Urological Management of the Patient with Spinal Cord Injury

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SUMMARY

A total of 515 patients with spinal cord injuries were admitted to the Conradie Hospital's Spinal Cord Injuries Centre during a 3-year period from September 1974 to September 1977.

Intermittent catheterization was used for urinary drainage in all patients with incomplete lesions as initially assessed neurologically, and indwelling catheterization in those with complete lesions. Transcutaneous suprapubic Bonnano (stab) continuous catheter drainage was used in a random group of 24 male patients with complete neurological lesions. The majority of the patients were admitted within 24 hours of injury. The follow-up period varied from 1 to 4 years.

At 3 months more than 50% of patients had a balanced neurogenic bladder and were catheter-free. At 12 months 19% of patients were still catheter-dependent for reasons explained. Bladder outlet operations were more frequent among patients with thoracic lesions and were indicated 3 times more often in patients with complete neurological lesions. Bladder outlet operations were performed on 8.6% of patients. Only 5 patients (1%) required permanent urinary diversion.

A urodynamic work-up is no longer regarded as merely a research tool in the investigation of patients with neurogenic bladder dysfunction. Both urodynamic and videoradiological techniques are a prerequisite to proper management of the neurogenic urinary tract.


Mastering the technique of emptying the paralysed bladder can be equated with enjoyment of health, prolongation of life and social acceptance for a paraplegic patient. Spinal cord injury is almost invariably followed by a period of spinal shock; bladder areflexia with urinary retention makes some form of bladder drainage essential during this period, to prevent overdistension of the bladder and its sequelae.

The type, level and completeness of the spinal cord injury, as well as the correct early management of the neurogenic bladder, all profoundly influence the ultimate urological status and therefore the long-term prognosis.

CLINICAL MATERIAL

Between September 1974 and September 1977 a total of 515 patients with spinal cord injuries were admitted to the Conradie Hospital's Spinal Cord Injuries Centre. The majority of patients were airlifted from outlying regions, covering the Cape and Eastern Provinces, including Transkei. Stab wounds accounted for 26% of the injuries.

The sex incidence was similar to that in other reported series, 85% being male and 15% female.

Mortality

The majority of the 59 deaths, usually within 10 - 14 days of injury, were due to respiratory problems as a result of high or ascending spinal cord paralysis. This is similar to the 12% mortality reported previously from the same unit by Key.

Level and Extent of Spinal Lesion

Cervical spinal cord lesions accounted for 253 (49%), thoracic spinal lesions for 216 (42%) and lumbodorsal including cauda equina lesions for 46 (8.9%). Complete lesions accounted for 219 (42.5%) and incomplete lesions for 296 (57.5%) of cases. In 76% of the patients bladder function was of the reflex neurogenic type, in 4.8% of the lower motor neuron type, and in 18.9% it was normal or near normal.

METHODS OF URINARY DRAINAGE AND INITIAL MANAGEMENT

The majority of patients were catheterized soon after injury, usually within 24 hours, prior to transfer to the Spinal Cord Injuries Centre. After admission, all patients with incomplete lesions were started on intermittent catheterization 6-hourly round the clock. A sterile aseptic technique was used. All catheterizations were done by trained nursing staff, the ideal being a catheter team specially trained for this purpose. All those with complete lesions were left with indwelling urethral catheters, no larger than size 16 Foley, which were changed weekly. The catheter was strapped to the abdomen, to straighten the natural curve of the urethra at the penoscrotal junction and thus avoid pressure necrosis on the floor of the urethra. A fluid intake of at least 3 litres was encouraged. Patients on intermittent catheterization required fluid restriction to no more than 2 litres per 24 hours.

As a trial, 24 male patients with complete cord lesions had their bladders drained by percutaneous suprapubic Bonnano (stab) catheter drainage from the time of admission. The Bonnano catheter used was a 14 pigtail Teflon catheter introduced by using an 18-puncture needle as a stent, after the bladder had been filled to capacity via an urethral catheter. A continuous closed drainage
system including a cystoflow bag with a non-return flow valve was used. The Bonnano catheter was irrigated daily with 20 ml 0.25% acetic acid solution followed by saline to clear the catheter of any concretions. Catheter urine was cultured weekly. No chemotherapeutic prophylaxis was used, but any significant urinary infection was treated with the appropriate antibiotic.

