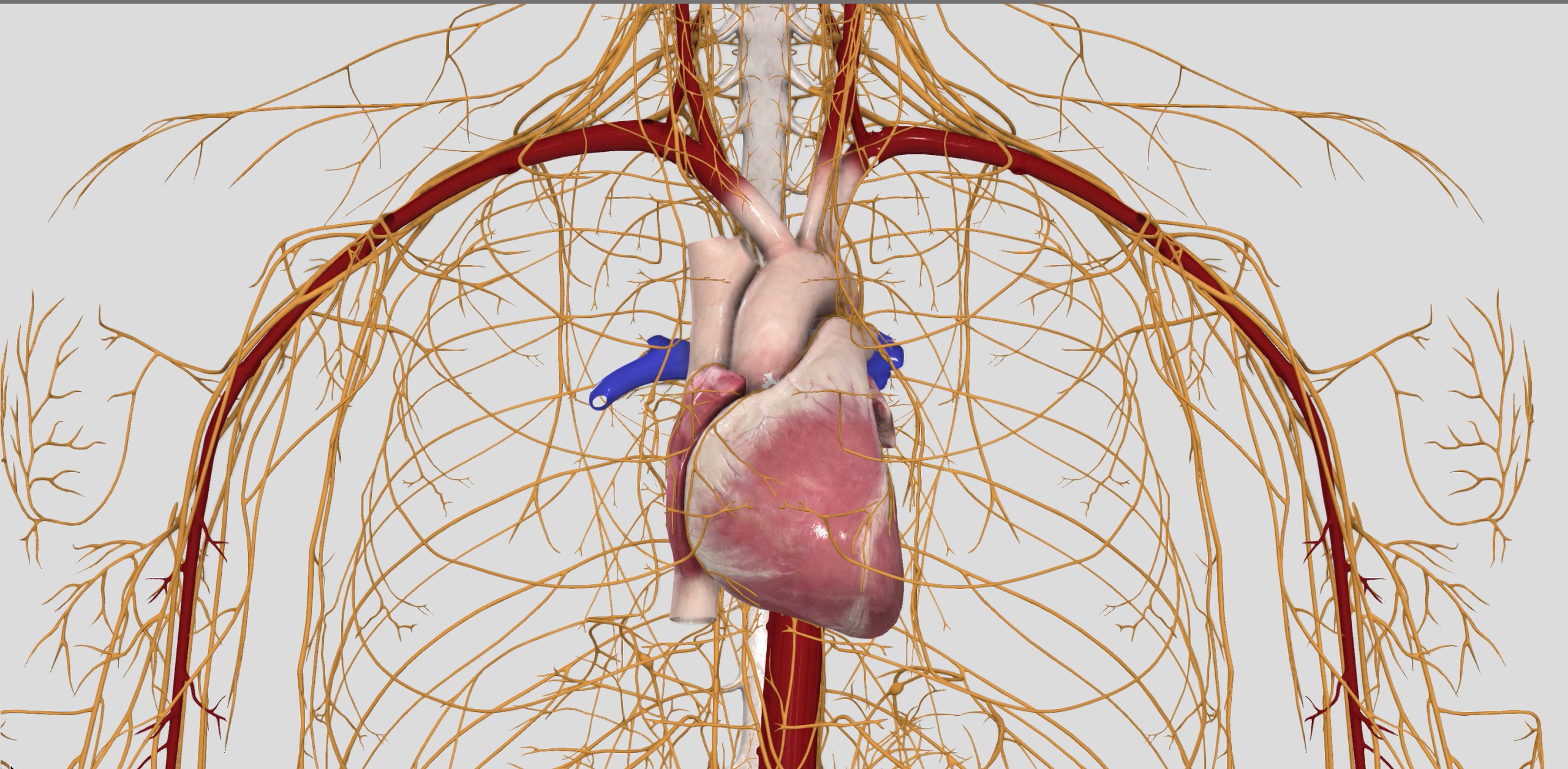
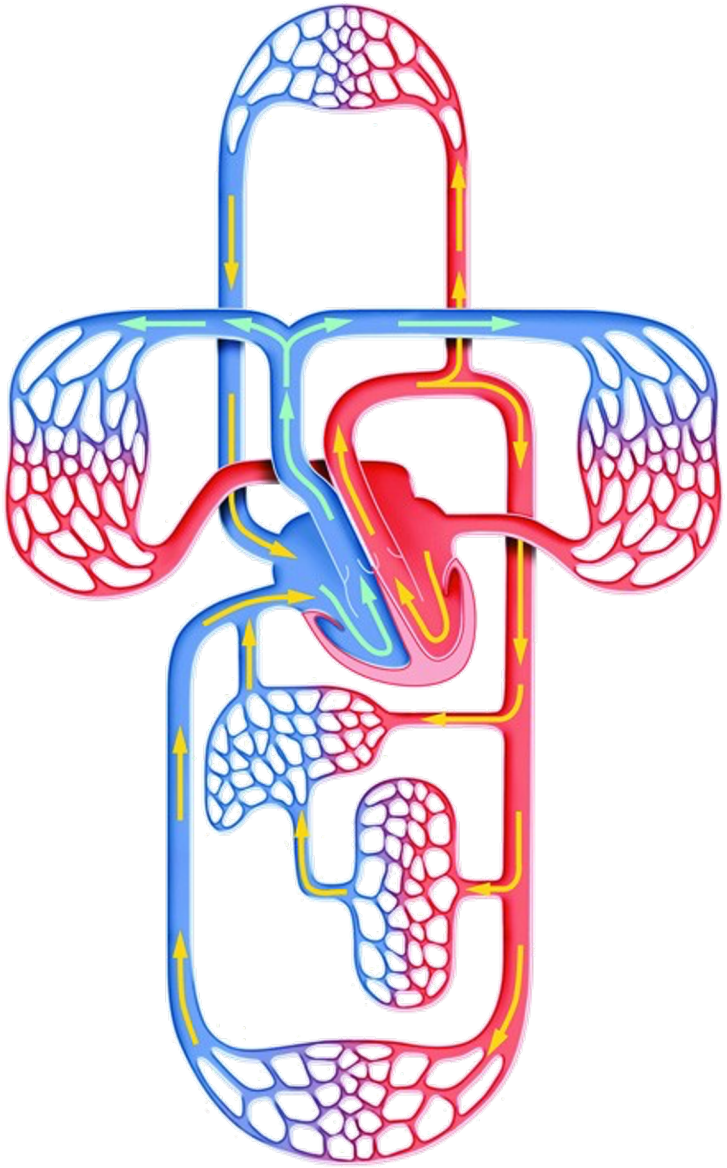
General Anatomy 2



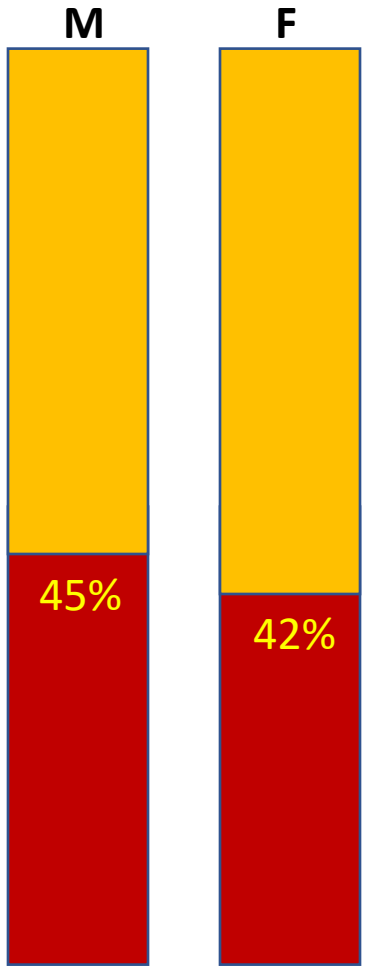
Body fluids and their circulation

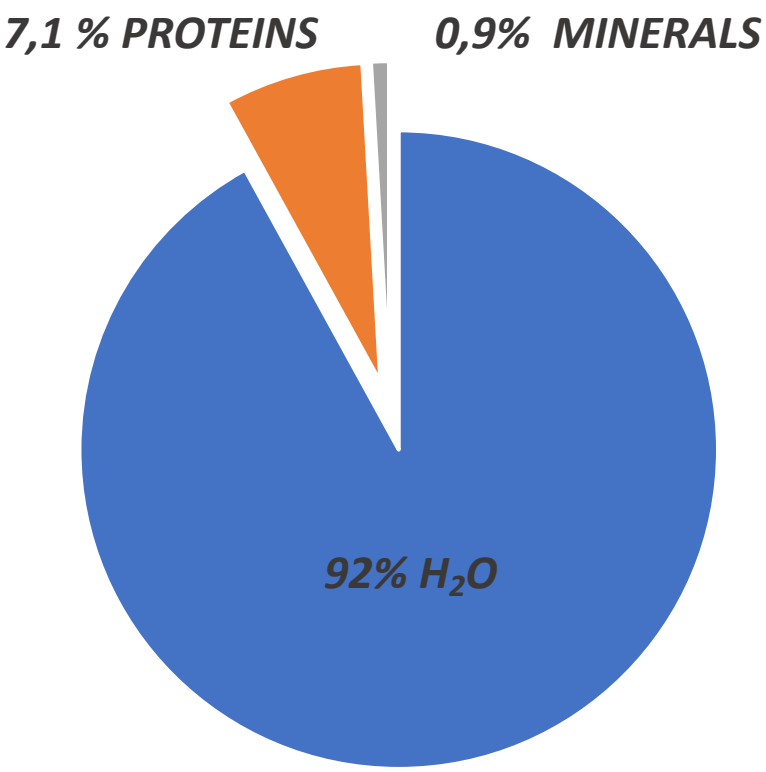
- **Blood – sanguis**
  - *Circulation in closed system*
  - *Blood elements (corpuscles)*
  - *Blood plasma*
- **Lymph**
  - *Taken from intercellular space*
  - *Flows through the lympatic system*
  - *Inflow into blood systém into venous angles*
- **Function of the circulation**
  - *Transportation*
  - *Body termoregulation*
  - *Turgor of tissues*



Blood – sanguis

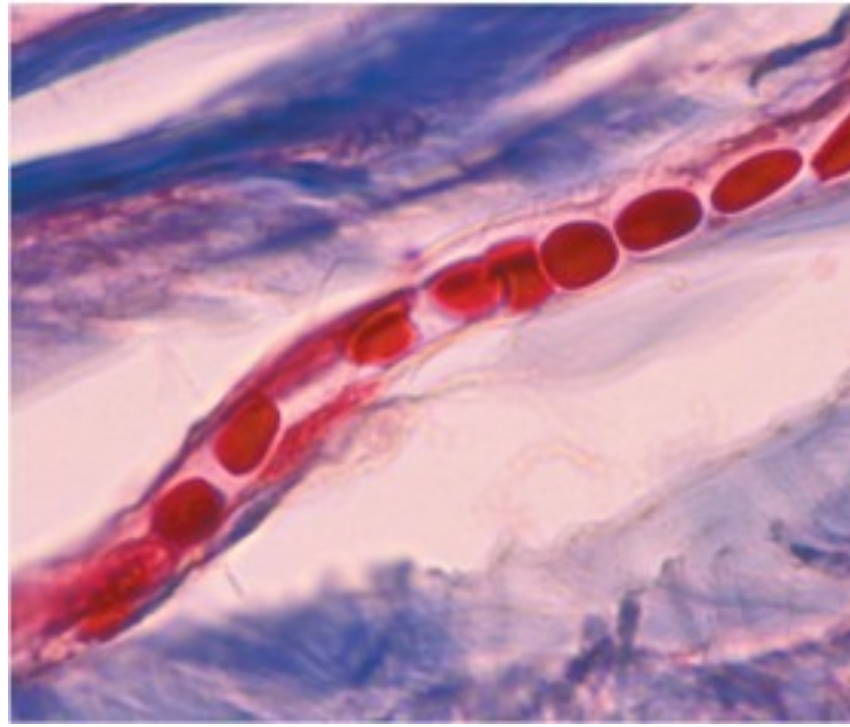
- **blood**
  - *5 liters, 6 % of body weight*
- **corpuscula sanguinis – blood cells**
  - *males* *44-46 %*
  - *females* *41-42 %*
- **plasma**
  - ***H_2O*** ***92 %***
  - ***proteins*** ***7,1 %***
    - *albumins* *4,1 %*
    - *globulins* *2,7 %*
    - *fibrinogen* *0,27 %*
  - ***elektrolytes (salts)*** ***0,9 %***
  - ***rest*** ***0,0…1 %***
- ***Blood serum – plasma without fibrinogen***





Corpuscula sanguinis – blood corpuscles

- **erythrocytes** — **4,3 – 5,3 x 10^6 / 1 mm^3**
  - *7,2 x 2,5* µm
- **leucocytes** — **4,0 – 10,0 x 10^3 / 1 mm^3**
  1. *Neutrophilic granulocytes* — *60 – 70 %*
  2. *Eosinophilic granulocytes* — *3 -5 %*
  3. *Basophilic granulocytes* — *0,5 -1 %*
  4. *Lymphocytes* — *15 – 40%*
  5. *Monocytes* — *5 %*
- **thrombocytes** — **150 - 400 x 10^3 / 1 mm^3**



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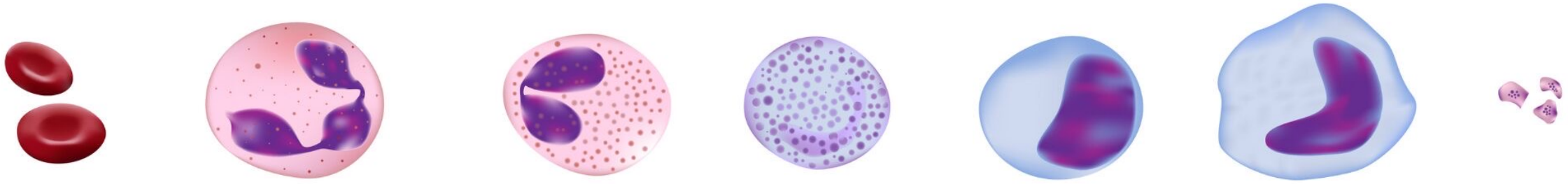


Bone marrow– medulla ossium

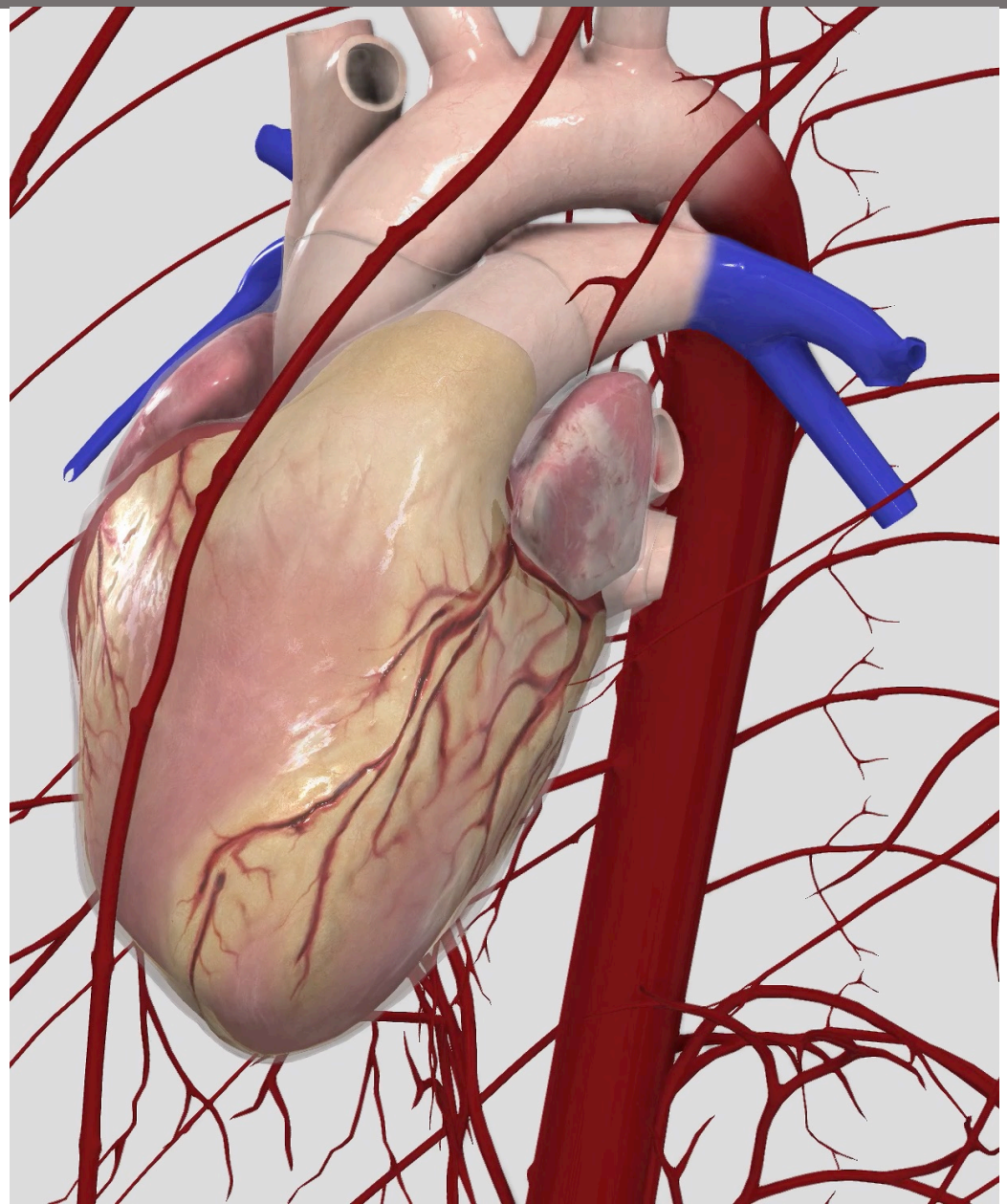
- **Hematopoetic bone marrow**
  - **Blood cellse prescursores**
  - **megakaryocytes**
  - **Wide capillaries - sinusoids**
  - *Red, ywéllow, grey bone marrow*
- **Newborn**
- **Adult**
- **Activation of hematopoesis**
  - *Increased needs of cell creation*
- **Eextramedullary hematopoesis**
  - **liver**
  - **spleen**
  - **retroperitoneum**

https://open.oregonstate.education/aandp/chapter/6-1-the-functions-of-the-skeletal-system/

Active red bone marrow in adolescency – ^{18}F-FLT-PET

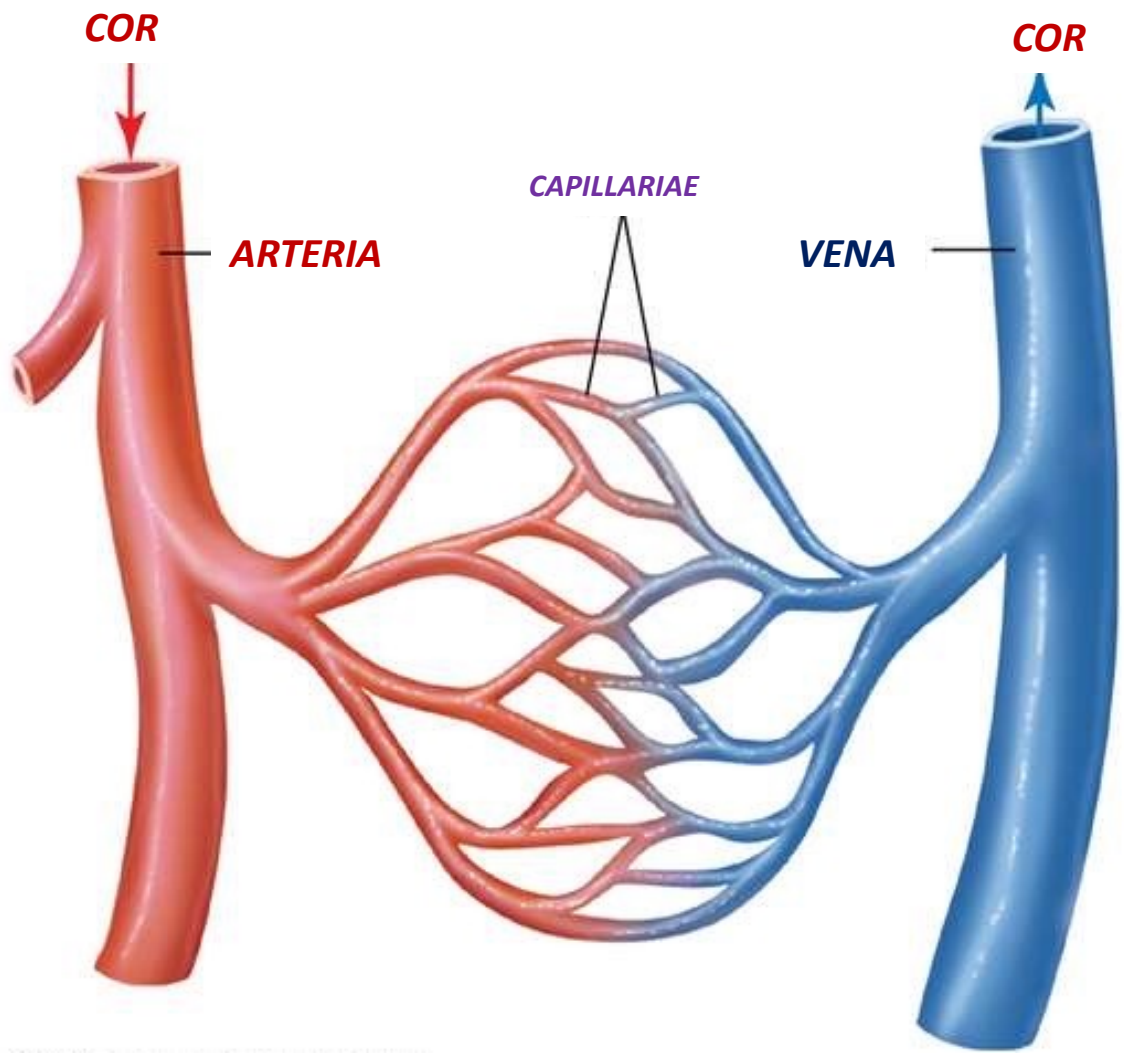
Heart - cor

- Cavitated muscullar organ
- Paired seriál pump
- Endocardium
  - valves
- Myocardium
  - working
  - conducting
- Epicardium
  - Epicardial fatty tissue
  - Cardiac vessels
- Pericardium
  - Pericardial sac
- Cardiac nerves and lymphatic vessels



