Endoscopic Anterior Cervical Discectomy under Epidurogram Guidance

KAI-XUAN LIU, MD, PhD
Chief Surgeon of Atlantic Spinal Care
Edison, NJ

BRYAN MASSOUD, MD
Chief Surgeon of New Jersey Back Institute
Fair Lawn, NJ

ABSTRACT

Cervical discectomy is commonly required for spinal cord and nerve compression disorders. Currently, anterior cervical discectomy and fusion is the standard procedure for the treatment of cervical disc herniations and cervical degenerative disorders, whereas endoscopic cervical discectomy is considered an important alternative. Despite the advancement in surgical technology, endoscopically removing hard pathological tissues remains challenging. Inspired by lumbar epidurogram-guided decompression, we have developed an epidurogram-guided endoscopic cervical decompression technique. The technique uses contrast dye through cervical discography to generate an epidurogram. Under fluoroscopic view, the spinal cord is posterior to the contrast line. The endoscopic instruments can safely reach the epidural space, if it’s necessary, as long as they stay anterior to the contrast line. We have used this technique to treat both soft and hard cervical disc herniations, and we have found it makes the surgical procedures safer when more aggressive decompression is required.
Early descriptions of cervical diseases can be traced back to the early 1900s.\(^1,2\) In 1934, posterior surgical access to the cervical spine was first described by Mixter and Barr, and the approach remained standard surgical treatment of cervical disc herniations for several years.\(^3\) The early posterior approaches, however, were associated with a number of disadvantages, including operation-induced deformity, excessive bone and tissue removal, risk of spinal cord injury, and postoperative neck pain. In the mid-1950s, anterior cervical discectomy followed with fusion was independently reported by Robinson and Smith and by Cloward.\(^4,5\) In the following years, techniques using both anterior and posterior approaches were modified to improve clinical safety and efficacy.\(^6\text{-}11\)

Since the 1990s, anterior cervical discectomy combined with fusion (ACDF) has been widely used for the treatment of degenerative diseases of the cervical spine.\(^2\text{-}5\) Because of its satisfactory clinical outcomes in the majority of the cases, ACDF has been considered the “gold standard” for surgical treatment of cervical diseases, especially soft disc herniations.\(^6\text{-}11\) A large body of evidence, however, has suggested that anterior cervical discectomy and fusion is associated with a number of disadvantages, including serious surgical complications, such as degeneration of the adjacent segments, loss in height of the intervertebral space, pseudarthrosis, and access-related injuries.\(^13\text{-}14\) In addition, studies showed no statistically significant difference between anterior discectomy with or without fusion for surgical treatment of disc herniations.\(^15\text{-}18\)

In the past decade, minimally invasive surgical techniques have been widely used for the treatment of spinal diseases, including diseases in the cervical spine. Compared with traditional open-surgery techniques, minimally invasive surgical techniques offer such advantages as less tissue and bone damage, reduced blood loss, shortened hospital stay, and faster recovery.\(^19\text{-}21\)

Minimally invasive percutaneous endoscopic cervical discectomy (PECD) for the treatment of cervical diseases was introduced in the early 1990s.\(^22,23\) Over the years, the technique has been gradually modified and improved to treat not only contained but also noncontained herniations.\(^23\text{-}25\) Both endoscopic anterior access\(^23,26,27\) and endoscopic posterior access\(^26\) to the cervical spine have been reported.

Compared with ACDF, PECD offers comparable pain relief and is associated with a number of advantages, including better vision of the working zone, shorter operation time, quicker recovery, less tissue damage, and reduced blood loss. In addition, endoscopic cervical decompression preserves the stability and mobility of the operated spinal segment.\(^26\) The technique has been proven safe and effective in treating soft disc herniations.

Today, ACDF remains the surgical standard for the treatment of cervical disc herniations, whereas PECD is considered an effective alternative. Studies have shown that ACDF and PECD, as well as a number of other minimally invasive techniques, can lead to excellent clinical outcomes when used to treat soft disc herniations.\(^26\text{-}29,30\) However, treatment of hard cervical disc herniations, especially disc-osteophyte-complex formation remains very challenging.\(^1,13\)

Discography, in which a contrast agent is injected into the nucleus pulposus of the intervertebral disc, has long been proven effective in identifying a painful spine disc, depicting corresponding spinal derangements, selecting surgical candidates, and improving surgical outcomes.\(^13\text{-}36\) On the basis of our experience with cervical discography, we have developed an epidurogram-guided endoscopic cervical discectomy technique for the treatment of cervical disc herniations, especially hard disc herniations. The purpose of this chapter is to introduce our epidurogram-guided anterior cervical discectomy technique. Because PECD techniques, especially when used to treat soft disc herniations, have been well described, in this chapter we mainly introduce our experience in treating hard cervical disc herniations such as disc-osteophyte complexes.

### Indications

Indications for epidurogram-guided anterior cervical discectomy include:

- Headache, neck pain, and radiating arm pain
- Symptoms of tingling and numbness in the arms and hands
- Sensory loss and muscle weakness of the upper extremities
- No improvement of symptoms after 8 weeks of conservative therapy
- MRI- and CT-confirmed disc herniations, calcified disc protrusions, or osteophytes
- Discography provoked concordant neck and arm pain
CONTRAINDICATIONS

Our epidurogram-guided anterior cervical discectomy is not suitable for treating patients with severe disc space narrowing, multiple levels of extensive degenerative diseases, severe central spinal stenosis, massive cervical disc herniation with signs of myelopathy, tumors, infections, segmental instabilities, and other neurologic or vascular pathologies that may share the symptoms of disc herniations.

