



Delayed Posttraumatic Tension Pneumocephalus: Case Report and Review of Literature

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Abstract

Keywords

- ▶ delayed
- ▶ pneumocephalus
- ▶ skull fracture
- ▶ tension
- ▶ traumatic

Delayed tension pneumocephalus is a rare entity. Twelve cases of posttraumatic delayed tension pneumocephalus have been reported. This study is a case report of a patient presenting with delayed posttraumatic tension pneumocephalus, and highlights the nuances of management.

Introduction

Trauma is the most common cause of pneumocephalus with reported incidence of up to 9.7% in head injury.^{1,2} Tension pneumocephalus is characterized by continued buildup of air within the cranial cavity, leading to abnormal pressure exerted on the brain and subsequent neurologic deterioration. Exact incidence of tension pneumocephalus in trauma patients is not known.

There have been only 21 reported cases of delayed posttraumatic tension pneumocephalus. In this article, an unusual case of intracerebral tension pneumocephalus presenting 10 years after trauma has been reported. A literature review was performed to assess the management options and outcomes.

Case Report

A 30-year-old man presented with left hemiparesis of 45 days' duration. He had suffered a road traffic accident 10 years ago with head injury and posttraumatic right facial palsy and hearing loss in the right ear. He was managed conservatively. Since the trauma, he had intermittent cerebrospinal fluid rhinorrhea from the right nostril which was not evaluated. He also had recurrent generalized seizures, which would occur on

noncompliance with medications. He was HIV positive and was taking antiretroviral therapy. On examination, he was conscious, alert, and oriented; pupils were equal and reacting to light; and right lower motor neuron facial palsy and sensorineural hearing loss were noted. Left hemiparesis was noted.

At presentation to the hospital, he had already been evaluated with computed tomography (CT) and magnetic resonance imaging (MRI) of the brain (▶**Fig. 1**), which showed a right frontal intraparenchymal hydropneumocephalus. Brain CT was repeated on admission and showed increase in the pneumocephalus. Right frontal sinus fracture was noted and there was no contrast enhancement or diffusion restriction noted, ruling out an abscess.

He underwent a right frontal craniotomy. A linear displaced fracture of the inner table of the frontal sinus and orbital roof was seen with a dural tear in the region of the fracture. The pneumocephalus was evacuated. The dural defect could not be repaired directly as it was located over the anterior cranial fossa base. The defect was covered intradurally with a fascia lata graft. Brain parenchyma appeared normal without any evidence of infection. Postoperatively, the patient recovered well, and hemiparesis improved over 2 days. Postoperative CT (▶**Fig. 1**) showed significant reduction in size of pneumocephalus. He was discharged on postoperative

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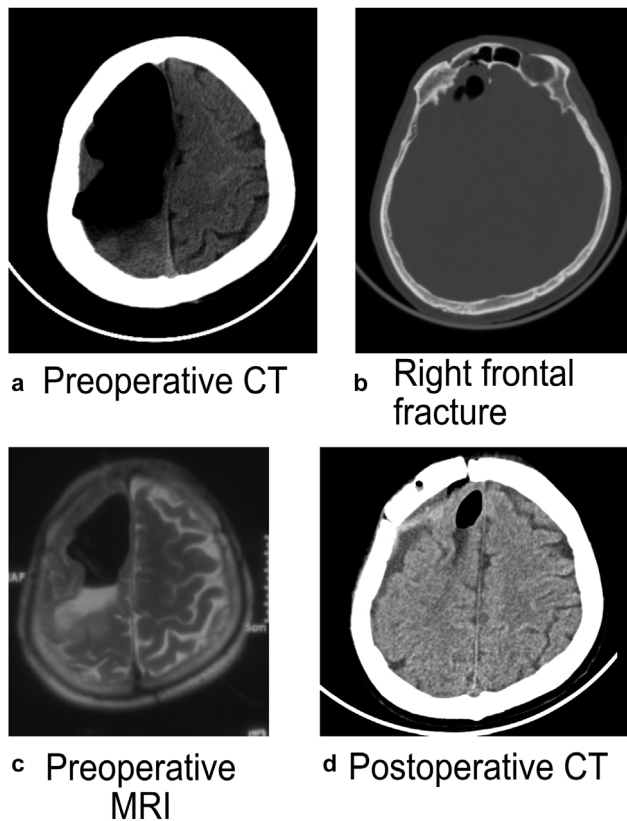