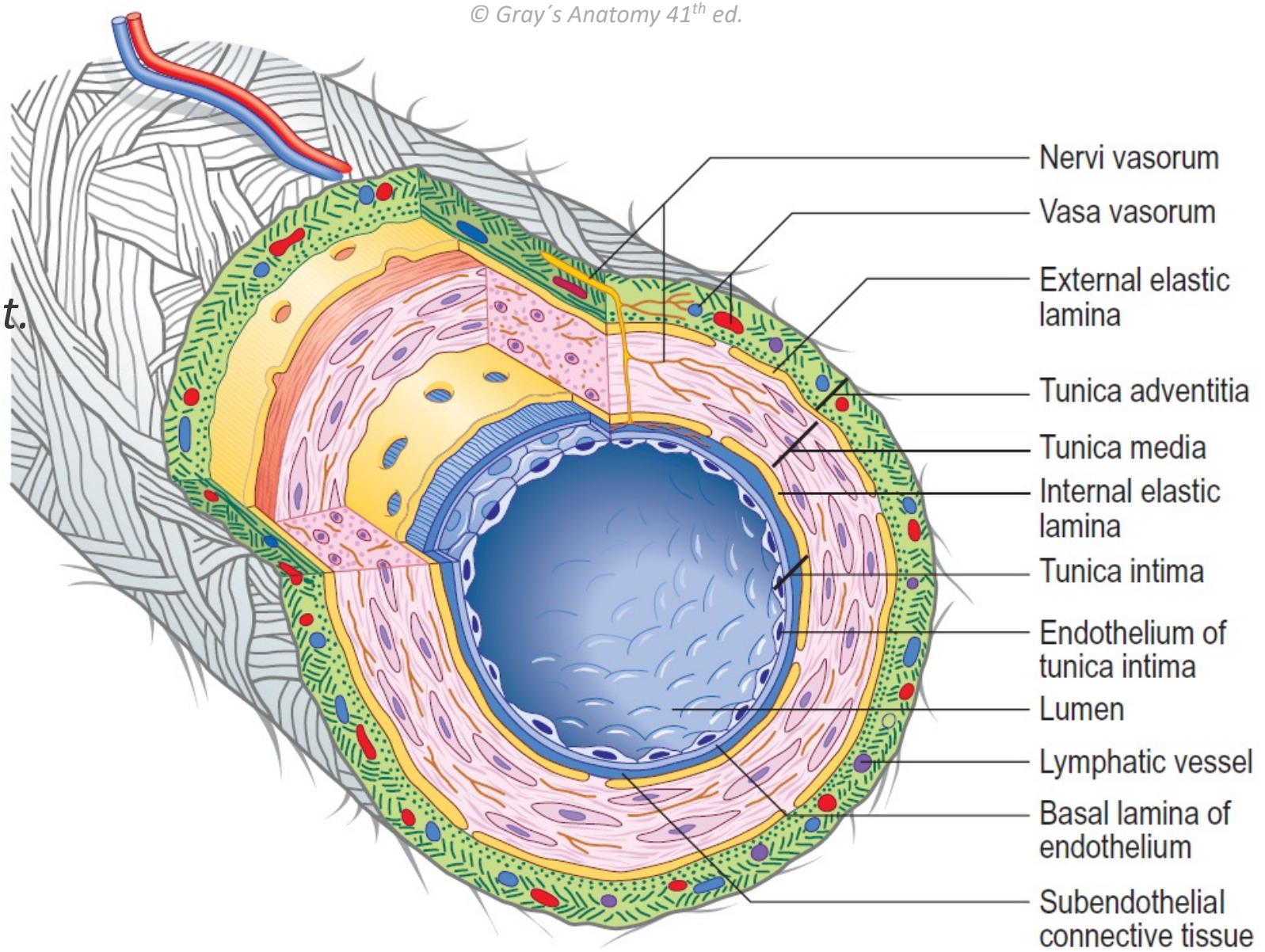
Blood vessels– vasa sanguinis

- **Arteries**
  - **Conducting blood from heart**
  - **High-pressure vessels**
  - Empty on cadaver
  - Wall thicker than in parallel vein
  - Less compressible
  - Bod brightly red
- **Veins**
  - **Conducting blad towards to the heart**
  - **Low-pressure vessels**
  - Filled on cadaver
  - Wall thinner
  - Easily compressible
  - Blood darkly red

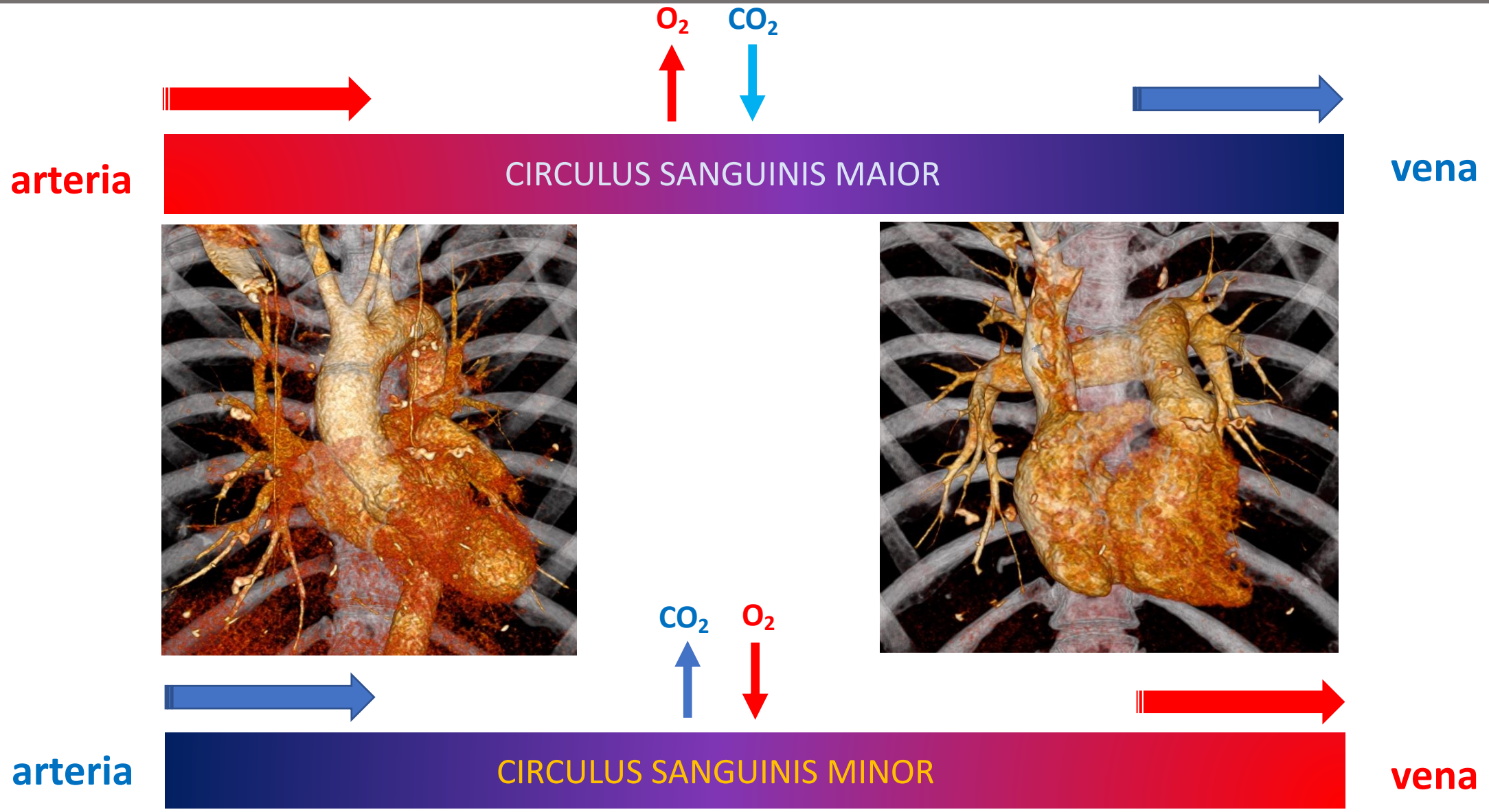


Vascular wall

- **mesodermal**
- **tunica intima**
  - *endothelium*
  - *Basal membrane*
  - *Subendothelial connective t.*
  - *lamina elastica interna*
- **tunica media**
  - *Smooth muscle*
  - *Ending of nervi vasorum*
  - *lamina elastica externa*
- **tunica adventitia**
  - *nervi vasorum*
  - *vasa vasorum*
  - *vasa lymphatica vasorum*



circulus major - circulus minor



arteries - arteriae

- **Truncus pulmonalis and branches**
  - De-oxigenated blood
  - **Arteria pulmonalis dextra et sinistra**
  - *Lobar, segmentary and subsegmentary*
- **Aorta and branches**
  - Oxigenated blood
  - **30 mm diameter, area 7 cm^2**
  - *Division to 4 x 10^6 arterioles*
  - *Diameter of the arteriole 10 µm*
  - *Area of all arterioles 150 cm^2*
  - *Decreasing flow velocity*
  - *Number of capillaries 16 x 10^6*

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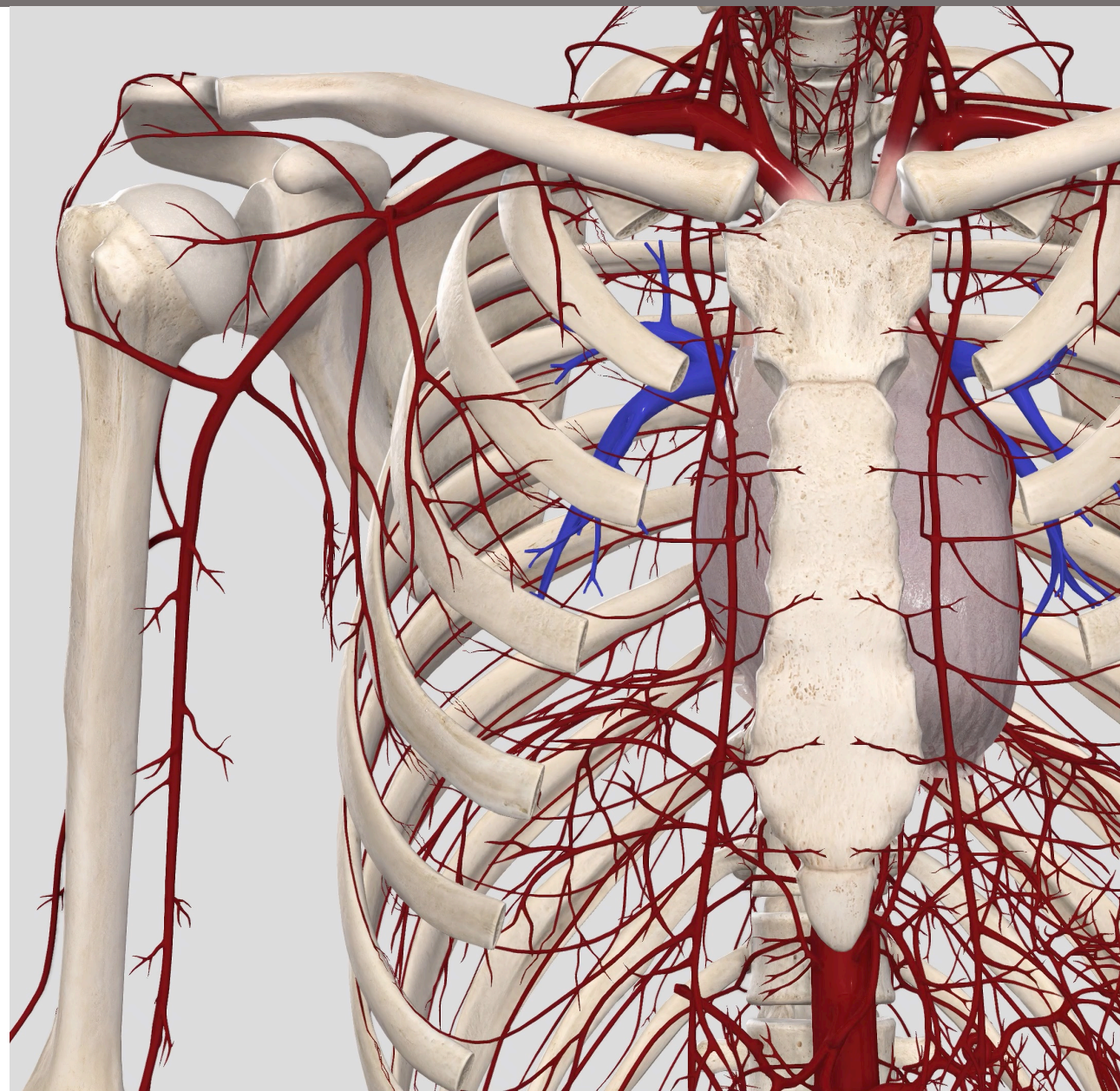
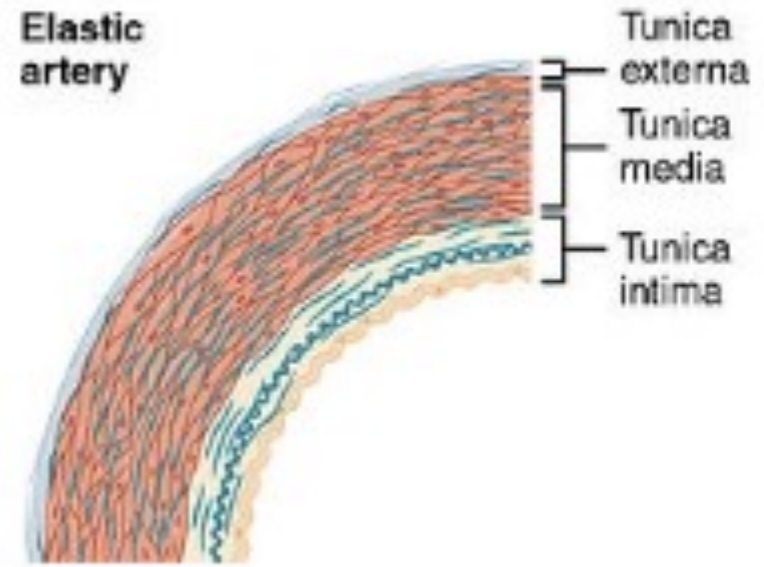
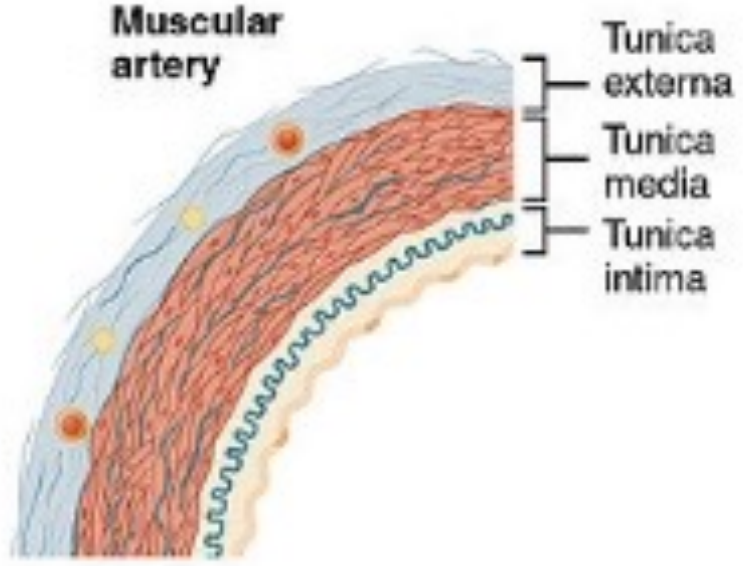


Arterial wall

- **Increasing ratio to the full diameter**
  - *Great arteries1/5 -1/15*
  - *Aorta descendens – diameter 17 mm - wall 1,1 mm*
  - *arterioly 1/2*
- **Large elastic arteries**
  - ***Ellastic recoil***
  - *Rich of the elastic connective tissue*
- **Arteries with continuous diastolic flow**
  - **A. carotis interna**
  - **Aa. renales**
- **Musculary type of arteries**
  - **Flow regulation**
  - **The most thick muscular portion**





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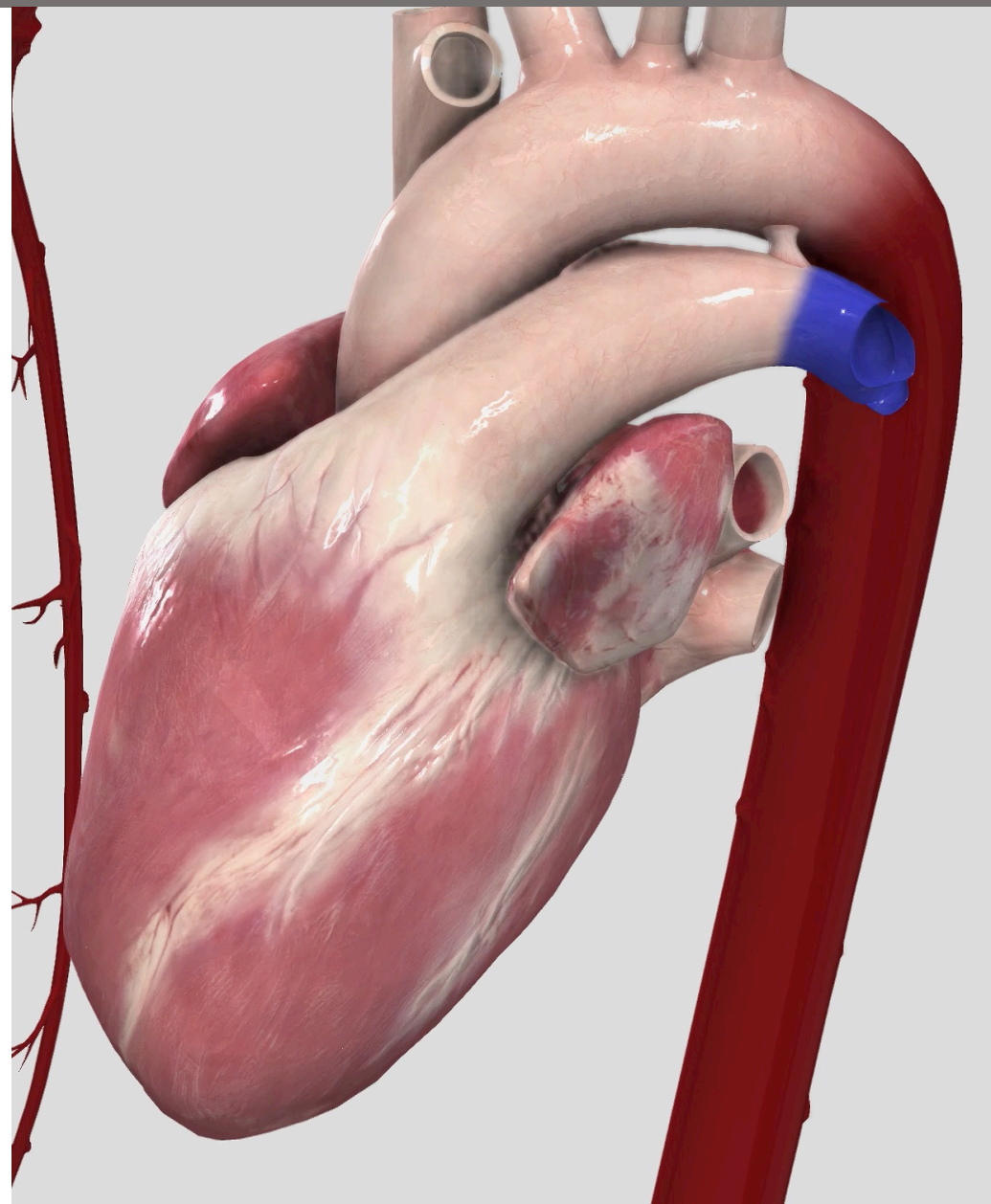
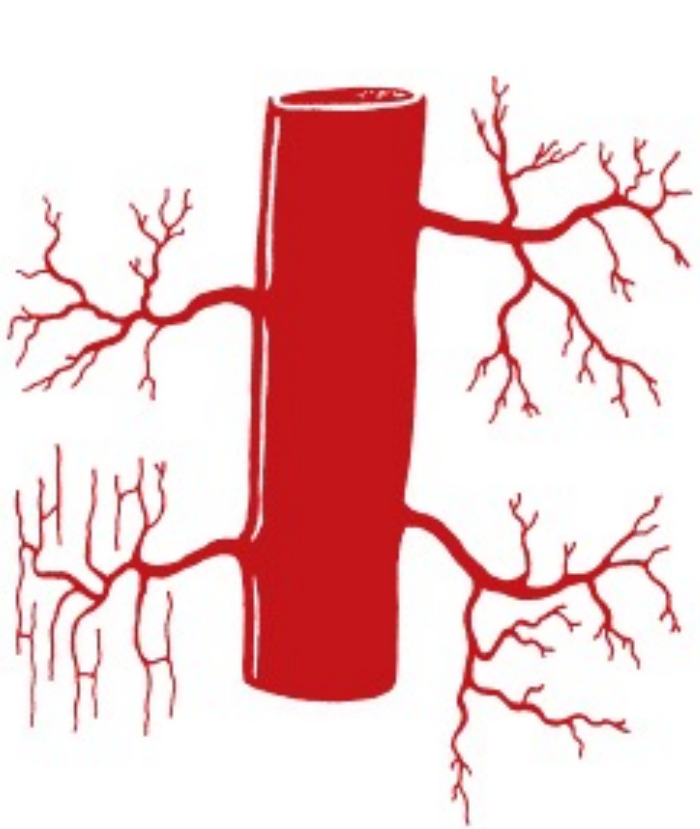
Pružníkový efekt

