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Relationship between clinical data and urodynamic findings in patients with lumbar intervertebral disk protrusion

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Abstract The relationship between voiding disturbances and urodynamic diagnosis in patients with lumbar intervertebral disk protrusion is controversial. The objective of this study was to determine the association between clinical data and urodynamic diagnosis, in order to reveal whether bladder dysfunction can be assessed on the basis of urological symptoms and signs. We prospectively studied 122 patients with lumbar intervertebral disk protrusion. Detrusor areflexia was found in 32 of these patients, while in the remaining 90 detrusor activity was normal. All patients with detrusor areflexia reported difficulty voiding by abdominal straining. The patients with normal urodynamic findings were either free of voiding disturbances (77 patients) or complained of frequent voiding (13 patients). In conclusion, there are cases of lumbar intervertebral disk protrusion in which the presence of bladder dysfunction can be predicted on the basis of clinical urodynamic testing, i.e. clinical neurological alterations, decreased bladder sensation, voiding by straining, increased bladder capacity, residual volume, and intermittent or continuous low flow curve on free uroflowmetry.

Keywords Spine · Bladder · Urodynamics · Intervertebral disk displacement

Introduction

Ninety years ago Middleton and Teacher found that “injury of the (lumbar) intervertebral disc without injury of the vertebral bodies” could be the cause of clinical, neurological abnormalities, i.e. sensory, reflex or motor

changes, in the lower extremities [8]. In 1927, Rose published his method of bladder pressure determination as a new principle in diagnosis [9]. Since then, the neurological evaluation of such patients can be supplemented by urodynamic findings.

Urological symptoms and signs can be more or less reproduced in the form of urodynamic findings. There is no consensus of opinion concerning the relationship between voiding disturbances and urodynamic diagnosis in patients with lumbar intervertebral disk protrusion. According to the observations of some authors, there appears to be an association between voiding disturbances and detrusor areflexia [2,11], while others believe that abnormal urodynamic findings can even develop in patients free from any voiding disturbances [7,10]. Thus, the aim of this study was first to examine the relationship between clinical urological and urodynamic findings, i.e. to examine whether there is an association between voiding disturbances and bladder dysfunction, and second to reveal whether bladder dysfunction can be assessed on the basis of urological symptoms and signs.

Materials and methods

We carried out a prospective study of 122 patients with lumbar intervertebral disk protrusion, all of whom were hospitalized at a neurosurgical department as candidates for surgical treatment. There were 83 males and 39 females aged 25–63 years. All patients complained of lower back pain radiating along the lower lumbar and/or sacral root areas on one or both sides. Clinical neurological examination included the assessment of sensory, reflex and motor signs in the lower extremities. Patients who suddenly developed severe neurological disturbance as a result of the involvement of the cauda equina by a large protrusion (cauda equina compression syndrome) were not included in the study. None of the patients had undergone any surgical procedure of the lower urinary tract. In the study only those patients who had no signs of intravesical obstruction were included. Digital rectal examination and ultrasonography of the prostate was carried out in all male patients and urethroscopy in most of them.

Urodynamic examination consisted of the simultaneous measurement of intravesical and abdominal pressures during bladder

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filling and voiding as previously described [3]. At the beginning of the procedure, flowmetry during free voiding was performed. Upon voiding, an 8 F double lumen catheter was introduced into the bladder, and the residual volume was measured. Medium water fill cystometry (100 ml/min) was performed. The abdominal pressure was measured by the use of a rectal balloon catheter. Detrusor pressure was determined by computer as the difference between total vesical and abdominal pressure. Bladder filling was interrupted when the maximum bladder capacity was achieved. The patient was then instructed to void beside the urodynamic catheter introduced into the bladder at the beginning of the procedure. In such a way, both vesical and abdominal pressures were determined simultaneously with flowmetry.

Definitions

The term *detrusor areflexia* means that there is no detrusor contraction during the voiding phase. As detrusor contraction is absent, the patients void by abdominal straining. Thus, intravesical pressure increases on account of the rise in abdominal pressure.

The first sensation of bladder filling at a volume of less than 300 ml is defined as *normal bladder sensation*. *Decreased bladder sensation* is defined as the first sensation of filling at a volume of 300 ml or more. Beside the exact volume, the patient's ability to describe changes in sensation is of equal importance in the assessment of bladder sensation.

