

Pneumocephalus Following Dural Puncture Epidural Technique for Labor Analgesia

Chenyang Shi

The Affiliated Hospital of Xuzhou Medical University

Fangzheng Hu

The Affiliated Hospital of Xuzhou Medical University

Qiumin Huang

Taixing People's Hospital

Xianlan Zhang

Taixing People's Hospital

Henrui Zhang

The Affiliated Hospital of Xuzhou Medical University

Yang Niu

The Affiliated Hospital of Xuzhou Medical University

Su Liu

The Affiliated Hospital of Xuzhou Medical University

Linlin Zhao

zhaolinlin@xzhmu.edu.cn

The Affiliated Hospital of Xuzhou Medical University

Case Report

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Abstract

Background

Pneumocephalus, the presence of intracranial air, is an uncommon complication of neuraxial anesthesia. This case is notable because symptomatic pneumocephalus developed after dural puncture epidural analgesia, a technique that intentionally punctures the dura.

Case Presentation

A 28-year-old woman at 40 weeks of gestation received dural puncture epidural analgesia using loss of resistance to air. After intentional dural puncture, she delivered vaginally about 5 hours later. Six hours postpartum, she developed sudden severe occipital headache, neck and back pain, dizziness, and tinnitus. The headache worsened with movement and only slightly improved when supine. Initially treated as post-dural puncture headache, she did not improve with bed rest and fluids. Brain computed tomography showed air in the suprasellar cistern and bilateral frontal horns of the lateral ventricles. She was managed conservatively with fluids, oxygen, and analgesics and declined an epidural blood patch. Follow-up computed tomography at 60 hours showed complete air absorption; she was discharged 5 days later without neurologic deficits.

Conclusions

Pneumocephalus should be considered when postpartum headache after neuraxial analgesia is atypical, persistent, or not relieved by recumbency. Early brain imaging and conservative management usually lead to full recovery. When dural puncture epidural analgesia is used and the dura has already been breached, additional use of loss of resistance to air should be avoided; saline is preferred.

Introduction

Neuraxial anesthesia is a commonly used clinical anesthetic method, and is especially widely used in obstetric painless delivery, due to its advantages of precise analgesic effect and minimal impact on mother and fetus. Post-dural puncture headache (PDPH) is a common complication, whereas pneumocephalus—defined as intracranial air or gas accumulation—is an extremely rare neuraxial anesthesia-related complication with limited clinical reports, rendering it prone to misdiagnosis[1].

The first widely recognized description of intracranial pneumocephalus was provided by Thomas in 1866, while the term “pneumocephalus” was formally introduced by Wolff in 1914 to characterize this unusual condition[2]. Traditionally, the leading causes of pneumocephalus include head trauma and skull or skull base disruption from cranial surgery, which trap air in the cranial vault[3]. However, in recent years, an increasing number of reports have indicated that pneumocephalus can also occur after invasive spinal procedures such as spine surgery, lumbar puncture, and spinal anesthesia[4].

The dural puncture epidural (DPE) technique, an advanced approach in labor analgesia, intentionally creates a dural perforation with a spinal needle without intrathecal drug administration, thereby combining the advantages of spinal and epidural anesthesia. However, the deliberate dural puncture still carries potential risks, including PDPH and, particularly when the loss of resistance to air (LORA) technique is employed, pneumocephalus. This case report describes a rare instance of pneumocephalus following labor analgesia with DPE

Case Presentation

A 28-year-old woman (165 cm, 75 kg) at 40 weeks of gestation was admitted for labor analgesia. She had no significant medical history and had been in good health before. With the patient in the left lateral decubitus position, epidural puncture was performed at the L2–L3 interspace. The epidural space was identified using the loss-of-resistance to air (LORA) technique. A 25G spinal needle was then advanced through the epidural needle to puncture the dura mater, and clear cerebrospinal fluid (CSF) was obtained. This intentional dural puncture was part of the dural puncture epidural (DPE) technique. After the spinal needle was withdrawn, the epidural needle was rotated 90°, and LORA was repeated to reconfirm the needle position. An epidural catheter was slowly advanced, but frank blood was aspirated at a depth of 10 cm, so the catheter was removed. The puncture direction was adjusted, and the catheter was reinserted to 10 cm. Aspiration revealed no CSF or blood. After a negative test dose, epidural analgesia was initiated with 0.1% ropivacaine plus sufentanil via patient-controlled epidural analgesia. She delivered a healthy female infant vaginally approximately 5 hours later. The epidural catheter was removed after 30 minutes of observation without discomfort.

