SELECTIVE PERCUTANEOUS SACRAL ROOT BLOCKADE WITH PHENOL IN NEUROVESICAL DYSFUNCTION

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NORMAL URINARY BLADDER FUNCTION and micturition are the result of well integrated somatic and visceral nervous activity. Micturition requires complex reciprocal actions between detrusor force and outflow resistance.¹ Poor reciprocal interaction of the detrusor and outlet is described as dyssynergia.

In previous work we have demonstrated that the integrity of detrusor activity can be shown by stimulating the second, third, and fourth sacral roots and recording the subsequent increase in intravesical pressure.² The lowering of outflow resistance is accomplished by the reciprocal inhibition of sympathetic impulses to the internal sphincter³ as the detrusor contracts and to a small extent is actively helped by detrusor fibres which diverge obliquely from the vesical neck.⁴ Relaxation of the external urinary sphincter which is under somatic control occurs simultaneously. The higher centers of the brain also have been shown to play a significant role in control of micturition.⁵ This triple cholinergic, adrenergic, and voluntary innervation of the bladder outlet contradicts any idea of a simple reciprocal reflex, and for a number of years now we have employed percutaneous sacral root electrocystometry as one phase in the total evaluation of patients with neurologic vesical dysfunction.^{2,6}

The following case report is presented as an example of how this test can be of diagnostic value in neurologic vesical dysfunction due to a poor reciprocal response of the detrusor and outlet (dyssynergia). Therapeutic effects of selective sacral root blockade with phenol based on the electro-cystometric results are also shown.

CASE REPORT

History

On May 17, 1964, while swinging on a playground swing the patient "blacked out" and fell forward, striking his forehead on the ground. He heard a snap in his neck and was unable to move any of his extremities. A fracture dislocation at c-5 was found on X-ray. One month later, June 18, 1964, when an anterior cervical fusion was performed without complications, some motor return to the upper extremities occurred. From that time motor improvement was continuous and fairly rapid until the only motor deficit was some weakness of the right wrist and leg. By the fifth post-accident month the patient was able to walk but required a short leg brace on the right. There was hypalgesia on the left side from the sixth cervical to the tenth thoracic dermatomes and analgesia below the tenth thoracic dermatome. On the right, hypalgesia was present in the c-7-8 dermatome, with

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normal sensation below T-1. Proprioception and stereognosis were normal. Six months after the accident the patient was discharged home with a Foley catheter in place as he was unable to initiate voiding. Episodes of acute pyelonephritis occurred on each of two occasions when the catheter was removed for trial periods of attempted voiding. After that time the patient had numerous bouts of urinary tract infections, and by June 25, 1965, the capacity of the bladder had decreased to 175 cc, with a cystometrogram showing a shift to the left ("spastic bladder"). A denervation sensitivity test was positive. During cystoscopy it was noted that when the bladder contracted the internal meatus and external sphincter both contracted. The bladder wall showed marked evidence of a chronic cystitis.

Because of continuing urinary infection and inability to void, a suprapubic cystostomy was done in June of 1965. Bladder neck surgery reconstruction was also done at this time. Attempts to void with the suprapubic catheter clamped were made intermittently over the next three years with no success. Oral mendeamine was taken and the bladder was irrigated regularly with 10 per cent Renocidin® in an attempt to control bladder infection.

When the patient was admitted to hospital for electrocystometric examination, a bypass procedure of the bladder using an ileal loop was being contemplated.

Method

The technique used was essentially the same as described by us previously.² Briefly, a spinal anaesthetic to a level of T-6 was administered with the patient in a lateral position, using 75 mg of 5 per cent lidocaine. The patient was placed supine until the anaesthetic level was fixed, the suprapubic catheter clamped, and a urethral catheter inserted. The urethral catheter was connected to a constant flow pump and a pressure transducer and the bladder was filled with a volume of air on a preliminary cystometrogram produced reflex detrusor contraction. The patient was then returned to a lateral position, and 22 gauge needles insulated with teflon except for the tip were inserted through the second, third, and fourth sacral foramina bilaterally. A pulsating current delivered by a Meditron Nerve Locator Stimulator* helped place the needles in close proximity to the sacral nerves and also confirmed needle placement in the correct foramen. Stimulation of the second sacral nerve produces plantar flexion of the large toe. Gastrocnemius contraction and plantar flexion of the foot result from stimulation of the third sacral root, and with stimulation of the fourth sacral root the rectal sphincter contracts. Satisfactory bladder stimulation requires a tetanic stimulation delivered for a period of approximately six seconds at a repetition rate of 20-30 times a second and at a minimum of six volts (with our needles) with each pulse duration being between 0.2 and 1.0 milliseconds.

