

ARTERIES (*ARTERIAE*)

Arteries carry blood from the heart. Arteries have firm and elastic walls adapted to hits of blood ejected from the heart. The pressure wave dilates the vascular wall and it is palpated as a pulse. During systole blood is ejected from the left ventricle into the aorta. Having traversed numerous successive branchings of the aorta, the blood eventually enters a capillary bed in the tissues. There are many progressive changes in the structural and functional properties of arteries with increasing distance from the heart. The largest are elastic arteries, smaller are muscular arteries, the smallest arterioles continue to capillaries. However, lining the interior of the whole system from the finest capillaries up to and including heart is a smooth, continuous single-layered endothelium.

In the **systemic circulation** arteries carry oxygenated blood and veins carry deoxygenated blood. In the **pulmonary circulation** deoxygenated blood flows through the arteries into lungs and oxygenated through the veins to the heart. The arterial branches accompanying the main trunk are called **collaterals**. The collaterals may be important during the blockage of the main artery by a thrombus to ensure blood supply of an organ. Branches of various arteries may be connected by **anastomoses** that allow overrunning of blood between adjacent regions. Anastomoses may be missing or functionally insufficient in some organs (heart, retina, and kidney). Arteries that have no or very small anastomoses are termed as **terminal arteries**.

Pulmonary trunk (*Truncus pulmonalis*)

- arises from the right ventricle
- ascends towards the aortic arch below which divides into the right and left pulmonary arteries

Right pulmonary artery (*A. pulmonalis dx.*)

- behind the ascending aorta and superior vena cava
- enters the hilum of the right lung below the right bronchus

Left pulmonary artery (*A. pulmonalis sin.*)

- connected to the inferior margin of the aortic arch by the **ligamentum arteriosum** (the remnant of the ductus arteriosus from the fetal period)
- enters the left hilum above the left bronchus

Both arteries accompany the bronchial tree in the lungs to capillary plexuses which surround alveoli where exchange of gasses takes place. Two pulmonary veins leave each lung in the hilum and enter the left atrium. They convey oxygenated blood to the left half of the heart.

Aorta (*Aorta*; Fig. 42; Table 2)

- the largest and longest artery of the human body
- emerges from the left ventricle
- distributes blood to all organs and tissues of the body
- has 3 segments:

Ascending aorta (*Aorta ascendens*)

- 3-5 cm long
- passes through the pericardium from the level of the 3rd right sternocostal junction to the level of the 2nd right sternocostal junction where it fluently continues to the aortic arch
- first located behind the pulmonary trunk, then on its right side
- **bulbus aortae** – widening at the origin formed by aortic sinuses

Aortic arch (*Arcus aortae*; Fig. 43)

- from the 2nd right sternocostal junction obliquely backwards to the left side of T3 vertebra

- the convexity of the arch is oriented upwards, the uppermost point reaches the level of the 1st right sternocostal junction
- located first anterior to the tracheal bifurcation, then it runs above the left pulmonary root and then it apposes to the left side of the oesophagus
- gives off 3 branches that supply the head, neck and upper limbs – the **brachiocephalic trunk**, the **left common carotid artery** and **left subclavian artery**

Descending aorta (*Aorta descendens*)

- continuation of the aortic arch
- descends in the thoracic cavity (*Aorta thoracica*) and in the abdominal cavity (*Aorta abdominalis*)
- ends at the level of the L4 vertebra dividing into the **common iliac arteries**

Artery	Branches
Truncus pulmonalis	A. pulmonalis dx.
	A. pulmonalis sin.
Aorta ascendens	A. coronaria dx.
	A. coronaria sin.
Arcus aortae	Truncus brachiocephalicus
	A. carotis communis sin.
	A. subclavia sin.
Aorta thoracica	Rr. bronchiales
	Rr. oesophageales
	Rr. pericardiaci
	Rr. mediastinales
	Aa. phrenicae sup.
	Aa. intercostales post.
	Aa. subcostales
Aorta abdominalis	Aa. phrenicae inf.
	Aa. lumbales
	Truncus coeliacus
	A. mesenterica sup
	A. mesenterica inf.
	Aa. suprarenales mediae
	Aa. renales
	Aa. testiculares/ovaricae
	Aa. iliacae communes
	A. sacralis mediana

Table 2. Pulmonary trunk and aorta - survey

Brachiocephalic trunk (*Truncus brachiocephalicus*)

- the largest and first branch of the aortic arch
- supplies the right half of the head and neck and the right upper extremity
- arises from the right part of the aortic arch
- ascends behind the manubrium of sternum to the right sternoclavicular joint where it divides into the **right common carotid** and **right subclavian arteries**

Common carotid artery (*A. carotis communis*)

- supplies the head and upper part of the neck

- the left artery (a direct branch of the aortic arch) is 4 cm longer than the right one, which is a branch of the brachiocephalic trunk
- ascends lateral to the trachea and larynx
- behind the lobe of the thyroid gland
- covered by the sternocleidomastoid and omohyoid caudally
- in the carotid triangle covered only by the platysma and superficial layer of the cervical fascia (its pulse easily palpated here)
- posteriorly related to anterior tubercles of the cervical transverse processes, there is possible compression of the artery by the push against the C6 anterior tubercle (*Tuberculum caroticum*)
- accompanied by the internal jugular vein (laterally) and vagus nerve (posteriorly), all enclosed in the common connective tissue sheath (*Vagina carotica*)
- divides into the **external** and **internal carotid arteries** at the level of the upper margin of the thyroid cartilage (*Bifurcatio carotidis*)
- a chemoreceptor that informs about the amount of oxygen in flowing blood (*Glomus caroticum*) is located in the carotid bifurcation

External carotid artery (*A. carotis externa*; Table 3)

- supplies the upper half of the neck and head, except the brain, orbit and inner ear
- extends from the carotid triangle to the temporomandibular joint
- medial to the stylohyoid and posterior belly of the digastric muscle
- enters the submandibular triangle where is crossed by the facial, lingual, and superior thyroid veins, and the hypoglossal nerve
- then enters the retromandibular fossa, where it passes through the parenchyma of the parotid gland
- lies lateral to the wall of the pharynx, and ventral to the styloid septum
- gives off ventral, lateral, dorsal, medial and terminal branches

