

# Pneumocephalus after a prolonged course of bacterial sinusitis: A case report

Amanda Tieu-Mi Huynh, Jessica Tieu-Uyen Huynh,  
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## ABSTRACT

**Introduction:** Pneumocephalus, or air in the intracranial cavity, is an uncommon finding that suggests a breach in the meningeal layer. Sinusitis, on the other hand, is a common phenomenon caused by inflammation of the tissue lining, the nasal cavity, and paranasal sinuses secondary to bacterial or viral infections. Rare cases of spontaneous pneumocephalus, in the absence of trauma or surgery, have been reported in the literature. They may also occur with more common pathologies such as nose blowing, sneezing, and Valsalva maneuvers. **Case Report:** Here, we report a case of spontaneous pneumocephalus associated with sinusitis in a 28-year-old man who presented to the hospital with a history of severe frontal headaches in the context of three weeks of sore throat, cough, and rhinorrhea. He was struggling with significant coughing and sneezing leading up to the hospital admission. A computed tomography (CT) scan of his head showed pansinusitis with extra-axial pneumocephalus measuring 5 mm over the anterior left frontal lobe that was worrisome for intracranial extension of sinusitis. Otolaryngology determined that either

a stifled sneeze or a vigorous nose blowing may have introduced air intracranially. Repeat CT head showed resolution after treatment with antibiotics and conservative management. **Conclusion:** In our literature search, we have found only seven other cases of pneumocephalus associated with sinusitis, and four cases of spontaneous pneumocephalus associated with either sneezing or nose blowing. Although sinusitis is an extremely common condition, red flags such as nonresolving symptoms, headache, or facial pain should prompt further work-up to consider alternative diagnoses or complications such as pneumocephalus.

**Keywords:** Pneumatocoele, Pneumocephalus, Sinusitis, Sneeze

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## INTRODUCTION

Pneumocephalus, or air in the intracranial cavity, is an uncommon finding that suggests a breach in the meningeal layer [1]. It is most often caused by trauma or surgery, however, infection and neoplasm are other etiologies [2]. Headache, nausea, vomiting, seizure, and dizziness are common presentations [3], while severe manifestations including neurological deterioration,

coma, and shock have been reported [4]. In tension pneumocephalus, the resulting mass effect on the brain is a clinical emergency requiring urgent neurosurgical intervention [1, 5, 6].

Sinusitis, on the other hand, is a very common phenomenon caused by an inflammation or swelling of the tissue lining, the nasal cavity, and paranasal sinuses secondary to bacterial or viral infections. About one in seven or eight people in North America experience at least one episode of sinusitis a year.

Cases of spontaneous pneumocephalus, in the absence of trauma or surgery, have been reported in the literature [1, 7]. Spontaneous, nontraumatic pneumocephalus is rare, but may occur with more common pathologies such as nose blowing, sneezing, and Valsalva maneuvers [8]. Here, we report a case of spontaneous pneumocephalus associated with sinusitis.

## CASE REPORT

A 28-year-old man presented to the Emergency Department following a five-day history of severe frontal headaches in the context of three weeks of sore throat, cough, and rhinorrhea. His past medical history was unremarkable, and he was not on any routine medications.

He complained of significant headaches with no associated fevers, chills, focal neurological symptoms, or meningismus. He did not have a recent history of trauma. He had initially presented to a walk-in-clinic five days prior to his hospitalization and received a course of clarithromycin and a nasal spray for sinusitis. He worked as an accountant during the busy tax season and was struggling with coughing and sneezing while talking to clients over the phone. His symptoms worsened leading him to come to the Emergency Department. On exam, his temperature was 37.3°C, heart rate was 120 beats per minute (bpm), blood pressure was 94/52 mmHg, respiratory rate was 16 breaths per minute, and oxygen saturation was 94% on room air. He was alert and oriented. His physical exam was grossly unremarkable. He had no focal neurological findings and no nuchal rigidity. He was noted to have a deviated nasal septum.

