

Case report

A case of longitudinally extensive transverse myelitis with an isolated pontine lesion following epidural and spinal anesthesia for cesarean section

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ABSTRACT

Severe neurologic complications following epidural and spinal anesthesia rarely occur. Transverse myelitis has been reported as a rare complication of epidural or spinal anesthesia. We report a case of longitudinally extensive transverse myelitis and an isolated pontine lesion, which responded to immunotherapy. The patient was a 31-year-old pregnant woman who underwent elective cesarean section under epidural and spinal anesthesia. Though the insertions of the epidural and spinal catheters were smooth, she experienced back pain and transient hearing loss during epidural anesthesia. Postoperatively, she exhibited severe motor weakness in both lower extremities, neuralgia below the level of Th10 dermatome, and urinary retention. Magnetic resonance imaging showed longitudinally extensive transverse myelitis from T6 to T10 with a ring-shaped enhanced lesion and an isolated pontine lesion. These findings on magnetic resonance imaging were suggestive of autoimmune diseases such as neuromyelitis optica. The patient was diagnosed with an immunoreactive disease triggered by epidural or spinal anesthesia and was administered high-dose methylprednisolone, which led to the improvement in clinical symptoms. Clinicians should be aware of the possibility of the development of longitudinally extensive transverse myelitis and isolated pontine lesions after cesarean section under epidural and spinal anesthesia.

1. Introduction

Severe neurologic complications following epidural anesthesia occur in only 0.005–0.007% of patients [1]. Transverse myelitis (TM) and neuromyelitis optica (NMO) have been reported as rare neurological complications of epidural or spinal anesthesia [2–6]. Longitudinally extensive transverse myelitis (LETM) is a lesion involving three or more vertebral body segments on magnetic resonance imaging (MRI) [7]. It is a characteristic feature of autoimmune diseases such as NMO.

Herein, we report a case of LETM with an isolated pontine lesion developed following epidural and spinal anesthesia; MRI findings resembled those of autoimmune diseases. Clinicians should be aware of

the possibility of the development of spinal and brainstem lesions after epidural and spinal anesthesia.

2. Case report

A 31-year-old pregnant Japanese woman without a history of neurological disease (first pregnancy) underwent elective cesarean section under spinal and epidural anesthesia. The insertion of the epidural catheter for anesthesia in the right-lying position was smooth at Th12-L1 interval without leakage of blood or cerebrospinal fluid (CSF). The patient experienced severe back pain only upon epidural puncture. She had no symptoms during insertion and placement of the epidural catheter. Following 1% lidocaine injection for an epidural test dose, she

Abbreviations: LETM, Longitudinally extensive transverse myelitis; MRI, Magnetic resonance imaging; MS, Multiple sclerosis; NBD, Neuro-Behcet's disease; PCEA, Patient-controlled epidural analgesia; POD, Postoperative day; STIR, Short TI-inversion recovery; TM, Transverse myelitis; CSF, cerebrospinal fluid; NMO, neuromyelitis optica; PSL, prednisolone; MMT, manual muscle tests; AQP4, anti-aquaporin-4; DWI, Diffusion-weighted imaging

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experienced transient hearing loss in the left ear, which resolved spontaneously in a few minutes. Lumbar puncture for spinal anesthesia was performed smoothly at L3-L4 interval, but she complained of slight neuralgia for a few seconds in the left lower extremity upon lumbar puncture, which also resolved spontaneously and immediately. After the aspiration of flowing CSF, 2 mL 0.5% bupivacaine was administered. Although the surgical procedure was successful, the patient experienced severe pain when her uterus was being sutured after the surgery. She had severe neuralgia and pain in both lower extremities postoperatively. After that, pain management was continued using patient-controlled epidural analgesia (PCEA) with 0.25% ropivacaine.

On postoperative day (POD) 2, neurological examination revealed motor weakness, decreased thermal sensation below the level of Th10 dermatome, and urinary retention. The position and vibration sensations in both lower extremities were impaired. Results of manual muscle tests (MMTs) were 3/4 iliopsoas, 3/4 hamstrings, and 3/4 quadriceps. Otolaryngological and ophthalmological examinations revealed normal findings. PCEA was discontinued on POD 2, because the continuous administration of anesthesia was suspected to be associated with the development of neurological symptoms.

