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PART II

DIVERSION OF THE URINE IN PARAPLEGIA

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It was Isak Dineson who said in *Seven Gothic Tales* '... What is man, when you come to think of him, but a minutely set, ingenious machine for turning with infinite artfulness, the red wine of Shiraz into urine?'

This may be a somewhat cynical view of life, but those clinicians dealing with patients with paraplegia are fully conscious of the great importance of the secretory function, and of the fact that should death occur at a later stage the cause is usually renal failure. It would appear that the problem of diversion in the adult is somewhat different to that in the child and it is the purpose of this communication to deal with adults only.

There is, however, no doubt that diversion of the urine is rarely needed in the adult neurogenic bladder, and over many years at the Southport Centre the writer has carried out this surgical procedure on few occasions only (20 patients out of a total of 567 cases since 1948).

TABLE I

Diversion of the Urine in Paraplegia

Ileal loop	4
Colonic loop	1
Ureterostomy	1
Anteversion of urethra	3
Suprapubic cystostomy	11
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Total	20

TABLE II

Suprapubic Cystostomy carried out for:

Urethral complications	4
Advanced disseminated sclerosis	2
Ankylosing spondylitis	1
Advanced reflux with renal failure	2
Early cases	2
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Total	11

Indications. With one or two well-defined exceptions, urinary diversion is usually necessary only when the well-known, conventional and simpler methods have been given a thorough trial and have disastrously failed. There are so many methods of treatment now available that such failure is not usual.

The main single indication is progressive renal failure, progressive in spite of all recognised counter-measures such as catheter drainage, bladder-neck resection and division of the external urethral sphincter. This renal deterioration is usually due to a combination of partial obstruction and intractable infection.

The indications for the operation are shown in the following table:

TABLE III

Indications for Diversion of the Urine in the Neurogenic Bladder

1. Progressive hydronephrosis with renal failure.
2. Stage 3 ureteric reflux with progressive renal deterioration.
3. Intractable urinary infection with pyelonephritis.
4. Continuous incontinence in women with disseminated sclerosis or spina bifida.
5. Urethral complications leading to difficulty of catheterisation.

This looks a formidable list but, as has been said before, these situations rarely develop. The important word is *progressive*. As is well known, hydronephrosis may be present for many years without detrimental change—indeed, as has been shown on previous occasions, both hydronephrosis and ureteric reflux may be labile conditions, sometimes appearing without obvious cause and later spontaneously disappearing (Cosbie Ross, Gibbon & Damanski, 1960).

With regard to reflux, diversion is certainly not necessary in stages 1 or 2, and even in stage 3 the operation is rarely needed provided the infection can be kept under control by continuous chemotherapy and provided that renal function is maintained in *statu quo*.

A clear-cut indication is intolerable incontinence in women, whether due to spina bifida or to disseminated sclerosis. It is just possible that in the future it may be possible to control this dribbling incontinence by means of continuous electrical stimulation of the external sphincter, as advocated by Caldwell (1965). This method would be unsuitable in disseminated sclerosis but in spina bifida would be worth a clinical trial, though it is doubtful whether the external sphincter muscle would be effective in this type of case.

Methods. Certain procedures carried out sometimes for diversion of the urine are unsuitable in paraplegia, such operations as vesico-recto-plasty and Gersuny's operation for the provision of a sphincter-controlled urinary reservoir as both these depend on a normal anal sphincter (Coetzee, 1966).

The following table indicates the available methods:

TABLE IV

1. Segregated ileal loop.
2. Segregated colonic loop.
3. Uretero-colonic anastomosis.
4. Nephrostomy.
5. Ureterostomy.
6. Anteversion of the urethra.
7. Cutaneous vesicostomy and suprapubic cystostomy.

1. *The Ileal Loop.* This is the usual method in spina bifida and is also used on other occasions. The operation carries a small but definite mortality as a troublesome ileus often develops during the immediate postoperative period, giving anxiety for about a week. There are also certain difficulties about the placing of the end of the loop in the right iliac fossa as it may not always be possible to close the gap between the lateral peritoneum and the ileal loop. Once the conduit is established it is usually trouble-free, in spite of the fact

that if an opaque fluid is injected into the loop, free reflux up both ureters may be demonstrated. Probably this reflux does not cause trouble as there is no increase in pressure in the conduit, similar to that occurring in the bladder during micturition. Certain complications may develop rarely at a later date and require revision of the stoma. These include prolapse, a fistula at skin level and trouble with the skin around the stoma, but these complications usually stem from defects of technique and should not happen.

