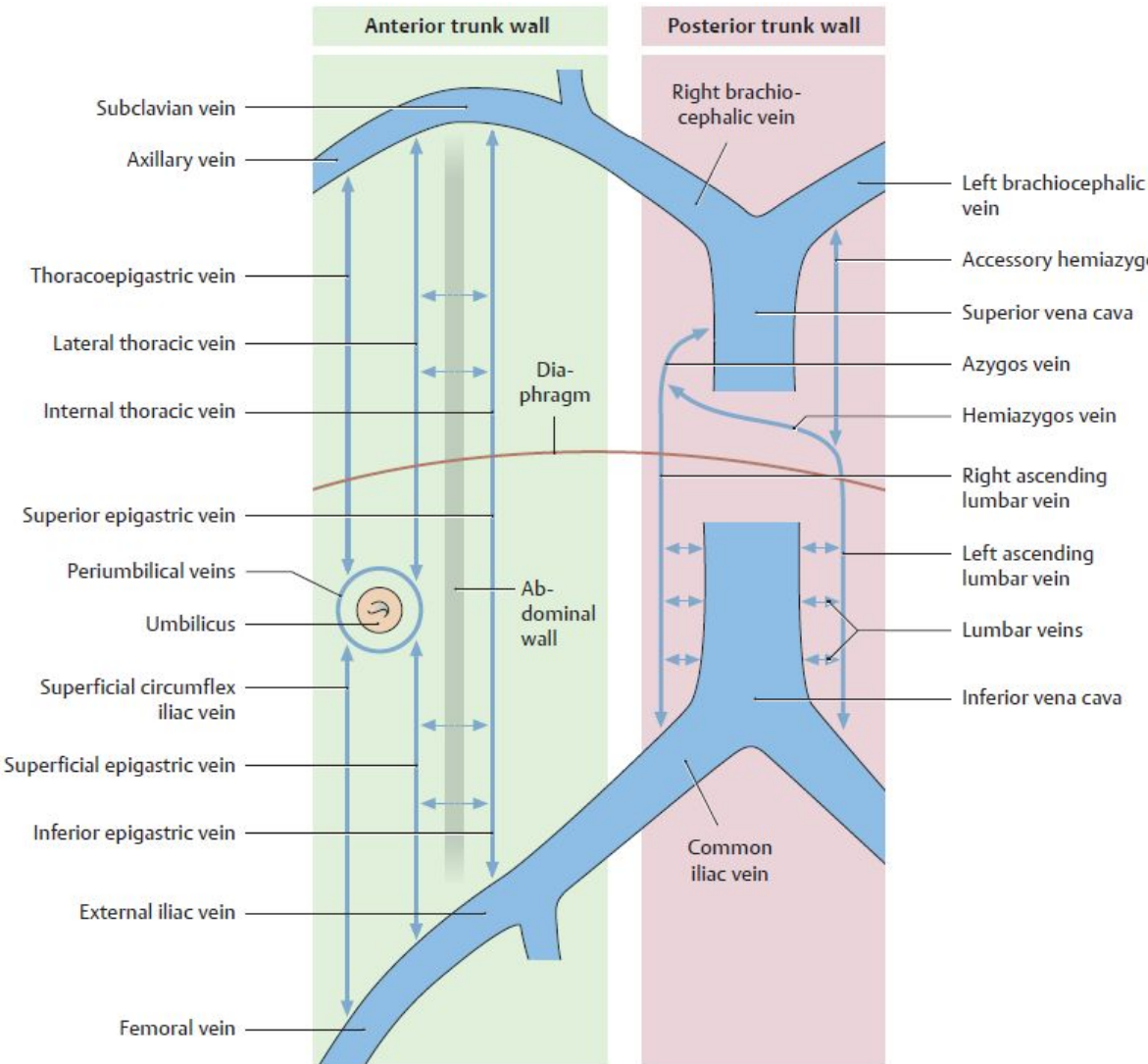
# PORTOCAVAL ANASTOMOSES

- connections between peripheral branches of the portal vein and venous branches draining from the superior or inferior vena cava
- become more important when blood flow through the liver is impaired
- connections between the gastric veins and esophageal veins
- connections between the paraumbilical veins and subcutaneous veins around the navel
  - caput Medusae – drainage via a) vv. thoracoepigastricae into v. axillaris, b) via vv. epigastricae superficiales into v. femoralis
- connections between vv. paraumbilicales and veins along the chorda urachi
- connections from the liver to the veins of the diaphragm
  - veins of the diaphragm into v. cava inf.
  - via v. azygos/hemiazygos and further into v. cava sup.
- plexus venosus rectalis
  - anastomosis v. rectalis superior (v. mesenterica inferior) with vv. rectales mediae (v. iliaca externa)
- connections in the retroperitoneal space
  - v. lienalis or vv. mesentericae with tributaries v. cava inferior

