A rare case of pneumocephalus and pneumorrhachis after epidural anesthesia

Xhang-Xian Hsieh 1, 2, Sun-Wung Hsieh 3, 4, Chueng-He Lu 2, Zhi-Fu Wu 2, Da-Tong Ju 5, Billy Huh 6, Jia-Chang Wang 8, Chan-Yang Kuo 2, 7, 8 *

1 Department of Anesthesiology, Kaohsiung Armed Forces General Hospital, Kaohsiung, Taiwan, ROC
2 Department of Anesthesiology, Tri-Service General Hospital and National Defense Medical Center, Taipei, Taiwan, ROC
3 Department of Neurology, Kaohsiung Municipal Hsiao-Kang Hospital, Kaohsiung, Taiwan, ROC
4 Department of Neurology, Kaohsiung Medical University Hospital, Kaohsiung Medical University, Kaohsiung, Taiwan, ROC
5 Department of Neurosurgery, Tri-Service General Hospital and National Defense Medical Center, Taipei, Taiwan, ROC
6 Pain Medicine, The University of Texas MD Anderson Cancer Center, Houston, TX, USA
7 Department of Anesthesiology, Keelung Branch, Tri-Service General Hospital and National Defense Medical Center, Taipei, Taiwan, ROC
8 Graduate Institute of Mechanical and Electrical Engineering, National Taipei University of Technology, Taipei, Taiwan, ROC

1. Introduction

Since epidural anesthesia was first described, several methods for identification of the epidural space have been suggested. Loss of resistance to air (LORA) is widely used by anesthesiologists, but there are several complications involved, such as pneumocephalus,1, 2 subcutaneous emphysema, 3 venous air embolism, 4 and spinal cord and nerve root compression.5

Pneumocephalus is a rare complication of inadvertent dural puncture and injection of air into the subarachnoid or subdural space.6, 7 The symptoms of pneumocephalus depend on the distribution and amounts of intracranial air.7 The symptoms include headache, elevated intracranial pressure, vomiting, convulsions, and unstable vital signs.

Here, we report a rare case of iatrogenic pneumocephalus combined with pneumorrhachis in a patient after undergoing epidural anesthesia. The case was further complicated by subdural hemorrhage (SDH) following pneumocephalus.

2. Case Report

A 72-year-old woman underwent an elective surgery of total knee replacement (TKR) in a regional hospital. The patient had no significant past medical history except hypertension without medical control. Before surgery, she had undergone several lumbar spine surgeries, such as laminectomy for spondylolisthesis and vertebroplasty for compression fracture. She did not use any anti-platelet or anticoagulation medications. Her coagulation tests were within normal limits on the admission day. Intravenous fentanyl 50 µg and midazolam 2 mg were administered prior to epidural anesthesia. A 18-gauge Tuohy needle was inserted into the L4–L5 intervertebral space using the LORA technique with a paramedian approach. Unfortunately, accidental dural puncture occurred on the third attempt, when bupivacaine (Marcaine [AstraZeneca AB,
Södertälje, Sweden] Spinal 0.5% Heavy) 12 mg was administered. The epidural catheter was placed successfully on the fourth attempt at the L3–L4 intervertebral space, and no cerebrospinal fluid drained via the catheter. A test dose with 1.5% lidocaine 3 mL with 1:200,000 epinephrine was used without change of vital signs.

The patient lapsed into drowsy consciousness 20 minutes after the start of the surgery, but gradually regained consciousness within 10 minutes. She was clear during the surgery and the TKR went smoothly. Unfortunately, persistent drowsy consciousness (GCS: E1M3V1) was noted 10 minutes after TKR, followed by generalized convulsions. Anticonvulsants were prescribed and endotracheal intubation was performed immediately. The patient was transferred to a medical center right away. Computed tomography (CT) of the brain taken at the center revealed air in the bilateral anterior, middle, and posterior cranial fossa and the cavernous sinus (Fig. 1). There, the patient received urgent external ventricular drain (EVD) placement. In order to trace the source of pneumocephalus, spine CT was performed, which revealed some air retention in the spinal canal of the lumbar spine and the posterior spinous muscle (Fig. 2). The day after the procedure, the patient regained full consciousness and the endotracheal tube was removed. The vital signs were stable. The patient did not have any abnormal neurological deficits, such as numbness or weakness of the extremities. The neurosurgeon decided to give conservative treatment for her pneumorrhachis.

