Tension Pneumocephalus Secondary to Frontal Sinus Osteoma

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Introduction

Osteomas are slow-growing, benign tumours of the nasal sinuses. They are the most common tumour arising in the frontal sinus and are usually asymptomatic [1]. Rarely they breach the skull base, causing CSF leak, mucocele and pneumocephalus[2]. Tension pneumocephalus is is a potentially life-threatening surgical emergency and needs urgent surgical review and management. Severe tension pneumocephalus can be associated with abnormal respiratory patterns and lead to cardiorespiratory arrest[3]

Methods

- We present a rare case of frontal sinus osteoma causing a recurrent tension pneumocephalus in a 60 year old female.
- Literature review (PubMed, Embase, Medline): pneumocephalus from sinus osteoma, 1971–2025

Results

Case summary

1. **Index presentation**
   60F: Left headache, progressing to acute confusion, slurred speech, right facial droop
   CT: left frontal tension pneumocephalus beside a frontal sinus osteoma.
2. **Emergency surgery**
   Bilateral FESS + modified Lothrop: no skull base defect seen. Left frontal burr hole decompression. Post operative improvement on serial imaging. Discharged home day 3.
3. **Recurrence at 3 months**
   Two days of confusion, headache, new bilateral leg weakness.
   MRI: 79 × 41 × 40 mm pneumatocele, 5 mm midline shift.
4. **Revision endoscopic Lothrop**
   Obliterating mucosa cleared, exposing a left frontoethmoidal osteoma and 4 × 4 mm skull base/dural defect with olfactory bulb prolapse. Osteoma excised; multilayer repair.
5. **Outcome**
   Home day 3. Histology: benign osteoma. Symptom-free, no recurrence at 3 months post repeat surgery

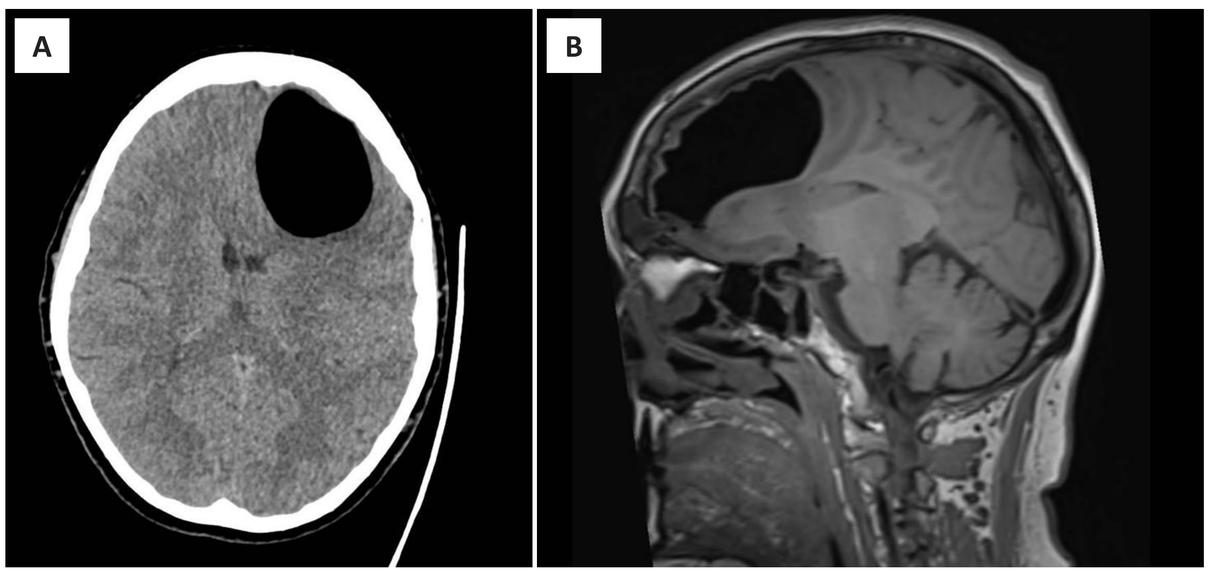

Figure 1. Re-presentation imaging. (A) Axial CT: recurrent left frontal tension pneumocephalus with mass effect. (B) Sagittal T1 MRI.

Results (continued)