# PORTOCAVAL ANASTOMOSES

- v. portae – vv. gastricae – vv. oesophageales – v. azygos et hemiazygos – v. cava superior
- v. portae – vv. paraumbilicales – vv. epigastricae superiores – vv. thoracicae internae – v. cava superior
  - v. portae – vv. paraumbilicales – vv. epigastricae inferiores – vv. iliacaе externae – v. cava inferior
  - v. portae – vv. paraumbilicales – vv. thoracoepigastricae, vv. costoaxillares, vv. thoracicae laterales – vv. axillares – v. cava superior
  - v. portae – vv. paraumbilicales – vv. epigastricae superficiales – vv. saphenae magnae – v. cava inferior
  - v. portae – vv. paraumbilicales – Burow's veins (along the chorda urachi) – plexus vesicalis – v. cava inferior
- v. portae – v. mesenterica inferior – v. rectalis superior – vv. rectales mediae et inferiores – v. cava inf.
- v. portae – v. mesenterica sup. et v. lienalis – veins of Retzius – vv. lumbales, v. azygos – v. cava sup.
- patent ductus venosus
- connections between the veins of the liver (in the area nuda) and the diaphragm

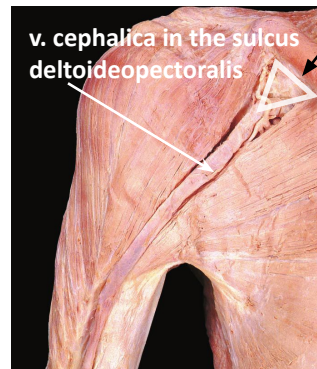
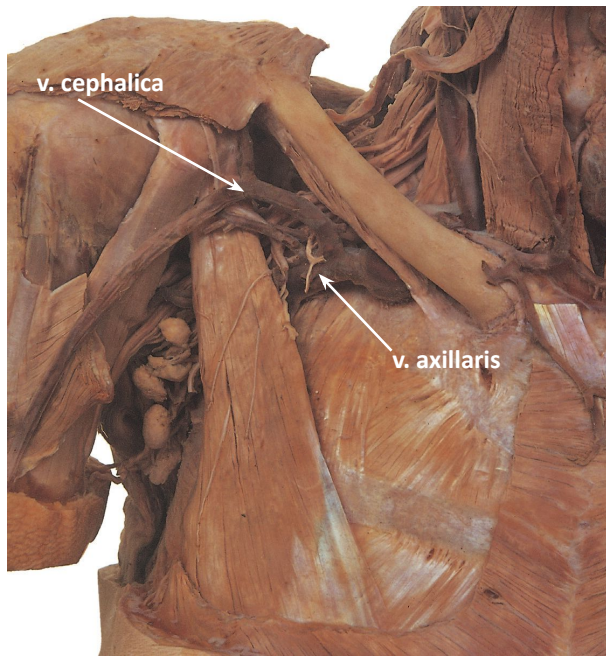
# CAVOCAVAL ANASTOMOSES