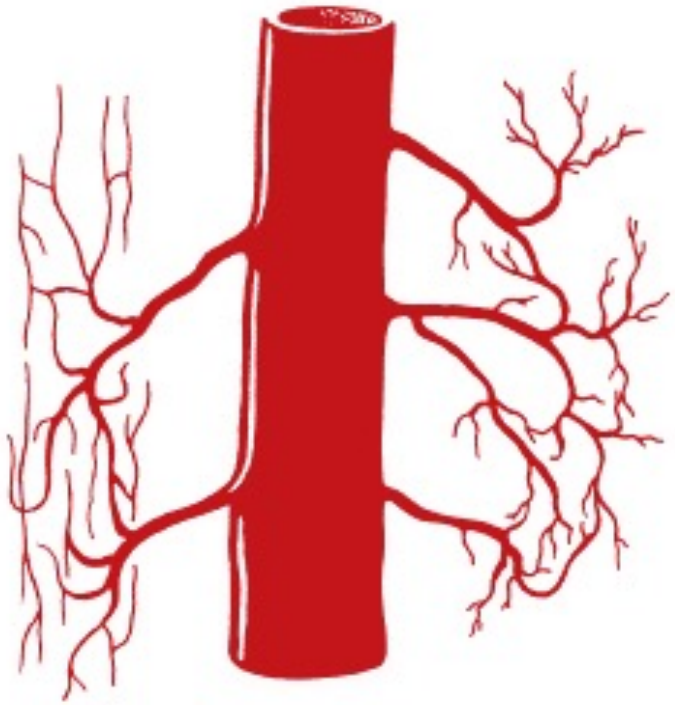
- **Posun pulsové vlny tepnou**
  - *Velké tepny*
- **Akumulace energie z ejekční fáze levé komory**
  - ***Pružníkový efekt***
  - *Elastická deformace stěny tepny*
  - *transformace energie*
- **Uvolnění energie retrakce elasticity**
  - **Komprese lumina**
  - **Posun krve vpřed**
- **Pulsová vlna**

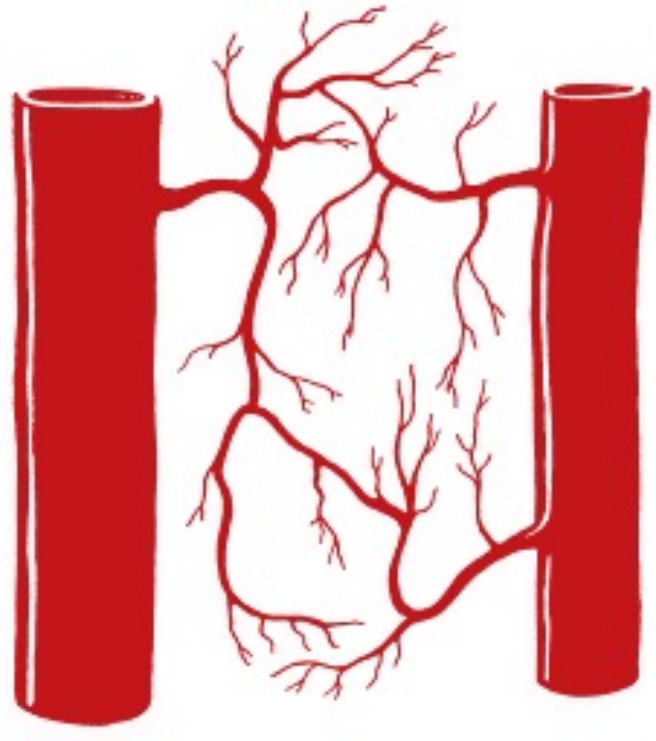


Teritorial architecture

- **Terminal ending** – *renal arteries, splenic pennicillate aa, nutritive aa of developing bone*
- **Anastomosed ending** – *cerebral and coronary arteries* – **ending arteries in their function**
- **Inter-territoriary anastomoses** – *limb arteries*
- **Primary anasotmsing arteries** – *circle of Willis, mesenterial arteries*

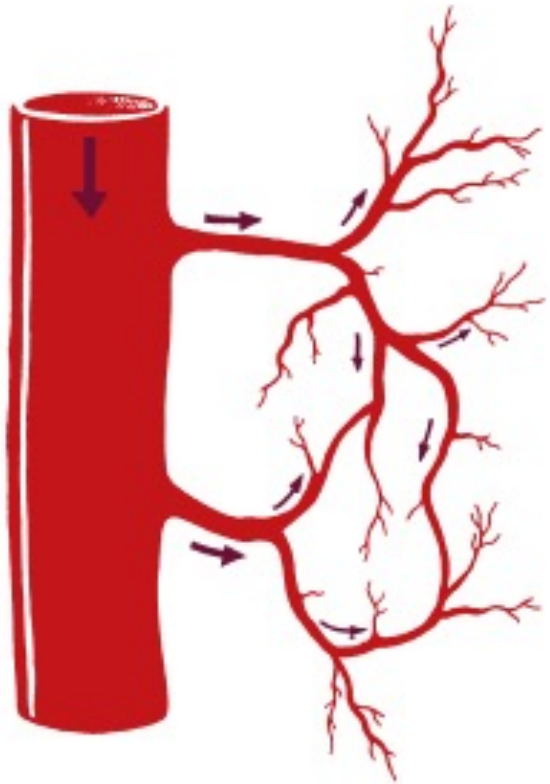


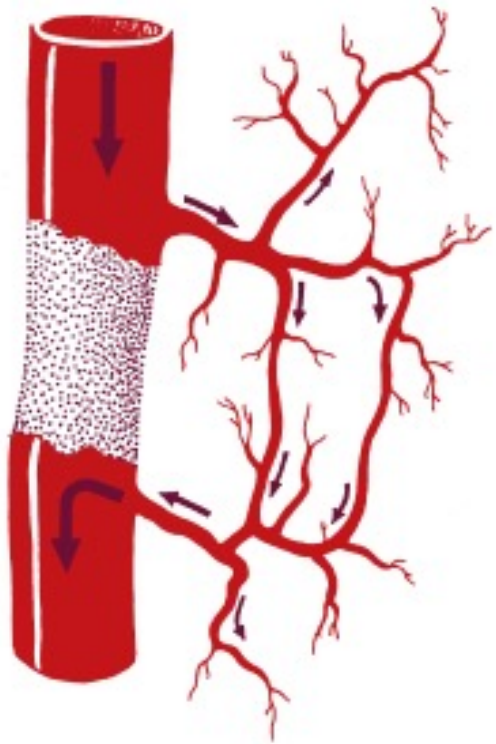


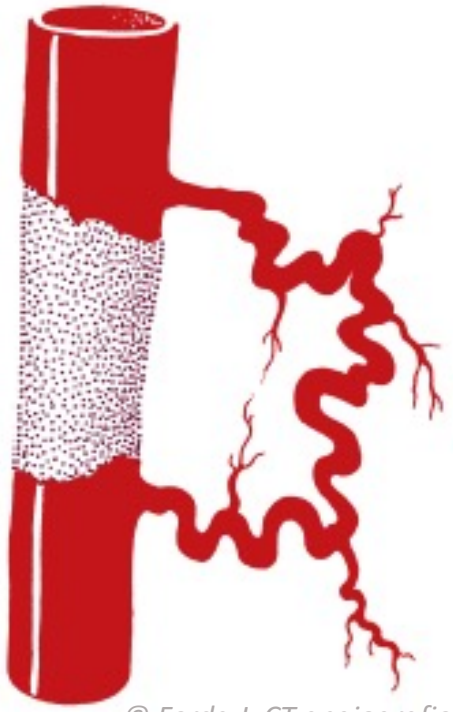


Collateral circulation

- **Prefpormed connection of territories**
  - When the flow is reduced, the connections are dilated
  - **After the main stem occlusion – collaterals take the flow**





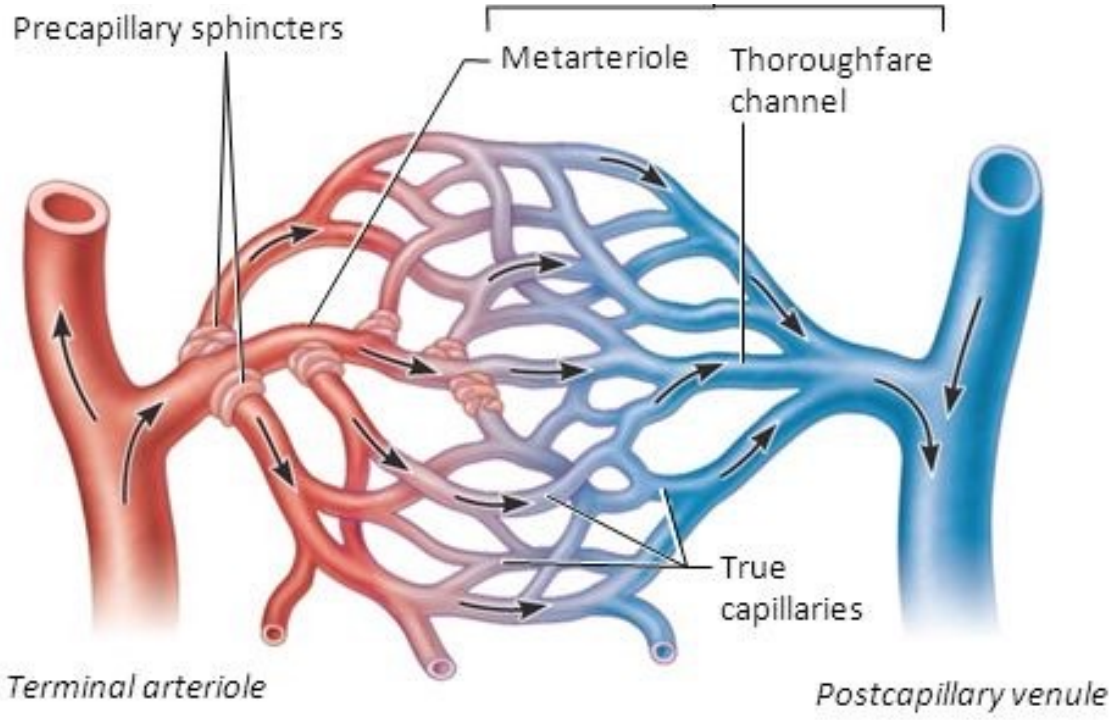


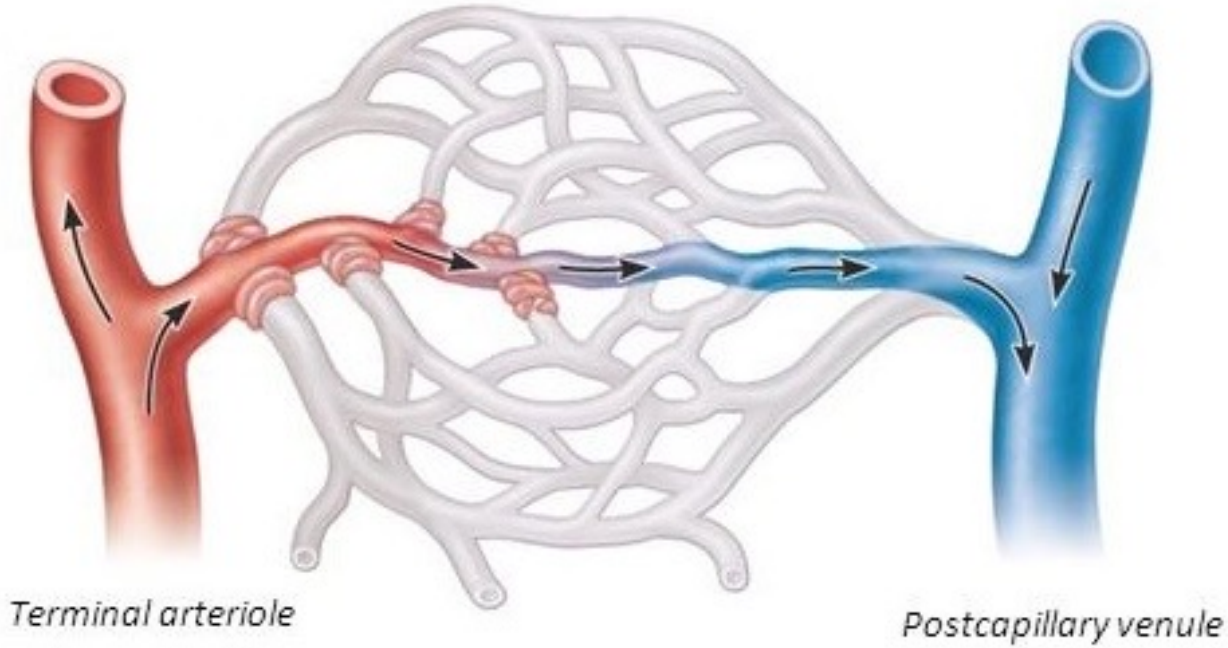
Terminal vascular riverbed

- **Capillary web**
  - *5 – 7 micrometers*
  - *Sfincters*
  - *Flow regulation*
  - ***Thoroughfare channel***
- **Arteriovenous anastomose**
- **Sinusoids**
  - 12 – 15 micrometers
  - ***Widen spaces with mixing blood***
  - ***Liver, bone marrow***
- **Glomus**
  - *Richly inervated, epithelial cells*
  - *Regulation*

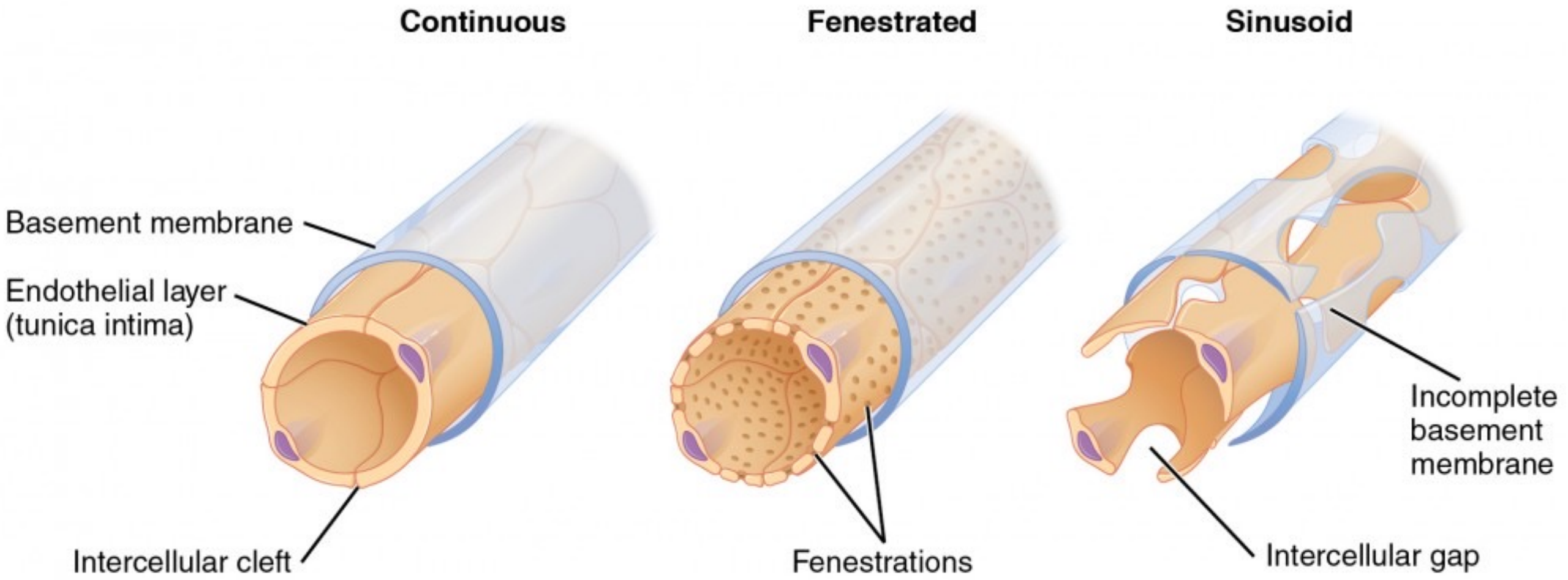
thelawofscience, from slideshare.net

microcirculation





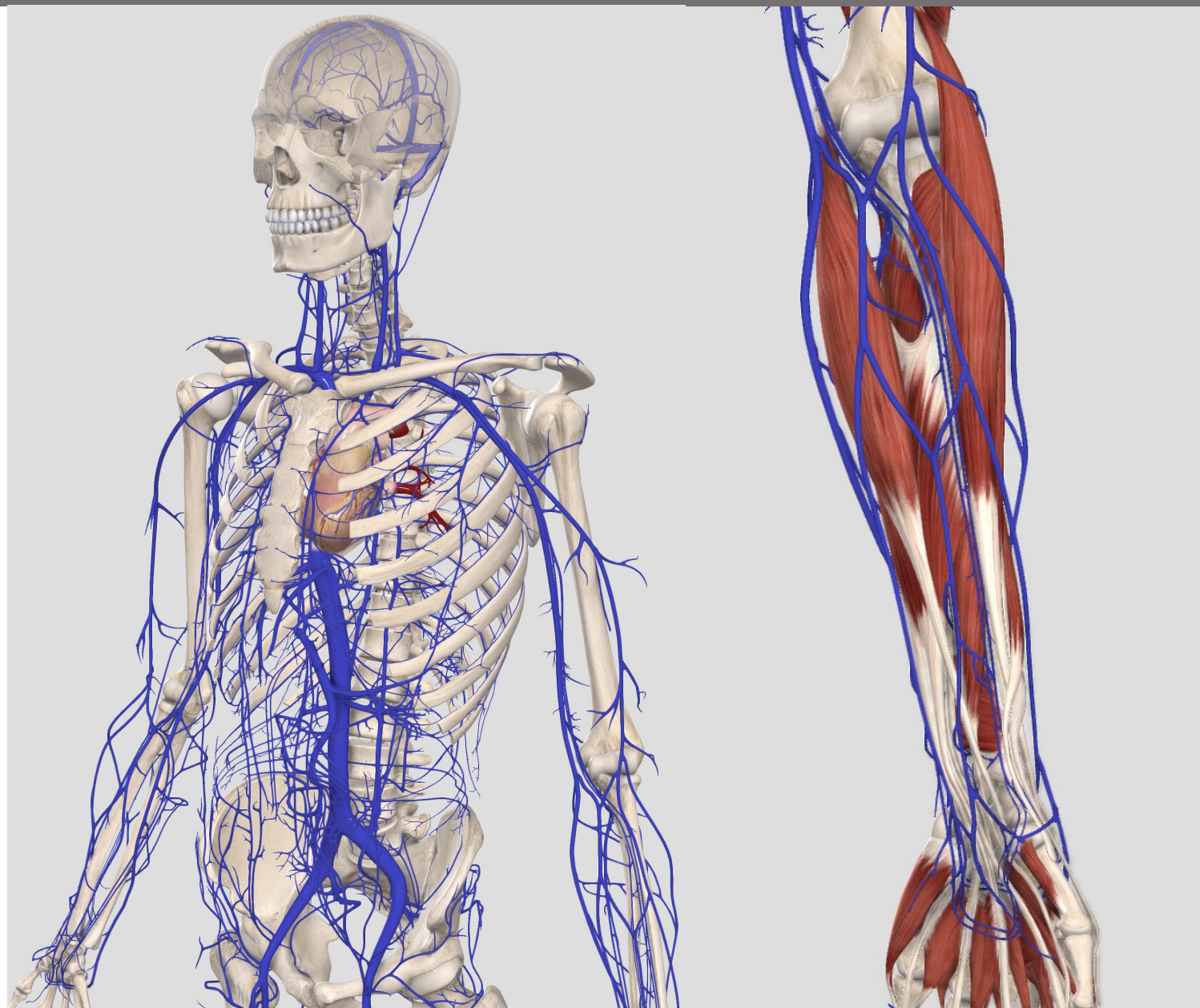
Capillary types



Veins - venae

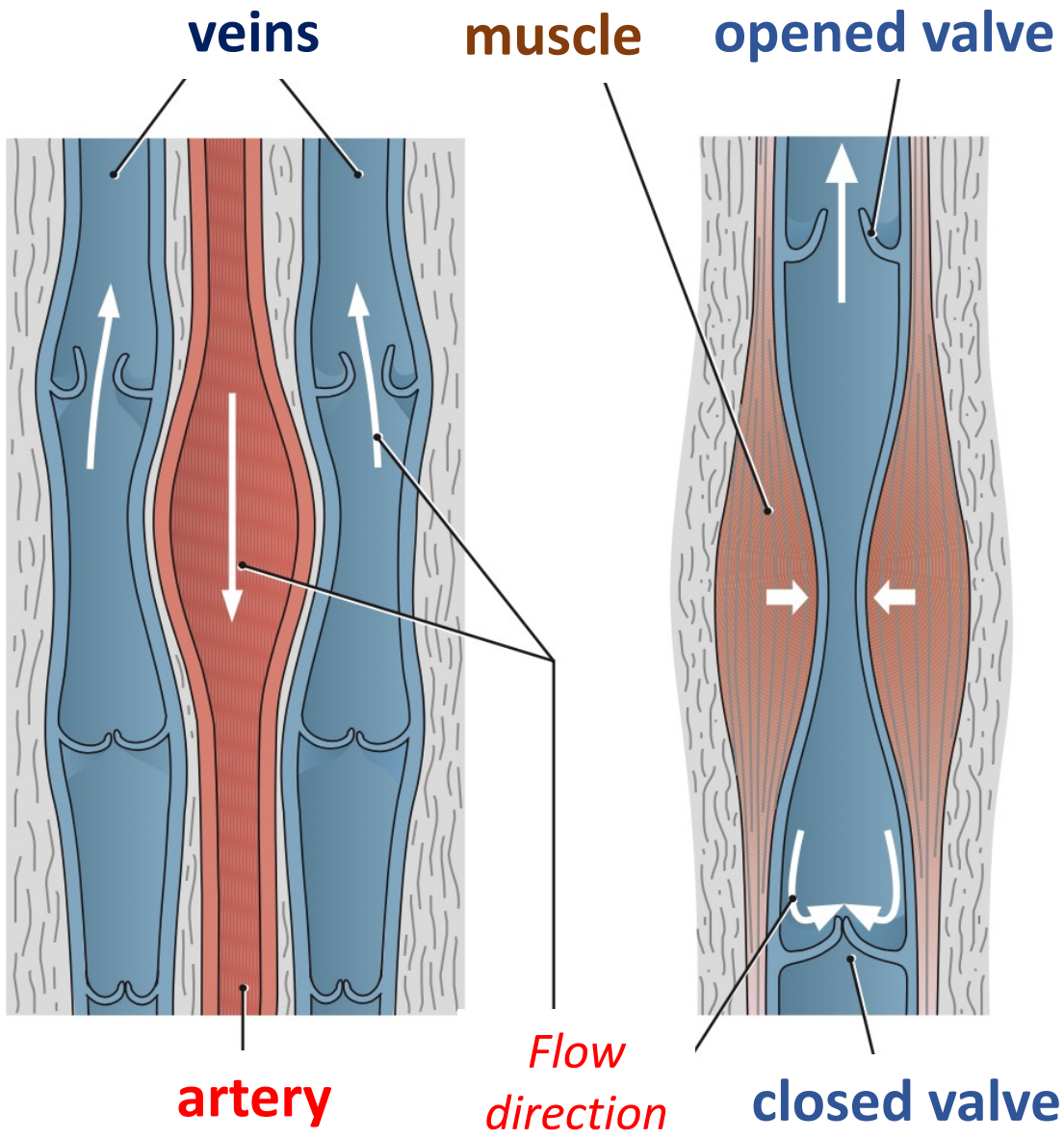
- More vaiable
- Entering the heart
  - Vena cava superior
  - Vena cava inferior
  - Venae cordis
  - Venae pulmonales
- V. portae hepatis
- Sinuus cerebrales

