Is Fluoroscopy-Guided Drainage of Tension Pneumocephalus an Appropriate Intervention?: Surgical Technique

Tansiyon Pnömosefalinin Floroskopi Eşliğinde Drenajı Uygun Bir Yaklaşım mı?

Özgür DEMİR, MD, Assis.Prof.,[a]
Fatih ERSAY DENİZ, MD, Assis.Prof.,[a]
Erol ÖKSÜZ, MD, Assis.Prof.,[a]
Erdoğan AYAN, MD, Assis.Prof.[a]

[a]Department of Neurosurgery, Gaziosmanpaşa University Faculty of Medicine, Tokat

Geliş Tarihi/*Received:* 26.09.2011
Kabul Tarihi/*Accepted:* 23.12.2011

Yazışma Adresi/*Correspondence:*
Özgür DEMİR, MD, Assis.Prof.
Gaziosmanpaşa University Faculty of Medicine, Department of Neurosugery, Tokat, TÜRKİYE/TURKEY
cerendemir40@gmail.com

ABSTRACT Tension pneumocephalus is not a common entity after head trauma. It requires urgent intervention when associated with raised intracranial pressure. A 22 year-old man was admitted in our emergency unit after being involved in a traffic accident. Initial assessment of the patient revealed a Gloskow Coma Score (GCS) of 8. Radiological exams showed left fronto-orbital depression fracture, left fronto-basal fracture and left frontal cerebral contusion. The patient was operated urgently. Depressed bones were elevated and cranial reconstruction was done. After the initial operation, his neurological level elevated day by day. Thirty days after the operation computed tomography (CT) scan showed left frontal pneumocephalus. Conservative treatment was initiated. First, the volume of air in the field decreased spontaneously but after strong coughing, the amount of air increased and showed resistance to absorption. The patient was reoperated. Left frontal pneumatic space was irrigated with physiologic saline until all air was evacuated. Fluoroscopy showed the location of the intracranial air and no air was left after evacuation. The patient recovered well. No intracranial air was detected in his follow-up. There is no standard surgical intervention for tension pneumocephalus. Fluoroscopy-guided drainage with punctuation needle for tension pneumocephalus is a minimally invasive and effective procedure.

Key Words: Tension pneumocephalus; head trauma; surgical treatment

ÖZET Tansiyon pnömosefali, kafa travmalarından sonra sık görülen bir durum değildir. İntrakraniyal basınçta artışa neden olduğunda acil müdahale gerektirir. Yirmi iki yaşında bir erkek hasta, trafik kazası geçirdikten sonrası acil servisimize başvurdu. Hastanın ilk nörolojik muayenesinde Glasgow Koma Skoru (GKS) 8 bulundu. Radyolojik çalışmalar, sol fronto-orbital çökme kırığı, sol frontobazal kırık ve sol frontal serebral kontüzyon olduğunu gösterdi. Hasta acilen ameliyat edildi. Operasyonda çökmüş kemikler kaldırıldı ve kraniyal rekonstrüksiyon yapıldı. İlk operasyondan sonra hastanın kliniği günden güne düzeldi. Otuz gün sonra hastaya çekilen bilgisayarlı tomografi (BT) incelemesinde sol frontal pnömosefali tespit edildi. Öncelikle hastaya konservatif tedavi başlandı. Önce alandaki hava miktarı spontan olarak azaldı. Fakat hastanın güçlü öksürmesinin ardından, alandaki hava miktarı arttı ve absorbe olmadı. Hasta bunun üzerine tekrar operasyona alındı. Operasyonda sol frontal bölgedeki hava serum fizyolojik ile irrigasyonla boşaltıldı. Floroskopi intrakraniyal havanın lokalizasyonunu ve drenaj işlemi sonrasında da bölgede havanın kalmadığını gösterdi. Hasta iyileşti. Hastanın takiplerinde de intrakraniyal hava tespit edilmedi. Tansiyon pnömosefali için standart bir tedavi yöntemi yoktur. Tansiyon pnömosefalide floroskopi yardımlı ponksiyon iğnesiyle havanın drenajı, invaziv olmayan etkili bir yöntemdir.

