

MENINGES AND VENOUS SINUSES OF BRAIN

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I. ARTERIAL SUPPLY OF BRAIN - derived from two sources

A. Internal Carotid Artery – Common Carotid Artery arises from Brachiocephalic Artery on right, Arch of Aorta on left; bifurcates at level of upper border of thyroid cartilage (Adam's apple) into Internal and External Carotid Arteries; Internal Carotid ascends to enter skull via Carotid Canal to Middle Cranial Fossa.

B. Vertebral Artery – arises from Subclavian Artery; ascends through Foramina Transversaria of vertebrae C1-C6; enters skull via Foramen Magnum.

II. MENINGES OF BRAIN - 3 layers, as in spinal cord; however, **dura mater is tightly attached to inner side of cranial cavity and has extensions (= reflections) into the cranial cavity. There is no epidural space in the cranial cavity.**

A. **Dura mater** (tough mother) - tough connective tissue layer said to be composed of two layers: inner meningeal (true dura) and outer endosteal (periosteum of inner side of calvarium); the two layers are fused in most places and tightly attached to inner surface of calvarium and cranial cavity (there is normally no epidural space) however, layers of dura separate to form inward folds called dural reflections. Dural reflections support and stabilize the brain and contain venous sinuses (see below):

1. **Falx cerebri** - sickle shaped fold between cerebral hemispheres; attached anteriorly to crista galli of ethmoid bone; posteriorly blends into tentorium cerebelli.

2. **Falx cerebelli** - small sickle-shaped fold that projects anteriorly from posterior wall of posterior cranial fossa between cerebellar hemispheres.

3. **Tentorium cerebelli** - crescent-shaped fold, forms roof over posterior cranial fossa; anteriorly has gap called tentorial notch for passage of brainstem.

4. **Diaphragma sella** - small circular fold of dura mater over sella turcica (has opening for stalk of pituitary).

B. **Arachnoid** (spider like) – similar to spinal cord; layer attached to inner surface of dura (separated from dura by potential space, subdural space); separated from pia mater by subarachnoid space which contains cerebrospinal fluid.

C. **Pia mater** (tender mother) - thin layer closely adherent to brain, surrounds arteries and veins that course on surface of brain.

III. VENOUS SINUSES OF BRAIN - course between two layers of dura; receive blood from brain, orbit and emissary veins.

A. Named sinuses

1. **Superior Sagittal sinus** - courses in upper fixed border of Falx Cerebri; begins anteriorly at foramen cecum and ends posteriorly by becoming continuous with transverse sinus; communicates laterally with outpocketings called venous lacunae; receives blood from Superior Cerebral veins which course on surface of hemispheres (via branches called **bridging veins**).

2. **Inferior Sagittal sinus** - courses in lower free border of Falx Cerebri; joins Great Cerebral vein to form Straight Sinus.

3. **Straight sinus** - courses between dural layers at junction of Falx Cerebri and Tentorium Cerebelli; posteriorly can join with Superior Sagittal sinus at Confluens of Sinuses or just turn left and be continuous with Transverse sinus.

4. **Transverse sinuses** - course posteriorly in fixed part of Tentorium Cerebelli; arise either at Confluens of Sinuses or as continuations of Superior Sagittal and Straight Sinuses.

5. **Sigmoid sinuses** - S-shaped continuations of Transverse sinuses; end at jugular foramen to drain into Internal Jugular veins.

6. **Occipital sinus** - courses in attached part of Falx Cerebelli; drains to confluens of sinuses.

7. **Cavernous sinuses** - situated in the middle cranial fossa on each side of the body of the sphenoid bone surrounding Pituitary gland (both Cavernous sinuses are connected by Intercavernous sinus); receive venous blood from Superior and Inferior Ophthalmic veins, cerebral veins; drains to Superior and Inferior Petrosal sinuses.

Note: Cavernous sinus also has anastomoses with Pterygoid venous plexus; provides a pathway by which infection can spread from face to brain.

Note: Cavernous Sinus Thrombosis - Internal Carotid artery and a number of cranial nerves (III, IV, V1, V2, VI) pass through wall of the cavernous sinus; disease processes in sinus can produce neurological symptoms; (Carotid siphon = U shaped turn of Int. Carotid as it passes through Cav. Sinus)

8. **Superior and Inferior Petrosal Sinuses** - situated on superior and inferior parts of petrous part of temporal bone; receive blood from cavernous sinus anteriorly; Superior Petrosal drains to Transverse sinus, Inferior Petrosal to Internal Jugular Vein.

IV. **CEREBROSPINAL FLUID** - made inside brain in choroid plexuses; flows out of brain into subarachnoid space; is re-absorb into venous sinuses at inpockets of subarachnoid

space called **arachnoid villi** (arachnoid granulations containing arachnoid villi are particularly prominent in walls of Superior Sagittal sinus); calcification of arachnoid villi common in elderly.

Note: **Communicating Hydrocephalus - Reduced re-absorption** of cerebrospinal fluid can result in **communicating hydrocephalus**; can damage brain by increased pressure.

V. **HEMATOMAS** - internal bleeds; in cranium can occur at a number of places; can damage brain by increasing intracranial pressure and by physically pressing brain.

A. **Epidural hematomas** - bleeding between dura mater and bone; often results from tearing of a **meningeal artery** (caused by skull fracture near pterion); bleeding can be quite profuse and **rapid** (arterial); lens shaped (biconvex) mass on CT; can displace brain and cause herniation (Uncal herniation = displacement of temporal lobe (uncus) through Tentorial Notch; Tonsillar herniation = displacement of cerebellum (tonsil) through Foramen magnum; patient often lucid at first (ex., following car accident) but bleeding can be fatal within hours.

B. **Subdural hematomas** - bleeding into potential space between dura and arachnoid; often results from tearing of branches of Superior Cerebral veins (**bridging veins**) or **venous sinus**; bleeding is often **slow** (venous blood) and chronic subdural hematomas can remain undetected; crescent shaped mass on CT; can cause herniation if untreated.

C. **Subarachnoid hematomas** - bleeding into subarachnoid space; can result from rupture of aneurysm (swelling on vessel wall) or physical tearing of **cerebral artery or vein**; bleeding can be **rapid (if arterial blood)** and fatal.

SUMMARY: INTRACRANIAL HEMATOMAS

| Clinical | Anatomy | Cause | Sign/Symptom |
|------------------------------|--|---|---|
| Epidural Hematoma | Middle Meningeal artery (90% of Epidural hematomas); branch of Maxillary artery that passes through foramen spinosum; supplies bone of calvarium; | Blow to side of head (fracture skull in region of pterion) | Patient conscious after accident; loses consciousness within hours; coma, death (Note: hematoma is lens-shaped on CT) |
| Subdural Hematoma | Bridging veins link Superficial cerebral veins on surface of brain and Superior Sagittal sinus (also other venous sinuses) | Blow to head; in elderly can occur without distinct event | Slow onset of neurological symptoms, headache (often hours to days) (Note: hematoma is crescent-shaped on CT) |
| Subarachnoid hematoma | Rupture of artery (ex. ' berry aneurism') or vein into subarachnoid space | Many, Hypertension, Trauma, etc. | Berry Aneurysm: Headache (sudden onset); rapid loss of consciousness, 25-50 % die |