

Case Report

Posttraumatic delayed subdural tension pneumocephalus

Volodymyr O. Solomiichuk, Vitaliy O. Lebed, Konstantin I. Drizhdov

Neurosurgical Department, Yalta City Hospital, Yalta, Crimea, Ukraine

E-mail: *Volodymyr O. Solomiichuk - solomiichuk@gmail.com; Vitaliy O. Lebed - lebed_vitaliy@ukr.net; Konstantin I. Drizhdov - yaltaneurozav@bigmir.net
*Corresponding author

Received: 23 January 13 Accepted: 05 March 13 Published: 25 March 13

This article may be cited as:Solomiichuk VO, Lebed VO, Drizhdov KI. Posttraumatic delayed subdural tension pneumocephalus. *Surg Neurol Int* 2013;4:37.Available FREE in open access from: <http://www.surgicalneurologyint.com/text.asp?2013/4/1/37/109537>

Copyright: © 2013 Solomiichuk VO. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

Background: Pneumocephalus is a complication of head injury in 3.9-9.7% of the cases, it also appears after supratentorial craniotomy in 100% of cases. The accumulation of intracranial air can be acute (<72 hours) or delayed (≥72 hours). When intracranial air causes intracranial hypertension and has a mass-effect with neurological deterioration, it is called tension pneumocephalus.

Case description: We represent a clinical case of a 75-year-old male patient with open penetrating head injury, complicated by tension pneumocephalus on the fifth day after trauma and underwent urgent surgical correction. Operation performed: Burr-hole placement in the right frontal region, evacuation of tension pneumocephalus.

Conclusion: Tension pneumocephalus is a life-threatening neurosurgical emergency case, which needs to undergo immediate surgical or conservative treatment.

Key Words: Computed tomography scan, cerebrospinal fluid leak, craniofacial trauma, head injury, tension pneumocephalus

Access this article online**Website:**www.surgicalneurologyint.com**DOI:**

10.4103/2152-7806.109537

Quick Response Code:**INTRODUCTION**

Pneumocephalus, also known as intracerebral aerocele or pneumatocele, is a collection of air in the cranial cavity.^[7] It is a complication of head injury in 3.9-9.7% cases,^[8] it also appears after supratentorial craniotomy in 100% of cases.^[19] The accumulation of intracranial air can be acute (<72 hours) or delayed (≥72 hours).^[16] As a rule, intracranial collection of air is benign and asymptomatic. When intracranial air causes intracranial hypertension and has a mass-effect with neurological deterioration, it is called tension pneumocephalus. In the literature, 23 cases of tension pneumocephalus were described, 17 of them needed urgent surgery. In this article, we describe a rare case of delayed tension pneumocephalus who underwent urgent surgical treatment.

The first description of pneumocephalus was provided by Thomas in 1866.^[20] Chiari in 1884 described a pneumocephalus found on the autopsy as a complication of ethmoiditis.^[14] Lockett in 1913 showed ventricular air in plain skull radiographs. The term “pneumocephalus” was invented by Wolff in 1914.^[20] “Tension pneumocephalus” was first described in 1962 by Ectors, Kessler, and Stern.^[4]

Mechanism of pneumocephalus development was described by two theories: (1) Dandy theory of “ball valve”^[3] and (2) Horowitz “Inverted-soda-bottle effect”.^[5] First one describes a unidirectional air movement from outside into the cranial cavity, which then gets trapped. The second theory tells that negative intracranial pressure occurs as a result of excessive cerebrospinal fluid (CSF) loss due to any mechanism, for example, drainage in the

physiological way during Valsalva maneuver, or through the iatrogenic lumbar drain.

Pneumocephalus can be caused by:

- Trauma (basal skull fractures, paranasal sinuses fractures,^[23] open cranial convexity fractures with dural laceration)
- Neurosurgical operations (twist-drill evacuation of chronic subdural hematomas;^[21] ventriculo-peritoneal shunting;^[18] posterior fossa surgery in sitting^[15] or lateral^[13] position; cranial surgery in supine position;^[19] ICP monitoring;^[24] transsphenoidal or endoscopic sinus surgery)
- ENT operations (paranasal sinuses surgery; nasal septum resection; nasal polypectomy)
- Lumbar punctures^[10]
- Barotrauma
- Tumors
- CNS infections caused by gas-producing microorganisms
- Nitrous oxide
- Congenital skull and tegmen tympani defects
- Spinal anesthesia
- Positive pressure ventilation
- Hyperbaric oxygen therapy
- Spontaneous
- Scuba diving

Clinical presentation of tension pneumocephalus may include headache, generalized seizures, agitation, delirium, reflex abnormalities, otherwise altered level of consciousness, pupillary changes, and frontal lobe syndrome. Tension pneumocephalus localized in the posterior cranial fossa can cause clinical signs of brainstem dislocation,^[9] including breathing rhythm changes and cardiac arrest. Some rare neurological symptoms of tension pneumocephalus were reported, such as marked weakness of both legs^[17] and transient hemiplegia.^[1]

