Provocative Discography Following Focal Selective Coagulation in a Patient with Chronic Lumbar Discogenic Pain

Dahn Kim, M.D. 1, Nackhwan Kim, M.D. 2 and Sang-Heon Lee, M.D., Ph.D. 1

1Department of Physical Medicine and Rehabilitation, Korea University Anam Hospital, Seoul,
2Department of Physical Medicine and Rehabilitation, Korea University Ansan Hospital, Ansan, Korea

This is a case report of the provocative discographic findings before and after focal selective coagulation of the major annular fissure using intradiscal navigable catheter. A 46-year-old woman had a 30-month history of axial low back pain and magnetic resonance imaging findings suspicious for painful L4/5 disc. The provocative discography confirmed painful disc before coagulation. The final electrode tip position in the coagulation procedure was at the largest fissure within the outer annular margin identified through the discography. Six months after the successful coagulation therapy, inadvertently performed discography resulted in decreased pressure rise over time. Neither evoked pain nor change in the integrity of outer annulus as compared with the previous results was reported. Such an interventional method has not been reported previously, and the analytic results suggest that it may be possible to relocate the pressure of the entire nucleus pulposus only by focal selective coagulation of the fissure. (Clinical Pain 2019;18:142-146)

Key Words: Discogenic low back pain, Percutaneous disc decompression, Coagulation therapy

INTRODUCTION

The prevalence of discogenic low back pain, with or without internal disc derangement, is estimated to range between 26% and 39% in individuals with chronic low back pain (CLBP).1 The most common pathologic feature is annular disruption, as evidenced by reproduction of concordant pain during disc stimulation with injection of contrast media and identification of radial and circumferential annular tears using both fluoroscopy and post discography computed tomography (CT).2,3

During provocative discography, increased intradiscal pressure susceptibility, concordant nature of pain, and the degree of the annular tear are related to the diagnosis of a painful disc, and they may be simultaneous pathologic causes.2 Hence, after ablative therapy for a painful disc, the change in diagnostic features is bound to be interesting. Although studies on intradiscal pressure drop after percutaneous coagulation therapy had already reported, the clinical effect is not significant in patients with CLBP compared to the symptomatic disc herniation in other studies.2,4 Also, although mechanical pressure is one of the major mechanisms of CLBP, it is doubtful whether the decompression is directly related to symptom relief.

A navigable percutaneous disc decompression device generating high energy plasma, meanwhile, was applied to improve CLBP.5 The catheter wand can be navigated to the desired site, the posterior outer annular tear, and high energy plasma can ablate nucleus pulposus and adjacent neural fibers.6 The results of the prior pilot study conclude that the method have a significant clinical effect, but the individual differences in the symptomatic changes were considerably great in twenty subjects. In addition, in the pilot study, the interventional method included the coagulation
of the nucleus pulposus inside the fissure.

It is difficult to deny the existing consensus that decompression in target discs of patients with CLBP is an effective parameter for successful treatment. However, the results of provocative discography measured before and after the focal selective coagulation in this case suggest that the role of decompression may not be so large.

**CASE REPORT**

A 46-year-old woman presented with a 30-month history of axial low back pain and magnetic resonance imaging (MRI) of the lumbar spine revealed a diffusely bulging disc with a posteroentral high intensity zone at L4/5 (Fig. 1-A). The patient’s low back pain did not improve after 6 months of conservative therapy including lumbar transforaminal epidural block at L4/5. She had no other past medical history and no history of taking pain killers regularly.

Physical examination demonstrated axial low back pain with a maximum numeric rating scale (NRS) score of 8 with aching characteristics, which was aggravated gradually by prolonged sitting and standing for more than half an hour. She did not have any motor weakness or sensory deficit. Deep tendon reflex of the lower extremity was intact, and the straight leg raise test was negative. Nerve conduction studies and a needle electromyographic test did not show lumbar radiculopathy or peripheral neuropathy.

