



Case Report

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Cord Compression Caused by a Tangled and Warped Lumbar Catheter After Lumboperitoneal Shunt Placement

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The present study reports the case of an 81-year-old woman who underwent lumboperitoneal shunt (LPS) placement for idiopathic normal-pressure hydrocephalus. After LPS placement, the patient presented with radicular pain. A computed tomography scan revealed that the intradural lumbar catheter was tangled at the T11 vertebra; therefore, we decided to remove the catheter under local anesthesia. When 1 cm of the lumbar catheter was withdrawn, the patient suddenly complained of complete loss of bilateral leg sensation and muscle strength. Emergency magnetic resonance imaging revealed that the lumbar catheter was tangled and wedged into the ventral spinal cord at T11, causing severe spinal cord compression. In the operating room under general anesthesia, the lumbar catheter was removed through a right T12 hemilaminectomy. Postoperatively, her neurological function was fully restored. Although LPS placement is frequently indicated for idiopathic normal-pressure hydrocephalus, recognition of this rare complication is important for proper LPS management.

Keywords: Lumboperitoneal shunt, Myelopathy, Spinal cord compression

INTRODUCTION

Idiopathic normal pressure hydrocephalus (iNPH) is a disease characterized by a triad of cognitive impairment, gait disturbance, and urinary incontinence.¹ In Japan, the prevalence of iNPH is estimated to be 0.51%–2.9% in the elderly population.²⁻⁴ A recent randomized controlled trial (Study of Idiopathic Normal Pressure Hydrocephalus on Neurological Improvement: SINPHONI-2) indicated that patients with iNPH can benefit from lumboperitoneal shunt (LPS) placement.⁵ By selecting LPS, the risk of intracranial hemorrhage may be avoided, which could potentially occur during ventriculoperitoneal shunt (VPS) placement when the ventricular catheter passes through the brain parenchyma. However, radiculopathy may be encountered after LPS placement because of mechanical irritation of cauda equina.⁶

CASE REPORT

1. History and Examination

A previously healthy 81-year-old woman was evaluated for a 6-year history of a progressive gait disorder and cognitive decline. She also had a 3-year history of urinary urgency and incontinence. Neurological examination revealed slight weakness in the lower limbs and small-stepped and broad-based gait with multistep turn. She denied having any history of head trauma, meningitis, or subarachnoid hemorrhage. Brain magnetic resonance imaging (MRI) revealed ventriculomegaly accompanied by disproportionate enlargement of the subarachnoid space (Evans Index of 0.37) (Fig. 1A, B). Although lumbar spine MRI showed a compression fracture at the first lumbar vertebra (L1), the degrees of canal compromise and segmental kyphosis were judged to be mild (Fig. 1C, D). N-isopropyl-p-[123I]iodoam-



Fig. 1. Preoperative magnetic resonance imaging. Axial (A) and coronal (B) T2-weighted images of the brain showing enlarged ventricles, tight high-convexity subarachnoid spaces, and expanded Sylvian fissures. Sagittal (C) and axial (D) T2-weighted images of the thoracolumbar spine demonstrating a compression fracture at L1. Mild spinal canal stenosis and kyphotic change were noted. Arrow in panel C indicates the slice level of D.

phethamine single photon emission computed tomography revealed relative hyperperfusion in the high convexity of the brain compared to the Sylvian fissure regions. On examination, Mini-Mental State Examination⁷ score was 18/30. The patient underwent a lumbar puncture, which revealed an opening pressure of 12 cmH₂O and yielded clear watery fluid with cell count, 0 / μ L; total protein, 43 mg/dL; and glucose, 54 mg/dL. Queckenstedt's test result was normal. After removing 30-mL cerebrospinal fluid, the patient's gait disturbance clearly improved. On the basis of these findings, she was diagnosed with a probable iNPH.

2. Operation

Spinal stenosis was judged to be mild and Queckenstedt's test result was normal, therefore, we decided to perform LPS placement using an adjustable pressure valve (CODMAN CERTAS, Codman & Shurtleff Inc., Raynham, MA, USA). The lumbar



Fig. 2. Coronal reconstructed image of a thoracolumbar computed tomography scan when the patient complained of radiculopathy after the lumboperitoneal shunt. Note the tangled lumbar catheter (arrowheads).

catheter was inserted at 17 cm from the fascia at the level between L2 and L3. The surgeons did not have problem when they forwarded the lumbar catheter.