More serious troubles may arise from persistent infection in the non-functioning bladder.

Schoenberg (1963) has carried out this procedure on a number of paraplegics and believes that the indications are as follows:

1. Peri-urethral abscess and fistula.
2. Repeated attacks of upper urinary tract infection.
3. Failure to void after prolonged treatment.
4. Patients requiring an incontinence device.

The writer does not agree with all these indications, especially with numbers 3 and 4.

2. *Segregated Colonic Loop.* A segregated loop of pelvic colon may be used in lieu of the ileum, the method being suitable especially when only the left kidney is functioning. In favour of this operation is the fact that a prolonged dissection of the mesocolon is usually unnecessary and also that the anastomosis between the iliac colon and upper rectum does not give rise to the post-operative anxiety attending the ileal loop, ileus being unusual. A possible objection is interfering with the colon, especially where daily reflex defaecation has been achieved.

3. *Uretero-Colonic Anastomosis.* This method not only has biochemical and other disadvantages, but is unsuitable in the neurogenic bladder in which there may well be concomitant defects in the control of defaecation. It is only mentioned to be condemned in this connection.

4. *Nephrostomy.* In spite of all that has been written on the subject of nephrostomy over the last few years, there are certain inherent difficulties when using this for long-term drainage. Firstly, it is difficult to fit an efficient collecting apparatus and, as a result of the anatomical position of the kidney, it is awkward if not impossible for the patient to deal with it himself.

Secondly, there is the problem of the drainage tube and its periodic replacement. It is necessary to use some method, such as was described by Tresidder (1957), to facilitate the changing of the tube. Tresidder uses a U-tube, and, when carrying out the operation makes careful measurements so that a replacement tube is available (fig. 1).

The replacement tube is exactly the same size and length as the original and has the side holes cut in the same positions. Using this identical replacement tube, the drainage can be continued indefinitely.

In some cases it has proved impossible to replace the tube, and in such a case it is usually necessary to dilate the outer end of the fistula. It is usually the distal part of the track (especially at skin level), which tends to contract.

5. *Ureterostomy*. There is a great deal in favour of carrying out urinary diversion by means of a ureterostomy, but the operation requires meticulous care if stenosis of the orifice and other troubles are to be avoided.

FIG. 1

Diagrammatic representation of operation (Tresidder).

The main disadvantage is that a double apparatus is required and may prove cumbersome. Lapidès and others have suggested methods whereby both ureters are brought out through one orifice, but these operations have not yet proved themselves. In the procedure advocated by Lapidès (1962), both ureters are brought out together at a point halfway between the symphysis pubis and the umbilicus. But it is generally accepted that the optimum site for a ureterostomy is high in the iliac fossa.

A serious disadvantage of ureterostomy is the danger of sloughing of the ureter, particularly if there is tension in a ureter of normal size. In fact, in the writer's opinion, the operation is not satisfactory if the tube is a normal size but is more suitable when the ureter is dilated, convoluted and thickened, as in some cases of stage 3 reflux.

The great advantage of the operation is that it can be carried out at an advanced stage of renal failure and that it puts little strain upon the patient and has a negligible mortality.

Other advantages may be enumerated:

1. It is unnecessary to open the peritoneal cavity.
2. As no bowel anastomosis is involved there is no danger of ileus.
3. No problems arise related to biochemical disturbances due to absorption from the bowel.
4. It is easy to collect urine from the kidney after operation and to investigate the kidney by retrograde pyelogram if necessary.

5. There is no trouble with the accumulation of mucus encountered by using the ileal loop.

Moreover, ureterostomy need not be the final procedure and it is always possible to carry out a conversion to an ileal conduit later, if this is advisable.

In comparing the ileal loop with ureterostomy the writer's view is that while he is attracted by the theoretical advantages of the ureterostomy there is always the danger of serious sloughing of the ureter or of later stenosis of the orifice.

It is, of course, necessary to fashion a skin spout (fig. 2).

(a) To show lateral cuts to form a ureteric spout.
(b) The wound sutured, the skin spout embracing the ureter.