Fig. 1 Top left: preoperative computed tomography (CT) showing right frontal pneumocephalus. Top right: preoperative CT bone window showing right frontal fracture involving frontal sinus. Bottom left: Preoperative T2-weighted magnetic resonance imaging (MRI) showing right frontal pneumocephalus with fluid level. Bottom right: Postoperative CT showing resolution of pneumocephalus.

day 5 with power 5/5 in all muscle groups and without cerebrospinal fluid (CSF) rhinorrhea.

Discussion

Tension pneumocephalus is a rare clinical entity. Two theories have been put forward to explain the mechanism of tension pneumocephalus: (1) Dandy’s ball-valve theory¹—unidirectional flow of air into the cranial cavity through a defect and (2) Horowitz’s inverted soda bottle effect¹—excessive loss of CSF creates negative pressure leading to pneumocephalus.

Tension pneumocephalus may present in an acute (<72 hours) or delayed (>72 hours) manner.

A review of literature showed only 21 case reports of delayed tension pneumocephalus occurring after trauma (–Table 1). Most patients presented within a few days to weeks after trauma, but Hong et al³ reported a case presenting 12 years after trauma. Only one patient was managed conservatively. Sixteen patients underwent craniotomy and dural repair, 2 patients underwent burr holes, and 2 patients underwent twist drill and tapping. All patients had good outcomes. CSF rhinorrhea was reported in seven of these patients and CSF otorrhea was reported in

Table 1 Summary of published articles on delayed post traumatic tension pneumocephalus

Article	Patient	CT	Delay	Pneumocephalus	Presentation	CSF rhinorrhea	Treatment	Outcome
Howng et al ⁶	2 patients	Left frontal pneumocephalus	5 mo, 12 mo	Intracerebral	Altered sensorium	Not mentioned	Craniotomy and dural repair	Good
Bayassi ⁷	19/M	Right frontal pneumocephalus	7 wk	Intracerebral	Frontal lobe symptoms	Absent	Craniotomy and dural repair	Good
Zasler ⁸	26/M	Right frontal pneumocephalus with ethmoid fracture	4 y	Intracerebral	Headache	Absent	Craniotomy and dural repair	Good
Hong et al ³	38/F	Right frontal pneumocephalus	12 y	Intracerebral	Persistent seizures, left hemiparesis	Present	Craniotomy and dural repair	Good
Klymaz et al ⁹	63/M	Left frontal sinus fracture with left frontal pneumocephalus	9 d	Intracerebral	Drop in GCS, pupillary asymmetry, right hemiparesis	Absent	Burr hole and saline irrigation	Good
Rathore et al ¹⁰	30/M	Left frontal sinus fracture with subdural pneumocephalus	14 d	Subdural	Drop in GCS	Present	Twist drill and closed water seal	Good
Ausman et al ¹¹	75/M	Right frontal sinus fracture with subdural pneumocephalus	5 d	Subdural	Drop in GCS	Present	Burr hole and irrigation, later craniotomy and dural repair	Good
Tripthy et al ⁴	35/M	Left frontal sinus fracture with left frontal pneumocephalus	1 mo	Intracerebral	Drop in GCS	Absent	Craniotomy and dural repair	Good

Table 1 (Continued)

