

An Unusual Case of Non-traumatic Tension Pneumocephalus

Sumana Kedilaya¹, Niharika Gupta¹, Hejjaji Anand Krishnamurthy¹, Arjun Raju P¹, Deepak Haldipur²

1. Radiology, Tenet Diagnostics, Bangalore, IND 2. Ear, Nose, and Throat, Trustwell Hospitals, Bangalore, IND

Corresponding author: Sumana Kedilaya, sumana92@gmail.com

Review began 04/13/2025

Review ended 04/23/2025

Published 04/27/2025

© Copyright 2025

Kedilaya et al. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 4.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

DOI: 10.7759/cureus.83064

Abstract

Tension pneumocephalus is a life-threatening situation in neurosurgery. It can occur due to various causes, such as trauma, complications of neurosurgery or sinus surgery, and also in conditions where there is a CSF leak. We present an unusual case of a 53-year-old woman who came with complaints of severe headache and CSF rhinorrhea. On radiologic evaluation, tension pneumocephalus was noted as a result of sphenoid encephalocele. Sphenoidal encephaloceles are herniations of brain parenchyma, meninges, and CSF through a defect in the sphenoid bone. It typically presents as CSF rhinorrhea. Rarely, tension pneumocephalus can occur in the form of a severe headache. The recognition of clinical and radiologic features can help in making an accurate diagnosis of this rare condition at the earliest.

Categories: Emergency Medicine, Radiology, Neurosurgery

Keywords: csf fistula, csf rhinorrhea, mri cisternogram, sphenoid encephalocele, spontaneous tension pneumocephalus

Introduction

Pneumocephalus refers to the presence of intracranial air. It is mostly asymptomatic. The most common causes are head trauma and iatrogenic causes such as neurosurgery, sinus surgery, or epidural injections [1]. Non-traumatic causes are relatively uncommon and occur due to CSF leak, pneumosinus dilatans, or excessive vigorous sneezing [2].

Tension pneumocephalus refers to the accumulation of air within the cranium, causing elevated intracranial pressure, presenting with headache, vomiting, and neurological deficits. It can lead to coma and become a life-threatening condition [3].

Sphenoid encephalocele is a herniation of the temporal lobe through a defect within the sphenoid bone. It is accompanied by a leak of CSF. Very rarely, tension pneumocephalus can occur in association with sphenoid encephalocele and pose as a neurosurgical emergency [4]. In this report, we describe a case of spontaneous tension pneumocephalus secondary to sphenoid encephalocele in a 53-year-old woman.

Case Presentation

A 53-year-old lady presented to the clinic with a history of watery discharge from the left nostril for three weeks. She also had episodes of on-and-off severe headaches in the last three weeks. There was no history of previous trauma, sinus surgery, neurosurgery, meningitis, or intracranial tumors. No similar episodes had occurred in the past. On clinical examination, clear watery discharge was seen coming from the left nostril. There were no clinical signs of meningitis or elevated intracranial pressure, such as papilledema. CSF rhinorrhea was suspected, and she was subsequently referred to our diagnostic center for a CT scan of the paranasal sinuses and brain.

CT revealed a bony defect in the left lateral recess of the sphenoid sinus measuring 0.6 x 0.4cm, as can be seen in Figure 1. The left half of the sphenoid sinus was completely opacified by fluid (Figure 1). Small focal areas of bony scalloping were seen in the region of the left lateral recess of the sphenoid sinus.

How to cite this article

Kedilaya S, Gupta N, Krishnamurthy H, et al. (April 27, 2025) An Unusual Case of Non-traumatic Tension Pneumocephalus. Cureus 17(4): e83064. DOI 10.7759/cureus.83064

