

VEINS (*VENAE*)

Blood is collected from tissues to exchange vessels - capillaries, sinusoids and postcapillary venules. Exchange between blood and tissue fluid around cells, the essential function of circulatory systems, occurs through their walls. This exchange includes oxygen, carbon dioxide, nutrients, water and inorganic ions, vitamins, hormones, metabolic products, antibodies and defensive cells of various kinds. Larger venules and veins form large volume, low pressure vessels conveying blood back to the heart.

Most veins (especially of the limbs) have valves to prevent reflux of blood. In the lower limbs where the venous return is against gravity, such valves are of great importance to venous flow, as blood is moved towards the heart by the intermittent pressure produced by contractions of the surrounding muscles. Valves are absent in very small and very large veins. Flow in veins is slower than in arteries, veins are larger and more numerous than corresponding arteries, what is important for efficient return of blood to the heart.

Arteries and veins usually accompany each other. The vein may be single, but is often paired; such *venae comitantes* flank an artery, with numerous cross-connections, all is enclosed in a single connective tissue sheath. The proximity of an artery and vein aids venous return, because veins are compressed by arterial pulsation.

VEINS OF THE HEAD (Table 12)

Vein	First tributaries	Next tributaries
V. facialis	V. supratrochlearis V. supraorbitalis	Vv. palpebrales superiores Vv. palpebrales inferiores Vv. nasales externae V. labialis superior V. profunda faciei Vv. labiales inferiores Vv. parotideae V. palatina externa V. submentalialis
V. lingualis	Vv. dorsales linguae V. comitans n. hypoglossi	Vv. linguales V. profunda linguae V. sublingualis
V. temporalis spf.	R. frontalis R. parietalis	V. temporalis media Vv. parotideae Vv. auriculares ant. V. transversa faciei
V. maxillaris	Plexus pterygoideus	Vv. meningeae mediae Vv. temporales profundae V. canalis pterygoidei Vv. auriculares anteriores Vv. parotideae V. tympanicae V. stylomastoidea V. alveolaris inf. et sup. V. sphenopalatina Vv. palatinae
V. retromandibularis	V. temporalis spf. V. maxillaris	

Table 12. Veins of the head – survey. Tributaries accompany respective arteries and have names according to the drained regions. Exceptions as well as important details are described in the following text.

Supratrochlear vein (*V. supratrochlearis*)

- from the forehead
- connected to the tributaries of the superficial temporal vein
- joined to the contralateral vein by the **nasal arch** across the root of the nose
- joins the supraorbital vein to form the facial vein near the medial canthus

Supraorbital vein (*V. supraorbitalis*)

- begins near the zygomatic process of the frontal bone
- connected to the tributaries of the superficial and middle temporal veins
- connected to the superior ophthalmic vein through the supraorbital notch
- pierces the orbicularis oculi to join the supratrochlear vein

Facial vein (*V. facialis*)

- its uppermost segment is termed the **angular vein (*V. angularis*)**
- from the medial canthus descends obliquely posterolaterally
- behind the facial artery
- less tortuous than the artery
- passes under the zygomaticus major, risorius and the platysma
- on the surface of the masseter
- crosses the body of mandible and runs back superficial to the submandibular gland and digastric
- anteroinferior to the mandibular angle has a connection to the retromandibular vein
- descends superficial to the hypoglossal nerve and external and internal carotid arteries
- enters the internal jugular vein near the greater horn of the hyoid bone

Deep facial vein (*V. profunda faciei*)

- the connection of the facial vein with the pterygoid plexus

Lingual veins (*V. linguales*)

- **dorsal lingual veins** drain the dorsum and sides of the tongue and join the lingual veins accompanying the lingual artery between the hyoglossus and genioglossus
- **the deep lingual vein** runs near the inferior surface and joins the sublingual vein at the anterior border of the hyoglossus to form the **vena comitans of hypoglossal nerve**
- the **vena comitans of hypoglossal nerve** runs back between the mylohyoid and hyoglossus and joins the lingual vein

