

Tension Pneumocephalus After Craniofacial Surgery Treated with Conservative Measures

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Abstract

Tension pneumocephalus (TP) is a neurological emergency characterized by air in the intracranial cavity. This can present with seizures, neurological deficits, coma, or even cardiac arrest in severe cases. Typically, TP requires urgent/emergent surgical intervention to decompress the intracranial cavity; however, this is not always the case. The aim of this case report is to highlight one such scenario where large-volume TP was treated with, full neurological recovery, using only conservative measures.

Keywords: Tension, Pneumocephalus, Oxygen therapy

Introduction

Tension pneumocephalus (TP), though uncommon, is a critical neurological condition characterized by the presence of pressurized air within the intracranial cavity. This condition can present with a spectrum of symptoms, including seizures, neurological deficits, coma, and, in severe cases, cardiac arrest. While urgent or emergent surgical intervention is often required to alleviate intracranial pressure (ICP), there are circumstances where conservative management alone may be sufficient. This case report explores one such instance of TP in an 89-year-old male patient following craniofacial surgery, highlighting the efficacy of conservative management even in patients with significant neurological deterioration.

Case history

History of present illness

The patient was an 89-year-old white male with a past medical history of hypertension, hyperlipidemia, coronary artery disease, chronic obstructive pulmonary disease, hypothyroidism, and sinonasal carcinoma, for which he had a left open and endoscopic medial maxillectomy, rib graft, and septal flap in September 2020. At the time, margins were noted to be negative; however, a year later, the patient had a recurrence of disease in the same area. After a discussion with his surgeon, both parties decided that repeat surgical intervention was the best path forward.

Surgery

The patient underwent maxillectomy, orbit exenteration, neck dissection, craniofacial resection, rhinectomy, sinusectomy, and free flap. The case was remarkable for stable hemodynamics and unremarkable extubation. Furthermore, the operation note did not mention any immediately apparent complications of the surgery.

Intensive care unit (ICU) course

On initial presentation to the ICU, the patient was hemodynamically stable and maintaining adequate oxygenation on supplemental O₂ through face tent, and over the next few hours, the patient was able to be weaned to room air. The following morning the patient became acutely obtunded, though the patient's respiratory status remained stable. The decision was made to emergently intubate which was successfully performed through the Relative Strength Index with etomidate and rocuronium. Of note, pre-oxygenation was done through a non-rebreather. Bag-mask ventilation was not utilized. The following morning, all sedation was held for a spontaneous breathing trial which the patient failed. Computed tomography (CT) of the head was subsequently obtained which revealed a large volume of TP. Neurosurgery was consulted and, upon completion of a full neuro examination, determined that there was no indication for acute surgical intervention. Instead, the patient was placed on 100% oxygen, and serial neuroexaminations and CT scans were performed. Over the next few days, the patient's neuroexamination and CT scans improved and eventually normalized. Eventually, the patient was extubated and transferred from the ICU.

Discussion

Pneumocephalus, characterized by the accumulation of air within the cranial cavity, is a fairly common phenomenon, particularly after trauma and intracranial surgery. Usually, this is a benign finding, does not present with neurological deficits, and usually self-resolves given time [1].

As opposed to regular pneumocephalus, TP is a neurosurgical emergency and can result in rapid clinical deterioration. TP typically presents with altered mentation, focal neurological deficits, seizures, and can even present with coma and cardiac arrest in particularly

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Figure 1: Head CT from the day after intubation. Note the prominent “Mount Fuji” sign.



Figure 2: Head CT four days after intubation. Note that the air pocket has been replaced with CSF

severe cases [2]. The pathogenesis is thought to involve a dural tear that creates a one-way-valve effect, similar to tension pneumothorax [3]. Cerebrospinal fluid leaks can also contribute to this picture, as air replaces the lost fluid, further exacerbating the picture in a phenomenon known as the “inverted bottle effect” [3, 4]. Air filling the cerebral cavity causes an increase in ICP, which is the cause of the symptoms indicated above. TP has been implicated in a number of scenarios, including but not limited to: Trauma, infection, epidural injections, intracranial surgery, spinal surgery, and craniofacial surgery [3].

Diagnosis of TP requires a degree of clinical suspicion. In a minority of patients, a splashing sound can be heard by the patient with postural change. This is called bruit hydroaérique or succussion splash and is pathognomonic for TP [4]; however, most cases will present with the non-specific neurological symptoms mentioned above. With this in mind, a CT scan becomes the gold standard for the diagnosis of TP [5]. In particular, the finding of intracranial air causing a widening of the interhemispheric space between the frontal lobe tips, also known as the “Mount Fuji sign,” is specific for TP on imaging [6].

Regarding management, benign or uncomplicated pneumocephalus is oftentimes treated with conservative measures, such as supplemental oxygen, elevated head of bed, avoidance of cough and valsalva, and antipyretics. Supplemental oxygen constitutes a basis in the management of simple pneumocephalus. It works by decreasing the partial pressure of nitrogen in the lungs. This in turn results in a lower partial pressure of nitrogen in the blood, creating a gradient that favors the diffusion of nitrogen out of the intracranial air pocket and into the blood, eventually making its way back to the lungs and out of the body [7]. TP, as opposed to uncomplicated pneumocephalus, is

classically treated with some form of surgical intervention such as burr hole, aspiration of air, needle aspiration, or craniotomy [6]. Supplemental oxygen has its role in these scenarios, but it is usually in combination with some procedures. In fact, there are few reports of patients with large volumes TP being treated solely with supplemental oxygen [5]. Perhaps there are a number of patient factors, TP etiology likely being one of them, that play a role in whether supplemental oxygen alone will be efficacious. Finally, it is important to note that despite our success with supplemental oxygen in this case, had the patient displayed worsening clinical status or imaging our next step would have been a surgical intervention. Rather than denying the need for procedural intervention, this case report was done mainly to show it may not necessarily need to be the first step in the treatment of TP. Conservative measures alone may be adequate.

Conclusion

This case provides an interesting look into a less invasive, less morbid, and more cost-effective way to treat even large-volume TP.

One interesting idea is that the patient’s age-related cerebral atrophy may actually have been a protective factor against the TP. Our hypothesis is that, by providing more room in the intracranial cavity for the air to expand, this patient’s ICP did not rise as much as it might have if he were 40 years younger. This change could have staved off herniation or more damaging decreases in cerebral perfusion. Although beyond the scope of this study, we believe this may present an area for further exploration.

Regardless, the main learning objectives from this case can be summarized by the points listed below:

1. Tension pneumocephalus is a dangerous medical disease characterized by air in the cerebral cavity. It can present with seizures, somnolence, deterioration in neurological exam, and even cardiac arrest in severe cases
2. CT scan is the benchmark for accurate diagnosis. The Mount Fuji sign is a finding on CT that is specific for tension pneumocephalus
3. Classically, uncomplicated pneumocephalus can be treated solely with conservative measures, while tension pneumocephalus is treated with urgent surgical intervention (burr hole aspiration of air, needle aspiration, craniotomy, and ventriculostomy placement) in addition to conservative measures
4. Supplemental oxygen, by enhancing the rate of nitrogen washout from the intracranial cavity, can be efficacious in treating even tension pneumocephalus without the need for surgical intervention.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his/her consent for his/her images and other clinical information to be reported in the Journal. The patient understands that his/her name and initials will not be published, and due efforts will be made to conceal his/her identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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