## Diagnosis

A CT scan of his head showed pansinusitis (paranasal, maxillary, frontal, and sphenoid sinuses) with extra-axial pneumocephalus measuring 5 mm over the anterior left frontal lobe worrisome for intracranial extension of sinusitis (Figure 1). A lumbar puncture was performed and subsequently ruled out meningitis. A magnetic resonance imaging (MRI) was ordered for further evaluation. It showed the previously identified pneumocephalus in the anterior left frontal cerebral convexity with minimal local mass effect. A nasopharyngeal swab was negative for tested viruses.

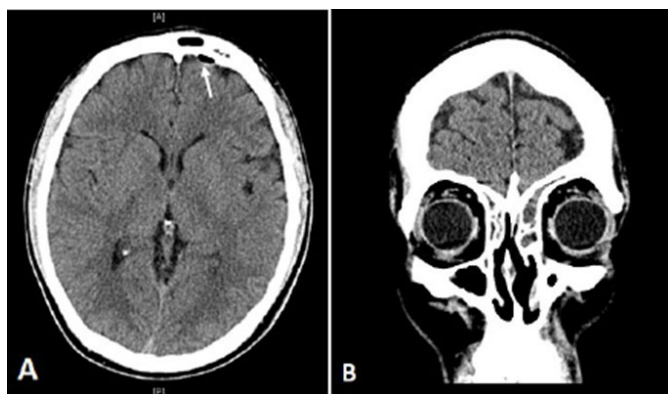


Figure 1: CT head without contrast. (A) Axial images of the head from the vertex to the skull base demonstrating a locule of extra-axial pneumocephalus measuring 5 mm overlying the anterior left frontal lobe (arrow) which raises concern for intracranial extension of sinusitis. There is no significant mass effect or cerebral edema. (B) Coronal images of the head highlighting the paranasal sinuses.

## Management

The patient was resuscitated with intravenous (IV) fluids and initially treated empirically for possible meningitis with ceftriaxone 2 g IV daily, vancomycin 1.5 g IV BID, clindamycin 450 mg IV q4h, and dexamethasone 6 mg BID. Eventually, the Infectious Diseases team recommended a seven-day course of amoxicillin/clavulanic acid. Otolaryngology determined that either a stifled sneeze or vigorous nose blowing may have introduced air intracranially. They recommended intranasal decongestants for symptomatic relief. The patient remained stable throughout his hospitalization and was discharged home five days later. Neurosurgery suggested a repeat CT head within a month and follow-up appointments were arranged with Internal Medicine and Otolaryngology.

## Follow-up

About four weeks after his discharge, he was feeling much better. His repeat CT head showed resolution of the pneumocephalus and sinusitis. He was counseled to continue nasal steroids and a neti pot in the event he develops recurrent sinusitis.

## DISCUSSION

Pneumocephalus is defined as the presence of gas in the cranial cavity. It can be found in different anatomic locations including intravascular, intraparenchymal, subdural, epidural, and subarachnoid spaces. The mechanism of air entry into the intracranial cavity occurs via skull fractures, breach of paranasal sinuses, mastoid air cells, spine, and vasculature.

Pneumocephalus can be iatrogenic, caused by neurosurgical procedures such as intracranial surgery, pressure monitor insertion or shunt-placement, and lumbar and spinal procedures. It can be a sequela of trauma such as cranial and facial fractures. Infectious causes such as meningitis and abscesses have also been reported [8].

However, pneumocephalus secondary to sinusitis is very rare. In our literature search, we have found only seven other cases of pneumocephalus associated with sinusitis [9–14], and four cases of spontaneous pneumocephalus associated with either sneezing or nose blowing [7, 15, 16] (Table 1). From 284 reported cases of pneumocephalus from 1884 to 1962, Markham [17] identified a total of 26 cases of pneumocephalus secondary to infection, and of those, only three were associated with sinusitis. The most frequent cause of sinusitis is viral, although secondary bacterial infection may occur [17]. Delay in appropriate therapy could lead to severe complications, such as orbital or intracranial extension of infection.

We present a case of pneumocephalus found in a young and healthy individual with no previous history of intracranial trauma. We hypothesized that our patient started off with a simple viral upper respiratory tract infection. Unfortunately, it progressed to a superimposed bacterial sinusitis with intracranial extension as highlighted by his symptoms of worsening frontal

headaches after three weeks. Perhaps a stifled sneeze or vigorous nose blowing subsequently introduced air into the intracranial vault. His CT head reported a mild irregularity along the fovea ethmoidalis, which may represent the site of dehiscence.

