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# Pneumocephalus during continuous epidural block

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**Abstract**
We report a case of pneumocephalus during continuous epidural infusion. A 52-year-old malnourished man with rectal cancer had been treated with continuous epidural block for the relief of pain in the left thigh. Eleven days after catheter insertion, a dull, persistent headache occurred in the frontal region, and it worsened gradually. It was precipitated by any head motion and was not relieved by the supine position. A head computed tomography (CT) scan taken 3 days after the onset of the headache revealed about 15 ml of intracranial air and backward compression of the brain. The catheter was removed and the patient maintained bed-rest. The headache disappeared 2 days later. It is speculated that the air was sucked in through the space along the epidural catheter.

**Key words** Epidural block · Pneumocephalus · Subdural block

## Introduction

Pneumocephalus is a well-known complication of epidural block [1–9]. In most reported cases, air was injected while the operator was identifying the epidural space by the loss-of-resistance technique, using air. Here we report a case of pneumocephalus occurring during continuous epidural block, in which the air was speculated to have been sucked through the space along the epidural catheter that was unintentionally placed in the subdural space.

## Case report

A 52-year-old malnourished man was referred to our pain clinic for the treatment of pain in the posterior side of the left thigh. He had undergone pelvic exenteration 8 months previously because of rectal cancer. Wound infection had occurred and repeated debridement had been performed. He had been in a malnourished state and the cause of the pain was thought to be nerve root compression caused by osteoporotic changes in the lumbar spine.

An epidural catheter was inserted through the L3/4 intervertebral space, using the loss-of-resistance technique with air. Continuous infusion of 0.25% bupivacaine, at a rate of 2 ml·h$^{-1}$ relieved the pain, but caused weakness in the legs. The concentration of bupivacaine was gradually reduced to 0.08%, which resulted in good pain control without weakness. Ten days after the epidural puncture, the catheter accidentally came out. Another catheter was inserted through the L4/5 intervertebral space, using the loss-of-resistance technique with saline. The inserted site was draped with a small piece of gauze and surgical tape. For the following 10 days, the patient did not need any analgesics other than continuous epidural infusion of 0.08% bupivacaine 2 ml·h$^{-1}$ and morphine 7 mg·day$^{-1}$. An aspiration test of the catheter was carried out, but no backflow was seen. Eleven days after the second catheter insertion, a dull, persistent headache occurred in the frontal region and it gradually worsened. It was precipitated by any head motion and was not relieved by the supine position. A head computed tomography (CT) scan on day 14 after the second catheter insertion (3 days after the onset of the headache) revealed about 15 ml of intracranial air in the frontal region and some air bubbles in the interhemisphere fissure, with backward compression of the brain (Fig. 1). The epidural catheter was removed and the patient maintained bed-rest. Although no additional analgesics were given after removal of the catheter, the headache gradually ameliorated and had disappeared in 2 days. A CT scan taken 3 days after the removal of the catheter showed that the intracranial air had disappeared.

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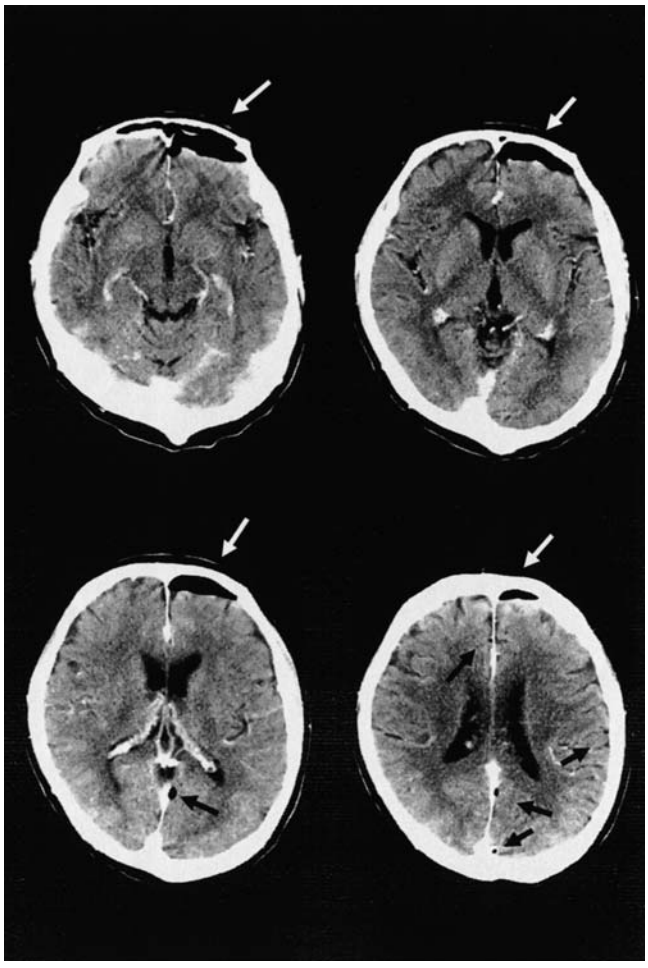

