Neurological recovery after surgical treatment of giant cervical pseudomeningoceles extending to lumbar spine associated with previous brachial plexus injury

Yoshihisa Kotani · Kuniyoshi Abumi · Manabu Ito ·
Satoshi Terae · Yukiyoshi Hisada · Akio Minami

Received: 30 July 2009 / Revised: 10 December 2009 / Accepted: 18 March 2010 / Published online: 11 April 2010
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Abstract The authors describe a case of 28-year-old man who presented with cervical myelopathy and lumbar radiculopathy due to the giant cervical pseudomeningocele extending to the lumbar spine at 10 years after previous brachial plexus injury. To evaluate the communicating tract between pseudomeningocele and subarachnoidal space, the multidetector-row helical CT with simultaneous myelography was performed preoperatively. The surgical treatment in the cervical spine included the resection of pseudomeningocele and the repair of dural defects communicating into the cyst following multi-level laminoplasty and foraminotomies. At 6 years after surgery, the significant neurologic recovery and complete obliteration of cysts in the whole spine area were maintained. This serves as the first report describing the significant neurologic recovery after the surgical treatment of giant cervical pseudomeningocele extending to the lumbar spine after previous brachial plexus injury.

Keywords Giant pseudomeningocele · Cervical spine · Lumbar spine · Communicating tract · Surgical treatment

It is known that pseudomeningocele is caused either by traumatic avulsion of the brachial plexus, dural injury, or by direct surgical injury of dura mater [1, 5–7]. However, traumatic pseudomeningocele rarely enlarges to cause neurologic disturbance due to neural compression [2, 4, 8, 9]. In some reports, cervical pseudomeningocele associated with brachial plexus injury caused cervical myelopathy due to spinal cord compression [2, 4, 8, 9]. There were only three cases reported in the literature in which giant cervical pseudomeningocele extended towards the lumbar spine causing myelopathy and radiculopathy over long periods following brachial plexus injury [3]. Surgical treatment with or without a cystoperitoneal shunt was performed in these three cases; however, the neurologic recovery was insufficient.

We encountered a case of cervical giant pseudomeningocele extending towards the lumbar spine causing myelopathy and radiculopathy after previous brachial plexus injury. The surgical outcome was excellent without any recurrence of symptoms during the 6-year follow-up. We present this patient as the first case of successful neurologic recovery following surgical treatment for the giant cervical pseudomeningocele.

Y. Kotani (✉) · M. Ito · A. Minami
Department of Orthopaedic Surgery, Hokkaido University
Graduate School of Medicine, Kita-15, Nishi-7, Kitaku,
Sapporo 060-8638, Japan
e-mail: y-kotani@med.hokudai.ac.jp

K. Abumi
Hokkaido University Health Administration Center,
Kita-8, Nishi-5, Kitaku, Sapporo 060-0808, Japan

S. Terae
Department of Radiology, Hokkaido University Graduate School
of Medicine, Kita-15, Nishi-7, Kitaku, Sapporo 060-8638, Japan

Y. Hisada
Department of Orthopaedic Surgery, Kushiro Rosai Hospital,
Kushiro, Japan

Case report

History

A 18-year-old man suffered from left brachial plexus palsy of C5 and C6 nerve root avulsion and a partial injury of C7 nerve root due to a traffic accident and underwent surgical

reconstruction of his elbow flexion for his remaining disability. Ten years after the injury, he presented with pain and numbness over his right lower extremities and subsequently complained of decreased power in his right hand grip and the inability to elevate his right shoulder. He gradually presented with gait disturbance and bilateral numbness in both his upper and lower extremities.

Examination

Upon physical examination, the patient presented with a spastic gait, with hyperreflexia in bilateral triceps tendon,

patella tendon, and Achilles tendon reflexes. Manual muscle testing showed 2/5 in right deltoid and 4/5 in right biceps. Sensory disturbance was bilateral hypalgesia from C3 dermatome to whole trunk and lower extremities. Japanese orthopaedic association score for cervical myelopathy was 8 out of 17 full marks. There were no bladder and bowel disturbances. MRI demonstrated diffuse extradural pseudomeningocele extending from C2 to L3 that compressed the spinal cord and cauda equina (Figs. 1, 2). In the cervical spine, the pseudomeningocele was located on the anterior and left side of dura mater. In the lumbar spine, it was located mostly at the anterior aspect of dura

Fig. 1 Preoperative MR images in the cervical spine. The pseudomeningocele surrounded the dura mater compressing the spinal cord. The high signal intensity was depicted in the spinal cord from C2 to C5 level

Fig. 2 Preoperative MR images in the thoracic and lumbar spine. The pseudomeningocele was located mostly on the anterior and lateral side of the dura mater compressing the spinal cord and cauda equina. The pseudomeningocele terminated caudally at the L3 level

Fig. 3 Helical CT image at C6/7 level using simultaneous myelography demonstrating the early flow from subarachnoid space to pseudomeningocele

mater. A high signal intensity change was identified in the spinal cord from C2 to C5 level. The 4-detector row helical CT scan with simultaneous myelography was performed to identify the communicating tract between the pseudomeningocele and subarachnoid space. Analyzing the initial phase CT slices of consecutive spine levels, the dorsolateral communication at the C6/7 level was estimated (Fig. 3).