An oblique incision is made in the iliac fossa and (after siting the opening accurately), two cuts are made at right angles to the incision, these being about 2.5 cm. apart. The ureter is then exposed extraperitoneally and divided at the brim of the pelvis, the lower end being ligated. The upper end is then brought out between the two transverse cuts, care being taken firstly to avoid kinks and twists and secondly to preserve the blood supply of the tube. By suturing the main incision together above and below the transverse cuts it is possible to provide a skin flap on either side to form a spout. Fat is carefully excised from the two flaps, the ends of which are sutured without tension to the turned back extremity of the ureter. To obtain this eversion it is sometimes an advantage to make two lateral cuts in the free end of the ureter.

6. *Anteversion of the Urethra.* This operation is usually reserved for women with disseminated sclerosis who have reached a point of continuous dribbling incontinence, especially if the patient is still mobile. It has been customary in these unfortunate women to insert progressively larger Foley catheters in a futile attempt to prevent leaking around the catheter.

This operation, first described by Griffiths (1960), involves the 'coring out' of the urethra from the vaginal wall and its anteversion to the suprapubic region, being brought out through the abdominal wall as far above the pubis as possible. If the urethra is short and the patient obese, the operation is not suitable although it is possible to excise some of the suprapubic fat around the spout.

As with the ureterostomy it is desirable to evert the extremity of the urethral mucosa and suture it to the skin spout. This operation may make life tolerable in a number of patients with disseminated sclerosis; they are no longer constantly wet and, if the hands are not badly affected, the patient herself can change and adjust the collecting apparatus. Suprapubic drainage and vesicostomy are not suitable in women as urethral incontinence continues in spite of the suprapubic opening.

If the patient is confined to bed and mobility is no longer possible, this operation is not indicated and nursing comfort may be achieved by the use of the vulval suction apparatus, designed by Keane of Dublin (1963).

7. *Suprapubic Cystostomy and Vesicostomy.* The question of suprapubic cystostomy still presents a difficult and controversial problem in the neurogenic bladder. Like many others the writer has been prejudiced against this method of diversion, but perhaps Lapidès' advocacy of flap vesicostomy provides an opportunity of reappraisal. First it must be acknowledged that there are patients who have had a suprapubic cystostomy carried out many years ago and are still in excellent health and with a normal upper urinary tract. Secondly, the writer believes that it is inadvisable to close a long-standing cystostomy as there is a danger of hydronephrosis and reflux developing. This is not the view of Guttman (1953), who reported a number of late closures with good results. After these preliminary observations there appear to be certain circumstances in which suprapubic drainage should be considered, including:

1. Urethral lesions, such as stricture, recurrent peri-urethral abscess, peri-urethritis, diverticulum, false passage and fistula, leading to difficulty of catheterisation.
2. Shortness of the penis leading to difficulty of external fixation of the catheter.

It is undesirable to use a Foley catheter (with its bulb pressing on the trigone) indefinitely as this may cause haematuria.

When considering these indications, however, it must be pointed out that urethral complications have been largely eliminated by the use of modern methods, such as the fine Gibbon catheter and by the gradually increasing control of infection.

Moreover, Bors (1962) has suggested a minor plastic procedure to lengthen the penis to facilitate the external fixation of the catheter. The indications for suprapubic drainage are therefore rare indeed.

It is inadvisable to carry out a suprapubic cystostomy in the female patient as she may continue to dribble from the urethra and an anteversion operation is more suitable. Vesicostomy, the tubeless cystostomy using skin and bladder wall flaps, is recommended by Lapidès (1960) at an early stage, within weeks of the initial cord injury. Quite apart from the merits or demerits of the operation, the writer is completely opposed to carrying out *any* diversionary operation at such an early stage. Damanski (1966) has shown that automatic voiding may only develop 87-109 days after the cord injury so it is essential to postpone drastic diversionary procedures until it is evident that they are really essential.

There is no comparison between the comfort of the patient with an automatic bladder with one doomed to spend the rest of his life with a suprapubic apparatus.

A typical example of diversion of the urine was a male, aged 63 years when first seen in 1956 and who complained of a slow stream and difficulty of micturition. He had had a spastic paraplegia since childhood and could walk only with difficulty. The bladder was distended, the fundus reaching the umbilicus. Urethrosopy and cysto-urethrogram showed a ridge at the bladder neck and also some narrowing at the external sphincter level. It was impossible to carry out a T.U.R. owing to the spasticity of his legs, so a suprapubic operation was carried out, resecting a wedge from the bladder neck and at the same time removing about a third of the redundant bladder. After the operation there was an improvement, but the residual urine remained high. Initially, the intravenous pyelogram showed that the kidneys were normal in appearance and function. Early in 1957 (the following year), an I.V.P. showed bilateral hydronephrosis and hydro-ureter, but the function remained satisfactory.

