Assessment of bladder function after lumbar decompressive laminectomy for spinal stenosis: a prospective study

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Lumbar spinal stenosis is a common problem in elderly patients. In its more advanced forms, it typically causes intractable leg pain, but many patients also manifest varying degrees of bladder dysfunction. The goal of lumbar decompressive laminectomy is relief of leg pain and paresthesias, yet some patients also achieve improvement in bladder function. This study prospectively investigated patients with lumbar spinal stenosis to determine whether laminectomy had any effect on urological function. Of the 20 patients in the study, 10 were men and 10 women (average age 70.9 years). All patients had severe lumbar stenosis affecting between two and four spinal segments, and all reported some degree of bladder dysfunction. Cystoscopy and urodynamic testing were completed preoperatively. A standard decompressive laminectomy was performed over the appropriate number of spinal segments. Urodynamic studies were repeated at 2 and 6 months postoperatively. At the 6-month follow-up review, bladder function was subjectively improved in 12 patients (60%) and unchanged in eight (40%). Postvoiding residual urine volume was the urodynamic factor most likely to be improved by laminectomy. In nine patients (45%), baseline postvoiding residual urine volume was elevated and all nine had improvement postoperatively. In the remaining 11 patients (55%), this urine volume was normal before and after surgery. Maximum urine flow rates also improved, but the results of cystometry and electromyography, urine flow pattern, and bladder capacity were unchanged postoperatively. Cystoscopy detected previously undiagnosed malignancy of the lower urinary tract in two patients (10%). It is concluded that lumbar decompressive laminectomy can have a beneficial effect on bladder function in a significant number of patients with advanced lumbar spinal stenosis.

Key Words: cauda equina syndrome · lumbar spinal stenosis · neurogenic bladder · urodynamic testing

Lumbar spondylosis encompasses the degenerative hypertrophy of the ligamentous, cartilaginous, and osseous structures of the lumbar spine. In its more advanced forms, this disorder often causes chronic and progressive symptoms, usually without significant neurological deficit. Symptoms generally evolve slowly over months to years. Patients typically seek medical attention when intractable leg pain develops, yet when questioned, about 50% of patients report symptoms of bladder dysfunction, including incontinence, urinary hesitancy, nocturia, or frequent urinary tract infections. In some cases, these symptoms may be overlooked or attributed to primary urological disorders such as benign prostatic hypertrophy. In addition to being distressing to the patient, in some cases these urological symptoms may indicate the presence of significant cauda equina dysfunction.

When intractable pseudoclaudication develops, lumbar decompressive laminectomy is the treatment of choice. The goal of surgery is relief of leg pain and paresthesias; however, some patients have also reported improvement in bladder function. This prospective study was undertaken to determine whether patients with urological symptoms and spinal stenosis experience improvement in bladder function after lumbar decompressive laminectomy.

Clinical Material and Methods

Twenty patients (10 men and 10 women) ranging in age from 60 to 80 years (average 70.9 years) were studied prospectively. The diagnosis of lumbar spinal canal stenosis was established by an appropriate medical history of disabling pseudoclaudication affecting one or both lower extremities, a clinical neurological exami-
nation, and a neuroimaging study confirming severe lumbar spinal stenosis at one or more levels. Myelography using water-soluble dye was performed, with postmyelographic computerized tomography or magnetic resonance imaging.

Neuro-urological evaluation was conducted in all patients. The components of this evaluation included a patient questionnaire with preoperative and postoperative sections, preoperative cystoscopy, and urodynamic testing preoperatively and 2 and 6 months postoperatively.

The subjective aspects of a patient's bladder function were assessed by means of the patient questionnaire, which was completed by a nurse reviewer who was not part of the surgical team. Patients were asked about urinary stress, urinary urge, overflow incontinence, urinary hesitancy, nocturia, sense of incomplete voiding or double voiding, dysuria, voiding frequency, incidence of urinary tract infection or hematuria, and intermittency.

Cystoscopy was performed preoperatively to determine the presence of obstructing lesions, including prostatic hyperplasia, urethral stricture, and bladder neck contracture. The bladder was further assessed for the presence of mucosal lesions or diverticula that could cause elevated residual urinary volumes not related to the primary neurological condition. Standard urodynamic testing was carried out preoperatively and at 2 and 6 months postoperatively in all patients.* Cystometryography, electromyography, urine flow studies, and determination of bladder capacity and postvoiding residual (PVR) urinary volume were performed for all patients.

The surgical procedure was a standard lumbar decompressive laminectomy performed at the appropriate levels. Surgery was not carried out if any of the following exclusion criteria were present: congenital lumbar spinal stenosis, lack of urological or bladder symptoms, previous lumbar laminectomy, previous operation on the lower urinary tract, presence of advanced prostatic hypertrophy, and need for simultaneous fusion.

Results

Neurological Outcome

All 20 patients in this series underwent a standard lumbar decompressive laminectomy extending over an average of three levels (range two to four levels). At the 6-month follow-up review, neurological outcome (the degree of leg pain relief) was assessed as excellent in 18 patients and fair in two.

Bladder Symptoms

At the time of the initial evaluation, patients reported various symptoms indicative of bladder dysfunction (Table 1). After laminectomy, bladder function was subjectively improved in 60% of patients and unchanged in 40%. No patient reported deterioration in bladder function. Seven of the 10 women reported improvement and the other three were unchanged; five of the 10 men were improved and the remaining five were unchanged. When improvement occurred, it was prompt and was noticeable at the 2-month postoperative follow-up review. Only one patient suffered frequent urinary tract infections before laminectomy, and she had none after surgery. Because urinary tract infection was infrequent, it was not possible to determine whether the incidence was affected by surgery.

