Cauda Equina Syndrome Caused by Intervertebral Lumbar Disk Protrusion: Mid-Term Results of 22 Patients and Literature Review

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Abstract

This retrospective study analyzes the mid-term results of 22 patients who underwent discectomy following a diagnosis of cauda equina syndrome due to prolapsed intervertebral lumbar disks (mean follow-up: 3 years and 9 months). Postoperatively, 17 of 22 patients had complete urinary function recovery within the follow-up period, 4 patients had a persistent stress incontinence, and 1 patient, incontinent 4 years postoperatively, required catheterization. Thirteen of 17 patients had recovery of motor deficits, 14 of 21 of sensory deficits, and 13 of 15 patients regained perianal sensation. There was no statistically significant difference concerning the time between onset of symptoms and surgical decompression and subsequent outcome. Complete evaluation must include imaging and urodynamic investigations. After an accurate diagnosis and adequate operative treatment, postoperative results of cauda equina syndrome appear satisfactory.

Cauda equina syndrome is considered one of the few surgical emergencies in the management of spinal disorders. Its clinical presentation, which does not always appear completely, consists of uni- or bilateral sciatica, perianal or so-called saddle anesthesia, as well as urinary and stool incontinence and sensory and motor deficit in the lower extremities.

The incidence of cauda equina syndrome due to a nucleus pulposus protrusion is rare and is reported in approximately 1%–10% of all lumbar nucleus pulposus prolapses.\(^1,2\) Only a few reports have been published with sufficient number of patients for analysis\(^1,16\) (Table 1).

This study provides an overview and prognosis of this rare but important neuro-orthopedic syndrome. The results of the present series after operative treatment of cauda equina syndrome were compared to those in the literature. Criteria influencing postoperative outcome were evaluated, especially the timing of surgical decompression, which often is debatable.

MATERIALS AND METHODS

Since 1975, 28 patients have undergone surgery for clinical cauda equina syndrome following lumbar nucleus pulposus prolapse at our institution.

Cauda equina syndrome was defined by cauda equina compression secondary to a prolapsed intervertebral disk with consecutive urinary dysfunction and decreased rectal tone combined with varying degrees of motor or sensory loss in the perineal area and the lower limb. Urinary dysfunction consisted of urinary retention with overflow incontinence requiring catheterization.

Nucleus pulposus prolapse was verified using computed tomography, magnetic resonance imaging (MRI), and myelography. Patient charts, surgery, emergency room reports, and follow-up reports were analyzed. For patients with incomplete information, an interview was performed via telephone. Patients with cauda equina syndrome due to trauma, tumor, or congenital disorders were excluded from this study.

Data of 22 patients (13 men and 9 women) were evaluated. The remaining 6 patients were not included because of short follow-up (<1 year, 2 patients) or incomplete information (4 patients). In total, 9 patients were also interviewed by phone because of incomplete chart information.

Average patient age at surgery was 42 years (range: 22–67 years). Mean time between surgery and final documented follow-up or interview was 3 years and 9 months (range: 13 months to 8 years).

At admission, 10 of 22 patients reported lumbosacral pain of >6
months' duration, and 4 reported pain of >1 year duration. Three patients had previous surgery in the concerned lumbar area: 1 spondylodesis (16 years prior), 1 decompression (6 years prior), and 2 decompressions in 1 patient (1 and 7 months prior, respectively).

Eleven patients had a chronic onset of symptoms with a progressive lumbar pain (sometimes for weeks) that finally culminated in cauda equina syndrome (Table 2). The remaining 11 patients had an acute onset of symptoms of <72 hours prior to presentation. Mean time between onset of urinary dysfunction and surgery was 44 hours (range: 4 hours to 7 days) (Table 3).

The mean interval between admission and surgery was 38 hours (range: 2 hours to 8 days). Twenty-one patients were treated surgically by bilateral decompression and additional hemilaminectomy (12 patients) or laminectomy (9 patients). One patient underwent a laminectomy with additional spondylodesis. In one patient, a dural tear was treated by dura repair.

During follow-up, four reoperations were performed: one decompression 3 days postoperatively, one decompression 2 months postoperatively, one spondylodesis 9 months postoperatively, and one decompression 14 months postoperatively.

Results in this study concern the outcome after revision surgery. Mean time of postoperative inpatient treatment was 31 days (range: 11-106 days).

The following criteria were analyzed for their prognostic value regarding postoperative outcome, which was defined as postoperative urinary function recovery: gender; age; previous surgery in the concerned lumbar area; lumbar pain >6 months prior to admission, acute or chronic onset of symptoms; preoperative stool incontinence, motor deficit, perianal and saddle anesthesia, deep tendon reflex deficit, and uni- or bilateral lumbar sciatic pain; time between onset of urinary symptoms and surgery; and length of postoperative recovery of sensory, motor deficit, and perianal and saddle anesthesia.