- Deep system
- Superficial system
- Venous plexus



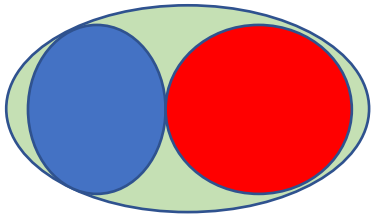
Veins - venae

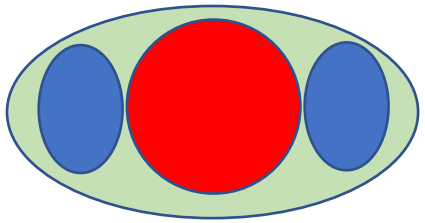
- **wall**
  - *Tunica intima*
  - *Tunica media*
  - *Tunica adventitia*
  - *Chybí elastická vrstva*
- **valves**
  - **Muscular pump**
  - **Arterial contrapulsation**
  - **Valvular inssuficiency**
  - **Varices**
- **Pressure in veins**
  - Smaller than in arteries
  - Negative nearby heart
  - (underpressure – sucking the air)
  - Air embolisation

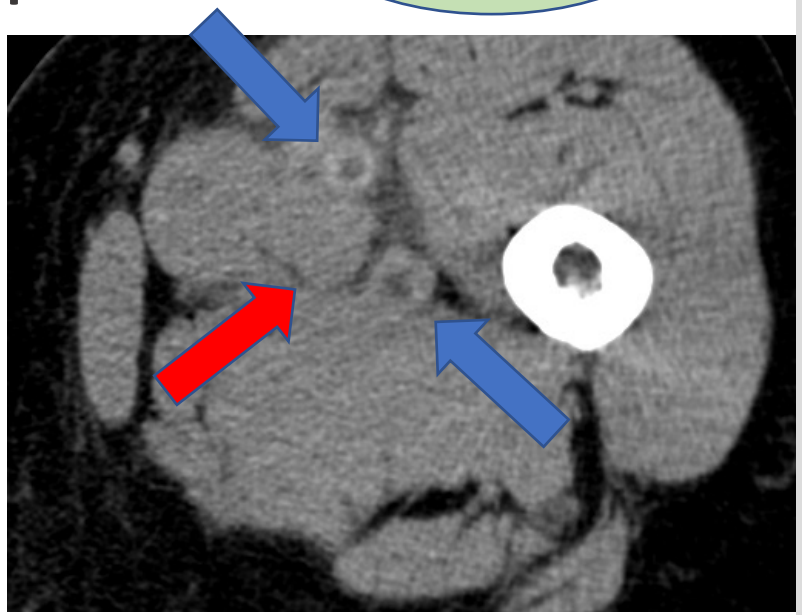


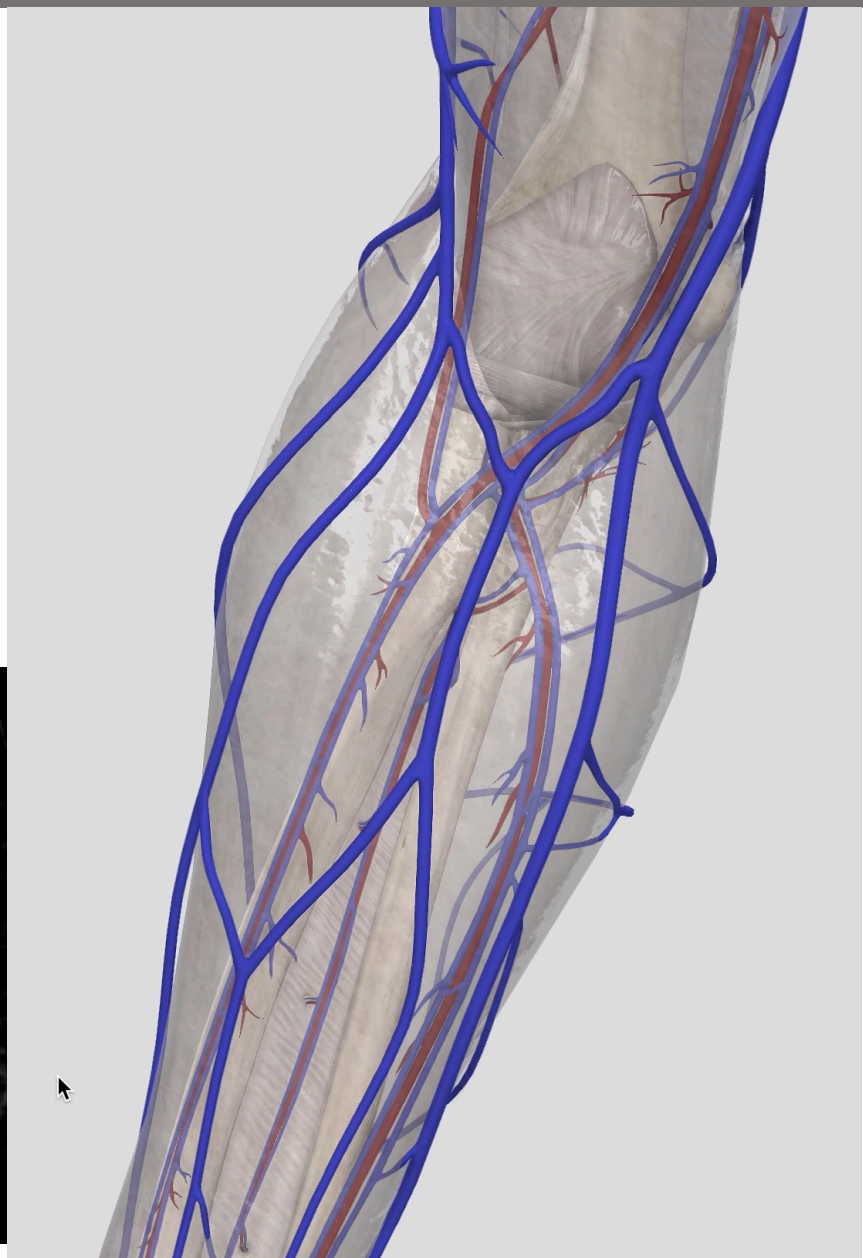
Arteries and veins

- **Superficial system**
  - **Variable in subcutaneous space**
  - **Main stem veins constant**
  - *v. saphena magna, v. saphena parva*
  - *v. cephalica, v. basilica*
- **Deep veins accompanied with A**
  - **Large artery with one vein**
  - *Vasa iliaca*
  - *Vasa subclavia*
  - **Artery and twin veins**
  - *Deep vessels*
  - *Arm and forearm*
  - *Crural and femoral*









Lymphatic system

- **Lmyph**
- **Lyphatic vessels**
  - *Lmyph capilalries – vasa lymphocapillaria*
  - *rete lymphocapillare*
  - *Afferent – vasa afferentia*
  - *Efferent – vas efferens*
  - *Collecting – collectores et trunci lymphatici*
  - ***Ductus thoracicus***
  - **valves**
- **Tributary region**
- **Lymph nodes – nodi lymphatici**
- **Lymph follicles – folliculi lymphatici**
- *Tonsilles, thymus, spleen, bone marrow*

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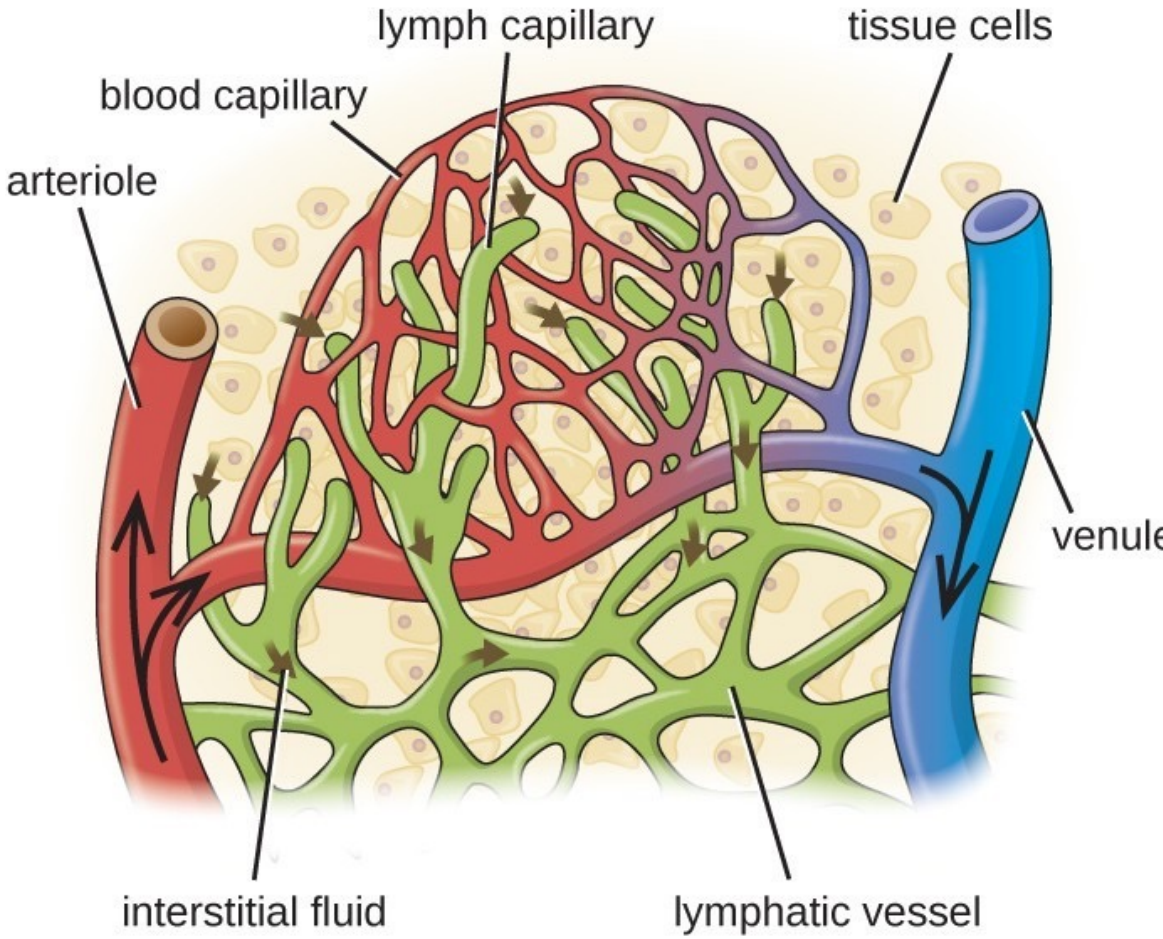
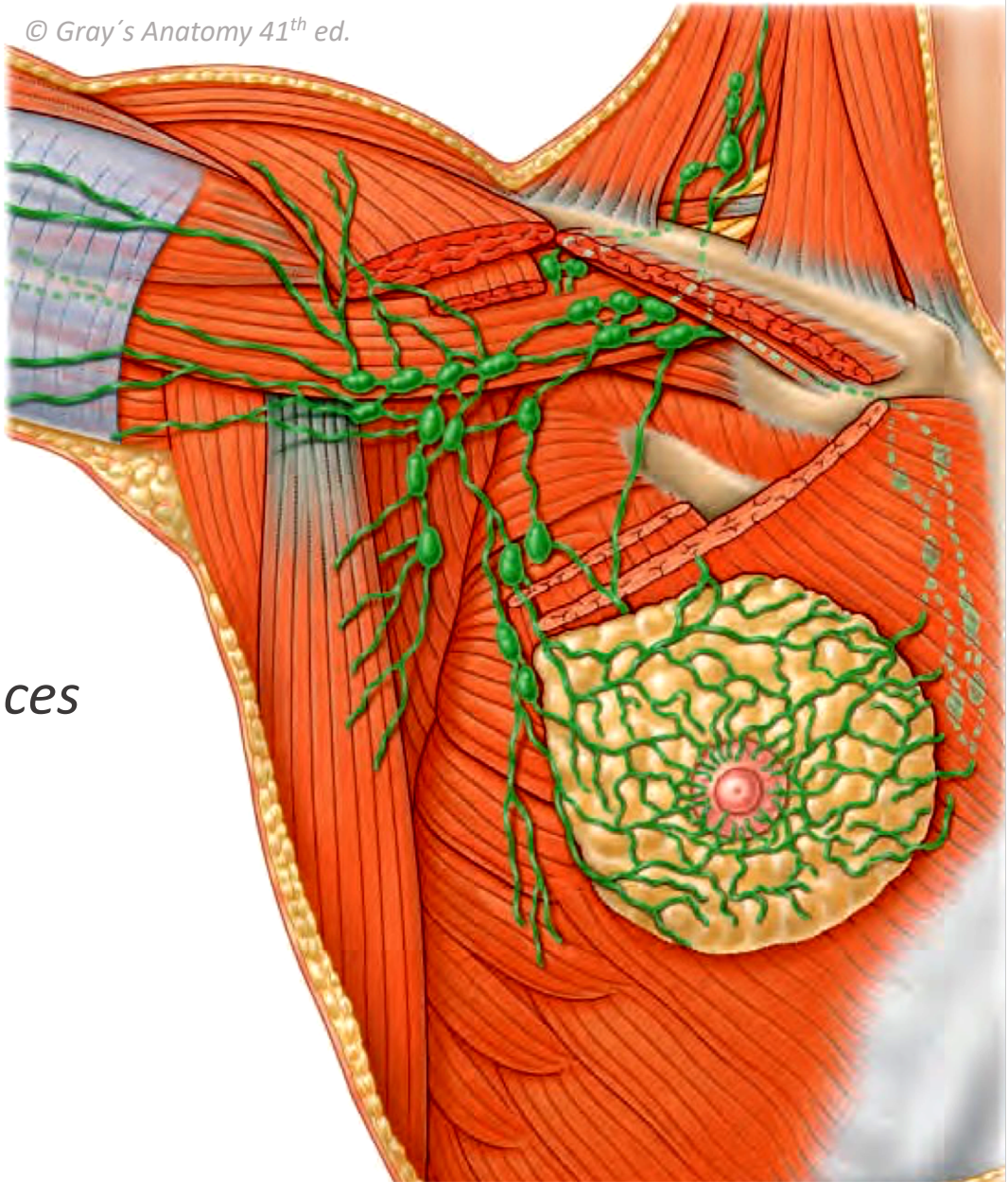


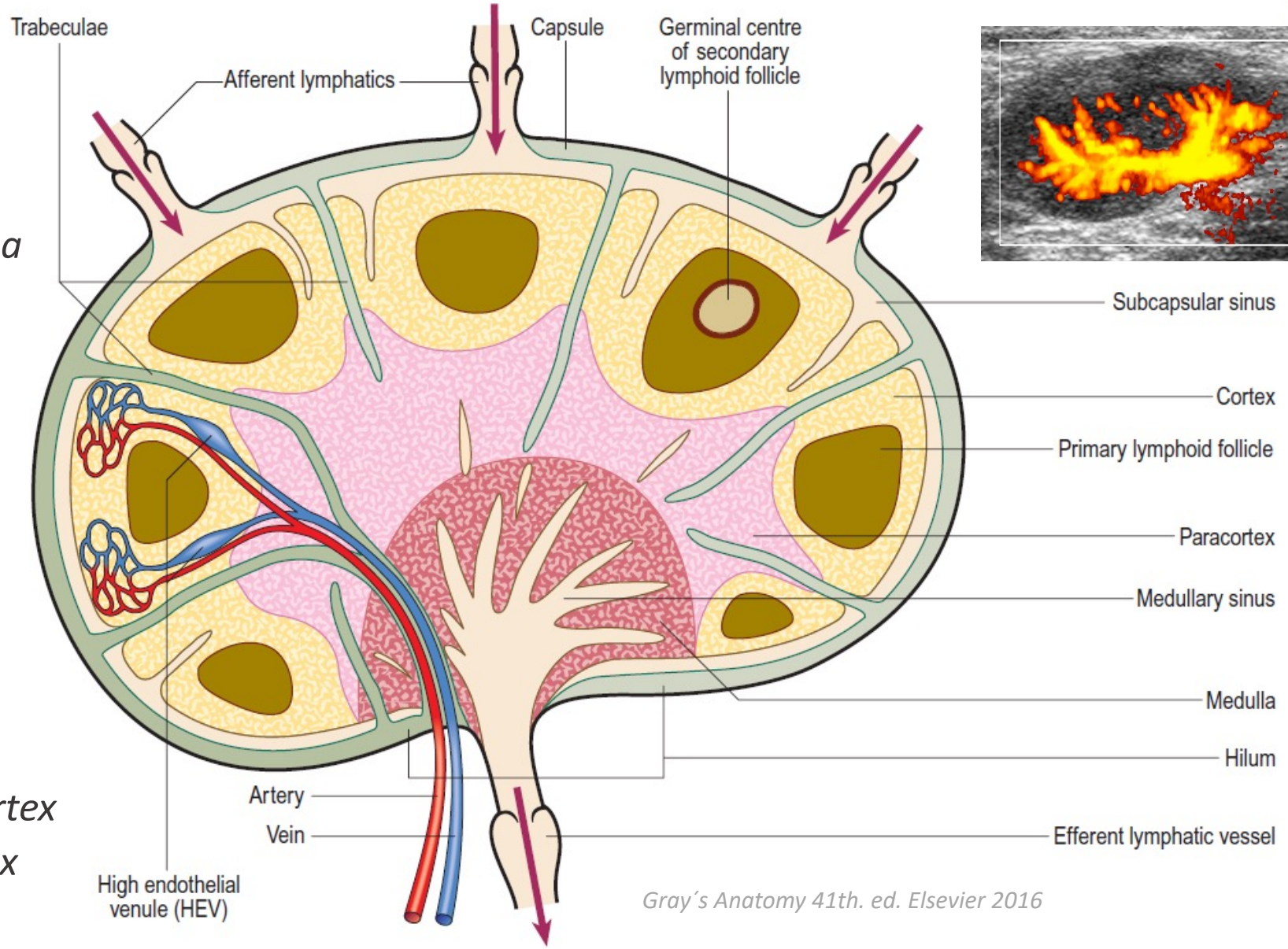
Lymph circulation

- **lymph**
  - *Opalescent, containing lymphocytes*
- **Chylus**
  - *Lymph originating in GIT*
  - *Emulgated fatty substances*
  - *Milk-like*
- **The function of lymphatic system**
  - *Outflow of the tissue humour and waste substances*
  - *Resorption of faty substances from bowel*
  - *Infection spread*
  - *Lymphogenic metastases*
  - *Lymphogenic edema*



Nodus lymphaticus – mízní uzlina

- **Beal-like shape**
- **Size varying**
  - *Largest at the neck and inguina*
- **Vasa afferentia et efferentia**
  - *More afferent*
  - *Less efferent*
- **valves**
  - *insuficiency*
  - *Retrograde flow*
  - *Retrograde spread of tumors*
- **Blood supply**
  - *Arteries and veins entering cortex*
  - *Capillary network within cortex*