Blood examination showed leukocytosis (12,800/ μ L; normal range, 3500 to 9000/ μ L) and altered C-reactive protein levels (3.42 mg/dL; normal range, < 0.30 mg/dL). Serologic tests for infection, including those for Epstein-Barr virus, cytomegalovirus, and varicella-zoster virus, were negative. Serum samples were negative for antinuclear antibodies, anti-myelin oligodendrocyte glycoprotein antibodies, and anti-aquaporin-4 (AQP4) antibodies tested by both cell-based assay and enzyme-linked immunosorbent assay. CSF analysis revealed pleocytosis (7/ μ L; normal range, < 5/ μ L), elevated myelin basic protein (499.7 pg/mL; normal range, < 102 pg/mL), and normal protein and glucose levels. Interleukin-6 levels in the CSF were within the normal range. CSF-IgG index was elevated (0.74; normal range, < 0.63). Oligoclonal bands were determined as absent. Brain-spinal MRI performed on POD 2 showed a high-intensity isolated lesion in the pons (Fig. 1A) and abnormalities in the spinal cord from T6 to T10 (Fig. 1B). Spinal MRI with gadolinium enhancement revealed enhancement of the spinal cord lesions (Fig. 1C). Axial T1-weighted image with gadolinium enhancement showed ring-shaped lesions in the central region of the spinal cord from

T8 to T10 (Fig. 1D, E). Axial MRI of the spine showed no evidence of spinal cord injuries such as epidural or spinal subarachnoid hematoma. The isolated lesion in the pons appeared as a high-intensity lesion on fluid-attenuated inversion recovery image and as a low-intensity lesion on T1-weighted image (Fig. 2A, B). The low-intensity lesion on apparent diffusion coefficient image and the high-intensity lesion on diffusion-weighted imaging (DWI) were not correlated, and the high-intensity lesion on DWI showed T2 shine-through in the pons (Fig. 2C, D).

We excluded infection, tumor, and trauma, which are common with LETM and brainstem lesions. The patient was diagnosed with an immunoreactive disease, and high-dose methylprednisolone (1 g/day for 3 days, a total of 3 courses) was administered from POD 3. Immunotherapy improved the patient's neurological symptoms and resolved urinary dysfunction. Results of MMTs showed 5/5 in all muscles, and repeat brain-spinal MRI performed on POD 15 confirmed that the lesions had regressed. Although she could walk without assistance, the patient's position and vibration sensations continued to be mildly impaired. The patient was discharged on POD 30. She did not show any evidence of relapse even after five months subsequent to immunotherapy. Her neurological symptoms and brain-spinal MRI lesions had regressed almost completely by POD 170.

3. Discussion

We report a case of LETM with an isolated pontine lesion developed after epidural and spinal anesthesia. TM has been reported as a rare complication of epidural and spinal anesthesia [2–6] (Table 1). The poignant points of this case are: (1) Brain-spinal MRI showed the LETM and isolated pontine lesion developed following epidural and spinal anesthesia. (2) LETM and the pontine lesion responded to immunotherapy. (3) MRI findings resembled those of autoimmune diseases such as NMO.

LETM refers to an extensive TM that spans three or more vertebral segments on spinal MRI [7]. Spinal lesions in past cases developed following epidural or spinal anesthesia could be classified as LETM (Table 1) [2–6]. Past reports of severe back pain and lower extremity neuralgia following epidural or spinal anesthesia could be attributed to LETM [2,4,5]. Interestingly, brain-spinal MRI of our case showed an

