Brain Edema Etiology

Cerebral edema is a life-threatening condition that develops as a result of an inflammatory reaction. Most frequently, this is the consequence of cerebral trauma, massive cerebral infarction, hemorrhages, abscess, meningitis or encephalitis, tumor, allergy, sepsis, hypoxia, and other toxic or metabolic factors.

The blood–brain barrier (BBB) or the blood–cerebrospinal fluid (CSF) barrier may break down, allowing fluid to accumulate in the brain's extracellular space.

Altered metabolism may cause brain cells to retain water, and dilution of the blood plasma may cause excess water to move into brain cells.

Fast travel to high altitude without proper acclimatization can cause high-altitude cerebral edema (HACE).

Previous studies have shown that female mice have less brain edema and better recovery in neurological deficits after intracerebral hemorrhage (ICH) and that 17β-estradiol treatment in male mice markedly reduces ICH-induced brain edema.

Some authors have reported a rare unexplained complication of sudden death in association with massive cerebral edema immediately after cranioplasty. Sviri reports on 4 patients who underwent cranioplasty after decompressive craniectomy (DC) between January 2005 and August 2010 at his department and died because of massive cerebral edema immediately after uneventful surgery and anesthesia. All 4 of the new cases reported involved young male patients who underwent decompressive hemicraniectomy after traumatic brain injury. They developed massive cerebral swelling immediately after uneventful cranioplasty (3 patients) or after removal of an epidural hematoma several hours after surgery (1 patient). All 4 patients had a large skull defect and significantly sunken craniotomy site, and all were treated with a closed vacuum suction system that was placed under the scalp and kept open at the end of the cranioplasty procedure. After surgery, the patients' pupils became fixed and dilated, and brain CT scans showed massive brain edema. Despite emergency DC, the patients did not recover, and all 4 died. A MEDLINE search showed 8 similar cases that were reported previously. Fatal cerebral swelling after uneventful cranioplasty is a distinct clinical entity, although it is unpredictable. It is postulated that a negative pressure difference from the elimination of atmospheric pressure that had been chronically applied on the injured sinking brain in combination with the negative pressure applied by the closed subgaleal suction drain may lead to a massive brain shift toward the cranioplasty site and initiate a fatal vasomotor reaction [1)].

Postoperative cerebral edema around a deep brain stimulation (DBS) electrode is an uncommon reported complication.

A retrospective chart review was performed on all patients who underwent DBS electrode implantation over a 3-year period. Routine CT imaging on postoperative day (POD) 1 was negative. Patients were identified based on clinical neurological changes, leading to imaging and subsequent diagnosis.

Five of 145 patients (3.4%) presented with new neurological symptoms from POD 1 to 14, which were confirmed by CT imaging to show perilead and/or subcortical edema around 6 of 281 electrodes (2.1%). Four of 5 patients had unilateral edema despite bilateral implantation. Clinical presentations varied widely. Two patients presenting on POD 1 with deteriorating conditions required longer inpatient stays with supportive measures than those presenting later (p = 0.0002). All patients were treated with corticosteroids and returned to baseline by 3 months after surgery.

Acute instances of DBS lead edema may occur as early as POD 1 and can rapidly progress into profound deficits. Treatment with supportive care and corticosteroids is otherwise identical to those cases presenting later [2].

Postoperative Brain Edema

Postoperative Brain Edema.

Traumatic brain edema

Traumatic brain edema.

Peritumoral edema

Peritumoral edema.

Subarachnoid hemorrhage

Subarachnoid hemorrhage

1)
Sviri GE. Massive cerebral swelling immediately after cranioplasty, a fatal and unpredictable complication: report of 4 cases. J Neurosurg. 2015 Jun 19:1-6. [Epub ahead of print] PubMed PMID: 26090828.
2)
Fenoy AJ, Villarreal SJ, Schiess MC. Acute and Subacute Presentations of Cerebral Edema following Deep Brain Stimulation Lead Implantation. Stereotact Funct Neurosurg. 2017 Feb 17;95(2):86-92. doi: 10.1159/000454892. [Epub ahead of print] PubMed PMID: 28208150.

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Last update: **2024/06/07 02:57**