EARLY TREATMENT OF THE BLADDER IN TRAUMATIC PARAPLEGIA

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Disordered bladder function in traumatic paraplegia is only one of the many problems presented by such patients and successful treatment of this one aspect cannot be achieved by even the most meticulous management of the urinary tract without successful treatment of the patient as a whole. All the problems of traumatic paraplegia such as are concerned with the orthopaedic lesion—the bladder, the bowels, the skin, the circulation or the muscles—are inter-related and each is as much dependent on the whole as the whole is dependent on each integral part. Sores, sepsis, muscle spasms, prolonged recumbency and immobility all produce profound structural and functional changes in the urinary tract and, because of this, great care must be taken to avoid the development of complications in one system while special attention is being given to the treatment of another.

For this paper analysis has been made of the first fifty patients with paraplegia who were admitted to the unit over a period of four years. All were admitted within a few hours or days from the time of injury and they all had the same régime of general treatment as well as the same method of bladder management. They include eleven cervical, six thoracic, twenty-five thoraco-lumbar and eight lumbar spinal injuries.*

MANAGEMENT OF THE PATIENT AS A WHOLE

Orthopaedic measures—Specific orthopaedic measures were used on twenty-eight occasions and, except in two cases of cervical injury in which skull traction was employed, the operative procedure was one of open reduction and internal fixation (Holdsworth and Hardy 1953). No patient was immobilised in plaster.

Nursing—All the patients were nursed on ordinary mattresses on spinal beds. The natural curves were supported by pillows and initially each patient was rolled in bed at two-hourly intervals throughout the day and night. This time interval was increased after some weeks and lengthened according to the reactions observed in the skin and subcutaneous tissues.

From the fourth week onwards the upper half of the spinal bed was racked up for several periods each day, and mobilisation to the chair stage was attained after a further four to eight weeks according to individual circumstances.

Skin—The skin over the bony prominences in the paralysed areas was massaged with soap and water, dried and powdered at least once each day. All areas could be observed at all times of the routine two-hourly turns.

Diet—The normal diet was supplemented by extra protein in the form of cheese and meat. A liberal fluid intake of between six and eight pints daily was encouraged and easily maintained by most patients.

Bowel control—Inopportune incontinence and soiled linen were reduced to a minimum by the regular use of laxatives, aperients, enemas and manual evacuation of the rectum either singly or in combination according to the return of reflex or other activity in the lower bowel.

Physiotherapy—Early active and passive physiotherapy included spring expander exercises for the upper limbs and passive movements of the lower. These were done several times daily.

Therapeutics—All patients were given iron in the form of ferrous sulphate three times a day and vitamins B and C. No antibiotics or chemotherapeutic agents were given as a routine, and eleven patients went right through their period of in-patient treatment without the use of penicillin, chloromycetin or other antibiotics.

General mobilisation—After the first few weeks the general activity of the patients was increased. They were encouraged to ease themselves in bed, to assist in their routine turnings

* The injuries described as thoracic and lumbar do not include those involving both the twelfth thoracic and first lumbar vertebrae, which are here called thoraco-lumbar.
and all nursing procedures, so that by the time they were ready for the chair stage they were in a confident and reasonable state of physical fitness.

**MANAGEMENT OF THE BLADDER**

With this outline of the general treatment in the background the management of the bladder can be dealt with more specifically. After spinal cord injury no organ can be more fickle and temperamental in its efforts at readjustment. In the first instance there is a phase of inactivity which may last from hours to many months. Then there is a phase of increasing reflex activity, when for long periods the reflex muscle contractions are of insufficient strength or duration to produce efficient emptying and the co-ordination of detrusor action and sphincter relaxation is very imperfect.

Co-ordinated reflex activity depends for its existence on an intact sacral cord. Its appearance or non-appearance can be predicted in some measure by the presence or absence of other reflexes using the same sacral segmental pathways, such as the bulbocavernous and anal skin reflexes and the ankle jerks. It can be observed in the first free efforts of urine voiding and recorded in part by cystometry. The latter unfortunately records only the power of detrusor action. It does not give information about sphincter co-ordination, which is equally, if not more, important.

