Article published online: 2021-12-13

Trauma-Associated Tension Pneumocephalus with Characteristic Mount Fuji Sign—Case Report

Utkarsh Khandelwal[1] Anuj Ajayababu[1] Tej Prakash Sinha[1] Sanjeev Bhoi[1]

[1] Department of Emergency Medicine, All India Institute of Medical Sciences, New Delhi, India

Indian J Neurotrauma 2023;20:45–48.

Address for correspondence Tej Prakash Sinha, MBBS, MS, Department of Emergency Medicine, Jai Prakash Narayan Apex Trauma Centre, All India Institute of Medical Sciences, New Delhi 110029, India (e-mail: drsinha123@gmail.com).

Abstract

Tension pneumocephalus is a rare and life-threatening neurosurgical emergency in the setting of blunt or penetrating head trauma, especially in those with craniofacial fractures, which emergency physicians should be aware about. Early identification and appropriate treatment measures including supine positioning, 100% oxygen via mask, early neurosurgery consultation and, if required, operative intervention are paramount to optimal neurological and survival outcome. Definitive diagnosis requires imaging usually in the form of computed tomography (CT) head and serial monitoring of neurological status, optic nerve sheath diameter measurement and repeat imaging, essential to identify patients who might have features of increased pressure on brain matter, which could lead to adverse neurological and clinical outcomes. We present two cases of tension pneumocephalus with the characteristic Mount Fuji sign on CT head, who were managed nonoperatively with optimal neurological outcome. In patients with severe head or maxillofacial trauma presenting to emergency department, CT should be evaluated for signs of tension pneumocephalus, and such patients need to be closely observed for complications of pressure effect on brain matter to ensure optimal neurological and survival outcomes.

Keywords
- case report
- head trauma
- mount fuji sign
- raised intracranial pressure
- tension pneumocephalus

Introduction

Pneumocephalus (also known as pneumatocele) is quite common in the setting of trauma, especially those associated with head injury. In this setting, it can occur either as a result of trauma itself or postsurgical intervention. Tension pneumocephalus, a potentially fatal condition, however, is quite rare and is a treatable emergency. It occurs due to collection of air within the cranial cavity with increased pressure on brain matter along with neurological deterioration.[1] There are two theories postulated for the development of tension pneumocephalus, which include the Dandy theory and Horowitz theory. The Dandy theory suggests a ball valve mechanism, leading to one way entry of air through a dural defect, resulting in entry of air into cranial cavity with trapping of air.[2] The Horowitz theory suggests an inverted soda bottle effect from loss of cerebrospinal fluid (CSF), resulting in negative pressure in the cranial cavity.[3] Posttraumatic tension pneumocephalus reported in literature is mostly associated with severe craniofacial fractures. Early and prompt identification is of utmost importance to avoid adverse neurological outcomes and mortality. Management involves conservative measures, including high-flow oxygen therapy, supine positioning, analgesia, prophylactic antibiotics in posttraumatic cases, frequent monitoring of neurological status clinically, and using imaging. Operative management for those not improving or those with symptomatic tension

article published online
December 13, 2021

DOI https://doi.org/10.1055/s-0041-1739482.
ISSN 0973-0508.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

pneumocephalus includes prompt decompression by drilling burr holes, needle aspiration, and craniotomy or ventriculostomy. In addition, the dural defect should be identified and sealed off to prevent further worsening or recurrent pneumocephalus. Here, we present two patients who presented with trauma-associated tension pneumocephalus who were successfully managed nonoperatively.

Case 1

A 30-year-old male presented with history of road traffic accident. The patient was a pedestrian who was hit by a truck. On arrival in ED, primary survey showed patent airway and normal breathing; patient was hemodynamically stable with Glasgow coma scale (GCS) E4V4M5 along with bilateral pupils of normal size and reactive to light. He was moving all four limbs, although there was pain and swelling of right thigh, and all peripheral pulses were normal.

Investigations

E-FAST examination was normal with normal chest and pelvic X-rays. X-ray of right thigh showed fracture of shaft of femur. Computed tomography (CT) head showed small contusion in right frontal lobe with large contusion in left frontal region along with associated edema. Pneumocephalus was seen in bilateral frontal region (►**Fig. 1**) with bilateral frontal fracture and right ethmoidal, maxillary and mandibular fracture. Noncontrast CT (NCCT) face showed bilateral Le-Forte 1 and 2 fractures (►**Fig. 2**). Contrast-enhanced CT (CECT) chest and abdomen showed no evidence of intrathoracic injury, hemothorax/pneumothorax, no solid organ or hollow viscus injury, and no evidence of any intraperitoneal free air/fluid.

Fig. 1 Case 1. Noncontrast computed tomography (NCCT) head showing Mount Fuji sign with left frontal contusion.

Fig. 2 Case 2. Noncontrast computed tomography (NCCT) head showing Mount Fuji sign.

Treatment

Patient was managed nonoperatively with supine positioning, high-flow oxygen therapy, frequent neurological examination, and repeat imaging to look for increase in size of pneumocephalus and for significant pressure effect on the brain matter or ventricles. He underwent closed reduction and internal fixation for femur fracture. He improved neurologically during the course of his hospital stay and GCS improved to E4V5M6.

