Correlation Between the Degree of Sciatica and the Size of Lumbar Disc Prolapse

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Abstract. Disc herniation is a common pathological entity. The relationship between disc prolapse magnitude and severity of symptoms is not known. Controversy exists as to the exact cause of lower back pain and the anatomical structures being irritated. Seventy-seven patients with definite and resistant lumbar disc herniation underwent discectomy under local anesthesia. Type of disc was correlated with severity of symptoms. Assessment of painful structures within the spinal canal was performed. Fifty-one patients had bulging disc and disc protrusion. Most patients (86.3%) of those with bulging discs and 82.8% of those with protruded disc) experienced moderate or severe pain. All patients with inflamed nerve roots had severe radicular pain on stimulation. All patients required infiltration of posterior elements to allow pain-free retraction of paraspinal muscles to perform laminectomy. Greater magnitude of disc disruption does not correlate with more severe symptoms. Inflamed structures within the spinal canal are exceptionally sensitive to stimulation. Posterior spinal elements are a cause of significant back pain.

Introduction

Herniation of the lumbar intervertebral disc is recognized as a cause of back pain and sciatica. Severity of pain is thought to be related to the extent of disc pathology and extrusion from the intervertebral position. The extent and type of lumbar disc protrusion has not been correlated with the severity of low back pain and sciatica. The tissues involved in the generation of low back and leg pain have not been clearly identified, although significant clarification has occurred due to descriptions of sequential stimulation of spinal tissues under local anesthesia. However, there was no comment on the significance of magnitude and type of disc protrusion in relation to the severity of symptoms of lower back pain and sciatica. In this study we tried to relate the extent and type of disc protrusion with the clinical severity of symptoms of lower back pain and sciatica.

Materials and Methods

This series consisted of 77 consecutive patients undergoing lumbar discectomy. Fifty-one patients were males (66.2%) and 26 were females (33.8%). The average age of the population was 46 years, with a range from 33 to 64 years. The duration of symptoms prior to surgery ranged from 2 months to 3.4 years, with an average time to presentation of 1 year and 5 months. Patient assessment included a complete history and physical examination with particular emphasis on neurological findings. In 23 patients, myelogram and computed tomography (CT) scan were occasionally performed. The rest of the patients in this series, 46 out of 54 patients, had CT scan performed routinely, while 8 had magnetic resonance imaging (MRI) examination. Patients diagnosed by discography were excluded to avoid interference of the results with the gained bulge due to dye injection into the disc with consequent increase of the intradisc pressure that may add to its bulge.

Indications for surgery included severe pain not responsive to 6 weeks of conservative treatment, including bed rest and analgesia; confirmation of disc protrusion by CT or myelography and even by MRI with appropriate clinical symptoms and signs; and cauda equina syndrome. Levels of surgery were L2-3 in 4 patients, L4-5 in 39 patients, and L5-S1 in 34 patients. Patients diagnosed with more than one disc herniation were excluded in this study to avoid combination of more than one type of prolapse (e.g., bulge, protrusion, extrusion, or sequestration).

Preoperative pain severity was assessed using a back pain scale that combined the symptoms of back pain and sciatica (Table 1).

Operative Technique

All surgery was performed under local anesthesia [1]. Patients were placed prone on the operating table and bolsters were applied beneath the chest and iliac crest. Routine prepping and draping for a midline approach to the lumbar spine was performed. Infiltration of the skin and subcutaneous tissue was performed using a combi-
nation of 10 ml 0.75% pupivacaine and 70 ml 0.25% novocaine. These local anesthetics have long- and short-
acting effects, respectively, and provide excellent analgesia. Further infiltration of local anesthetic into
muscle and the posterior elements of the spine was performed. This local infiltration of the posterior elements is
necessary for adequate lateral retraction of the paraspinal musculature. This posterior element infiltration is re-
quired to avoid severe back and leg pain [2].

Following entrance into the spinal canal hemilaminotomy to provide safe visualization of the pathological
disc, pathological findings were documented. Blunt surgical instruments were then used to stimulate tissues
within the spinal canal. Patient response was observed with this sequential stimulation. All patients remained
fully awake during the entire procedure.

Results

The intraoperative findings of the pathological disc are described in Table 2. Bulging and protruding discs ac-
counted for 51 of 77 patients (66.2%). Relation of type of disc protrusion with clinical symptoms is described in
Table 3.

