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THE MANAGEMENT OF THE CORD BLADDER

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Infection of the urinary system is generally held to be the main cause of death in paraplegic patients.[1] Proper management of the bladder has been one of the chief reasons for the reduction of mortality figures to as low as 1·5% in 350 patients treated at Baragwanath Hospital, and this article is a résumé of the methods used at this hospital.

ANATOMY

The bladder is emptied by the detrusor muscle. Continence is maintained by the internal sphincter, containing both smooth and striated muscle, and the external sphincter, which consists of striated muscle only. The nerve supply of the bladder includes the parasympathetic and sympathetic systems, and a somatic nerve supply to the external sphincter. The parasympathetic supply comes from S 2, 3 and 4, and is motor to the detrusor muscle and the internal sphincter. The internal sphincter is reciprocally inhibited when the detrusor contracts. The parasympathetic nerves are also sensory to the bladder.

The sympathetic supply comes from as high as T 10 spinal segment along the sympathetic chains and through the presacral nerve; it is relayed in the pelvic plexuses. From there the fibres go to the bladder wall where vasomotor impulses are supplied to the blood vessels and motor impulses to the trigonal muscle. The sympathetic nerves convey sensory fibres which are stimulated by distension of the bladder.

The external sphincter has a somatic supply from S 2, 3 and 4. The muscles of the pelvic floor are also supplied by the same nerves. Micturition can be voluntarily inhibited by contracting the pelvic floor and the external sphincter, with reciprocal relaxation of the detrusor.

The bladder is emptied by contraction of the detrusor muscle, associated with relaxation of the internal and external sphincters and the pelvic floor. The bladder descends a little at the same time. The abdominal muscles can also aid in emptying the bladder.

The ice-water test can be used to see whether the reflex arc along the parasympathetic nerves from the bladder mucosa to the spinal cord and back to the detrusor is intact. An amount of 2-3 oz. of water at 38°F. is instilled into the bladder through an F 16 whistle-tip catheter. If the water is returned immediately, the arc is intact. If not, the catheter is removed and, if the water is returned within a minute, the arc is still taken to be intact.

To test whether the somatic arc through S 2, 3 and 4 is intact, the bulbocavernosus and anal reflexes are used. The bulbocavernosus reflex is elicited by pulling sharply on the catheter or pinching the glans penis. If present, the anal sphincter will contract. The anal reflex is elicited by pricking the skin around the anus. If present, the anal muscles will contract. The finger can also be introduced into the anus, and if the reflex arc is intact the anal muscles will contract on pricking the peri-anal skin.

NEUROGENIC BLADDERS

Five different types of neurogenic bladder are recognized:

1. *Uninhibited Neurogenic Bladder*

The cerebral cortex or the long tracts between the cortex and the sacral bladder centre at S 2, 3 and 4 are partially damaged and the patient suffers from urgency and precipitancy. The patient can still pass urine voluntarily.

2. *The Sensory Neurogenic Bladder*

The nerve fibres conveying sensation from the bladder are interrupted and the patient does not feel that the bladder is overdistended — overflow incontinence occurs. Conditions in which this is found are tabes dorsalis, diabetes and disseminated sclerosis.

3. *The Motor Neurogenic Bladder*

The motor nerves are interfered with, as in infantile paralysis. The patients have normal bladder sensation, but are unable to void. Up to 10-20% of patients with poliomyelitis may be affected in this way.[6] The condition is, fortunately, usually temporary.

4. *Automatic Bladder or Upper-motor-neurone Bladder*

This type of bladder occurs when the spinal cord is transected above S 2, 3 and 4 segments. The bladder empties reflexly with a strong contraction of the detrusor, usually leaving little or no residual urine.

5. *Autonomous Bladder or Lower-motor-neurone Bladder*

This type of bladder occurs when the spinal cord is injured at S 2, 3 and 4 segments or at the corda equina below it. The contractions of the detrusor are dependent on a reflex arc in the bladder wall. The contractions are weak, and the bladder empties incompletely and is dilated.

Neurogenic Bladders in Spinal-cord Injuries

The types of neurogenic bladder found in spinal-cord injuries are the automatic (or upper-motor-neurone bladder) and the autonomous (or lower-motor-neurone bladder). Since the sacral bladder centre in S 2, 3 and 4 spinal segments lies roughly opposite L1 vertrebra, lesions above L1 will result in an upper-motor-neurone bladder, and lesions at L1 or below in a lower-motor-neurone bladder.