Article	Patient	CT	Delay	Pneumocephalus	Presentation	CSF rhinorrhea	Treatment	Outcome
Kankane et al ¹	30/M	Bifrontal fracture with right frontal pneumocephalus	1 mo	Intracerebral	Drop in GCS	Present	Burr hole, later craniotomy and dural repair	Good
Wang et al ¹²	20/F	Post-op case of self-inflicted gunshot wound, post craniotomy and dural repair	16 wk	Intracerebral	Headaches	Present	Re-exploration and dural repair	Good
Kankane and Gupta ¹³	25/M	Left frontal pneumocephalus with left frontal sinus fracture	1 mo	Intracerebral	Altered sensorium	Absent	Craniotomy and dural repair	Good
Kankane and Gupta ¹³	30/M	Right frontal pneumocephalus with right frontal sinus fracture	1 mo	Intracerebral	Altered sensorium	Present	Craniotomy and dural repair	Good
Kankane and Gupta ¹³	55/M	Left frontal pneumocephalus with left frontal sinus fracture	2 mo	Intracerebral	Altered sensorium	Absent	Craniotomy and dural repair	Good
Kankane and Gupta ¹³	55/M	Left frontal pneumocephalus with left frontal sinus fracture	6 wk	Intracerebral	Altered sensorium	Absent	Craniotomy and dural repair	Good
Soin et al ¹⁴	35/M	Left frontal sinus fracture with left frontal pneumocephalus	8 mo	Intracerebral	Left hemiparesis	Absent	Craniotomy and dural repair	Not mentioned
Parish et al ⁵	38/M	Right frontal sinus fracture with right frontal pneumocephalus	14 d	Intracerebral	Drop in GCS	Absent	Craniotomy and dural repair	Good
Rajan et al ¹⁵	45/M	Right frontal sinus fracture with subdural pneumocephalus	7 d	Subdural	Drop in GCS	Present	Burr hole and tapping	Good
Mirkarimi et al ¹⁶	12/M	Right frontal sinus fracture with right frontal hydropneumocephalus	6 wk	Intracerebral	Drop in GCS	Absent	Conservative	Good
Praneeth et al ¹⁷	51/M	Right temporal bone fracture with subdural pneumocephalus	12 d	Subdural	Stroke-PCA infarct	CSF otorrhea	Twist drill craniotomy and underwater seal	Good
Ortiz-Galloza et al ¹⁸	72/F	Right frontal sinus fracture with right frontal pneumocephalus	21 d	Intracerebral	Drop in GCS, left hemiparesis, and gaze deviation	Absent	Craniotomy and dural repair	Good

Abbreviations: CSF, cerebrospinal fluid; GCS, Glasgow Coma Scale; PCA, posterior cerebral artery.

one patient. It resolved in all cases either spontaneously or after dural repair.

Tension pneumocephalus occurs most commonly in the subdural location.⁴ But it can occur within the epidural, subarachnoid, intraparenchymal, and intraventricular areas as well. In the articles outlined below, 17/21 cases had parenchymal pneumocephalus, while 4/21 cases had subdural pneumocephalus. The patient in our case report also had an intracerebral pneumocephalus. No association between parenchymal pneumocephalus and delayed presentation has been discussed in the literature thus far. Parish et al⁵ suggested a possible hypothesis for parenchymal pneumocephalus wherein swollen brain parenchyma may stick to the dural tear clogging the fistula. Once the swelling resolves, the fistula could be freed and air could enter the stuck brain, encouraged by Valsalva maneuvers.

Our case report highlights the nuances in the management of delayed tension pneumocephalus. It is a rare condition and insufficient evidence exists in the literature. Treatment in this group of patients should focus on relief of mass effect surgically by twist drill/burr hole or craniotomy and repair of the dural defect to prevent recurrence. Patients presenting with a delayed tension pneumocephalus usually require urgent evaluation and emergency surgery. In posttraumatic cases, multiple skull base fractures may end up clouding decision-making. If the condition of the patient permits, 3D T2 driven equilibrium radiofrequency reset pulse (DRIVE) MR cisternography or CT cisternography can be utilized to localize the site of CSF leak, if present. One should also rule out infection with gas-forming bacteria. Good outcomes have been reported in patients managed in a timely manner.