Six hours postpartum, the patient developed sudden severe occipital headache accompanied by lower back and neck pain. The pain was exacerbated by positional changes such as rising from bed and was only slightly relieved in the supine position. She also reported dizziness and tinnitus, without nausea or vomiting. The visual analog scale score was 8–9. The headache was initially misdiagnosed as post-dural puncture headache (PDPH), but bed rest and intravenous fluid replacement did not alleviate the symptoms. Brain noncontrast computed tomography (CT) was performed promptly and revealed small amounts of subarachnoid air in the suprasellar cistern and bilateral frontal horns of the lateral ventricles, confirming symptomatic pneumocephalus (Fig. 1). She was managed conservatively with strict bed rest, fluid intake of 2000–3000 mL/day, continuous oxygen supplementation, oral analgesics, and avoidance of abrupt positional changes. An epidural blood patch was not performed because the patient explicitly refused. A follow-up CT scan at 60 hours showed complete absorption of intracranial air, and she was discharged 5 days later without neurological deficits (Fig. 2).

Discussion and Conclusion

Pneumocephalus after neuraxial anesthesia is uncommon, but it is increasingly recognized. The reviewed literature includes cases after spinal anesthesia, epidural anesthesia, combined spinal-epidural anesthesia, and DPE analgesia. Most reported cases used LORA to identify the epidural space, including

those by Liu et al. [5], Figueira et al. [6], Wu et al. [7], Saeidi et al. [8], and Shawar et al. [9]. However, Jones et al. [10] reported pneumocephalus and seizures after combined spinal-epidural anesthesia using loss of resistance to saline (LORS), which suggests that the dural breach itself is a risk, even when air is not deliberately injected. Maglione et al. [11] described pneumocephalus in a child after spinal anesthesia, likely caused by air introduced when the stylet was reinserted. The present case is instructive because pneumocephalus occurred after DPE with LORA.

The mechanisms are well described. A dural defect allows air to enter the subarachnoid or subdural space. CSF leakage can create a negative intracranial pressure gradient, the so-called “inverted bottle” effect, and a ball-valve mechanism can trap air intracranially. In DPE, the dura is intentionally punctured to improve analgesia. If LORA is then used, especially repeatedly, air has a more direct route into the subarachnoid space. If a second dural puncture occurs, or if the catheter has to be manipulated after blood aspiration, the risk may increase further. In this case, DPE created one dural breach, LORA was used more than once, the catheter was adjusted after blood was aspirated, and postpartum Valsalva maneuvers may have further pushed air cranially. Under these conditions, pneumocephalus should be considered a plausible complication.

Clinically, headache is the most common symptom. It is often sudden and severe, frontal or occipital, and may be postural or non-postural. It can be accompanied by neck stiffness, nausea, vomiting, dizziness, tinnitus, seizures, altered mental status, and cranial nerve deficits. In the present case, the patient developed sudden severe occipital headache, lower back and neck pain, dizziness, and tinnitus 6 hours postpartum. Her headache was initially misdiagnosed as PDPH. However, unlike typical PDPH, which usually improves with recumbency, her headache persisted when supine and did not respond adequately to bed rest and fluids. This atypical feature prompted brain CT. Similar diagnostic challenges appear in the reports by Wu et al. [7] and Shawar et al. [9], both of whom initially raised concern for PDPH.

The duration of pneumocephalus varies. Symptoms may improve over hours to 2 weeks, while imaging evidence of air usually resolves within 2–7 days. Figueira et al. [6] noted relief after 4 hours and no neurological symptoms at 24 hours. Jones et al. observed complete air reabsorption by day 6. Wu et al. [7] reported headache resolution after 2 weeks of postpartum bed rest. Shawar et al. [9] showed gradual improvement over 4 days and near-complete resolution by postpartum day 9. In the present case, follow-up CT at 60 hours showed complete absorption, and the patient was discharged 5 days later without deficits.

Management is mainly conservative. Bed rest, head elevation, high-flow oxygen, hydration, analgesics, caffeine, and avoidance of Valsalva maneuvers are first-line measures. Oxygen accelerates nitrogen reabsorption and is widely recommended. Epidural blood patch may relieve concomitant PDPH but is not a definitive treatment for pneumocephalus. Antibiotics are indicated when empyema or meningitis is present, as reported by Liu et al. [5]. Surgery is reserved for tension pneumocephalus. In the present case, conservative management led to complete recovery. The patient declined an epidural blood patch, and none was required.

Overall, outcomes are favorable in most non-tension cases. Prevention should include preferring LORS over LORA, limiting air to ≤ 1 mL if LORA is unavoidable, avoiding LORA after known or suspected dural puncture, avoiding nitrous oxide, and obtaining early brain CT for atypical post-neuraxial headache. The present case reinforces that DPE with LORA can be complicated by pneumocephalus, that symptoms may mimic but not fully fit PDPH, and that early brain CT followed by conservative management usually leads to complete recovery. It also suggests that when DPE has already breached the dura, further use of LORA should be avoided.

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Written informed consent for publication was obtained from the patient.

Availability of data and materials

Not applicable

Competing interests

The authors declare no conflicts of interest.

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Authors' contributions

All authors read and approved the final manuscript.

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Figures



Figure 1

Brain CT scan showing low-density air shadows



Figure 2

Follow-up brain CT scan 60 hours later showing no obvious abnormal density shadows in the brain, with complete resolution of intracranial air