BMS 129
Physiological Sciences 1

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WEEK 5/6
BRAIN STRUCTURE AND FUNCTION, INTEGRATIVE BRAIN FUNCTION AND CRANIAL NERVES

State and identify the major subdivisions and anatomical landmarks of the brain

Cerebrum split into two hemispheres by a longitudinal fissure. gryi= folds and sulci= grooves. Cortex is the surface layer of grey matter. Nuclei= deeper masses of grey matter. Tracts= bundles of axons (white matter).

Cerebrum
Diencephalon- thalamus, epithalamus and hypothalamus
Midbrain
Hindbrain- cerebellum, pons & medulla oblongata

Describe and identify the meninges of the brain

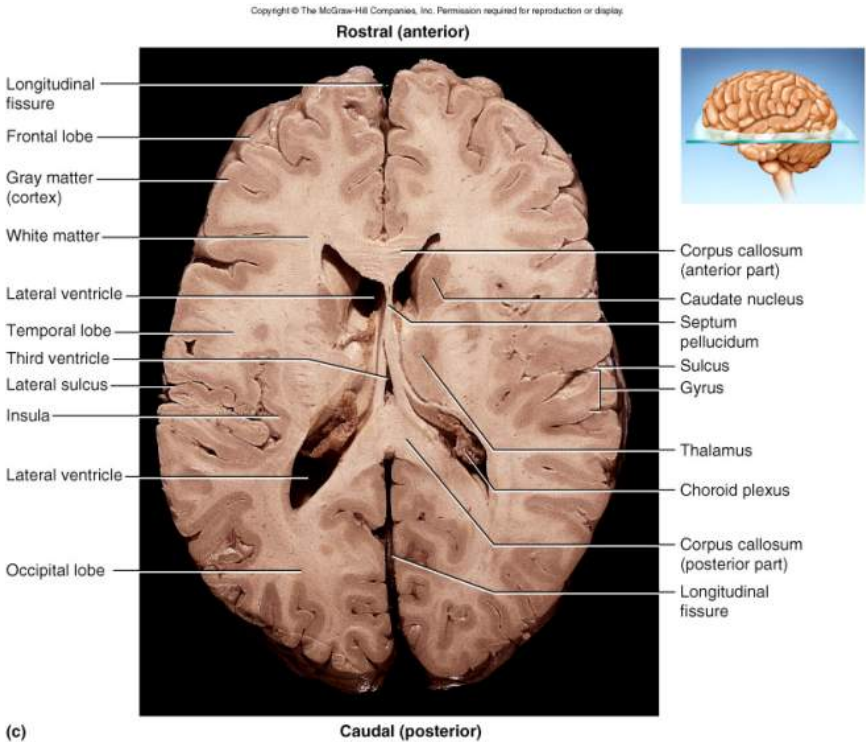
Dura Mater- Outermost tough membrane. Has two layers: an outer periosteal layer against bone and an inner meningeal layer. In some places the two layers are separated in parts to form dural sinuses that drain blood from the brain: two major superficial ones are superior sagittal sinus (found just under the cranium along the median line) and transverse sinus (runs horizontally from the rear of the head toward teach ear). The meningeal layer continues into the vertebral canal where it forms the dural sheath around the spinal cord.

Arachnoid Mater- middle layer with extensions called arachnoid villi that pierce dura and extend into sinuses. Sub arachnoid peace between the arachnoid and pia mater for blood vessels and flow of CSF. Transparent membrane over the brain surface, visible caudal half of the cerebrum.

Pia Mater- Inner layer that directly adheres to brain tissue and follows sulk and gyri. very thin, delicate membrane, generally need a microscope to see.

Describe and identify the ventricles within the brain

Lateral ventricles in cerebral hemispheres are the longest and most rostral ones. through a tiny pore called the inter ventricular foramen, each lateral ventricle is connected to the third ventricle.
Third ventricle- single vertical space under corpus callosum
Cerebral aqueduct runs through midbrain and leads to the fourth ventricle.



Fourth ventricle- chamber between pons and cerebellum. Caudally, this space narrows and forms a central canal that extends through the medulla oblongata and into the single cord.