Four days after the EVD procedure, the patient again experienced a sudden onset of consciousness change (GCS: E1M4V1). An emergent brain CT scan showed acute SDH in the left cerebral convexity causing obvious mass effect with midline shift. The SDH occurred at the left cerebral convexity, involving the frontal, temporal, and parietal lobes (Fig. 3). Subsequently, we performed emergent decompressive craniectomy with hematoma removal. Unfortunately, the patient’s condition deteriorated and she died 2 days after the craniectomy, due to multiorgan failure.

3. Discussion

There were few case reports about simultaneous occurrence of pneumocephalus and pneumorrhachis following epidural anesthesia. The possible mechanism could be attributed to the use of the LORA technique, thereby leading to injection of air into the subarachnoid or subdural space causing cephalad migration.

Prior to this operation, the patient had undergone several lumbar spine surgeries, which made administering epidural anesthesia difficult. Perhaps, the anesthesiologist who performed the epidural anesthesia did not control the amount of air when using the LORA technique. This probably led to accumulation of air within the spine with each attempt. It is also possible that some air had entered the cranium after inadvertent dural puncture.

Treatment of pneumocephalus includes nonoperative and operative treatment. Patients should also undergo serial imaging examinations in order to detect a decrease or increase of

![Fig. 1. Air in bilateral anterior, middle, and posterior cranial fossa and cavernous sinus (arrows).](image1)

![Fig. 2. Air retention in the spinal canal of L-spine and the posterior spinous muscle (arrows, panels A and B).](image2)
intracranial air. Prompt treatments can result in improvement in most cases. Nonoperative treatment includes continuous high-inspired oxygen therapy, which can lead to rapid denitrogenation and reabsorption of trapped air; maintaining the patient in the supine or Trendelenburg position; administration of prophylactic antibiotics; frequent neurologic examinations; and repeat CT scans if clinical deterioration occurs. Operative treatment includes decompression of intracranial air in symptomatic pneumocephalus patients. In our case, the patient’s coagulation function and platelet counts were within normal limits on admission. Following the developments post TKR, she received emergent EVD placement, wherein she regained consciousness the day after the operation. However, acute SDH occurred 4 days after the EVD placement. After the emergent craniectomy, the patient developed thrombocytopenia, the cause of which is unclear. We could not rule out disseminated intravascular coagulation, sepsis, operation, and systemic viral or bacterial infection. The occurrence of SDH may be associated with thrombocytopenia, EVD replacement, or the multiple attempts at spinal puncture causing spinal vessel rupture, either directly or indirectly, by inducing differential pressure changes between cerebrospinal fluid and intravascular spaces. We also could not rule out the possibility of fat embolism syndrome or air-induced systemic inflammatory response syndrome for her critical condition, despite the craniectomy for SDH.

According to the radiographic findings, massive air was trapped within the spine and the brain. Air entrapment could have been caused by repeated improper use of the LORA technique, i.e., the anesthesiologist injected too much air into the epidural space. Therefore, it is suggested that when performing the LORA technique, air should by no means be injected into the epidural space when loss of resistance is experienced. Presumably, this complication can be avoided if saline is used rather than air to identify the epidural space or ultrasound guidance is used to avoid multiple attempts. We suspected that the incidence of pneumorrhachis is underestimated in the literature, and that most epidural anesthesia-related pneumocephalus complications occur, in fact, in combination with pneumorrhachis. Further studies are warranted to confirm this hypothesis.

In conclusion, pneumocephalus combined with pneumorrhachis is a rare complication following epidural anesthesia. The presence of pneumocephalus combined with pneumorrhachis should be kept in mind when a sudden conscious change is noted during or after neuraxial anesthesia. Early recognition and high index of clinical suspicion of perhaps dural puncture are important. Importantly, the very minimal volume of air should be injected into the epidural space when employing the LORA technique.

References