Brain Herniation

The supporting Dural septa divide the intracranial cavity into various compartments and protect the brain against excessive movement, but limit the amount of compensatory shift and displacement that can develop in response to abnormal conditions. There are two major Dural septa; the **falx cerebri** and the **tentorium cerebelli.** The term **herniation** refers to the abnormal shifting of brain tissue within the cranial vault. Typically, the herniation occurs through a rigid opening composed of dura or bone and it is caused by focal masses. These masses could be; (1) Tumors (2) Intracranial Hematomas (3) Focal brain edemas.

Effects of rise intracranial pressure (ICP)

Normal ICP range from 10 to 15 mm. Hg. (135 to 200 mm. H_2O). an increase in ICP have an effect on the brain in two ways:

(1) Brain ischemia may occur when the cerebral perfusion pressure is reduced to critical level

(2) Focal masses can cause distortion and herniation of the brain, resulting in compression of
critical structures.

As a general rule; an increase in ICP without a shift of brain structures (as in pseudotumor cerebri or chronic hydrocephalus) is better tolerated than an increase secondary to a focal mass (as in tumor, intracranial hematoma, focal brain edema).

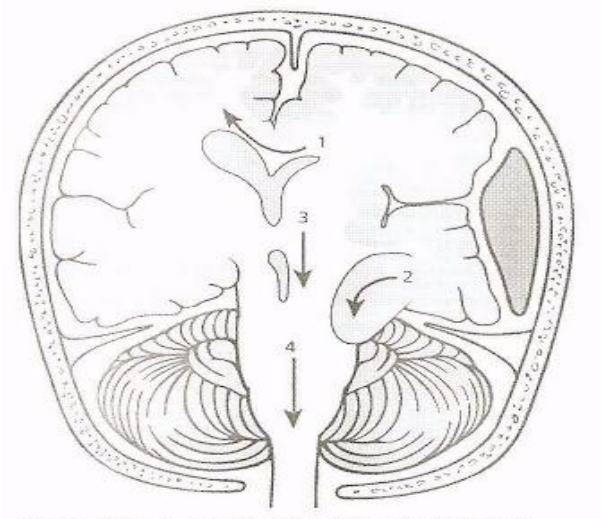
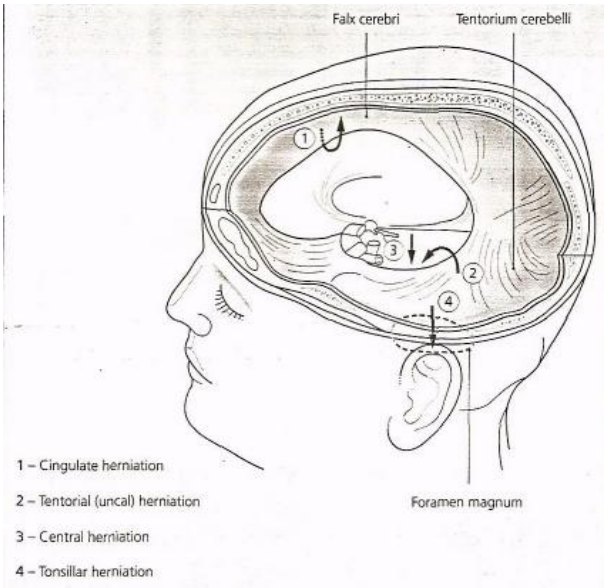


Fig. 3.3 Brain herniations. A lateral supratentorial mass will cause displacement of the lateral ventricles with (1) subfalcine herniation of the cingulate gyrus below the falx cerebri; (2) herniation of the uncus into the tentorial hiatus; (3) caudal displacement of the brainstem. Raised pressure within the posterior fossa may cause herniation of the cerebellar tonsils into the foramen magnum (4). (Adapted from Jennett & Teasdale (1981). Reproduced with permission.)



Types of brain herniation

A- Supratentorial herniations: the major supratentorial shift can be categorized as;

(1) **Cingulate herniation:** a supratentorial mass lesion may displace the cingulate gyrus, which is next to the free edge of the falx cerebri and cause it to herniate under the falx to the opposite side. The anterior cerebral artery may be compromised by tight, sharp edge of the falx cerebri. There are no clinical signs and symptoms specific to cingulate herniation.

(2) **Central trans-tentorial herniation:** this is most commonly occurring with mass lesions located far from tentorial hiatus; such as frontal, parietal or occipital areas. There is downward displacement of the diencephalon and midbrain centrally through the tentorial incisura. The patient tends to have bilaterally small reactive pupils, exhibit chyne-stokes respirations and may show loss of vertical gaze.

(3) **Uncal herniation:** It is the most common herniation syndrome observed clinically. It is often caused by mass lesions of middle cranial fossa, which cause the uncus (the most inferomedial structure of the temporal lobe) to herniate between the brain stem (at level of midbrain) and tentorial edge into the posterior fossa. The clinical syndrome consists of progressive impairment of consciousness (compression on reticular activating system), dilated ipsilateral pupil (compression of the third nerve) and contralateral hemiparesis (direct compression of cerebral peduncle). The posterior cerebral artery may be compromised causing secondary infarction of the occipital lobe. When there is compression of the opposite cerebral peduncle against the tentorial edge (Kernohan's notch), the (false localizing) hemiparesis is ipsilateral to the herniation.
(4) **transcalvarial herniation**: through a defect in the skull.

B- Infra tentorial herniation: includes; **Tonsillar herniation,** which results from expansion of posterior fossa mass lesions. It may also result from lumbar puncture in patient with mass lesion in posterior fossa. The tonsil of the cerebellum herniates through the foramen magnum into the upper spinal canal, compressing the medulla which results in impair consciousness, neck stiffness and ataxic breathing.