Computed tomography (CT) is a golden standard for tension pneumocephalus diagnostics. A bilateral subdural hypoattenuation (Hounsfield coefficient – 1000) collections, causing compression and separation of frontal lobes (widened interhemispheric fissure), with separated frontal lobes tips on CT scans were described as “Mount Fuji sign” by Ishiwata, *et al.* as pathognomonic sign of tension pneumocephalus.^[12,22] Plain X-rays can be also used for pneumocephalus diagnosis.^[20]

Tension pneumocephalus treatment includes a complex of manipulations directed to removing of intracranial air mass-effect, adequate skull base defects closure, and secondary posttraumatic meningitis prophylaxis.

Initial treatment is usually conservative, including bed rest in an upright position, high concentration oxygen, avoidance of maneuvers that might increase intracranial

pressure (such as nose-blowing or valsalva maneuver) and antibiotics if there is evidence of meningism. Surgical treatment is indicated when there is recurrent pneumocephalus or signs of increasing intracranial pressure suggesting development of tension pneumocephalus.^[2] Surgical options include direct insertion of a subdural drain connected to underwater seal or, indirectly, with the use of a saline-primed Camino bolt.^[11]

CASE REPORT

A 75-year-old right-handed male with trauma signs on his head (right-sided paraorbital hematoma and a wound in his frontal region) was admitted to Yalta City Hospital after he fell down at the entrance of his house. He lost consciousness for about 2 minutes. On admission, he was Glasgow coma scale (GCS) 15 with right-sided exophthalmos up to 4 mm. He complained of headache and diplopia while looking to the right.

Neurologically: Limitation of the right eye abduction, eyeballs weak of convergence.

CT showed frontal sinus fracture with extension to the right orbital roof and minimal pneumocephalus [Figure 1]. A wound with fracture of frontal sinus outer wall in its depth was closed with sutures. Next day, nasal liquorrhea occurred.

On the fifth day after admission to neurosurgical department, he was noticed to be deteriorating neurologically. His GCS dropped to 12, meningeal signs were found and he became bradyapneic. It was a “Mount Fuji sign” on the cranial CT scans [Figure 2].

Under general anesthesia, a burr-hole was placed in the right frontal region and subdural space was irrigated with normal saline and admitted to the intensive care unit (ICU).

Next day after the surgical treatment, he improved and became awake. He was successfully weaned of the ventilator and admitted to the neurosurgical department. Subdural drain was removed.

On the brain CT scans there was a minimal residual air [Figure 3]. Liquorrhea stopped.

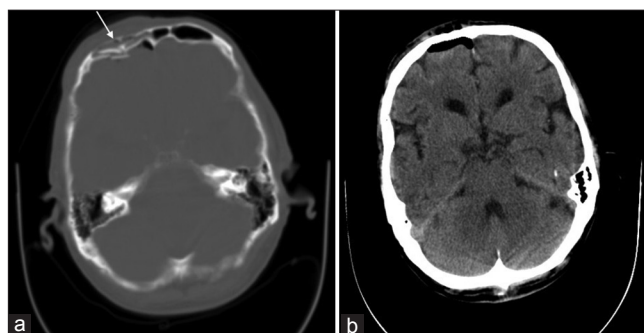


Figure 1: CT scans on patients admitting to hospital: Fracture of frontal sinus and minimal pneumocephalus

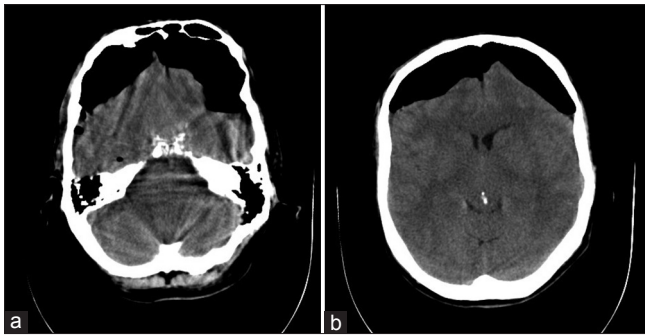


Figure 2: "Mount Fuji sign"



Figure 3: Postoperative residual air

Patient underwent a conservative treatment and observation. On the sixth day after the operation, an episode of hyperthermia up to 38°C developed.

On the 11th day, nasal liquorrhea resumed. On the background of the therapy, a sustained clinical improvement was achieved.

Patient refused to undergo proposed surgical intervention, aimed at dura defect closure in the posterior wall of the frontal sinus. On the 22nd day after hospitalization, on the urge of family members, patient was transferred to Kyiv Municipal Clinical Emergency Hospital. On the second day after transfer, nasal liquorrhea resumed. Watertight dura closure and cranioplasty was performed. The postoperative period was uneventful and CSF was without signs of inflammation. In 12 days after surgery, patient was discharged. At his 14 month follow-up, he has no neurological deficit and no signs of liquorrhea and meningitis.

