

Silent intruder: Traumatic pneumocephalus without a fractured skull

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Section: Neuroradiology

Area of Interest: Neuroradiology brain Trauma

Imaging Technique: CT

Case Type: Clinical Case

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Patient: 20 years, male

Clinical History:

20-year-old male cyclist hit by a high-speed car, landing head-first on the pavement. He lost consciousness en route to the hospital and was taken for cranial imaging upon arrival.

Imaging Findings:

Non-contrast computed tomography (CT) head was performed. Results showed diffuse pneumocephalus with air seen within the sulci, ventricles and infratentorial regions (Figures 1 to 5). Mild subcutaneous soft tissue swelling along the left frontal region, likely post-traumatic. No evident craniofacial fractures on imaging. An urgent neurosurgical opinion was advised.

The remaining CT trauma whole-body series showed no other injuries.

Discussion:

Background

Pneumocephalus, the presence of pathological intracranial air, is primarily caused by disruption to the cranial vault following head trauma and neurosurgery. Less common causes include barotrauma [1], otogenic pneumocephalus, sneezing [2] and meningitis caused by a gas-forming organism [3].

Pneumocephalus with no fracture to the cranial vault is rare, with no definitive cause identified for its presence [4].

The onset of pneumocephalus can be measured by time of presentation—acute (<72 hours) and delayed (>72 hours) [1] with grading ranging from non-tension to tension pneumocephalus—an important distinction for patient management.

The main complication of pneumocephalus is it evolving into the tension variant, caused by a ball-valve mechanism: air gets trapped inside the skull through fracture points, but cannot escape due to sealing by arachnoid membrane, ventricles or brain parenchyma [5]. Where there is clinical suspicion of tension pneumocephalus, emphasis is placed on patients' presentation and any evidence of them experiencing symptoms such as deteriorating consciousness or focal neurological deficits. If there is such clinical suspicion, CT head imaging is warranted with urgent neurosurgical review and surgery advised.

Imaging Perspective

CT is the gold-standard imaging modality for the diagnosis of pneumocephalus [6], where thin slices should be utilised to ensure small bony disruptions or dural tears are not missed. Clinical suspicion should be high for tension variants with the pathognomonic “Mount Fuji Sign” especially useful—conveying that the pressure of the gas is greater than that of the intracranial cerebrospinal fluid between the frontal lobes—suggesting the need for immediate neurosurgery to prevent permanent neurological damage.

Outcome

In cases of non-tension pneumocephalus, surgery is not indicated as the air is gradually reabsorbed over 2–3 weeks [7]. The patient is managed with antibiotics, analgesics, antipyretics, high-flow oxygen therapy and head of bed positioning of 30° [1]. Clinical suspicion of evolution of pneumocephalus warrants a repeat CT head.

This patient was managed conservatively during a two-week inpatient stay with careful monitoring for signs suggesting development of tension pneumocephalus.

Teaching Points

Traumatic pneumocephalus with no craniofacial fracture is a rare presentation, and as such, extra care should be taken to ensure fractures are not missed. The main complication which can arise from a traumatic pneumocephalus is the development of tension pneumocephalus, a neurosurgical emergency which needs timely intervention to prevent permanent neurological damage. The use of CT head is gold-standard and is paramount in informing clinicians on the management of the patient.

All patient data have been completely anonymised throughout the entire case report and related files.

Differential Diagnosis List: Tension pneumocephalus, Cerebral air venous embolism, Traumatic pneumocephalus without craniofacial fracture, Fat in dural sinus