INSTRUMENTS AND TECHNIQUES

The main surgical instruments we use include intraoperative fluoroscopy, high-speed drill, endoscopic spinal instruments, endoscopic camera system, and tubular retractor system with compatible endoscope. The endoscopic instruments were purchased from Richard Wolf Medical Instruments Corporation (Vernon, IL). The Holmium:YAG (Ho:YAG) laser system was purchased from Trimedyne, Inc (Lake Forest, CA).

Position, Discogram, and Epidurogram

The patient lies in a supine position with arms positioned on the sides of the body and the neck mildly extended. Under general anesthesia, a small incision is made in the front of the patient’s neck either from the right side or the left side depending on the patient’s pathology and clinical symptoms (Fig. 1). Gentle, blunt dissections are then made with forceps in the safe zone so that a guiding needle and later a dilator can reach the middle of the anterior disc space in the prevertebral facia. After the ideal position is confirmed with fluoroscopy, an 18-gauge guiding needle is inserted into the center of the disc, and a few milliliters (2-3mL) of contrast agent mixed with indigo-carmine is injected into the disc (Fig. 2). In our practice, we have observed simultaneous formation of both cervical discogram and cervical epidurogram in most patients with extruded disc herniations.

Insertion and Position of Working Cannula

After the discography is performed, a guide wire is inserted through the
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Removing the Instruments and Closing the Incision
After the disc herniation and disc-osteophyte complex are adequately removed, the surgical instruments are removed allowing the tissue to close. The surface wound is covered with a bandage.

CASE STUDY
A 52-year-old male patient underwent a standard ACDF operation at the C4-5 and C5-6 levels in 2004 for the treatment of disc herniations resulting from a motor-vehicle accident. The ACDF operation initially produced an excellent outcome, which, unfortunately, only lasted for a few years. The patient then experienced progressive neck pain and headaches. Repeat MRI studies showed a cervical disc herniation with osteophyte-complex formation at the C3-4 level (Fig. 9).

To relieve the pain, the patient received an epidurogram-guided endoscopic anterior cervical discectomy at Atlantic Spinal Care. Under general anesthesia and with the guidance of discogram and epidurogram, the osteophytes were safely removed. No complications occurred during or after the surgery. The patient was followed up for 9 months. At the 9-month follow-up, the patient achieved 75% neck pain and headache relief.

DISCUSSION
Cervical discectomy is commonly required for spinal cord and nerve compression disorders. Although ACDF is still a standard procedure for the treatment of cervical disc disorders, full-endoscopic cervical decompression has been attracting increasingly more attention. Both anterior cervical discectomy and posterior endoscopic cervical discectomy produce satisfactory outcomes in treating soft cervical disc herniations. However, treatment of cervical degenerative diseases associated with hard disc herniations or disc-osteophyte complexes remains challenging. A number of studies have demonstrated that the satisfactory rate in patients with hard disc or a mixture of soft and hard disc herniations is much lower than in patients with pure soft disc herniations. And because of the fear of possible spinal cord trauma and inefficient surgical decompression, endoscopic techniques are less often used for hard disc herniations than for soft disc herniations.

In the past few years, we have applied the endoscopic anterior transdiscal approaches for treating both soft disc herniations and hard disc osteophyte compression disorders. However, it’s technically very challenging to remove solid pathological tissues with limited endoscopic visualization.
Discography, an image-guided procedure in which a contrast agent is injected into the nucleus pulposus of the intervertebral disc, has long been proven effective in identifying a painful spine disc, depicting corresponding spinal derangements, selecting surgical candidates, and improving surgical outcomes. The procedure has also been used to produce an epidurogram and to delineate a safe working zone for surgical operation by using contrast dye. The role of epidurography in spinal surgery has been reenhanced in the MILD® (Vertos Medical, Columbia, CA) procedure, which allows percutaneous, image-guided treatment of lumbar spine stenosis by concurrently removing tissue and bone to decompress the spine. Preliminary clinical studies showed that patients (N=30) who have undergone the mild treatment report at least 75% reduction in pain (VAS) and 70% improvement in mobility (ODI), and that no device-related complications or adverse effects have been reported to date. No reports, however, are currently available to show whether or not a similar technique is applicable to cervical decompression.

In our studies on cervical discography, we noticed that the majority of the patients with soft or hard cervical disc herniations have an epidural leak of contrast, which means we can use dye to create a working zone in the epidural space for surgical operations on not only soft disc herniations but also hard disc herniations. On the basis of our extensive research in the lumbar spine and our experience with cervical discography, we have developed our epidurogram-guided endoscopic cervical discectomy technique for the treatment of cervical disc herniations, soft and hard.

In our surgical operations, discogram and epidurogram were used throughout the surgery: Preoperative discography was used to help identify symptomatic disc for surgery, whereas intraoperative discography was used to help create a discogram and an epidurogram for image guidance. Discogram and epidurogram produced by discography, which is an essential part of our surgical procedure, help the surgeon safely manipulate the surgical instruments, accurately target the pathological tissue,
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and greatly minimize the potential for surgical trauma. The technique has been proven safe and effective for the treatment of both soft and hard disc herniations.

Like any surgical procedure, our epidurogram-guided anterior cervical discectomy technique is associated with certain risks. The potential risks of our technique include potential injury to the epidural veins, dura, and nerve roots caused by the needle, dilator, access cannula, grasper, and other instruments. However, with meticulous preparation and adequate experience of the surgeon, the risks can be minimized.

AUTHORS’ DISCLOSURES

The authors have no competing financial interests to declare.

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