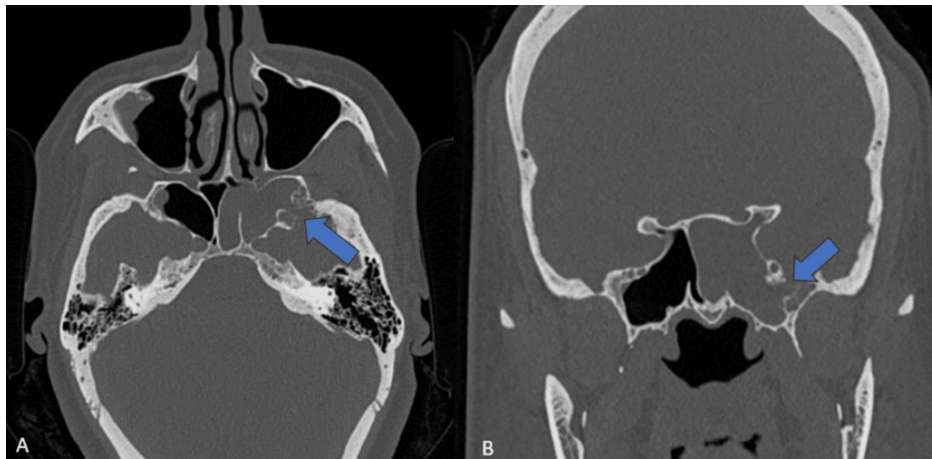


FIGURE 1: Axial and coronal CT sections at the level of the sphenoid sinus

A: axial CT section; B: coronal CT section shows a focal defect (blue arrow) in the left lateral recess of the sphenoid sinus. There is complete opacification of the left side of the sphenoid sinus with fluid.

A small focal defect was also seen in the right lateral recess of the sphenoid sinus, as can be seen in Figure 2. However, the right half of the sphenoid sinus was clear with no fluid opacification.

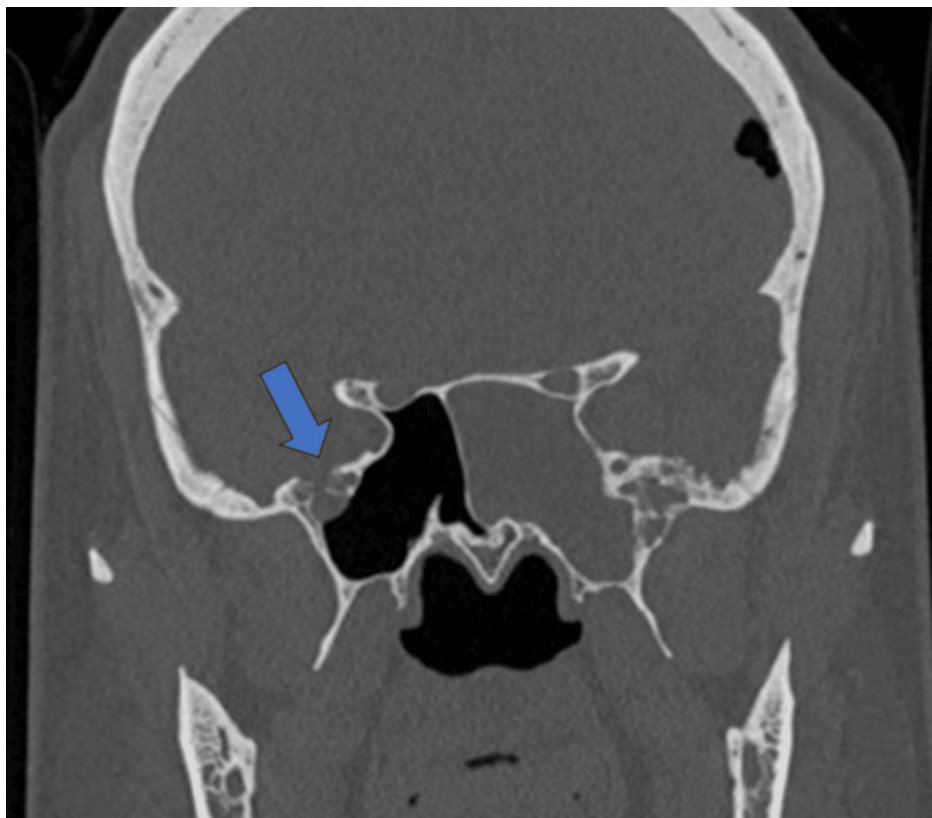


FIGURE 2: Coronal CT section at the level of sphenoid sinuses

The image shows a small focal defect (blue arrow) in the right lateral recess of the sphenoid sinus with mild adjacent fluid opacification.

Focal dehiscence of the left cribriform plate was also appreciated (Figure 3).