Bors[2] has divided each type of bladder into a balanced bladder and an unbalanced bladder. A balanced upper-motor-neurone bladder has a residual urine of less than 20% of its capacity. The residual usually amounts to less

than 2 oz. An unbalanced bladder has a residual urine of more than 2 oz. and such a patient cannot safely live without a catheter. In the case of a lower-motor-neurone bladder, a residual of greater than 10% of its capacity, or usually more than 1½ oz., makes it an unbalanced bladder, and a catheter is essential.

Immediately after the spinal cord has been injured, a state of spinal shock supervenes. The internal sphincter closes (the external sphincter at this stage is usually flaccid) and retention of urine occurs. This state may last for a day or up to more than a year. The contractions of the detrusor return slowly; good contractions develop in the case of an upper-motor-neurone bladder and weak contractions in the case of a lower-motor-neurone bladder.

MANAGEMENT OF THE CORD BLADDER

To develop good bladder function the patient's general condition must be good. The patient must be turned 2-hourly day and night to prevent bedsores. Bedsores must be excised and grafted if necessary. The haemoglobin level must be kept above 13 G. per 100 ml. by transfusion if necessary. A high-protein diet must be given. Fluid intake must be a glass of water every hour to maintain a high urinary output. The patient must be got out of bed and moved in a wheel chair as soon as possible.

To keep a check on urinary function an intravenous pyelogram should be performed as soon as possible and then yearly or more often if indicated. The same holds for panendoscopy, blood-urea estimations and cysto-urethrograms.

Catheterization and Other Drainage

During the stage of urinary retention the bladder is emptied first by 8-hourly catheterization (as advocated by Guttmann[3] from the Stoke Mandeville Paraplegic Centre) for the first few days until the urethral mucosa is conditioned to the presence of a catheter. Then an indwelling catheter is left *in situ;* this is changed weekly to prevent blockage and encrustation which can lead to stone formation. Nowadays the tendency is to dispense with the 8-hourly catheterization, and to drain the bladder with an indwelling Gibbon's catheter from the start.

The catheterization must be aseptic. The catheters must be smaller than F 16 to prevent pressure sores in the urethra, and if a Foley's catheter is used, the size of the bag must be 5 ml. The polythene Gibbon's catheter has been used for the last 2 years at Baragwanath Hospital and seems to be the catheter of choice, since the smooth polythene causes minimal urethral irritation and the size of the lumen is bigger than that of a Foley's catheter with the same external diameter. The catheter and penis must be strapped up on to the abdomen (Fig. 1), otherwise a penoscrotal fistula is very liable to form. As long as the patient is having catheter drainage he must be given a urinary antiseptic to combat infection. At Baragwanath Hospital bladder washouts are seldom used, except in the presence of severe infection.

Tidal drainage[4] is going out of fashion and is not used at Baragwanath Hospital. It entails a lot of work, since the level of the siphon has to be re-adjusted every time the patient is turned. Bladder contractions develop as easily without tidal drainage as with it. The bladder can be distended rhythmically by clamping and unclamping the catheter hourly; this helps to prevent contracture of the bladder. Simple straight drainage can also be used.

