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Case Report

Iatrogenic Pneumocephalus Presenting as Seizure: A Rare Case Report

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ABSTRACT

Pneumocephalus is a rare condition characterized by the presence of intracranial air, most commonly seen after head trauma or surgery. Although it is often asymptomatic, it can lead to serious complications such as tension pneumocephalus and seizures. This study presents a case of iatrogenic pneumocephalus and seizures that developed after a flap rotation operation in a patient with a history of craniotomy. An 82-year-old male patient presented to the emergency department shortly after flap rotation surgery with loss of consciousness and generalized tonic-clonic seizures. Brain computed tomography revealed a left temporal bone defect and epidural air collection. Diffusion magnetic resonance imaging showed no acute ischemic lesion. The patient was initially started on levetiracetam, but due to side effects, he was switched to a combination of valproate and lamotrigine. The patient developed pneumonia during follow-up and was treated in the intensive care unit and discharged in stable condition. In patients who have previously undergone craniotomy, the risk of pneumocephalus should be considered even in minor surgical procedures, and early imaging should be performed when new neurological symptoms develop.

Key words: Pneumocephalus, intracranial air, craniotomy, seizure

INTRODUCTION

Pneumocephalus is defined as the accumulation or presence of air within the cranium, which can develop due to causes such as trauma, tumors, radiotherapy, or infection, and rarely occurs spontaneously. [1–4] It is most commonly seen following trauma or surgical intervention, and while it is frequently observed after intracranial surgeries, it is often asymptomatic. [2] However, if it progresses to tension pneumocephalus, it can cause serious neurological impairments such as seizures and brainstem compression. [2]

Pneumocephalus is classified as simple or tension pneumocephalus. Although it is generally benign, tension pneumocephalus can lead to serious neurological complications. [5] Pneumocephalus is most commonly seen after trauma or neurosurgical procedures, but it has also been reported rarely after gastrointestinal surgeries; therefore, patients who have previously undergone neurosurgical procedures should be carefully evaluated in this regard. [5] Two main mechanisms are suspected in the pathophysiology. The first is the "valve effect," which allows one-way air entry from the external environment into the skull, and the second is the "inverted soda bottle effect," which explains the suction of air into the cranial cavity due to negative pressure caused by cerebrospinal fluid (CSF) loss. [2,3,6]

Symptoms typically develop due to pressure on the meninges and brain tissue. This condition can lead to meningitis and other neurological complications. [1] Surgical manipulation and changing pressure dynamics may contribute to the formation of a transient epileptogenic focus in the central nervous system. [4] Clinically, altered

consciousness, seizures, headache, meningeal irritation findings, and, in advanced cases, brain herniation and death may be observed. [6–8] Prolonged coma has been reported rarely. [7]

This case presentation discusses an 82-year-old male patient who presented to the emergency department with seizures following iatrogenic pneumocephalus.

CASE REPORT

An 82-year-old male patient was brought to the emergency room by his relatives due to loss of consciousness and convulsions. According to his relatives, the patient had undergone a flap rotation operation under local anesthesia at another hospital due to subcutaneous wound healing problems that developed after a previous subdural hematoma in the left temporal region. After returning home following the surgery, he experienced a generalized tonic-clonic seizure with loss of consciousness, foaming at the mouth, and a fall at the doorway. There was no report of sphincter incontinence or trauma. The patient was brought to the emergency department by ambulance in the red zone and was in the postictal phase after the seizure.

In September 2024, he underwent ventriculoperitoneal shunt placement due to normal pressure hydrocephalus and craniotomy due to subdural hematoma. After this operation, he had no sequelae other than loss of fine motor skills in his right hand. The patient also had a history of chronic obstructive pulmonary disease, benign prostatic hypertrophy, dementia, hyperlipidemia, and coronary stenting in 2019.

A cranial computed tomography (CT) scan revealed a bone defect in the left temporal region due to previous surgery, direct contact between the dura mater and subcutaneous tissue, and an appearance consistent with air in the epidural space (**Figure 1**). This condition was assessed as iatrogenic pneumocephalus, thought to have developed after flap surgery. No new ischemic areas were observed on diffusion magnetic resonance imaging.

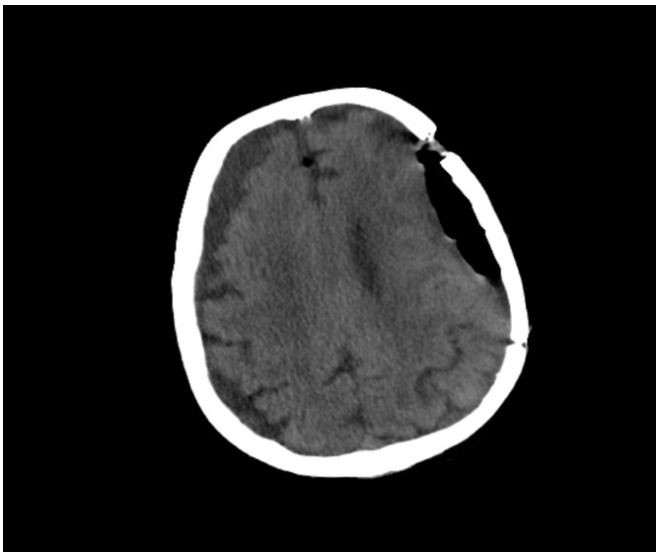

Figure 1: Free air in the cranium.

