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Case Report

Spontaneous Meningoencephalocele of the Sphenoid Sinus: Clinical and Radiological Insights

Dr. Eknoor[1]*, Dr. Saransh Puri[2], Dr. Gaurav Shah[3], Dr. Tanisha Gupta[4], Dr. B D Charan[5]

[1]Junior Resident, Department of Diagnostic and Interventional Radiology, AIIMS Rishikesh, India
[2]Senior Resident, University College of Medical Sciences, New Delhi, India
[3]Junior Resident, Department of Diagnostic and Interventional Radiology, AIIMS Rishikesh, India
[4]Junior Resident, Department of Paediatric Medicine, AIIMS Rishikesh, India
[5]Assistant Professor, Department of Diagnostic and Interventional Radiology, AIIMS Rishikesh, India

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Abstract: Sphenoid sinus meningoencephaloceles are rare basal skull defects characterized by herniation of meninges and brain tissue into the sphenoid sinus. They can present with nonspecific symptoms such as chronic headache and may be mistaken for benign sinus pathology. We report a case of a patient with persistent headache and CSF rhinorrhoea in whom imaging revealed herniation of the right temporal lobe and the meninges through a bony defect in the right lateral wall of the sphenoid sinus, identified by High Resolution CT of the paranasal sinuses and MR Cisternography. This case underscores the importance of considering skull base defects in the differential diagnosis of isolated sphenoid sinus lesions and highlights the utility of combined CT and MRI imaging. Timely diagnosis and surgical intervention are crucial to prevent complications such as meningitis or neurologic deterioration.

Keywords: Meningoencephalocele, Sphenoid sinus, Skull base defect, Cerebrospinal fluid leak, High Resolution CT, Endoscopic repair, Spontaneous encephalocele.

BACKGROUND

Meningoencephaloceles involving the sphenoid sinus are exceedingly rare and often present a diagnostic challenge due to their subtle imaging features and non-specific clinical manifestations. These lesions represent herniation of both meninges and brain parenchyma through a congenital or acquired defect in the skull base into the sphenoid sinus cavity. They are categorized under basal encephaloceles and may be further subclassified based on their location as transsphenoidal or intrasphenoidal, depending on whether they extend into the nasal cavity or remain confined within the sinus cavity respectively [1,2].

Congenital skull base defects such as a persistent lateral craniopharyngeal canal (Sternberg canal) have been implicated in the pathogenesis of intrasphenoidal meningoencephaloceles, although other etiologies including trauma, prior surgery, and elevated intracranial pressure have also been described [3]. Clinically, these entities may present with cerebrospinal fluid (CSF) rhinorrhea, recurrent meningitis, or, less commonly, isolated symptoms such as chronic headache, vertigo, or visual disturbances [4]. In the absence of CSF leakage, the diagnosis may be delayed or misattributed to sinus pathology.

Imaging plays a crucial role in the identification and characterization of these lesions. Computed tomography (CT) is essential to detect bony defects in the skull base, while magnetic resonance imaging (MRI) allows for precise delineation of herniated intracranial contents and differentiation from other sphenoid sinus lesions such as mucoceles or fungal infections [5]. However, due to the subtlety of osseous dehiscence and often nonspecific MRI findings, misdiagnosis is not uncommon. In uncertain cases, CT cisternography may be warranted to confirm communication with the subarachnoid space.

Given the risk of ascending infection and potential for neurological complications, early recognition and surgical repair typically via an endoscopic endonasal approach are advocated even in asymptomatic patients [6]. In this report, we present a case of sphenoid sinus meningoencephalocele identified

***Corresponding Author:** Dr. Eknoor
Junior Resident, Department of Diagnostic and Interventional Radiology, AIIMS Rishikesh, India

during evaluation for chronic headache and CSF rhinorrhoea, highlighting the diagnostic challenges and importance of maintaining a high index of suspicion for this rare condition.

CASE PRESENTATION

A young female adult presented with a history of intermittent headaches for the past 5 years, which had recently worsened in intensity and frequency. The pain was described as right-sided, throbbing in nature, and occasionally associated with photophobia, phonophobia, and nausea, which was relieved during the CSF rhinorrhoea episode. She denied any history of trauma or prior sinus surgery.

Investigations:

Non-contrast HRCT of the paranasal sinuses demonstrated a well-defined osseous defect along the right lateral wall of the sphenoid sinus. The defect measured approximately ~8.3mm and was associated with an expansile soft-tissue density lesion projecting into the sinus cavity. The lesion showed attenuation similar to cerebrospinal fluid (CSF), without evidence of calcification or bony erosions. The surrounding bony margins were smooth, consistent with a chronic or congenital etiology.