Superficial temporal vein (*V. temporalis superficialis*)

- begins from the venous network of the scalp connected to the tributaries of the contralateral vein, ipsilateral facial, posterior auricular, and occipital veins
- enters the parotid gland to join the maxillary vein to form the retromandibular vein

Pterygoid plexus (*Plexus pterygoideus*)

- in the infratemporal fossa
- blood flows by several directions from the pterygoid plexus:
 - through **v. maxillaris** > *v. retromandibularis*
 - through **v. prof. faciei** > *v. facialis*

through vv. **ophthalmicae** > *sinus cavernosus*

Retromandibular vein (*V. retromandibularis*)

- descends in the parotid gland
- between the external carotid artery and facial nerve
- joins the facial vein
- joins the posterior auricular to form the external jugular vein
- it may be a tributary of the internal jugular vein

Occipital vein (*V. occipitalis*)

- begins in a posterior network in the scalp
- joins the deep cervical and vertebral veins in the suboccipital triangle
- it may follow the occipital artery to end in the internal jugular
- sometimes it joins the posterior auricular and hence the external jugular vein
- joins the superior sagittal and transverse sinuses through parietal and mastoid emissary veins

Intracranial veins and dural venous sinuses – see blood supply of the central nervous system

VEINS OF THE NECK (Table 13)

Vein	First tributaries	Next tributaries
V. jugularis ext.	V. retromandibularis V. auricularis post.	V. jugularis ext. post. V. jugularis ant. V. suprascapularis Vv. transverse colli
V. jugularis int.	Sinus durae matris through sinus sigmoideus	Vv. meningeae Vv. pharyngeae V. facialis V. lingualis V. thyroidea sup. V. thyroidea media V. sternocleidomastoidea
V. vertebralis	Plexus venosi vertebrales interni	V. vertebralis ant.
V. thyroidea inf.	Plexus thyroideus impar	V. laryngea inf.

Table 13. Veins of the neck – survey. Tributaries accompany respective arteries and have names according to the drained regions. Exceptions as well as important details are described in the following text.

External jugular vein (*V. jugularis externa*)

- arises near the mandibular angle
- descends obliquely, superficial to the sternocleidomastoid
- enters the supraclavicular fossa
- pierces the superficial layer of the cervical fascia
- drains into the venous angle/subclavian vein/internal jugular vein

Anterior jugular vein (*V. jugularis ant.*)

- starts near the hyoid bone by confluence of the superficial submandibular veins

- descends near the midline
- communicates with the internal jugular vein
- turns laterally, posterior to the lower part of the sternocleidomastoid
- above the manubrium of sternum joins the contralateral vein by the **jugular arch (*Arcus venosus juguli*)**
- joins the end of the external jugular vein

Internal jugular vein (*V. jugularis interna*)

- collects blood from the cranial cavity, face and neck
- arises in the dorsolateral part of the jugular foramen as a continuation of the sigmoid sinus
- its beginning is widened (***Bulbus superior v. jugularis internae***)
- descends first lateral to the internal carotid artery, then lateral to the common carotid artery in the carotid sheath
- before it unites with the subclavian vein posterior to the sternal end of the clavicle it is again enlarged (***Bulbus inferior v. jugularis internae***)

Vertebral vein (*V. vertebralis*)

- formed in the suboccipital triangle by small tributaries from internal vertebral plexuses
- enters the transverse foramen of the atlas
- descends through the successive transverse foramina as a plexus around the vertebral artery
- emerges from the sixth transverse foramen as the vertebral vein
- opens superoposteriorly to the brachiocephalic vein
- a small **accessory vertebral vein** usually passes through the seventh transverse foramen and joins the brachiocephalic vein

Inferior thyroid vein (*V. thyroidea inferior*)

- from the lower part of the *plexus thyroideus impar*
- descends anterior to the trachea to join the brachiocephalic vein
- the right vein may be a tributary of the left brachiocephalic vein or superior vena cava
- ***V. thyroidea ima*** – unpaired, may replace the inferior thyroid veins
- ***V. laryngea inferior*** – may be a tributary of the inferior thyroid vein