A full urological assessment at 12-16 weeks included an intravenous pyelogram (IVP), micturating cysto-urethrogram and cystometrogram. Cystography with ice-cold contrast medium to obtain a voiding picture in patients with poor reflex detrusor contraction was found useful, particularly to distinguish outlet obstruction at the bladder neck from that at the external urethral sphincter, as reported by Pearman et al.²

Bladder training was attempted provided the patient had (i) normal upper tracts on IVP and no ureteric reflux; (ii) sufficient bladder tone and effective uninhibited contractions (i.e. above 50 cm H₂O pressure of bladder on cystometry) in upper motor neuron bladders; (iii) minimum detrusor sphincter dyssynergia; (iv) a urinary tract free of significant infection; (v) good expressibility (manual and abdominal) in lower motor neuron bladders.

The patient also had to be well motivated and cooperative, with good bowel evacuation.

**RESULTS**

At 12-16 weeks 53% of patients were free of the catheter with a balanced neurogenic bladder. At the end of 1 year a further 28% became catheter-free, leaving 19% still catheter-dependent for reasons to be discussed (Table I). Only 8 patients initially on intermittent catheterization switched to indwelling catheter drainage and 10 patients required a condom and bag appliance for poor control at 1 year. The average period of intermittent catheterization was 2 weeks (range 24 hours - 8 weeks). One woman is doing well on intermittent self-catheterization at 1 year. Eighty-five per cent of all stab wound injuries were incomplete Brown-Séquard type lesions.³ More than 90% of these patients were catheter-free and did not require any appliance at 1 year. Only 50% of patients with anatomical dorsiolumbar fracture dislocations had a lower motor neurone type bladder. The majority managed to void by abdominal straining or Crédé’s expression, but 50% of these patients required an appliance because of incontinence or for convenience. Only 1 patient was left with an indwelling catheter at 1 year.

Of the 24 patients on Bonnano catheter drainage, 13 were drained for an average of 4 weeks and the other 11 for an average of 8 weeks. At 6 weeks only 2 patients were relatively free of significant infection; most had a significant urinary tract infection at 4 weeks. At 12 weeks 75% had switched to indwelling urethral catheter drainage and at 1 year 30% were still catheter-dependent (Table II). There was a significantly higher incidence of resistant urinary tract infection and bladder calculi (Table III).

**DISCUSSION**

The benefit of intermittent catheterization in spinal cord injury patients is well established.⁴ This report once again confirms this.

Intermittent catheterization was limited to all patients with incomplete lesions admitted to our unit because of the large number of admissions and the resultant demands upon medical and nursing staff. It is also known that patients with incomplete lesions require a shorter period of bladder drainage before return of reflex micturition, provided no overdistension of the bladder or infection has occurred. Intermittent catheterization allows some distension of the bladder which is a physiological stimulus for micturition, promoting earlier return of detrusor activity. With complete lesions, reflex bladder activity tended to appear later, only after 6-8 weeks or even later if complications had been present.

It is well established that intermittent catheterization markedly reduces the incidence of urinary tract infections and almost eliminates urethral complications. Above all it results in a larger percentage of patients becoming catheter-free earlier. Of the patients on intermittent catheterization, hence with incomplete lesions, 95% were catheter-free by 6 months. Of those on indwelling catheter
drainage, hence with complete lesions, only 58% were catheter-free by 6 months. The regrettably large number of patients (19%) still catheter-dependent at 12 months was due to associated complicating factors, either urological or non-urological.

Urological complications necessitating indwelling catheter drainage included: (i) non-reactive bladder (delayed spinal shock); (ii) recurrent bladder infections; (iii) urethral fistula; (iv) intractable urethral stricture; (v) severe ureteric reflux; (vi) a small-capacity, irritable urinary bladder in females (too-frequent voiding).

Non-urological complications necessitating indwelling catheter drainage included: (i) tetraplegia and inability to use an appliance, often owing to poor social circumstances at home; (ii) inability of female patients to get on or off a toilet, lack of satisfactory appliance, obesity, or tetraplegia; (iii) poor control with incontinence during physiotherapy and occupational therapy in females; (iv) autonomic dysreflexia resistant to treatment; (v) patient's choice for convenience; (vi) extensive pressure sores; (vii) intractable spasticity of the lower limbs not amenable to drug or surgical treatment; (viii) discharge against advice before attaining a catheter-free, balanced bladder; (ix) small penis impractical for condom and bag.

