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A Case of Dural Herniation of the Cauda Equina Caused by Enlarged Spinal Subdural Extra-arachnoid Hygroma Following Lumbar Microsurgical Decompression: Case Report

Kunio YOKOYAMA,[1] Makoto YAMADA,[1] Hidekazu TANAKA,[1] Yutaka ITO,[1] Akira SUGIE,[1] Masahiko WANIBUCHI,[2] and Masahiro KAWANISHI[1]

[1]*Department of Neurosurgery, Takeda General Hospital, Kyoto, Kyoto, Japan*
[2]*Department of Neurosurgery, Osaka Medical College, Takatsuki, Osaka, Japan*

Abstract

We experienced a rare case of transdural herniation of cauda equina caused by increased pressure with spinal subdural extra-arachnoid hygroma (SSEH) following lumbar microsurgical decompression. A 68-year-old woman presented with complaints of right leg pain and intermittent claudication. By the diagnosis of L2/3 lumbar spinal stenosis, microsurgical decompression was performed. The surgery was successful with no issues arising such as damage to the dura mater. Lumbar magnetic resonance imaging (MRI) performed 8 days after the surgery confirmed asymptomatic SSEH on the ventral side of the cauda equina. However, posterior cervical pain and lower back pain developed 32 days after the surgery. Lumbar MRI demonstrated that SSEH had markedly increased and advanced from the lumbar spine to the cranium, compressing the spinal cord posteriorly. In addition, herniation of the cauda equina was confirmed in the dura. An emergency surgery was performed. The herniated cauda equina was fully positioned in the dural sac, and the arachnoid membrane with accumulation of spinal fluid on the ventral side was fenestrated. Immediately after the surgery, the patient's symptoms disappeared. Sufficient caution is required regarding the possibility of SSEH associated with spinal failed back surgery syndrome as it can become excessively enlarged, leading to a poor prognosis.

Keywords: cauda equina dural herniation, spinal subdural extra-arachnoid hygroma, lumbar microsurgical decompression, lumbar spinal canal stenosis

Introduction

Spinal subdural extra-arachnoid hygroma (SSEH) can occasionally develop even in spinal surgeries that do not include operations in the dura.[1–4] Involvement of intraoperative damage to the arachnoid membrane is suggested as the cause of onset.[1,4,5] SSEH presents diverse symptoms such as lower back pain, leg pain, and bladder and rectal dysfunctions. However, since the number of reports is limited, much remains unknown regarding causes of onset and treatment methods. We herein report on a rare case of transdural herniation of the cauda equina in fenestrated dura caused by aggravated SSEH following lumbar decompression to treat lumbar spinal stenosis despite no intraoperative damage to the dura being observed in the first operation.

Case Report

A 68-year-old woman presented with the chief complaint of lower back pain and intermittent claudication that she had been suffering for the past 2 years. Her medical history included L3 vertebra fracture. Neurologically, there was weakness in the right iliopsoas muscle (MMT4), and pain in the right anterior thigh that was aggravated by walking. In imaging, there was crushing in L3 and advanced spinal stenosis in L2/3 (Figs. 1A–1C). Microsurgical decompression was performed on