Upon admission, we performed provocative discography at L3/4, L4/5, and L5/S1 at an injection speed of 0.1 mL per second using the Automated Pressure-Controlled Discography (APCD) system (Cybermedic Corp, Iksan, Korea). All the other details of the procedure were followed as practice guidelines for performing discography, which had been published by the International Spine Intervention Society (ISIS). After the procedure, lumbo-sacral computed tomographic scan confirmation was obtained for precise grading of the torn annulus. The findings indicated ‘no pain’ over the L3/4 and L5/S1 discs, and ‘concordant pan’ with an NRS score of 8 at 26.4 psi above opening pressure and 1.56 mL of injected contrast over L4/5 disc (Table 1). The torn annulus, which was classified as the fissured type based on the Adams classification, was identified with the C-arm image (Fig. 1-B).

The patient’s intradiscal pressure susceptibility and concordant nature of pain during provocative discography provide a significant diagnostic clue. ISIS recommends ‘concordant pain’, ‘with a score of more than 7 on the visual

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**Fig. 1.** The patient’s initial image studies on L4/5 disc. (A) Diffuse bulging disc with posterior high intensity zone on initial lumbar magnetic resonance image. (B) Fissured type of Adams classification on C-arm image before ablative therapy.
analogue scale’ and ‘pain-evoking pressure of less than 15 psi above opening pressure or of less than 50 psi’ for the diagnosis of discogenic pain. The patient’s concordant pain was evoked at total 29.5 psi with an injected volume of 1.56 mL. Hence, it was appropriate to make a diagnosis of L4/5 discogenic pain.

After diagnosing the painful disc, we performed percutaneous coagulation therapy of the L4/5 disc using the navigable plasma-generating catheter. The subject was in a prone position and the introducer needle was directed gently toward the annular surface of the foramen on fluoroscopic guidance. After confirming the introducer needle position with the lateral and anteroposterior (AP) views, the catheter wand was advanced through the introducer needle to the center of the fissured portion using fluoroscopic monitoring of the AP and lateral views. Before the

Table 1. Provocation Discographic Findings on L4/5 Disc before and after Ablative Therapy

<table>
<thead>
<tr>
<th></th>
<th>Before coagulation</th>
<th>After coagulation</th>
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<tbody>
<tr>
<td>Pain characteristics</td>
<td></td>
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<tr>
<td>Pain severity (NRS*)</td>
<td>Concordant as aching</td>
<td>Dissimilar as dullness</td>
</tr>
<tr>
<td>Pressure (psi)</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Opening</td>
<td>3.10</td>
<td>4.00</td>
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<tr>
<td>Pain provoking</td>
<td>26.4</td>
<td>37.8</td>
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<tr>
<td>Total</td>
<td>29.5</td>
<td>41.8</td>
</tr>
<tr>
<td>Volume of injection (mL)</td>
<td>1.56</td>
<td>4.49</td>
</tr>
<tr>
<td>Calculated pressure rise (mL/s)</td>
<td>1.69</td>
<td>0.84</td>
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<tr>
<td>Disc configuration as CT discogram†</td>
<td>Grade 4</td>
<td>Grade 4</td>
</tr>
</tbody>
</table>

*NRS: numeric rating scale. †An injection velocity was 0.1 mL per second using automated pressure-controlled discography (APCD) system. ‡The criteria were used as a Modified Dallas Grade.
coagulation, negative motor nerve stimulation confirmed that the needle was not close to the traversing or exiting nerve root. However, this electrical stimulation evoked similar pain in the same area as usual. Only the focal region was coagulated (Fig. 2-A).

After the coagulation, her symptom improved and she was discharged. However, 1 month later, the patient fell down and her axial low back pain was aggravated, but she had no neurologic deficit and no definite disc herniation on MRI. There was no significant response to conservative therapy during 5 months, and we performed provocative discography to differentiate between recurrent annular tear and new annular tear. The symptomatic disc level was on L3/4. During this process, we obtained provocative discographic findings of the L4/5 disc, which showed ‘dissimilar pain’ with an NRS score of 3 with dullness at 37.8 psi above opening pressure and 4.49 mL of injected contrast with grade 4 on the Modified Dallas discogram scale via the post-procedure CT (Table 1, Fig. 2-B).

The opening pressure was higher in the discography after the coagulation, but no significant pain was evoked even at a dose of about 3 times. The results of both CT discograms presented the disc configuration with grade 4 on the Modified Dallas Grade and the intact integrity of the outer annulus. The pressure rise was almost proportional to the volume of injected contrast under the speed of 0.1 mL per second. The intradiscal pressure showed a rise of 1.69 psi per second before the coagulation, and 0.84 psi per second after the coagulation.