Artery	Primary branches	Secondary branches
<i>A. carotis ext.</i>		
Ventral branches:	<i>A. thyroidea sup.</i>	<i>R. infrahyoideus</i>
		<i>R. sternocleidomastoideus</i>
		<i>A. laryngea sup.</i>
		<i>R. cricothyroideus</i>
		<i>R. glandularis ant., post., lat.</i>
	<i>A. lingualis</i>	<i>R. suprahyoideus</i>
		<i>Rr. dorsales linguae</i>
		<i>A. sublingualis</i>
		<i>A. profunda linguae</i>
	<i>A. facialis</i>	<i>A. palatina ascendens</i>
		<i>R. tonsillaris</i>
		<i>A. submentalis</i>
		<i>Rr. glandulares</i>
		<i>A. labialis inf.</i>
		<i>A. labialis sup.</i>
		<i>R. lateralis nasi</i>
		<i>A. angularis</i>
Lateral branch:	<i>A. sternocleidomastoidea</i>	
Dorsal branches:	<i>A. occipitalis</i>	<i>R. mastoideus</i>

		R. auricularis
		Rr. sternocleidomastoidei
		Rr. occipitales
		R. descendens
	A. auricularis post.	A. stylomastoidea
		A. tympanica post.
		R. auricularis
		R. occipitalis
Medial branch:	A. pharyngea ascendens	Rr. pharyngeales
		A. tympanica inf.
		A. meningea post.
Terminal branches:	A. temporalis superficialis	Rr. parotidei
		A. transversa faciei
		A. zygomaticoorbitalis
		Rr. auriculares ant.
		A. temporalis media
		R. frontalis et r. parietalis
	A. maxillaris	(see below)

Table 3. External carotid artery – branches (some details explained in the following text)

Superior thyroid artery (*A. thyroidea superior*)

- arises just above the carotid bifurcation
- runs ventrocaudally to the thyroid gland
- supplies the larynx, adjacent muscles, and superior part of the thyroid gland anastomosing with branches of the inferior thyroid

Lingual artery (*A. lingualis*)

- arises at the level of the hyoid bone
- runs to the medial side of hyoglossus
- then directs between the hyoglossus and genioglossus toward the apex of the tongue
- the **sublingual artery** runs forward below the sublingual gland, supplies the gland, the muscles and mucosa of the mouth floor
- the **deep lingual artery** is the terminal branch of the lingual that enters the tongue and supplies its muscles

Facial artery (*A. facialis*)

- arises at the level of the mandibular angle
- enters the submandibular triangle
- passes below or through the submandibular gland
- at the anterior margin of the masseter turns over the mandible to the face (here may be compressed in order to stop bleeding in the face)
- then directs towards the mouth angle, nasal wing and medial angle of the eye
- the **ascending palatine artery** supplies the pharynx, isthmus faucium, palate and auditory tube. It anastomoses with descending palatine artery.
- the **tonsillar branch** supplies the palatine tonsil
- the **submental artery** runs below the mylohyoid towards the chin, supplies suprahyoid muscles
- **glandular branches** supply the submandibular gland
- **superior and inferior labial arteries** anastomose with their fellows to form the **inferior and superior labial arches (*Arcus labialis sup. et inf.*)**, that constitute the circuit around the mouth (*Circulus arteriosus oris*)
- the **lateral nasal branch** supplies the wing of the nose

- the **angular artery** supplies the medial angle of the eye, anastomoses with the ophthalmic and infraorbital arteries

The ventral branches of the external carotid artery may form common trunks (*Truncus thyro-lingualis* or *tr. linguo-facialis* or *tr. thyro-linguo-facialis*)

Sternocleidomastoid artery (*A. sternocleidomastoidea*)

- descends backwards over the hypoglossal nerve and internal jugular vein
- enters the sternocleidomastoid
- may be a branch of the occipital artery

Occipital artery (*A. occipitalis*)

- arises opposite the facial artery
- directs dorsocranially along the posterior belly of the digastric to the scalp in the occipital region
- the **mastoid branch** runs through the foramen mastoideum to the cranial cavity
- the **auricular branch** supplies the medial surface of the auricle
- the **descending branch** descends deep to the splenius, anastomosing with the transverse cervical artery (the superficial branch), and between the semispinales capitis and cervicis, anastomosing with both the vertebral and the deep cervical artery (the deep branch)

Posterior auricular artery (*A. auricularis posterior*)

- arises above the mandibular angle
- directs along the posterior belly of the digastric to the auricle
- the **stylomastoid artery** passes through the stylomastoid foramen to the facial canal to enter the cranial cavity
- the **posterior tympanic artery** supplies the tympanic cavity and mastoid cells

Ascending pharyngeal artery (*A. pharyngea ascendens*)

- arises at the same level as the lingual artery
- ascends at the pharyngeal wall to the skull base
- the **inferior tympanic artery** passes through the tympanic canal to the tympanic cavity
- the **posterior meningeal artery** passes through the jugular foramen to the posterior cranial fossa and gives off branches for its dura mater

Superficial temporal artery (*A. temporalis superficialis*)

- begins behind the mandibular neck
 - passes through the parotid gland
 - then ascends superficial to the temporal fascia and anterior to the auricle to the temporal region
 - the **transverse facial artery** accompanies the parotid duct to the face
 - the **zygomatiko-orbital artery** goes to the lateral angle of the eye
 - **anterior auricular branches** are for the mandibular joint, external acusticus meatus and the lateral side of the auricle
 - the **middle temporal artery** passes through the temporal fascia to the temporalis muscle
 - the **frontal and parietal branch** for the scalp in the frontal and parietal regions
- When the artery runs over the zygomatic arch it may be palpated and compressed.

