Surgical Therapeutic Strategy of Transdural Nerve Root Herniation during Anterior Lumbar Interbody Fusion: Report of Two Cases

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We report two cases of transdural nerve root herniation caused by incidental dural tear during anterior lumbar interbody fusion. We also describe how these unexpected complications were managed. Two patients suffered from degenerative spondylolisthesis and foraminal stenosis with a redundant dural sac. In these patients, the dural tears occurred during anterior discectomy and the nerve roots subsequently herniated outward because of intradural pressure. The herniated neural tissues were restored via a posterior transdural approach. There is always the possibility of a dural tear with nerve root herniation during surgery employing an anterior lumbar approach. If this occurs, we should be aware of the difficulty in repairing the dura from this approach. We should also keep in mind that adequate repair of it is important to avoid related postoperative complication.

Key Words: Lumbar, Complication, Dura, Interbody fusion, Nerve root

INTRODUCTION

An anterior surgical approach to the lumbar spine was first described in the early 1930s as a technique for managing spondylolisthesis¹⁾. Since then, many authors have reported various results and complications because this surgical exposure requires extensive mobilization of the abdominal great vessels and the peritoneal contents^{1,6)}. The most of complications reported related to this procedure are vascular or visceral damage and reports describing injuries to the dural membrane or neural tissues are rare⁶⁾.

The repair in this case is important to prevent further complications, such as the leakage of CSF, infection, or neural tissue injury due to exposure. But it have been rare reported about the solution in this case⁶⁾. Many authors have merely reported the methods to prevent vascular or visceral injury or the advantages and disadvantages of those methods so far.

In our cases, we decided on anterior lumbar interbody fusion (ALIF), owing to the following advantages for elderly patients reported by some authors.

ALIF is better managed in those patients with significant kyphosis and osteoporosis and it generally provides maximal lordosis reconstruction⁴⁾. The other advantages of ALIF are reduced back muscle injury, the preservation of posterior structures, no need

for blood transfusion, no epidural scarring as a result of avoiding contact with the thecal sac, minimal postoperative pain, and early discharge⁸⁾.

To the best of our knowledge, no reports have mentioned incidental dural tears occurring during the anterior lumbar approach. We report two cases of transdural herniation of the nerve root into the intervertebral disc space caused by inadvertent dural tears during the anterior retroperitoneal approach for fusion.

CASE REPORT

1. Case 1

1) History and Examination

A 70-year-old woman had a three-year history of progressive bilateral leg and inguinal numbness. She had chronic lower back pain, which was exacerbated by prolonged standing and walking. Neurological examination revealed hypoesthesia in the inguinal and perianal areas with intermittent neurogenic claudication. Radiological examination revealed degenerative spondylolisthesis with foraminal stenosis at the L5-S1 level (Fig. 1).

2) Operation

The procedure was performed according to the standard ALIF technique as previously described³. The patient was placed in the supine position for the retroperitoneal approach to the lumbosacral junction through a vertical skin incision on the marking confirmed by fluoroscopy. The lumbosacral junction was then routinely exposed. After the level and the disc space were marked, the anterior longitudinal ligament was removed. We used conventional methods to remove the disc, but the posterior ligament adhered so strongly to the dura that the dura unexpectedly tore in the ventral area while the posterior annulus was being removed. We found the hernia of the nerve root through the dural defect, but were unable to repair it and insert the herniated nerve root into the dural sac. The herniated root was constantly being pulled out because of the pressure gradient created by the intradural pressure, and the operational field was too narrow to repair the dural defect effectively. Therefore, we decided on a posterior approach for proper management. The patient was placed in the prone position for the posterior approach to restitute the kinked herniated nerve root sleeve and repair the dural tear. After the soft tissue dissection, a bilateral laminectomy was performed, and the inter-

spinous ligament was removed. The dura was widely exposed to search for the dural defect and the epidural space was filled with hemostatic agents and covered with long cottonoids. We used a microscope to search for the dural defect, but could not find it because it was ventrally located. A transdural repair was required for proper management and after the dura had been opened longitudinally, it was elevated and tacked with sutures to keep the durotomy open in order to expose the dural defect. With careful intradural exploration, we found the hernia of the nerve root through the dural defect (Fig. 2A). The nerve root was strangulated and congested and had been jammed into the small dural defect. We pulled the nerve root out carefully with a blunt hook and fine forceps, and then restored it into the dural sac. Finally, we repaired the dural defect with primary sutures using 7-0 Prolene and sealed it with Tachocomb[®] (Nycomed Austria GmbH, Linz, Austria) (Fig. 2B). After surgery, the pre-operative symptoms were relieved, and no neurological deficit or CSF leakage were observed.

2. Case 2

1) History and Examination

A 72-year-old woman presented with buttock pain and intermittent neurogenical claudication. It was diagnosed that these symptoms were caused mainly by a lumbar disc herniation and degenerative spondylolisthesis with foraminal stenosis at the L4-5 level (Fig. 3). Neurological examination revealed a grade IV degree weakness in the dorsiflexion of the patient's left big toe.

2) Operation

We performed the anterior retroperitoneal approach for L4-5 discectomy and interbody fusion. The dural defect was created while the annulus was being removed, and the herniated nerve root was found through the dural defect. Initially, we were unable to repair it because the high CSF pressure in the dural

Fig. 1. Preoperative MRI showing degenerative spondylolisthesis with disc herniation and foraminal stenosis at the L5-S1 level.