VEINS OF THE UPPER LIMB (Table 14)

Vein	First tributaries	Next tributaries
V. cephalica	V. cephalica antebrachii	V. cephalica accessoria V. thoracoacromialis (V. mediana cephalica)
V. basilica	V. basilica antebrachii	V. mediana cubiti (V. mediana basilica)
Vv. brachiales	Vv. radiales Vv. ulnares	Tributaries follow the arterial branches
V. axillaris	V. basilica	Vv. brachiales Vv. thoracoepigastricae V. cephalica Other tributaries follow the arterial branches
V. subclavia	V. axillaris	Vv. pectorales V. scapularis dorsalis (V. jugularis ext.)

Table 14. Veins of the upper limb – survey. Tributaries accompany respective arteries and have names according to the drained regions. Exceptions as well as important details are described in the following text.

Superficial veins of the upper limb (*Vv. superficiales membri superioris*)

– subcutaneous, interconnected with the deep veins

Dorsal digital veins (*Vv. digitales dorsales*)

- unite to form three **dorsal metacarpal veins (*Vv. metacarpales dorsales*)** which form a **dorsal venous network (*Rete venosum dorsale manus*)**
- the network joins laterally dorsal digital veins of the index and thumb to form the cephalic vein and medially the dorsal digital vein of the little finger to drain proximally in the basilic vein

Palmar digital veins (*Vv. digitales palmares*)

- drain to the plexus superficial to the palmar aponeurosis
- connect to dorsal digital veins by **intercapitular veins** passing between metacarpal heads

Cephalic vein (*V. cephalica*)

- starts as the **antebrachial cephalic vein (*V. cephalica antebrachii*)** which curves round the radial side of the forearm to its ventral aspect receiving veins from both aspects
- crosses superficial to the lateral cutaneous nerve of the forearm
- lateral to the biceps
- between the deltoid and pectoralis major
- in the infraclavicular fossa enters the claviopectoral triangle
- passes through the claviopectoral fascia to join the axillary vein

Basilic vein (*V. basilica*)

- starts as the **antebrachial basilic vein (*V. basilica antebrachii*)**
- ascends in the forearm posteromedially, inclines forwards to the elbow
- distal to the elbow receives connection from the cephalic vein, the **cubital median vein (*V. mediana cubiti*)**
- ascends medial to biceps
- passes through the basilic hiatus of the brachial fascia together with the medial cutaneous nerve of forearm
- enters the medial bicipital groove
- at the lower border of the teres major becomes the axillary vein
- venous medication is injected and blood is taken from the venous connections in the cubital fossa

Median vein of forearm (*V. mediana antebrachii*)

- drains the superficial palmar veins
- ascends anteriorly in the forearm to join the basilic or cephalic

Deep veins of the upper limb (*Vv. profundae membri superioris*)

– accompany arteries usually in pairs, connected by short transverse links

Superficial and deep palmar arches (*Arcus palmaris spf. et prof.*)

Radial veins (*Vv. radiales*)

Ulnar veins (*Vv. ulnares*)

Anterior interosseous veins (*Vv. interossee ant.*)

Posterior interosseous veins (*Vv. interossee post.*)

Brachial veins (*Vv. brachiales*)

Axillary vein (*V. axillaris*)

- a continuation of the basilic from the lower border of the teres major
- lies ventral to the axillary artery

Subclavian vein (*V. subclavia*)

- the continuation of the axillary vein (from the first rib)
- joins the internal jugular behind the sternoclavicular joint
- located ventral to the scalenus anterior (does not pass through the *fissura scalenorum*)
- ventral to the cupula pleurae
- behind the subclavius (fused with its fascia)

VEINS OF THE THORAX (Table 15)