Imaging, surgery and histology

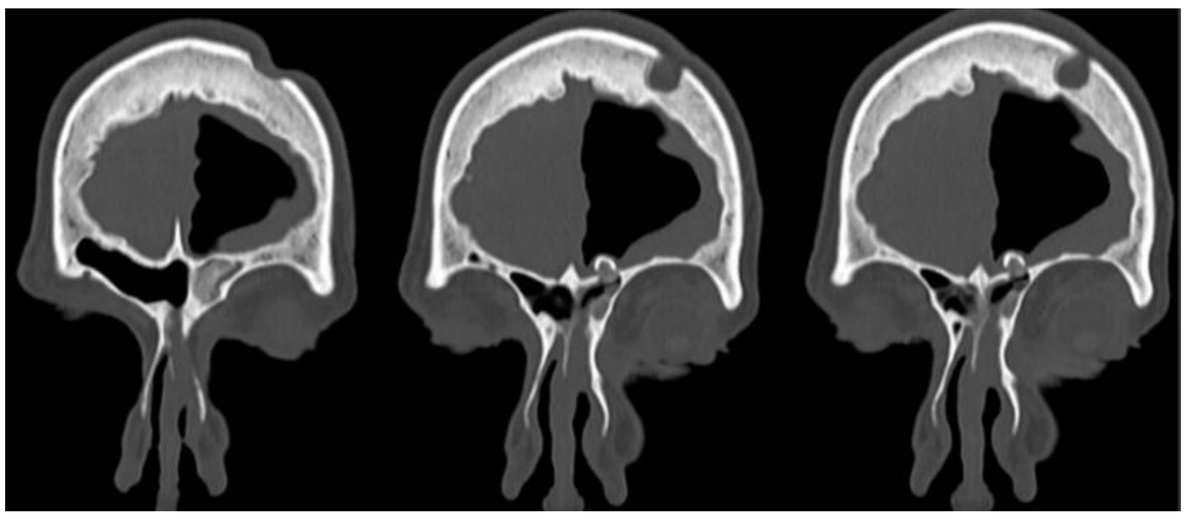

Figure 2. Coronal CT (bone window): left frontal sinus osteoma with posterior table erosion and adjacent pneumocephalus.

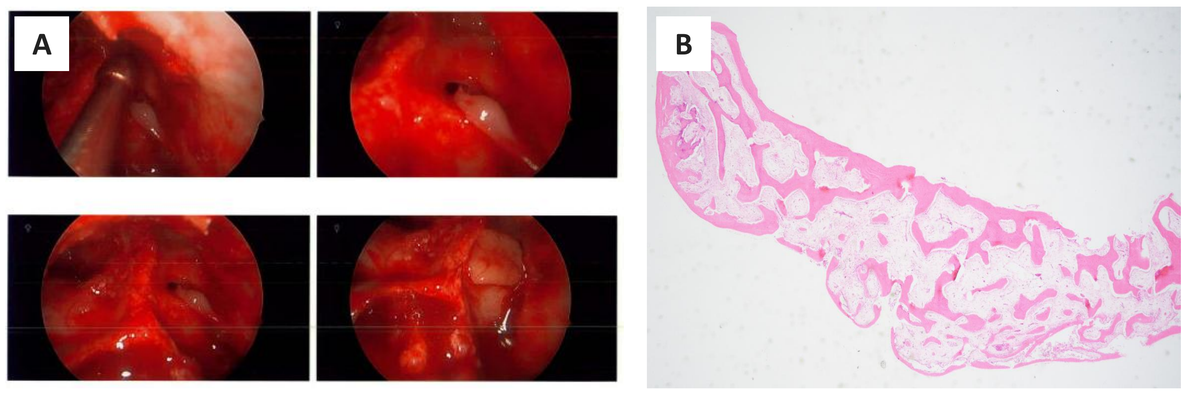

Figure 3. (A) Endoscopic view: frontoethmoidal osteoma and 4 × 4 mm skull base defect. (B) Histology: trabecular bone with intervening fibrous tissue.

Discussion

This case highlights that recurrence can occur despite apparently successful initial surgery and underscores the importance of identifying and repairing the skull base defect.

Proposed Mechanisms of tension pneumocephalus:

- Ball-valve mechanism: elevated sinonasal pressure (sneeze, nose-blowing, flight) forces air through the defect; the arachnoid seals behind it, trapping air[4–5]
- Inverted soda-bottle mechanism: loss of CSF creates negative intracranial pressure which draws air into the cranial cavity to replace the lost fluid

In this case recurrence likely occurred because the persistent skull base defect maintained an ongoing pathological communication between the frontal sinus and intracranial cavity, allowing the ball-valve mechanism to continue despite successful decompression

A comprehensive literature review searching databases including PubMed, Embase and Medline found 24 cases of pneumocephalus secondary to sinus osteomas reported between the years 1971 – 2025. Multiple cases in the literature report posterior wall or table erosion causing the pneumocephalus

Whilst there are no clear guidelines on approach, management for tension pneumocephalus secondary to frontal sinus osteoma is surgical. Most cases reported involved resection of the osteoma via frontal craniotomy or endoscopy, followed by dural repair

Learning Points

1. Frontal sinus osteomas, whilst usually benign, carry a rare but serious risk of potentially life-threatening tension pneumocephalus. Posterior wall location should prompt careful specialist assessment as posterior table involvement appears over-represented among reported intracranial complications.
2. Reoccurrence after surgical decompression is possible if the underlying bony defect or lesion is not removed or repaired. In our case, burr hole decompression without osteoma resection led to symptomatic reoccurrence after 2 months, highlighting the importance of definitive surgical management of the primary defect.
3. This case demonstrates that, in selected patients with favourable anatomy and appropriate expertise, a purely endoscopic approach can successfully achieve decompression, lesion excision and skull base reconstruction

References

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