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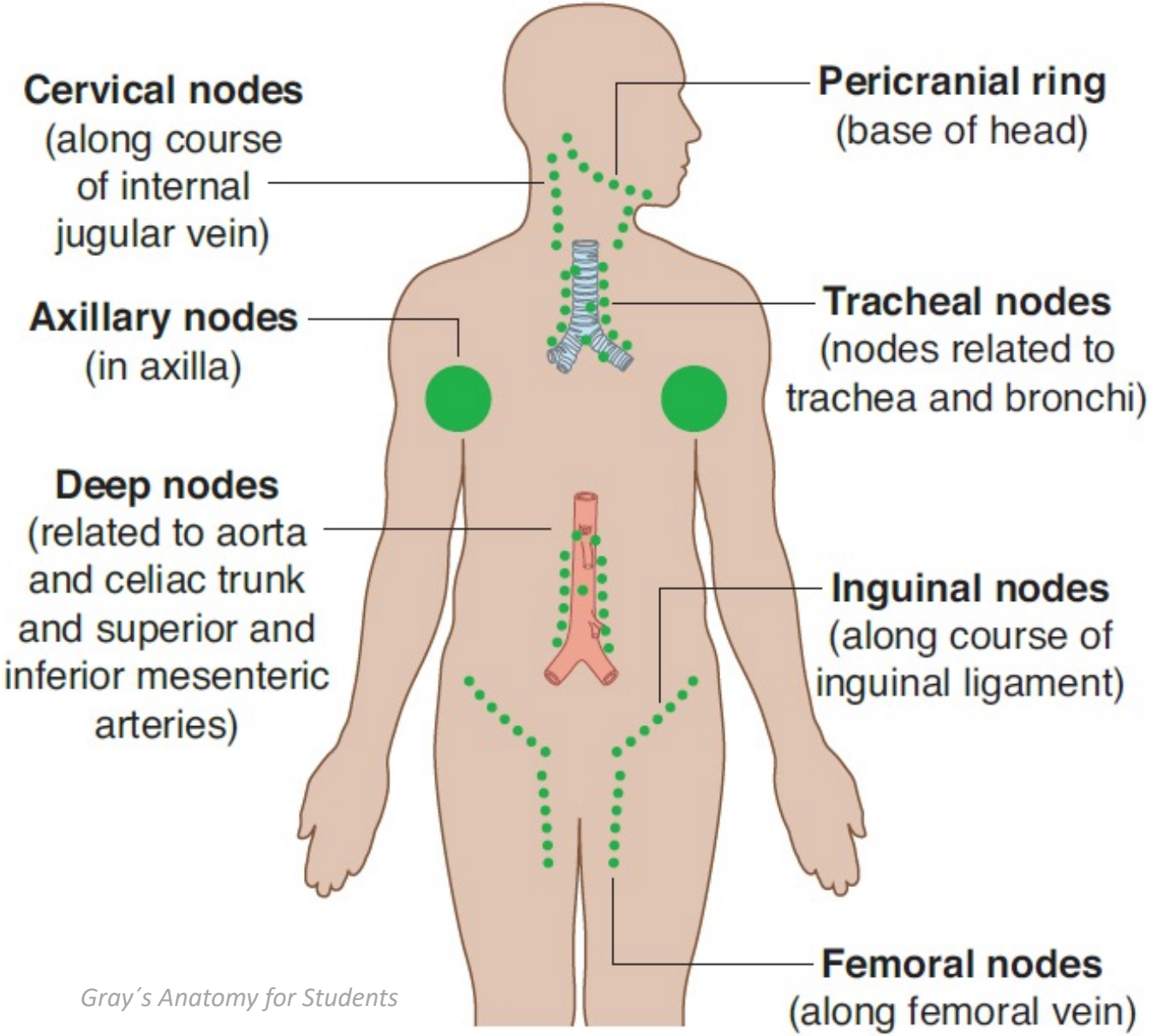
Lymph nodes group, tributaries



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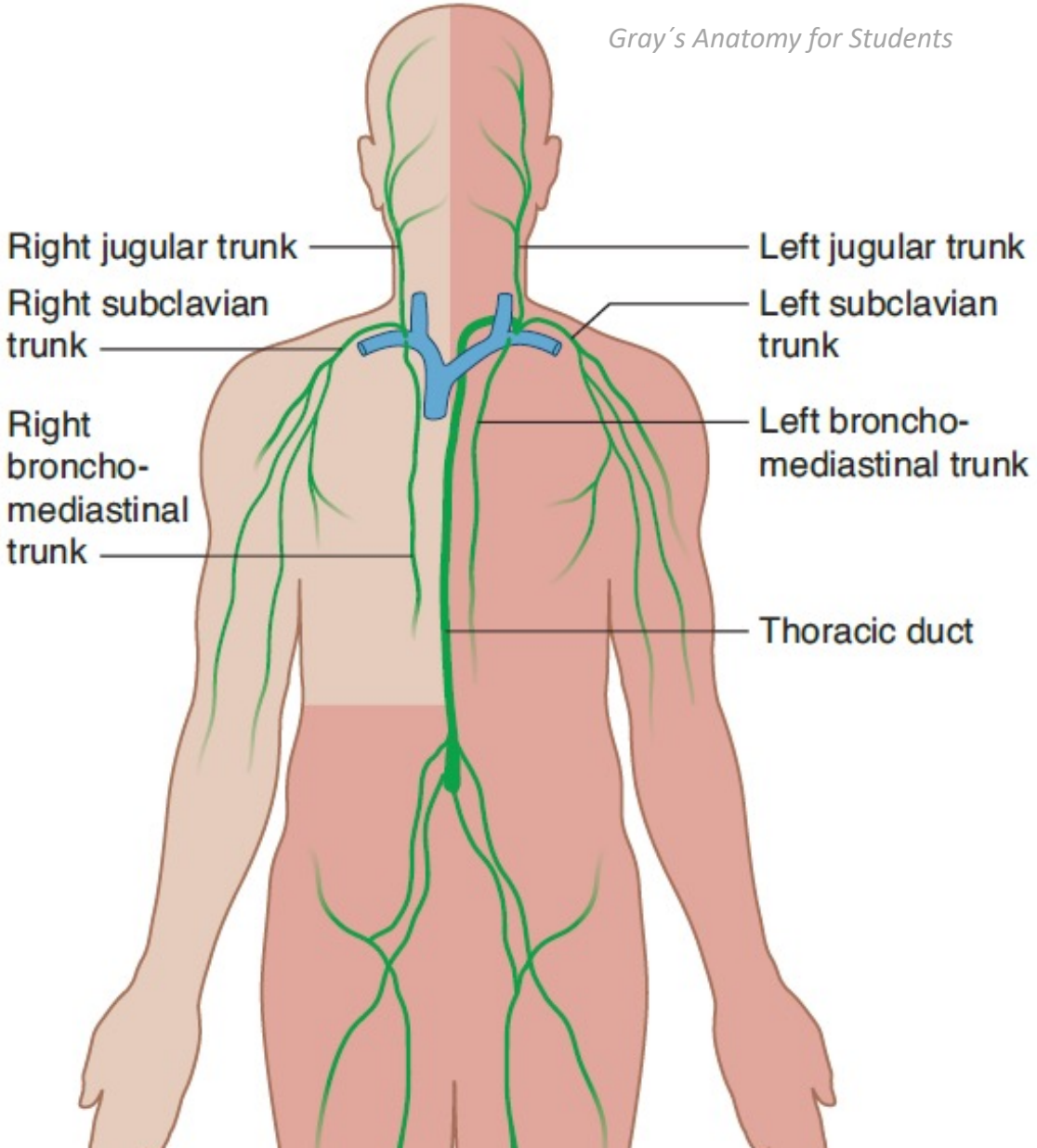

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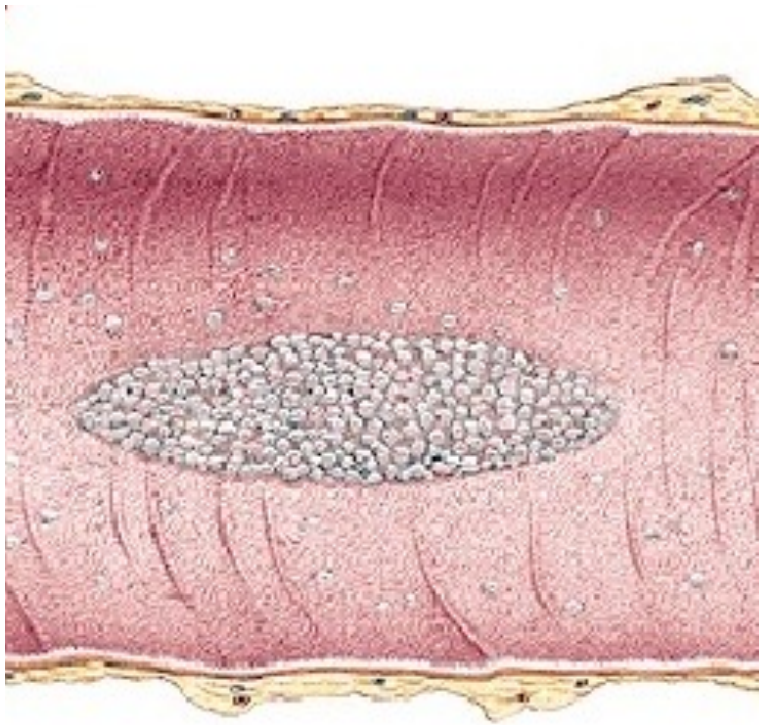
Folliculi lymphatici

- Nodulary assembled tissue
  - In mucosa of GIT (bronchi)
- Folliculi lymph. solitarii
- Folliculi lymph. aggregati *Peyer´s patches*

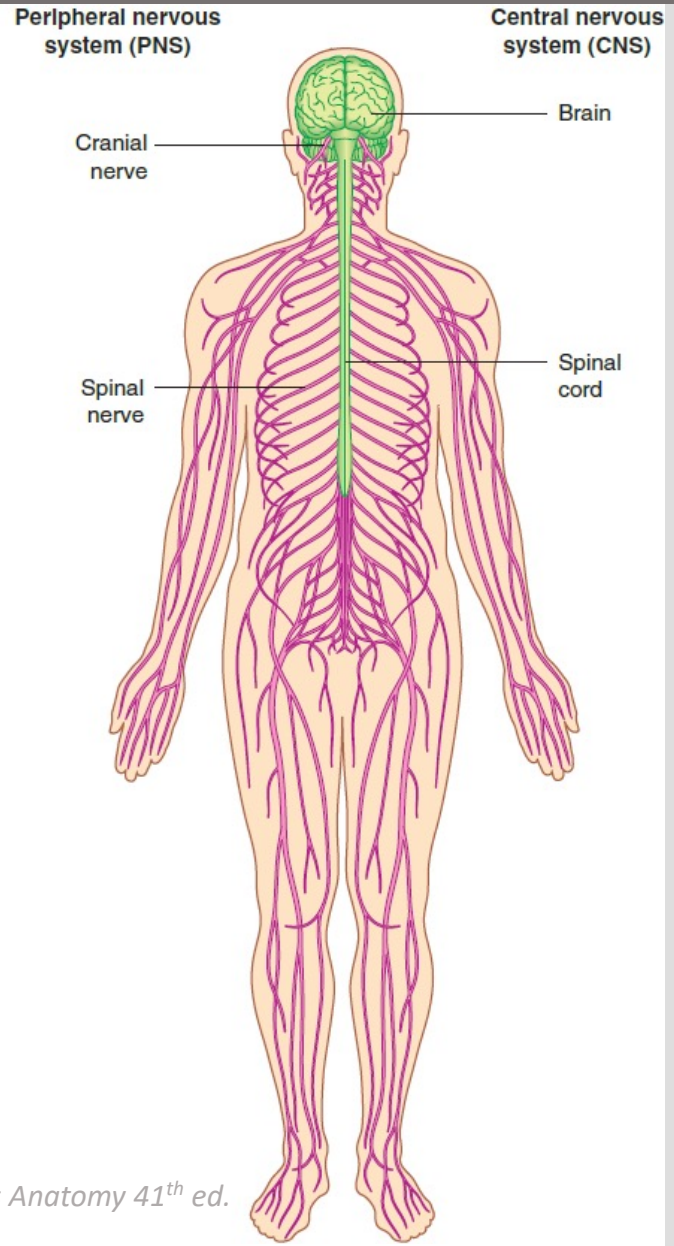


Bowel TB

Nervous system

- **Central nervous system (CNS)**
- Brain
- Spinal cord
- Optic nerve
- Retina
- **Peripheral nerves (PNS)**
- Cranial nerves
- Spinal nerves
- Periperalautonomous system (ANS)
  - Sympaticus
  - Parasympaticus
- ***Enteral nervous system (ENS)***

- special senses



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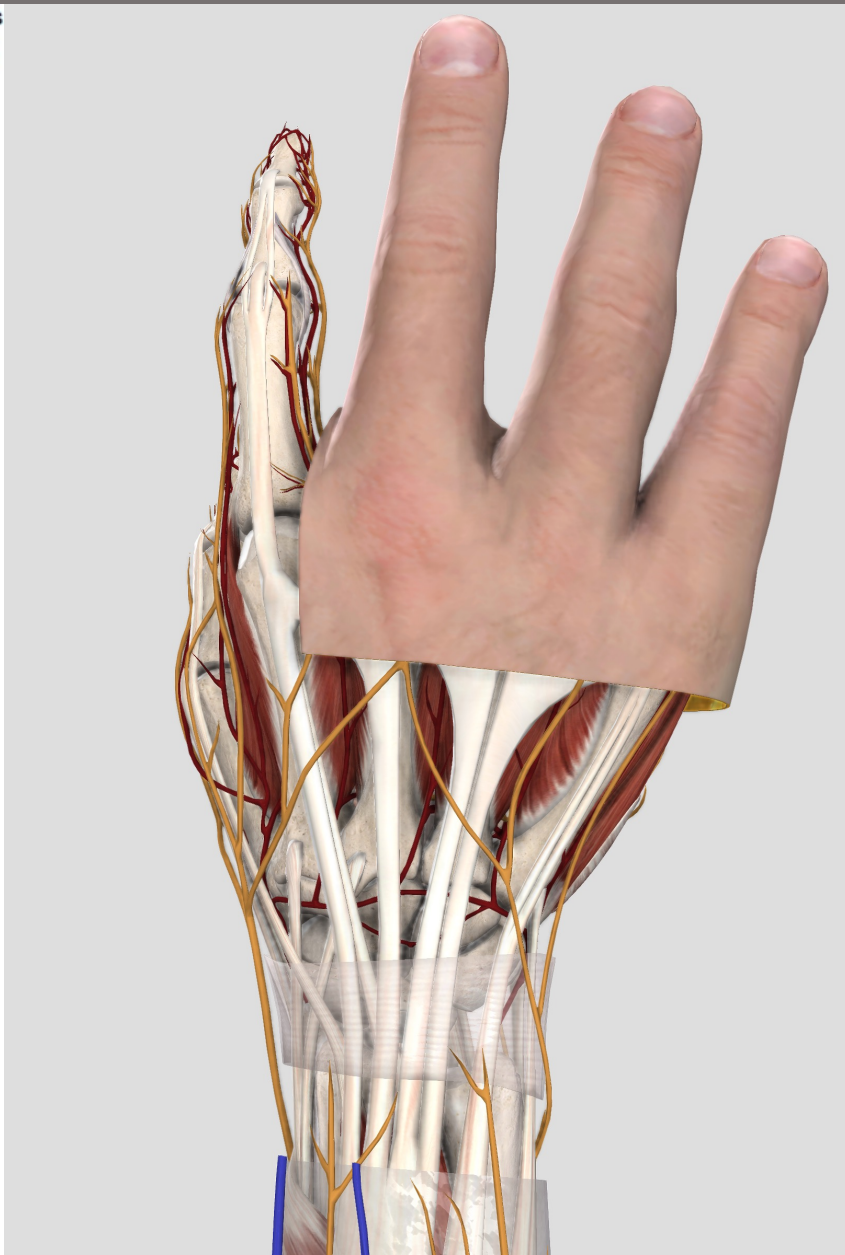
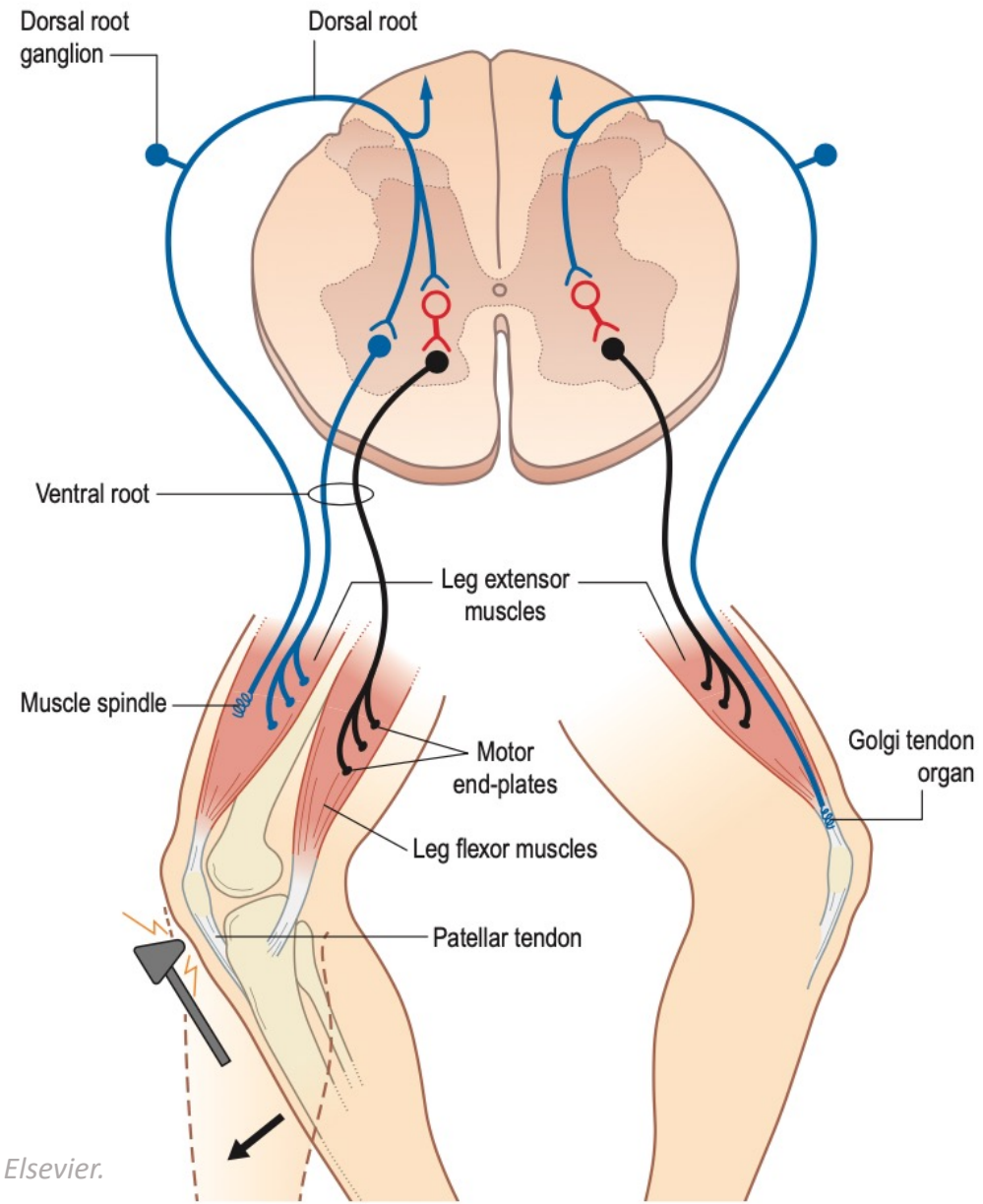


Function

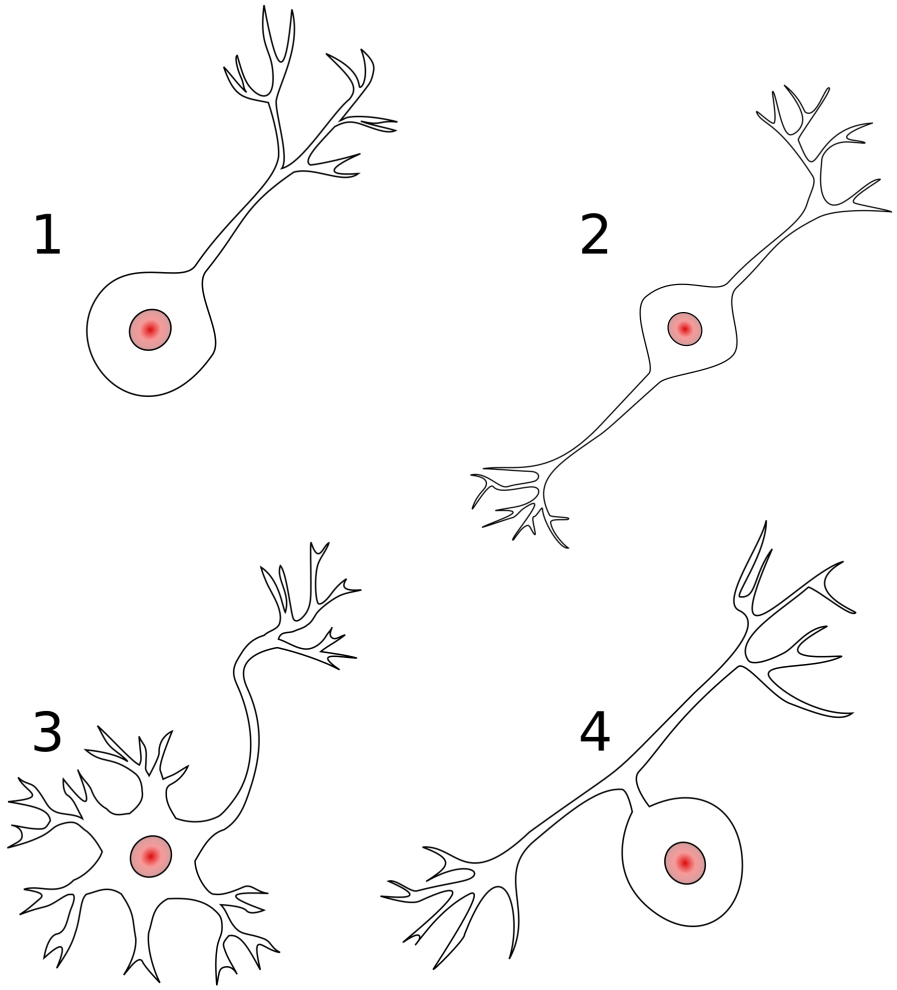
- **Neurons**
- **encoding**
  - *Special ending*
  - *Creation of the information quantum*
  - *Transpaltion into electrical potential*
- **conduction**
  - *propagation*
  - *Fast conduction of the electrical impulse*
  - *Action potential*
- **transmission**
  - *Next neurons*
  - *Muscular cells*
  - *Glandular cells*
  - *synapse and neurotransmiters*



Fundamental Neuroscience for Basic and Clinical Applications, 4th Edition, 2013, Saunders, Elsevier.