Bladder capacity was determined as the maximum cystometric capacity [6]. Some problems in determining bladder capacity exist in patients with reduced bladder sensation. If bladder sensation is considerably reduced, the patient is not aware of his bladder condition. With a very full bladder, the patient feels only some discomfort in the lower abdomen. This situation was observed by the early investigations of such patients. Rosomoff et al. stated that: "If discomfort did not occur before a total inflow of 500 millilitres, the test was continued until it became obvious that normal bladder capacity had been exceeded or that bladder sensation was impaired" [10]. With these patients, the investigator must decide when to terminate bladder filling [6].

Results

All patients had clinical neurological abnormalities, i.e. sensory, motor or reflex changes in the lower extremities. Detrusor areflexia was found in 32 of the 122 patients, while in the remaining 90 patients detrusor activity was normal (Table 1). In 13 of the 90 patients with normal detrusor activity, the bladder capacity was greater than 500 ml (502–752 ml). The maximum flow rate in these 13 patients was 28.4 ± 3.0 ml/s (mean \pm SD). Sensitivity and specificity for bladder capacity greater than 500 ml were 100% and 85.6%, respectively. The likelihood ratio of a positive test was 6.9.

Each patient was asked for symptoms associated with the lower urinary tract. A total of 77 patients had no voiding disturbances. A further 32 patients reported difficulty voiding by abdominal straining, and the

remaining 13 patients complained of the frequency of voiding. The 77 patients free from lower urinary tract symptoms had normal urodynamic findings. Patients with frequency problems also had normal urodynamic findings. Detrusor areflexia was found in all 32 patients reporting difficulty voiding by abdominal straining. The first sensation of bladder filling was reduced in all patients with detrusor areflexia (Table 1). None of the patients had detrusor overactivity.

Residual urine was recorded in 23 of the 32 patients with detrusor areflexia. The median residual volume was 45 ml ranging from 25 to 145 ml. The sensitivity and specificity for the residual volume were 71.9% and 100%, respectively.

In 14 patients with detrusor areflexia, interrupted urine flow was recorded during free flowmetry (Fig. 1). In ten patients with detrusor areflexia, the flow curve was not interrupted but was continuous with low flow rate: the maximum flow rate in these ten patients was 6–12 ml/s (mean 7.8 ml/s). Eight patients with detrusor areflexia could not void spontaneously. In patients with normal detrusor activity there were no cases with interrupted urine flow, but there were 11 patients with a flow rate of less than 12 ml/s. The sensitivity and specificity for the interrupted pattern of the flow curve were 43.8% and 100%, respectively. Sensitivity and specificity for the low flow curve were 31.3% and 87.8%, respectively. The likelihood ratio of a positive test for low flow curve was 2.6. In the pressure-flow part of the study, the patients often could not void during the examination (15 patients with detrusor areflexia) or the voided volumes were too small for reliable interpretation (30–154 ml in nine patients). In the remaining eight patients with detrusor areflexia, the voided volumes were sufficient for interpretation and the findings were consistent with free flow (three interrupted and five continuous flows with low flow rate).

Discussion

The patients described were those with known neurological disorders. All of these patients had clinical neurological and neuroradiological alterations that indicated surgical treatment, and most of them subsequently underwent surgery. All patients with detrusor areflexia had decreased bladder sensation (Table 1). Patient history revealed that the sensation of bladder fullness was almost absent. With a very full bladder, the patient feels discomfort in the lower abdomen but

Table 1. Urodynamic findings in 122 patients with lumbar intervertebral disk protrusion

Urodynamic parameter	Detrusor activity: mean \pm SD (range)	
	Normal detrusor activity	Detrusor areflexia
First sensation of bladder filling (ml)	153.2 \pm 58.5 (76–282)	350.8 \pm 29.2 (309–458)
Bladder capacity (ml)	397.5 \pm 149.9 (220–752)	612.6 \pm 73.0 (516–800)
Maximum flow rate (ml/s)	19.1 \pm 9.4 (4–33)	5.3 \pm 3.1 (0–12)
Number of patients	90	32