Vein	First tributaries	Next tributaries
Vv. thoracicae int.	V. epigastrica sup. V. musculophrenica	Vv. subcutaneae abdominis Vv. intercostales ant.
V. brachiocephalica	V. jugularis interna V. subclavia	V. jugularis externa V. thyroidea inferior (V. thyroidea ima) (V. laryngea inferior) Vv. thymicae Vv. tracheales Vv. oesophageales Vv. mediastinales Vv. bronchiales Vv. pericardicae Vv. pericardiophrenicae V. vertebralis V. cervicalis prof. Vv. thoracicae int. 1 st v. intercostalis post. V. intercostalis sup. sin.
V. azygos	V. lumbalis ascendens dx. V. subcostalis dx.	5 th -11 th vv. intercostales post. dx. V. intercostalis sup. dx. V. hemiazygos Vv. oesophageales Vv. pericardicae Vv. mediastinales Vv. bronchiales Vv. phrenicae sup.
V. hemiazygos	V. lumbalis ascendens sin. V. subcostalis sin.	9 th -11 th vv. intercostales post. sin. V. hemiazygos accessoria Vv. oesophageales Vv. bronchiales Vv. mediastinales
V. hemiazygos accessoria	5 th -8 th vv. intercostales post.	

	sin.	
V. intercostalis sup.	2 nd -4 th vv. intercostales post.	
V. intercostalis post.		R. dorsalis R. spinalis V. intervertebralis
V. cava superior	V. brachiocephalica dx. V. brachiocephalica sin.	V. azygos

Table 15. Veins of the thorax – survey. Tributaries accompany respective arteries and have names according to the drained regions. Exceptions as well as important details are described in the following text.

Internal thoracic veins (*Vv. thoracicae internae*)

- are venae comitantes of the internal thoracic artery
- their tributaries, which accompany branches of the internal thoracic artery, include:
 - the **superior epigastric veins (*Vv. epigastricae superiores*)** that receive also the **subcutaneous veins of the abdomen (*Vv. subcutaneae abdominis*)**
 - the **musculophrenic veins (*Vv. musculophrenicae*)**
 - ***vv. intercostales anteriores***

Brachiocephalic vein (*V. brachiocephalica*)

- arises by the confluence of the internal jugular and subclavian veins (***Angulus venosus***) behind the sternoclavicular joint
- the right lymphatic trunk drains to the right venous angle
- the thoracic duct drains to the left venous angle
- the right brachiocephalic vein is about 3 cm long and descends vertically
- the left brachiocephalic vein is longer (6-7 cm) and descends obliquely posterior to the upper half of the sternum and anterior to branches of the aortic arch to the level of the first right sternocostal joint

Azygos venous system

Azygos system of veins drains the back and thoraco-abdominal wall as well as the mediastinal viscera. It offers alternate means of venous drainage from the lower part of the body when obstruction of the inferior vena cava occurs because it forms a collateral pathway between the superior and inferior vena cava (***Cavo-caval anastomoses***).

Azygos vein (*V. azygos*)

- arises anterior to the twelfth thoracic vertebral body by union of the right ascending lumbar vein and right subcostal vein
- passes through or behind the right crus of the diaphragm or through the aortic hiatus
- ascends in the posterior mediastinum to the level of T4 vertebra
- arches forwards above the right pulmonary hilum to end in the superior vena cava

Hemiazygos vein (*V. hemiazygos*)

- starts on the left like the azygos
- ascends anterior to the vertebral column, passes through the diaphragm
- reaches the level T8
- crosses the column behind the aorta, esophagus and thoracic duct to drain into the azygos

Accessory hemiazygos vein (*V. hemiazygos accessoria*)

- receives posterior intercostal veins from the fifth to eighth intercostal spaces

- anastomosis with the left superior intercostal vein

Superior intercostal vein (*V. intercostalis superior*)

- drains upper 2nd to 4th intercostal spaces
- the left one is a tributary of the left brachiocephalic vein and anastomoses with the accessory hemiazygos inferiorly
- the right one is a tributary of the azygos vein

Posterior intercostal veins (*Vv. intercostales posteriores*)