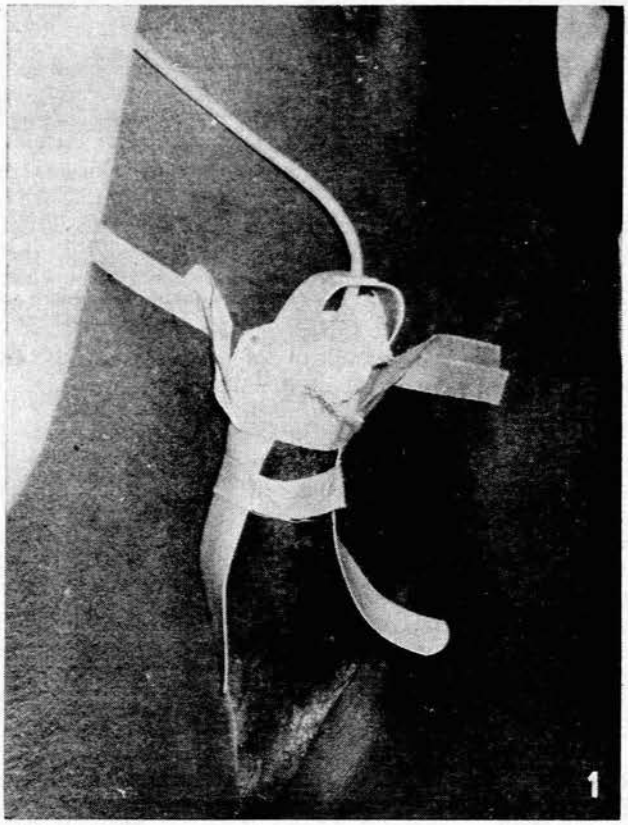

Fig. 1. Catheter and penis strapped up on to the abdominal wall.

Cystometry is done every 4 weeks to see when contractions of the detrusor muscle are returning. Excretory cystometry[4] is the most physiological method.

Resistance offered by the external and internal sphincters can be measured by a sphinctometer devised by Bors,[5] using an 'asepto' bladder syringe and a T-connection, which is connected to the cystometer. By this means the resistance offered by the sphincters can be compared with the strength of the contractions of the detrusor muscle as estimated by cystometry.

When bladder contractions develop, the patient is taken off catheter drainage and the residual urine is estimated as soon as the patient has passed urine. If the bladder is balanced, the catheter can be left out permanently. Many patients may have to revert to catheter drainage later if the urine becomes infected or the bladder becomes unbalanced for some other reason.

Suprapubic drainage is used under battlefield conditions where facilities for aseptic catheterization do not exist. It is also used if perineal abscesses or fistulae make catheter drainage difficult. Patients with suprapubic cystostomies tend to develop contracted bladders, cystitis and stones.

Lower-motor-neurone bladders can be emptied by Credé expression at fixed times if the resistance offered by the sphincters is not too great.

Balancing the Bladder

To obtain a balanced bladder, anaesthetic blocks, neurectomies, and transurethral resections of the bladder neck can be performed.

The simplest block by means of which a balanced bladder may be temporarily, or in some cases even permanently, obtained, is a bladder mucosal block in which 2 - 3 oz. of a 0·25% pontocaine solution is instilled into the bladder. This blocks a reflex arc between the bladder mucosa and the pelvic floor, allowing relaxation of the pelvic floor during voiding. After the block residual urine is estimated and a delayed residual-urine estimation is done again the next day. This block can be repeated as often as necessary.

The other nerve block that is used is the pudendal nerve block. This can also be repeated as often as is necessary.

More radical procedures can be adopted after about a year if the bladder is not yet balanced. A pudendal neurectomy can be done if a pudendal block has helped. It is first performed on the dominant side (that is on the right-hand side in right-handed people), and if not successful, on the other side as well. A bilateral pudendal neurectomy will cause the power of erection to be lost, and this will have to be taken into consideration.

If nerve blocks are not effective, transurethral resection can be done. This is the method of choice in lower-motor-neurone bladders in which nerve blocks are not of much help. Small amounts of tissue can be taken away in several sittings. Even bladders with wide-open necks may improve. Transurethral resection may be combined with pudendal nerve blocks or neurectomies in upper-motor-neurone bladders.

Sometimes the external sphincter is contracted and fibrosed and causes the block. It can then be resected.

Severe adductor spasms may prevent a bladder from becoming balanced. An obturator neurectomy may have the necessary effect.

Patients with severe flexor spasms and hyperactive bladders can be improved by intrathecal alcohol or phenol injections.[4] These convert the bladder into a lower-motor-neurone bladder with good capacity, which can be emptied by Credé expression. Erection is abolished, however.

Severely contracted bladders can be replaced by ilial bladders or conduits.

Some patients never become catheter-free, and some prefer a catheter.

Drugs

To stimulate bladders to contract, especially in incomplete lesions, 'urecholine', 30 mg. *t.i.d.*, or mecholyl, carbachol, furmethide, or 'prostigmine' can be used.

To inhibit the bladder, especially in hyperactive bladders, 'pro-banthine' or ephedrine may be used.