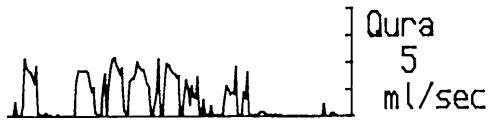


Fig. 1. Free uroflow curve in a patient with detrusor areflexia

does not have a strong desire to void. Normal sensation is a prerequisite for the normal initiation of and sustained voiding. In detrusor areflexia there is no detrusor contraction during voiding, thus the patient voids by abdominal straining. The flow stops each time the patient takes a breath. On uroflowmetry, performed during free voiding, this was seen as an intermittent pattern in the flow curve. A normal flow curve indicates good detrusor contractility. However, 11 patients with normal detrusor activity voided only small volumes during the examination and, thus, the recorded flow rates were less than 12 ml/s. The likelihood ratio of a positive test was 2.6, which means that the low flow curve is 2.6 times as likely in patients with detrusor areflexia. Bladder capacity was always increased (> 500 ml) in detrusor areflexia. However, bladder capacity was also increased in some patients with normal detrusor activity. We found 13 patients with a bladder capacity of more than 500 ml who had normal detrusor activity. The maximum flow rate was normal in these 13 patients, contrary to the patients with detrusor areflexia in whom the maximum flow rate was always low. The likelihood ratio of a positive test was 6.9, which means that a bladder capacity greater than 500 ml is 6.9 times as likely in patients with detrusor areflexia. A residual volume was found in the majority of patients with detrusor areflexia, but the volumes recorded were not high (25–145 ml).

The term “urodynamic testing” means the assessment of the urinary tract function and dysfunction by any appropriate method [6]. Hinman studied various voiding abnormalities and introduced the term “clinical urodynamic testing” which includes the following: voiding disturbances, bladder capacity, residual volume, miction cystography and neurological evaluation [5]. Hinman states that: “Electronic urodynamic testing may supplement the basic studies but it cannot substitute for them.” It is noteworthy that Emmett and Love made the diagnosis of bladder dysfunction in lumbar disk protrusion on the basis of cystoscopic examination. They believed that classical cystoscopic findings could be considered in this disease: bladder sensation is reduced or absent, the patient is hardly aware that the cystoscope has been inserted and bladder capacity is greatly increased, in some patients by as much as 1,500–3,000 ml [4].

In terms of Hinman’s clinical urodynamic testing, the following clinical urodynamic findings should be considered indicative of detrusor areflexia in patients with lumbar intervertebral disk protrusion: clinical neurological alterations (i.e. sensory, motor or reflex abnormalities in the lower extremities), decreased bladder sensation, voiding by straining, increased bladder

capacity, residual volume, and, on free uroflowmetry, an intermittent pattern of the flow curve or a continuous low flow curve with a maximum flow rate of 12 ml/s or less. There are clearly cases of lumbar intervertebral disk protrusion in which the presence of detrusor areflexia can be quite certainly predicted on the basis of these clinical, urological signs.

There is no consensus in the literature on the relationship between voiding dysfunction and urodynamic findings in patients with lumbar intervertebral disk protrusion. According to the results of Sandri et al., detrusor areflexia occurs in patients with voiding disorders. However, their results refer to patients who had previously undergone surgery for intervertebral disk protrusion and who had voiding disturbances [11]. Andersen and Bradley reported the presence of detrusor areflexia and voiding by straining in all of their eight patients with lumbar disk protrusion [2]. On the other hand, in earlier literature the opinion is presented that abnormal urodynamic findings develop in patients free from voiding disorders in the case of lumbar intervertebral disk protrusion [7,10]. We believe that such opinions resulted due to the methods and diagnostic criteria used in these studies which were different from our methods and criteria. These authors measured intravesical pressure alone, without measuring intra-abdominal pressure during voiding. Their criteria for the diagnosis of decreased detrusor activity were a large bladder capacity and the inability to elicit a sharp terminal rise in pressure. We made the diagnosis of detrusor areflexia only on the basis of the simultaneous measurement of intravesical and abdominal pressures. After all, according to the recommendations of the International Continence Society, neurogenic bladder dysfunction can be diagnosed if there is a correlation between the urodynamic diagnosis and the patient’s symptoms and signs, [1] and in the presence of neurological pathology only [12].

Conclusion

In patients with lumbar intervertebral disk protrusion with neurological alterations of such a degree that they are candidates for surgical treatment, vesical dysfunction can be predicted by the parameters of clinical urodynamic testing: decreased bladder sensation, voiding by straining, increased bladder capacity, residual volume, and intermittent or continuous low flow curve on free uroflowmetry.

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