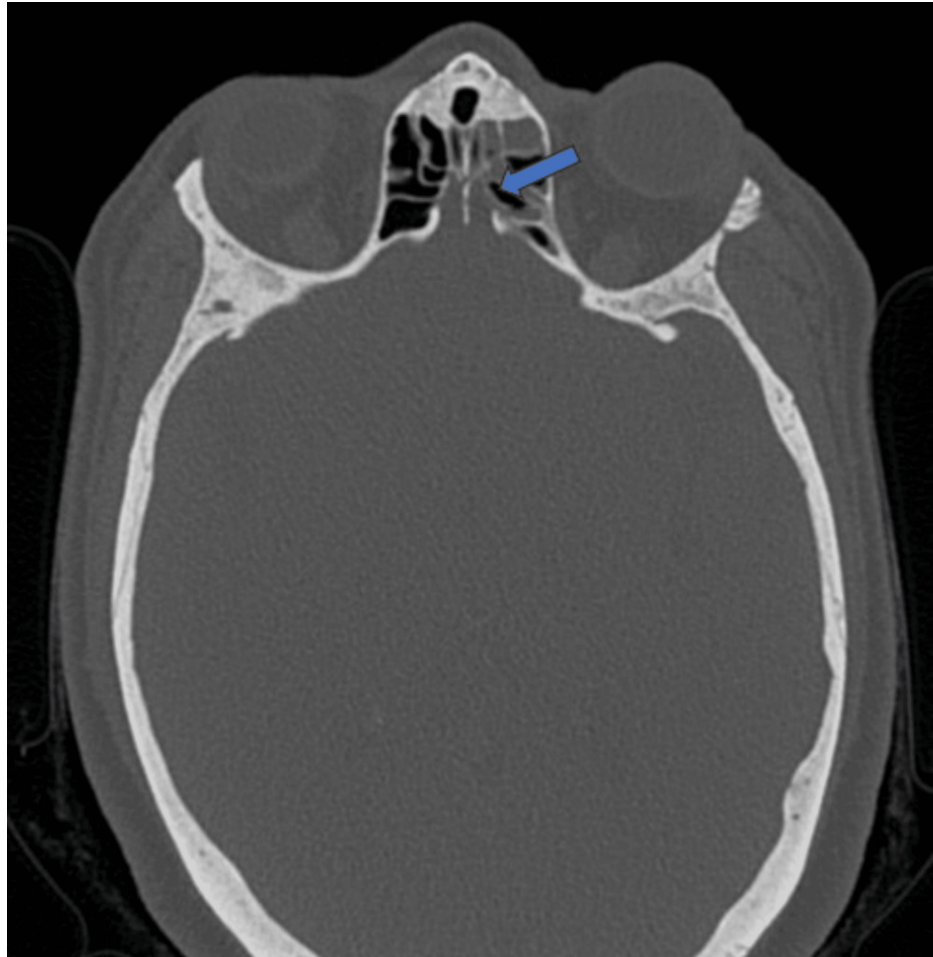


FIGURE 3: Axial section of CT paranasal sinus at the level of cribriform plate

The image shows a focal dehiscence (blue arrow) in the left cribriform plate.

In the brain sections, extensive air foci were seen along the subarachnoid spaces of bilateral fronto-parietal sulci, bilateral Sylvian fissures, perimesencephalic cisterns, prepontine cistern, and cerebellar folia (Figure 4). Similar air foci were seen along the subdural spaces of bilateral anterior frontal and anterior temporal convexities.