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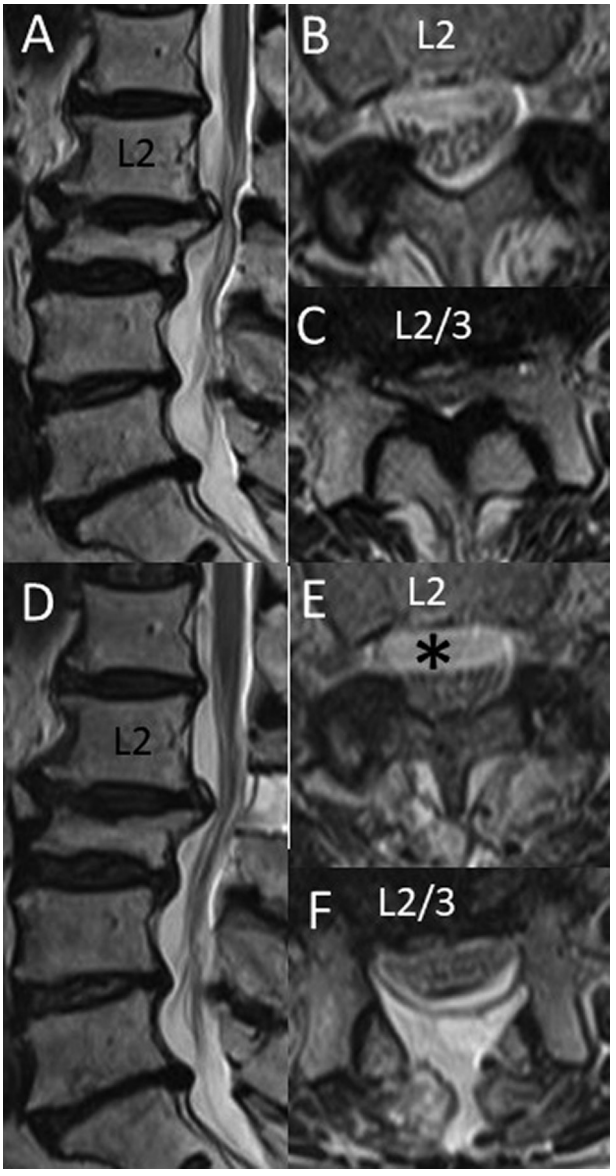

Fig. 1 Preoperative and post-1st operative MRI of lumbar spine. (A–C) Preoperative T2-weighted MRI demonstrating the L2/3 canal stenosis with L3 collapse. (D–F) Postoperative T2-weighted MRI demonstrating the ventral SSEH 8 days after surgery (black asterisk). There were no appearance of herniated cauda equina fibers. MRI: magnetic resonance imaging, SSEH: spinal subdural extra-arachnoid hygroma.

L2/3. The unilateral paraspinal muscle and multifidus muscle were dissected from the spinal process, and the vertebral arch of the operated level was exposed. The base of the spinal process was then sectioned, and the contralateral vertebral arch was exposed. Trumpet laminectomy was then performed using a diamond drill. The medial portion of the bilateral articular processes was removed (partial medial facetectomy). After resecting the ligamentum flavum, the medial side of the superior articular process of the vertebral body underneath was removed using a Sonopet ultrasound aspirator, and the medial side of the pedicle of vertebral arch was confirmed. There was no intraoperative damage to the dura, and there was no waste spinal fluid even during the Valsalva maneuver (Fig. 2A). The surgery was completed with extradural drainage detained. Rehabilitation focusing on walking started the day after the surgery. A routine lumbar magnetic resonance imaging (MRI) performed 8 days after the surgery confirmed fluid collection on the ventral side of the cauda equina in the extended dural sac (Figs. 1D–1F). Since there was no exacerbation of the patient's symptoms, an observation was taken. However, the subject complained of posterior cervical pain and lower back pain 32 days after the surgery, followed by relapse of right leg pain 2 days later. Symptoms deteriorated and the subject was unable to get into a supine position due to pain. Lumbar MRI revealed that fluid collection in the dural sac had notably increased, extending to the cranium (Figs. 3A, 3B, and 3D). Spinal cord was severely compressed to the dorsal side from the upper cervical cord by the collected fluid (Fig. 3D). In addition, at the fenestrated L2/3, the cauda equina was found to have perforated through the dura (Fig. 3A; yellow arrow). Thus, emergency surgery was performed. Spinal fluid collected around the dural sac, and a part of the cauda equina incarcerated from the fistula on the dura (Fig. 2B; yellow arrow). The dural sac was extremely tense, and a small amount of spinal fluid leaked through the fistula with each pulse. Laminectomy was extended longitudinally, and the dura was further dissected longitudinally from the fistula. Incarcerated cauda equina was positioned in the dura mater. The surrounding arachnoid membrane was found to be thickened and adhered. When the arachnoid membrane on the ventral side of the cauda equina (Fig. 2C; black asterisk) was incised, a large volume of waste spinal fluid was discovered. There was no cyst formation in the arachnoid membrane and the fluid was SSEH that was collected in the extra-arachnoid space. The incision was enlarged as much as possible to prevent relapse. Incised dura was sutured tightly using a myofascial flap (Fig. 2D). Immediately following the surgery, the patient's lower back pain, posterior cervical pain, and leg pain disappeared. Lumbar MRI demonstrated the disappearance of SSEH after the reoperation (Figs. 3C and 3E). The displaced spinal cord returned to its original position.

