Chapter 18: The Brain & Cranial Nerves

BIO 218
Fall 2011

Origin of the Brain

- Neurulation results in formation of the neural tube
- Neural tube gives rise to brain and spinal cord
Protection for the Brain

Meninges
- Dura mater
- Falx cerebri
- Falx cerebelli
- Tentorium cerebelli
- Arachnoid mater
- Pia mater

Hematomas
A. Epidural hematoma
B. Subdural hematoma
Cerebrospinal Fluid

Formed by choroid plexuses of the ventricular system.
- Capillaries covered by ependymal cells
- CSF is formed from blood plasma by filtration and secretion

CSF composition
- Water
- Proteins
- Lactic acid
- Urea
- Cations & anions
- White blood cells
Functions of CSF

• Mechanical protection – shock absorption, buoys brain, reduces weight of brain
• Chemical protection – optimal chemical environment necessary for normal neuronal signaling
• Circulation – minor exchange of nutrients and waste products between the blood and surrounding nervous tissue

Arachnoid Villi

• Extend into dural venous sinuses
• Entry of CSF into blood dependent on pressure

Blood flow in the brain

Blood flow in via carotid & vertebral arteries
Divisions of the Brain

1. Cerebrum
2. Diencephalon
3. Brainstem
4. Cerebellum
Cerebrum

The white matter contains association tracts, commissural tracts, projection tracts.

Cerebral cortex – 4 lobes

- Hand/eye movement
- Pain
- BP
- Emotion

Commissural & projection tracts

- Motor area
- Sensory area
- Association area
- Limbic area
- Frontal lobe
- Parietal lobe
- Occipital lobe
- Temporal lobe

Insula

- Cerebral cortex
- Corpus callosum
- Lateral sulcus
- Calcarine sulcus
- Sylvian sulcus
- Temporal lobe
- Insula
Functional Organization

Frontal Lobe
- Prefrontal cortex – personality, intelligence, planning, decision making, learning, recall
- Primary motor cortex – motor plan
  - Unequal representation of muscles
  - More distribution to those muscles that perform delicate or complex tasks
- Broca’s area
  - Speech production
  - Left hemisphere

Parietal Lobe
- Primary somatosensory area
  - Receives nerve impulses for touch, pressure, vibration, temperature, pain, proprioception
  - Perception & localization
  - Contains a “map” of the body
  - Representation depends on sensory receptor density in area of body
- Wernicke’s area
  - Speech comprehension
Speech

Broca’s Area – speech formation
• nonfluent aphasia results from damage to this area

Wernicke’s Area – speech comprehension
• fluent aphasia results from damage to this area

Aphasia is an impairment of language, which can involve speech, reading, writing

Occipital Lobe

• Primary visual area
  – Processing of visual information
  – Perception

• Visual association area
  – Important for recognizing & evaluating what is seen
Temporal Lobe

- **Primary auditory area**
  - Processing of auditory info
  - Perception
- **Auditory association area**
  - Allows recognition of sound
- **Primary olfactory area**
  - Processing of olfactory info
  - Perception

Hemispheric Lateralization (functional asymmetry)

*hemispheres receive sensory data from and control muscles on the opposite side of the body*
*L hemisphere – reasoning, scientific/math skills, spoken & written language*
*R hemisphere – musical & artistic awareness, spatial and pattern discrimination, recognition of faces and emotional content of language*

Basal Nuclei

- **Putamen** – control of movement, performance, movement sequences
- **Globus Pallidus** – motor movement
- **Caudate Nucleus** – learning & memory, OCD
Parkinson Disease

Is a result of the death of dopamine-releasing neurons extending from the substantia nigra to the basal nuclei

An imbalance of neurotransmitters (dopamine, ACh) is probably responsible for the symptoms, which include tremors, difficulty in initiating motor movement, impaired movement

Thought to be a significant environmental component to the disease

Limbic System

Amygdala – emotion, memory
Hippocampus – learning & memory
Mammillary bodies – add element of smell to memories, processing recognition memory
Olfactory bulbs – part of olfactory pathway
Fornix – connects hypothalamus & hippocampus

Diencephalon

Thalamus, hypothalamus, pineal gland
**Thalamus**
- Intermediate mass is a strip of gray matter connecting the two sides
- Major relay station for most types of sensory info (except olfactory)
- Transmits motor info from cerebellum and basal nuclei to the primary motor area
- Sleep/wake cycle

**Hypothalamus**
- Contains many homeostatic control centers (i.e. temperature, hunger, thirst)
- Link between the nervous and endocrine systems
- Integrates activities of the Autonomic Nervous System
- Regulates emotional & behavioral patterns

**Pineal gland**
-Secretes melatonin, a hormone important for setting the body’s internal clock
- Melatonin secretion higher in the dark vs. light

**Brainstem**
- Contains many homeostatic control centers (i.e. temperature, hunger, thirst)
- Link between the nervous and endocrine systems
- Integrates activities of the Autonomic Nervous System
- Regulates emotional & behavioral patterns

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![Brainstem Diagram](image-url)
Medulla Oblongata

- Continuous with spinal cord
- Cardiovascular center – bp regulation
- Medullary rhythmicity area
- Vomiting center
- Deglutition center

Pons & Midbrain

- Apneustic & Pneumotaxic centers
- Superior/inferior colliculi
  - Visual pathway
  - Auditory pathway
  - Integration of startle reflex

Reticular Formation

- Broad area within brainstem that contains a net-like arrangement of white and gray matter
- Reticular Activating System (RAS) contains sensory axons that project to cerebral cortex
  - Sleep/wake cycle
  - Maintains consciousness
  - Attention & focus
- Descending portion of RF projects to cerebellum and spinal cord and regulates muscle tone

Reticular Activating System (RAS)
Cerebellum

- Monitors muscle movements initiated by the motor areas in cerebrum
- Coordination of skilled movements

Cranial Nerves