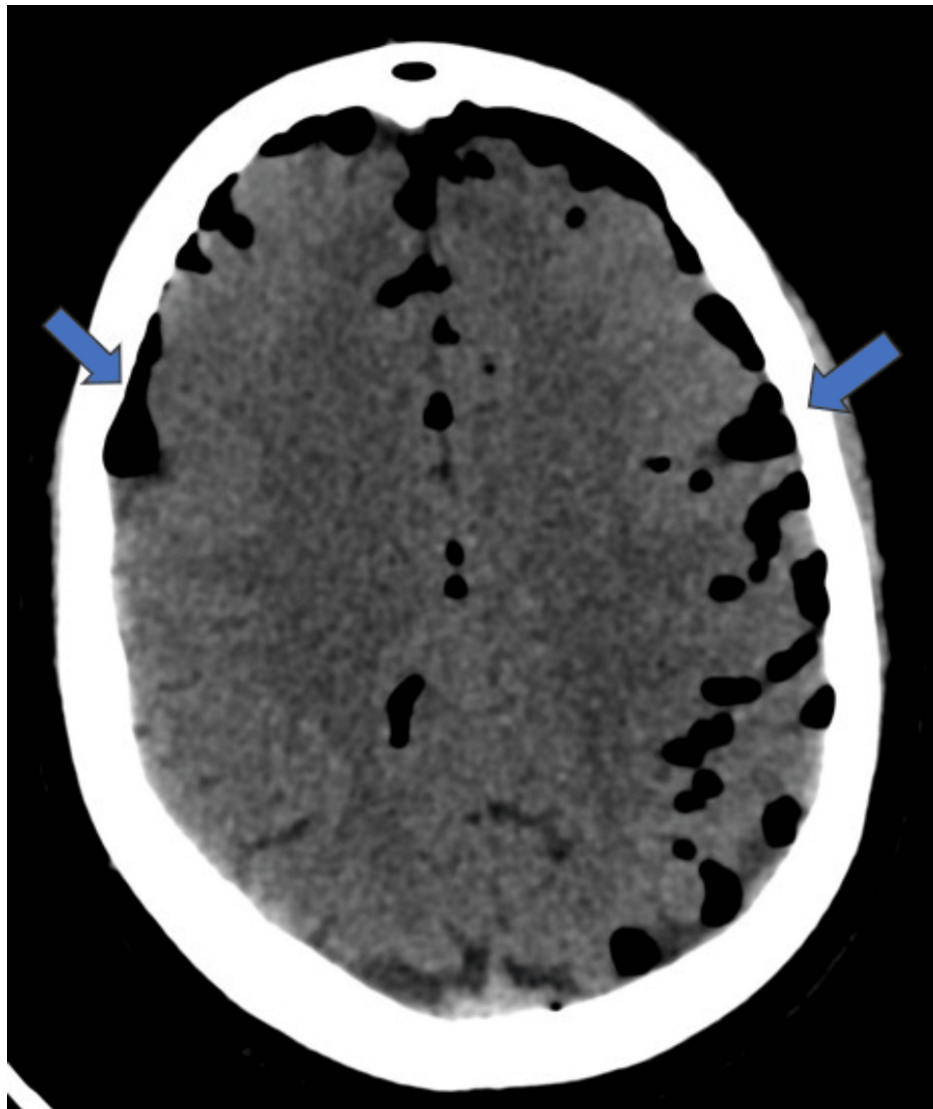


FIGURE 4: Axial CT brain at the level of frontoparietal lobes

The image shows extensive air foci (blue arrows) along the subarachnoid and subdural spaces of bilateral cerebral convexities, predominantly on the left side.

Following this, a suspicion of sphenoid encephalocele was raised, and the patient was subjected to an MRI cisternogram to confirm the same.

MRI also revealed a bony defect in the left lateral recess of the sphenoid sinus with herniation of a portion of the left anteromedial temporal lobe, dura, and CSF into the sphenoid sinus (Figures 5, 6). The left half of the sphenoid sinus was completely filled with CSF.

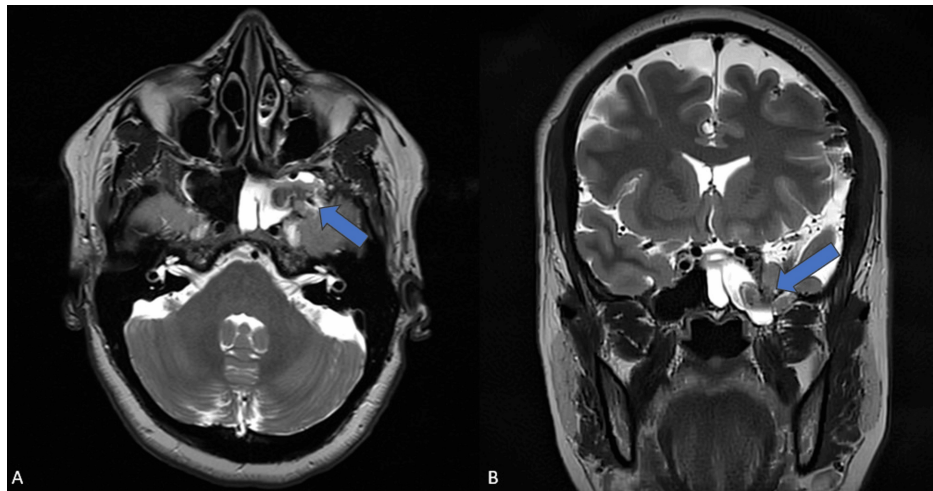


FIGURE 5: MRI brain axial and coronal T2W image at the level of the sphenoid sinus

A: axial T2W MRI brain; B: coronal T2W MRI brain shows a defect (blue arrow) in the left lateral recess of the sphenoid sinus with herniation of meninges, CSF, and a portion of the left anterior temporal lobe.