Even after reflex activity has appeared there is a phase when the establishment of compensatory mechanisms such as manual compression, abdominal straining, abdominal massage and special postures take further time, and much depends on the ability and co-operation of the patient.

A type of bladder management must therefore be employed which will meet the demands of these potentially long periods, which will keep infection of both the upper and lower urinary tract to a minimum, which will avoid genital sepsis and at the same time permit frequent and easy observation of the state of efficiency of the bladder musculature.

Treatment must be designed primarily to prevent complications and secondly to encourage and reinforce reflex activity. It must continue not to the stage of unaided urine voiding but to the stage of efficient bladder emptying.

These objects can be achieved only by the principles of bladder drainage, bladder lavage, by frequent observation and by instruction of the patient.

**Methods of bladder drainage**—The various methods of bladder drainage are well known and will not be discussed here apart from comments on experiences gained from the treatment of other patients admitted to the unit.

**Drainage by manual compression**—It is not considered that the programme of control by manual compression should be used even though the incidence of infection has been thereby reduced in a number of cases. Experience shows that prolonged distension invariably occurs and hydronephrosis and hydro-ureter are early in evidence. This method can also be dangerous in high cord lesions when rupture of the bladder can occur. At its best it may be regarded as a form of retention with expressible overflow of varying amount.

**Drainage by intermittent urethral catheterisation**—This invariably leads to irregular and varied distension and almost certain infection, and the repeated irritation of the urethra adds even greater risks of infection than those of an indwelling urethral catheter.

**Drainage by suprapubic catheter**—This method has its advocates (Riches 1943, Donovan 1947, 1949), and it has occasional advantages, but experience gained from cases referred to this unit shows that the sinus always takes three or four weeks to heal and a period of urethral drainage is necessary ultimately. It is not considered that bladder training can be successfully attained while the bladder is attached to the anterior abdominal wall by a tube. The incidence of calculi is high, urine tends to “pond” and the ease with which the bladder is drained leads to a false sense of efficiency. Many suprapubic cystostomies have been maintained until chronic infection, fibrosis and bladder contracture were irreversibly established.
Drainage by perineal urethrostomy—This is only mentioned for the sake of completeness. One case only has been seen and it is thought that the risks of lying in a puddle of urine are far too great to make this theoretically ideal method of bladder drainage a practical possibility.

Drainage by indwelling urethral catheter—All the fifty patients under review have been treated by this method. With it the bladder capacity can be strictly controlled and distension easily avoided. Regular exercise can be given and the interior of the cavity kept clear of debris by bladder lavage. Strict asepsis can keep lower urinary tract infection and genital sepsis at a minimum, and at all times frequent and easy observations can be made on the efficiency of the bladder musculature. A more detailed analysis of this method of bladder management is set out below.

DETAILS OF BLADDER DRAINAGE BY INDWELLING CATHETER

The catheter—The indwelling urethral catheter is of the self-retaining Foley type, usually size 16 or 18 French gauge. This has been well tolerated and any urethral discharge can escape down the urethra alongside the catheter. Meatotomy or dorsal slit has been done where necessary to avoid the train of infection set up by a tight meatus or prepuce. The catheters have been changed each week irrespective of whether they were clean or dirty. To leave them in longer increases the liability of encrustation on the catheter tip and on the balloon in particular. On deflation of the latter phosphatic debris may be left in the bladder base, thus providing a focus for infection and stone formation.

The aseptic handling of the catheter cannot be over-emphasised. Changing is done with sterile forceps and gloves and at all other times a similar aseptic technique is followed. The meticulous attention to the details of asepsis is a most vital part of this method.

Drainage—The catheter is attached to a rubber tube, and urine is allowed to flow freely into a drainage bottle beneath the bed except at times when drainage is being controlled by the use of a clip on the tubing during the later stages of bladder retraining.

Irrigation—During its period of inactivity the bladder does not lie completely empty. At this stage it is astatic and rather like an old flat deflated rubber balloon. For this reason it is advisable in the early stages to employ a method of lavage that is certain to empty the bladder cavity at each operation. This has been achieved by suction with a Canny Ryall syringe. Twice daily the bladder had been cleared of debris, distended with half a pint or a pint of solution and then sucked clear of all fluid by the syringe.

