Pneumocephalus Etiology

Anything that can cause a Cerebrospinal fluid fistula can produce associated pneumocephalus.

Postoperative

Postoperative pneumocephalus.

Traumatic

Posttraumatic pneumocephalus.

Spinal trauma.

Barotrauma [1] e.g. with scuba diving (possibly through a defect in the tegmen tympani)

Spontaneous Pneumocephalus

Spontaneous Pneumocephalus.

Invasive procedure

Lumbar puncture or continuous lumbar drainage: If the patient deteriorates with a drain in place: immediately stop drainage, place patient flat in bed (or slight Trendelenburg), start 100% O2, get CT or bedside cross-table skull X-ray (to R/O tension pneumocephalus due to drawing in of air).

Maybe potentiated in the presence of a Cerebrospinal fluid fistula [2].

Spinal anesthesia [3].

Congenital

Congenital skull defects: including defect in tegmen tympani.

Neoplasm

(Osteoma [4], epidermoid [5], pituitary tumor): usually caused by tumor erosion through the sella floor into the sphenoid sinus.

Infection

a) Occasionally gas-producing organisms may cause pneumocephalus.

b) Mastoiditis

Pneumocephalus is usually a self-limiting condition commonly associated with neurosurgical interventions, penetrating intracranial injury, craniofacial trauma, tumors of the skull base and rarely, can occur spontaneously or after an inadvertent dural tear.

Nontraumatic leaks primarily occur in adults > 30 yrs. Often insidious. May be mistaken for allergic rhinitis. Unlike traumatic leaks, these tend to be intermittent, the sense of smell is usually preserved, and pneumocephalus is uncommon.

Pneumocephalus occurs in ≈ 20% of patients with Cerebrospinal fluid fistulas [6].

Empty sella syndrome

In primary empty sella syndrome: Simple shunting for hydrocephalus runs the risk of producing tension pneumocephalus from air drawn in through the former leak site. This may necessitate transsphenoidal repair with simultaneous external lumbar drainage, to be converted to a permanent shunt shortly thereafter.

Cerebrospinal fluid fistula

At least two possible mechanisms for the development of PNC are described [7]. One is the effect of the ball valve, where the air enters from the extracranial space through Cerebrospinal fluid fistula, which allows input but not output. When the intracranial pressure increases, the brain, and the dura plug the fistula tract and prevent air from going out. Another theory is known as the inverted soda bottle effect. Loss occurs when the CSF for a fistula or external drainage causes negative intracranial pressure. Air enters as bubbles, replacing the CSF as the pressure in the two cavities balance. A more unusual mechanism is the production of gas in situ due to infection by germs forming gas [8].

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