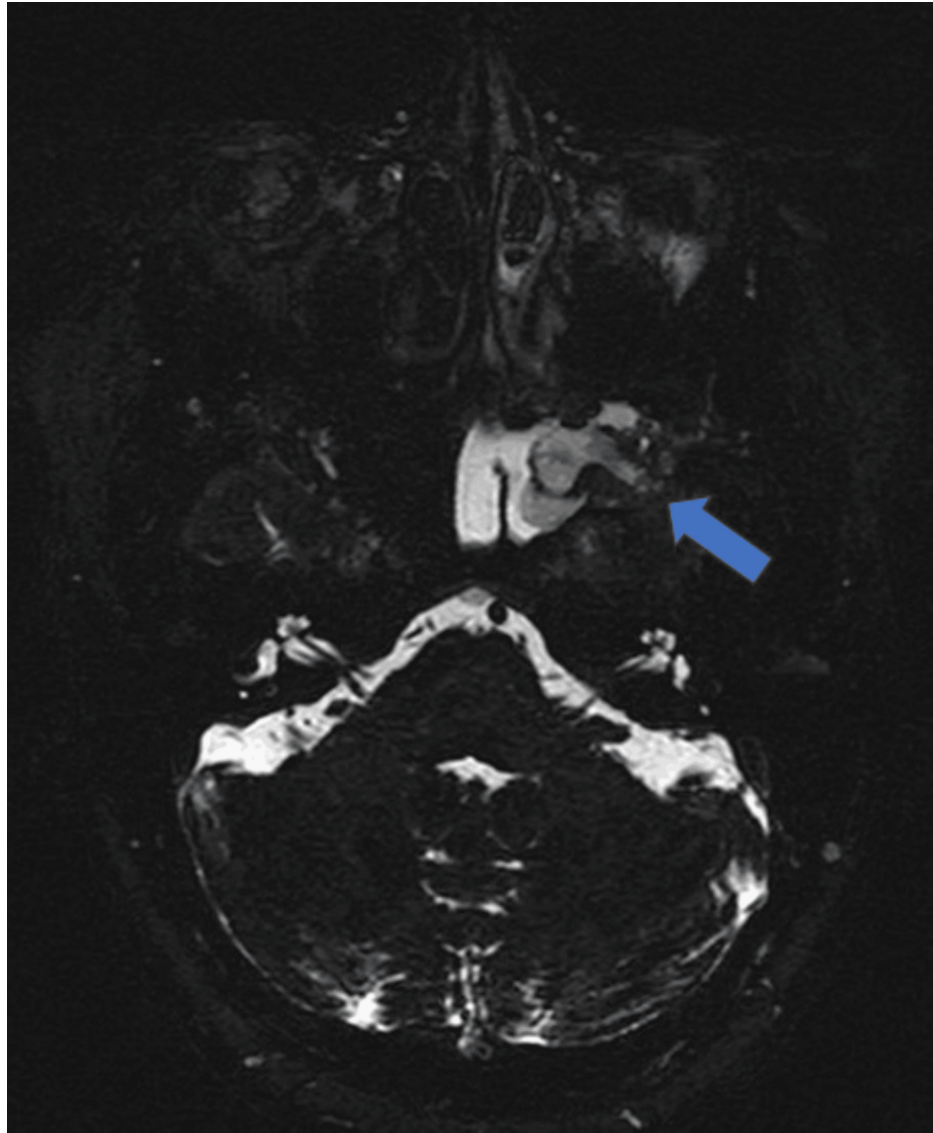


FIGURE 6: Axial heavily T2W CISS image (cisternogram) at the level of the sphenoid sinus

MR cisternogram shows clear delineation of defect (blue arrow) in left lateral recess of sphenoid sinus with protrusion of meninges, CSF and portion of left anterior temporal lobe. The left half of sphenoid sinus is completely filled with CSF.

CISS: constructive interference in steady state

Also noted were extensive air foci along the subarachnoid, subdural spaces, and cisterns of the brain (Figure 7).