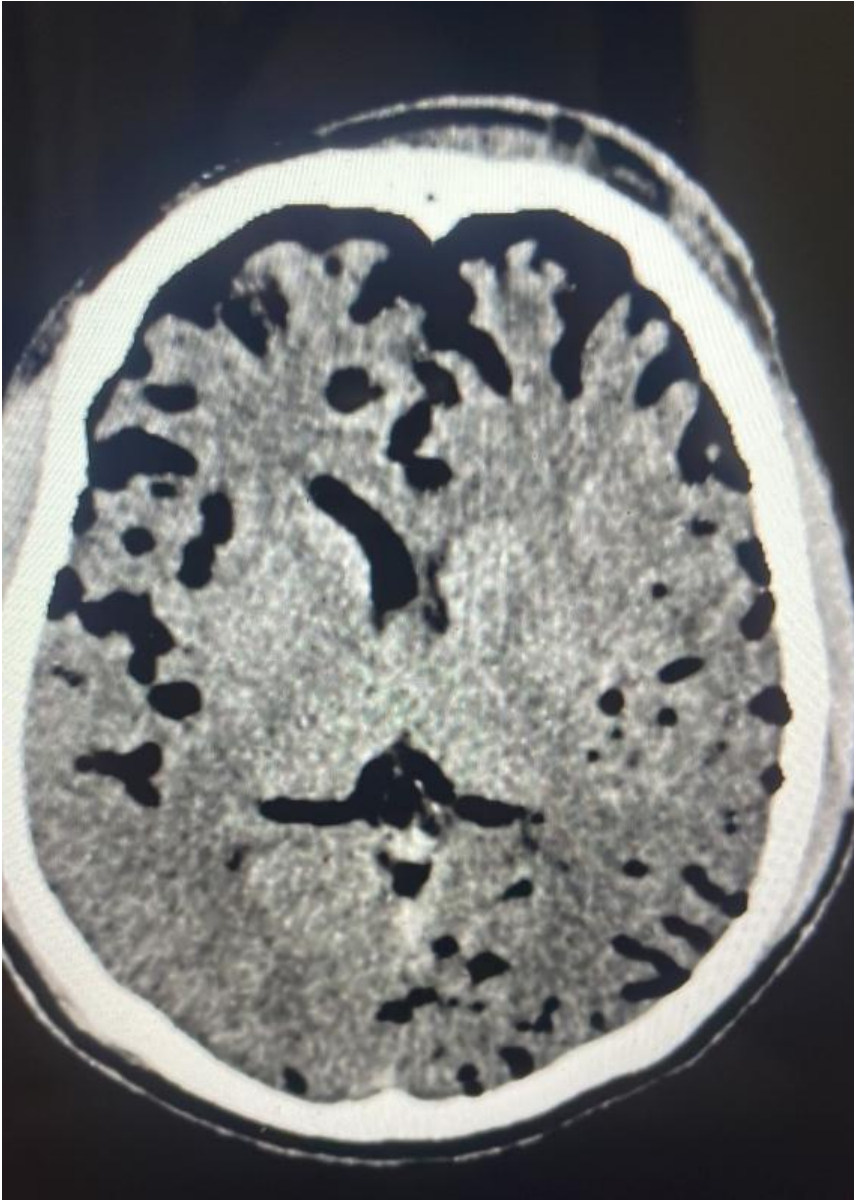
Final Diagnosis: Traumatic pneumocephalus without craniofacial fracture

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Figure 1

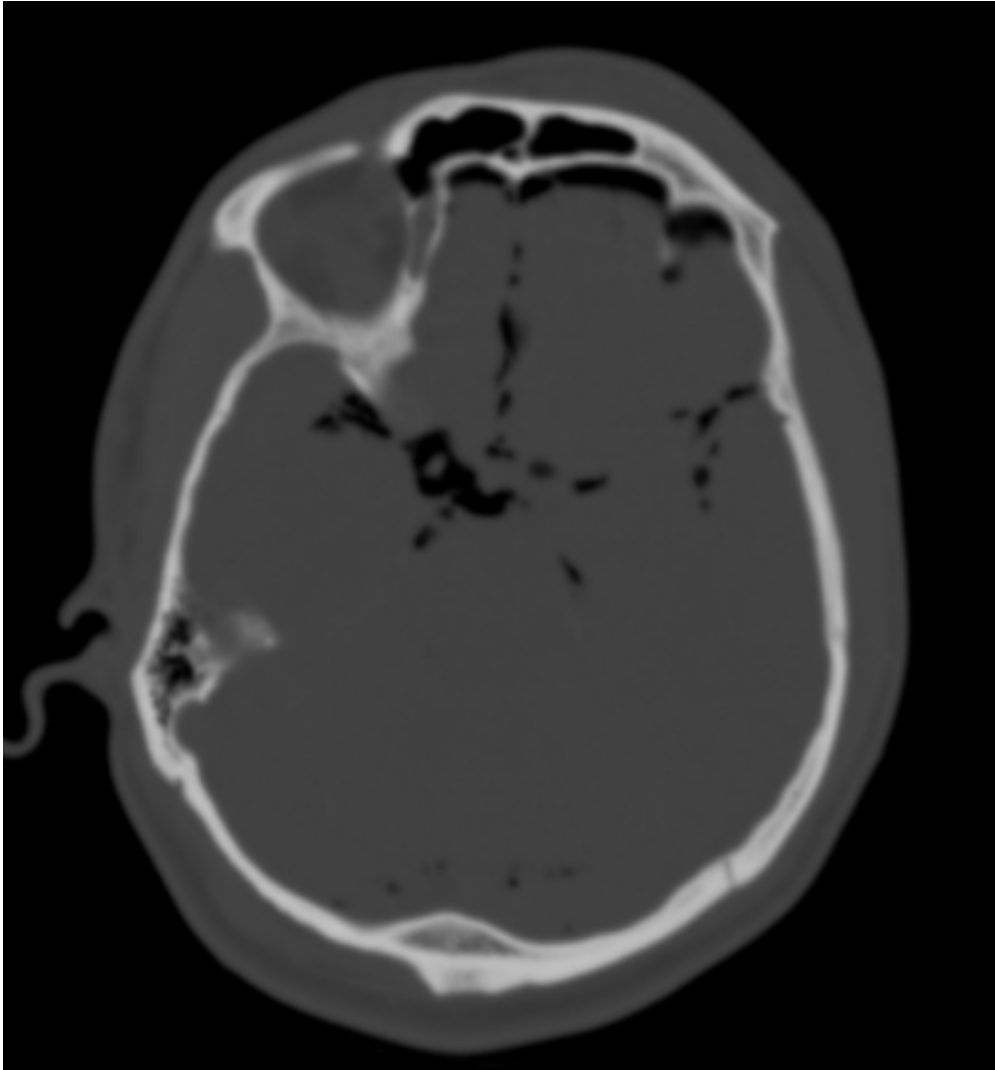
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Description: CT head showing pneumocephalus within the sulci, and ventricle with subcutaneous soft tissue swelling in the left frontal region. **Origin:** © Department of Radiology, Ameen Diagnostic Center, Mirpur Khas, Pakistan, 2024