The syringe suction is abandoned as soon as the tone of the bladder muscle is sufficient to clear its own cavity of debris and solution during washouts. The syringe is then replaced by a closed manually operated system of irrigation (Nesbit and Gordon 1941, Prather 1947) in which the irrigating solution, irrigating jar and tubing are autoclaved as a single unit. The quantity of fluid used can be easily controlled, and the force of the irrigation is regulated by the height of the reservoir. This operation is repeated several times each day while free drainage is maintained in the intervals. The solution used is Suby’s solution M, which has a pH of 5·5 (Suby and Albright 1943).

Tidal drainage (Munro 1943) has not been used because it has often been found to produce a condition of retention with automatic overflow, particularly in the early phases of bladder inactivity. In these circumstances it does not remove debris effectively and the apparatus itself needs much attention.

Manual control of catheter drainage—The manual control of catheter drainage has already been mentioned. A screw clip is applied to the drainage tube and operated by the patient in an endeavour to simulate normal bladder activity. Normal or perverted sensations of bladder fullness can be noted by the patient and at the same time he can practise voiding by abdominal straining or manual compression.

Perverted sensations produced by bladder fullness are common in paraplegia. They may appear as vague suprapubic discomfort, as sweating, as fluttering in the buttocks and in
many other ways. They are all important because they are signs of impending bladder activity and if developed can give sufficient warning to be of practical value to the patient.

Trials without a catheter—Each week, when it has been removed for routine changing, the catheter is left out for a trial period of several hours during which observations are made on the bladder’s ability to void urine. As soon as some evidence of voiding occurs the trials are continued over longer periods and at the end of each the residual urine is withdrawn and the amount measured. The volume of the residual urine depends on the efficiency of the voiding power of the bladder, and the trial periods without the catheter are continued at weekly intervals until the residual urine is far less than the amount voided at any one time.

At this stage the catheter is left out for several days at a time and the residual urine estimations again repeated at regular intervals until it is apparent that the voiding power is adequate to prevent an insidious increase in the volume of urine left in the bladder.

### Table 1

<table>
<thead>
<tr>
<th>Bony level</th>
<th>Neurological state</th>
<th>Number of cases</th>
<th>Catheter period (weeks)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Actual</td>
</tr>
<tr>
<td>Cervical</td>
<td>Complete</td>
<td>5</td>
<td>2 to 56</td>
</tr>
<tr>
<td></td>
<td>Incomplete</td>
<td>6</td>
<td>3 to 16</td>
</tr>
<tr>
<td>Thoracic</td>
<td>Complete</td>
<td>6</td>
<td>12 to 23</td>
</tr>
<tr>
<td></td>
<td>Incomplete</td>
<td>0</td>
<td>—</td>
</tr>
<tr>
<td>Thoraco-lumbar</td>
<td>Complete</td>
<td>20</td>
<td>2 to 34</td>
</tr>
<tr>
<td></td>
<td>Incomplete</td>
<td>5</td>
<td>1 to 13</td>
</tr>
<tr>
<td>Lumbar</td>
<td>Complete</td>
<td>6</td>
<td>12 to 53</td>
</tr>
<tr>
<td></td>
<td>Incomplete</td>
<td>2</td>
<td>2 and 4</td>
</tr>
</tbody>
</table>

A residual urine of 25 per cent of the total bladder capacity is regarded as a reasonable amount to allow of cessation of catheter drainage.

Table 1 shows the duration of the catheter periods which had to be maintained until satisfactory voiding was attained. It will be noticed that all the patients with incomplete neurological lesions had short periods of catheter drainage whereas those with complete lesions had much longer ones, the longest being those in the complete lesions of the cauda equina in which the bladder was isolated from all cord activity.

Therapeutics—Antibiotics were given only for acute infections with constitutional disturbance. Sixteen patients did not receive any antibiotic therapy during the period of catheter drainage. Short courses of urine-acidifying treatment were given in eighteen cases, the acidifying agent being ammonium chloride in doses of fifteen grains three times a day. This was sometimes supplemented with methenamine mandelate. At no time were alkalies used. Twenty-nine patients had more specific therapy, particularly when the newer antibiotics became available. The response was dramatic but relapse was common.