- Anastomoses on the *posterior wall* of the abdomen. They utilize the connection between the ascending lumbar vein and the azygos/hemiazygos vein. Two pathways are available:
  1. A *direct* pathway between the ascending lumbar vein and azygos/hemiazygos vein:  
**Inferior vena cava** → (possibly via the common iliac vein) ascending lumbar vein → azygos/hemiazygos vein → **superior vena cava**.
  2. An *indirect* pathway between the ascending lumbar vein and azygos/hemiazygos vein by way of horizontal trunk wall veins (intercostal and lumbar veins, mediated by venous plexuses on the spinal column; for clarity, not shown here):  
**Inferior vena cava** → (possibly via the common iliac vein) ascending lumbar vein → lumbar veins → vertebral venous plexus → posterior intercostal veins → azygos/hemiazygos vein → **superior vena cava**.
- Anastomoses on the *anterior wall* of the abdomen. They utilize superficial and deep cutaneous veins, which may exchange blood between them. Two pathways are available:
  1. Deep pathway (posterior to the rectus abdominis):  
**Inferior vena cava** → common iliac vein → external iliac vein → inferior epigastric vein → superior epigastric vein → internal thoracic vein → subclavian vein → brachiocephalic vein → **superior vena cava**.
  2. Superficial pathway (anterior to the rectus abdominis):  
**Inferior vena cava** → common iliac vein → external iliac vein → femoral vein → superficial epigastric vein/superficial circumflex iliac vein → thoracoepigastric vein/lateral thoracic vein → axillary vein → subclavian vein → brachiocephalic vein → **superior vena cava**.

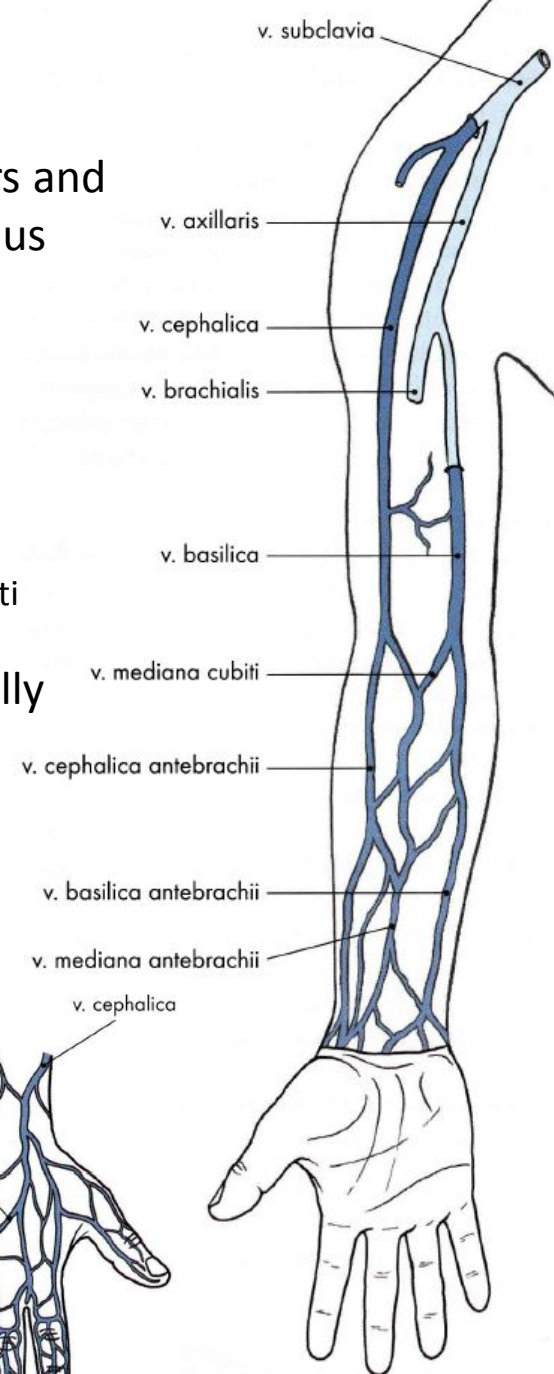
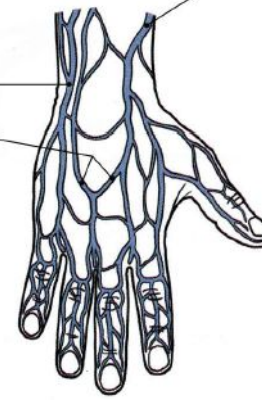
# OVERVIEW OF THE VEINS OF THE UPPER LIMB