Maxillary artery (*A. maxillaris*; Table 4)

Artery	Primary branches	Secondary branches
A. maxillaris		
<i>Pars mandibularis:</i>	A. auricularis prof.	
	A. tympanica ant.	
	A. meningea media	A. tympanica sup.
		R. frontalis, r. parietalis et r. orbitalis

	A. alveolaris inf.	R. mylohyoideus
		Rr. dentales et rr. peridentales
		R. mentalis
<i>Pars pterygoidea:</i>	A. masseterica	
	Aa. temporales prof.	
	Rr. pterygoidei	
	A. buccalis	
<i>Pars pterygopalatina:</i>	A. alveolaris sup. post.	Rr. dentales et rr. peridentales
	A. infraorbitalis	Aa. alveolares sup. anteriores (Rr. dentales et rr. peridentales)
	A. palatina descendens	A. palatina major
		Aa. palatinae minores
	A. canalis pterygoidei	
	A. sphenopalatina	Aa. nasales posteriores laterales et septi

Table 4. Maxillary artery - segments and their branches (some details explained in the following text)

Maxillary artery

- runs medial to the mandibular neck (*Pars mandibularis*)
- then through the infratemporal fossa (*Pars pterygoidea*)
- then enters the pterygopalatine fossa (*Pars pterygopalatina*)
- the **anterior tympanic artery** passes through the petrotympanic fissure to the tympanic cavity
- the **middle meningeal artery** passes through the foramen spinosum to the middle cranial fossa, its branches supply the tympanic cavity, dura mater and skull bones
- the **inferior alveolar artery** supplies the mylohyoid muscle, teeth and gingiva of the lower jaw, and mental region.
- branches of the **pterygoid part** supply mainly masticatory muscles
- the **posterior superior alveolar artery** passes through alveolar foramina of the maxillary tuberosity for upper molars
- the **infraorbital artery** passes through the inferior orbital fissure to the infraorbital sulcus and canal, where it gives off branches for upper premolars, canine, and incisors and enters the face
- the **descending palatine artery** gives off the **greater palatine artery** for the hard palate and **lesser palatine artery** for the soft palate
- the **artery of pterygoid canal** runs to the nasal part of the pharynx
- the **sphenopalatine artery** supplies the dorsal part of the nasal cavity

Internal carotid artery (*A. carotis interna*; Table 5)

Artery	Primary branches	Secondary branches
A. carotis int.		
<i>Pars petrosa:</i>	Aa. caroticotympanicae	
<i>Pars cavernosa:</i>	R. sinus cavernosi	
	R. meningeus	
	A. hypophysialis inf.	
<i>Pars cerebralis:</i>	A. ophthalmica	A. centralis retinae
		A. lacrimalis
		R. meningeus recurrens

		Aa. ciliares posteriores
		Aa. musculares
		A. supraorbitalis
		A. ethmoidalis post.
		A. ethmoidalis ant.
		Aa. palpebrales med.
		A. supratrochlearis
		A. dorsalis nasi
	A. hypophysialis sup.	
	A. communicans post.	
	R. meningeus	
	A. choroidea ant.	
	A. cerebri ant. et media	(for more see blood supply of the central nervous system)

Table 5. Internal carotid artery - segments and their branches (some details explained in the following text)

Internal carotid artery

- supplies most of the brain and the contents of the orbit
- its widened origin (**Sinus caroticus**) contains numerous baroreceptors (register changes of the tension of the vascular wall)
- the **cervical part** ascends first dorsally and laterally from the external carotid artery, then through the retrostyloid space to the skull base (separated from the external carotid artery by the styloid septum), this part has no branches
- the **petrosal part** enters the external opening of carotid canal and runs through the carotid canal
- the **cavernous part** passes through the cavernous sinus, where is sigmoidally curved, convex first medially and then laterally – the **carotid syphon (Siphon caroticum)**
- the **cerebral part** is on the base of the brain
- **caroticotympanic arteries** pass through the caroticotympanic canals to the tympanic cavity
- the **cavernous branch** supplies the trigeminal ganglion and nerves passing through the cavernous sinus
- the **meningeal branch** for the dura mater of the anterior cranial fossa
- the **ophthalmic artery** supplies the orbital region, sphenoid and ethmoid sinuses, dura mater of the anterior cranial fossa, anterior part of the nasal cavity, scalp in the frontal region and anastomoses with the branches of the facial and infraorbital arteries (for more see the visual system)

Arteries of the cerebral part supply the bigger anterior part of the brain.

Subclavian artery (*A. subclavia*; Table 6)

- the left artery (a direct branch of the aortic arch) is 4 cm longer than the right one which is a branch of the brachiocephalic trunk
- runs over the dome of pleura and produces an impression on the apex of the lung (the first/intrasclenic part)
- enters the fissura scalenorum (the second/intersclenic part)
- goes below the clavicle (the third/extrasclenic part)
- at the lateral border of the clavicle it becomes the **axillary artery**

Artery	Primary branches	Secondary branches
A. subclavia	A. vertebralis	Rr. spinales

		Rr. musculares
		Rr. meningei
		A. spinalis post.
		A. spinalis ant.
		A. inferior posterior cerebelli
		A. basilaris (for more see blood supply of the central nervous system)
	A. thoracica int.	Rr. mediastinales
		Rr. thymici
		Rr. tracheales
		Rr. bronchiales
		Rr. sternales
		A. pericardiophrenica
		Rr. perforantes
		Rr. intercostales anteriores
		A. musculophrenica
		A. epigastrica sup.
	Truncus thyrocervicalis	A. thyroidea inf.
		A. cervicalis ascendens
		A. suprascapularis
		A. cervicalis spf.
		A. transversa colli
	Truncus costocervicalis	A. cervicalis profunda
		A. intercostalis suprema

Table 6. Subclavian artery - branches (some details explained in the following text)

Vertebral artery (*A. vertebralis*)

- arises from the first part of the subclavian artery
- directs cranially, enters the transverse foramen of the C6 vertebra and passes through transverse foramina of upper cervical vertebrae
- after leaving the transverse foramen of the atlas it lies in the groove for the vertebral artery of the atlas, then it penetrates the posterior atlantooccipital membrane
- enters the skull through the foramen magnum
- supplies the cervical spinal cord and meninges and deep cervical muscles
- supplies meninges of the posterior cranial fossa
- the **posterior spinal artery** descends to the posterolateral groove of the spinal cord
- the **anterior spinal artery** descends to the anterior median fissure of the spinal cord
- the **posterior inferior cerebellar artery** supplies the inferior surface of the cerebellum
- the **basilar artery** arises by union of both vertebral arteries at the inferior border of the pons, supplies the inner ear and posterior part of the brain

