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Case Report

Pneumocephalus following fluoroscopy-guided lumbar epidural injection in elderly patients: two cases report and a review of Korean literatures - Two cases report -

Sun Kyung Park, Sang Hyun Park, Bang Won Lee, Woo Jin Cho, and Yun Suk Choi

Department of Anesthesiology and Pain Medicine, Jeju National University Hospital, Jeju, Korea

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Corresponding author
Yun Suk Choi, M.D.
Department of Anesthesiology and Pain Medicine, Jeju National University School of Medicine, 15 Aran 13-gil, Jeju 63241, Korea
Tel: 82-64-717-2025
Fax: 82-64-717-2042
E-mail: solafide5@hanmail.net

Background: Pneumocephalus can originate from accidental dural puncture while performing epidural block using the loss-of-resistance (LOR) technique with an air-filled syringe.

Case: We present two cases of pneumocephalus after lumbar epidural block under fluoroscopy for pain control in elderly patients.

Conclusions: Lumbar epidural block should be performed under fluoroscopic guidance in elderly patients with severe lesions. The physician should be aware of the increased possibility of a dural puncture occurring due to anatomical changes in older patients. The use of saline is recommended for the LOR technique. A contrast injection should be used together with the LOR technique to locate the epidural space. If a dural puncture occur, the patient should be carefully monitored to determine whether pneumocephalus has developed.

Keywords: Back pain; Complications; Fluoroscopy; Headache; Pneumocephalus.

Pneumocephalus is an extremely rare complication of dural punctures. Early diagnosis, correct management, and patient counseling promote a successful management [1]. Unlike previous blind epidural block procedures, the recent introduction of fluoroscopy has made performing epidural block safer. The need for epidural steroid injections is increasing with the growing elderly population. The development of safe interventions for pain control is especially important in elderly patients because of the high risk of complications due to multiple underlying diseases as well as generalized frailty. Herein, we report two cases of pneumocephalus following unintentional dural puncture in two elderly patients during a fluoroscopy-aided interlaminar lumbar steroid injection.

CASE REPORT

We obtained written informed consent from the patients' guardians.

Case 1

An 82-years-old woman (height 157 cm, weight 56 kg) presented with bilateral buttock pain. Three years prior, she received multiple injections for epidural block. Magnetic resonance imaging (MRI) of the lumbar spine revealed spondylolytic spondylolisthesis, a bulging disc, ligamentum flavum (LF) thickening, and moderate central stenosis at L4/5 (Fig. 1). On presentation, a fluoroscopy-guided epidural steroid injection was scheduled. In the prone

Fig. 1. Lumbar MRI of patient (case 1) shows spondylolytic spondylolisthesis, bulging disc, ligamentum flavum thickening, and moderate central stenosis in L4/5. MRI: magnetic resonance imaging.

position, the injection site was disinfected and 1% lidocaine was injected. The L4/5 interspace was identified under fluoroscopy, and an 18-gauge Tuohy needle was advanced into the interlaminar space under an anterior-posterior (AP) fluoroscopic view. The needle was advanced into the epidural space under lateral fluoroscopy using the loss of resistance (LOR) technique with a 1.0 ml air-filled syringe. After checking for the negative aspiration of cerebrospinal fluid (CSF), 0.5 ml of contrast agent (Pamiray 250 Injection®, Dong Kook Pharm. Co., Korea) was injected. After examining the AP and lateral fluoroscopic images, a mixture of 0.125% ropivacaine (6 ml) and 10 mg triamcinolone was injected (Fig. 2). In the recovery room, the patient's blood pressure was 140/60 mmHg, and her heart rate (HR) was 77 beats/min. Thirty minutes later, her blood pressure declined to 82/53 mmHg, and her HR increased to 88 beats/min. Supplement oxygen was administered using a facial mask with reservoir and intravenous fluids were started, and ephedrine (5 mg) was injected. The patient exhibited intense perspiration, and complained of a severe occipital headache (numerical rating scale [NRS] 7), dizziness and nausea. Her body temperature decreased to 35˚C. The hypothermia improved 1 h after oxygen therapy was initiated and warming intervention were applied. The patient was referred to a neurologist. Neurological examinations revealeds no deficits; however, pneumocephalus was suspected. Brain computed tomography (CT) scans revealed multiple locules of air in the cranial cavity and air at