- deep and superficial venous system (with valves) connected by trans fascial junctions
- superficial veins originate from a network of fine veins in the fingers and pass to the dorsum of the hand into the rete venosum dorsale manus
- v. cephalica
  - radially, runs in the sulcus bicipitalis lateralis on the arm
- v. basilica
  - ulnarly, on the arm runs in the sulcus bicipitalis medialis
  - in the hiatus basilicus pierces the fascia and flows into the v. brachialis
- v. mediana cubiti
  - connection (variable shape: M, N, V) v. cephalica and v. basilica in the fossa cubiti
- deep veins of the same name accompany the arteries and are usually paired

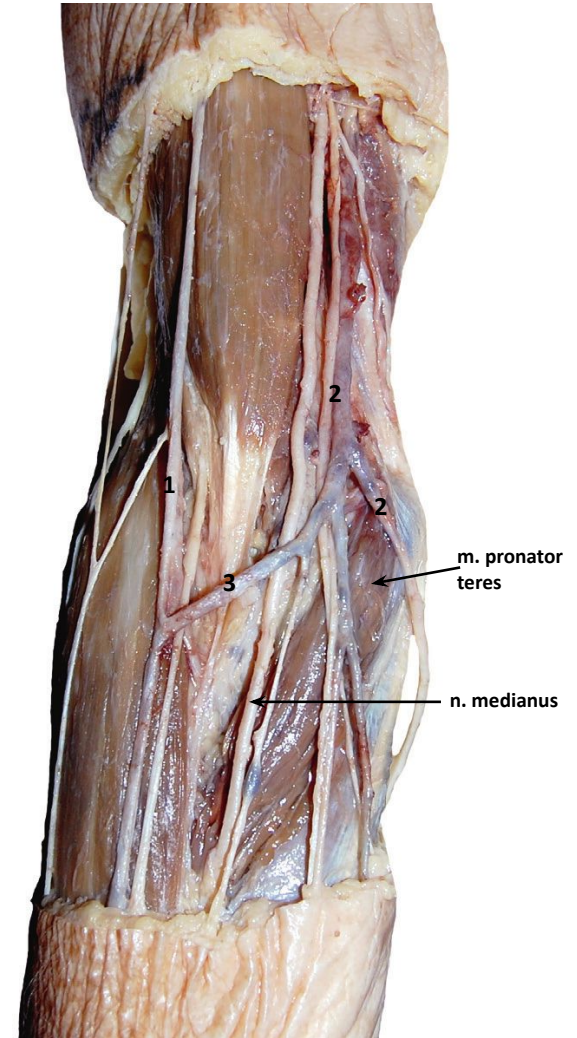
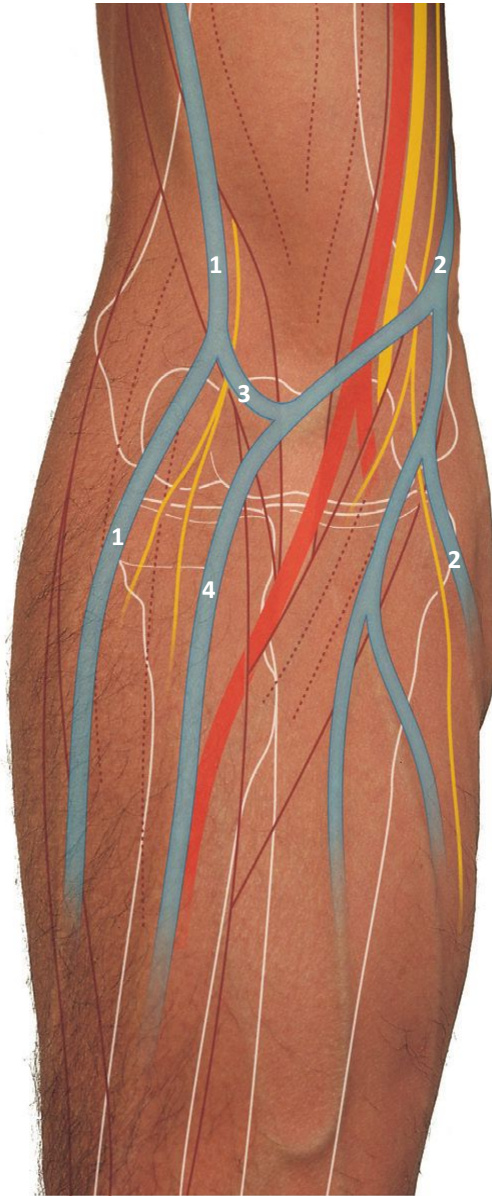