Anahtar Kelimeler: Tansiyon pnömosefali; kafa travması; cerrahi tedavi

Turkiye Klinikleri J Med Sci 2012;32(3):891-4

Tension pneumocephalus is usually used to describe air trapped under pressure. It behaves like a space occupying mass and threatens life. Urgent intervention is required for decreasing intracranial pressure.[1]

doi: 10.5336/medsci.2011-26576

Indicated surgery can be done as open surgery, endoscopic surgery and evacuation by punctuation needle from cranial hole or holes. The last one is a less invasive procedure compared to others.[2] Fluoroscopy makes this procedure easier. Although fluoroscopy is not an adequate imaging technique for cerebral tissue, it can show the location and amount of air.[3] Thus, it is useful to determine the localization of intracranial air before evacuation. It can also show the air amount during the evacuation procedure. Evacuation by punctuation needle with fluoroscopy is also an effective procedure. Thus, we recommend this procedure initially before attempting more invasive procedures.

CASE REPORT

A 22 year-old man was involved in a road traffic accident where he sustained head injury. He was admitted to our emergency unit with Glasgow Coma Scala 8. Radiological studies revealed left fronto-orbital depression fracture, left fronto-basal fracture and left frontal cerebral contusion (Figure 1). The patient was operated urgently. Depressed bones were elevated and cranial reconstruction was done. After the initial operation, the patient was monitored in the intensive care unit. His neurological level elevated day by day and his GKS increased to 14. Thirty days after his initial operation rhinorrhea started. Computed tomography (CT) showed left frontal pneumocephalus. Conservative treatment was initiated. Conservative treatment included bed rest, avoidance of Valsalva maneuver, analgesia, sedation and high concentration oxygen. First, the air amount in the field decreased and rhinorrhea stopped spontaneously but after strong coughing, the air amount increased and showed resistance to being absorbed. The air amount stayed constant for 2 weeks. Then we performed fluoroscopy-guided drainage with punctuation needle (Figure 2). Left frontal tense air was evacuated. Fluoroscopy showed the location of the intracranial air and that no air was left after evacuation. CT showed no air in the field after the second inter-

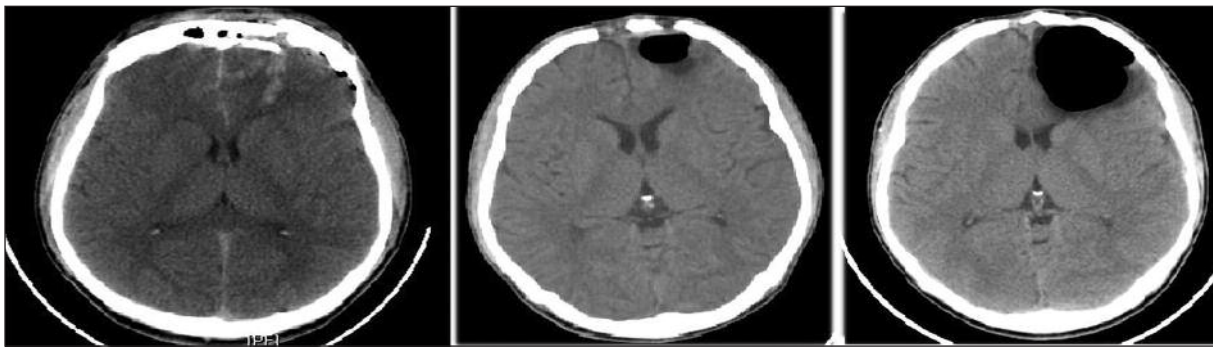

FIGURE 1: Cranial tomography showed left fronto-orbital depression fracture and development of tension pneumocephalus.