Instruction of the patient—All patients were informed of the importance of recognising dulled or perverted sensations of bladder fullness and to correlate these with impending bladder activity. During the later stages of catheter drainage the patients operated their own screw clips on the drainage tubes in an attempt to stimulate bladder action. Urine voiding was reinforced by abdominal straining, deep breathing, and manual compression of the abdomen according to individual circumstances.
Each patient endeavoured to find out in which position he could void best, whether lying, sitting or squatting, and the procedures were repeated during the trial periods without a catheter and subsequently. Advice was also given on control by regulation of the fluid intake and establishment of habit reflexes and other methods of initiating bladder emptying.

RESULTS OF TREATMENT
The early general results (Table II) did not provide any features which were detrimental to bladder control in itself. There were five deaths within two months. One was due to the rupture of a congenital intrathoracic stomach in a stage of paralytic ileus a few days after injury. Two were due to massive pulmonary embolism and two to respiratory failure in high cervical lesions. All the surviving patients had been mobilised to the chair stage by the end of the twelfth week. There were no spinal deformities or secondary neurological complications and—most important of all—there were no skin sores.

The bladder state in the forty-five surviving patients as observed within three months of the end of the period of catheter drainage varied with the site and severity of the

<table>
<thead>
<tr>
<th>TABLE II</th>
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<tbody>
<tr>
<td><strong>General Results (Fifty Cases)</strong></td>
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<tr>
<td>Number of operations . . . .</td>
</tr>
<tr>
<td>First-intention healing of wound .</td>
</tr>
<tr>
<td>Deaths within two months of injury .</td>
</tr>
<tr>
<td>Usual interval before mobilisation to chair stage . . . .</td>
</tr>
<tr>
<td>Spinal deformity . . . .</td>
</tr>
<tr>
<td>Pressure sores . . . .</td>
</tr>
</tbody>
</table>

neurological lesion. Nine of the eleven patients with cervical cord lesions lived and achieved some form of reflex bladder action. Six patients with incomplete cervical cord damage acquired voluntary bladder control but with some precipitancy of action. The other three patients with complete cervical cord damage developed uncontrolled bladder action necessitating the use of a portable urinal.

Four of the six patients with complete thoracic cord lesions survived. One patient acquired excellent habit control by means of a careful regulation of his fluid intake. The remaining three developed uncontrolled reflex bladder action which was later converted to the flaccid type by intrathecal alcohol block. This resulted in considerable benefit in two cases but none in the third.

All the twenty-five patients with thoraco-lumbar injuries survived but with considerable variation in bladder control. Five patients with incomplete and nine with complete cord lesions developed voluntary bladder control. The remaining eleven patients did not achieve a state of efficiency that could be regarded as socially safe.

One of the eight patients with cauda equina injuries died. Two of the remainder had almost normal bladder control. Two others were able to void by abdominal straining and did not need a portable urinal, but four were potentially incontinent on all occasions involving muscular effort.

Further treatment has been necessary in certain of the less successful cases and it is hoped to present a report on more radical procedures at a later date.

COMPLICATIONS
Complications during the catheter period—Of the complications (Table III) balanitis and urethritis were mild. The periurethral abscesses were difficult and the fistula that occurred
as a result of one of these took a long time to heal. Epididymo-orchitis occurred in five cases, but this complication occurs at any time and at any stage in the treatment of paraplegia and the incidence has been quoted as high as 20.8 per cent by Bors (1948). The calculi that occurred during the catheter period were all small and easily removed through a direct-vision cystoscope or through metal Bigelows evacuators. They were mainly soft flat stones from one to two centimetres in diameter, frequently showing moulding suggestive of their having been formed round the catheter balloon.