Nervous microstructure

- **Neurons**
- **Non-neuronal cells – neuroglia, glia**
  - *Non-generationg action potential*
  - *calcium signalling*
    -
  - *Interaction neuron-glia*
- ***Population ratio***
  - *glia : neurons*
  - *Then 17:1*
  - *Now 1:1*
- ***Secretory part – corioidela plexus***
  - *Roof of the neural tube is not producing neurones*
- ***Hematoencephalic barrier (blood-brain barriere – BBB)***
  - *Molecular exchange*
  - *Interaction between mikorcirculation, glia and neurones*



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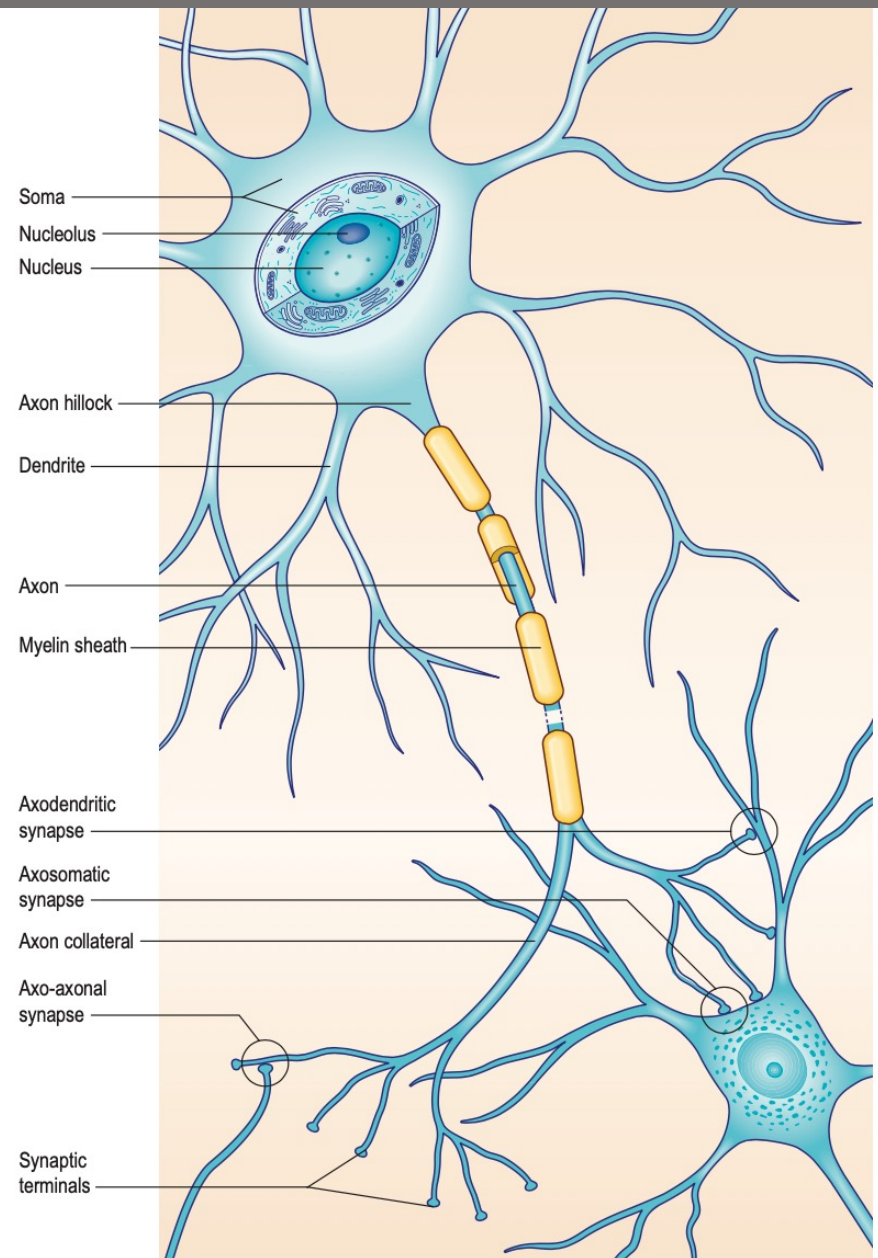
Neuron

- ***Embedded in clusters***
- ***Nuclei, columnes, strata (CNS)***
- ***Ganglia (PNS)***
- ***Dispersion (ENS)***

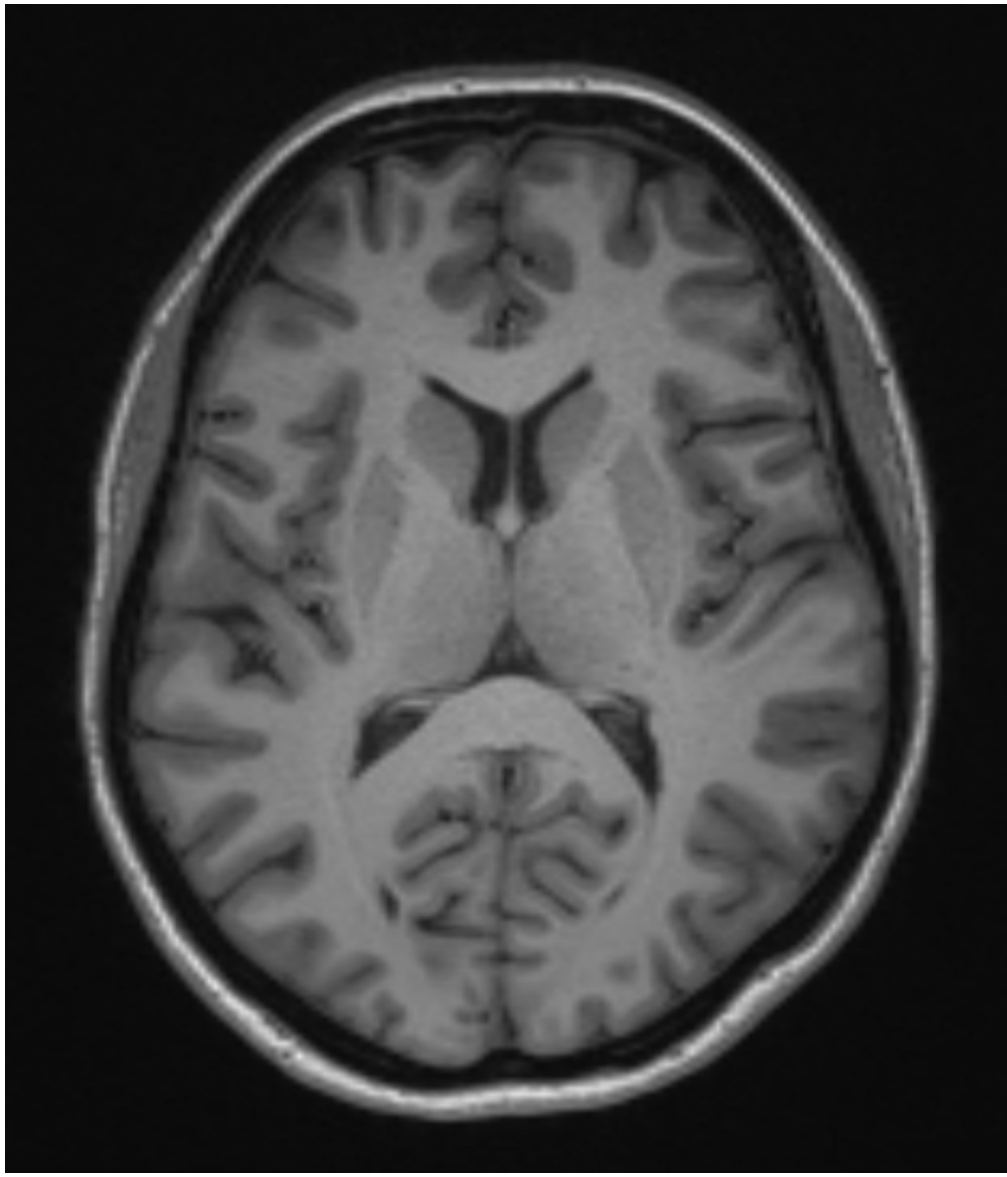
- *Variability of the size and shape*
- **Extreme ratio be‘tween surface and volume**
  - *Multiple processes*
  - *Classification according shape and localisation*
- **Dendrites multiple afferent processes**
- **Body (soma)**
- **Axon – only one efferent process**
  - **Axonal hillock**



Gray´s Anatomy, 41th ed.

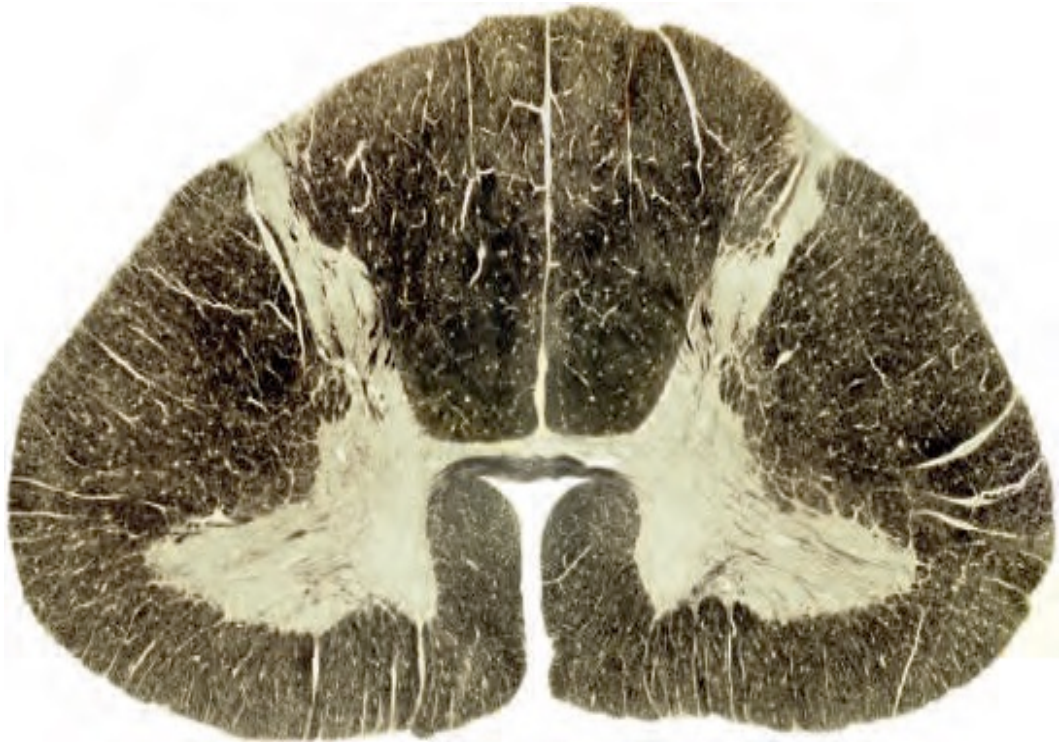
CNS

- **Grey matter– substantia grisea**
  - Neuronal bodies
  - Nuclei
  - Local assembled grey matter – basal ganglia
  - Cortex
  - Substantia grissea – spoinal cord - horns
- *Neuropil – largest part of voleúme in grey matter*
  - Unmyelinized axons, dendrites, synapses, glie
- **White matter – substantia alba**
  - Axons
  - Bundles
  - Prone to be assembled and organized - tracts
  - where tract are dominating
  - Telencefalon white matter
  - Cerebellum
  - Spinal cor‘d



CNS

- Substantia alba – fibers
- Substantia grissea – bodies
- To be distinguished
- Columna (cornu) = column (horn)
  - *Columna inspace , cornu in plane*
- Funiculus (fasciculus) = funicle (fascicle)
- Radix = root
- Ramus = branch

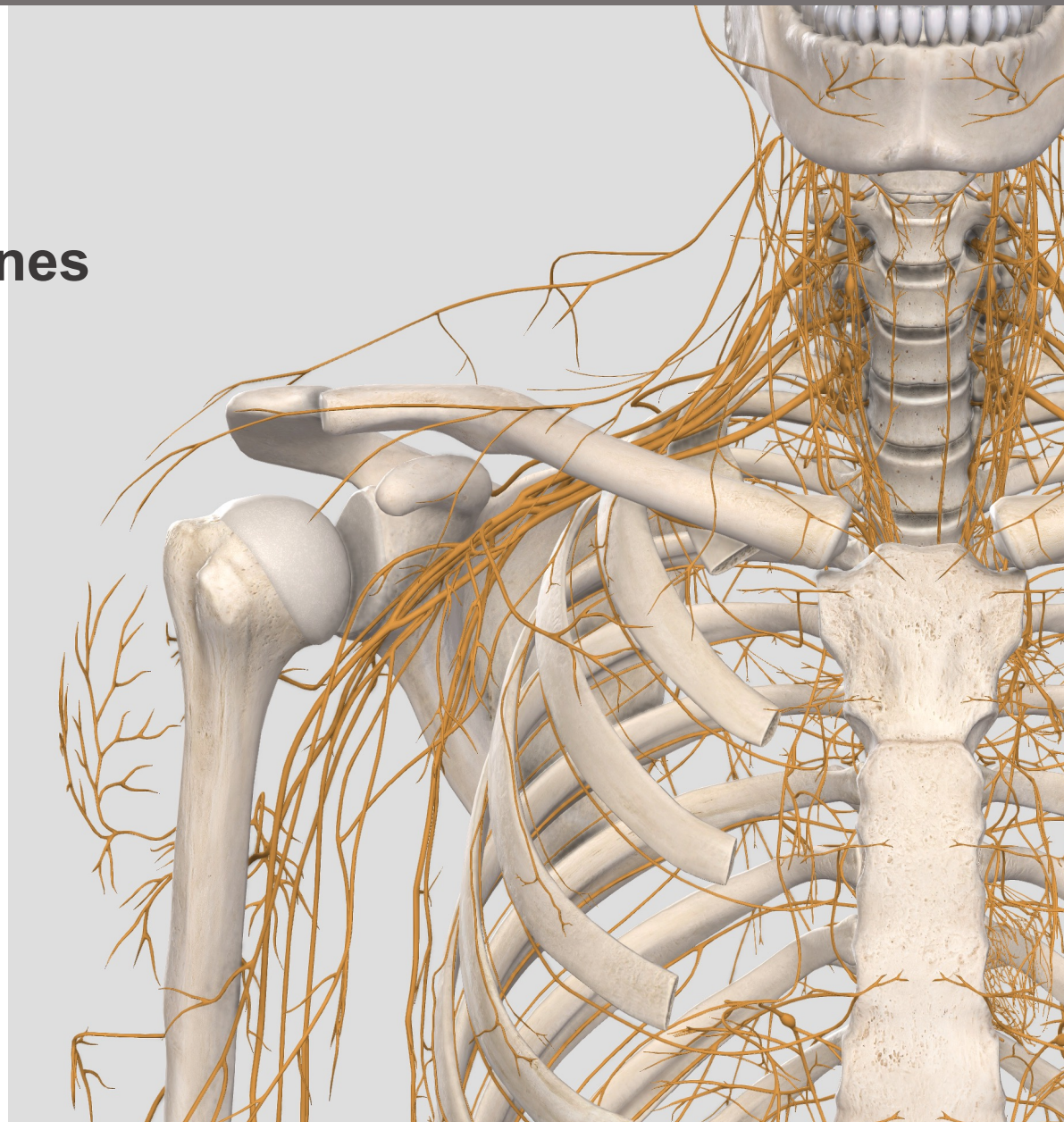


- dorsal columns – sensoric neurons
- ventral columns – motor neurons
- Lateral columns – autonomous neurons (visceromotoneurons)

Gray´s Anatomy, 41th ed.

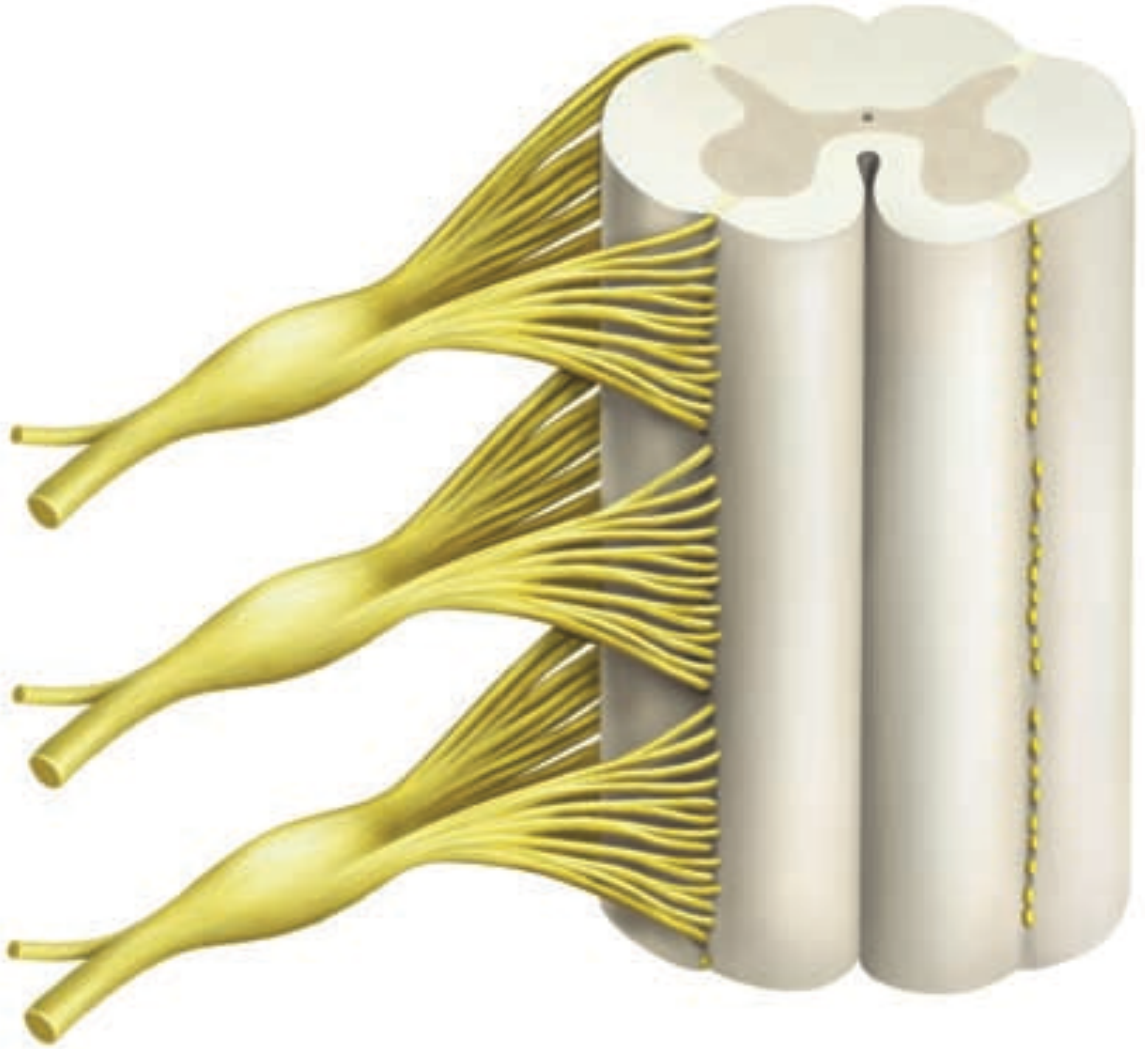
Peripheral nervous system

- **Egferent axons of motor neurons**
  - *Motor neurons enclosed to grey matter*
- **Bodies and processes of sensoric neurones**
  - *afferent*
  - *Bodies (pseudounipolar) in spinal ganglia*
  - *efferent*
- **Ganglial autonomous neurons**
  - *In autonomous ganglia*
  - **Sympaticus**
  - **Parasympaticus**
- **Peripheral autonomous fibers**
  - *Somata in CNS*



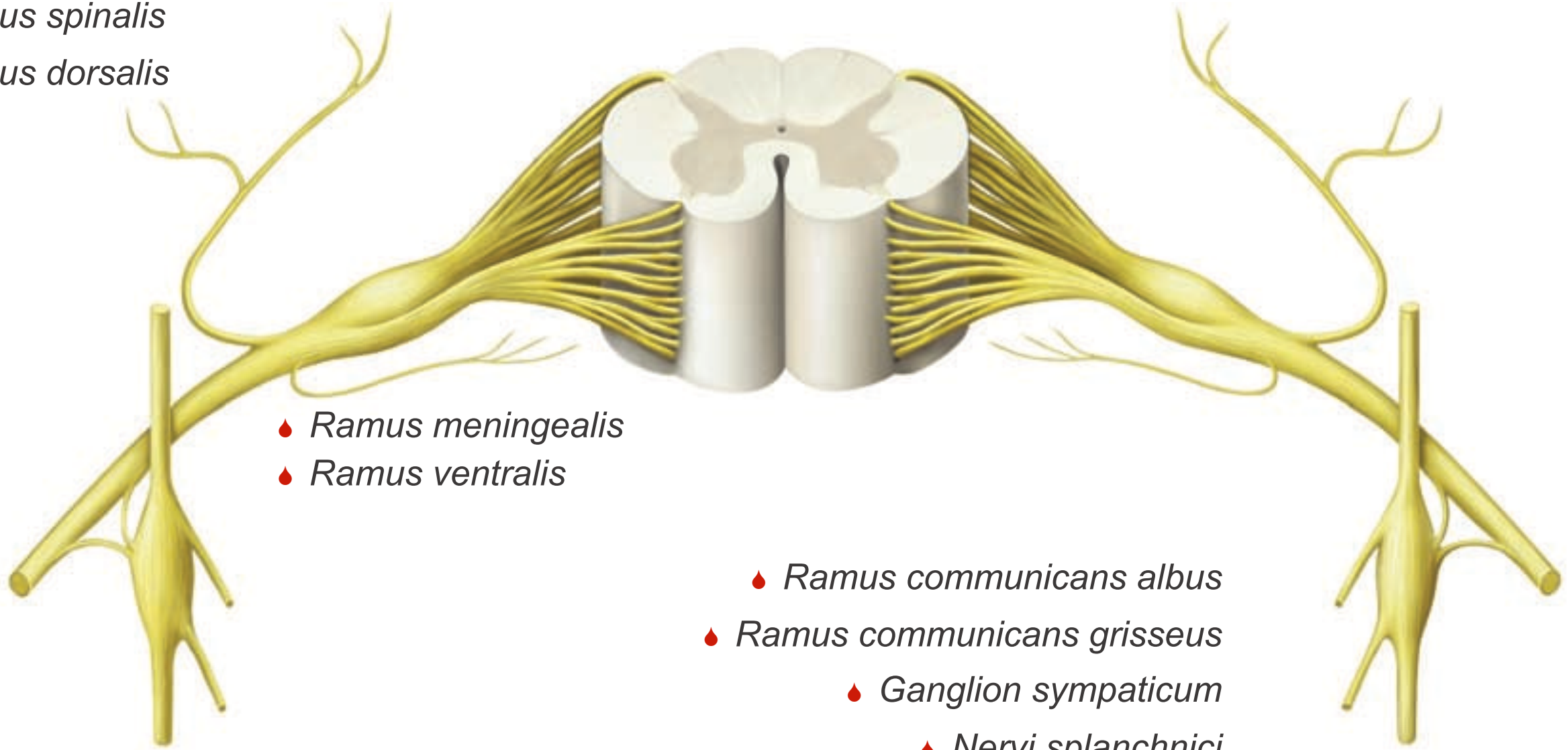
Spinal nerve

- *Radiculi anteriores*
- *Radix anterior*
- *Radiculi posteriores*
- *Radix posterior*
- *Ganglion spinale*
- *Nervus spinalis*
- *Ramus dorsalis*
- *Ramus ventralis*



