
Clinical, Urodynamic and Neurophysiological Findings in Patients with Neuropathic Bladder Due to a Lumbar Intervertebral Disc Protrusion

F. Fanciullacci, MD, S. Sandri, MD, P. Politi, MD, A. Zanollo, MD
Section for Myelolesions, Urological Department, Hospital of Magenta—Milano, Italy.

Summary

Sacral nerve roots are affected in 1 to 15% of reported cases of lumbar disc protrusions (mainly posterior) (Scott, 1965). Urinary retention is the commonest symptom. In the last 6 years, we have observed 22 patients (18 males and 4 females) with a neuropathic bladder due to this condition in the acute phase. They underwent intermittent catheterisation (IC), and manoeuvres such as Credé and Valsalva's at fixed times. Almost all obtained a balanced bladder. (Follow-up: 24 months.) The most common urodynamic finding at the onset was bladder areflexia with severe denervation of the perineal floor. At follow-up, 65% still had bladder areflexia and 29% normoreflexia, all with normal compliance. Perineal floor innervation showed a fair recovery, mainly in the efferent part. An hypothesis is presented to explain why this kind of neuropathic bladder has a normal compliance.

Key words: *Neuropathic bladder; Electromyography; Intervertebral disc protrusions; Neurophysiological tests; Urodynamics.*

The syndrome from a protruded lumbar intervertebral disc is most often caused by a post-lateral protrusion, the most frequent sites being L₄-L₅ and L₅-S₁. The highest incidence is between 35 and 45 years. Lumbar disc protrusion, principally in the posterior (central) position may disturb nerves leading to the bladder, the perineal floor and the cavernous tissue of the penis (Ravichandran, 1981). The intrathecal sacral nerve roots have been affected in 1 to 15% of reported cases of lumbar disc prolapse verified at operation (Scott, 1965), and the commonest disturbance is a urinary disorder, usually retention (and possibly associated with other neurological symptoms). Authors have observed urinary bladder hypofunction (Rosomoff, 1963; O'Connel, 1951; Emmet, 1971; Andersen, 1976). The perineal floor generally shows a better recovery (Andersen, 1976). Perineal anaesthesia seldom recovers (O'Connel, 1951; Hellstrom, 1986). There are few reports on the clinical evolution as seen at follow-up (Shephard, 1959; Scott, 1965; Emmet, 1971; Rosomoff, 1963): the urological balance

usually appears to be favourable except for Shephard's report. But all of these reports date back to the pre-intermittent catheterisation (IC) era. The aim of this paper is to report our experience of the clinical, urodynamic and neurophysiological findings in patients with a neuropathic bladder due to a lumbar intervertebral disc prolapse, at the onset of the disease and at follow-up examinations.

Materials and methods

In the past 6 years, we observed 22 patients (18 males and 4 females) with a neuropathic bladder due to a lumbar intervertebral central disc protrusion, in the acute phase (mean age 46 years; range 28–66). The affected discs were: L2–L3 (2); L3–L4 (4); L4–L5 (8); L5–S1 (7); lumbar canal stenosis (2). In one case, there was a double disc prolapse (L4–L5 and L5–S1).

Neurological abnormalities were present before the operation in all of the patients. In one case, urinary retention followed the operation. Generally, the most cranial root compressed was the root below the protruded disc, as shown by neurological motor-sensory symptoms in the limbs.

All patients underwent urological, X-ray and urodynamic examinations: uroflow, water cystometry with recording of abdominal and intrinsic bladder pressure during filling and micturition (through a 10 French catheter) and electromyography (EMG) of the periurethral muscles with concentric needle electrodes. The needle is inserted through the perineal skin, below the bulb of the urethra, with the help of a finger placed in the rectum. Proper needle placement was confirmed by audio monitors. A Disa Neuromatic 2000 was used for recording. EMG behaviour during cystometry, motor unit potentials (MUP) analysis, insertion and spontaneous activity, interference pattern at maximal voluntary contraction, sacral evoked potentials (SEP) evaluation and penis or clitoris sensory threshold at the electrical stimulation were determined. SEP determination consists in electrical stimulation of the penile skin and in registration of the reflex EMG response of the periurethral muscles. According to our method, the latency of the response in normal people is $32 \text{ msec} \pm 3.3$.

Results

Clinical picture at the onset of the disease

All patients had urinary retention, except 2 women who had urinary incontinence. The patients had an indwelling catheter for a mean time of 15.5 days, and underwent IC (self) and manoeuvres such as Credé and Valsalva's at fixed times. The number of IC was progressively reduced as micturition reappeared. A variable number of IC were performed for a mean time of 4.9 months. One patient had transurethral resection of the bladder neck. Only 2 males continued IC in the chronic phase. The mean time for the reappearance of micturition was 1.3 months. Nine patients underwent therapy with alpha-blockers because of unfavourable evolution (6 improved their bladder emptying). Urography showed a normal upper urinary tract (UUT) in all cases. 47.5% showed urinary tract infections (UTI) with features of asymptomatic bacteriuria.

Clinical picture at follow up

21 patients (24 months). 17 (81%) had a well balanced bladder (residue absent, good continence); 3 had incomplete urinary retention and 1 complete urinary retention. 81% were free of UTI; UUT was checked in 13 cases (10 by urography and 3 by echography): it was normal in all but 1, who showed a slight pyelectasis.