- 11 pairs
- anastomose with the anterior intercostal veins which are tributaries of the internal thoracic and musculophrenic veins

Superior vena cava (*V. cava superior*)

- brings blood to the heart
- 6 cm long and 2-3 cm in diameter
- arises by a confluence of the right and left brachiocephalic veins at the level of the first right sternocostal joint
- descends in the anterior upper mediastinum
- at the 2nd right sternocostal joint passes through the pericardium
- at the level of the 3rd right sternocostal joint opens to the right atrium
- located to the right from the ascending aorta

VEINS OF THE VERTEBRAL COLUMN

External vertebral venous plexuses (*Plexus venosi vertebrales externi*)

- anterior plexuses are anterior to the vertebral bodies receiving tributaries from them and communicate with basivertebral and intervertebral veins
- posterior plexuses lie posterior to the vertebral laminae and around the vertebral processes and anastomose with the internal plexuses

Internal vertebral venous plexuses (*Plexus venosi vertebrales interni*)

- between the dura mater and vertebrae
- arranged vertically as four interconnecting longitudinal vessels
- connect with the vertebral and occipital veins, sigmoid sinuses and basilar plexus around the foramen magnum
- anterior internal plexuses flank the posterior longitudinal ligament and receive **basivertebral veins (*Vv. basivertebrales*)**
- posterior internal plexuses are in front of the vertebral arches and ligamenta flava

Veins of the spinal cord – see blood supply of the central nervous system

VEINS OF THE LOWER LIMB (Table 16)

Vein	First tributaries	Next tributaries
V. saphena magna	V. marginalis med.	V. saphena accessoria V. epigastrica spf. V. circumflexa ilium spf. Vv. pudendae ext. Vv. dorsales spf. clitoridis (female)

		Vv. dorsales spf. penis (male) Vv. labiales ant. (female) Vv. scrotales ant. (male)
V. saphena parva	V. marginalis lat.	V. femoropoplitea
V. poplitea	Vv. tibiales ant. Vv. tibiales post.	V. saphena parva Other tributaries follow the arterial branches
V. femoralis	V. poplitea	V. saphena magna Other tributaries follow the arterial branches

Table 16. Veins of the lower limb – survey. Tributaries accompany respective arteries and have names according to the drained regions. Exceptions as well as important details are described in the following text.

Superficial veins of the lower limb (*Vv. superficiales membri inferioris*)

- have valves
- numerous tributaries are mostly unnamed

Dorsal digital veins (*Vv. digitales dorsales*)

- join to form **dorsal metatarsal veins (*Vv. metatarsales dorsales*)** that form the **dorsal venous arch (*Arcus venosus dorsalis*)** proximal to which is an irregular **dorsal venous network (*Rete venosum dorsale*)**
- the network joins medially to the medial marginal vein and laterally to the lateral marginal vein

Plantar digital veins (*Vv. digitales plantares*)

- are connected to the dorsal digital veins by the **intercapitular veins (*Vv. intercapitulares*)** in the clefts between the toes
- join to form **plantar metatarsal veins (*Vv. metatarsales plantares*)** which form the **plantar venous arch (*Arcus venosus plantaris*)** and **plantar venous network (*Rete venosum plantare*)**

Dorsal and plantar subcutaneous plexuses constitute:

Medial marginal vein (*V. marginalis medialis*)

- continues as the great saphenous vein

Lateral marginal vein (*V. marginalis lateralis*)

- continues as the small saphenous vein

Great saphenous vein (*V. saphena magna*)

- the longest vein of the body, often duplicated, especially distal to the knee
- ascends on the crus about 3 cm ventral to the medial ankle
- along the medial border of the tibia
- accompanied by the saphenous nerve
- medial aspect of the thigh
- ventromedially to the saphenous opening (*Hiatus saphenus*) of the fascia lata
- opens into the femoral vein

Small saphenous vein (*V. saphena parva*)

- begins posterior to the lateral malleolus
- ascends at the dorsal side of the calf