Percutaneous Suprapubic Bonnano (Stab) Catheter Drainage

This method, described by Riches as long ago as 1943, was designed to provide a safe technique of bladder drainage with minimal nursing and medical care, and sparing of the urethra. A recent report by Cook and Smith on 41 patients treated by this method is encouraging. Forty-three percent of their patients remained free of urinary tract infection for an average period of 7 weeks while on percutaneous suprapubic catheter drainage. The majority, however, required long-term intermittent catheterization and 23% required further indwelling catheters. The majority of patients later developed urinary tract infection. From our experience with a small number of patients this method of bladder drainage appears to have shortcomings and limitations. Probably it should be reserved for patients in whom intermittent catheterization is not possible, such as those with urethral strictures, urethral bleeding as a result of catheterization, or false passages making intermittent catheterization difficult. Possibly a larger-calibre, Porges-type cannula, made of Silastic and of superior quality, may give better results, as reported by Smith et al.

Pharmacological Management

In patients who satisfied the criteria for bladder train-
transurethral bladder neck incisions. The incidence of various operations in our series is compared with that in O'Flynn's\textsuperscript{58} 1976 series in Table V; 80\% of our patients underwent external sphincterotomy only, in contrast to 20\% reported by O'Flynn. Combined operations were necessary in 5 of our patients (16\%) with no repeat operations. In 1 case a bladder neck incision only was performed. No females required bladder outlet surgery. Venous bleeding was rarely troublesome and there was little or no complaint of impotence. The incidence of outlet obstruction surgery in this survey was much lower than the previously reported incidence of 22.2\% from the same unit.\textsuperscript{9} The Liverpool spinal centre\textsuperscript{11} in 1976 reported a 23\% incidence and O'Flynn\textsuperscript{59} a 29.5\% incidence of surgery for outlet obstruction. Secondary or repeat operations were done in 2 patients only, within 1 year after the initial operation. This differs from the secondary operation rate of 52\% reported by O'Flynn.\textsuperscript{10}

One of the reasons for the high incidence of repeat operations was that the first operation was performed too early, within the first year before bladder outlet function had time to stabilize. Delaying intervention during the first year, as advocated by Bors and Comar\textsuperscript{12} and as practised by us, may mean that more patients are on catheter drainage for longer. It is our policy, certainly in incomplete lesions, to delay external sphincterotomy until at least 12 months after injury and not to perform it before 6 months in complete lesions.\textsuperscript{13} This allows for maximal neurological recovery and non-interference with the continence mechanism if present, particularly in females for whom no appliance is available. The other reason for the lower incidence of outlet operations in our patients was that of the 45 patients with evidence of hold-up at the external sphincter level on a voiding cystourethrogram, this represented a radiological finding only and was not associated with significant detrusor-sphincter dyssynergia.

**Surgical Technique**

Division of the external sphincter for a neuropathic bladder is now a well-established surgical procedure, first carried out by Ross.\textsuperscript{14} We used the same technique as described by Ross et al.\textsuperscript{15} A recent report of anteromedian external urethral sphincterotomy (at the 12 o'clock position) in neuropathic bladders with the direct-vision Storz electro-knife and a 30° lens shows that results are at least as good as with the 3 and 9 o'clock incisions, while morbidity from haemorrhage is claimed to be much less.\textsuperscript{16}

Functional outlet obstruction in the reflex neurogenic bladder occurs more frequently at the external sphincter level than at the bladder neck. In lower motor neuron lesions, bladder outlet obstruction usually occurs at the bladder neck and is usually diagnosed when voiding cysto-

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**Fig. 1.** Micturating cysto-urethrogram showing bilateral ureteric reflux and hold-up at the external sphincter level in a paraplegic patient with a complete lesion at T8.

**Fig. 2.** Micturating cysto-urethrogram in the same patient as in Fig. 1 after external sphincter had been cut. Note absence of reflex and the wide open posterior urethra with no hold-up at external sphincter level.
urethrogramy is combined with manual expression of the bladder. This shows as a failure of the bladder neck to open and an undilated posterior urethra. Failure to respond to phenoxybenzamine is an indication for bladder neck incision. The transurethral incision of the bladder neck is made with a Collings diathermy knife electrode through the full thickness of the muscle layer from a point distal to the interureteric ridge, ending proximally to the verumontanum at the 6 o'clock point. Bleeding is minimal and easily controlled by diathermy coagulation. Postoperatively, a size 24 Foley catheter is left indwelling for 2 days, then changed to an 18 Foley for 8-12 days, after which intermittent catheterization and bladder training are resumed.