Spinal nerve

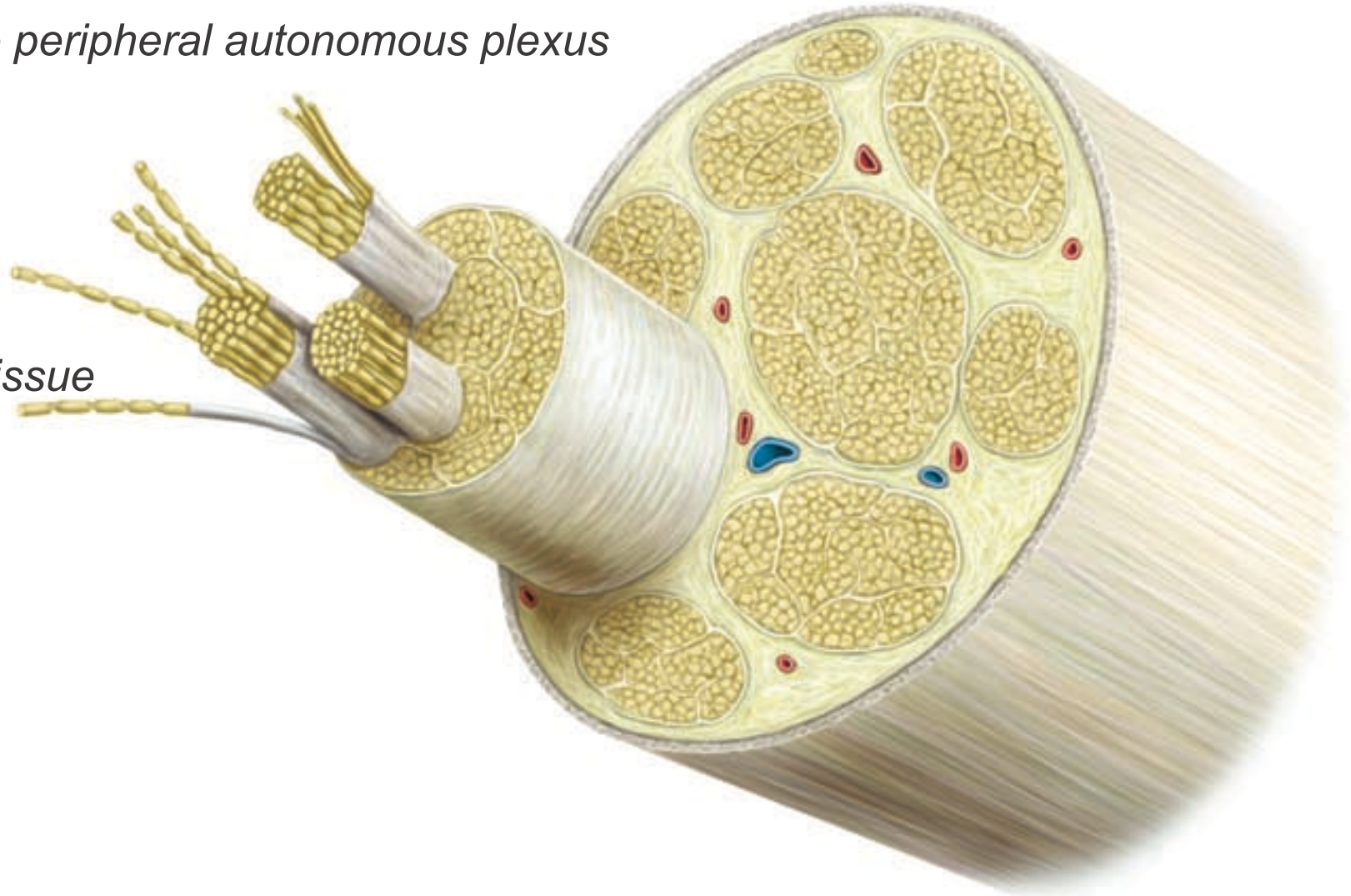
- *Nervus spinalis*
- *Ramus dorsalis*



- *Ramus meningealis*
- *Ramus ventralis*
- *Ramus communicans albus*
- *Ramus communicans grisseus*
- *Ganglion sympaticum*
- *Nervi splanchnici*

Peripheral nerve structure

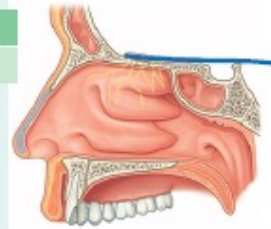
- **epineurium**
  - *Fibrous sheath of peripheral nerve*
  - *Containing vessels with the peripheral autonomous plexus*
- **Perineurium**
  - *Separating fascicles*
  - *No lymphatic vessels*
- **Endoneurium**
  - *Intrafascicular donnective tissue*
  - *Separating particular fibers*
- **Myelinized**
  - *Sensoric*
  - *motor*
- **Un-myelinzed**
  - *autonomous*



Nervi craniales

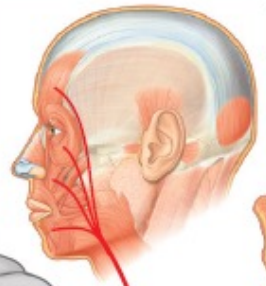
Optic nerve [II]

Special sensory – vision



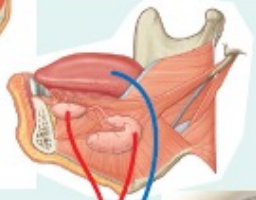
Olfactory nerve [I]

Special sensory – smell



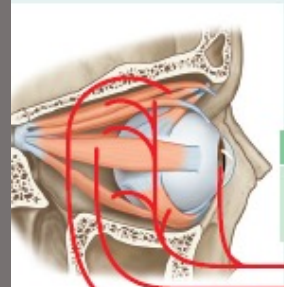
Facial nerve [VII]

Branchial motor – all muscles of facial expression, and stapedius, stylohyoid, and posterior belly of digastric



Facial nerve [VII] (intermediate nerve)

Special sensory – taste (anterior 2/3 of tongue)
Somatic sensory – part of external acoustic meatus and deeper parts of auricle
Visceral motor (parasympathetic) – secretomotor to all salivary glands except for parotid gland; all mucous glands associated with the oral and nasal cavities; lacrimal gland

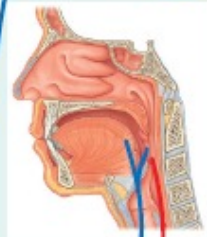


Oculomotor nerve [III]

Somatic motor – five extra-ocular muscles (superior rectus, medial rectus, inferior oblique, inferior rectus, and levator palpebrae superioris)
Visceral motor – ciliary muscles and sphincter pupillae muscles

Vestibulocochlear nerve [VIII]

Special sensory – hearing and balance



Glossopharyngeal nerve [IX]

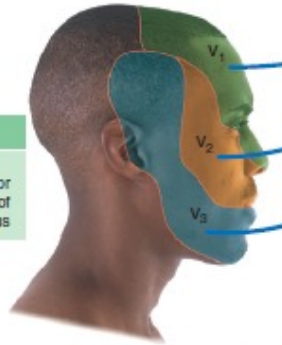
Special sensory – taste (posterior 1/3 of tongue)
Somatic sensory – posterior 1/3 of tongue, oropharynx, palatine tonsil, middle ear, pharyngotympanic tube, and mastoid air cells
Branchial motor – stylopharyngeus
Visceral motor – (parasympathetic) – secretomotor to the parotid gland
Visceral sensory – from carotid body and sinus

Trochlear nerve [IV]

Somatic motor – one extra-ocular muscle (superior oblique)

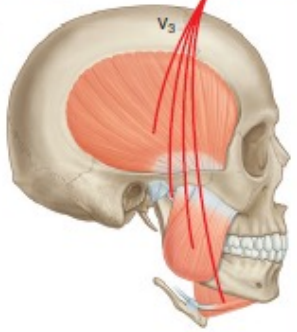
Abducent nerve [VI]

Somatic motor – one extra-ocular muscle (lateral rectus)



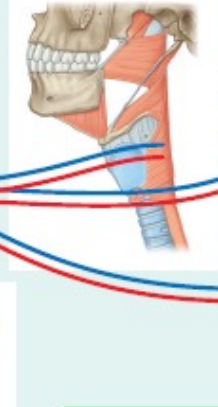
Trigeminal nerve [V] sensory root

Somatic sensory – eyes, orbital contents, face, sinuses, teeth, nasal cavities, oral cavity, anterior 2/3 of tongue, nasopharynx, dura, anterior part of external ear,and part of external acoustic meatus



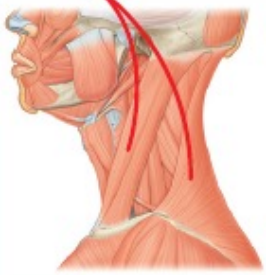
Trigeminal nerve [V] motor root

Branchial motor – the four muscles of mastication (medial pterygoid, lateral pterygoid, masseter, temporalis) and mylohyoid, anterior belly of digastric, tensor tympani, and tensor veli palatini



Hypoglossal nerve [XII]

Somatic motor – all muscles of the tongue except palatoglossus



Accessory nerve [XI]

Branchial motor – sternocleidomastoid and trapezius

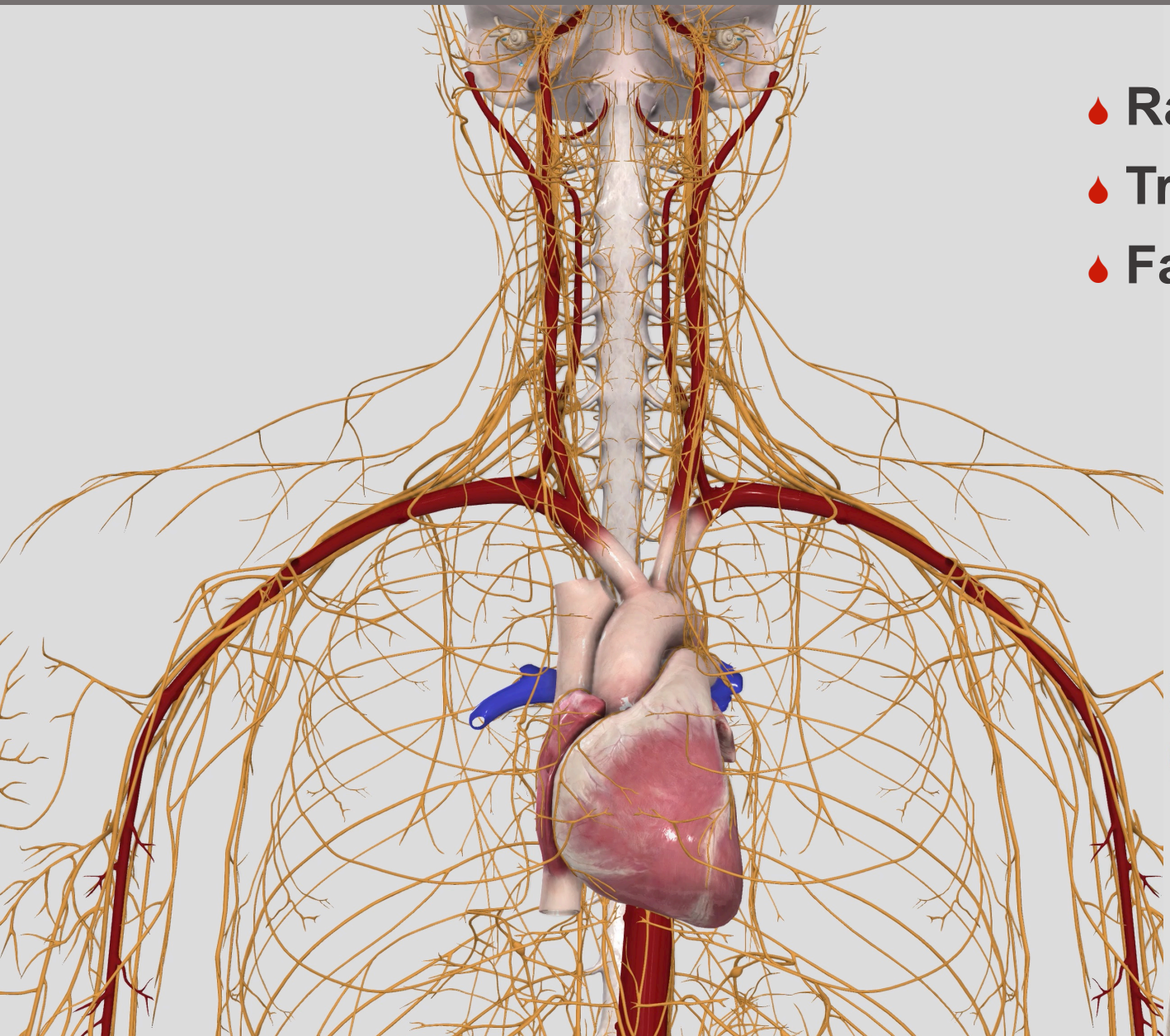
Vagus nerve [X]

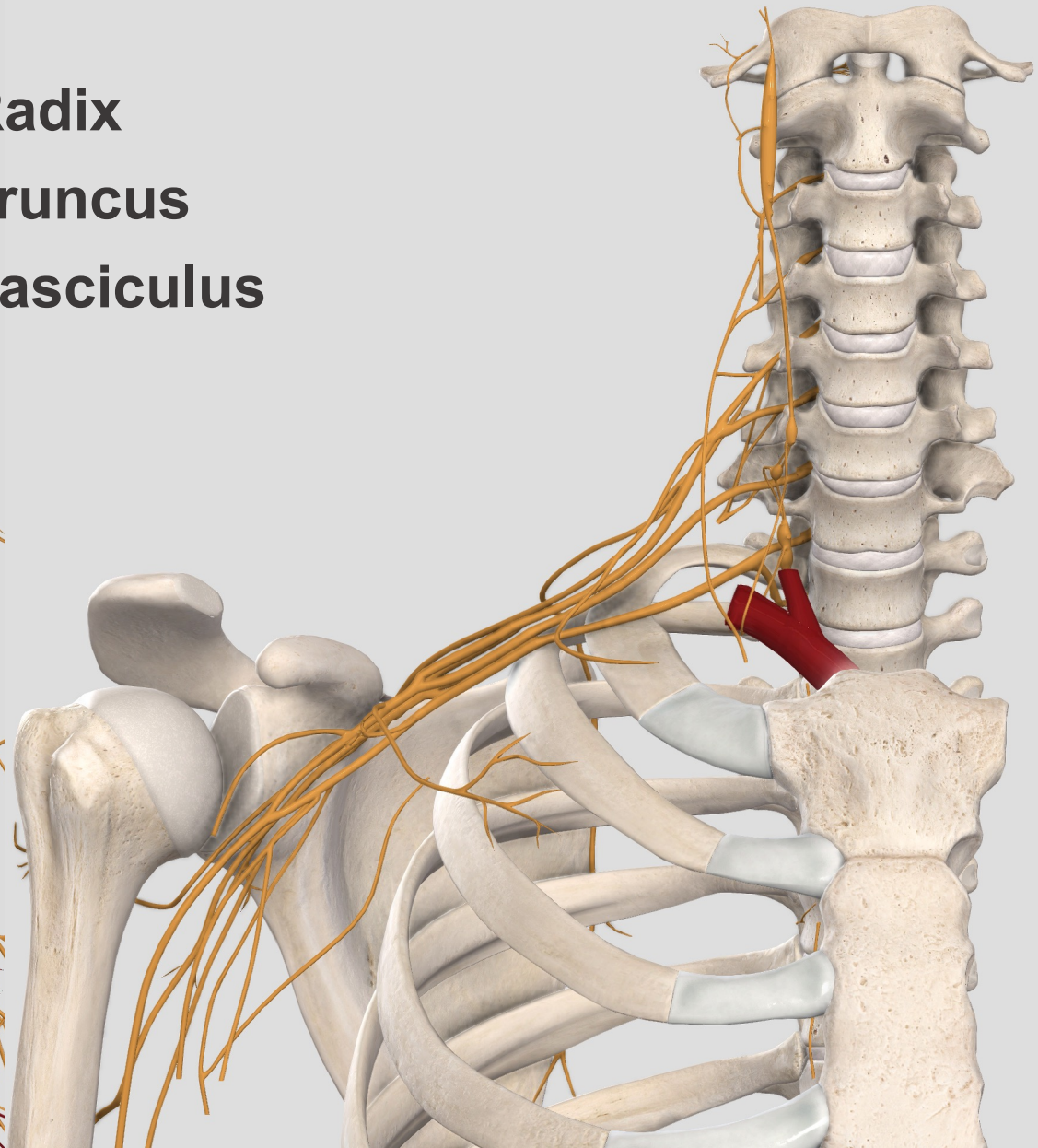
Somatic sensory – larynx, laryngopharynx, deeper parts of auricle, and part of external acoustic meatus
Special sensory – taste from epiglottis and pharynx
Branchial motor – all muscles of pharynx except for stylopharyngeus; all muscles of the soft palate except for tensor veli palatini, all intrinsic muscles of larynx
Visceral motor – (parasympathetic) – thoracic viscera and abdominal viscera to end of midgut
Visceral sensory – thoracic viscera and abdominal viscera to end of midgut, chemo- and baroreceptors
(and in some cases carotid body)

Efferent (motor) fibers
Afferent (sensory) fibers

Plexus

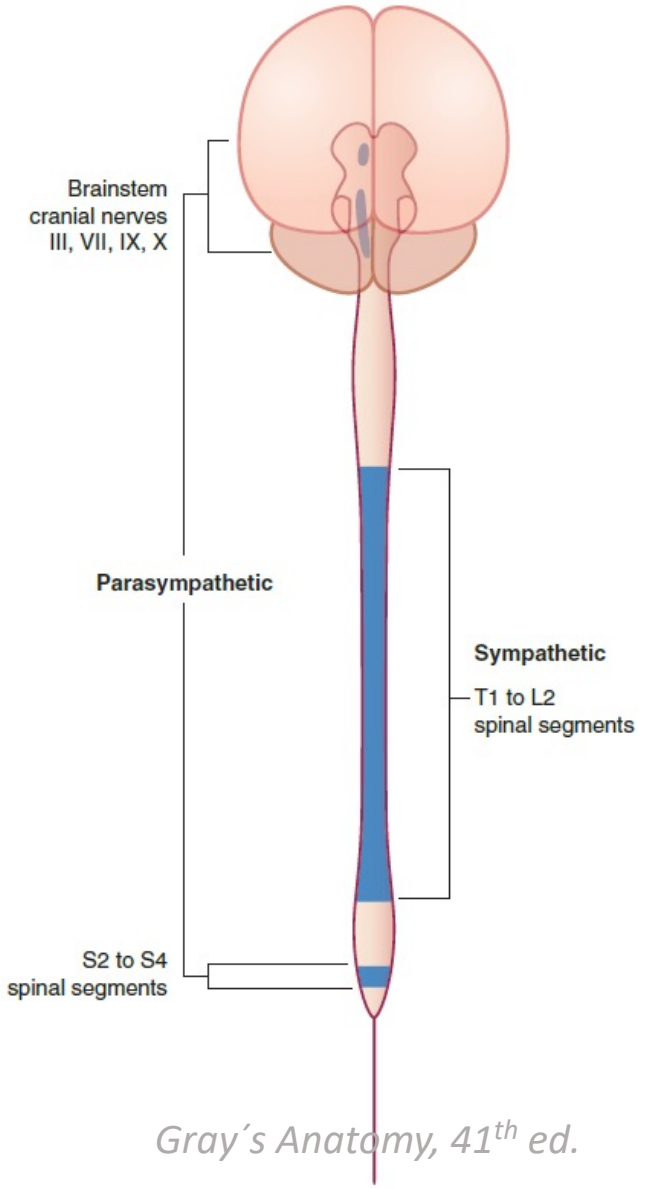
- Radix
- Truncus
- Fasciculus





Auztonomous system

- **Parasympaticus**
  - ***Cranial nerves***
  - *N. oculomotorius (III) - ggl. ciliare*
  - *N. facialis (VII) – ggl. pterygopalatinum, ggl. submandibulare*
  - *N. glossopharyngeus (IX) – ggl. oticum*
  - *N. vagus (X)*
  - ***Sacral spoinal cordS2-4***
- **Sympaticus**
  - ***Th1 – L3***
  - *Ganglion cervicale superius*
  - *Ganglion stellatum*
  - *Ganglion coeliacum*
  - *Ganglion mesentericum superius*
  - *Ganglion mesnetricum inferius*



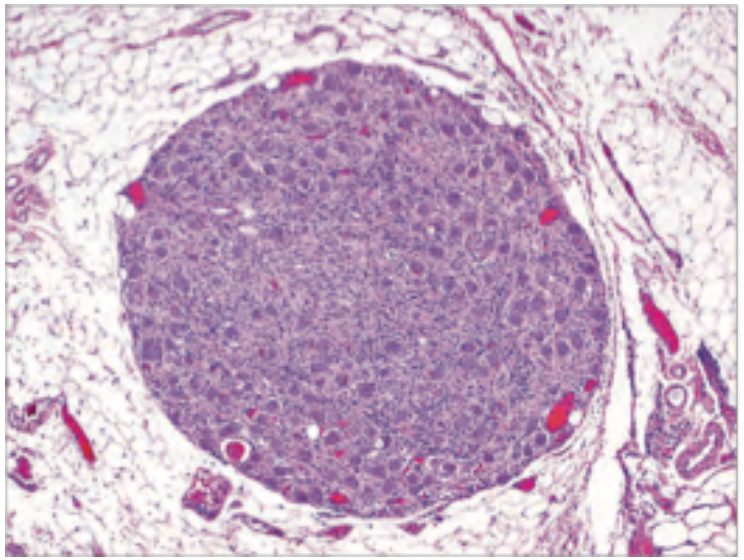
Gray´s Anatomy, 41th ed.