Statement of Approval from All Authors
Granted.

Conflict of Interest
None declared.

References

- Kankane VK, Jaiswal G, Gupta TK. Posttraumatic delayed tension pneumocephalus: rare case with review of literature. *Asian J Neurosurg* 2016;11(04):343–347
- Pillai P, Sharma R, MacKenzie L, et al. Traumatic tension pneumocephalus: two cases and comprehensive review of literature. *Int J Crit Illn Inj Sci* 2017;7(01):58–64
- Hong WJ, Yoo CJ, Park CW, Lee SG. Two cases of delayed tension pneumocephalus. *J Korean Neurosurg Soc* 2005;37:59–62
- Tripathy P, Mohapatra SSG, Ranjan SK, Sarangi GS, Mohanty S. Post-traumatic delayed intracerebral tension pneumatocele: a case report and review of literature. *Indian J Neurotrauma* 2013;10(02):127–130
- Parish JM, Driscoll J, Wait SD, Gibbs M. Delayed traumatic tension pneumocephalus: a case report. *J Emerg Med* 2020;59(06):e217–e220
- Howng SL, Lieu AS, Chuang MC. Delayed intracerebral tension pneumocephalus: report of two cases. *Kao Hsiung I Hsueh Ko Hsueh Tsa Chih* 1994;10(04):217–221
- Bayassi S. Delayed post-traumatic intracerebral pneumatocele: a case report and literature review. *Neurol Neurochir Pol* 1997;31(05):1047–1051
- Zasler ND. Posttraumatic tension pneumocephalus. *J Head Trauma Rehabil* 1999;14(01):81–84
- Kıymaz N, Demir Ö, Yılmaz N, Üniversitesi YY, Fakültesi T, Van NA. Posttraumatic delayed tension pneumocephalus: case report. *Inönü Üniversitesi Tıp Fakültesi Dergisi* 2005;12(03):189–192
- Rathore Singh Y, Satyarthee Dutta G, Mahapatra Kumar A. Post-traumatic tension pneumocephalus: series of four patients and review of the literature. *Turk Neurosurg* 2016;26(02):302–305 PubMed
- Ausman JI, Solomiichuk VO, Lebed VO, Drizhdov KI. Posttraumatic delayed subdural tension pneumocephalus. *Surgical Neurol Int* 2013;4:37 PubMed
- Wang A, Solli E, Carberry N, Hillard V, Tandon A. Delayed tension pneumocephalus following gunshot wound to the head: a case report and review of the literature. *Case Rep Surg* 2016;2016:7534571
- Kankane VK, Gupta TK. Outcome of posttraumatic delayed intracerebral tension pneumatocele: prospective study of four cases: single institutional experience. *Asian J Neurosurg* 2018;13(04):1087–1095
- Soin P, Sharma P, Goyal P, Singh Kochar P. Isolated intraparenchymal tension pneumocephalus. 2018;31(04):537–538 PubMed
- Rajan VTT, Dharini GK III, Anand VSS, Nandish HS. When Mount Fuji can erupt after seven days: a case report of delayed posttraumatic tension pneumocephalus with literature review. *J Neurosci Rural Pract* 2020;11(01):187–190
- Mirkarimi T, Modirian E, Namdar P, Salek M. Delayed post-traumatic tension hydropneumocephalus; a case report of conservative treatment. *Arch Acad Emerg Med* 2021;9(01):e22
- Praneeth K, Nachiappan DS, Gupta D. A stitch in time saves nine: delayed presentation of tension pneumocephalus as stroke. *Neurol India* 2021;69(06):1635–1636
- Ortiz-Galloza EX, Arechiga B, Heer J, Quesada D. Delayed tension pneumocephalus following frontal sinus fracture. *Clin Pract Cases Emerg Med* 2022;6(01):81–82