Operation

The laminoplasty from C3 to C7 as well as left foraminotomies at the C5/6 and C6/7 levels were performed. After opening the laminae, the pseudomeningocele covered by thin membrane extended to the dorsolateral side of dura mater. From C3 to C5 levels, the majority of the pseudomeningocele was located on the dorsal side of dura mater. Between the C5 and C7 levels, the pseudomeningocele was located on the left side, communicating with the dorsal side of the pseudomeningocele (Fig. 4). The dural defects were identified in the avulsed C6 nerve root and partially in the C7 nerve root, where it was in close communication with the pseudomeningocele. After resecting the left and dorsal pseudomeningocele, these dural defects were primarily sutured (Fig. 5). During these procedures, the opened hemilaminae on the left side between C3 and C7 were resected for the improved visualization of pathology.

Fig. 4 The dorsal side of pseudomeningocele covered with a thin membrane communicating to lateral side of cyst (arrow)

Fig. 5 The surgical repair of dural defects was performed at avulsed left C6 and partial C7 nerve root by oversewing (arrows)

Postoperative course

After the operation, right deltoid and biceps muscle weakness recovered to 4/5 and 5/5 level, respectively. At the final postoperative follow-up at 6 years, this recovery had been maintained without complaint in the quality of daily living. There was no gait disturbance and JOA cervical myelopathy score recovered to 15 out of 17 full marks. The sensory disturbance remained slightly below the knee level. On the follow-up MRI, the pseudomeningocele disappeared from the proximity of all spine levels (Fig. 6). The patient is working full time at a gas station and participating in an active daily life.

Discussion

In this report, we demonstrated a giant pseudomeningocele extending from the cervical to lumbar spine, causing both myelopathy and radiculopathy 10 years after initial

Fig. 6 The follow-up MR images in the cervical and thoracolumbar spine at 6 years postoperatively, demonstrating the complete loss of the cysts and avoidance of neural compression

brachial plexus injury. The surgical resection and repair of the pseudomeningocele were fully effective without any recurrence in clinical symptoms and radiologic imaging modalities.

Hader et al. [3] previously reported three cases of giant pseudomeningocele after brachial plexus injury, extending from cervical to thoracic or lumbar spine. The patient age at surgery ranged from 26 to 52 years. The clinical symptoms of pseudomeningocele occurred at 12, 16, and 30 years after initial brachial plexus injury. The levels of pseudomeningocele were distributed in C3–L4, C2–T10, C2–L1, respectively. In all the three cases, the surgery was performed using different techniques of laminectomy with or without the oversewing the dural defect and laminectomy combined with cystoperitoneal shunt. However, the recovery of neurologic disturbance was limited especially in motor function of the upper extremities despite the complete surgical removal of these cysts. In our present case, the neurologic recovery was almost complete with the total removal of all the cysts.

The preoperative diagnosis of a communicating tract between the pseudomeningocele cyst and the subarachnoid space is often difficult using the current imaging techniques. We utilized the multidetector-row helical CT (MDCT) with simultaneous myelography to estimate the location of communicating tracts. Using MDCT with simultaneous myelography, the initial flow from the subarachnoid space to the pseudomeningocele could be detected, leading to the determination of communicating tract. Additionally, multiplanar reconstructed images helped to visualize the 3D configuration of the communicating tract. In this preoperative examination, the location of tract was estimated at the proximal

site of left C7 nerve root. However, the operative finding suggested that the tract was located at the proximal site of the left C6 nerve root and the proximity of C7 nerve root was a partial dural defect. The limitations of current MDCT with myelography techniques were that the contrast medium was injected from the lumbar spine and the caudal communicating tract tended to be highlighted more strongly than the cephalad tract. Even with discrepancy between the preoperative imaging and operative findings, this dynamic evaluation was useful in preoperatively estimating of the communicating tract anatomy. This technique can be applied to arachnoid cysts or other similar pathologies and therefore, further developments or modification in imaging techniques can be expected in the future.

For surgical treatment, majority of the pseudomeningocele was covered by a thin membrane structure; however, it was easily ruptured by the maneuver dividing the dura and cyst. Therefore, it was difficult in proper identification of the communicating tract without preoperative information. In the cases reported by Hader et al. [3], one case required multiple surgeries due to the recurrence of symptoms and remaining cysts. It should be emphasized that the shunt procedure or resection of cysts alone does not lead to a reliable curative procedure. Using meticulous microscopic techniques and dynamic preoperative imaging modalities, the communicating tract should be identified intra-operatively and primarily repaired. Although this pseudomeningocele was located throughout the entire spinal levels, surgical treatment was required solely in the cervical spine.

Conflict of interest statement None of the authors has any potential conflict of interest.

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