Fig. 2. The operative findings. (A): After dural opening, a nerve root (arrow) is herniated through the ventral dural defect (dotted circle). (B): After transdural rescue of the herniated nerve root, the ventral dural defect was closed with an intradural primary suture (arrowhead) and Tachocomb[®] application.

Fig. 3. Preoperative MRI shows degenerative spondylolisthesis with disc herniation and spinal stenosis at the L4-5 level.

Fig. 4. The operative findings. (A): The herniated nerve root (*) and dural defect (arrow) were found on the ventrolateral side of the dural sac. (B): After restoration of the herniated nerve root, the dural defect was closed with an extradural primary suture and Tachocomb® application.

sac pulled the herniated neural tissues out and the operational field was too narrow and deep to perform an appropriate procedure. Therefore, the posterior approach was employed to repair the dural defect effectively. Soft tissue dissection and a total laminectomy were performed and we exposed the dura widely with meticulous hemostasis. Both the dural defect and the nerve root herniation through the defect were found in the ventrolateral portion of the dural sac. It was difficult to repair the defect effectively because there was not enough flexibility to adjust the thecal sac; therefore, we cut the dentate ligament closest to the dural defect to create pliability to aid its management. We found the hyperemic swollen nerve root sleeve caught in a small dural defect and made an extensive dural incision along the dural defect because of the limited area for the procedure (Fig. 4A). The root was inserted and arranged carefully with a blunt hook and fine forceps. The dural defect was repaired with a primary suture using silk and Tachocomb® (Fig. 4B). There were no neurological sequelae or other wound related problems and the preoperative symptoms were also relieved.

DISCUSSION

As occurred in our cases, Kothbauer and Seiler reported transdural nerve root incarceration after microsurgical lumbar discectomy³. In 1994, Toppich et al reported complications similar to that case⁹. These studies tell us that unrelieved trapped roots have a high possibility of incarcerating themselves in much the same manner that bowel loops are incarcerated in an abdominal wall hernia. The ischemic damage led to progressive pain and sensory motor deficit^{5,9}; however, no morbidity was associated with these events when the dura was adequately closed, primarily with sutures².

Several investigators have reported the prevalence of unintended dural tears during lumbar spine surgery with variable incidences ranging from 1-17%^{2,10}. The morbidity rate was relatively lower for younger patients and for surgery on herniated discs. In contrast, the morbidity rate increased with age and with procedures for spinal stenosis^{2,10}.

Our two cases had the same condition, degenerative spondylolisthesis with severe stenosis. However, this is the first case

report to our knowledge of incidental durotomy associated with ALIF. So far, there is no published report describing ventral durotomy during ALIF^{11,12}. Anterior discectomy and decompression was performed by one surgical team. The goal of anterior discectomy was removal of extruded disc fragment and through dural sac decompression. We postulate that the underlying adhesion and redundant dura were caused by increased intradural pressure over a long time, and could be risk factors for dural tears during surgery.

Some studies that investigated the clinical outcomes of patients with incidental durotomies found no long-term sequelae when the patients were treated successfully for incidental durotomies during surgery^{6,8}. However, unrepaired dural tears have many complications, including pseudomeningocele, CSF fistula, and meningitis. Saxler et al. reported that patients who had sustained a dural tear had increased rates of back pain and headaches compared to a matched cohort of control subjects⁷.

The methods of repairing and subsequently managing patients with an incidental durotomy have also been reported extensively in the literature. Various methods have been suggested, but their main aim is to expose the dural tear and then repair it in a watertight fashion. The use of drains is controversial, and there seems to be no clear consensus in the literature. Some authors have found that mandatory bed rest was not necessary for patients who had a dural tear repaired intraoperatively.

Once a dural tear occurs during the anterior approach, the relationship between the dural defect and the neural tissue is important. If the neural tissues are just exposed, but not herniated into the disc space, primary closure of the defect is feasible. If the nerve root is herniated through a small dural orifice, however, it is nearly impossible to repair the lesion because of the narrow surgical field and the check-valve mechanism caused by the pressure gradient. As the surgeon tries to insert the herniated tissue into the dural sac, more neural tissues might pop out into the disc space. Thus, we believe that posterior transdural exploration to restore the herniated nerve root is better than anterior repair.

Another important determinant of the proper approach is the location of the dural tear. Dural closure after the neural rescue can be performed either intradurally or extradurally. If the defect is located in the ventral dura's lateral zone, transdural exploration followed by extradural repair may be possible. In contrast, if the defect is located medially, a transdural approach with intradural repair is required to completely restore the herniated nerve root. In both our cases, transdural exploration was performed to restore the herniated nerve root. However, dural closure was achieved by intradural repair for the case of a medial defect, and by extradural repair for the case of a lateral defect.

We have shown that these cases can be treated successfully using the posterior approach. However, the best way to manage this unexpected complication is prevention. Therefore, a meticulous microscopic technique might be helpful during anterior decompression, especially for patients at high risk of this complication. Dural tears and herniated nerve roots should be re-

paired during the operation to avoid long-term sequelae.

CONCLUSION

The anterior approach to the lumbar spine poses the potential risk of dural tears and nerve injury, which may be difficult to repair in the anterior surgical field. Because the surgical field for dura repair is deeper and narrower than it is in the posterior approach. However, this lesion should be repaired during the operation to prevent further related complications. In our cases of nerve root herniation into the disc space, it was possible to treat the dural tear using a posterior transdural approach.

We present dura repair through the posterior approach as one of the repair methods if dural injury occurs unexpectedly during anterior lumbar surgery and it must be kept in mind that great care is required to prevent this unexpected complication, especially for a patient with risk factors.

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