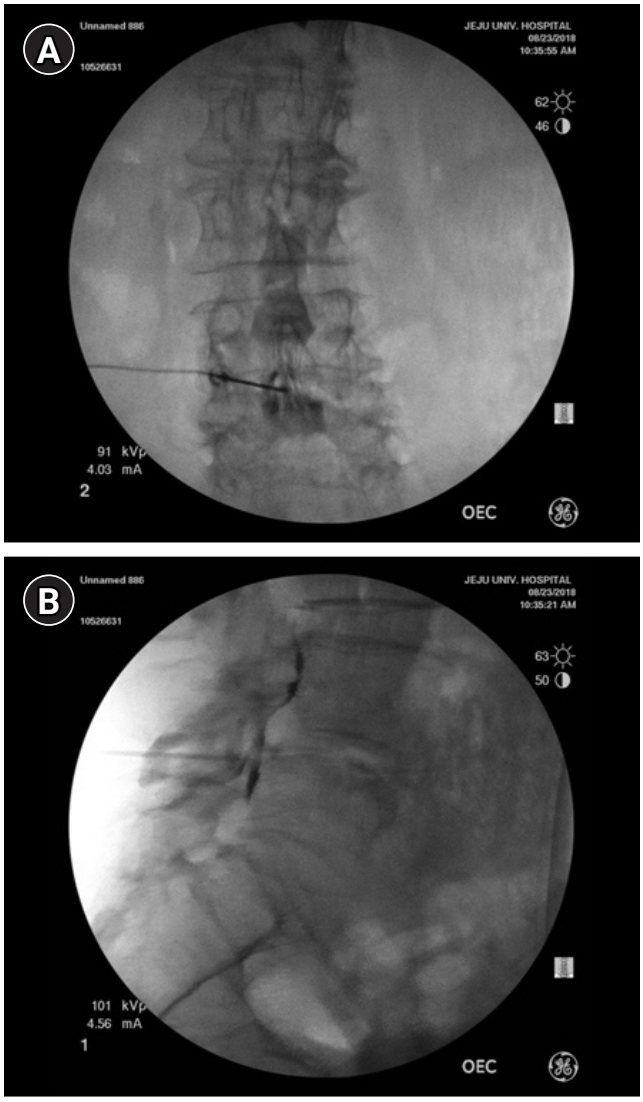

Fig. 2. Fluoroscopic image of patient (case 1). (A) AP post-contrast image. (B) Lateral post-contrast image. Two images show intrathecal injection. AP: anterior-posterior.

the velum interpositum, anterior and posterior interhemispheric fissure, supracerebellar cistern and right sylvian fissures (Fig. 3). The patient was admitted to the hospital and oxygen was administered (5 L/min) using a facial mask with a reservoir. Her headache was reduced by 50% after 24 h and she was discharged the next day. Five days after discharge, her headache had completely resolved. Subsequent physical examination at follow-up was negative for pneumocephalus.

Case 2

An 88-years-old woman (height 146 cm, weight 50 kg) presented with complaints of low back and bilateral buttock

Fig. 3. Axial cranial CT scan (case 1) revealing multiple locules of air in the cranial cavity and air at velum interpositum (black arrow), posterior interhemispheric fissure (black dotted arrow) supracerebellar cistern (white dotted arrow) and right sylvian fissure (white arrow). CT: computed tomography.