The patient was administered a 2,500 mg intravenous loading dose of levetiracetam in the emergency department and was admitted to the neurology ward with levetiracetam 500 mg twice daily, acetylsalicylic acid 100 mg orally once daily, and enoxaparin 40 mg subcutaneously once daily. However, the patient continued to experience somnolence during follow-up. Levetiracetam was discontinued due to suspected side effects and replaced with valproic acid, 1200 mg intravenous loading dose, and 400 mg intravenously twice daily as maintenance treatment. Lamotrigine 25 mg orally once daily was started due to the observation of myoclonic jerks in the right arm during the clinical course.

At admission, the patient had no respiratory distress or desaturation, and the initial chest X-ray did not reveal any signs of pneumonia. However, on the third day of hospitalization, a chest X-ray showed diffuse consolidation in the left hemithorax. Bronchoscopy revealed purulent secretions, and cultures grew Klebsiella. Given the absence of pulmonary findings at presentation and the timing of onset, the pneumonia was considered hospital-acquired rather than community-acquired or aspiration pneumonia. After developing hospital-acquired pneumonia, the patient required intensive care management and mechanical ventilation. He was extubated after approximately 3 weeks of ICU follow-up and subsequently transferred back to the neurology department.

In the pre-discharge evaluation, the patient was conscious but sleepy, with hypophonic speech and general weakness. No lateralized deficits were observed on neurological examination. The patient was discharged on valproic acid 600 mg in the morning, 400 mg at noon, and 400 mg in the evening, and lamotrigine 25 mg once daily (increased to 50 mg once daily after 2 weeks). Follow-up appointments were scheduled with the neurology, pulmonary medicine, and physical therapy clinics.

DISCUSSION

Pneumocephalus is a rare but potentially serious complication that usually occurs after head trauma or intracranial surgery. In most cases described in the literature, air enters the cranial cavities as a result of negative pressure or a valve mechanism associated with CSF leakage. In our case, iatrogenic pneumocephalus and seizures developed following a subcutaneous flap rotation operation performed under local anesthesia in a patient who had previously undergone craniotomy.

The seizure that developed after pneumocephalus can be attributed to pressure on the meninges and brain tissue or the irritative effect of air, as in many previous cases. [2,4,7] This situation may cause the development of a temporary epileptogenic focus. In a similar case described by Palacios-García et al., seizures developed in the early period after cochlear implantation, and intraparenchymal pneumocephalus was detected. [8] Similarly, in reported cases after spinal surgery, [7] pneumocephalus can manifest itself with seizures and changes in consciousness.

In our patient, the skin and bone defect in direct contact with the dura following flap surgery may have facilitated the passage of ambient air into the epidural space. The epidural air appearance is consistent with the bone defect on CT imaging supports this hypothesis. The "inverted soda bottle" effect and "balloon-valve" mechanism have been proposed

in the literature as pathophysiological explanations for such cases. [2,3,6] Especially in patients who have previously undergone neurosurgical procedures, reopening of the wound site or manipulation-related disruption of dura integrity may increase this risk.

From a treatment perspective, most cases of pneumocephalus are managed conservatively, with close clinical and imaging monitoring of patients recommended. In cases where seizures develop, antiepileptic treatment may be necessary. [7,8] Hyperbaric oxygen therapy has been reported as a potential treatment option in selected cases of tension pneumocephalus or persistent symptomatic cases. [9] However, most patients, including ours, can be managed conservatively with close clinical and imaging follow-up, and additional interventions such as hyperbaric oxygen were not deemed necessary. In our case, levetiracetam, the first-line antiepileptic agent, did not provide an adequate response, and combination therapy with valproate followed by lamotrigine was initiated.

CONCLUSIONS

This case is noteworthy in that it shows that pneumocephalus can develop even after minor surgical procedures performed on patients who have previously undergone craniotomy, and that it can be complicated by seizures. Even in procedures performed under local anesthesia, the risk of direct contact with intracranial structures must be taken into account.

PATIENT CONSENT

Written informed consent was obtained from the patient for the publication of this case report and all associated images.

AUTHORS' CONTRIBUTION

All authors have significantly contributed to the work, whether by following the case at the bedside, conducting literature searches, drafting, revising, or critically reviewing the article. They have given their final approval of the version to be published, have agreed with the journal to which the article has been submitted, and agree to be accountable for all aspects of the work.

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CONFLICT OF INTEREST

None.

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