A typical post-stimulation bladder contraction shows an initial rapid pressure rise due to contraction of the external urethral sphincter and pelvic floor. Following this there is a slow rise in bladder pressure during the remaining period of stimulation. At the cessation of the stimulating current there is a sudden small drop in pressure as the pelvic floor relaxes and then a further gradual rise in

*The Meditron Company, 5440 North Peck Road, El Monte, California.

FIGURE 1. A typical bladder response following the percutaneous stimulation of the third sacral root.

intravesical pressure to 80 cm H₂O or greater. A gradual decrease in bladder pressure secondary to detrusor relaxation over a period of 30–50 seconds is then observed (Fig. 1).

In a normal response following sacral root stimulation, there is little or no response to s-2 stimulation, a maximal response to s-3, and a lesser response to s-4. Commonly one side is dominant but intravesical pressure increases occur with the stimulation of all roots (Fig. 2). Occasionally the greatest rise in pressure can be produced by stimulating s-4, indicating some variability of the major neural input to the bladder.

Prior to administration of the spinal anaesthetic a cystometrogram was done, and this was repeated after the anaesthetic level was fixed. Any cystometric test is based on a continuous pressure recording during bladder filling to show a gradual rise in pressure until reflex induction of detrusor contraction occurs at a volume of about 225 cc. A shift in pressure response to the right of the read-out graph is compatible with an absent reflex or detrusor muscle non-contractility. Conversely, a shift to the left suggests abnormal detrusor muscle contractility, with hypersensitive neuromuscular function, compatible with infection or neuromuscular disease (Fig. 3). The superiority of air cystometry over fluid cystometry has been demonstrated by Cass *et al.*⁷

FIGURE 2. Typical changes in intravesical pressure following percutaneous stimulation of the second, third, and fourth sacral roots.

FIGURE 3. Cystometrograms showing a normal reflex emptying after filling the bladder with approximately 225 cc of air; a shift to the left indicating a "spastic" bladder, and a shift to the right indicating a hypotonic bladder.

In this patient, stimulation of s-4 on the left produced a normal detrusor contraction and increased intravesical pressure to 60 cm H₂O. No increase in bladder pressure was produced by the stimulation of s-2 or s-3 on the left.

Stimulation of s-4 and s-3 on the right produced similar rises in pressure to 60 cm H₂O, with the elevation in pressure at the two root levels being equal and not showing the usual greater response at s-3.

A control air cystometrogram showed that with 115 cc of air, detrusor contraction occurred. The response curve was shifted to the left, indicating hyperreflexia of the bladder. Because of this hyperreflexia a selective block of s-4 on the right was done with 3 cc of dibucaine HCl 0.15 per cent. Very little decrease in the hyperreflexia was seen, as a cystometrogram done 45 minutes after the block showed a detrusor response occurring with 140 cc of air.

On the following day the fourth sacral root on the left was blocked, with a marked decrease in the hyperreflexia; 240 cc of air was required to produce a detrusor response (Fig. 4). Following this block the patient was able to micturate normally with the suprapubic catheter clamped. The urine volume increased from 70 cc to 180 cc, with a residual volume of only 20 cc.

Bilateral s-4 blocks done the following day reduced the hyperreflexia little more than the left s-4 block had done; 275 cc of air were required to produce a detrusor reflex.

Because of the marked decrease in hyperreflexia and improved micturition following the s-4 block on the left, a permanent block of this root was decided upon and two days later 3 cc of 5 per cent phenol were injected on this root. Relief of hyperreflexia was only transitory - 12 hours - so 3 cc of 6.8 per cent

FIGURE 4. The patient's cystometrogram, showing a shift to the left (hypertonia) converted to normal by blocking the right fourth sacral nerve root with 3 cc of 0.15 per cent dibucaine.

phenol, a saturated solution, were injected. Bladder volume increased to 200 cc with 20 cc residual volume.