CONCLUSION

Tension pneumocephalus is a life-threatening neurosurgical emergency case, which needs to undergo immediate surgical or conservative treatment.

Even minor air collection in the cranial cavity has a risk

of transformation into tension pneumocephalus in case of valve mechanism development.

Considering existence of tension pneumocephalus mentioned cases and development in the late postoperative or/and posttraumatic period, these patients should be subject for long-term follow-up after discharge from hospital.^[6]

REFERENCES

- Chandran TH, Prepageran N, Philip R, Gopala K, Zubaidi AL, Jalaludin MA. Delayed spontaneous traumatic pneumocephalus. *Med J Malaysia* 2007;62:411-2.
- Cho HL, Han YM, Hong YK. Tension pneumocephalus after transsphenoidal surgery: Report of two cases. *J Korean Neurosurg Soc* 2004;35:536-8.
- Dandy WE. Pneumocephalus (intracranial pneumatocele or arocele). *Arch Surg* 1926;12:949-82.
- Hong WJ, Yoo CJ, Park CW, Lee SG. Two cases of delayed tension pneumocephalus. *J Korean Neurosurg Soc* 2005;37:59-62.
- Horowitz M. Intracranial pneumocele. An unusual complication following mastoid surgery. *J Laryngol Otol* 1964;78:128-34.
- Kiyamaz N, Demir O, Yilmaz N. Posttraumatic Delayed Tension Pneumocephalus: Case Report. *Inonu Universitesi Tip Fakultesi Dergisi* 2005;12:189-92.
- Komolafe EO. Tension Pneumocephalus: A rare but treatable cause of rapid neurological deterioration in traumatic brain injury: A case report. *Afr J Med Sci* 2010;29:88-91.
- Kon T, Hondo H, Kohno M, Kasahara K. Severe tension pneumocephalus caused by opening of the frontal sinus by head injury 7 years after initial craniotomy: Case report. *Neurol Med Chir (Tokyo)* 2003;43:242-5.
- Kuncz A, Roos A, Lujber L, Haas D, Al Refai M. Traumatic prepontine tension pneumocephalus: Case report. *Ideggyogy Sz* 2004;57:313-5.
- Lee SH, Koh JS, Bang JS, Kim MC. Extensive tension pneumocephalus caused by spinal tapping in patient with Basal skull fracture and pneumothorax. *J Korean Neurosurg Soc* 2009;45:318-21.
- Leong KM, Vijayanathan A, Sia SF, Waran V. Pneumocephalus: An uncommon finding in trauma. *Med J Malaysia* 2008;63:256-8.
- Michel SJ. The Mount Fuji Sign. *Radiology* 2004;232:449-50.
- Nayak PK, Mahapatra AK. Tension pneumocephalus in lateral position following posterior fossa surgery. *Pan Arab J Neurosurg* 2011;15:76-8.
- Oge K, Akpinar G, Bertan V. Traumatic subdural pneumocephalus causing rise in intracranial pressure in the early phase of head trauma: Report of two cases. *Acta Neurochir Wien* 1998;140:655-8.
- Pandit UA, Mudge BJ, Keller TS, Samra SK, Kilaru P, Pandit SK, et al. Pneumocephalus after posterior fossa exploration in the sitting position. *Anaesthesia* 1982;37:996-1001.
- Pillai P, Sharma R, MacKenzie L, Reilly EF, Beery PR 2nd, Papadimos TJ, et al. Traumatic tension pneumocephalus: Two cases and comprehensive review of literature. *OPUS 12 Scientist* 2010;4:6-11.
- Pruss H, Klingebiel R, Endres M. Tension pneumocephalus with diplegia and deterioration of consciousness. *Case Rep Neurol* 2011;3:48-9.
- Sankla S, Khan GM, Khan MA. Delayed tension pneumocephalus: A rare complication of shunt surgery. *Neurol India* 2004;52:401-2.
- Satapathy GC, Dash HH. Tension pneumocephalus after neurosurgery in the supine position. *Br J Anaesth* 2000;84:115-7.
- Schirmer CM, Heilman CB, Bhardwaj A. Pneumocephalus: Case illustrations and review. *Neurocrit Care* 2010;13:152-8.
- Shaikh N, Masood I, Hanssens Y, Louon A, Hafiz A. Tension pneumocephalus as complication of burr-hole drainage of chronic subdural hematoma: A case report. *Surg Neurol Int* 2010;1:27.
- Thapa A, Agrawal D. Mount Fuji Sign in tension pneumocephalus. *Indian J Neurotrauma* 2009;6:161-2.
- Vikram A, Deb AK. Tension pneumocephalus secondary to a dural tear. *Appl Radiol* 2011;40:37-8.
- Vitali AM, le Roux AA. Tension pneumocephalus as a complication of intracranial pressure monitoring: A case report. *Indian J Neurotrauma* 2007;4:115-8.