Internal thoracic artery (*A. thoracica interna*)

- arises from the lower side of the first part of the subclavian artery
- descends in a distance about 1 cm from the border of the sternum
- at the level of the 6th and 7th costal cartilages divides into its terminal branches
- the **pericardiophrenic artery** arises below the superior thoracic aperture, gives off branches for the pericardium and diaphragm
- **perforating branches** pierce the anterior thoracic wall and give off **medial mammary branches**
- **anterior intercostal branches** supply 6 cranial intercostal spaces and anastomose with

- posterior intercostal arteries
- the **musculophrenic artery** – a terminal branch which passes laterally at the circumference of the diaphragm and gives off **anterior intercostal branches** for 5 caudal intercostal spaces
- the **superior epigastric artery** – the other terminal branch, penetrates the diaphragm in the sternocostal triangle, passes at the posterior surface of the rectus abdominis, supplies it, anastomoses with the inferior epigastric artery at the level of the umbilicus

Thyrocervical trunk (*Truncus thyrocervicalis*)

- arises from the first part of the subclavian artery
- a short trunk directing cranially
- the **inferior thyroid artery** runs first cranially, and then turns medially and caudally towards the thyroid gland (important relation to the recurrent laryngeal nerve). It gives off inferior laryngeal artery, pharyngeal, oesophageal, thymic, and tracheal branches for corresponding organs.
- the **ascending cervical artery** ascends on the anterior tubercles of the cervical transverse processes, supplies the surrounding muscles
- the **suprascapular artery** runs transversally towards the superior border of the scapula, enters the supraspinous fossa over the transverse ligament of the scapula, enters the infraspinous fossa where it anastomoses with the scapular circumflex artery, supplies the supraspinatus and infraspinatus
- the **transverse cervical artery** passes through the scalenus anterior to the trapezius, gives off the **superficial branch/superficial cervical artery** for trapezius and levator scapulae (dividing into the ascending and descending branches) and **deep branch/ dorsal scapular artery** for trapezius and rhomboids

Costocervical trunk (*Truncus costocervicalis*)

- arises from the second part of the subclavian artery
- directs dorsally towards the neck of the 1st rib
- the **deep cervical artery** passes between the C7 vertebra and neck of the 1st rib, ascends between the semispinalis capitis and cervicis, supplies the adjacent muscles
- the **supreme intercostal artery** gives off **posterior intercostal arteries** for two upper intercostal spaces

Arteries of the upper limb (Table 7)

Artery	Primary branches	Secondary branches
A. axillaris	Rr. subscapulares	
	A. thoracica superior	
	A. thoracoacromialis	R. acromialis
		R. deltoideus
		Rr. pectorales
	A. thoracica lateralis	Rr. mammarii lat.
	A. subscapularis	A. circumflexa scapulae
		A. thoracodorsalis
	A. circumflexa humeri ant.	
	A. circumflexa humeri post.	
A. brachialis	A. profunda brachii	R. deltoideus
		Aa. nutriciae humeri
		A. collateralis media
		A. collateralis radialis
	A. collateralis ulnaris sup.	

	A. collateralis ulnaris inf.	
	A. radialis	
	A. ulnaris	
A. radialis	A. recurrens radialis	
	A. nutricia radii	
	R. carpalis palmaris	
	R. palmaris superficialis	
	R. carpalis dorsalis	Aa. metacarpales dorsales
	A. metacarpalis dorsalis prima	
	A. princeps pollicis	
	A. radialis indicis	
	Arcus palmaris profundus	Aa. metacarpales palmares
		Rr. perforantes
A. ulnaris	A. recurrens ulnaris	
	A. interossea communis	A. interossea anterior
		A. interossea posterior
	R. carpalis palmaris	
	R. carpalis dorsalis	
	R. palmaris profundus	
	Arcus palmaris superficialis	
Arcus palmaris spf.	3 aa. digitales palmares communes	2 aa. digitales palmares propriae
		A. palmaris digiti quinti ulnaris

Table 7. Arteries of the upper limb (some details explained in the following text)

Axillary artery (*A. axillaris*)

- a continuation of the subclavian artery in the axilla
- extends from the lateral margin of the 1st rib to the lower border of the pectoralis major
- the **superior thoracic artery** supplies pectoral muscles
- the **thoracoacromial artery** enters the deltoideopectoral triangle and gives off branches for the acromial anastomosis, the deltoid and pectoral muscles
- the **lateral thoracic artery** descends at the lateral side of the serratus anterior, supplies it and gives off branches for the mammary gland
- the **subscapular artery** divides into the **scapular circumflex artery**, which traverses the triangular space (*Foramen omotricipitale*) and anastomoses with the suprascapular artery in the infraspinous fossa, and the **thoracodorsal artery**, which supplies the latissimus dorsi
- the **anterior humeral circumflex artery** is a thin branch that runs horizontally anterior to the surgical neck of the humerus, supplies the shoulder joint and anastomoses with the **posterior circumflex humeral artery**, which runs through the quadrangular space (*Foramen humerotricipitale*) and supplies the shoulder joint, deltoid, teres major and minor, long and lateral heads of triceps

Brachial artery (*A. brachialis*)

- a continuation of the axillary artery
- from the lower margin of the pectoralis major to the cubital fossa
- runs in the medial bicipitalis groove
- in the cubital fossa divides into terminal branches – the **radial and ulnar arteries**
- the **profunda brachii artery** accompanies the radial nerve in the groove for radial nerve and reaches the cubital region, supplies the deltoid, humerus, and ends in the *rete articulare*

cubiti

- the **superior ulnar collateral artery** arises from the brachial artery in the halfway of the arm, accompanies the ulnar nerve, descends first on the anterior side of the medial intermuscular septum, then pierces the septum to its dorsal side, and ends in the *rete articulare cubiti*
- the **inferior ulnar collateral artery** arises from the brachial artery proximal to the cubital fossa, gives off branches for surrounding muscles, ends in the *rete articulare cubiti*

Radial artery (*A. radialis*)