MRI Brain with heavily T2-weighted MR cisternography sequences confirmed the herniation of the right temporal lobe and meninges with surrounding CSF intensity contents through a defect in the right lateral wall of the sphenoid sinus, suggestive of meningoencephalocele. The lesion appeared hyperintense on T2 and hypointense on T1-weighted sequences, consistent with CSF signal. Continuity of subarachnoid CSF with the sinus lesion was clearly demonstrated. No pathological enhancement was seen on post-contrast sequences. These findings confirmed a diagnosis of spontaneous meningoencephalocele.

Follow-up:

Following the diagnosis of spontaneous sphenoid sinus meningoencephalocele, the patient was referred to a neurosurgical team for further evaluation. Given the absence of active cerebrospinal fluid (CSF) leakage at the time and the stable clinical condition, surgical intervention was deferred. The patient has since been placed on close clinical and radiological follow-up. There has been no progression of existing symptoms or development of new symptoms. The patient's headaches have significantly reduced in frequency and severity with conservative management and avoidance of activities that could raise intracranial pressure. She remains under periodic review by neurology and ENT teams, with plans for surgical repair if CSF leak or other complications arise. The ongoing multidisciplinary monitoring aims to prevent future neurological sequelae and ensure timely intervention if needed.

Figure 1: HRCT images in axial (right) and coronal (left) planes in bone window, show an osseous defect in the right lateral wall of the sphenoid sinus

Figure 2: HRCT image in coronal plane in soft tissue window show herniation of soft tissue and CSF density contents through the osseous defect into the sphenoid sinus

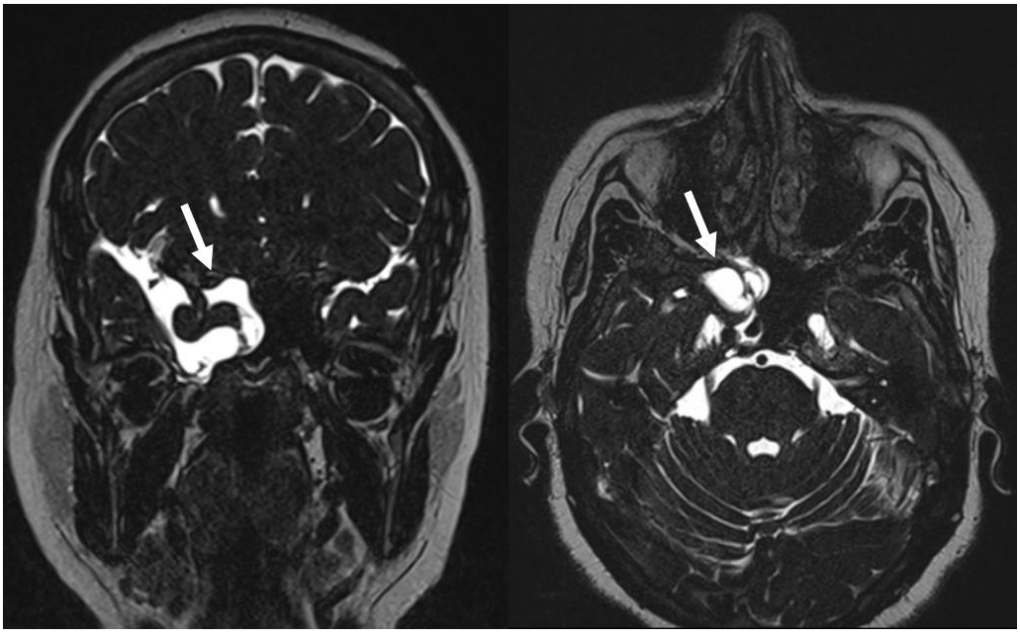

Figure 3: Heavily T2-Weighted MR Cisternography images of the brain in axial (right) and coronal (left) planes show herniation of the right temporal lobe, associated meninges and surrounding CSF through the osseous defect into the sphenoid sinus, suggestive of meningoencephalocele

DISCUSSION

Meningoencephaloceles involving the sphenoid sinus are rare, particularly when occurring spontaneously and in the absence of cerebrospinal fluid (CSF) rhinorrhea or a history of trauma. These lesions result from herniation of intracranial contents, including both meninges and brain parenchyma, through a defect in the skull base. The lateral recess of the sphenoid sinus is a particularly uncommon site, often associated with congenital bony defects such as a persistent Sternberg canal, or acquired defects resulting from elevated intracranial pressure, prior surgery, or trauma [2,3].

