Embryology
/organogenesis/

Development and teratology of nervous system.
Repetition: nervous tissue.
Special embryology - questions

• Development of neural (ganglionic) crest and its differentiation.
• Development of spinal cord.
• Development of the brain – differentiation of secondary brain vesicles; brain chambers.
• Developmental abnormities of central nerve system.
**Neural plate** – thickened area of embryonic ectoderm
Invagination of neural plate $\Rightarrow$ neural folds + neural groove
Neural tube and neural crest

*Neuroporus ant.*, *post.*
Histogenesis of neural tube

The wall of neural tube – several cell layers
(simple → pseudostratified neural epithelium)
Cell proliferation ⇒ 3 layers (zones):

(in brain and cerebellum: cells from mantle zone migrate through marginal zone; gray matter covers white matter)

(in medulla spinalis)
Spinal cord development

- **Dorsal horns**
- **Sensory zone**
- **Basal plate**
- **Motor zone**
- **Floor plate**
- **Roof plate**
- **Marginal layer**
- **Mantle layer**
- **Ependymal layer**
- **Alar plate**
- **Sulcus limitans**

**Ventral horns**
HISTOGENESIS of SPINAL CORD:
1. Ependymal layer (germinal) – lining of central canal
2. Mantle layer (gray matter) – neuroblasts + spongioblasts give rise to neurons and glial cells
1. Marginal layer (white matter) – without neurons
Vertebrate canal grows more rapidly than spinal cord and caudal end of spinal cord doesn’t extend the entire length of canal in adult; it terminates at L1 in adults #.
Brain development

- Brain develops from cranial part of neural tube
- Week 4 – three primary brain vesicles: **prosencephalon** (forebrain), **mesencephalon** (midbrain), **rhombencephalon** (hindbrain)
5 secondary vesicles:

1 – ventriculi lat., 2 – ventriculus tertius, 3 – aqueductus cerebri, 4 – ventriculus quartus
CNS malformations

• failure neurulation (absence of notochord inductive influence or teratogen influence on neuroectodermal cells)
• defects of spinal cord
• defects of brain
• difficult malformations of CNS are usually connected with skull or spinal column (vertebral) defects.
Spinal cord malformations

Defects - clefts of vertebral arches (rarely bodies)

- Menigocele
- Menigomyelocele
- Menigohydromyelocele

- **Myeloschisis** – complete cleft of spinal column in the whole length

**spina bifida cystica**
Brain malformations

• Anencephalia (†) (+ myeloschisis)
Brain malformations

- Microcephalia
- Hydrocephalus
Brain and meninges herniation

A. Meningoencephalocele
B. Meningocele
C. Meningoencephalocele
D. Meningomyelocele
General histology - questions

- Nerve tissue – definition, structure, function and origin.
- Microscopic structure of nerve cell, types of neurons. The sheaths of nerve processes.
- Synapses – their structure and function. Nerve mediators (neurotransmitters).
- Central and peripheral nerve endings.
- Neuroglia – classification, cytological character and function.
Terms

• Neuron – perikaryon – axon (= neurite) – dendrite(s)
• Nissl bodies = rough ER
• Axon hillock
• Myeline sheath
• Schwann sheath
• Mesaxon
• Internodium
• Node of Ranvier
• Neuron – classification
• Synapse (presynaptic knobe, synaptic cleft, postsynaptic membrane)
• Neurotransmitters
Terms

- **Neuroglia - classification**
- Oligodendroglia
- Astrocytes
- Microglia (of Horteg)
- Ependyma - tanycytes
- Schwann cells
- Satellite cells

CNS: in CNS

PNS: in PNS
Special histology - questions

- Structure of the brain cortex. Cyto- and myeloarchitecture.
- Structure of the cerebellum. Synapses of the cerebellum.
- Microscopic structure of the spinal cord.
- Microscopic structure of ganglia and peripheral nerves.
- Ependyma, plexus chorioideus and meninges.
Terms

- Brain cortex – 6 layers (lamina)
- Cajal cells, Martinotti cells, granular and pyramidal cells
- Membrana limitans gliae superficialis et profunda (seu perivascularis)
- Brain barrier
- Cerebellum – 3 layers of cortex (stratum)
- Purkinje cells, basket cells, granular cells
- Glomeruli cerebellares
- Mossy and climbing fibers
Terms

• Dura mater – arachnoidea – pia mater
• Endoneurium – perineurium – epineurium
• Plexus chorioideus
Figure 3. Schematic view of vertebrate braincase development
Fig. 1 (a) A myelinated axon in the peripheral nervous system and (b) its development. Each Schwann cell myelinates a single axon, to which it is directly apposed. During development (anticlockwise) Schwann cells loosely ensheath axons and the myelin sheath grows around the axon to form concentric layers, which become tightly apposed.
Fig. 3 Myelination in the central nervous system. A single oligodendrocyte myelinates numerous axons (a) and, in section, concentric layers of myelin are seen to spiral around the axon (b). Myelin sheaths are arranged along axons in segments 1 mm long separated by short nodes, and would appear as large sheets if they were unwrapped from around the axon.
Dorsal root ganglion

Alar plate

Basal plate

Outgrowing motor axons

Dorsal sensory root

Dorsal horn

Ventral horn

Ventral motor root

Trunk of spinal nerve
hydrocephalus