trigonum clavipectorale

v. basilica  
rete venosum dorsale manus



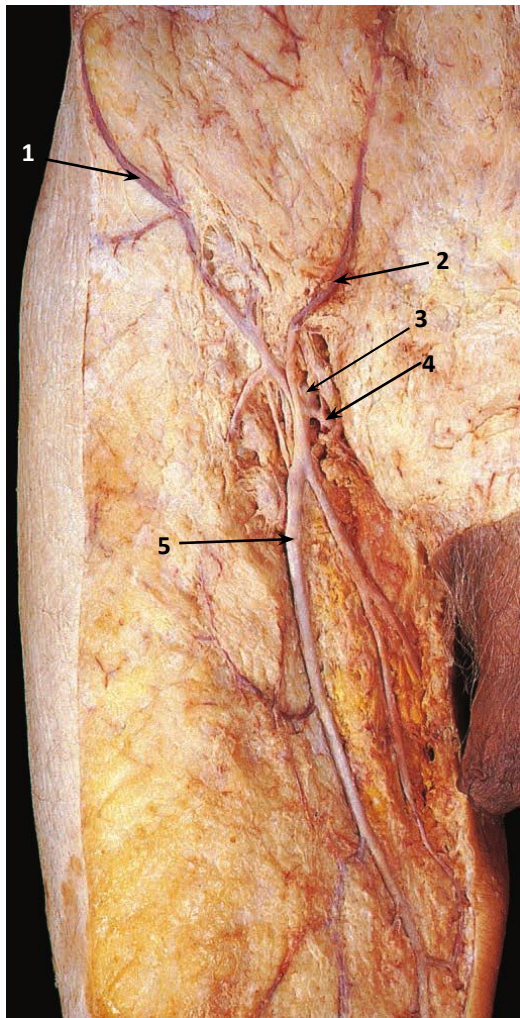
# OVERVIEW OF THE VEINS OF THE UPPER LIMB



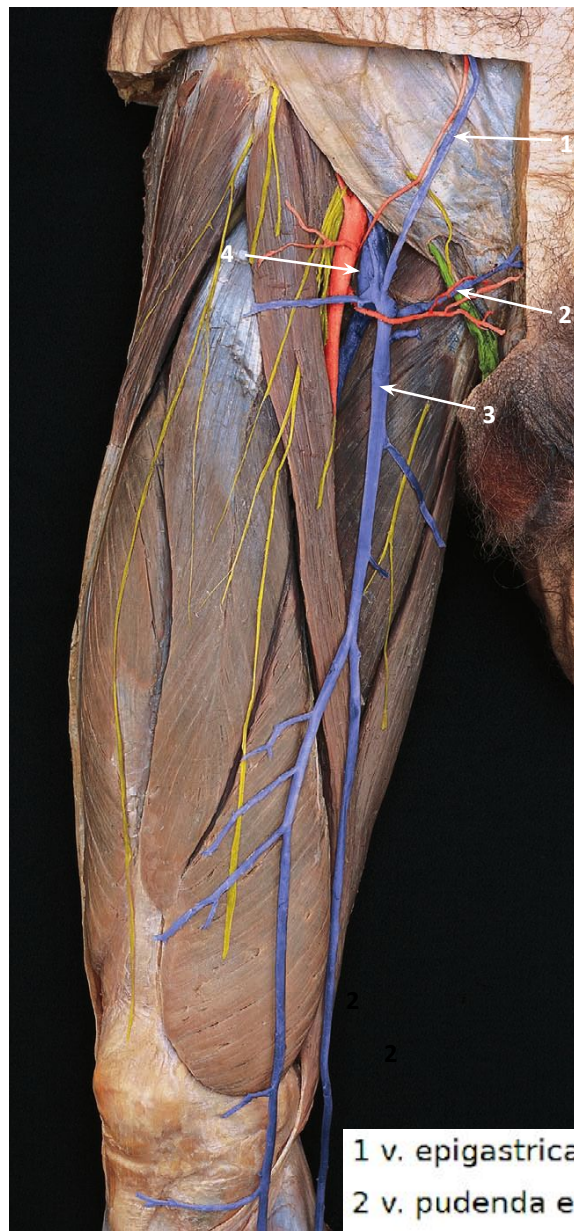
# OVERVIEW OF THE VEINS OF THE LOWER LIMB

