Tension pneumocephalus

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Pneumocephalus under pressure compared with the outside atmospheric pressure, when, in most circumstances, a valve mechanism allows air to enter the skull but prevents it from escaping, thus creating a pressure differential.

Etiology

Intracranial gas can develop elevated pressure in the following settings:

1. when nitrous oxide anesthesia is not discontinued prior to closure of the dura [1].

2. when a “ball-valve” effect occurs due to an opening to the intracranial compartment with soft tissue (e.g. brain) that may permit air to enter but prevent the exit of air or CSF

3. when trapped room temperature air expands with warming to body temperature: a modest increase of only ≈ 4% results from this effect [2]

4. in the presence of continued production by gas-producing organisms

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see Pneumocephalus in the sitting position

see Tension pneumocephalus after shunt insertion.

see Tension pneumocephalus after acute subdural hematoma evacuation.

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see Tension pneumocephalus after chronic subdural hematoma evacuation.

see Postoperative pneumocephalus.

Epidemiology

Tension pneumocephalus is extremely rare, and considered a neurosurgical emergency.

Clinical features

Clinical deterioration due to increased intracranial pressure secondary to pneumocephalus [3].

Diagnosis

see Mount Fuji sign.

Treatment

If there is not infection or CSF fistula, pneumocephalus usually gets absorbed without any clinical manifestations. The conservative treatment involves placing the patient in the Fowler position of 30°, avoiding Valsalva maneuver (coughing and sneezing), administering pain and antipyretic medications to prevent hyperthermia, and osmotic diuretics. With these measures, reabsorption was observed in 85% of cases after 2–3 weeks [4]

Case reports

2016

Shieh et al report a case of postoperative mental status changes after exenteration due to tension pneumocephalus. After surgical and medical management, the patient's pneumocephalus resolved and she recovered fully. Risk factors for tension pneumocephalus, mechanism, clinical presentation, and management techniques are discussed [5].

2015

A rare cause of reversible ophthalmoplegia: tension pneumocephalus with brainstem compression [6].

A rare case of post-traumatic epidural tension pneumocephalus in a 30-year-old white man who deteriorated rapidly after a blunt head trauma. Imaging revealed a large, right temporoparietal epidural pneumocephalus with mass effect, most likely arising from a small defect in the mastoid sinus. A pre-existing mucocele was also suspected. Emergency burr hole evacuation was performed and he experienced full recovery, but more invasive treatment was eventually needed to resolve the condition.

Epidural tension pneumocephalus is a rare and potentially life-threatening condition, but treatable

with the right management [7].

2013

A 39-year-old man was suffered from bacterial meningitis spread from sphenoid sinusitis. During the first several days of the hospitalization, his clinical and laboratory findings were improved by the antibiotics. But he developed impaired consciousness and paraparesis on the sixth hospital day. A CT scan of the brain revealed pneumocephalus with compression of frontal lobes and the widening of the interhemispheric space between the tips of the frontal lobes, which was known as “Mount Fuji sign”. Tension pneumocephalus was diagnosed on the basis of the clinical symptoms and the characteristic CT findings. As the bacterial meningitis itself was improving, the surgical treatment was not performed, but the antibiotics therapy continued. He gradually recovered and discharged without any other complications. The mechanism of tension pneumocephalus could not be disclosed. However, it was speculated that tension pneumocephalus was formed due to combined conditions of following factors; the fistula formation between sphenoid sinus and subdural space, the reduced CSF pressure on lumbar puncture, and a ball-valve mechanism though the fistula. We would emphasize that “Mount Fuji sign”on CT or MRI was the important finding to diagnose tension pneumocephalus [8].

2009

A 40-year-old man presented with subdural hemorrhage, skull bone fractures, facial bone fractures, sinus fractures, and CSF leakage after a one-story fall. He received HBOT as an adjunctive treatment to reduce brain edema and increase oxygen availability in brain tissue. Tension pneumocephalus developed after HBOT. Bur hole drainage was performed emergently to relieve the tension pneumocephalus. Cranioplasty and repair of skull base fracture were subsequently performed. The patient was discharged in a vegetative state. We proposed a possible mechanism by which tension pneumocephalus developed after HBOT sessions in this patient. Pneumocephalus, untreated skull base fracture, and CSF leakage should be considered contraindications to HBOT [9].

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