Urodynamic and neurophysiological findings at the onset of the disease

Mean time from the onset: 2.3 months. All patients showed bladder areflexia with normal compliance; mean capacity 430 cc. Bladder sensation was abolished in 16 and reduced in 6. EMG showed signs of severe denervation: basic activity and voluntary contraction were absent in 16 and reduced in 6. For this reason, MUP analysis was difficult. There was an impairment of penis (or clitoris) sensation at the electrical stimulation in 19/22. SEP were tested in 9 (and proved absent in 6 out of them).

Urodynamic and neurophysiological findings at follow-up

Seventeen patients (mean time from the onset 21.8 months). 11 had bladder areflexia (65%); 5 normoreflexia (29%) and 1 hyperreflexia; mean capacity 390 cc. All these bladders had a normal compliance. Bladder sensation was absent in 6, reduced in 8 and normal in 3. EMG of the periurethral muscles showed very good recovery of voluntary contraction (normal or slightly reduced in 13/17) and in basic activity (14/17); while penis or clitoris anaesthesia persisted at the electrical evaluation (14/17). All patients had SEP studies: being abnormal in 14 (absent or delayed response). MUP analysis: 216 different MUP were analysed in all patients. Polyphasic potentials were 16%, irregular 25% and normal 59%. (Mean duration: polyphasic 8.9 msec; irregular 7.12 msec and normal 4.45 msec).

Conclusions

(1) Clinically, it is possible to conclude that most patients obtained a balanced bladder, had UUT normal and no UTI at follow-up (mean 24 months).

(2) Bladder areflexia tends to persist even if in 35% of the cases the micturition reflex reappeared. All bladders had a normal compliance.

(3) Somatic innervation recovered from the initial denervation, mainly in the efferent fibres. Indeed at follow-up, 10/17 recovered voluntary contraction and EMG activity in the pelvic floor, but sensory fibres remained impaired (threshold increased and SEP abnormal); 4/17 showed an impairment of both sensory and motor fibres and 3 recovered completely.

In patients with a lumbar intervertebral disc protrusion, the sacral roots can be compressed to a variable degree, therefore, nervous conduction is impaired. At the lumbar level, there are both pelvic and pudendal fibres, sensory and motor. SEP determination measures nervous conduction in both the afferent and efferent branches of the pudendal nerve. The pudendal nerve does not

measure neuronal activity directly to or from the bladder. Thus direct correlation with bladder function must be interpreted with caution. However, the pudendal nerve follows a pathway similar to the bladder pelvic nerve through the S2 to S4 nerve roots and cauda equina to the spinal cord. Therefore lesions affecting the pudendal nerve may also affect the pelvic nerve and vice-versa.

EMG of the perineal floor studies only the efferent innervation. The main points in needle EMG are insertion activity, spontaneous activity, MUP shape and interference pattern at maximal voluntary contraction. Thus SEP determination and EMG of the perineal floor permit us to establish if a lesion affects the afferent or efferent branches of the pudendal nerve or of both. In our cases, at follow-up, we showed that 13/17 recovered the efferent innervation of the perineal floor (normal basic EMG activity and almost complete interference pattern at maximal voluntary contraction with 16% of polyphasic potentials, which are to be considered as reinnervation potentials); while 14/17 showed an impairment of the sensory fibres of the pudendal nerve (sensory threshold increased and SEP abnormal). Therefore it appears that in patients with an intervertebral disc protrusion, the afferent fibres of the pudendal arc are more vulnerable than the efferent ones.

If we suppose that for the visceral fibres, the sensory component is also more vulnerable (Emmet, 1971), this could explain why all our patients have an areflexic bladder with normal compliance (while areflexia of traumatic origin and in myelodysplasia is often hypertonic). In fact, experimental section of the cauda equina in monkeys causes a low compliance bladder (Murnaghan, 1979). Parasympathetic denervation causes a marked increase in adrenergic innervation of the bladder, with a contractile effect, leading to a low compliance bladder with autonomous wave (Norlen, 1976). Furthermore, our group has shown that it is almost always possible to obtain a pharmacological improvement of low detrusor compliance in areflexic bladders by phentolamine and emepromium bromide, which suggests a neurogenic origin of low compliance in the areflexic bladder, mediated by cholinergic and alpha-adrenergic activity (Sandri, 1985). Therefore, if we assume that low compliance in a decentralised bladder is mainly neurogenic, we can explain the normal compliance in areflexic bladders due to a lumbar intervertebral disc protrusion, with a pure bladder sensory fibres lesion (or with an incomplete damage of the pre-ganglionic parasympathetic fibres). Reinnervation is a well-known process occurring in the skeletal neuromuscular unit and supposed to exist also for the visceral neuromuscular unit (Carlson, 1968). On the contrary, damage of sensory fibres is more likely to be irreversible. O'Connell stated that a lumbar intervertebral disc protrusion affects the posterior nerve fibres centrally to their ganglion cells and consequently the sensory deficit will be persistent since there is no regeneration of these root fibres within the spinal canal.

Furthermore, experimental works show that regeneration of severed dorsal roots did not reestablish a functional pathway in the spinal cord (Conzen, 1982).

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