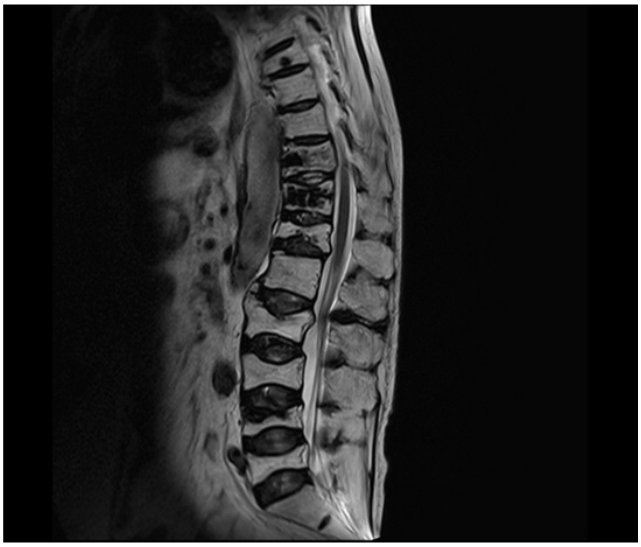

Fig. 4. Lumbar MRI of patient (case 2) shows multiple old compression fractures (T10–12, L2–4), vertebroplasty at T7, 10, 11, and L4 and spinal canal stenosis (severe central stenosis L1/2, bilateral mild foraminal stenosis T10–L1). MRI: magnetic resonance imaging.

pain as well as numbness in both lower extremities. The patient was suffering from a gait disorder which severely restricted her mobility without a wheelchair. A history of congestive heart failure and cerebral infarction was reported. The patient also had a 5-year history of lumbar nerve root and epidural blocks to manage her symptoms. MRI revealed multiple old compression fractures (T10–12, L2–4), vertebroplasty at T7, 10, 11, and L4 and spinal canal stenosis (severe central stenosis L1/2, bilateral mild foraminal stenosis T10–L1) (Fig. 4). On presentation, a fluoroscopy-guided epidural steroid injection was scheduled. In the prone position, the injection site was disinfected and 1% lidocaine was injected. The L5/S1 interspace was identified by fluoroscopy, and an 18-gauge Tuohy needle was advanced into the interlaminar space under an AP fluoroscopic view. The needle was advanced into the epidural space using the LOR technique with a 1-ml air-filled syringe though the LF and a location where the syringe would not rebound. However, CSF aspirated, and on injecting 0.5 ml of the contrast, a dural puncture was confirmed through the fluoroscopic AP and lateral images (Fig. 5). The procedure was aborted immediately. After explaining the occurrence of the dural puncture to the patient, she was sent to the recovery room. Her blood pressure was 103/61 mmHg, HR was 87 beats/min and oxygen saturation was 96%. Normal saline was infused intravenously and oxygen (5 L/min) was administered using a facial