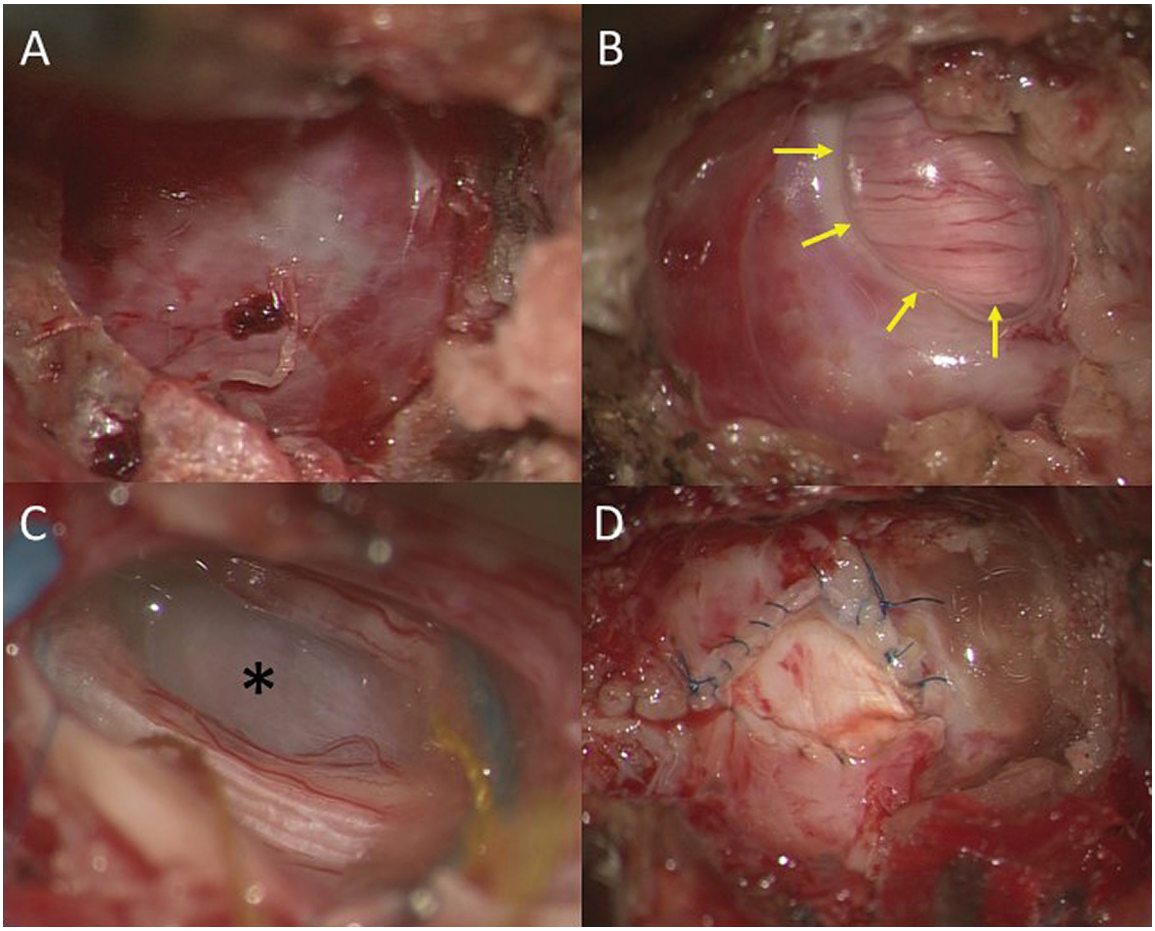

Fig. 2 1st and 2nd intraoperative photographs. (A) Final operative view of the index surgery. L2-L3 decompression was achieved with no dural injury. (B) Operative view of the 2nd operation. Transdural herniation of cauda equina fibers through a dural defect. (C) The black asterisk indicates ventral arachnoid membrane containing fluid collection. (D) For the dural repair, myofascial patch was used, and no leakage of CSF was noted. CSF: cerebrospinal fluid.