Postoperative urinary function recovery was defined according to Gleave and Macfarlane6: excellent—full subjective recovery of bladder function within the immediate postoperative inpatient period; good—full subjective recovery of bladder function during follow-up, fair—incomplete recovery of bladder function during follow-up (persisting stress incontinence), and poor—permanent urinary incontinence requiring catheterization.

Statistical analysis was performed using the Mann-Whitney U-test (time between urinary incontinence and surgery) and chi-square test (other variables) with a significance of P<.05.

RESULTS

Ten of 22 patients had excellent results and regained full subjective urinary capacity within the immediate postoperative period. Seven patients had good results and regained urinary continence within the follow-up period (Table 4). In 4 patients with fair results, only 1 patient had incomplete recovery of bladder function during follow-up with a persisting stress incontinence. One patient with a poor result required catheterization for 4 years after operative decompression.

In the present series, no patient underwent urodynamic testing preoperatively, and only 7 of 22 patients had cystometric studies postoperatively (Table 4).

In 13 of 17 patients with preoperative motor deficits, recovery was noted during postoperative follow-up: 6 in the immediate postoperative period and 6 within 6 months postoperatively. One patient regained motor function at 3-year follow-up.

Fourteen of 21 patients with preoperative sensory deficits recovered: 6 patients in the immediate postoperative period and 8 within 6 months postoperatively.

Thirteen of 15 patients with complete perianal and saddle anesthesia regained perianal sensation postoperatively: 6 patients in the immediate postoperative period, 5 within 6 months postoperatively, and 2 patients within 1 year postoperatively.
A statistically better postoperative outcome was correlated with the following variables: female sex ($P=.03$), absence of preoperative complete perianal or saddle anesthesia ($P=.03$), and absence of preoperative radicular motor deficit ($P=.05$).

A lesser prognosis regarding postoperative outcome was correlated with a postoperative recovery time $>6$ months or no recovery at all during follow-up regarding perianal or saddle anesthesia ($P=.007$) or motor deficit ($P=.003$).

The following variables did not show a statistically significant correlation with postoperative therapy outcome ($P>.05$): age, previous lumbar spine surgery, preoperative sciatica $>6$ six months’ duration, acute or chronic onset of symptoms, preoperative fecal incontinence or reflex deficit, preoperative uni- or bilateral sciatic pain, time of postoperative recovery of sensibility function, and time between onset of urinary symptoms and surgery (Table 5).

### DISCUSSION

Few studies have reported the outcome and prognosis of surgery following cauda equina syndrome due to prolapsed intervertebral lumbar disks. The rare incidence of this syndrome and, as a consequence, the small number of study patients make it difficult to allow clinically relevant therapeutic and prognostic conclusions.

The data of 22 patients from the present study failed to have a prospective character and depended on adequate chart information and subjective patient statements. However, the number of patients in this study compared to those in other studies may allow us to reach clinically relevant conclusions, especially when considering that subjective well-being of the patient indicates a valid outcome assessment.

Regarding postoperative outcome of cauda equina syndrome and postoperative bladder function recovery, results are encouraging. Gleave and Macfarlane reported postoperative urinary function recovery in 26 of 33 patients, Kostiku et al in 23 of 30 patients, and O'Laioire et al in 18 of 29 patients. Also in the present study, 17 of 22 patients regained full subjective urinary capacity; 10 of these 17 patients in the immediate postoperative period.

There always is the possibility of postoperative urinary function recovery in further follow-up. Seven of 22 patients in the present study did not regain urinary continence in the immediate postoperative (inpatient) period. In 2 patients, recovery occurred $>1$ year postoperatively. These results support the findings of Hellstrom et al and Jennett who suggest nervous tissue repair may take several years.

Problems arise regarding objective assessment of postoperative urinary function recovery. Many authors emphasize the discrepancy of subjective patient satisfaction and objective urodynamic findings. In the study by Hellstrom et al, 10 of 17 patients reported subjective urinary improvement, whereas only 4 of 17 patients had negative cystometric studies. In the study by Aho et al, 11 of 16 patients did not show satisfactory objective cystometric results, whereas the same number of patients subjectively did not indicate problems with their urinary function. Some authors therefore insist on pre- and postoperative urodynamic measurements.

In the present study, there was a lack of cystograms in all preoperative and most postoperative (15/22) patients. Nevertheless, even in the absence of objective results, subjective well-being of the patients plays an important role in the assessment of results and represents the ultimate evaluation of therapeutic outcome.

The use of preoperative urodynamic investigations has created controversy regarding timing of surgical decompression following cauda equina syndrome. Hellstrom et al reported positive results in 9 of 13 patients who underwent surgery within 48 hours of symptom onset and came to the same conclusion as Shepard that cauda equina syndrome is an emergency operation that does not allow any delay of surgery.