- lies near the sural nerve
- passes through the crural fascia
- passes between both heads of the gastrocnemius
- enters the popliteal vein, but may join the great saphenous, which may be its main continuation

Deep veins of the lower limb (*Vv. profundae membri inferioris*)

- have numerous valves
- accompany arteries and their branches

Deep plantar arch (*Arcus venosus plantaris profundus*)

- receives **plantar metatarsal veins (*Vv. metatarsae plantares*)**

Medial plantar vein (*V. plantaris medialis*)

Lateral plantar vein (*V. plantaris lateralis*)

Posterior tibial veins (*V. tibiales posteriores*)

Fibular veins (*V. fibulares*)

Anterior tibial veins (*V. tibiales anteriores*)

Popliteal vein (*V. poplitea*)

- superficial to the popliteal artery

Femoral vein (*V. femoralis*)

- receives the **deep femoral vein (*V. profunda femoris*)** with tributaries accompanying arteries

Superficial veins are connected with the deep ones by the perforating veins (*Vv. perforantes*). Normally blood flows from the superficial veins through the perforators to the deep venous system. Some valves of the perforating veins may become incompetent with age. The superficial veins are overfilled, blood flows from the deep to the superficial veins that enlarge to form varicose veins (visible and palpable under the skin because veins are swollen and twisted). Chronic venous insufficiency can lead to ulceration in some patients. Varicose veins affect 20–30% of adults. If the deep system is functional, the superficial veins may be removed.

VEINS OF THE ABDOMEN AND PELVIS (Table 17)

Vein	First tributaries	Next tributaries
V. iliaca externa	V. femoralis	V. epigastrica inf. V. circumflexa ilium prof.
V. iliaca interna		Vv. gluteae sup. Vv. gluteae inf. Vv. obturatoriae Vv. sacrales lat. Vv. rectales mediae Vv. vesicales Plexus venosus prostaticus (male) Plexus venosus vaginalis (female) Vv. uterinae (female) V. pudenda int. Vv. scrotales post. (male) Vv. labiales post. (female) V. bulbi penis (male)

		V. bulbi vestibuli (female)
V. pudenda int.	Vv. profundae penis (male) Vv. profundae clitoridis (female)	Vv. rectales inf.
V. iliaca communis	V. iliaca ext. V. iliaca int.	V. sacralis mediana V. iliolumbalis
V. cava inf.	V. iliaca communis dx. V. iliaca communis sin.	<u>Parietal tributaries:</u> Vv, lumbales Vv. phrenicae inf. <u>Visceral tributaries:</u> V. testicularis dx. (male) V. ovarica dx. (female) Vv. renales V. suprarenalis dx. Vv. hepaticae
V. renalis	Vv. capsulares Vv. intrarenales	V. testicularis sin. (male) V. ovarica sin. (female) V. suprarenalis sin.

Table 17. Veins of the abdomen and pelvis – survey. Tributaries accompany respective arteries and have names according to the drained regions. Exceptions as well as important details are described in the following text.

External iliac vein (*V. iliaca externa*)

- a continuation of the femoral vein
- begins in the vascular lacuna where it lies medial to the artery
- the right vein ascends behind the artery, the left one lies medial to the artery
- crossed by the ureter and internal iliac artery
- in males crossed by the ductus deferens, in female by the round ligament of uterus and ovarian vessels
- its tributary **inferior epigastric vein (*V. epigastrica inferior*)** receives the pubic branch that connects to the pubic branch of the obturator vein and may replace this vein

Internal iliac vein (*V. iliaca interna*)