**DISCUSSION**

The diagnostic gold standard for lumbar discogenic pain is ‘provocative discography’ and MRI plays a supplementary role. The information regarding intradiscal pressure susceptibility, the nature of pain, and the severity of annular tear are comprehensively interpreted to diagnose a painful disc. However, it is unclear how the above factors relieve or aggravate the discogenic pain and contribute the chronicity.

Anatomical and histological investigation has demonstrated the nerve supply to the human lumbar intervertebral discs. The sinuvertebral nerves innervate the posterior aspects of the discs and the posterior longitudinal ligament, and the grey rami communicantes and branches from adjacent ventral primary rami innervate the posterolateral aspects of the discs. These nerve endings are distributed on the outer one-third of the annulus fibrosus. Fissured type based on Adams classification presents as an annular fissure that invades the outer one-third of the annulus fibrosus, which has diagnostic value in the management of discogenic pain.

The above mentioned electrode can control the wand with a plasma-generating tip. The catheter is inserted into the anterolateral aspect of the target disc, and it finally runs curved in the posterocentral direction. This device was designed for navigating the intradiscal space. High energy plasma is thought to disrupt the biochemical bonds in organic structures, and the human cadaveric study showed denaturation of some disc tissue.

While the final position of the needle tip in the discography is the center of disc, the approach of this device does not involve the center of disc. Therefore, deformation of the nucleus at the center of disc is difficult to expect. In this case, the change in pressure measured at the center of disc should be assumed to be a structural relocation leading to a change in the intradiscal pressure distribution. It is difficult to explain that the pressure rise per second after coagulation is halved compared to the previous one, only by focal tissue removal of the posterior disc. Furthermore, the target disc had a closed hydraulic space without ruptured outer annulus. This suggests that the deformation of the central nucleus pulposus, which was previously accepted in the case of a straight wand-type Nucleoplasty® that crosses the center of disc, may be indirectly induced by the focal coagulation of the posterior disc.

The heat-exposure near the torn annulus may directly effect to disrupt the nociceptors. Post-procedure CT confirmed tissue removal adjacent to the annular tear. After coagulation, about three times more volume than before was injected into the L4/5 disc, and it was distributed over the annular fissure on post-CT discogram, but the pain severity was reduced and the nature of pain was changed from ‘aching’ to ‘dull’.

As a result, it may be possible to relocate the pressure of the entire nucleus pulposus only by focal removal of the nucleus within fissure. Two important conditions in which
this report is significant are rare and difficult to get in clinic for the following reasons. First, the containment of L4/5 was maintained during the 5-month follow-up period, which is an important condition for interpreting the result of the pressure change. Second, at a controlled infusion rate using APCD system, the injected volume and the intradiscal pressure were directly proportional to each other, which means that the pressure changes over time at the needle tip located at the disc center may be a variable to account for the response of the nucleus tissues.

However, this case does not explain whether the cause of symptom relief is pressure relocation or heat-induced nociceptor disruption. Previous preliminary study reported significant results of twenty subjects, but the individual variability of symptom changes was too large. The visual analogue scale change after the coagulation was 9 or more in one case, but it was worse in another case.\textsuperscript{4} The author performed coagulation targeting the most prominent and radial fissure among multiple fissures identified on MRI and CT discograms. Therefore, in order to determine the quantitative effect of pressure relocation, the target fissure must first be identified as a symptom-causing lesion. Existing provocative discography does not provide this detail. More research is needed to determine if the electrical stimulation of the catheter located within the fissure would help to differentiate the symptomatic fissure. In this case, the electrical stimulation evoked the concordant pain.

The provocative discographic changes before and after focal selective coagulation of annular fissure in a patient with CLBP have not been reported previously. Based on the principles of provocative discography and this case analysis, intradiscal pressure susceptibility and pain sensitivity of the torn annulus are important as both diagnostic and therapeutic targets. Hence, further experimental studies about plasma action of focal selective coagulation of annular fissure on disc tissues and histologic confirmation of a painful disc should be performed for highlighting the pathophysiology and developing a therapeutic strategy.

REFERENCES