Cases of pneumocephalus are predominantly associated with some form of anatomical abnormality including trauma (74%), or neoplasm (13%) [17]. If infection precedes the diagnosis of pneumocephalus, gas forming organisms in the setting of intracranial infection (e.g., meningitis) are the most likely the culprit. However, invasion of the infection into the brain and subsequent destruction of the bony anatomy can also create a conduit for air to enter the skull, thereby causing pneumocephalus [17]. In our literature review, we found 11 cases of pneumocephalus associated with sinusitis or sneezing, and of those, five cases had documented bony defects. As in our case, we wonder if the anatomical abnormality involved the finding of mild irregularity of the fovea ethmoidalis.

Sneezing and nose blowing are usually benign and common phenomena, but intranasal pressures can be high with peak pressures going up to 176 mmHg if the subject's mouth and nose are closed during sneezing [18]. These activities can propel up to 1 mL of fluid into the maxillary sinus [18]. In our case, we wonder if a stifled sneeze or aggressive nose blowing introduced air into

Table 1: Literature review of cases involving pneumocephalus associated with sneezing or sinusitis [7, 9, 16, 27]

Case	Age, sex	Sinusitis	Sneeze, nose blowing	Head trauma	Location of free air	Site of dehiscence	Surgical drainage	Outcome
1 [7]	24M	–	+	–	Left occipital lobe	–	–	Resolution
2 [16]	26M	–	+	+	Diffuse	–	N/A	Resolution
3 [15]	17M	–	+	–	Extradural in the posterior cranial fossa	+	+	Resolution
4 [15]	50F	–	+	–	Intracranial extradural air in the left petrous apex	+	+	Resolution
5 [14]	18M	+	–	–	Subarachnoid space	–	+	Resolution
6 [9]	41M	+	–	–	Bilateral cavernous sinus	+	–	Resolution
7 [12]	72M	+ <sup>a</sup>	–	–	Frontal lobes	–	–	Death
8 [11]	14M	+ <sup>a</sup>	–	–	Bilateral parasellar region and right ambient cistern	–	+	Death
9 [13]	11moM	+	–	–	Orbital cavity, frontal and right temporal regions	+	–	Resolution
10 [10]	60M	+	–	–	Basilar cistern	+	+	Bedridden
11 [27]	10M	+	–	–	Middle cranial fossa	–	+	Resolution

<sup>a</sup>Associated with fungal sinusitis.

Abbreviations: M: male, F: female, mo: month, N/A: not applicable.

the intracranial cavity in a patient with bony dehiscence caused by the extension of bacterial sinusitis into the intracranial area. Complications related to sneezing have been documented in a few case reports. These include aortic dissection, cerebral venous thrombosis, loss of hearing due to fracture footplate, abortus, orbital emphysema, pneumocephalus, acute wide-angle glaucoma, pneumatocele of the lacrimal sac, retinal hemorrhage, and costal fracture [19–25]. Red flags that would prompt further investigation and consideration of alternative diagnoses including bacterial sinusitis with complications include persistent and nonresolving symptoms beyond 10 days, onset of severe symptoms including fever or facial pain lasting at least 3–4 days, or sudden worsening of symptoms such as fever, headache, or nasal discharge lasting 5–6 days [26].

## CONCLUSION

In conclusion, sinusitis is an extremely common condition, one that most often requires only supportive management. Pneumocephalus can be a complication of sinusitis or sneezing and should be considered. Early diagnosis and treatment, either by surgical drainage, supportive management, or antibiotic treatment, are essential for recovery. These patients should undergo a repeat CT scan to assess resolution. Failure to recognize pneumocephalus can lead to significant morbidity and mortality.

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### Author Contributions

Amanda Tieu-Mi Huynh – Conception of the work, Design of the work, Acquisition of data, Analysis of data, Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Jessica Tieu-Uyen Huynh – Conception of the work, Design of the work, Acquisition of data, Analysis of data, Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

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Written informed consent was obtained from the patient for publication of this article.

### Conflict of Interest

Authors declare no conflict of interest.

### Data Availability

All relevant data are within the paper and its Supporting Information files.

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