Neuroembryology II

Dr. Newton
COPH G210
Anterior and posterior neuropore closure at E25 & E27, respectively, is essential for normal nervous system development.

NTDs occur 1/1K births. Incidence can be as high 1/100.

NTDs can be detected by ultrasound or elevated alpha-fetoprotein levels.
Failure of closure of the anterior neuropore. Can be born alive & live for several hours or days. Brainstem and spinal cord formation is normal.

(1/1.5K births; Females 4X > Males)
Various Types of “Spina Bifida”

Neural tube closure can fail at any point along the neuraxis.
Spina bifida has varying degrees of severity.

A. Spina Bifida Occulta
B. Meningo(myelo)cele
C. Rachischisis (Myeloschisis)
Craniorachischisis Totalis
The malformation of the spinal cord results in a portion of the brainstem and/or cerebellum to be pulled into the vertebral canal (Arnold-Chiari Malformation). This inhibits egress of CSF into the subarachnoid space where it is absorbed into the venous system.
Multiple neural tube defects can occur in the same individual: here both the anterior and posterior neuropores failed to close.
Encephaloceles result from a failure of closure of the flat bones of the skull. They can be occipital (most common) or frontal.
Defects in occipital bone closure occur in 1/2K births.
Fig. 74–10. Encephalocele with Chiari III malformation. A and B, T2-weighted sagittal and axial MRI scans demonstrate a huge fluid-filled sac external to the skull posteriorly, with patent communication to intracranial structures. There is herniation of both cerebellar hemispheres into the extruded CSF-filled sac, most consistent with occipital encephalocele. Distortion of the brain stem and absence of the corpus callosum are also apparent. (Courtesy of Dr. S. Chan.)
Holoprosencephaly results from a failure of cleavage of the embryonic prosencephalon by E35.

One telencephalon and one diencephalon.
The most severe cases of holoprosencephaly can result in cyclopia and is incompatible with life. Note; the optic nn. and retinas are extensions of the diencephalon.
Autonomic Nervous System & Q&A
Autonomic Nervous System

Two Divisions: 
- **Sympathetic**
  - Location: T1-L2 spinal cord
  - Action: widespread, danger
    - “fight or flight”

- **Parasympathetic**
  - Locations: S2-4 spinal cord & Cranial nn. III, VII, IX & X
  - Action: localized, homeostasis

All organs, except the skin, receive a dual innervation.
Skin = SNS only
Within the skin, the SNS innervates sweat and apocrine glands, smooth mm. within blood vessels, and the Arrector pili mm.

SNS Activation causes:
Sweating
Vasoconstriction
Erection of body hair
Whereas only one lower motor neuron is needed to send information from the CNS to skeletal mm., it takes two neurons for the ANS to go from the CNS to the target, i.e., smooth mm., cardiac m., glands.
Pregang. SNS neurons can synapse on the postgang. SNS neurons at three different locations:

1. In the SNS chain ganglion adjacent to the spinal segment of origin of the pregang. SNS axon.

2. Up or down the SNS chain ganglia.

3. In a preaortic ganglia.
Sympathetic chain ganglia are found next to vertebral bodies and run from the base of the skull to the coccyx.
Preaortic ganglia are found on the ventral surface of the abdominal aorta & are composed of postganglionic sympathetic neurons.

Postganglionic SNS axons generally follow blood vessels to reach their targets.
Autonomic Nervous System

Two Divisions:
Sympathetic
Location: T1-L2 spinal cord
Action: widespread, danger

Parasympathetic
Locations: S2-4 spinal cord & Cranial nn. III, VII, IX & X
Action: localized, homeostasis
Hirschsprung’s Disease: failure of migration of postganglionic PSNS to into part of the hind gut; or the postganglionic PSNS neurons do not survive once they migrate to the colon. This results in a portion of the large intestine that is aganglionic and, therefore, incapable of propagating peristaltic waves.