Later the same year the intravenous pyelogram revealed a further deterioration and the blood urea had reached 100 mg. per cent. In view of the ominous course of events the ureters were implanted into a segregated ileal loop.

Following this operation he has progressed well and has been able to manage his business. Recently, nine years since the urinary diversion, he feels well and fit, has a satisfactory pyelogram with a little calyceal blunting and a blood urea of 52 mg. per cent.

E. H. sustained a fracture-dislocation of the spine in 1943 and became paraplegic, having initially a suprapubic cystostomy carried out. The renal function remained satisfactory and unchanged until the suprapubic fistula was closed in 1954, the closure being preceded by a careful investigation to make sure there was no obstruction at the bladder neck or at the external sphincter level. In spite of these precautions the suprapubic closure proved an error of judgment and a slow but steady decline of renal function ensued.

He was readmitted on several occasions with uraemia, the blood urea being 295 mg. per cent. in one instance.

There was a persistent *B. proteus* infection, a secondary anaemia and a tendency to salt depletion. Following treatment, including dialysis, the blood urea remained at approximately 90 mg. per cent. In 1965 an infusion I.V.P. revealed no function of the right kidney and a gross hydronephrosis and hydro-ureter on the left side. A further deterioration was observed recently in spite of adequate medical treatment, an indwelling catheter and continuous chemotherapy. Accordingly, the left ureter was exposed, divided and anastomosed end-to-end to a segregated loop of pelvic colon, the lower end of the loop being brought out in the left iliac fossa as an ostium. At operation the left ureter was 10 in. in diameter, most of this being due to thickening of the adventitia as the lumen was only $\frac{1}{2}$ in. across. It was obvious that the left kidney was the subject of an advanced pyelonephritis and the operation was essential to preserve life.

SUMMARY

1. Diversion of the urine is rarely indicated in the adult neurogenic bladder.
2. The major indication for the operation is progressive renal failure due to a combination of obstruction and intractable infection, unresponsive to all the usual methods of treatment.
3. The usual procedure is a segregated ileal loop, but there is possibly a case to be made out in favour of a well-conducted ureterostomy.
4. Anteversion of the urethra is worth while considering in cases of continuous dribbling incontinence in women suffering from disseminated sclerosis and who are still mobile.

Finally, a plea is made for patience and for time to give spontaneous recovery of micturition a chance to return.

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URINARY DIVERSION IN CONGENITAL PARAPLEGIA

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TWENTY years ago we were faced with the most appalling cases of advanced uropathology in children who had been born during the war, and whose apparently hopeless condition hardly warranted priority treatment when bombs and rockets were falling on our cities. Perhaps the most important weapon that came into use was the miniature resectoscope, and this transformed the picture of retention both in boys and girls. Better radiological study and constant additions to our antibiotic armamentarium certainly improved the situation, and the introduction of the light-weight Chailey urinal alleviated the incontinence problem in the boys.

The first major publications on urinary diversion in this country arose from the 12th Annual Meeting of the British Association of Urological Surgeons in 1956. The mortality from ileal loop urinary diversion had been considerable, but the applications of the procedure both in adults and children had been widespread and few surgeons had extensive personal experience. Of the 10 cases in children that I reported, all had severe previous urinary damage with recurrent infection, some with stones (Nash, 1956).

One girl was fully rehabilitated and six years after operation, while she was in perfect health, was murdered and must thus be excluded from this series. Another died from electrolyte imbalance following gastro-enteritis on holiday during which she received no hospital treatment—that was three years after operation. One girl who had been uraemic to the point of coma was operated on at the age of 9 and died at the age of 16 in a mental hospital undoubtedly from progressive renal infection aided by mismanagement. There was only one boy in this first group and he had been extremely toxic and anaemic, but improved greatly after operation and survived five years, dying eventually with acute rheumatic carditis unconnected with his original troubles. The only patient who underwent operation for a rather rapid deteriorating infection and obstruction died at 3 months after operation; with one's present knowledge and the antibiotic cover which is available 10 years later, this operation would I think have been postponed. Yet one other died about a year after operation at the age of 14, from peritonitis following an enema. Of the eight girls who underwent operation (that is excluding the murdered one), four are alive 11 years after operation. One has produced two normal children after normal pregnancies. Thus four out of eight girls operated on 10 years ago or longer are socially acceptable, wage earning, having progressed through normal puberty and education.