Shapiro examined 14 patients. All patients who had surgery within 24 hours of symptom onset had a favorable outcome. Only 33% of patients who underwent surgery after 24 hours reported a positive outcome. Nielsen et al, who limited the time of surgery to 48 hours after onset of acute symptoms, had similar results. Aho et al also confirmed the above statements, when they found an uroodynamically atonic bladder in 5 of 8 patients who were operated on after 48 hours. In a study of 19 patients, Kennedy et al found a statistically significant correlation between delayed decompression ($>24$ hours after symptom onset) and poor outcome.

In the present study, contradicting evidence was found concerning timing of surgery compared with two other studies with the most patients examined. Kostiku et al followed 30 patients of whom none had surgery within 6 hours of symptom onset. They did not find a difference concerning
TABLE 5
Urinary Function Outcome Correlated with Time Between Symptom Onset and Surgery

<table>
<thead>
<tr>
<th>Time</th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
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</thead>
<tbody>
<tr>
<td>&lt;12 h</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>12-24 h</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>1-3 days</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>4-7 days</td>
<td>2</td>
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Postoperative urinary recovery is correlated with timing of surgery, which, in some cases, occurred 5 days after acute onset of symptoms.

The recommendations to operate within 6 hours were based on studies of ischemic damage of peripheral neural tissue. However, in their series of 33 patients, Gleave and Macfarlane did not find a statistical difference concerning time between symptom onset and surgery in patients, some of whom had preoperative urinary dysfunction for up to 14 days.

In an experimental study in dogs, Delamarter et al. reported that outcome difference concerning postoperative bladder, sensory, and motor recovery was only a matter of time, and the final results did not show any difference. Six weeks after experimental compression of the spinal cord, all animals had adequate recovery of symptoms, regardless of when decompression occurred, immediately or 1 week after onset of cauda equina syndrome. These findings are consistent with the results of the present study. The authors could not recognize a statistically significant difference in outcome, although they found a trend for better results in those patients who underwent surgery within 3 days following onset of bladder dysfunction.

Although the literature has created controversy concerning this point, according to the results of the present study, there are several conclusions. First, 6 hours between symptom onset and surgery oftentimes is not logistically possible. Only two patients in the present study had surgery within 6 hours. Gleave and Macfarlane reported only 2% of 195 patients of different studies were operated on within this time.

Second, accurate clinical diagnosis of cauda equina syndrome can be difficult without additional diagnostic imaging (MRI) and urodynamic measurements. According to the results of the present study, adequate and rapid diagnostic procedures must be performed preoperatively, including cystometric studies. The reported results suggest there is no significant outcome difference based on whether surgery is performed within the first 24 or 48 hours after acute symptom onset. In this time, an exact diagnosis can be achieved by performing the above mentioned diagnostic procedures and by providing an experienced surgery team to guarantee an adequate postoperative outcome.

Cauda equina syndrome is an emergency and surgery should be performed as early as possible without any unfounded delay.

Many studies have tried to identify prognostic factors concerning therapy outcome after surgical treatment of cauda equina syndrome.

Some authors attach importance to the pre- and postoperative persistence of perianal and saddle anesthesia in correlation with the prognosis of postoperative bladder function. The present study confirmed these results. All seven patients who did not have a complete preoperative saddle anesthesia showed statistically improved postoperative results concerning outcome of urinary function. Moreover, all five patients without preoperative motor deficit showed postoperatively significant improvement in bladder recovery.

The following considerations may arise when interpreting these results: Is it justified to reduce the urgency of surgery in incoming patients with herniated disks and urinary symptoms, but without perianal anesthesia and motor deficit? Should surgery occur earlier and without any delay for the above-mentioned diagnostic procedures, in the presence of a "full" cauda equina syndrome including perianal anesthesia and motor deficit?

In addition, a persistent postoperative saddle anesthesia appears to correlate significantly with a poor prognosis of bladder outcome. All four patients who regained sensation of perianal and saddle area >6 months postoperatively or who did not regain sensation at all within the follow-up period had a persistent urinary dysfunction. These findings were statistically significant and support the results of Kostuk et al. and Scott. In similar results, four of five patients who did not recover from motor deficits before 6 months postoperatively or did not recover at all within the follow-up period had fair or poor results of urinary recovery, which can be of prognostic value.

A preoperative bilateral lumbosacral pain, which turned out to be a prognostically unfavorable factor in some studies, did not show a poorer postoperative outcome in the present study compared to unilateral sciatica.

In contrast to Kostuk et al., the present study did not find any difference in outcome between acute and chronic onset of cauda equina symptoms. Furthermore, neither age of the patient nor previous surgery in the concerned lumbar area had any statistical relevance concerning recovery of urinary function. The fact that all nine women had excellent results postoperatively and statistically better outcome than the men remains unclear and should be examined further.

REFERENCES