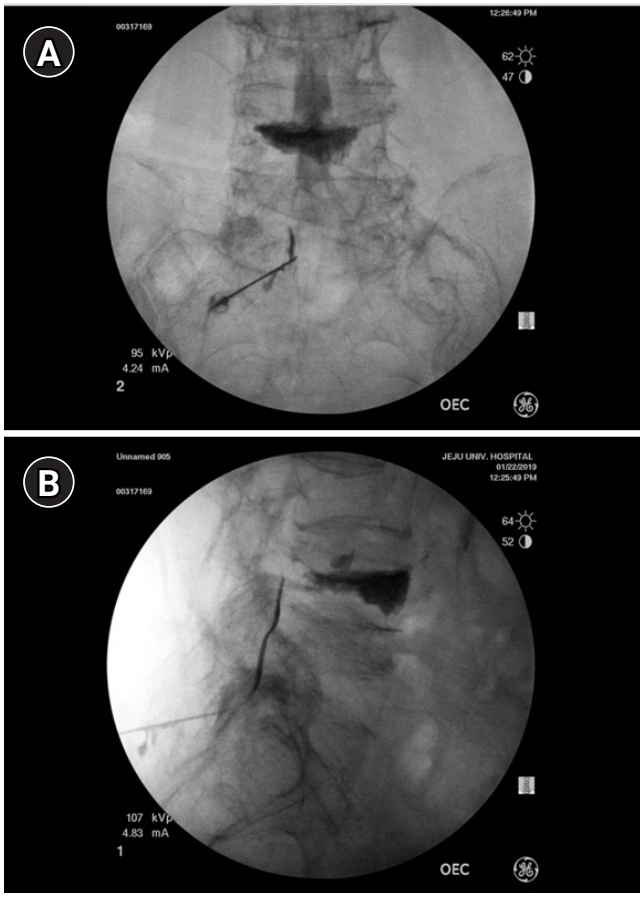

Fig. 5. Fluoroscopic image of patient (case 2). (A) AP post-contrast image suggesting intrathecal injection. (B) Lateral post-contrast image suggesting intrathecal injection. AP: anterior-posterior.

mask with a reservoir. One hour later, she complained of severe (NRS score 5–6) bilateral temporal headache and pain on the top of her head that persisted regardless of posture changes. Tramadol administration did not reduce her headache. A case of pneumocephalus was suspected. Brain CT examination showed the presence of air at the ventricular frontal horn, anterior interhemispheric fissure, right ambient cistern, and around bilateral cavernous sinuses (Fig. 6). The patient was admitted to the hospital after an explanation was provided to her and her guardian. After the admission, oxygen (5 L/min) was administered. Twenty-two hours later, the headache was reduced by 70%. Follow-up brain CT confirmed the reduction of the pneumocephalus. Therefore, she was discharged the next day. Follow-up 2 weeks after discharge, indicated complete resolution with no complaint of headache. Her physical examination was negative for pneumocephalus.

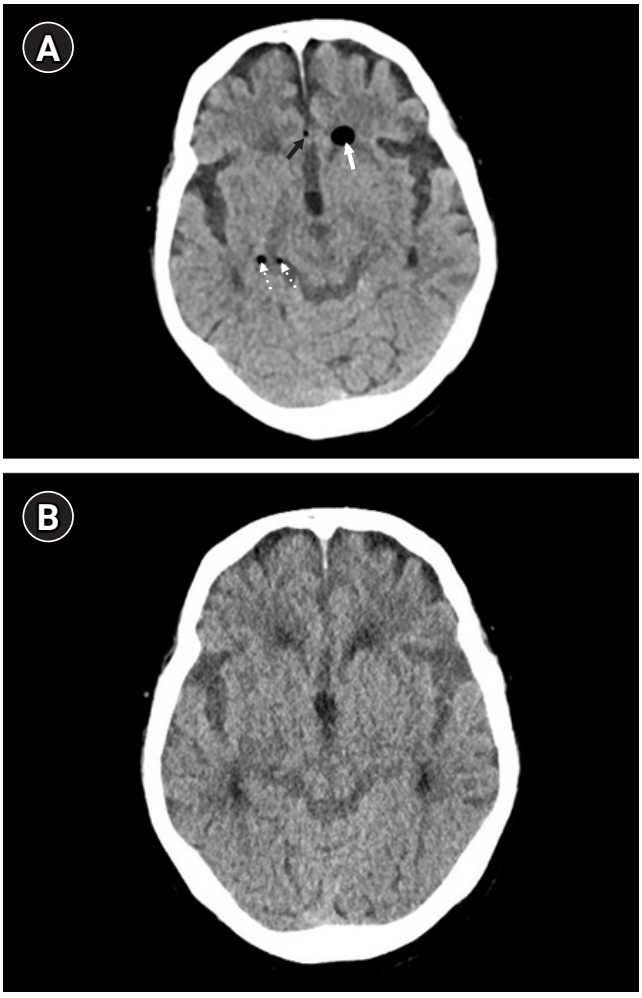

Fig. 6. (A) Axial cranial CT scan (case 2) demonstrating air in the lateral ventricular frontal horn (white arrow), anterior interhemispheric fissure (black arrow), and right ambient cistern (white dotted arrow), and around the bilateral cavernous sinuses of the patient (case 2). (B) Follow up CT scan showed decreased pneumocephalus (next day). CT: computed tomography.