- arises behind the bicipital aponeurosis
- descends between the pronator teres and brachioradialis
- distally between the brachioradialis and flexor carpi radialis
- at the level of the wrist passes beneath the tendon of extensor pollicis brevis
- enters the anatomical snuff box (*Foveola radialis*)
- beneath the tendon of extensor pollicis longus enters the dorsum of the hand
- penetrates through the first dorsal interosseus muscle to the palm
- gives off muscular branches for the surrounding muscles
- the **superficial palmar branch** arises at the distal end of the forearm, runs through the thenar muscles which it supplies, beneath the palmar aponeurosis anastomoses with the superficial palmar arch of the ulnar artery
- the **first dorsal metacarpal artery** arises from the radial artery on the dorsum of the hand and supplies the dorsal side of the thumb and radial side of the index
- the **princeps pollicis artery** arises in the palm, supplies the palmar side of the thumb
- the **radialis indicis artery** for the radial part of the index from the palmar side
- the **deep palmar arch** (Fig. 44) the terminal branch, which anastomoses with the deep palmar branch of the ulnar, lies in the palm at the bases of the 2nd to 4th metacarpal bones between the interosseous muscles and tendons of flexors and gives off three **palmar metacarpal arteries** that join the common digital branches of the superficial arch
- the **perforating branches** pass through interosseous muscles to dorsal metacarpal arteries

Ulnar artery (*A. ulnaris*)

- runs underneath the common origin of flexors
- descends at the ulnar margin of the forearm to the hand
- is located between the flexor digitorum profundus and superficialis
- distally between tendons of the flexor carpi ulnaris and flexor digitorum superficialis
- accompanies the ulnar nerve
- enters the palm over the flexor retinaculum
- the **anterior interosseous artery** descends on the anterior side of the interosseous membrane between the flexor pollicis longus and flexor digitorum profundus, proximal to the pronator quadratus pierces the interosseous membrane and ends in the dorsal carpal arch, it gives off the **median artery**
- the **posterior interosseous artery** pierces the interosseous membrane in its proximal part, descends between the deep and superficial groups of extensors, gives off the **recurrent interosseous** for the cubital anastomosis
- the **deep palmar branch** penetrates muscles of the hypothenar, anastomoses with the deep palmar arch of the radial
- the **superficial palmar arch** (Fig. 44) enters the palm anterior to the flexor retinaculum, between tendons of flexors and the palmar aponeurosis, anastomoses with the superficial palmar branch of the radial, lies approximately anterior to the halfway of the metacarpal bones, its three **common palmar digital arteries** give off **proper palmar digital arteries**

that supply adjacent sides of 2nd to 5th fingers

Arterial plexuses of the upper limb

Cubital anastomosis (*Rete articulare cubiti*) is located around the elbow joint.

Tributaries:

- the middle and radial collateral of the deep brachial artery
- the superior and inferior ulnar collateral of the brachial artery
- the radial recurrent of the radial artery
- the ulnar recurrent of the ulnar artery
- the recurrent interosseous of the posterior interosseous artery

Palmar carpal arch (*Rete carpale palmare*) lies on the palmar side of the wrist behind the tendons of flexor digitorum profundus and supplies the carpal articulations and joints.

Tributaries:

- palmar carpal branches of the radial and ulnar arteries
- branches of the anterior interosseous artery
- branches of the deep palmar arch

Dorsal carpal arch (*Rete carpale dorsale*) lies on the dorsal side of the carpal dorsum under the extensor tendons

Tributaries:

- dorsal carpal branches of the radial and ulnar arteries
- terminal branches from the anterior and posterior interosseous artery

This plexus sends three **dorsal metacarpal arteries**, each divides into two **dorsal digital arteries** to supply dorsal sides of the 2nd to 5th fingers.

Thoracic aorta (*Aorta thoracica*; Table 8)

- in the dorsal mediastinum
- descends from the left side of T3 to the level of T11-12
- leaves the thoracic cavity through the aortic hiatus of the diaphragm to continue as the abdominal aorta
- first descends at the left side of the thoracic vertebral column and oesophagus, more caudally descends between the oesophagus and the vertebral column
- gives off paired parietal branches for the thoracic wall and visceral branches for mediastinal organs

Artery	Primary branches	Secondary branches
Aorta thoracica		
Parietal branches:	Aa. intercostales post.	R. dorsalis
		R. collateralis
		R. cutaneus lat.
	Aa. subcostales	R. dorsalis
	Aa. phrenicae sup.	
Visceral branches:	Rr. bronchiales	
	Rr. oesophageales	
	Rr. pericardiaci	
	Rr. mediastinales	

Table 8. Thoracic aorta – branches (some details explained in the following text)

- the **posterior intercostal arteries** (9 pairs) for the 3rd to 11th intercostal spaces run in the costal groove, first at the inner side of external intercostal muscles, then between internal and innermost intercostals, anastomose with anterior intercostal branches from the internal thoracic and musculophrenic arteries
- the **dorsal branch** of the posterior intercostal artery supplies the skin and muscles of the back, vertebrae, spinal cord and meninges
- the **collateral branch** of the posterior intercostal arises near the costal angle, runs at the upper margin of the subjacent rib
- the **lateral cutaneous** of the posterior intercostal artery supplies the skin of the thorax, it gives off also **lateral mammary branches** for the breast
- the **subcostal arteries** are below the twelfth ribs, enter the abdomen behind the lateral arcuate ligaments, anastomose with the superior epigastric, posterior intercostal and lumbar arteries
- the **superior phrenic arteries** supply the cranial surface of the diaphragm

Abdominal aorta (*Aorta abdominalis*; Table 9)

- from the aortic hiatus to the level of L4 where it divides into the **right** and **left common iliac arteries (*Bifurcatio aortae*)**
- its continuation is the **median sacral artery**, which descends to the apex of the coccyx and terminates there by a ball of the arteriovenous anastomosis (***Glomus coccygeum***); it gives off **arteriae lumbales imae** and **sacral branches** that anastomose with the lateral sacral arteries
- located retroperitoneally
- on the left side of the inferior vena cava
- anteriorly related to the left renal vein, pancreas, duodenum and root of mesentery
- parietal branches of the abdominal aorta are paired
- visceral branches are either paired or unpaired