- posteromedial to the internal iliac artery
- receives veins from venous plexuses of pelvic viscera and tributaries following the branches of the internal iliac artery
- all veins converge superiorly in the great sciatic foramen
- the lateral sacral veins are interconnected by a **sacral venous plexus (*Plexus venosus sacralis*)**
- the **rectal venous plexus (*Plexus venosus rectalis*)** has the internal part (in the submucosa) that drains mainly to the superior rectal vein, a tributary of the portal vein, and the external part (outside the muscular layer) that drains mainly to the middle and inferior rectal veins. Both parts are interconnected through the musculature. The external/perirectal plexus communicates with the vesical and uterovaginal/prostatic plexuses.
- the **vesical veins (*Vv. vesicales*)** drain the **vesical venous plexus (*Plexus venosus vesicalis*)** that surrounds the lower bladder, in males communicates with the prostatic plexus, in females with the vaginal plexus
- the **prostatic venous plexus (*Plexus venosus prostaticus*)** receives the **deep dorsal vein of penis (*V. dorsalis profunda penis*)**
- the **vaginal venous plexus (*Plexus venosus vaginalis*)** receives the **deep dorsal**

vein of clitoris (*V. dorsalis profunda clitoridis*)

- the **uterine veins (*Vv. uterinae*)** drain the **uterine venous plexus (*Plexus venosus uterinus*)** that anastomoses with the ovarian and vaginal plexuses
- the **pubdental vein (*V. pudenda interna*)** connects to the prostatic venous plexus

Common iliac vein (*V. iliaca communis*)

- a paired vein arising ventral to the sacroiliac joint by union of the external and internal iliac veins
- the left vein is longer because it reaches over the midline
- the left vein lies medial to the artery, the right vein is lateral or posterior to the artery
- they have no valves
- the **median sacral vein (*V. sacralis mediana*)** is a tributary of the left common iliac

Inferior vena cava (*V. cava inferior*)

- a large vein without valves that collects blood from the lower half of the body
- begins at the right side of the body of L5 vertebra by union of the right and left common iliac veins
- ascends in the retroperitoneal space
- lies behind the liver where (*Sulcus v. cavae inferioris*)
- passes through centrum tendineum of the diaphragm (*Foramen v. cavae inferioris*)
- pierces the pericardium above the diaphragm
- opens into the right atrium of the heart
- the **lumbar veins (*Vv. lumbales*)** – 4 pairs, from the posterior abdominal wall, they are connected to the ascending lumbar vein (*V. lumbalis ascendens*) – a longitudinal vein passing anterior to lumbar costal processes, which joins the common iliac vein inferiorly, and the subcostal vein superiorly to form the azygos vein (right)/hemiazygos vein (left).
- the **right testicular vein (*V. testicularis dextra*)** begins as the **pampiniform plexus (*Plexus pampiniformis*)** at the dorsal side of the testis and epididymis and passes in the spermatic cord
- the **right ovarian vein (*V. ovarica dextra*)** arises from the **ovarian plexus (*Plexus venosus ovaricus*)** that lies between the ovary and uterine tube and communicates with the uterine plexus
- the **renal veins (*Vv. renales*)** lie anterior to renal arteries, the left vein lies ventral to the aorta and is three times the right in length
- the **hepatic veins (*Vv. hepaticae*)** open into the inferior vena cava in its groove on the posterior hepatic surface

Hepatic portal system (Table 18)

The portal system drains the abdominal part of the esophagus, stomach, intestine, spleen, pancreas, and gallbladder. The portal vein conveys this blood to the liver where ramifies, ending in sinusoids of hepatic lobules. Blood then converges to reach the inferior vena cava by the hepatic veins.

Vein	First tributaries	Next tributaries
V. portae	V. mesenterica sup. V. splenica	V. cystica V. gastrica dx. V. gastrica sin.
V. mesenterica sup.	V. colica media V. colica dx.	

	V. ileocolica V. jejunaes et ileales Vv. pancreaticoduodenales inf. Vv. pancreaticae V. gastromentalis dx.	
V. splenica	Vv. splenicar/lienales	Vv. gastricae breves V. gastromentalis dx. Vv. pancreaticae V. mesenterica inf.
V. mesenterica inf.	V. rectalis sup.	Vv, sigmoideae V. colica sin.