Table 2. Pathological findings.

<table>
<thead>
<tr>
<th>Type number</th>
<th>Clinical type</th>
<th>Description</th>
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<tbody>
<tr>
<td>Type I</td>
<td>Bulging disc</td>
<td>* Diffuse midline bulging disc protruding more to the right or left</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* No clear edge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Intact annulus fibrosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* A few gelatinous nuclear fragments can be removed</td>
</tr>
<tr>
<td>Type II</td>
<td>Protrusion</td>
<td>* Displaced nuclear material has protruded past the annulus fibrosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Nuclear material can be seen under a thin posterior longitudinal ligament (PLL)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Spontaneous extrusion of disc following incision of the PLL</td>
</tr>
<tr>
<td>Type III</td>
<td>Extrusion</td>
<td>* Nuclear material has extruded</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Appearance of &quot;Cauliflower&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Root is still situated within the disc space</td>
</tr>
<tr>
<td>Type IV</td>
<td>Sequestration</td>
<td>* A large fragment had extruded past the annulus and PLL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* The fragment lies free within the spinal canal:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a. The fragment lies trapped between the nerve root or dural sac and annulus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. The fragment migrates proximal or distal to the disc space posterior to the vertebral body</td>
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Pain Level in Relation to Disc Type

In disc bulge, the highest percentage lies in the groups of severe pain (Grade 3), while in disc protrusion, it occurs
in the group of moderate pain (Grade 2). On the other hand, the highest percentages of disc extrusion and se-
questation (52.9% and 44.5%, respectively) lies in the group of mild pain (Grade 1).

Neurological findings were present in 10% of disc bulge, 90% of disc protrusion, 97% of disc extrusion, and
62% of disc sequestration. All patients (44.5%) with disc sequestration with material caught anterior to the root
(Type 4) had moderate and moderately severe pain and positive neurological findings. However, only 1 of 5 pa-
tients who had sequestration and migration of the disc fragments away from the anterior aspect of the nerve root
had moderate pain, and none had severe pain. In the group of mild pain (Grade 1), the number of patients with
all types of disc prolapse was 21 (27.2%), while that of the group of moderate pain (Grade 2) was 32 patients
(41.6%), and that of severe pain (Grade 3) was 24 patients (31.2%) (Table 3).

Assessment of Inflammation

Inflammation of intracanal contents was defined by evidence of edema and erythema and congestion of the
nerve roots. All patients with inflammation, as defined visually, had significant pain on stimulation of the in-
flamed nerve roots. If inflammation was present in the surrounding canal and intracanal contents, stimulation
produced severe pain. Patients with normal dura, epidural fat, ligamentum flavum, uncompressed nerve roots,
and annulus fibrosis were completely insensitive to pain or blunt stimulation. Twenty-four patients (31.2%) had
significant inflammation and were exceptionally sensitive to stimulation of nerve roots. In some patients, inflam-
mation was localized between the prolapsed disc and nerve root, whereas in other cases all the surrounding tissues were significantly inflamed.

Those patients with diffuse inflammation were most sensitive to stimulation, and local infiltration of anesthetic was necessary to permit continuation of the operation. All patients with significant or severe inflammation were in Grade 3 with severe preoperative pain.

Discussion

Back pain has plagued man for many thousands of years. Descriptions of lumbago and sciatica were found in the ancient Egyptian documents (Ebers Papyrus), in the Bible, and in the writings of Hippocrates [3]. Despite the long history of awareness of this problem, a reasonable and scientific explanation of the source of low back and leg pain did not emerge until 1934 with the publication of the classic paper by Mixter and Barr [4]. These investigators for the first time delineated prolapse of the intervertebral disc as the etiologic agent in the production of these symptoms, and it was claimed that derangements of the intervertebral disc represent the great majority of cases of back pain and sciatica. After that, attention shifted dramatically to the disc and herniated nucleus pulposus as the primary culprit in low back and leg pain. So, severity of pain was thought to be related to the extent of disc pathology and extrusion from the intervertebral region. Correspondingly more extensive protrusion and extrusion would cause more severe pain and disability. We noticed that this is not the case, as lower back pain and sciatica recurred in some cases after removal of the disc, and it faded away with the use of antiinflammatory drugs. Also, the degree of lower back pain and sciatica was severe in acute disc prolapse, and it decreases in intensity with conservative treatment, although there is no change in the size of the prolapsed disc in acute stage and the stage during remission of symptoms as proved by CT scans before and after treatment.