Figure 2

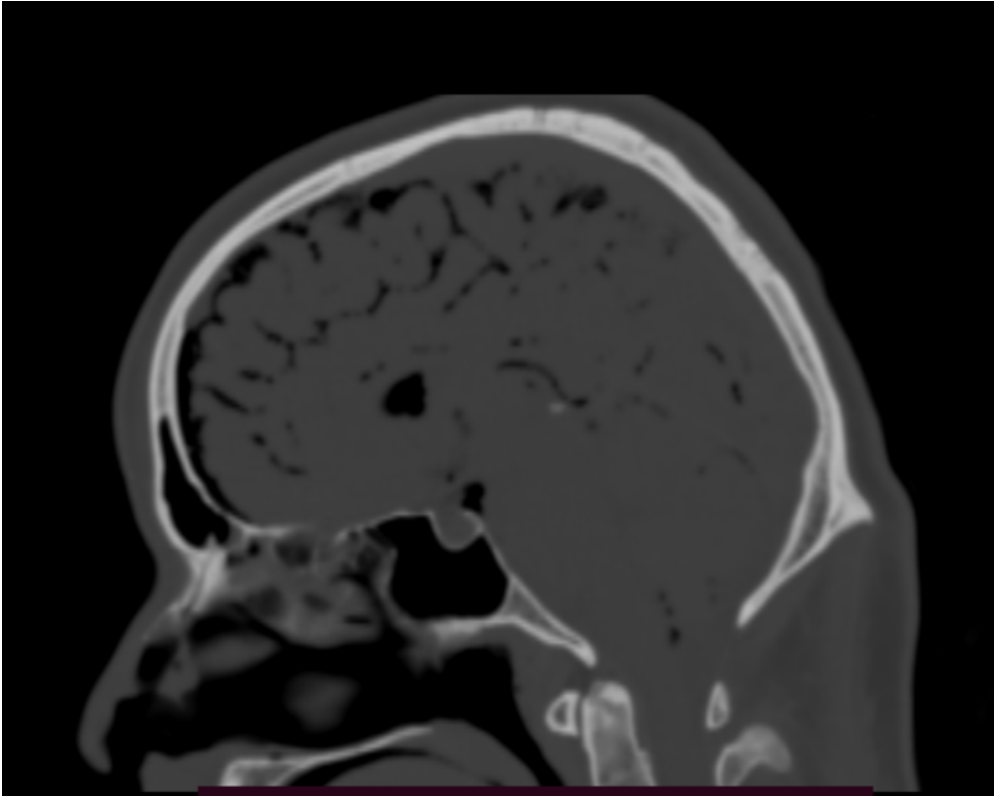
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Description: CT head (bone window) showing pneumocephalus within the basal cisterns and frontal regions. **Origin:** © Department of Radiology, Ameen Diagnostic Center, Mirpur Khas, Pakistan, 2024