COMPLICATIONS

Infection is the greatest complication. Scrupulous aseptic technique must be used in catheterization. A large fluid intake must be maintained and the patient must be given urinary antiseptics as long as he is having catheter drainage. The organisms causing most trouble are *B.coli* and *B.proteus*. Often they are sensitive only to kanamycin.

Stones are common in Europe and the USA. The incidence of stones at Baragwanath Hospital is 2% (100 cases analysed); they are normally uncommon in the Bantu. Stones are combated by a high fluid intake and control of infection. The patients are got out of bed as soon as possible to prevent excessive osteoporosis. Alkalinizing the urine assists stone formation, while acidifying it increases the osteoporosis.

Bladder stones should be crushed before they become too big. Renal calculi should be treated by conservative surgery, the object being to preserve all renal tissue, since the patients usually die from renal failure.

Urethritis leads to peri-urethral abscesses, and urethral diverticulae and fistulae. The dangers of a catheter larger than F 16 have already been mentioned. Failure to strap the catheter up on to the abdomen leads to penoscrotal fistulae. Prostatic abscesses and epididymo-orchitis may also occur.

A vesico-ureteral reflux occurs in some patients and is detected on cysto-urethrograms. Such patients have to have catheter drainage to relieve the back pressure on the kidneys.

Attacks of autonomic hyperreflexia[4] occur in patients with cord lesions above the splanchnic outflow of the sympathetic system. Attacks of severe hypertension with a blood pressure of more than 200 mm. Hg systolic, pounding headache, bradycardia, sweating, and stuffiness of the nose, come on if the bladder is overdistended from blockage of the catheter or during cystoscopy. The distention must be relieved immediately. 'Ansolysen' is given intravenously to lower the blood pressure, and sometimes 2 - 3 oz. of 0·25% pontocaine solution have to be instilled into the bladder to stop severe bladder spasms which maintain the syndrome.

If this syndrome occurs frequently because of a catheter which cannot be tolerated in the bladder, or arises from some other stimulus, it can be abolished by intrathecal alcohol or phenol injections.

Female patients present a special problem. Because the female urethra is short, urine tends to leak alongside the catheter. Bigger catheters are inserted until the urethra is dilated to the size of the bladder. The urethra has then to be closed, and this is usually accompanied by a high rate of breakdown of the suture line. Then a suprapubic cystostomy has to be performed, or an ilial conduit must be substituted. Female patients with reflex bladders cannot keep themselves dry by leading the urine through a condom into a portable urinal as male patients can do. Some of them can stimulate their bladders to empty by suprapubic tapping or by stroking the inside of the thigh, and so keep themselves dry.

Male patients who are catheter-free and without good bladder control can be fitted with a condom over the penis to lead the urine into a portable urinal. Some who leak a little urine occasionally only, keep cottonwool in a plastic bag between their legs to absorb the urine.

SUMMARY

1. Infection of the urinary tract is the greatest cause of death in paraplegic patients.

2. The nerve supply of the bladder and the muscles playing a part in micturition are described.

3. The different types of neurogenic bladder are described.

4. To become catheter-free the patient must be as fit as possible.

5. For the first few days after the onset of paraplegia the patient is catheterized intermittently, or continuous drainage with a Gibbon's catheter can be started immediately.

6. A patient is taken off catheter drainage once the residual urine is less than 2 oz. in an upper-motor-neurone bladder, or 1½ oz. in a lower-motor-neurone bladder.

7. Mucosal blocks, nerve blocks and transurethral resections can assist in obtaining a balanced bladder.

8. The main complications are urinary infection, stone formation, urethral fistulae, vesico-ureteral reflux and autonomic hyperreflexia.

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REFERENCES

1. Dietrick, R. B. and Russi, S. (1958): J. Amer. Med. Assoc., **166,** 41.
2. Bors. E. (1957): Urol. Surv., **7,** 177.
3. Guttmann, L. (1949): *British Surgical Practice*, vol. 6. London: Butterworth.
4. Comarr, A. E. (1959): Brit. J. Urol., **31.** 1.
5. Bors, E. (1948): J. Urol. (Baltimore), **60.** 287.
6. Lawson, B. B. and Garvey, F. K. (1947): J. Amer. Med. Assoc., **135,** 93.