There were documented cases of severe back pain and sciatica in the presence of a small prolapse or even a bulge of the lumbar disc, and there were also cases with a huge prolapse but with mild or tolerable pain. From these observations, we hoped to determine the relation of severity of symptoms of the prolapsed disc to its degree of protrusion.

In our study, the patients with the highest correlation between the findings and moderate to severe pain were those of Type I and II categories of disc pathology: bulge (86.3%) and protrusion (82.8%), while it was a little over half that amount in Types III and IV: extrusion (47.1%) and sequestration (55.5%).

Although disc bulge is the first degree of prolapse, 50% of its cases presented with severe pain (Grade 3). Also, in the disc protrusion group, the highest rate of presentation took place in Grade 2 (moderate pain). Surprisingly, the highest rates of presentation of disc extrusion and sequestration (the largest prolapse) were in the group of mild pain (Grades 0 and 1) (52.9% and 44.5%, respectively). Disc sequestration had poor correlation to both clinical severity of pain and neurological findings, with 33.3% agreement. This poor correlation of clinical findings to sequestration of disc has been reported in other studies [5]. It appears that the extent of disc pathology does not have as much bearing on severity of symptoms as the position of disc material in relation to the nerve root. This is confirmed in the patients with sequestrated fragments beneath the nerve root, all of whom had moderate or severe pain. A clear observation in our series was that all the patients with significant or severe pain (Grade 3) suffered severe inflammation of the nerve roots, regardless of the type of disc pathology. Although pain originating in the spine is nebulous and difficult to define accurately, identification of innervation of the posterior elements and other structures within the spinal canal has been cited as postulated reasons for production of pain in the spine [6]. Recently, doubt has been cast on the contribution of posterior elements to the lower back pain syndrome.

Kuslich et al. [7] described the posterior elements, "muscles, fascia and bone...are really quite insensitive." It is their belief that the majority of spinal pain originates from the disc, annulus, and inflamed nerve root. Saal et al. [8] demonstrated that exceptionally high levels of phospholipase A2 are present within the hemi-

<table>
<thead>
<tr>
<th>Pathological finding</th>
<th>Mild pain Grades 0 and 1</th>
<th>Moderate Grade 2</th>
<th>Severe Grades 3 and 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>%</td>
<td>No</td>
<td>%</td>
<td>No</td>
</tr>
<tr>
<td>Bulging disc</td>
<td>3</td>
<td>3.7</td>
<td>8</td>
<td>36.3</td>
</tr>
<tr>
<td>Protrusion</td>
<td>5</td>
<td>17.2</td>
<td>17</td>
<td>58.6</td>
</tr>
<tr>
<td>Extrusion</td>
<td>9</td>
<td>52.9</td>
<td>5</td>
<td>29.4</td>
</tr>
<tr>
<td>Sequestrated</td>
<td>4</td>
<td>44.5</td>
<td>2</td>
<td>22.2</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>27.3</td>
<td>32</td>
<td>41.6</td>
</tr>
</tbody>
</table>
ated intervertebral disc. This enzyme is the role limiting step in liberation of arachidonic acid from inflamed membranes, and its presence in high concentration in the herniated disc provides biochemical support for findings of severe pain in inflamed tissue within the spinal canal. We would agree that inflamed tissue within the spinal canal is a prime source of severe back and leg pain. However, it has also been our observation that all patients undergoing lower back surgery under local anesthesia require generous infiltration of “insensitive” posterior structures to proceed with adequate visualization and decompression of the spinal canal. Facets and their surrounding structures has been implicated in other functional studies as being significant in back pain production [9], and we believe that they contribute significantly to lower back pain syndromes.

Conclusion

Severity of pain in patients with herniated lumbar discs is related to inflammation of the intraspinal tissues posterior elements including the facet joints. Capsules are sensitive to stimulation and reproduce significant back pain symptoms with this stimulation.

The magnitude of pain with lumbar disc herniation is related to position of herniation rather than the extent of herniation. More extensive disruption of the integrity of the disc does not mean more severe symptoms.

References