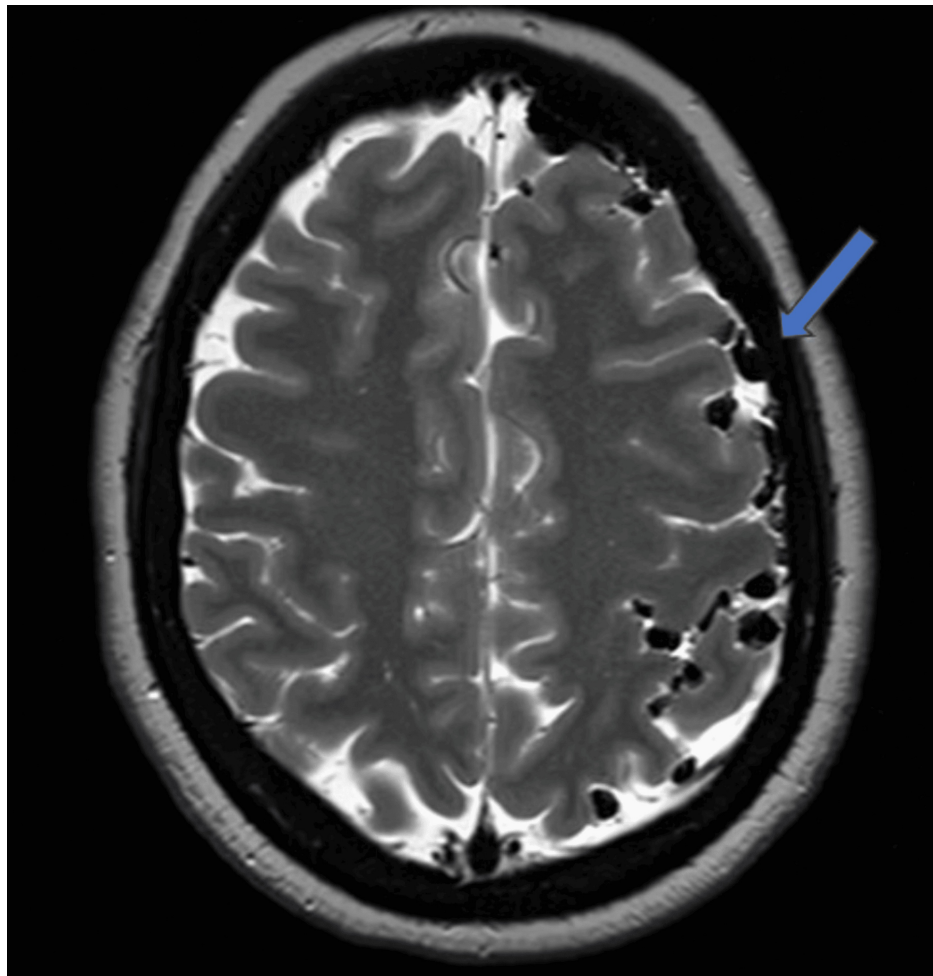


FIGURE 7: MRI brain axial T2W image at the level of the frontoparietal lobes

The image shows extensive air foci (blue arrow) along the subarachnoid spaces of the brain, more on the left side.

We arrived at the diagnosis of left sphenoidal encephalocele with resultant tension pneumocephalus. The patient was then referred to a head and neck surgeon. She underwent endoscopic endonasal CSF leak repair. Per operatively, the imaging findings were confirmed (Figure 8). A thigh muscle graft was used to cover the left lateral recess bone defect. The right lateral recess defect and cribriform plate dehiscence were also repaired. Postoperatively, the patient recovered well with resolution of headache and CSF rhinorrhea.

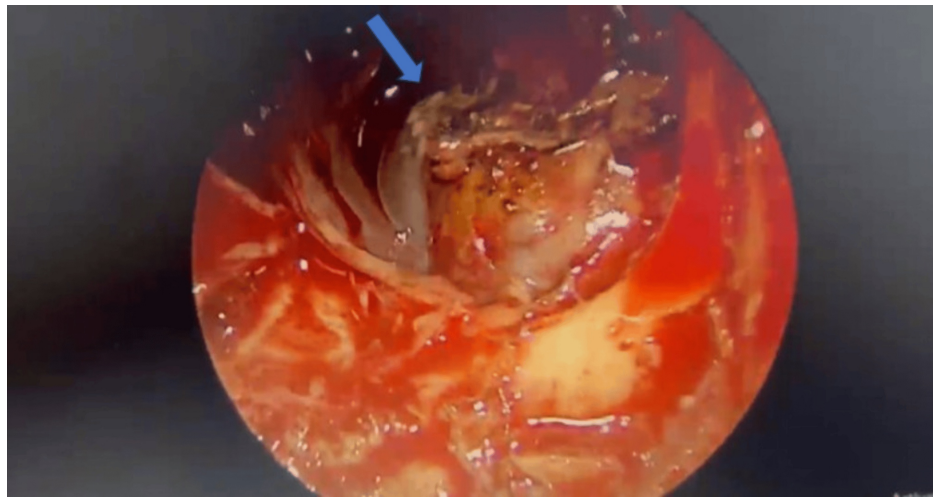


FIGURE 8: Intra-operative image

The image shows the herniated portion of the temporal lobe (blue arrow) through the defect in the left lateral recess of the sphenoid sinus.

Discussion

Tension pneumocephalus is thought to occur in conditions where there is an intracranial dural defect causing subsequent air expansion as a result of a ball-valve mechanism [5]. It leads to elevated intracranial pressure and deterioration in consciousness and neurologic deficits and can also result in cardiac arrest [6].