Figure 3

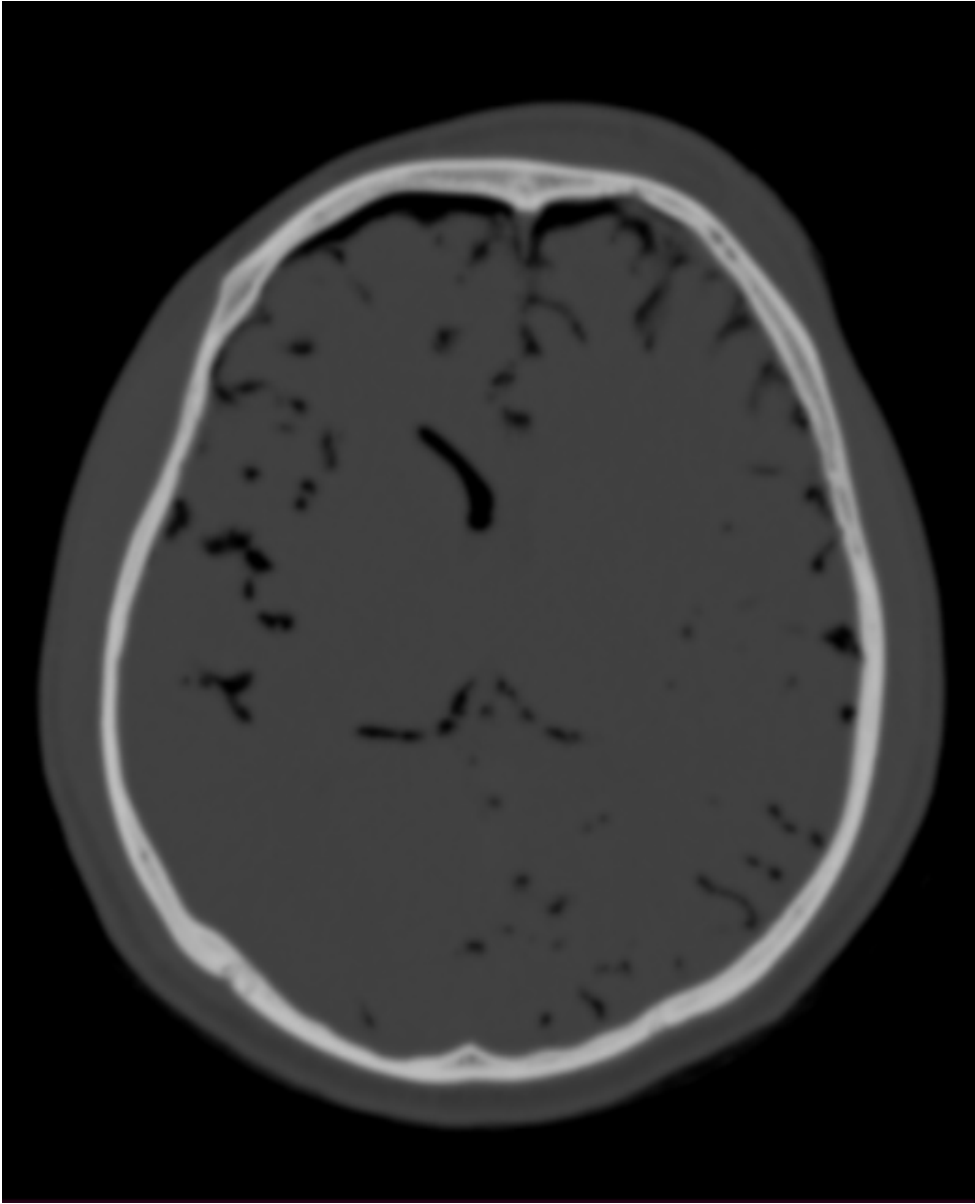
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Description: Sagittal CT head (bone window) showing diffuse air extending into the posterior fossa along the fourth ventricle. **Origin:** © Department of Radiology, Ameen Diagnostic Center, Mirpur Khas, Pakistan, 2024

Figure 4

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Description: Axial CT head (bone window) showing no obvious fracture in the bones with air in the ventricles. **Origin:** © Department of Radiology, Ameen Diagnostic Center, Mirpur Khas, Pakistan, 2024

Figure 5

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Description: CT head bone 3D reconstruction showing the absence of calvarial fracture. **Origin:**
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