3. Postoperative Course

After the surgery, the patient complained of lancinating pain on both sides of the femurs when stretching her legs. Computed tomography revealed that an intradural lumbar catheter was tangled at T11 (Fig. 2). Having considered that the redundant catheter mechanically irritated nerve roots and caused radicular pain, we decided to remove the catheter under local anesthesia. When 1 cm the lumbar catheter was withdrawn, the patient suddenly complained of complete loss of bilateral leg sensation and muscle strength at a level below T12. Emergent MRI demonstrated that the lumbar catheter was wedged into the ventral spinal cord at T11, which compressed the spinal cord dorsally (Fig. 3A, B). Subsequently, we performed an emergent operation and removed the catheter following right T12 hemi-

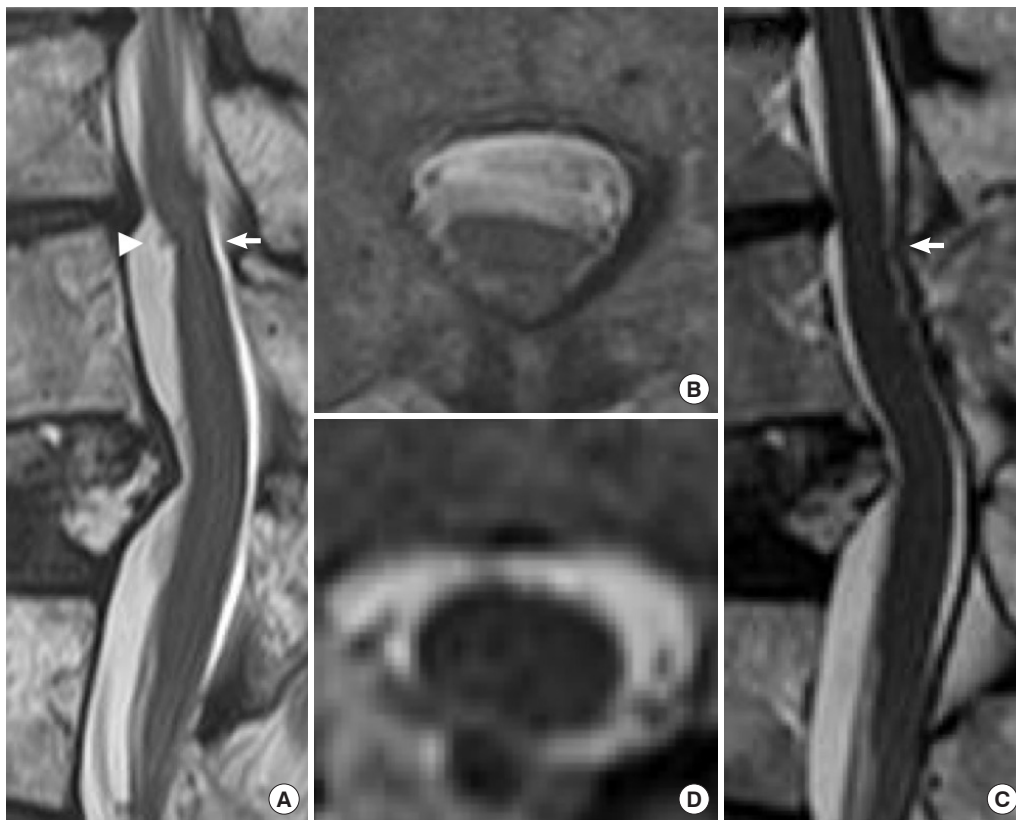


Fig. 3. T2-weighted magnetic resonance imaging of the thoracolumbar spine. Sagittal (A) and axial (B) images when the patient suffered from complete paraplegia after withdrawing 1 cm of the lumbar catheter. Note the lumbar catheter (arrowhead in panel A) compressing the ventral spinal cord (B, for comparison; see Fig. 1D). Arrow in panel A indicates the slice level of panel B. Sagittal (C) and axial (D) images after removing the catheter following right T12 hemilaminectomy. Note the complete disappearance of the spinal cord compression. Arrow in panel C indicates the slice level of panel D.

