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FROM TRAUMA TO TENSION PNEUMOCEPHALUS: A CASE REPORT WITH DIAGNOSTIC REVIEW

Neurosurgery

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ABSTRACT

Introduction: Tension pneumocephalus, caused by pressurized air within the cranial cavity, is a neurosurgical emergency. Differentiation from uncomplicated pneumocephalus is critical for proper diagnosis and treatment. **Case Report:** A 63-year-old male with a history of a road traffic accident presented with neurological symptoms, including limb weakness and speech disturbances. Imaging revealed tension pneumocephalus, and the patient underwent successful bifrontal craniotomy with sinus repair. **Discussion:** Tension pneumocephalus can result from trauma, surgery, or sinus pathology and presents with various neurological deficits. Anesthetic agents and therapies like hyperbaric oxygen can exacerbate the condition. Radiological signs aid diagnosis, but clinical deterioration is the key indicator for surgical intervention. **Conclusion:** Prompt identification and treatment of tension pneumocephalus are essential. Differentiating it from benign pneumocephalus is crucial for effective management, relying on clinical and radiological assessment.

KEYWORDS

INTRODUCTION

Post-traumatic pneumocephalus frequently occurs in neurosurgical patients. Tension pneumocephalus is characterized by pressurized air within the cranial cavity which leads to an extra-axial mass effect on the brain parenchyma.[1] Clinically, differentiating tension pneumocephalus from uncomplicated pneumocephalus is vital, as the former constitutes a neurosurgical emergency. Accurate diagnosis hinges on a high index of suspicion and familiarity with the distinct imaging features of tension pneumocephalus.

Case Report

Patient History:

A 63-year-old male presented with a history of a road traffic accident eight months ago. Initially managed conservatively, he recovered well but developed aggressive behavior five to six months post-accident. Over the past two months, he experienced progressive right-sided limb weakness, intermittent headaches, and speech disturbances. His hospitalization for five days with conservative management revealed no significant medical history or prior surgeries.

Examination And Initial Management:

Upon examination, the patient was conscious, cooperative, and oriented with stable vital signs. Neurological assessment showed right-sided hemiparesis, and hematological and biochemical investigations were within normal limits.

Diagnostic Workup:

EEG: Abnormal left frontotemporal discharges were noted.

CT Scan: Tension intraparenchymal pneumocephalous with perilesional edema noted involving left frontal lobe with elongated oval configuration noted approximately measuring 9.3(AP) x 5.1(ML) x 5.8(CC) cm region casing mass effect on the adjacent left frontal brain parenchyma, frontal horn of ipsilateral lateral ventricle and midline shift 9.00 mm to right with subfalcine herniation. The pneumatocele is seen to communicate with left frontal sinus through a bony defect in posterior wall of the left frontal sinus

Surgical Intervention:

Patient underwent bifrontal craniotomy with frontal sinus exteriorization and anterior cranial fossa base repair. Post-operative period was uneventful. Postoperative CT Brain was suggestive of hypodense area with air pockets involving the left frontal region with adjacent perilesional edema, approximately measuring 6.0(AP) x 2.4(ML) x 4.5(CC) cm. Significant reduction in midline shift noted. (Fig. 2)

DISCUSSION

The term "tension pneumocephalus" was coined in 1962 by Ectors, Kessler, and Stern.[2] It can occur following head injury or cranial surgery when the dura is compromised, allowing air entry into the cranial cavity. Clinical manifestations range from severe restlessness and decreased consciousness to focal neurological deficits and even cardiac arrest.[3] Understanding the underlying mechanisms and potential causes of tension pneumocephalus is essential for proper diagnosis and management. Trauma, cranial surgery, and sinus pathology are significant contributors. During head injuries or surgeries, air can enter the cranial cavity through a compromised dura.[4] Anaesthetic agents like nitrous oxide can exacerbate the condition by diffusing into the subdural space faster than nitrogen can escape.[5] Hyperbaric oxygen therapy and CPAP ventilation , can inadvertently exacerbate tension pneumocephalus.[6]

The "one-way valve effect," where increased nasopharyngeal pressure during activities like coughing or sneezing, can lead to tension pneumocephalus. Alternatively, cerebrospinal fluid loss might draw air intracranially, known as the “inverted bottle effect.”[7] Radiologically, subdural air initially compresses the frontal lobes, creating the "peaking sign," and as it progresses, the "Mount Fuji sign" appears. Multiple tiny air bubbles, termed the "air bubble sign," also indicate tension pneumocephalus.[8] However, these features are not exclusive to tension pneumocephalus and can appear in patients with normal intracranial pressures. Clinical deterioration is the key indicator for surgical intervention.