Artery	Primary branches	Secondary branches
Aorta abdominalis		
Parietal branches:	Aa. phrenicae inf.	A. suprarenalis sup.
	Aa. lumbales	R. dorsalis
Paired visceral branches:	Aa. suprarenales mediae	
	Aa. renales	A. suprarenalis inf.
		R. uretericus
		R. anterior
		R. posterior
	A. testiculares (male)	Rr. ureterici
	A. ovarica (female)	Rr. ureterici
		Rr. tubarii
Unpaired visceral branches:	Truncus coeliacus	
	A. mesenterica sup.	
	A. mesenterica inf.	
Terminal branches:	Aa. iliacae communes	
	A. sacralis mediana	
Tr. coeliacus	A. gastrica sin.	Rr. oesophageales
		Rr. gastrici
	A. splenica	Rr. pancreatici
		A. gastromentalis

		sin.
		Aa. gastricae breves
		Rr. splenici
		A. gastrica post.
	A. hepatica communis	A. hepatica propria
		A. gastroduodenalis
A. gastroduodenalis	A. gastromentalis dx.	
	A. pancreaticoduodenalis sup. ant.	
	A. pancreaticoduodenalis sup. post.	
	Aa. retroduodenales	
A. mesenterica sup.	A. pancreaticoduodenalis inf.	R. anterior
		R. posterior
	10 – 18 aa. jejunaes et ileales	
	A. ileocolica	R. ilealis
		R. colicus
		R. appendicularis
	A. colica dx.	
	A. colica media	
A. mesenterica inf.	A. colica sin.	
	Aa. sigmoideae	
	A. rectalis sup.	

Table 9. Abdominal aorta – branches (some details explained in the following text)

Abdominal aorta

- the **inferior phrenic arteries** supply the caudal surface of the diaphragm and upper part of the adrenal glands
- the **lumbar arteries** are four paired segmental branches that run at the bodies of lumbar vertebrae and behind the psoas major to the lateral abdominal wall; each gives off the **dorsal branch** that supplies the dorsal muscles, skin and spinal cord
- the **renal arteries** arise at the level of L1 or L2; each runs laterally over the psoas major and enters the hilum of the kidney; the right is longer than the left one; the **anterior branch** runs between the renal vein and pelvis and divides into four segmental branches; the **posterior branch** passes behind the renal pelvis and continues as the posterior segmental artery
- the **accessory renal arteries** often arise from the aorta or some other neighboring artery (25%), they may enter the kidney at any site of the renal surface and may be the cause of complications during surgery of kidneys
- the male **testicularis arteries** arise at the level of L2; each descends on the psoas major, enters the pelvis anterior to the common or external iliac vessels, then passes through the inguinal canal as the component of the spermatic cord and supplies the testis and epididymis
- the female **ovarian arteries** descend to the pelvis; each reaches the ovary through the suspensory ligament of ovary and anastomoses with the ovarian branch of uterine artery

Coeliac trunk (*Truncus coeliacus*; Fig. 45)

- arises from the anterior side of the aorta at the level of T12-L1
- is short (1-2 cm) and thick
- the **left gastric artery** runs at the dorsal wall of the omental bursa along the upper border of the pancreas to the gastric cardia and lower part of the esophagus and continues along the lesser curvature of the stomach where anastomoses with the right gastric artery
- the **splenic/lienal artery** runs to the left along the upper margin of the pancreas

- the left **gastroepiploic artery** arises from the splenic near the hilum of spleen, and gives off branches through the gastrosplenic ligament to the proximal part of the greater curvature and to the greater omentum
- the posterior **gastric artery** ascends behind the omental bursa to the gastric fundus to supply the posterior wall of stomach
- the **hepatic artery proper** runs to the porta hepatis in the hepatoduodenal ligament; it gives off the **right gastric artery**, which descends in the lesser omentum to the pyloric end of the stomach, and the **right** and **left branches** for hepatic lobes
- the **cystic artery** for the gallbladder is commonly a branch of the right hepatic branch
- **accessory hepatic arteries** are usually from the superior mesenteric or left gastric artery
- the **gastrooduodenal artery** descends behind the pylorus
- **superior pancreaticoduodenal arteries** descend between the head of the pancreas and the descending part of the duodenum and anastomose with branches of the inferior pancreaticoduodenal artery

Superior mesenteric artery (*A. mesenterica superior*)

- arises from the aorta at the level of L1
- enters the mesentery at the lower border of the pancreas
- forms the arch convex to the left
- ends in the right iliac fossa
- **jejunal** and **ileal arteries** arise from the convex side of the superior mesenteric, jejunal are longer and form 1-2 arcades, ileal are shorter and form 3-4 arcades
- the **right colic artery** for the ascending colon
- the **middle colic artery** enters the transverse mesocolon, supplies the transverse colon

Inferior mesenteric artery (*A. mesenterica inferior*)

- arises from the aorta at the level of L2-3
 - descends retroperitoneally to the left side
 - the **left colic artery** for the descending colon
 - the **superior rectal artery** anastomoses with the sigmoidal arteries and middle rectal artery
- Branches for the large intestine form also arcades but not so branched as at the small intestine.

Right and left common iliac artery (*A. iliaca communis dextra et sinistra*)

- arise at the level of L4
- each descends at the medial surface of the psoas major
- the right artery is longer than the left one and crosses the left common iliac vein anteriorly
- each divides into the internal and external iliac arteries anterior to the sacroiliac joint

Arteries of the pelvis (Table 10)

Artery	Primary branches	Secondary branches
A. iliaca int.	A. iliolumbalis	R. iliacus
		R. lumbalis
		R. sacralis
	2 aa. sacrales laterales	Rr. spinales
	A. obturatoria	R. pubicus
		R. anterior
		R. posterior
	A. glutea superior	R. superficialis
		R. profundus
	A. glutea inferior	A. commitans n. ischiadici
	A. umbilicalis	Aa. vesicales superiores
		A. ductus deferentis(male)