Sphenoid encephaloceles rarely cause tension pneumocephalus [7]. Rupture of sphenoid encephalocele, leading to a ball-valve mechanism, can lead to air entry into the subdural and subarachnoid spaces of the cranium [4]. Very rarely, intraventricular pneumocephalus can also be seen [4].

CSF fistulas are leaks of CSF from the subarachnoid space of the intracranial cavity through an osteodural defect into a pneumatized structure at the base of the skull [8]. CSF fistulas are broadly divided into acquired or congenital fistulas. They can also be classified as traumatic, non-traumatic, or spontaneous fistulas. The most common cause of CSF leak is trauma, such as fracture of the skull base, or iatrogenic reasons. Non-traumatic fistulas occur as a result of tumors and infections. Elevated intracranial pressure can lead to a spontaneous CSF leak. They tend to occur in areas where the bone is weak, such as pneumatized sinuses, especially the lateral recess of the sphenoid sinus and the cribriform plate. Other factors that can increase the chance of spontaneous leaks are obesity, age, chronic inflammation, bone remodeling, and anatomical variants in the bones of the skull base. Skull base encephaloceles usually co-exist in such situations. Cephalocele is a herniation of intracranial contents via a bony defect, mostly in the sphenoid sinus or cribriform plate. Meningocele refers to the herniation of only meninges and CSF. Encephalocele or meningoencephalocele are protrusions of CSF, meninges, and portions of neuroparenchyma. Skull base encephaloceles can be trans-ethmoidal, sphenoid-ethmoidal, sphenoid-orbital, and sphenoidal types [9].

Sphenoidal can be further classified as medial perisellar and lateral sphenoid encephaloceles. Medial perisellar transsphenoidal encephaloceles occur through a defect in the antero-inferior wall of the sphenoid sinus and communicate directly with the sella. Lateral sphenoid encephaloceles occur when there is a defect in the lateral recess of the sphenoid sinus through which the anterior temporal lobe protrudes [10]. Lateral sphenoid encephaloceles are one of the rarest types of skull base encephaloceles [11].

They often present with CSF rhinorrhea, which is a clear discharge through the nostril. Other presentations include symptoms of increased intracranial pressure, meningitis, and seizures. Seizures occur if the herniated brain parenchyma becomes gliotic [12].

Radiologic evaluation of sphenoid encephaloceles involves CT and MRI. CT of paranasal sinuses and brain helps in detecting bony defects in the walls of the sphenoid sinus. It also helps in assessing anatomical variations and the dehiscence of skull base bones. CT sections of the brain can detect pneumocephalus. MRI helps in visualizing the soft tissue details. Frank herniation of neuroparenchyma through bony defects is well made out on MRI. The presence of gliosis within the herniated brain can be made out. It helps in classifying the type of skull base encephalocele. It can also detect complications like features of meningitis or signs of increased intracranial pressure. Cisternograms are novel techniques for evaluating the presence of CSF leaks. CT cisternography is a minimally invasive method wherein contrast is injected intrathecally via lumbar puncture. Subsequently, CT images are acquired to see the intracranial CSF spaces and detect active

CSF leaks [13].

MR cisternography, on the other hand, is a non-invasive method of appreciating CSF leak by obtaining heavily weighted T2W fat-saturated images such as 3D constructive interference steady state sequence (CISS) or 3D T2 driven equilibrium (DRIVE) sequence [14].

It can be performed without the administration of contrast. Hence, people with adverse reactions or contraindications to contrast can undergo MRI cisternograms.

The most effective way of repairing lateral sphenoidal encephaloceles is via an endoscopic endonasal approach. It is also a less invasive technique compared to the conventional transcranial approach [15].

Conclusions

Tension pneumocephalus is a rare complication of sphenoidal encephalocele. It is important to detect tension pneumocephalus and the cause of it, since it is a life-threatening condition and requires prompt intervention. Accurate and timely diagnosis needs the use of appropriate radiologic investigations and correlating it with clinical information. MRI cisternography is a novel technique in detecting CSF leaks and encephaloceles. Surgical repair of sphenoid encephalocele includes an endoscopic endonasal approach.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Sumana Kedilaya, Niharika Gupta, Hejjaji Anand Krishnamurthy, Arjun Raju P

Acquisition, analysis, or interpretation of data: Sumana Kedilaya, Niharika Gupta, Arjun Raju P, Deepak Haldipur

Drafting of the manuscript: Sumana Kedilaya

Critical review of the manuscript for important intellectual content: Niharika Gupta, Hejjaji Anand Krishnamurthy, Arjun Raju P, Deepak Haldipur