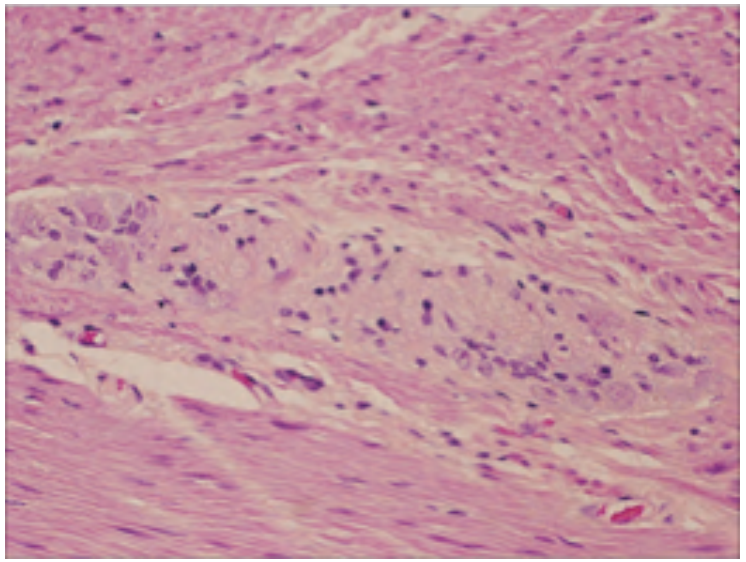
Autonomous effects

Organ	sympaticus	parasympaticus
Termin. synapse	noradrenaline	acetylcholine
eye	mydriase	miosis
Salivary glands	decreased salivation	increased salivation
Heatrt	tachycardia	bradycardia
Bronchi	dilatation	constriction
GIT	decreased activity	increased activity
Pancreas	less insuline	more insuline
Male genitalia	ejaculation	erection
Skin	sweeting, piloerection	--------

Ganglia

- **Somata assembled outside CNS**
  - *(cave: basal ganglia - CNS)*
- ***Spinal nerve ganglia***
  - ***Dorsal roots***
  - ***Pseudounipolar cells***
  - ***Nonsynaptic interaction between neurones themselves and with glia***
  - ***Vascularized endoneurium***
  - ***HERPES ZOOSTER***
- ***Ganglia autonomous***
  - ***autonomous ganglial neurons***
- *Ganglia parasypathetic*
  - ***Cranial nerves, sacral – cells less cooperating, less dendrites***
- *Ganglia sympathetic*
  - ***Mnultipolar, branched dendrites, interneurones***
  - ***Paravertebral ganglia – truncus sympaticus***
  - *Prevertebral ganglia – ggl. coeliacum, mesentericum sup, inf, renale*
- *Ganglia of enteric system*





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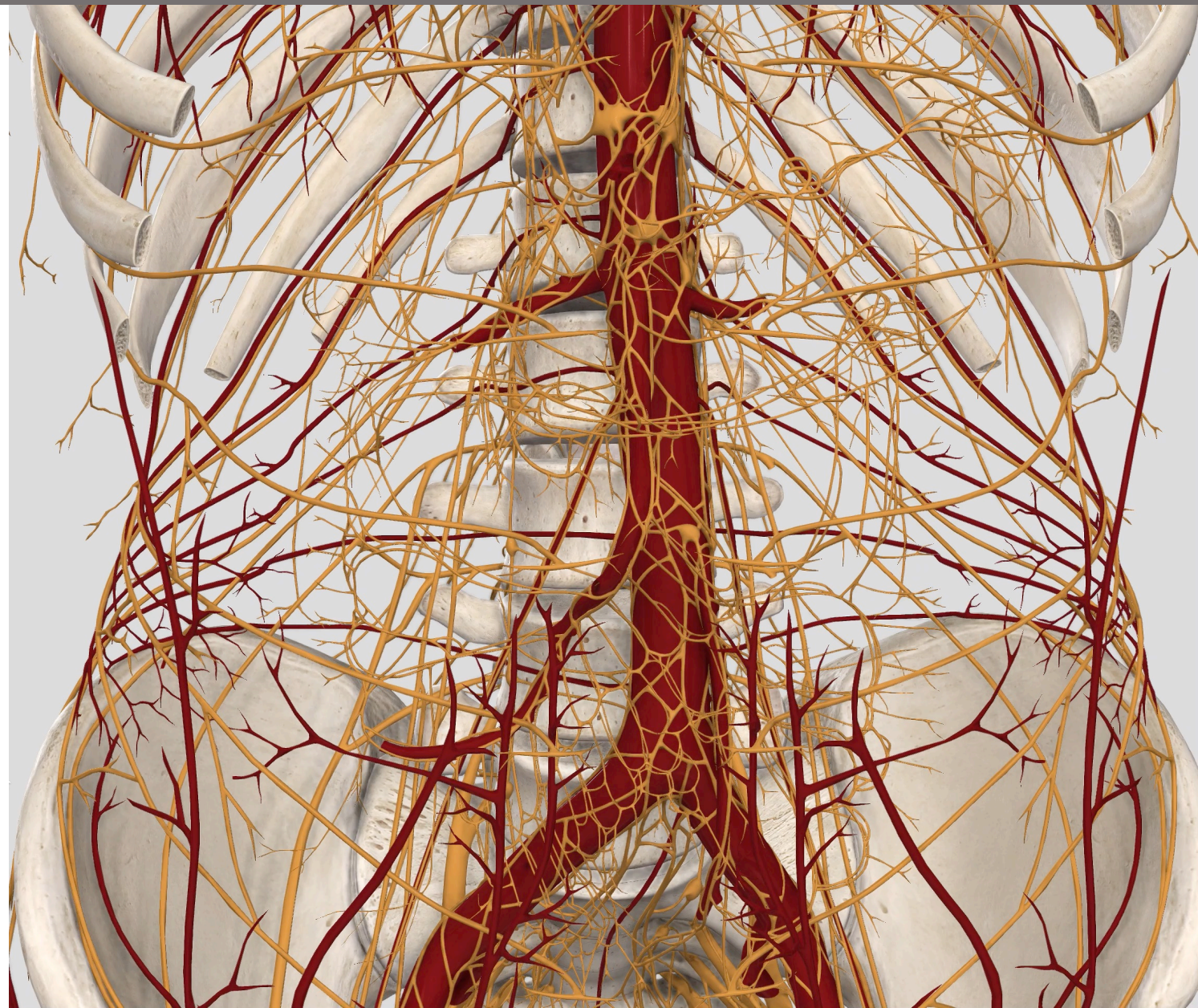
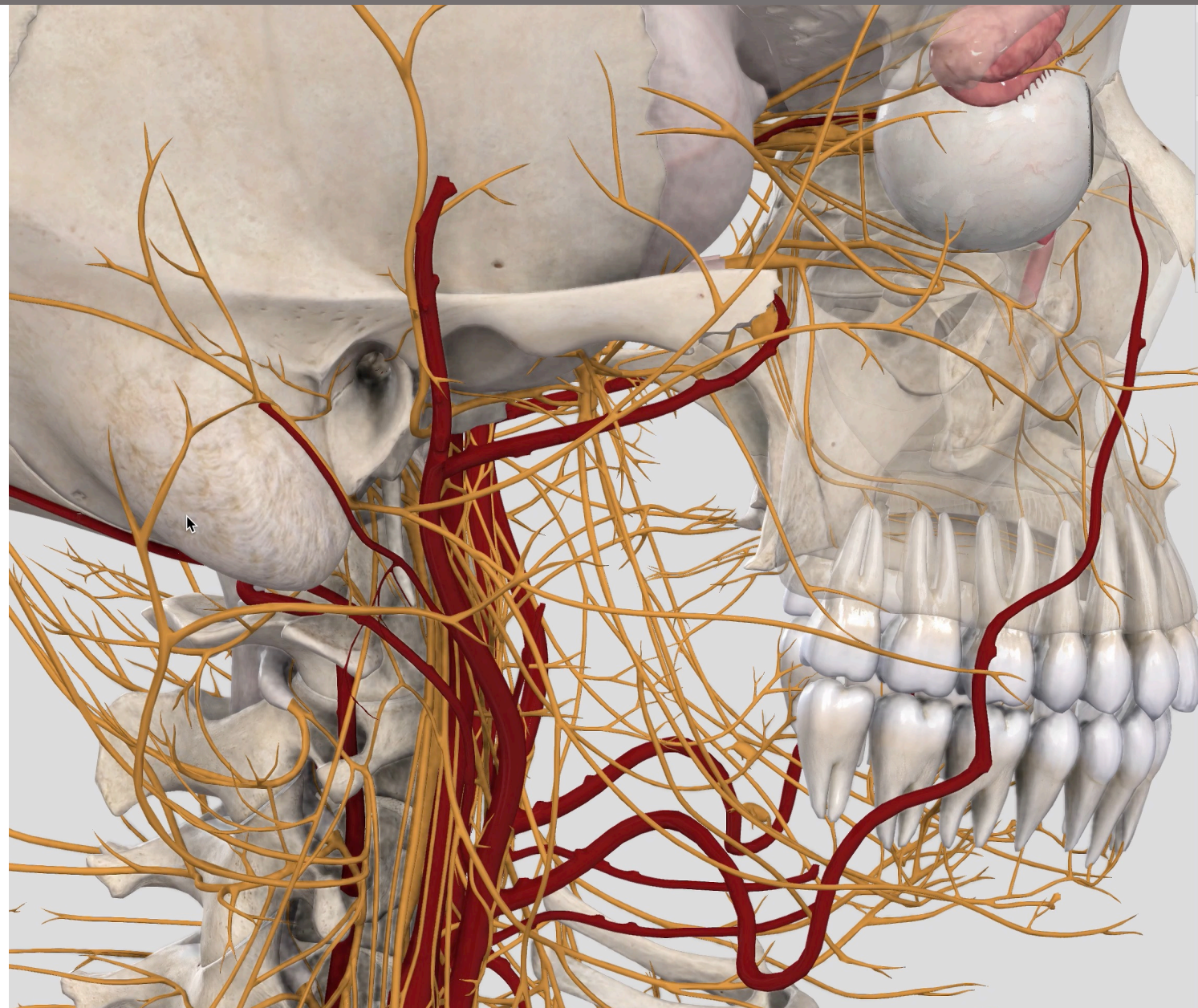
Sympathetic ganglia

- **Sympaticus**
  - ***Th1 – L3***
  - *Ganglion coeliacum*
  - *Ganglion mesentericum superius*
  - *Ganglion mesnetricum inferius*



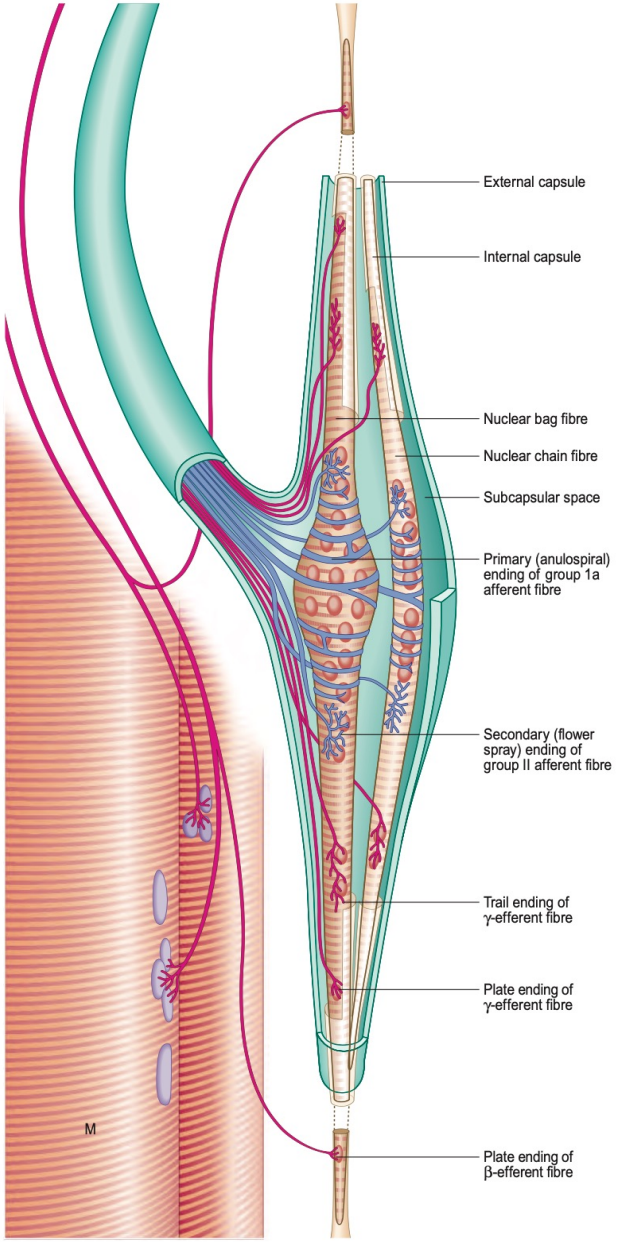
Parasympathetic ganglia

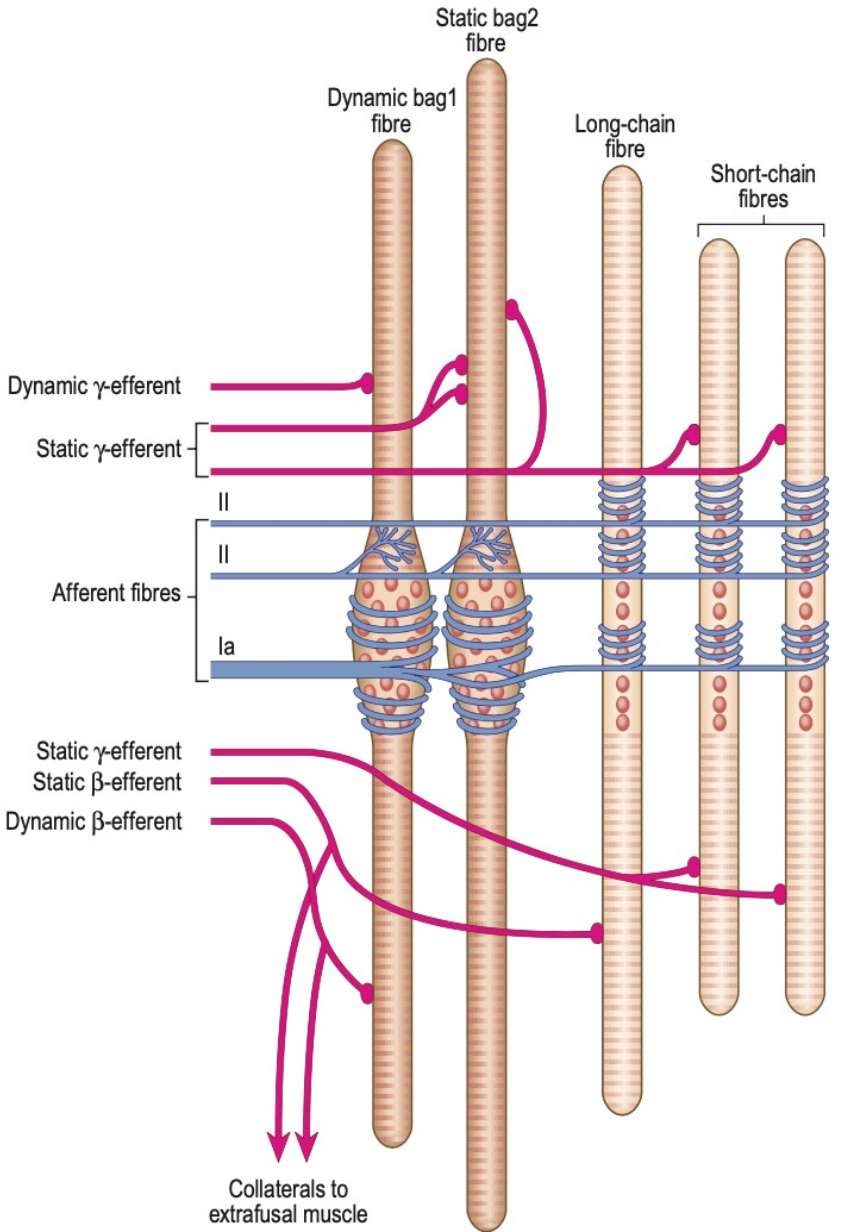
- **Parasympaticus**
  - ***Cranial nerves***
  - *N. oculomotorius (III) - ggl. ciliare*
  - *N. facialis (VII) – ggl. pterygopalatinum*
  - *N. facialis (VII) – ggl. submandibulare*
  - *N. glossopharyngeus (IX) – ggl. oticum*
  - *N. vagus (X)*



Neuromuscular spindle

- **In-one**
- **Motor ending**
- **Sensitive ending**
- **Modified muscular cells**
- **information**
- *velocity of contraction*
- *intensity of contraction*

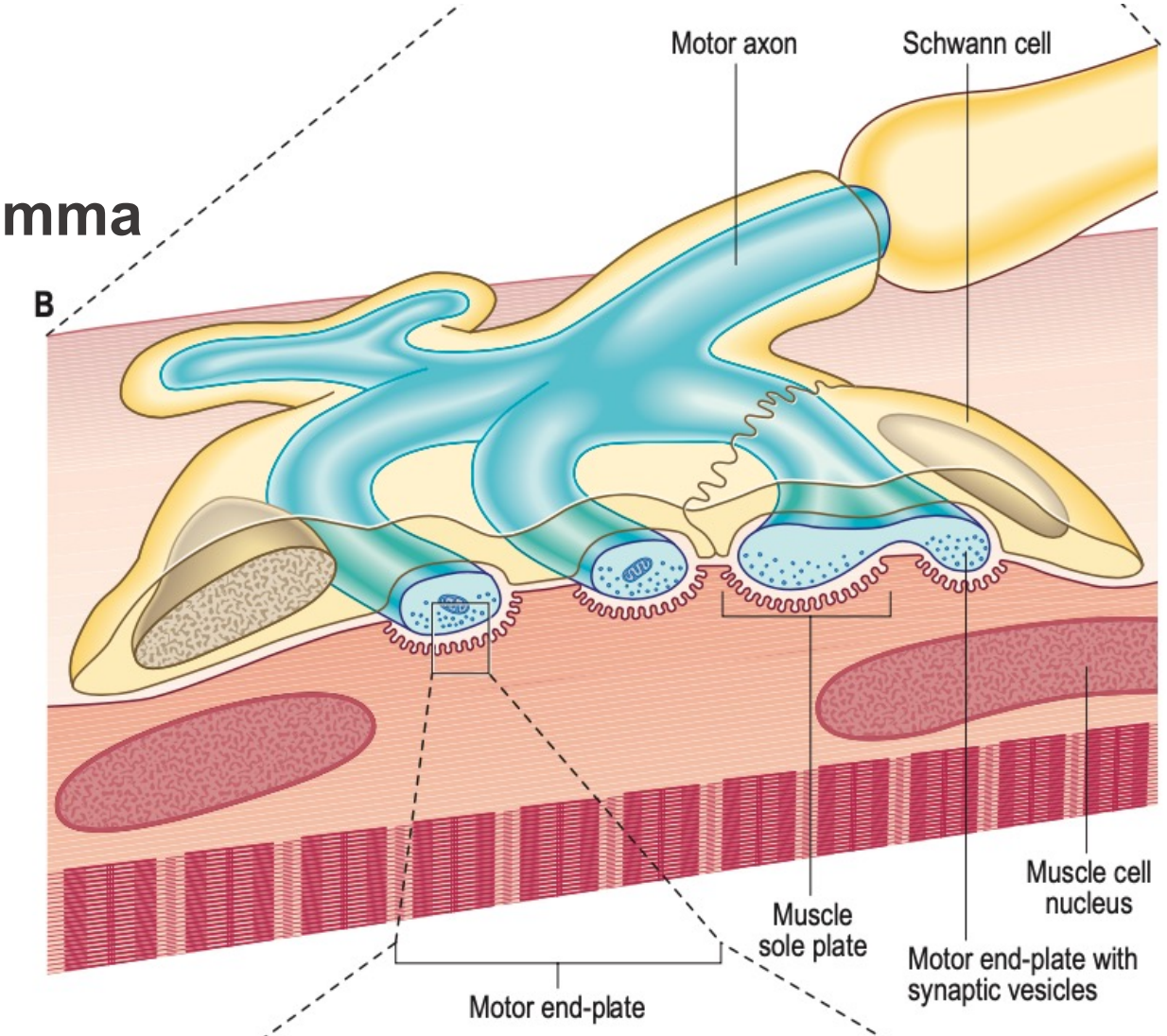




Neuromuscular transmission

- **Transmission to stripped muscle**
- Myelinized axon
- Cholinergic (ACh)
- Transmission into deeply folded sarcolemma

- **Autonomous motor transmission**
- Un-myelinized axon
- Varicose ending
- Adrenergic (norepinephrine = adrenalin)
  - Most of sympathetic
- Cholinergic - acetylcholine
  - parasympathetic
  - (rarely also sympathetic)



General anatomy 2