There was no correlation of urological outcome with patient age, sex, extent of laminectomy, or degree of prostatic hypertrophy in men. Interestingly, of the two patients who experienced only fair relief of leg pain and paresthesias after laminectomy, both reported improvement in bladder function. Postvoiding residual urine volume was normal preoperatively and postoperatively in these two patients.

Postvoiding Residual Urine Volume Measurements

Postvoiding residual urine volume was the urodynamic factor most likely to be improved by laminectomy. In nine patients (45%), baseline PVR urine volume was abnormally high (> 100 ml), but in eight (89%) of these, the volume was normal (< 100 ml) after surgery. The ninth patient had a cystocele; her PVR urine volume was 480 ml preoperatively and decreased to 300 ml after the operation. Although not within the normal range postoperatively, her PVR urine volume was significantly improved. In this patient, bladder symptoms were also much improved after surgery. In the remaining 55% of patients, the PVR urine volume was normal pre- and postoperatively. No patient's condition was made worse. Men and women were equally likely to experience improvement in PVR urine volume; in men, the presence of mild or moderate prostatic hypertrophy did not influence outcome.

Other Urodynamic Data

In men, the average maximum urine flow rate was 15.2 ml/sec preoperatively and showed no significant change postoperatively (mean 15.5 ml/sec). However, all four men with abnormal baseline maximum urine flow rates (<12 ml/sec) had significant improvement ranging from 40% to 100% after the operation. In women, the average maximum urine flow rate was 20.1 ml/sec.
ml/sec preoperatively and 26.1 ml/sec postoperatively. Five of the 10 women had improvement and five were unchanged.

Measurement of the baseline cystometrography and electromyography values as well as urine flow pattern yielded nonspecific findings and were essentially unchanged after surgery. Bladder capacity was also unchanged after laminectomy.

**Cystoscopy**

Cystoscopy was performed in all patients; in one patient a cystocele was detected and in two patients there was a lower urinary tract malignancy. Prostatic hypertrophy was graded as moderate in five men, mild in three, and absent in two.

**Discussion**

**Malfunction of the Urinary Bladder in Spinal Disorders**

The physiology of micturition is complex and has been reviewed in detail by Rockswold and Chou.13 Impaired function of the urinary bladder is a common problem and has major clinical, psychological, and social implications. Urinary dysfunction has many causes and has been the subject of increased recent attention.4,12 Disorders of the central and peripheral nervous systems often have a profound impact on bladder function. Various disorders of the lumbar spine may lead to neurogenic bladder dysfunction. Urinary incontinence due to lumbar disc herniation was described in 1934 by Mixter and Barr.9 Subsequently, several other disorders of the lumbar spine, including tethered cord syndrome,2 intraspinal tumor,14 disc herniation,1,5,6,10,11,15,17 and trauma,7 have been associated with neurogenic bladder. Complete traumatic cauda equina lesions result in detrusor areflexia with high bladder capacity (> 700 ml) and bladder neck incompetence.

Lumbar spondylosis may also lead to malfunction of the urinary bladder. Sharr, et al.,16 reported a series of 34 patients with lumbar spondylosis and spinal stenosis associated with bladder dysfunction. After lumbar decompressive laminectomy, 75% of their patients experienced some improvement in bladder function. Cystometrography was of limited value, and the diagnosis of neurogenic bladder depended as much on features in the medical history as on the results of urological and neurological investigations.

Experimental studies in this area are limited. Delamarter, et al.,2 studied urological function in dogs after experimental cauda equina compression. They reported that an acute 75% constriction of the thecal sac led to severe changes on cystometrography with detrusor areflexia, increased bladder capacity, and clinical urinary incontinence. Cystometrography revealed findings typical of a flaccid neurogenic bladder in animals subjected to an acute 75% constriction of the cauda equina, but the results were basically normal in animals subjected to lesser degrees (25% and 50%) of cauda equina constriction. Thus, cystometrography was not sensitive until severe cauda equina compression was present.

**Current Study**

In our study, although all patients had severe lumbar spinal stenosis with a high degree of constriction of the thecal sac and cauda equina, none had a true flaccid neurogenic bladder. The absence of this condition was probably due to the chronic and slowly progressive nature of lumbar spondylosis.

The most sensitive indicators of bladder function and its response to decompressive laminectomy were patient symptoms and the results of PVR urine volume testing. Maximum urine flow rates were also substantially improved. Women as a group improved in this area, as did the four men with abnormal maximum urine flow rates at baseline. Postvoiding residual urine volume and maximum urine flow rate are indicators of detrusor function and tone. Thus, improvement in these two factors may be considered evidence of improved bladder function.

Other urodynamic procedures were of limited value. Confirming the earlier work of Sharr, et al.,16 the cystometrographic and electromyographic studies showed nonspecific findings and no significant change after decompressive laminectomy. Measurement of urine flow pattern and bladder capacity were likewise of limited value.

Thus, on the basis of our study, evidence exists that most of the pertinent urological data in patients with bladder dysfunction and spinal stenosis can be obtained from a careful urological history and measurements of PVR urine volume. Little additional information is gained from full urodynamic testing.

**Conclusions**

The present study yields the following findings.

1. Lumbar decompressive laminectomy can have a beneficial effect on bladder function in a significant number of patients with advanced degenerative lumbar spinal stenosis.
2. In patients who improve, amelioration occurs early and is noticeable within 2 months of surgery.
3. The urodynamic factors most likely to be improved by lumbar decompressive laminectomy are PVR urine volume and maximum urine flow rate.
4. Results of cystometrography and electromyography, urine flow pattern, and bladder capacity do not change significantly after operation.

**References**

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