Hyperbaric oxygen therapy and CPAP ventilation, while beneficial for other conditions, can inadvertently exacerbate tension pneumocephalus.

The "one-way valve effect" explains how increased nasopharyngeal pressure from activities like coughing or sneezing can cause air to be trapped intracranially, leading to tension pneumocephalus. Additionally, the "inverted bottle effect" describes how cerebrospinal fluid loss due to trauma or surgery can result in air being sucked into the cranial cavity to replace the lost volume.

Radiological signs, such as the "peaking sign" and "Mount Fuji sign," along with the presence of multiple tiny air bubbles or the "air bubble sign," can aid in the diagnosis of tension pneumocephalus.[9, 10] However, these signs are not pathognomonic and can be present in patients with normal intracranial pressures. Therefore, clinical deterioration remains the key indicator for surgical intervention.

CONCLUSION

Tension pneumocephalus is a neurosurgical emergency necessitating prompt surgical intervention. Accurate diagnosis requires a high index of suspicion and thorough clinical correlation. Differentiating it from benign post-neurosurgical pneumocephalus is crucial for effective management. Understanding the clinical, radiological, and etiological aspects of tension pneumocephalus is essential for timely and

appropriate treatment.

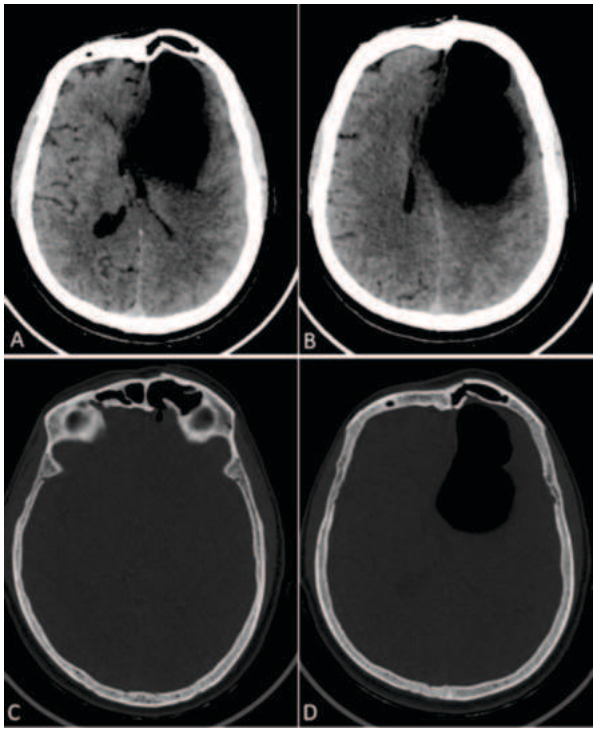

Figure 1- CT Brain Parenchyma (A,B) Axial view showing Tension intraparenchymal pneumocephalous with perilesional edema noted involving left frontal lobe causing mass effect and midline shift to right with subfalcine herniation; Bone window (C,D) showing defect in posterior wall of left frontal sinus.

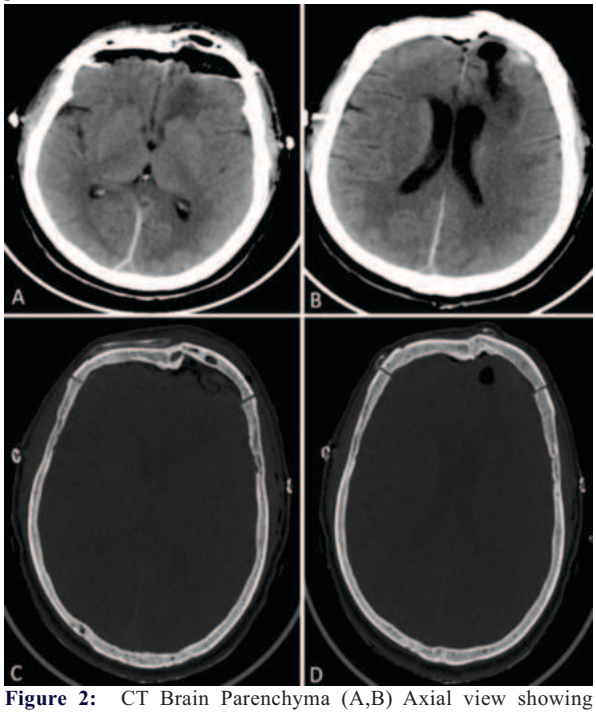

Figure 2: CT Brain Parenchyma (A,B) Axial view showing hypodense area with air pockets involving the left frontal region with significant reduction in midline shift.

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