DISCUSSION

In both cases, the elderly patients described each received, a fluoroscopy-guided lumbar epidural block. However, pneumocephalus occurred following a dural puncture in each case and was resolved only after oxygen therapy. Pneumocephalus is the presence of air in the intracranial compartments such as the intraventricular, intraparenchymal, subarachnoid, subdural and epidural space of the brain. Headache due to the presence of intrathecal air, following pneumoencephalography is well reported. This procedure was widely performed between 1919 and 1970. In pneumoencephalography, CSF is aspirated by dural puncture of the lumbar spine and 35–50 ml of air is injected to visualize the ventricles and cortical status. A wide range of side effects have been reported in association with pneumoencephalography, including headache, vomiting, pyrexia, tachycardia, changes in blood pressure neck stiffness, mental confusion, and temperature disorders. Resolution of pneumocephalus after injection of a large volume of air (20–50 ml) requires 1–2 weeks.

Conservative treatments for pneumocephalus include hydration, bed rest, use of analgesics and 100% oxygen therapy. Concentrated oxygen therapy decreases the partial pressure of nitrogen in the blood with an increase in the concentration gradient. This hastens the diffusion of intracranial air into the blood stream. The two patients described improvement with oxygen therapy.

To assess LOR, air or fluid is routinely used. Saline, a local anesthetic, and contrast are usually used in the LOR technique for epidural block. Use of air LOR (ALOR) was prevalent until the 1980s; however, because there are reported side effects associated with ALOR such as dural puncture with or without postdural puncture headache (PDPH), pneumocephalus, spinal cord and nerve root compression subcutaneous emphysema and paresthesia, practitioners prefer saline over the alternatives [2]. However, a systematic review or randomized controlled trial have reported no difference in safety between the use of air and saline during epidural block for gynecological cases [3]. The use of saline with LOR for epidural block in patients with chronic pain exhibited a lower incidence of pneumocephalus than ALOR; no large-scale studies have been

conducted recently [4].

Verdun et al. [1] recommended the use of saline to prevent pneumocephalus. For a clinician more familiar with air injection, the study recommended using a mixture of 1–2 ml saline and 1–2 ml air. The use of saline and contrast to increase positivity has been suggested. For severe cases of central canal stenosis in the lumbar epidural block area, interlaminar (or at other levels) or bilateral transforaminal injections may be recommended. In the first case, the dural puncture occurred due to the advancement of the needle into a region with severe central canal stenosis. Because no CSF was aspirated, the practitioner did not carefully scrutinize the fluoroscopy images and continued with the procedure. In the second case, the procedure was aborted due to the confirmation of pneumocephalus. It is important to carefully observe an intrathecal injection during fluoroscopy-guided epidural block. The contrast pattern of intrathecal injection rapidly descends in the CSF with gravity and outlines the excited nerve roots on the lateral view.

There are two types of headache seen after penetration of the dura mater; CSF leakage and pneumoencephalopathy due to intrathecal air. Headaches caused by pneumocephalus, reportedly, occur s few hours after the treatment and usually continue for a few days. The patient usually recovers naturally. The headache may even occur when the patient is supine. In case of PDPH, the headache may occur 24–48 h after dural puncture, and an epidural blood patch is sometimes required. PDPH worsens depending on the sitting position [1].