Discussion

Though rare, SSEH can develop following surgery for lumbar spinal stenosis and herniated disc even when the intradural area is not operated on.[1–3] Past reports all mentioned headache, lower back pain, leg pain, and bladder and rectal dysfunction shortly after the surgery, which led to the diagnosis.[1–3] A possible onset mechanism is the formation of one-way valve to the subdural space from the area on the arachnoid mater damaged by the surgery, which then leads to collection of spinal fluid in the subdural extra-arachnoid space.[4,5] Histologically, a dural border cell layer is located between the dura mater and the arachnoid mater, where a fissure may form with relative ease due to trauma or physical stress, making the area susceptible to fluid collection.[1,6]

In cases of severe stenosis with vertebral fracture, such as our patient, latent adhesion of arachnoid membrane might have been present. The decompression effect of the surgery might have created pores in the arachnoid membrane and a one-way valve, leading to SSEH. This SSEH advanced beyond the craniocervical junction, extending to the cranium and causing pain severe enough to prevent the subject from assuming the supine position. Moreover, the thecal sac was confirmed to be extremely tense during the second surgery, suggesting that the internal pressure of the dural sac was likely to have been highly elevated. Eight days after the surgery, there were no symptoms of spinal cord compression. MRI images indicated that the SSEH was mild, and the fenestrated dural sac did not exhibit a herniated nerve root. However, 1 month after surgery, SSEH notably increased and pressure on the fenestrated dura increased. This might have then caused the perforation of the dura mater. The spinal dura is thinner and more fragile than the cranial dura mater, and the bone edge and movement cause mechanical stress to be applied to the

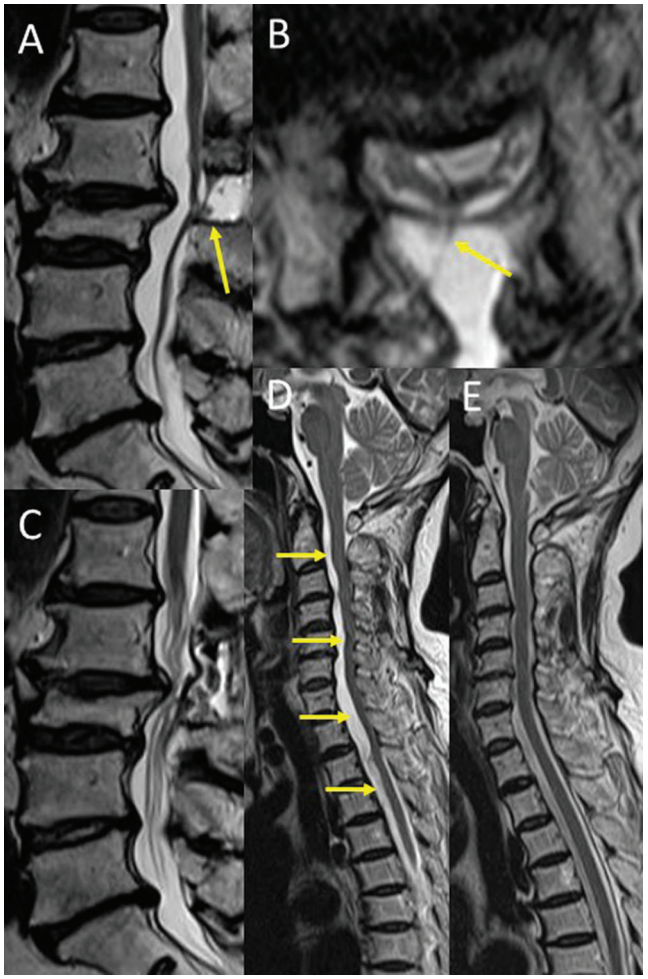

Fig. 3 Preoperative and post-2nd operative MRI of lumbar spine. (A, B) Herniated cauda equina fibers at L2-3 level (yellow arrows). (D) SSEH extending from lumber spine to the cranium (yellow arrows). (C, E) Lumbar MRI after the post-2nd operation demonstrating disappeared SSEH. The displaced spinal cord returned to its original position. MRI: magnetic resonance imaging, SSEH: spinal subdural extra-arachnoid hygroma.