The clinical presentation of sphenoid meningoencephaloceles can vary widely. While CSF rhinorrhea remains the most common presenting symptom due to communication between the subarachnoid space and the sinonasal tract, some patients may present solely with nonspecific symptoms such as persistent headache, visual changes, or even remain asymptomatic [4]. In our case, the patient presented with intractable headache and no rhinorrhea, mimicking sinusitis and complicating the diagnostic process. This highlights the importance of maintaining a high index of suspicion, especially in atypical presentations.

Radiologic evaluation plays a central role in identifying and characterizing these lesions. High-resolution computed tomography (CT) is invaluable for detecting bony dehiscence in the skull base, while magnetic resonance imaging (MRI) provides superior soft tissue contrast for differentiating herniated brain tissue from sinus pathology [1]. The MRI signal characteristics of a meningoencephalocele follow those of brain parenchyma, whereas pure meningoceles exhibit CSF signal intensity hypointense on T1-weighted and hyperintense on T2-weighted sequences. In our case, initial imaging failed to reveal the osseous defect, leading to misinterpretation as sinus disease. Retrospective analysis and correlation with CT angiography ultimately confirmed the diagnosis, underscoring the diagnostic limitations of routine MRI alone.

The differential diagnosis of sphenoid sinus lesions includes mucoceles, fungal infections (mycetoma), neoplasms, and encephaloceles. Among these, mucoceles are particularly challenging to differentiate radiologically due to their fluid-like signal and potential to erode surrounding bone [7]. However, lack of enhancement, absence of bone remodeling, and identification of a communication with the intracranial compartment help support the diagnosis of a meningoencephalocele.

Management typically involves surgical repair to prevent complications such as meningitis, recurrent CSF leaks, or progressive herniation. Endoscopic endonasal approaches are favored due to their minimally invasive nature and direct access to the sphenoid sinus, particularly the lateral recess [5]. Surgical success is high, with low recurrence rates and minimal morbidity when performed by experienced teams. In our case, early surgical referral was made following diagnosis, even in the absence of CSF leak, due to the risk of future complications.

CONCLUSION

In conclusion, sphenoid sinus meningoencephaloceles are rare entities that can easily be misdiagnosed as benign sinus pathology. Clinicians and radiologists should consider this diagnosis in patients with persistent or unexplained headaches and subtle sinus findings, especially when imaging reveals fluid collections in the sphenoid sinus without typical signs of infection. A multidisciplinary approach involving neurology, radiology, and neurosurgery is essential for accurate diagnosis and appropriate management.

Take Home Message:

Sphenoid sinus meningoencephaloceles are rare and often underrecognized lesions that can mimic more common sinonasal pathologies. Their nonspecific clinical presentation frequently leads to delayed or incorrect diagnosis. This case highlights the diagnostic value of combining high-resolution CT with MRI to identify subtle skull base defects and intracranial herniations. Early recognition is critical to prevent potential complications, including meningitis and progressive neurological impairment. Surgical repair via an endoscopic endonasal approach remains the mainstay of treatment, offering excellent outcomes when performed promptly. Clinicians should maintain a high index of suspicion when evaluating unexplained sphenoid sinus opacities, particularly in patients with persistent headaches or neurologic symptoms.

ABBREVIATIONS:

CSF: Cerebrospinal Fluid
CT: Computed Tomoography
MRI: Magnetic Resonance Imaging

Declaration:

- **Ethics approval:** Not required.
- **Consent for publication (include appropriate statements):** All the authors have approved submitting the manuscript to your esteemed journal. Patient-related identity anonymized. On behalf of all the contributors, I will act as a guarantor and correspond with the journal from this point onward.
- **Availability of data and material (data transparency):** Yes
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Patient's Perspective:

Living with persistent headaches for over five years was both physically draining and emotionally frustrating. I often struggled to explain the pain to others, as it was intense and unrelenting, yet no one could pinpoint a cause. The episodes of CSF rhinorrhea were confusing and frightening, especially because they brought temporary relief from the headache, which didn't make sense to me at the time. Despite multiple consultations, my symptoms were often dismissed as sinusitis or migraine. It wasn't until advanced imaging was done that I finally received a diagnosis of sphenoid sinus meningoencephalocele. While the term itself was unfamiliar and alarming, the clarity it brought was a relief. Knowing that the issue was real and treatable gave

me hope. I'm grateful for the medical team's persistence in uncovering the cause, and I now look forward to undergoing treatment and reclaiming a life free from chronic pain.

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