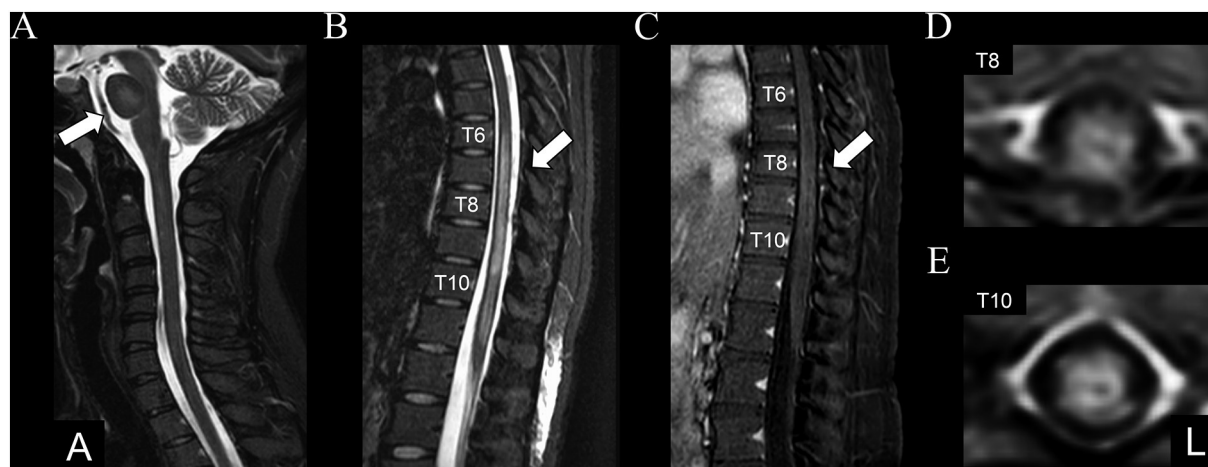


Fig. 1. Brain-spinal magnetic resonance image (MRI) of the patient on postoperative day (POD) 2 (A, B) and spinal MRI with gadolinium enhancement of the patient on POD 3 (C–E).

(A) The T2-weighted short T1-inversion recovery (STIR) image (1.5 Tesla; TR, 3500 ms; TE, 80 ms; sagittal) shows an isolated brainstem lesion (arrow) in the pons on POD 2.

(B) The T2-weighted STIR image (1.5 Tesla; TR, 3500 ms; TE, 80 ms; sagittal) shows a high signal intensity lesion that extends over three vertebrae from T6 to T10 of the thoracic spinal cord (arrow).

(C) The T1-weighted image (1.5 Tesla; TR, 3.8 ms; TE, 1.9 ms; sagittal) with gadolinium enhancement reveals enhancement of the lesion from T6 to T10 of the thoracic spinal cord (arrow).

(D, E) The T1-weighted image (1.5 Tesla; TR, 3.8 ms; TE, 1.9 ms; axial) with gadolinium enhancement reveals ring-shaped lesions in the central region of the spinal cord from T8 to T10.