		Rr. ureterici
	A. vesicalis inferior	
	A. vaginalis (female)	
	A. rectalis media	Rr. vaginales (female)
		Rr. prostatici (male)
	A. uterina (female)	Rr. helicini
		Rr. vaginales
		R. tubarius
		R. ovaricus
	A. pudenda interna	A. rectalis inf.
		A. perinealis
		A. urethralis (male)
		Rr. scrotales posteriores (male)
		Rr. labiales posteriores (female)
		A. bulbi penis (male)
		A. bulbi vestibuli (female)
		A. dorsalis penis (male)
		A. dorsalis clitoridis (female)
		A. profunda penis (male)
		A. profunda clitoridis (female)
		Aa. perforantes penis (male)
A. iliaca ext.	A. epigastrica inferior	R. pubicus
		A. cremasterica (male)
		A. ligamenti teretis (female)
	A. circumflexa ilium profunda	

Table 10. Arteries of the pelvis (some details explained in the following text)

Internal iliac artery (*A. iliaca interna*)

- supplies the wall and organs of the lesser pelvis
- the **iliolumbar artery** supplies the iliacus, psoas major, quadratus lumborum and sacral canal
- **lateral sacral arteries** run medial to the pelvic sacral foramina and anastomose with the middle sacral artery
- the **obturator artery** gives off the **pubic branch**, which anastomoses with the pubic branch of the inferior epigastric artery (*Corona mortis*), then passes through the obturator canal to supply adductors (the **anterior branch**) and muscles attached to the ischial tuberosity (the **posterior branch**). The posterior branch gives off the **acetabular branch** that enters the hip joint and if small in infants it may result in constrained supply of the developing femoral head.
- the **superior gluteal artery** supplies the gluteus maximus and medius (the **superficial branch**) and gluteus medius and minimus (the **deep branch**)
- the **inferior gluteal artery** supplies the gluteus maximus and gives off the artery for the sciatic nerve
- the **umbilical artery** carries blood from the fetus to the placenta. After birth it obliterates nearly completely to form the **cord of the umbilical artery** (*Pars occlusa*) but the beginning segment of the artery remains patent (*Pars patens*). It supplies the fundus of the urinary bladder, lower portion of the ureter and ductus deferens (in male).
- the **inferior vesical artery** supplies the lower part of the urinary bladder, in male also the seminal vesicle and prostate

- the **vaginal artery** (in female) – branches to the vagina, vestibular bulb, fundus of bladder and adjacent part of the rectum
- the **middle rectal artery** supplies the middle part of the rectum, vagina (in female) and prostate (in male), and anastomoses with the superior and inferior rectal arteries
- the **uterine artery** (in female) runs in the broad ligament of the uterus to the cervix of uterus, crosses the ureter from above (2 cm lateral to the cervix and 1.5 cm above the vaginal fornix), its **helicine branches** enter the uterine muscle and have tortuous course
- the **internal pudendal artery** passes through the *foramen infrapiriforme* and then through the greater sciatic foramen, enters the ischioanal fossa where passes through the pudendal canal (*Canalis pudendalis, Alcock*), then it proceeds below or above the perineal membrane to end behind the inferior pubic ligament dividing into the deep and dorsal arteries of the penis/clitoris.

External iliac artery (*A. iliaca ext.*)

- thicker than the internal iliac artery
- directs ventrally along the medial border of the psoas major
- passes through *lacuna vasorum* (lateral to the vein)
- the **inferior epigastric artery** ascends in the interfoveolar ligament to the dorsal side of the rectus abdominis, raises the peritoneal lateral umbilical fold, and anastomoses with the superior epigastric artery
- the **deep iliac circumflex artery** directs along the inguinal ligament towards the anterior superior iliac spine

Arteries of the lower limb (Table 11)

Artery	Primary branches	Secondary branches
A. femoralis	A. epigastrica superficialis	
	A. circumflexa ilium superficialis	
	A. pudenda externa superficialis	
	A. pudenda externa profunda	Rr. scrotales anteriores (male)
		Rr. labiales anteriores (female)
		Rr. inguinales
	A. profunda femoris	
	A. descendens genus	R. saphenus
		Rr. articulares
A. profunda femoris	A. circumflexa femoris medialis	R. superficialis
		R. profundus
		R. acetabularis
	A. circumflexa femoris lateralis	R. ascendens
		R. descendens
		R. transversus
	A. perforans prima	A. nutricia femoris sup.
	A. perforans secunda	
	A. perforans tertia	A. nutricia femoris inf.
A. poplitea	Aa. surales	
	A. superior lateralis genus	
	A. superior medialis genus	
	A. media genus	
	A. inferior lateralis genus	

	A. inferior medialis genus	
	A. tibialis anterior	
	A. tibialis posterior	
A. tibialis anterior	A. recurrens tibialis posterior	
	A. recurrens tibialis anterior	
	A. malleolaris anterior medialis	
	A. malleolaris anterior lateralis	
A. dorsalis pedis	Aa. tarsales mediales	
	A. tarsalis lateralis	
	A. arcuata	3 aa. metatarsales dorsales
		A. digitalis dorsalis V.
	A. metatarsalis dorsalis prima	Aa. digitales dorsales
	A. plantaris profunda	
A. tibialis posterior	R. circumflexus fibularis	
	A. fibularis	A. nutricia fibulae
		R. communicans
		R. perforans
		Rr. malleolares laterales
		Rr. calcanei
	A. nutricia tibiae	
	Rr. malleolares mediales	
	Rr. calcanei	
	A. plantaris medialis	R. profundus
		R. superficialis
	A. plantaris lateralis	
A. plantaris lateralis	Arcus plantaris profundus	4 aa. metatarsales plantares
A. metatarsae plantaris	R. perforans	
	A. digitalis plantaris communis	2 aa. digitales plantares propriae

Table 11. Arteries of the lower limb (some details explained in the following text)

Femoral artery (*A. femoralis*)