- superficial and deep system with valves
- **superficial system**
  - drained from the leg via the great saphenous vein (GSV) and small saphenous vein (SSV)
  - rete venosum dorsale pedis → arcus venosus dorsalis pedis → medial marginal vein (GSV) and lateral marginal vein (SSV)
  - VSM – begins in front of the medial malleolus, runs along the ventromedial side of the lower leg (with n. saphenus) to the knee, then to the hiatus saphenus through the fascia lata femoris to the v. femoralis
  - VSP – begins behind the lateral ankle, runs down the center of the back of the calf with the sural nerve, pierces the superficial fascia at the level of the popliteal fossa and flows into the popliteal vein between the heads of the gastrocnemius muscle
- **deep system**
  - accompanies arteries, often doubled
  - begins from vv. digitales plantares and vv. metatarsales plantares → (lower leg) vv. tibiales posteriores et anteriores and vv. fibulares → (thigh) v. profunda femoris and v. femoralis
- **perforating veins**
  - transfascial connections between the superficial and deep systems
  - mostly on the medial side of the lower leg

# ŽÍLY DOLNÍ KONČETINY

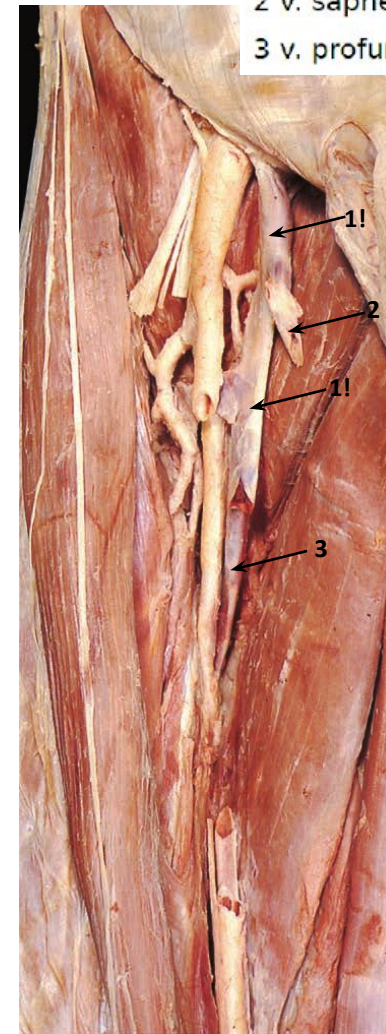


- 1 v. circumflexa ilium superficialis
- 2 v. epigastrica superficialis
- 3 v. femoralis
- 4 v. pudenda externa
- 5 v. saphena magna



- 1 v. epigastrica superficialis
- 2 v. pudenda externa
- 3 v. saphena magna
- 4 v. femoralis

- 1 v. femoralis
- 2 v. saphena magna
- 3 v. profunda femoris



# OVERVIEW OF THE VEINS OF THE LOWER LIMB