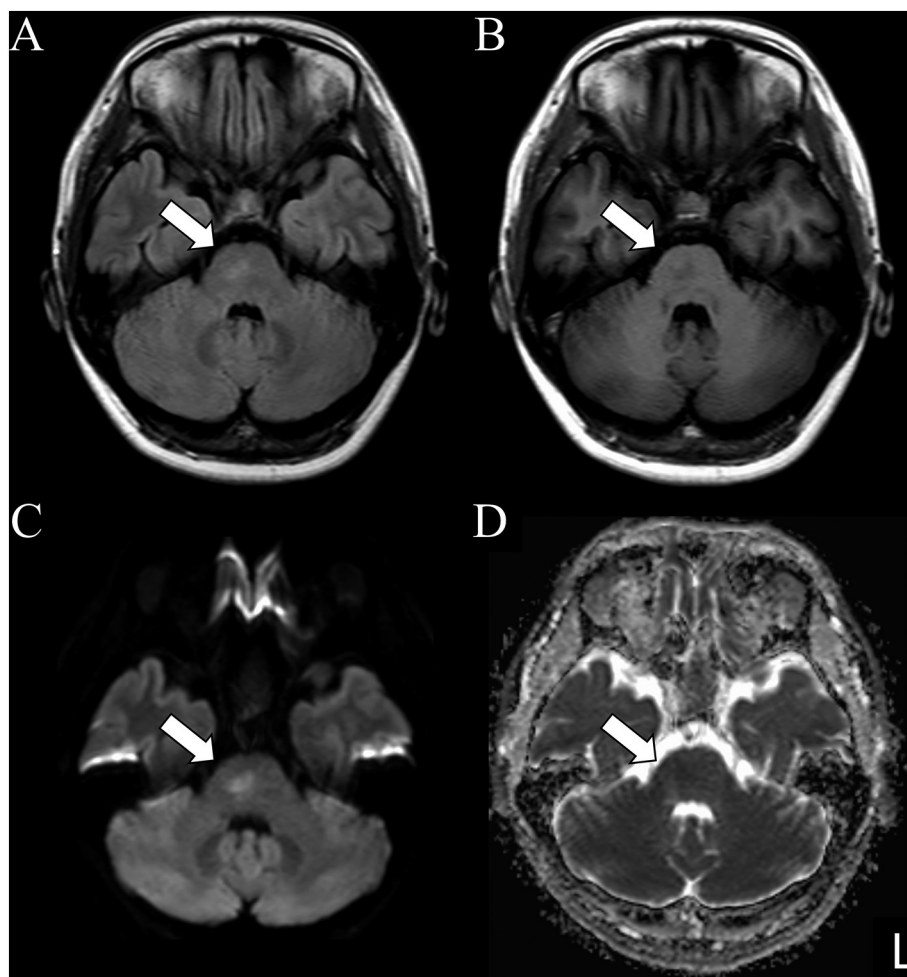


Fig. 2. Brain magnetic resonance image of the patient on postoperative day 3 (A–D).

(A) Fluid-attenuated inversion recovery image (3.0 Tesla; TR, 11,000 ms; TE, 125.0 ms; axial) shows high-intensity lesion in the pons (arrow).

(B) T1-weighted image shows low-intensity lesion in the pons (3.0 Tesla; TR, 2483 ms; TE, 18.9 ms; axial).

(C) Diffusion-weighted image (DWI; 3.0 Tesla; b value = 1000 s/mm²; TR, 5000 ms; TE, 59.6 ms; axial) shows the high-intensity lesion exhibiting T2 shine-through in the pons (arrow).

(D) Apparent diffusion coefficient image (3.0 Tesla; b value = 1000 s/mm²; TR, 5000 ms; TE, 59.6 ms; axial) shows no correlation between the low-intensity lesion and DWI hyperintensity in the pons (arrow).

Table 1

A summary of patients with longitudinally extensive transverse myelitis developed after epidural or spinal anesthesia along with the details of our patient [2–6].

	Shimada et al. [2]	Seok et al. [3]	Martinez-Garcia et al. [4]	Hsu et al. [5]	Hosseini et al. [6]	The present case
Age, (y)/Sex	46/F	37/F	13/F	63/M	53/F	31/F
Surgical site	Digestive	Obstetric	Orthopedic	Respiratory	Orthopedic	Obstetric
Anesthetic technique	General and Epidural	Epidural and spinal	General and epidural	General and epidural	Spinal	Epidural and spinal
Puncture site	Epidural T10/T11 Spinal –	L3/4 L3/4	L4/L5 –	T6/T7 –	– L4/L5	T12/L1 L4/L5
Back pain following anesthesia	+	–	+	+	–	–
Anesthetics	Epidural Ropivacaine Spinal –	Lidocaine Levobupivacaine Bupivacaine	Ropivacaine –	Bupivacaine –	– Bupivacaine	Lidocaine Ropivacaine Bupivacaine
Onset of symptoms (day)	POD 2	POD 2	Within 14 days	POD 2	POD 0	POD 2
Motor disturbance	+	+	+	+	+	+
Numbness	+	+	+	+	+	+
Urinary retention	+	–	+	+	–	+
Hearing loss	–	–	–	–	–	+
Transient coma	–	–	–	–	–	–
Diagnosis	TM	TM	TM	TM	NMO	Immune disorders
Location of the spinal MRI lesions	T5–T9 (LETM)	L3–S1 (LETM)	C2–C8 (LETM)	T2–T5 (LETM)	C6–C9 (LETM)	T6–T10 (LETM)
Location of brain MRI lesions	N/A	Normal findings	Normal findings	N/A	Left optical nerve	Brainstem
Immunotherapy	m-PSL	m-PSL and oral PSL	m-PSL and oral PSL	m-PSL	m-PSL	m-PSL
Immunotherapy response	Partial	Partial	Partial	Partial	Partial	Partial