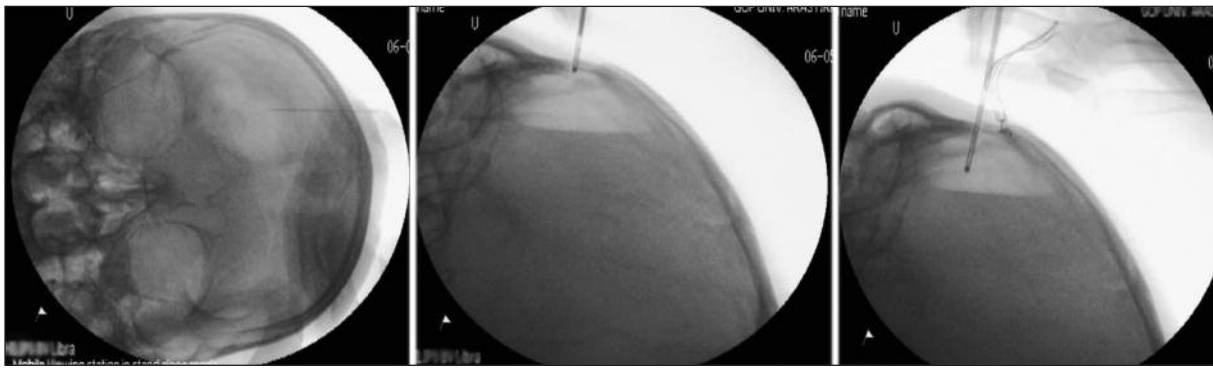

FIGURE 2: Peroperative fluoroscopy guidance for aspiration needle.

vention (Figure 3). The patient recovered well. No intracranial air was detected in his follow-up.

DISCUSSION

The most common cause of pneumocephalus is trauma. Other common causes are craniofacial operations, tumours, infections and fistulas.[4] There are also rare reports of pneumocephalus resulting from barotraumas in a pilot and scuba divers.[5,6] In our patient, two possible mechanisms could be suggested for the development of pneumocephalus. The first mechanism was fronto-basal fracture and the second mechanism was craniofacial surgery.

Commonly, two theories have been proposed as the mechanism by which tension pneumocephalus developed. The first one is a ball valve mechanism, which describes unidirectional airflow where air is trapped into the intracranial cavity.[7] The second one is the soda bottle theory in which continuous leakage of cerebro-spinal fluid (CSF) results in negative intracranial pressure, thus allowing replacement of lost fluid by air.[8] Both mechanisms could be responsible due to fronto-basal fracture and dural tear in our case.

Tension pneumocephalus may appear as a space occupying mass and suddenly leads to the development of increased intracranial pressure findings including worsening consciousness level, pupil dilatation, paresis, respiratory distress and death.[9] However, tension pneumocephalus may not cause sudden neurological depression because the air accumulates slowly and shows resistance to being absorbed.[10] Similarly, in our case, the air accumulated slowly and resisted to being absorbed and the findings did not support sudden increased intracranial pressure.

The presence of intracranial air is an indication of an open fracture or a fracture line extending into a sinus. Air mostly fills the subdural area in tension pneumocephalus. Air also can occupy the epidural, subarachnoid, intraparenchymal, and intraventricular areas.[4] In our case, air occupied the left frontal intraparenchymal area because of fronto-basal fracture and dural tear.

CT plays a vital role in determining intracranial gas collection. CT also plays an important role in the diagnosis in head trauma including acute hemorrhage and cranial fractures.[11] Pneumocephalus is also evident on plain skull x-rays and fluoroscopy.[3] We used fluoroscopy to determine the location of pneumocephalus and while we were aspirating the gas, it showed real time image. Thus, we were convinced that no air was left in the field. Fluoroscopy has a simple technology but it is very effective in tension pneumocephalus for guiding surgery.

Tension pneumocephalus should be managed after being diagnosed. Treatment options include aspiration through cranial hole and reconstruction of injured sites with open or endoscopic surgery.[12] The first one is a minimally invasive method. It is a very effective method with fluoroscopy guidance. We suggest that aspiration breaks the gentle formation mechanism of tension pneumocephalus and provides cure. We recommend fluoroscopy guided drainage to treat tension pneumocephalus before attempting more invasive methods.