Supervision: Hejjaji Anand Krishnamurthy

Disclosures

Human subjects: Consent for treatment and open access publication was obtained or waived by all participants in this study. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. Harvey JJ, Harvey SC, Belli A: Tension pneumocephalus: the neurosurgical emergency equivalent of tension pneumothorax. *BJR Case Rep.* 2016, 2:20150127. [10.1259/bjrcr.20150127](https://doi.org/10.1259/bjrcr.20150127)
2. Van Liedekerke L, Sanoussi S: Spontaneous pneumocephalus secondary to a cerebrospinal fluid fistula demonstrated by CT cisternography. *Radiol Case Rep.* 2020, 15:1829-31. [10.1016/j.radcr.2020.07.036](https://doi.org/10.1016/j.radcr.2020.07.036)
3. Pulickal GG, Sitoh YY, Ng WH: Tension pneumocephalus. *Singapore Med J.* 2014, 55:e46-8. [10.11622/smedj.2014041](https://doi.org/10.11622/smedj.2014041)
4. Ohkawa T, Nakao N, Uematsu Y, Itakura T: Temporal lobe encephalocele in the lateral recess of the sphenoid sinus presenting with intraventricular tension pneumocephalus. *Skull Base.* 2010, 20:481-6. [10.1055/s-0030-1261261](https://doi.org/10.1055/s-0030-1261261)
5. Michel SJ: The Mount Fuji sign. *Radiology.* 2004, 232:449-50. [10.1148/radiol.2322021556](https://doi.org/10.1148/radiol.2322021556)
6. Clement AR, Palaniappan D, Panigrahi RK: Tension pneumocephalus. *Anesthesiology.* 2017, 127:710. [10.1097/ALN.0000000000001703](https://doi.org/10.1097/ALN.0000000000001703)
7. Shafa B, Arle J, Kotapka M: Unusual presentations of middle fossa encephaloceles: report of two cases. *Skull Base Surg.* 1999, 9:289-94. [10.1055/s-2008-1058139](https://doi.org/10.1055/s-2008-1058139)
8. Alonso RC, de la Peña MJ, Caicoya AG, Rodriguez MR, Moreno EA, de Vega Fernandez VM: Spontaneous skull base meningoencephaloceles and cerebrospinal fluid fistulas. *Radiographics.* 2013, 33:553-70. [10.1148/rg.332125028](https://doi.org/10.1148/rg.332125028)
9. Pal NL, Juwarkar AS, Viswamitra S: Encephalocele: know it to deal with it. *Egypt J Radiol Nucl Med.* 2021,

- 52:105. [10.1186/s43055-021-00489-y](https://doi.org/10.1186/s43055-021-00489-y)
10. Kumar D, Maheshwari A, Rath B, Kapoor A, Sharma A, Kumar P, Basu S: Transalar transphenoidal meningoencephalocele: a rare cause of respiratory distress in a neonate. *J Pediatr Neurosci*. 2011, 6:118-20. [10.4103/1817-1745.92829](https://doi.org/10.4103/1817-1745.92829)
 11. Bikmaz K, Cosar M, Iplikcioglu AC, Dinc C, Hatiboglu MA: Spontaneous cerebrospinal fluid rhinorrhoea due to temporosphenoidal encephalocele. *J Clin Neurosci*. 2005, 12:827-9. [10.1016/j.jocn.2004.09.030](https://doi.org/10.1016/j.jocn.2004.09.030)
 12. Leblanc R, Tampieri D, Robitaille Y, Olivier A, Andermann F, Sherwin A: Developmental anterobasal temporal encephalocele and temporal lobe epilepsy. *J Neurosurg*. 1991, 74:933-9. [10.3171/jns.1991.74.6.0933](https://doi.org/10.3171/jns.1991.74.6.0933)
 13. Agladioglu K, Ardic FN, Tumkaya F, Bir F: MRI and CT imaging of an Intrasphenoidal encephalocele: a case report. *Pol J Radiol*. 2014, 79:360-2. [10.12659/PJR.890795](https://doi.org/10.12659/PJR.890795)
 14. Eberhardt KE, Hollenbach HP, Deimling M, Tomandl BF, Huk WJ: MR cisternography: a new method for the diagnosis of CSF fistulae. *Eur Radiol*. 1997, 7:1485-91. [10.1007/s003300050321](https://doi.org/10.1007/s003300050321)
 15. Pasquini E, Sciarretta V, Farneti G, Mazzatenta D, Modugno GC, Frank G: Endoscopic treatment of encephaloceles of the lateral wall of the sphenoid sinus. *Minim Invasive Neurosurg*. 2004, 47:209-13. [10.1055/s-2004-818522](https://doi.org/10.1055/s-2004-818522)