F, female; LETM, longitudinally extensive transverse myelitis; M, male; m-PSL, methylprednisolone; MRI, magnetic resonance imaging; NMO, neuromyelitis optica; N/A, not available; POD, postoperative day; PSL, prednisolone; TM, transverse myelitis.

additional brainstem lesion. The present case exhibited no abnormal otolaryngological findings. Hence, we initially assumed that the brainstem lesion was the cause of hearing loss. However, brain MRI of past cases with permanent hearing loss developed after accidental dural puncture showed normal findings, which was inconsistent with our case [8]. One hypothesis of hearing loss following epidural puncture during obstetric surgery was the combination of pathological changes in the inner ear caused by significant amount of CSF leakage after epidural puncture and a predisposing medical condition with pregnancy [8]. Our patient did not exhibit decreased CSF pressure or headache, suggestive of CSF leakage. In addition, the brainstem lesion was not localized to areas that could cause hearing loss. Therefore, we concluded that the brainstem lesion was not associated with the transient hearing loss of our patient.

Risk factors for the development of LETM following epidural anesthesia include immune response due to needle insertion and anesthetic toxicity [2–5]. Experimental studies in animals have showed the mechanisms of nerve injuries caused by intrathecal administration of local anesthetics. The neurotoxicity of local anesthetics has direct effects on the axons or Schwann cells and secondary effects that catastrophically alter the neural microenvironment [9]. Alterations in the microenvironment include changes in the permeability of the blood-nerve barrier or ischemic damage due to effects of local anesthetics that reduce the blood-nerve flow [9]. This hypothesis was supported by a pathological animal study, which showed the neurotoxicity of lidocaine in local intrathecal anesthesia on cultured nerve tissue [10]. Histological abnormalities caused by local anesthetics in cultured neural tissue included extensive degeneration with infiltration of macrophages and destruction of myelin sheaths and axons. These histopathological changes were primarily observed in the proximal part of the dorsal root at the beginning of the spinal cord. In severe cases, the posterior white matter was damaged, in addition to the dorsal root lesions [10]. The present case developed posterior spinal cord symptoms, including the reduction in both vibration and position sensations, which might be associated with these histopathological changes.

Past cases of LETM developed following epidural or spinal anesthesia responded to steroid immunotherapy (Table 1) [2–6]. Our case also showed improvement in neurological symptoms after steroid administration. Spinal MRI in the present case showed lesions of the spinal cord and brainstem at a higher level than the insertion site of epidural catheter. Therefore, these lesions were not considered to be caused by direct trauma from epidural or spinal anesthesia. As a result, we initiated immunotherapy early, and her neurological symptoms and MRI abnormalities improved. Brain-spinal MRI findings in our case revealed a brainstem lesion isolated from the LETM of the thoracic spinal cord, suggesting an immunological mechanism.

Patients with LETM and brainstem lesions should be suspected of NMO, multiple sclerosis (MS), or neuro-Behcet's disease (NBD) [7]. A past case of LETM following spinal anesthesia was diagnosed as NMO with optic neuritis [6]. Our case did not exhibit optic neuritis, and was negative for anti-AQP4 antibody; thus, our case did not match the diagnostic criteria for NMO/NMO-spectrum disorders. As this case had a monophasic and acute-onset course, MS and NBD were excluded by evaluating these clinical manifestations, MRI findings, and CSF profiles. The present case was considered an anesthesia-related immune disorder

because the neurological symptoms developed immediately after anesthesia and improved with immunotherapy.

4. Conclusion

Complications of epidural and spinal anesthesia during cesarean section include LETM and brainstem lesions. Early initiation of immunotherapy can improve neurological symptoms in patients with LETM and pontine lesions developed following epidural and spinal anesthesia.

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Declaration of Competing Interest

None.

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