**TABLE III**

**Early Complications (Fifty Cases)**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Cases</th>
</tr>
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<tbody>
<tr>
<td>Balanitis</td>
<td>1</td>
</tr>
<tr>
<td>Urethritis</td>
<td>7</td>
</tr>
<tr>
<td>Periurethral abscess</td>
<td>2</td>
</tr>
<tr>
<td>Fistula</td>
<td>1</td>
</tr>
<tr>
<td>Stricture</td>
<td>0</td>
</tr>
<tr>
<td>Epididymo-orchitis</td>
<td>5</td>
</tr>
<tr>
<td>Calculus: urethral</td>
<td>0</td>
</tr>
<tr>
<td>Calculus: vesical</td>
<td>5</td>
</tr>
<tr>
<td>Calculus: renal</td>
<td>1</td>
</tr>
</tbody>
</table>

**Infection**—Urinary infection almost always occurred though stringent measures were taken to reduce its effects. Five patients who had periods of catheter drainage of less than three weeks did, however, have sterile urine cultures throughout. Thirteen patients had severe urinary tract infections with gross constitutional upset, and twenty-seven had mild infections. The infecting organisms were those of the usual bacterial flora, continually changing both in type and sensitivity to chemotherapeutic and antibiotic agents.

Within a month of the end of the period of catheter drainage ten patients had sterile urine. Ten still had mild infection without constitutional upset, one had a severe and uncontrolled infection, and twenty-four had bacilluria.

**SPECIAL INVESTIGATIONS**

**Excretion pyelography**—This was carried out as a routine, and some dilation of the upper urinary tract was noted in seventeen cases. No single factor could be found to account for this complication. It did not accompany all the severe infections; it was found in cases of each group of injuries and it was not definitely related to the amount of residual urine. It was, however, commonest in the patients having isolated and autonomous bladders in which urine voiding was achieved by straining.

**Cystoscopy**—Both direct-vision and lens-instrument cystoscopy were performed in every case. Most findings were similar to those recorded by many other observers (Bumpus, Nourse and Thompson 1947, Prather 1949) and will not be repeated. Special attention was paid to the state of the region of the external sphincter. At this level resistance to the passage of the instruments was noted in thirteen patients, all of whom had heightened reflex activity in the isolated distal segments of the cord below the level of their injuries. Contraction of the sphincter could be invoked by producing general reflex spasm and a definite ridge was observed to appear in the urethra at the level of the external sphincter.

Bladder neck contracture at the level of the internal sphincter was uncommon at this early stage of bladder readjustment. When it occurred it was resilient and easily passed by the instruments.
COMMENTS

It is appreciated that this method of bladder management is well known and its comparative merits have frequently been discussed. From the experience gained from these and other cases it cannot be sufficiently emphasised that the handling and changing of the catheters must be controlled by a strict and regular aseptic routine. This routine must be observed at all times, whether the occasion be the daily catheter and mental toilet at the time of bladder washouts or the operations for catheter introduction or replacement.

Great importance is also attached to the emptying of the bladder during its phase of atonicity. This is the time when debris and residual urine are not easily removed by methods of irrigation other than syringe suction.

The great reduction of vesical calculi in this group of cases is attributed to the strictly aseptic catheter routine and the special attention to bladder emptying during and after washouts. The high fluid intake and early general mobilisation is considered largely responsible for the almost complete absence of renal calculi.

It has undoubtedly been an enormous advantage to have these cases admitted early to the unit and thus to have the management of all aspects proceeding concurrently. Similarly the management of many cases by the same staff has facilitated comparative observations and standard procedures. The absence of bedsores has cut out all delays in mobilisation and has reduced the incidence of toxaemia and sepsis so often seen in less fortunate circumstances.

The results obtained in the forty-five surviving patients have been better than those obtained in the same number of patients treated by other methods. The incidence of severe infection has been much reduced, as have the number of calculi. The early bladder state after catheter drainage has been more efficient and subsequently has required less attention in the way of surgical or other corrective procedures.

Although the improved results of bladder management are reflected in the equally improved successes of treatment the statement is just as true when put the other way round. Indeed the treatment of paraplegia must continue to be regarded as a single entity with detailed attention to each integral part.

I am indebted to Mr J. C. Anderson and members of the Urological Department of the Royal Hospital, Sheffield, for their encouragement, advice and technical assistance in connection with these cases.

REFERENCES