- a continuation of the external iliac artery
- starts behind the middle part of the inguinal ligament
- descends medially in the femoral triangle
- covered by the sartorius
- then through the adductor canal
- ends at the adductor hiatus (Hunter's canal)
- the **superficial epigastric artery** traverses the cribriform fascia and ascends in the subcutaneous tissue of the anterior abdominal wall
- the **superficial iliac circumflex artery** enters the subcutaneous tissue below the inguinal ligament and directs to the anterior superior iliac spine
- the **external pudendal arteries** supply the lower abdominal, perineal, penile, scrotal or labial skin, anastomosing with branches of the internal pudendal
- the **deep femoral artery** arises 3-5 cm below the inguinal ligament, descends behind the femoral artery, enters the dorsal side of the thigh between the adductor longus and magnus; its **medial femoral circumflex artery** supplies adductors and flexors of the thigh and the hip joint, its **lateral circumflex femoral artery** forms the anastomotic ring around the femoral neck with the gluteal arteries and the medial circumflex artery (supplies head and

- neck of the femur), and the **cruciate anastomosis** with the medial circumflex, inferior gluteal, and first perforating artery
- all **perforating arteries** supply posterior compartment of the thigh. They have ascending and descending branches, which interconnect to form a longitudinal channel on the posterior side of the femur. Superiorly it anastomoses with the circumflex arteries and inferiorly with the popliteal artery.
 - the **descending genicular artery** arises in the adductor canal, descends on the medial side of the knee joint, supplies the adductor magnus, vastus medialis, knee joint, and proximomedial area of the leg

Popliteal artery (*A. poplitea*)

- the continuation of the femoral
- from the adductor hiatus to the distal border of the popliteus
- inclines laterally
- the deepest structure in the popliteal fossa (deep to the vein and nerve)
- at the proximal end of the crural interosseous space divides into terminal branches – the anterior and posterior tibial arteries
- the **sural arteries** supply the gastrocnemius, soleus and plantaris
- the **superior and inferior genicular arteries** end in the *rete articulare genus*
- the **middle genicular artery** supplies the cruciate ligaments and synovial membrane of the knee joint

Anterior tibial artery (*A. tibialis anterior*)

- pierces the crural interosseous membrane to the ventral side of the crus
- descends between the tibialis anterior and extensor digitorum longus
- distally between the tibialis anterior and extensor hallucis longus
- at the ankle it is midway between the malleoli
- the **posterior tibial recurrent artery** arises before the anterior tibial artery penetrates through the interosseous membrane, ends in the *rete articulare genus*
- the **anterior tibial recurrent artery** arises after the anterior tibial artery pierces the membrane, ends in the genicular anastomosis

Dorsal artery of foot (*A. dorsalis pedis*)

- the continuation of the anterior tibial artery distal to the ankle
- runs medially along the dorsum to the proximal end of the first intermetatarsal space
- enters the sole between the heads of the first dorsal interosseous muscle
- the **medial tarsal arteries** (2-3) supply the medial margin of the foot
- the **lateral tarsal artery** runs under the extensor hallucis brevis and extensor digitorum brevis to the lateral margin of the foot, anastomoses with the arcuate artery
- the **arcuate artery** arises above the base of the 2nd metatarsal bone, directs laterally over the metatarsal bases deep to the tendons of digital extensors to form the arch convex distally, each of its dorsal **metatarsal arteries** divides into 2 **dorsal digital arteries** for adjacent sides of the 2nd to 5th toes
- the **first dorsal metatarsal artery** divides into **dorsal digital** for both sides of the big toe and the medial margin of the 2nd toe
- the **deep plantar artery** runs through the first interosseous fissure to the sole and anastomoses with the the lateral plantar artery

Posterior tibial artery (*A. tibialis posterior*)

- the continuation of the popliteal artery

- supplies the posterior and lateral compartments of the leg
- runs under the *arcus tendineus m. solei*
- descends on the deep flexors covered by the deep layer of the crural fascia
- runs behind the medial malleolus deep to the flexor retinaculum
- enters the sole where it divides into its terminal branches – medial and lateral plantar arteries
- the **fibular circumflex branch** directs laterally round the fibular neck to the *rete articulare genus*
- the **fibular artery** runs laterally parallel to the posterior tibial artery, enters the musculofibular canal (between the fibula and flexor hallucis longus), ends at the level of the lateral malleolus; its **communicating branch** anastomoses with the posterior tibial artery at the level of ankles, its **perforating branch** passes between the distal ends of the tibia and fibula to the arteries of dorsum of the foot

Lateral plantar artery (*A. plantaris lateralis*)

- runs distally and laterally between the flexor digitorum brevis and quadratus plantae
- below the base of the 5th metatarsal bone it continues to the **deep plantar arch**, which is convex distally and runs between the metatarsals and oblique head of the adductor hallucis to the 1st interosseous space where it anastomoses with the deep plantar artery of the dorsalis pedis and with the deep branch of the medial plantar artery
- each **plantar metatarsal artery** gives off the **perforating branch**, which connects to the dorsal metatarsal artery, and **common plantar digital artery** that divides into two **plantar digital proper arteries** for adjoining sides of the 1st to the 5th toes (the medial side of the big toe and the lateral side of the little toe are supplied by the direct branches from the arch)

Medial plantar artery (*A. plantaris medialis*)

- thinner than the lateral plantar artery
- runs between the abductor hallucis and flexor digitorum brevis
- supplies the medial side of the foot

Arterial plexuses of the lower limb

Genicular anastomosis (*Rete articulare genus*)

Tributaries:

- the descending genicular artery of the femoral artery
- the medial and lateral superior genicular arteries of the popliteal artery
- the medial and lateral inferior genicular arteries of the popliteal artery
- the fibular circumflex artery of the posterior tibial artery
- the posterior and anterior tibial recurrent arteries of the anterior tibial artery

Medial malleolar network (*Rete malleolare mediale*)

Tributaries:

- the medial anterior malleolar artery of the anterior tibial artery
- medial malleolar branches of the posterior tibial artery
- calcaneal branches of the posterior tibial artery
- medial tarsal arteries of the dorsal artery of foot
- branches of the medial plantar artery

Lateral malleolar network (*Rete malleolare laterale*)

Tributaries:

- the lateral anterior malleolar artery of the anterior tibial artery
- lateral malleolar branches of the fibular artery
- the perforating branch of the fibular artery
- branches of the lateral tarsal artery of the dorsal artery of foot
- branches of the lateral plantar artery

Calcaneal anastomosis (*Rete calcaneum*)

Tributaries:

- calcaneal branches of the posterior tibial artery
- calcaneal branches of the fibular artery
- branches of the lateral plantar artery