Describe the production, circulation and function of cerebrospinal fluid (CSF)

CSF is a clear colourless liquid that fills the ventricles and canals of the CNS and bathes its external surface
Produced within brain ventricles by choroid plexus.

Production begins with the filtration of blood plasma through the capillaries of the brain. Ependymal cells modify the filtrate as it passes through them so the CSF has more sodium and chloride than blood plasma, but less potassium, calcium and glucose and very little protein.

Circulation is continuous, as the CSF continually flows through and around the CNS, driven partly by its own pressure, partly by the beating of ependymal cilia and party by rhythmic pulsations of the brain produced by each heartbeat.
CSF of the lateral ventricles flows through the interventricular foramina into the third ventricle, then down the cerebral aqueduct to the fourth ventricle. The fourth ventricle has 3 pores- a median aperture and two lateral aperture and these lead into the subarachnoid space on the brain and spinal cord surface. CSF is reabsorbed by arachnoid granulations, extension of the arachnoid meninx shaped like little sprigs of cauliflower, protruding through the dura mater into the superior sagittal sinus.

Functions of the CSF include:
Buoyancy- the CSF gives buoyancy to brain and spinal cord. The brain hands from delicate specialised fibroblasts of the arachnoid meninx.
Protection- protection from blows and other trauma. If a strike is severe the brain may still hit the inside of the cranium or suffer shearing injury from contact with the angular surfaces of the cranial floor.
Chemical stability- nourishes the brain: contains nutrients and hormones. CSF rinses metabolic wastes from the nervous tissue and regulates its chemical environment. Slight changes in composition can cause malfunctions of the nervous system.

Explain the significance of the blood brain barrier (BBB) system

BBB is endothelium of blood vessels. Permeable to lipid soluble materials- alcohol, O2, CO2, nicotine and anaesthetics. Water soluble materials need to pass through the cells of endothelium- regulated uptake.
Breaks in BBB at circumventricular organs- breaks in the barrier (in 3rd and 4th ventricle) where blood has direct access.
Monitors glucose, pH, osmolarity and others.

There are two points of entry that needs to be guarded: the blood capillaries throughout the brain tissue and the capillaries of the choroid plexuses. The capillaries are protected by the **blood-brain barrier** which consist of tight junctions that completely seal off the gaps between them. Endothelial cells are more selective about what passes through them and can exclude harmful substances from the brain tissue whilst allowing the necessary ones to pass through.

The choroid plexuses is protected by a blood-CSF barrier formed by tight junctions of the ependymal cells. The brain barrier system is highly permeable to water, glucose and lipid soluble substances such as oxygen, carbon dioxide, nicotine, caffeine and anaesthetics. Slightly permeable to sodium, potassium, chloride and waste products urea and creatinine.

Circumventricular organs (CVOs) are in the third and fourth ventricle where the barrier is absent and the blood has direct access to brain neurons. These enable the brain to monitor and respond to fluctuations in blood glucose, pH, osmolarity and other variables.

List the components of the hindbrain and midbrain and describe their functions

Medulla Oblongata:
Ascending and descending nerve tracts- Largest group of descending tract is the pair of corticospinal tracts.
Nuclei of cranial nerves (IX, X, XI, XII)
Centres for control of many vital functions- rate and force of heart, blood vessel diameter, rate and depth of breathing.
Neural networks involved in a multitude of fundamental sensory and motor functions. Sensory: senses, equilibrium, touch, pressure, temperature, taste and pain. Motor: chewing, salivation, swallowing, gagging, vomiting, respiration, speech, coughing, sneezing, sweating, cardiovascular and gastrointestinal control and head, neck and shoulder movements.

Reflex centres- for coughing, sneezing, gagging, swallowing, vomiting, salivation, sweating, movements of tongue and head.

Hindbrain: Pons
Ascending and descending nerve tracts
Nuclei of cranial nerves (V, VI, VII, VIII)
Pathways in and out of cerebellum
Nuceli concerned with: posture, sleep, hearing, balance, taste, eye movements, facial expression, facial sensation, respiration, swallowing, and bladder control.