Outcome and Follow-up

He improved neurologically during the course of his hospital stay with conservative measures mentioned above and was discharged in stable condition. At the time of discharge, patient did not have any neurological deficits, was feeding orally, and voiding by self. At present, patient is doing well with no residual neurological deficit and did not require any further neurosurgical intervention for any complications

Case 2

A 67-year-old male presented with history of road traffic accident. Patient was a pedestrian who was hit by a two-wheeler. On arrival in ED, primary survey showed patent airway and normal breathing; patient was hemodynamically stable with GCS E3V4M5 with left pupil of normal size and reactive to light and right pupil nonassessable due to periorbital swelling. He was moving all four limbs, and all peripheral pulses were normal. Clinically, there was no facial bone/long bone fractures.

Investigations

FAST examination was normal; however, E-FAST showed left-sided PneumoScan positive with normal chest and pelvic X-rays. CT head showed pneumocephalus (►**Fig. 2**) with multiple hemorrhages in gray–white junction, suggestive of diffuse axonal injury. In addition, there was left frontal bone fracture involving left frontal sinus with hemosinus. CECT torso showed mild left-sided hemopneumothorax with no evidence of any rib fractures, no solid organ or hollow viscus injury, and no evidence of any intraperitoneal free air/fluid.

Treatment

Patient was managed conservatively with supine positioning, high-flow oxygen therapy, frequent neurological examination, and repeat imaging to look for increase in size of pneumocephalus and for significant pressure effect on the brain matter or ventricles.

Outcome and Follow-up

The patient was managed conservatively and discharged after complete neurological recovery and with no major neurological deficits. Patient is doing well postdischarge with complete neurological recovery and has not required further neurosurgical intervention for any complications.

Discussion

First described by Lecat in 1741,[4] pneumocephalus is described in variety of clinical settings. While pneumocephalus is quite often seen in the setting of trauma and postsurgery, especially posthead and neck or neurosurgical interventions, tension pneumocephalus is quite rare and a form of neurosurgical emergency. Tension pneumocephalus was first described by Ectors, Kessler and Stern in 1962.[1,5,6] It occurs when air in the cranial cavity exerts pressure on the brain matter or ventricles. Prompt and accurate diagnosis of this condition is absolutely vital to prevent mortality or poor neurological outcomes. This requires a high index of clinical suspicion and corroborative imaging in the appropriate clinical setting.

The most common clinical presentations include headache, vomiting, lethargy, decreased vision, altered mental status, CSF rhinorrhea, and stupor. Definitive diagnosis in most cases require imaging, most commonly a plain CT scan showing characteristic Mount Fuji sign[7] or showing dural air in any compartment with features of raised intracranial tension (ICT). This sign is characteristic of tension pneumocephalus and is characteristically described as bilateral frontal subdural air on CT with widened interhemispheric fissure due to compression and separation of frontal lobes by subdural air. It suggests that pressure of the gas is at least greater than the surface tension of CSF between the frontal lobes.[8,9] It is caused by cortical veins tethering the frontal lobes, resulting in this characteristic appearance. In the emergency department, optic nerve sheath diameter can be used to look for signs of raised intracranial pressure (ICP).

Management includes supine positioning, 100% oxygen via nonrebreathing mask, serial optic nerve sheath diameter measurement, regular monitoring of neurological status, repeat imaging in case of deterioration of neurological status and, if required, simple twist drill and aspiration of intracranial air with or without an underwater seal,[10] craniotomy, drilling of burr holes, ventriculostomy placement and closure of dural defects.

Learning Points

1. Tension pneumocephalus should be suspected in patients with craniofacial fractures, including those with blunt or penetrating trauma with decreased neurological status.
2. Early identification is important for optimal survival and neurological outcome. Such patients should be constantly monitored for worsening of neurological status and features of increased pressure on brain matter, so that early neurosurgical intervention can be done.
3. Definitive diagnosis depends on imaging.
4. Management includes both nonoperative measures like supine positioning, 100% oxygen, and frequent assessment of neurological status.
5. Early neurosurgical consultation and urgent decompression, if required, is necessary in cases showing significant pressure effect due to prevent neurological deterioration.

Authors' Contributions

U.K. and A.A. were involved in patient management. U.K. and T.P.S. did the interpretation of clinical images. A.A. wrote the first draft of the manuscript, and T.P.S. and S.B. reviewed and edited the final version. All authors take full responsibility of the manuscript.

Funding

None.

Conflict of Interest

None declared.

Acknowledgments

We thank the Department of Emergency Medicine, Department of Trauma Surgery, and Department of Neurosurgery, for complete care of the patients.

References

1 Kessler LA, Stern WZ. The ventriculopleural shunt procedure for hydrocephalus. Case report of an unusual complication. J Pediatr 1962;60:418–420
2 Dandy WE. Pneumocephalus (intracranial pneumatocele or aerocele). Arch Surg 1926;12:949–982
3 Horowitz M. Intracranial pneumocoele. An unusual complication following mastoid surgery. J Laryngol Otol 1964;78:128–134

4 Mcarthur LL. Pneumatocele of the cranium. JAMA 1905;XLIV(18):1418–1423
5 Ectors L. L'hematome sousdural chronique. Taitement chirurgical. Acta Chir Belg 1962;61:570–606
6 Ectors P, Martens F. Postoperative tension pneumocephalus. J Neurosurg 1988;69(04):641–642
7 Michel SJ. The Mount Fuji sign. Radiology 2004;232(02):449–450
8 Heckmann JG, Ganslandt O. Images in clinical medicine. The Mount Fuji sign. N Engl J Med 2004;350(18):1881
9 Mattick A, Goodwin P. Mount Fuji sign on CT following trauma. J Trauma 2005;59(01):254
10 Rathore AS, Satyarthee GD, Mahapatra AK. Post-traumatic tension pneumocephalus: series of four patients and review of the literature. Turk Neurosurg 2016;26(02):302–305