### TABLE V. COMPARISON OF INITIAL OPERATIONS FOR BLADDER OUTLET OBSTRUCTION

<table>
<thead>
<tr>
<th>Operation</th>
<th>Present</th>
<th>O'Flynn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transurethral incision</td>
<td>3.0%</td>
<td>0.7%</td>
</tr>
<tr>
<td>External sphincterotomy</td>
<td>80.0%</td>
<td>20.0%</td>
</tr>
<tr>
<td>Combination of above</td>
<td>16.0%</td>
<td>11.0%</td>
</tr>
<tr>
<td>Urinary diversion</td>
<td>1.1%</td>
<td>1.4%</td>
</tr>
</tbody>
</table>

### Urological complications

Vesico-ureteric reflux is commoner in tetraplegics and in patients paralysed for more than 4 years, as previously reported by Scher. In the neuropathic urinary tract, fullness of the ureters and pelvicalicial system is frequently seen on IVP and does not necessarily indicate outlet obstruction or reflux into the ureters. Hopefully, with the use of intermittent catheterization in all our patients in future, the high incidence of pyelonephritis (17%) should be markedly reduced. The incidence of urethral complications and epididymo-orchitis was surprisingly low, considering the large percentage of our patients with indwelling catheter drainage at 1 year (Table VI).

Urinary diversion is rarely indicated and is not without significant complications in the patient with a neuropathic bladder, despite careful technique and follow-up. The main indications in our 5 patients were one or more of the following: (i) failure to achieve balanced bladder function and inability to tolerate a urethral catheter; (ii) persistent reflux with deterioration of the upper tracts; (iii) persistent incontinence in the female patient despite catheter drainage, owing to a small, contracted bladder; and (iv) progressive deterioration of the upper tracts despite an apparently balanced bladder.

In the present survey 3 patients required urinary diversion to a colonic conduit, 1 had an ileal conduit and 1 had permanent suprapubic catheter drainage.

### CONCLUSION

A better understanding of the pathophysiology of the bladder and proximal urethra in neurological disorders has put management on a sound rational basis. The modern application of urodynamic and videoradiological techniques in the investigation of detrusor sphincter imbalance in the spinal cord injury patient is essential. The previously unrecognized detrusor-sphincter dyssynergia in the bladder with apparently balanced function and low residual urine values may have accounted for the very high detrusor voiding pressure and upper tract problems. Management today should aim at initial intermittent catheterization of the neuropathic bladder after spinal cord injury, rendering the patient catheter-free as early as possible. Using both urodynamic and radiological investigative techniques to select and properly evaluate drug therapy and surgery is routine today in most units.

We wish to thank Dr. D. F. Smith, Medical Superintendent of Conradie Hospital, for permission to publish. A special word of thanks to the nursing, physiotherapy and occupational therapy staff for their continued devotion and care.

### REFERENCES


### TABLE VI. UROLOGICAL COMPLICATIONS IN THE SPINAL CORD INJURY PATIENTS UNDER SURVEY

<table>
<thead>
<tr>
<th>Complication</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pyelonephritis on IVP</td>
<td>78</td>
<td>17.1</td>
</tr>
<tr>
<td>Reflux</td>
<td>20</td>
<td>4.3</td>
</tr>
<tr>
<td>Dilated upper tract</td>
<td>17</td>
<td>3.7</td>
</tr>
<tr>
<td>Resistant hyperreflexia</td>
<td>21</td>
<td>4.6</td>
</tr>
<tr>
<td>Hold-up at external sphincter</td>
<td>45*</td>
<td>9.8</td>
</tr>
<tr>
<td>Bladder calculi</td>
<td>29</td>
<td>6.4</td>
</tr>
<tr>
<td>Ureteric calculi</td>
<td>2</td>
<td>0.4</td>
</tr>
<tr>
<td>Pyonephrosis</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Traumatic rupture of kidney</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Epididymo-orchitis</td>
<td>14</td>
<td>3.0</td>
</tr>
<tr>
<td>Urethral stricture</td>
<td>51</td>
<td>1.0</td>
</tr>
<tr>
<td>Urethral diverticulum</td>
<td>4</td>
<td>0.8</td>
</tr>
<tr>
<td>Urethral fistula</td>
<td>2</td>
<td>0.4</td>
</tr>
<tr>
<td>Large bladder diverticulum</td>
<td>1</td>
<td>0.2</td>
</tr>
</tbody>
</table>

* Fourteen not cut.
† One due to traumatic rupture of urethra.