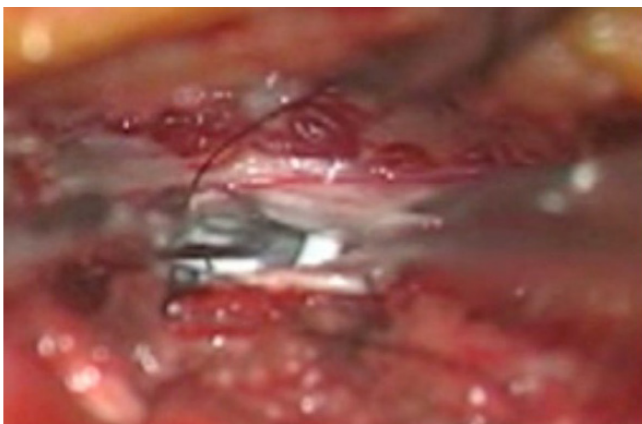


Fig. 4. Intraoperative photograph illustrating tangled lumbar catheter compressing the ventral spinal cord.

laminectomy. Pulsation of the spinal cord was soon restored, which confirmed that decompression of the spinal cord had been achieved (Fig. 4). The patient's lower limb functions were

restored immediately following the surgery. Fortunately, post-operative MRI revealed no spinal cord compression and evidence of spinal cord injury (Fig. 3C, D).

DISCUSSION

For patients with iNPH, implantation of a VPS has been the standard treatment of choice.⁸ However, recent studies indicate that the efficacy and safety of LPS is comparable to VPS in treating iNPH.^{5,9} In SINPHONI trials, when an improvement of one point or more in modified Rankin Scale⁷ was defined as "favorable outcome," the proportion of patients treated with LPS having a favorable outcome (63%) was comparable to those having VPS implantation (69%).^{5,9} With the idiopathic normal-pressure hydrocephalus grading scale (iNPHGS),¹⁰ 75% and 77% of patients improved 1 year after LPS placement and VPS placement, respectively.

Because LPS does not have the risk of brain parenchymal in-

jury seen in VPS, the use of LPS is expected to increase. From January 2011 to August 2016, we performed VPS and LPS for 64 and 48 patients, respectively. Nonetheless, these results should be interpreted with caution because LPS requires shunt revision procedures more frequently than VPS.⁹ In SINPHONI trials, after 87 LPS procedures, 6 revisions (7%) were required, while one out of 100 patients treated with VPS placement (1%) required a revision.

As previous reports indicated, complications of LPS may include subdural hematoma and shunt tube migration, rupture, or obstructions.^{5,9} Wang et al.⁶ categorized complications by those related to a peritoneal catheter, a pressure control valve, or a lumbar catheter. What we experienced in the presented case was radiculopathy and spinal cord compression related to a tangled lumbar catheter. A similar case was not reported previously.

Wang et al.⁶ reported three radiculopathies (4.4%) among 67 LPS procedures. Although the authors did not specify possible causes, 2 cases required LPS removals and one required a lumbar catheter revision. According to Aoki,¹¹ 5% of patients complained of radicular pain after the procedure of LPS. He hypothesized that radiculopathy was caused by excessive length of a lumbar catheter and the unnecessary compartment was twisted and migrated into the spinal canal leading to the compression of the nerve roots. Although Aoki¹¹ suggested that radiculopathic pain due to a lumbar catheter might resolve spontaneously in almost all the patients, we thought tangled catheter could not be released spontaneously and decided to perform revision.

Important aspect of the present case is why the lumbar catheter got tangled at T11. According to the preoperative lumbar spine MRI, subarachnoid space of the lower thoracic and lumbar spine seemed to be wide enough for the catheter to pass through. Retrospectively, we considered that the kyphosis at L1 played a role for the catheter to get tangled. Even the catheter passed L1, the kyphosis did not allow the catheter to ascend in the spinal canal, rather it was moved toward the spinal cord.

Nonetheless, it was difficult to predict the potential risk of the tangled catheter based on the preoperative examinations. We herein propose possible solutions to avoid this rare complication. First, the length of catheter insertion could be minimal, considering that redundant catheter became tangled in the present case. Second, LPS could be performed with a thinner lumbar catheter which would less likely to get tangled in the spinal canal.

As the SINPHONI trials indicated, patients with severe ver-

tebral degenerative diseases or spinal canal stenosis were not considered suitable candidates for LPS.⁵ However, no study has determined a definite severity of spinal canal stenosis to contraindicate LPS. In the present case, we performed LPS after MRI revealed that the spinal canal stenosis at L1 was not severe. However, it was noteworthy that manipulation of the tangled catheter at T11 could have potentially induced permanent and severe spinal cord injury.

CONCLUSION

It is important to recognize this potential complication, particularly when removing the lumbar catheter when revising a LPS placement. More importantly, clinical efforts should be made to specify surgical indications of LPS for elderly patients with mild or moderate spinal canal stenosis.

CONFLICT OF INTEREST

The authors have nothing to disclose.

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