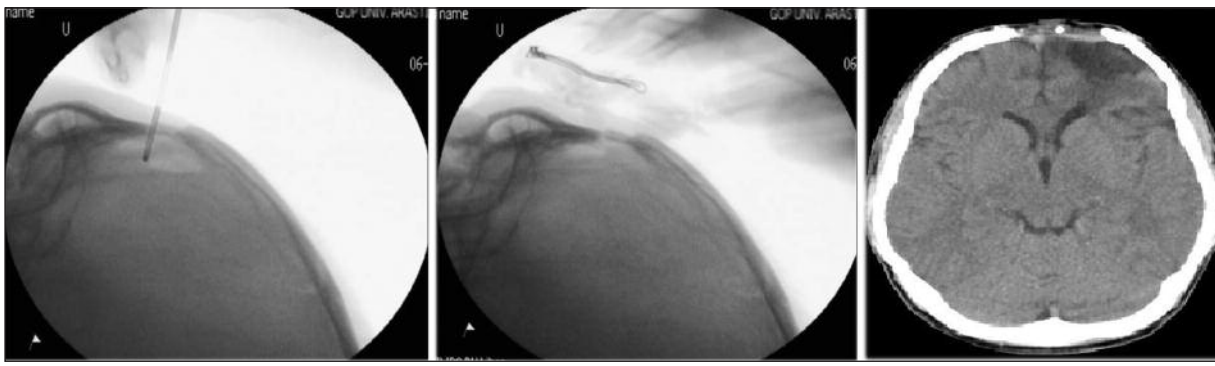

FIGURE 3: Peroperative fluoroscopy showed drainage of the air. Tomography supported fluoroscopic images postoperatively.

REFERENCES

1. Sprague A, Poulgrain P. Tension pneumocephalus: a case report and literature review. J Clin Neurosci 1999;6(5):418-424.
2. Por YC, Barcelo CR, Salyer KE. Extradural tension pneumocephalus after posterior cranial vault remodeling for ventriculoperitoneal shunt-induced craniosynostosis. J Craniofac Surg 2005;16(3):504-8.
3. Ishiwata Y, Fujitsu K, Sekino T, Fujino H, Kubokura T, Tsubone K, et al. Subdural tension pneumocephalus following surgery for chronic subdural hematoma. J Neurosurg 1988;68(1):58-61.
4. Markham JW. The clinical features of pneumocephalus based upon a survey of 284 cases with report of 11 additional cases. Acta Neurochir (Wien) 1967;16(1):1-78.
5. Canavan L, Osborn RE. Dural sinus air without head trauma or surgery: CT demonstration. J Comput Assist Tomogr 1991;15(3): 526-7.
6. Hermans PE, Bracke PG, Demeyer IV. Pneumocephalus due to barotrauma: CT demonstration. AJR Am J Roentgenol 1992;159(6): 1351-2.
7. Dandy WE. Pneumocephalus (intracranial pneumatocele or aerocele). Arch Surg 1926; 12(5):949-82.
8. Horowitz M. Intracranial pneumocoele. An unusual complication following mastoid surgery. J Laryngol Otol 1964;78:128-34.
9. Gönül E, Izci Y, Sali A, Baysefer A, Timurkaynak E. Subdural and intraventricular traumatic tension pneumocephalus: case report. Minim Invasive Neurosurg 2000;43(2):98-101.
10. Sprague A, Poulgrain P. Tension pneumocephalus: a case report and literature review. J Clin Neurosci 1999;6(5):418-24.
11. Keskil S, Baykaner K, Ceviker N, Işik S, Cengel M, Orbay T. Clinical significance of acute traumatic intracranial pneumocephalus. Neurosurg Rev 1998;21(1):10-3.
12. Kim JW, Lee SH, Lee KS, Ko KC, Kim HK, Khang CG, et al. Posttraumatic tension pneumocephalus of delayed onset. J Korean Neurosurg Soc 2002;31(3):289-92.