fenestrated area. Furthermore, dura matter contusions or micro-tears that occurred when the dura was peeled off from the adhered ligamentum flavum may have been latent. These also might have been involved in the development of dural defect. Although we cannot confirm whether there was any damage to the dura during the initial surgery, we confirmed the lack of spinal fluid leakage by Valsalva maneuver before closure; and thus, we assume that there was no damage to the dura. No past reports have described cases in which SSEH increased in size following a spinal surgery, leading to perforation of the dura at the fenestrated area and herniation of the cauda equina from the fistula.

Naturally, when the cauda equina becomes herniated through a dural defect, it needs to be positioned back within the dural sac. There is no consensus, however, regarding how to go about treating SSEH. While some reports have described conservative treatment leading to the alleviation of mild SSEH,[1,7] it would be extremely dangerous to continue with conservative treatment when there are severe cauda equina symptoms as in the present case. While it has been reported that symptoms may be disappeared by lumbar puncture,[8] this is not recommended if there is a localized SSEH on the ventral side of the cauda equina, as in the present case, since it could damage the cauda equina. Surgical fenestration of the arachnoid membrane performed as early as possible needs to be considered for such cases.

In conclusion, we experienced a case of transdural herniation of the cauda equina caused by an increase in SSEH following decompression to treat lumbar spinal stenosis. The cause was an excessive increase in SSEH which led to increased internal pressure of the dural sac. As SSEH associated with failed back surgery syndrome could take a severe course, a careful response is necessary.

Informed Consent

Informed consent was obtained from the patient included in the study.

Conflicts of Interest Disclosure

The authors declare that they have no conflict of interest.

References

1) Bharath A, Uhiara O, Botchu R, Davies AM, James SL: The rising root sign: the magnetic resonance appearances of post-operative spinal subdural extra-arachnoid collections. *Skeletal Radiol* 46: 1225–1231, 2017
2) Elder BD, Ishida W, Goodwin RC, Bydon A: Iatrogenic spinal subdural extra-arachnoid hygroma following uncomplicated lumbar decompression. *Cureus* 9: e1171, 2017
3) Kaliya-Perumal AK, Lu ML, Kao FC, Niu CC: Delayed extensive lumbar sub-dural effusion following discectomy – clinical imaging and case report. *Biomedicine (Taipei)* 7: 35–38, 2017
4) Singleton WG, Ramnarine D, Patel N, Wigfield C: Post-operative spinal subdural extra-arachnoid hygroma causing cauda equina compression: a report of two cases. *Br J Neurosurg* 26: 429–431, 2012
5) Nentwig MJ, Whitaker CM, Yang SY: Spinal subdural hygroma as a post-operative complication in revision spine fusion: a case report. *J Surg Case Rep* 11: 1–3, 2019

6) Vandenabeele F, Creemers J, Lambrichts I: Ultrastructure of the human spinal arachnoid mater and dura mater. *J Anat* 189: 417–430, 1996
7) Morgan RA, McCarthy MJ: Symptomatic postoperative spinal subdural extra-arachnoid hygromas: resolution with conservative management: a report of 2 cases. *JBJS Case Connect* 10: e0102, 2020
8) Wilkinson BM, Oh JY, Swarnkar AS, Galgano M: Dramatic resolution of symptomatic thoracolumbar traumatic spinal subdural hygroma with lumbar puncture: a literature review and case illustration. *World Neurosurg* 135: 19–22, 2020

Corresponding author: Kunio Yokoyama, MD, PhD
Department of Neurosurgery, Takeda General Hospital, 28-1 Ishidamoriminamimachi, Fushimi-ku, Kyoto, Kyoto 601-1495, Japan.
e-mail: neu100@osaka-med.ac.jp