Ch 13: Central Nervous System: Part 2

1. Meninges
2. CSF
3. Spinal Cord and Spinal Nerves

Explain spinal cord anatomy, including gray and white matter and meninges (give the general functions of this organ).

Discuss the structure and functions of the spinal nerves and plexuses.

Describe the structural components of reflexes.
1. Cranial Meninges

Three layers:

1. **Dura mater** - strong, "tough mother"
   a. falx cerebri
   b. falx cerebelli
   c. tentorium cerebelli

2. **Arachnoid** - spidery, holds blood vessels

3. **Pia mater** - "delicate mother"

Note: Subdural hematoma
The meninges
2. CSF: Cerebrospinal Fluid

- Formation in ventricles by specialized ependymal cells of **choroid plexus** (~500 mL/day; total volume ~ 150 mL)

**Functions**
- transport medium (nutrients, waste)
- shock absorption
- buoyancy (floats the brain)

**CSF circulation:** Ventricles → central canal → subarachnoid space

- An important diagnostic tool.
Hydrocephalus?
**Arachnoid granulations:** This is where the CSF produced in the choroid plexuses of the ventricles and which has circulated into the subarachnoid space is reabsorbed.
Meningitis: inflammation of meninges/CSF

Bacterial
- Relatively rare
- Life threatening
- Antibiotics

Fungal

Viral—most common
- Younger
- Self-resolving
Blood Brain Barrier (BBB)

- Tight Junctions in capillary endothelium prevent passive diffusion into the brain. Lots of Active Transport, especially of $H_2O$ soluble compounds (think glucose).
- Fat soluble compounds readily pass the BBB
  - E.g. steroid hormones, ADEK
- Major role of astrocytes
- 3 areas in brain don’t have BBB
  - portion of hypothalamus
  - pineal gland (in diencephalon)
  - choroid plexus
3. Spinal cord:

- Resides inside **vertebral canal**
  - Extends to L1/ L2
- 31 segments, each associated with a pair of dorsal root ganglia
- Two enlargements
  - **Cervical and Lumbar**
- **Conus medullaris**
- **Cauda Equina**
- **Filum Terminale**
  - Continuation of pia mater beyond the end of the spinal cord

\[Fig. \ 13-29\]
Cervical Enlargement

Gray matter expanded to incorporate more sensory input from limbs and more cell bodies for motor control of limbs.
Lumbar Enlargement

See fig 14-1
Spinal Meninges

Three membranes surround all of CNS

1) **Dura mater** - "tough mother", strong. Note the Epidural Space.

2) **Arachnoid** - spidery looking, carries blood vessels, etc. Note the Subarachnoid space which contains CSF

3) **Pia mater** - "delicate mother", adheres tightly to surface of spinal cord
Fig 13.30

Compare the spinal roots with the model of the vertebral column in the lab. Note that the dura covers both the dorsal and ventral roots.
Lumbar Puncture vs. Epidural

**Lumbar puncture:**
- Penetrates the dura, into the subarachnoid space
- Sample CSF
- Spinal anesthetic

**Epidural**
- “Upon the dura”
- Anesthesia
Organization of Spinal Cord

**Gray matter - interior horns**
- posterior - somatic and visceral sensory nuclei
- anterior (and lateral) gray horns – somatic and visceral motor control
- gray commissures - axons carrying information from side to side

**White matter - tracts or columns**
- posterior white column
- anterior white column
- lateral white column
- anterior white commissure

**functions**
- ascending tracts - sensory toward brain
- descending tracts - motor from brain
Sectional anatomy of spinal cord

Outer white part; inner gray butterfly
Organization of Spinal Nerves

1. **Root** – inside vertebral canal
   a. dorsal sensory root with a ganglion
   b. ventral motor root

2. **Mixed spinal nerve**

3. **Rami**
   a. dorsal - mixed to skin and muscles of back
   b. ventral - mixed “spinal nerve” to ventrolateral body surfaces and limbs
   c. *white ramus communicans* motor ANS
   d. *gray ramus communicans* motor ANS
Reflexes

Fast, preprogrammed, inborn, automatic responses

Occur in the CNS at the spinal cord or brainstem levels (cranial nerves)

May be either monosynaptic or polysynaptic

All require
  a. stimulus at receptor
  b. sensory information relay
  c. processing at CNS level
  d. activation of motor response
  e. response of peripheral effector
From interoceptors of back

From exteroceptors, proprioceptors of back

Dorsal root
Somatic sensory
Visceral sensory

From exteroceptors, proprioceptors of body wall, limbs

From interoceptors of body wall, limbs

Dorsal root ganglion
Rami communicantes

Ventral root

From interoceptors of visceral organs

(b) Sensory fibers
Ascending and Descending Tracts
Dermatomes

Sensory innervations by specific spinal nerves ➔
Each pair of spinal nerves monitors specific region of body surface.