Fluoroscopy-guided epidural block was attempted and failed in both patients. In normal adults, in the lumbar area, the epidural space is the largest, the LF is the thickest, and the midline gap is the smallest, enabling an easier epidural block. Zaki [5] reported the structural difference of the LF in the cadavers of older adults. Reduction of the elastic to collagen area ratio affected the spinal ligament and particularly lumbar LF ossification. Other obstacles including, increased vasculature, absence of the midline gaps, and fragmentation and rupture of the elastic fibers are reported to have occurred. Hogan [6] reported that, due to lumbar degenerative changes, loss of intervertebral disc height occurs causing buckling of the LF. This reduces the space between the posterior elements, causing the spinous process to stick together. This in turn causes needle insertion to be difficult during an epidural block. The patients in this study were above 80 years in age. The treatment was initiated at the lower level of the severe degenerative lesion of the lumbar spine. Nonetheless, due to the severe degenerative changes, pneumocephalus developed.

In elderly patients, even with the aid of fluoroscopy, dural punctures are inevitable during epidural block owing to anatomical changes in the spine. Thus, a blind epidural block for should be avoided in elderly patients. According to Table 1 [7–12], which contains reported cases of pneumocephalus, some Korean practitioners have performed blind epidural blocks. Although the practitioner may be very familiar with the technique, in blind epidural block, 30–40% of blocks are performed incorrectly [13]. We would like to emphasize that, careful identification of the location of the epidural space is strongly recommended to ensure safety. This is particularly true in elderly patients, during an epidural block using the LOR technique guided by fluoroscopy and contrast injection [14]. In addition, even when CSF is not aspirated when performing epidural blocks,

Table 1. Pneumocephalus Cases Resulting from Epidural Block for Pain Control in the Korean Literatures

Authors	Year of publication	Age of patient	Epidural LOR technique (air or saline/volume)	Procedure level (cervical/thoracic/lumbar)	Fluoroscopy or blind	Symptom/onset time	Pneumocephalus resolution in CT	Duration of symptom resolution
Han et al. [7]	1996	38	Air/9 ml	Lumbar 3/4 interlaminar	Blind	Headache/1 h	Unknown	4 days
Ahn et al. [8]	2012	70	Unknown/unknown	Lumbar 3/4 interlaminar	Unknown	Headache, nausea/immediately after the procedure	5 days	3 days
Kim et al. [9]	2012	68	Air/8 ml	Lumbar 4/5 interlaminar	Blind	Syncope/30 min	Unknown	1 day
Jung and Park [10]	2001	58	Air/3–4 ml	Lumbar 3/4 interlaminar	Blind	Headache, nausea/5 min	3 days	5 days
Kim et al. [11]	2015	54	Air/1 ml	C7/T1 interlaminar	Fluoroscopy	Headache/4 h	16 days	21 days
Chung et al. [12]	2017	58	Air/unknown	Lumbar 4/5 interlaminar	Blind	Headache and seizure/5 min	Unknown	11 days

LOR: loss-of-resistance, CT: computed tomography.

contrast injection should be used to confirm the subdural or subarachnoid injection, intravascular injection, and facet injection [15].

In conclusion, lumbar epidural block should be performed under fluoroscopic guidance in elderly patients with severe lumbar degenerative changes. The physician should be aware of the increased possibility of dural punctures due to anatomical changes. The use of saline is recommended for the LOR technique, and contrast injections should be used together with the LOR technique locate epidural space. If a dural puncture does occur, the patient should be carefully monitored to determine whether pneumocephalus has developed.

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CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

AUTHOR CONTRIBUTIONS

Conceptualization: Yun Suk Choi. Data acquisition: Sun Kyung Park, Bang Won Lee. Supervision: Yun Suk Choi. Writing-original draft: Sun Kyung Park. Writing-review&editing: Sang Hyun Park, Woo Jin Cho.

ORCID

Sun Kyung Park, https://orcid.org/0000-0002-4133-5806
Sang Hyun Park, https://orcid.org/0000-0003-4968-6755
Bang Won Lee, https://orcid.org/0000-0003-3786-5668
Woo Jin Cho, https://orcid.org/0000-0002-4338-5428
Yun Suk Choi, https://orcid.org/0000-0002-7983-8089

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