When the effects of the block had persisted for two months and the residual urine had not increased, the suprapubic catheter was removed. Three days after this the patient could void 200 cc normally and there was no residual urine. Ten months later the patient was able to void between 200 and 220 cc of urine, getting up only once during the night. There is no residual urine and he is off all prophylactic antibacterial agents. At the present time he has a small sensory deficit about the left side of the anus. Rectal sphincter tone is normal.

DISCUSSION

After long periods of neurovesical dysfunction, accurate measurement of residual neural and detrusor function becomes of paramount importance in planning long-term management on a logical basis. Inevitably urinary tract infection is found in most cases of chronic neurovesical dysfunction and at this point the cystometrogram shows a shift to the left. If the infection becomes chronic, ureterovesical reflex with pyelonephritis, renal stones, ureteral dilatation, and loss of renal function may result. At such a stage a supravvesical urinary diversion such as an ileal conduit is required.⁸

Hopefully with a complete evaluation including electrocystometry the neuro-vesical dysfunction can be corrected before the detrusor muscle is destroyed. Any procedures such as revision of bladder outlet or partial cystectomy must be based on evidence of an anatomical or physiological defect. Permanent nerve division or block must be preceded by measurement of detrusor muscle contractility and evidence, through reversible nerve blocks, that improvement will result from the proposed surgery.

Intrathecal alcohol injections and sacral rhizotomy have been used to convert a "spastic" bladder to a "flaccid" bladder in the hope of reducing bladder infection and urinary frequency.⁹ Selective sacral root stimulation under direct vision and selective sacral root blockage have been used more recently to treat dyssynergia on a more rational basis.¹⁰

An increased bladder tone and a shift to the left of an air cystometrogram was demonstrated in our patient to be activated via the fourth sacral root on the left. A reversible block of his root allowed the patient to micurate normally and decreased the tone of the bladder as demonstrated by the return of an air cystometrogram towards normal. Permanent therapy was indicated and a fourth sacral root phenol blockade was done.

We do not know the mechanism of the increased detrusor tone. In some patients with dyssynergia a single dibucaine block has resulted in normal micturition, suggesting a parasympathetic dysfunction similar to a sympathetic dystrophy. Unlike this patient, most patients show an improvement when the fourth sacral root on the same side as the residual peripheral motor paresis is blocked. This would suggest a reflex arc stronger than the co-ordinated response on the opposite normal side, and when the abnormal reflex is blocked normal co-ordination, detrusor contraction, and outlet relaxation occur, resulting in normal micturition.

It is obvious that not all patients with neurovesical dysfunction and dyssynergia who are evaluated and treated will show the clear-cut results of this patient. However, a large number will be benefited by selective sacral root blocks. The anaesthesiologist with his knowledge of regional anatomy and neurophysiology, and acting as a member of a team, can contribute greatly to the overall care of these patients.

SUMMARY

Normal urinary bladder function and micturition are the result of well integrated somatic and visceral nervous activity. Micturition requires complex reciprocal actions between detrusor force and outflow resistance, and abnormalities in this reciprocal activity can be demonstrated by percutaneous stimulation of the sacral roots while simultaneously measuring changes in intravesical pressure. When an abnormal sacral innervation is demonstrated by electrocystometry, selective root blockade with phenol may restore normal bladder function and micturition in some patients. Because of his knowledge of regional anatomy and neurophysiology the anaesthesiologist, acting as a member of a team, can contribute greatly to the overall care of patients with neurovesical dysfunction.

RÉSUMÉ

La miction et le fonctionnement normal de la vessie sont le résultat d'une activité nerveuse viscérale et somatique bien intégrée. La miction exige des actions réciproques complexes entre la force de retenue et la résistance au courant de sortie et l'on peut démontrer l'existence d'anomalies de cette activité réciproque par la stimulation percutanée de certaines racines sacrées et la mesure concomitante des changements de pression intravésicale. Si l'électrocystométrie met en évidence une innervation sacrée anormale, chez certains malades, un blocage au phénol de certaines racines peut rétablir une miction et un fonctionnement vésical normaux. Cette connaissance de la neurophysiologie et de l'anatomie régionale permet à l'anesthésiste, faisant partie de l'équipe, de contribuer grandement aux traitements des malades souffrant de dysfonction neurovésicale.

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