**Fig. 1.** Head computed tomography (CT) scan on day 14 after the second catheter insertion. About 15 ml of air in the frontal subdural region (*white arrows*), backward compression of the brain, and some air bubbles in the interhemisphere fissure (*black arrows*) were detected

## Discussion

In the case presented here, severe headache occurred in the patient 11 days after epidural puncture during continuous epidural block. A CT image revealed subdural air, which was presumed to be the cause of the headache.

The intracranial air revealed by the CT scan had the features of subdural air rather than subarachnoid air; it was trapped in a mass and had a compressive effect on the brain in spite of its small volume. Small bubbles in the interhemisphere fissure (Fig. 1) might have been present in the subarachnoid space, but it is common that these small bubbles exist with subdural air [10]. Even a small amount of subdural air would cause brain compression and retraction of the bridging vein, resulting in headache, disturbed cerebral blood circulation, brain edema, and an increase in intracranial pressure [11]. There are several reports of radiographically confirmed subdural air following epidural puncture due to the unintentional injection of air [1,5,7]. In a case described by Hukuuchi and Yokoyama [1], the patient manifested the most serious consequences, including loss of consciousness, hypotension, and bradycardia.

It is presumed that the headache in our patient must have been caused by the intracranial air, and that it could not have been a typical post-dural puncture headache (PDPH), for the following reasons. First, cerebrospinal fluid (CSF) was not aspirated at the epidural puncture or through the catheter. Secondly, the headache was severe and was not relieved by the supine position. Katz et al. [7] have suggested that the presence or absence of postural dependence is important to discriminate between headaches caused by dural puncture and by intracranial air, in that PDPH was relieved by lying supine. Conversely, headache caused by intracranial air is aggravated by any motion of the head and there is lack of relief with lying down, which is compatible with the characteristics in our patient. Thirdly, the onset of PDPH is usually within a few days after dural puncture. In the present patient, the onset of headache occurred on day 11 after the placement of the epidural catheter. Finally, the headache resolved with the disappearance of the air.

We presume that the intracranial air revealed by the CT scan had been aspirated by leakage though the catheter placed in the subdural space, for the following reasons. (1) Saline and not air was used in the loss-of-resistance technique at epidural puncture, (2) the epidural infusion was done with a closed-system disposable infuser pump from which air was carefully eliminated, and (3) the appearance of motor and sensory blockade with low-dose bupivacaine, in spite of negative aspiration tests, strongly suggests that the catheters were placed in the subdural space [12]. The patient was in a poor nutritional state after major surgery complicated with infection, so that it is likely that skin closure at the puncture site was prevented, and air leakage occurred between the skin and the subdural space. Although the subdural space usually has positive pressure in relation to atmospheric pressure, a cough and a deep breath can cause transient negative pressure and thus, trapped air could move into the intracranium [13].

We had administered morphine 7 mg·day$^{-1}$ through the catheter for more than 10 days with no remarkable side effects. The effectiveness of subdural opioid administration is not extensively documented, but some reports suggest that subdural administration works in the same way as epidural administration. Chadwick et al. [14] reported that, in three patients with post-cesarean section analgesia, a dose of 2–3 mg of morphine administered through a catheter that had been inadvertently placed subdurally produced no remarkable side effects.

Bernards and Hill [15] have demonstrated, in an in-vitro experimental system, that the arachnoid mater is the major barrier to the diffusion of morphine between the epidural space and spinal cord.

In the present case report, we have described a rare complication of epidural block: air leakage through the epidural catheter and subsequent pneumocephalus. The possibility of pneumocephalus should be checked for by CT scan when a patient complaints of severe headache during continuous epidural block. Nitrous oxide should not be used in these patients, because it would cause tension pneumocephalus [3,16].

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