Table 8. Portal vein

Hepatic portal vein (*Vena portae hepatis*)

- about 8 cm long and 1 - 2 cm in diameter
- arises behind the head of the pancreas (L2) by union of the superior mesenteric vein and splenic vein
- ascends behind the superior part of the duodenum and inclines right
- passes in the hepatoduodenal ligament of the lesser omentum (behind the bile duct and the hepatic artery)
- enters the porta hepatis where it divides into the right and left branches for the corresponding lobes

Superior mesenteric vein (*V. mesenterica superior*)

- begins in the right iliac fossa
- ascends in the mesentery on the right of the superior mesenteric artery
- the ileocolic vein receives the **appendicular vein (*Vv. appendicularis*)**

Splenic vein (*V. splenica/lienalis*)

- from the spleen, runs behind the pancreas below the splenic artery

Inferior mesenteric vein (*V. mesenterica inferior*)

- may be a direct tributary of the portal vein, ascends left of its artery, behind the duodenojejunal flexure

Portal-caval/Portal-systemic anastomoses

- are connections between areas drained by the portal vein and *vv. cavae*. In case of portal vein hypertension (when pressure in the portal vein rises), e.g., due to cirrhosis of the liver, part of the portal venous blood flow will bypass the liver via these portal-caval anastomoses, and they become prominent as varicose veins.

1. *Vv. gastricae* – *vv. oesophageae* – submucosal esophageal veins enlarge in esophageal varices that may bleed in a life-threatening fashion.

2. Connections around the umbilicus – paraumbilical veins running in the round ligament of the liver connect the portal vein with the subcutaneous veins of the anterior abdominal wall. The enlarged veins around the umbilicus are visible through the skin and this condition is referred to as **caput Medusae**.

Burrow's veins connect the venous plexus of the urinary bladder with the paraumbilical veins.

3. *Plexus rectalis* – submucosal and perirectal plexuses anastomose through the musculature. Veins of the rectal plexuses may become varicose not only due to the portal hypertension, varicose veins result in hemorrhoids that may prolapse from the anal canal and bleed.

5. Retzius' veins: connections between the splenic and mesenteric veins to the retroperitoneal tributaries of the inferior vena cava (*vv. renales, lumbales*).
6. Connections between hepatic veins and the phrenic veins – in the bare area of the liver.

Fetal circulation

The fetus receives oxygen and nutrients from the maternal blood into which it returns CO₂ and waste products of metabolism. All materials are exchanged in the placenta but the maternal and fetal blood do not mix. Blood from the placenta flows to the fetus through the **v. umbilicalis** and then flows by two directions:

- 1) through the **ductus venosus** directly into the inferior vena cava (IVC).
- 2) through the connection to the portal vein and hepatic circulation

Oxygenated blood blends with the deoxygenated blood from the lower part of the fetal body in the IVC. The *valvula v. cavae inf.* of the right atrium directs blood from the IVC to the left atrium through the opened *foramen ovale*, while blood from the superior vena cava (SVC) enters the right ventricle. Blood rich to oxygen flows from the left ventricle into the aorta and its branches to supply the upper part of the body. Deoxygenated blood from the right ventricle flows to the pulmonary trunk but most of it passes by the lungs (because of their collapse before birth) through the **ductus arteriosus**, which connects the pulmonary trunk to the aortic arch. From the junction of the aorta with the **ductus arteriosus** blood is poor to oxygen and thus the lower part of the body is delayed in development in contrast to the upper part. Most of blood from the descending aorta is conveyed through the internal iliac and then umbilical arteries to the placenta for oxygenation.

After birth, when the newborn baby takes its first breath, lungs expand with air and pressure in the right heart falls below that in the left heart. The umbilical cord is ligated, umbilical vessels obliterate. Umbilical vein changes to the **round ligament of the liver (Lig. teres hepatis)**, ductus venosus to the **venous ligament (Lig. venosum)**, umbilical arteries are occluded (**Chorda a. umbilicalis**), foramen ovale is closed, ductus arteriosus transforms in the **arterious ligament (Lig. arteriosum)**. When some connection persists, cyanotic diseases may occur.