Nineteen (38 per cent.) had transurethral bladder neck resections before diversion (including five of the seven who died of renal disease, and this is an indication of the extent of pre-operative renal insufficiency).

Stoma revision was required in two (4 per cent.), one shortening, one stenosis (two others required dilatation).

Four patients developed stones (8 per cent.).

One kidney has had to be removed due to obstruction (1 per cent of kidneys at risk).

Summary

The distinctive problems of congenital paraplegia are compared with those of the acquired form, particularly with regard to associated handicaps, renal immaturity, lack of perceptual experience and social deprivation in early life.

Reference is made to the management of retention of urine and to the changing urological picture as age advances.

The satisfactory management of male incontinence is discussed.

Against this background are enumerated the requirements of the ideal urinary diversion. The isolated ileal loop operation, or ileocutaneous ureterostomy is discussed. A series of 70 patients is surveyed and the criteria for operation are presented in relation to pre-operative management, morbidity and mortality.

Long-term follow-up data are given concerning 50 consecutive girl patients operated on between 1955 and 1963 selected for ileal loop diversion from 473 paraplegic children under observation since 1946. The operative mortality was nil. The subsequent fallout rate due to death from the paraplegia or related conditions has been seven (14 per cent.), three in the first 4 months, one in the 3rd year, two in the 4th year and one in the 10th year.

Ileal loop urinary diversion is claimed to be the most satisfactory method of dealing with incontinence arising from congenital paraplegia in the female, and should not be undertaken before the age of five.

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URINARY DIVERSION IN PARAPLEGIA

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The prime objective in the urological management of spinal cord injuries is to preserve renal function by ensuring an unobstructed drainage of the entire urinary tract. Failure to do this constitutes an important cause of morbidity and mortality. Despite the tremendous progress made in the treatment of particularly traumatic lesions of the spinal cord, renal failure and uraemia still foreshortens many of these lives.

The main effect of a spinal cord lesion on the urinary tract is functional obstruction at or below the bladder neck. The resultant residual urine invites urinary infection, and this in association with the almost inevitable raised intravesical tension and eventual detrusor hypertrophy, accounts for the complications like ureteric reflux, hydronephrosis, calculus formation and pyelonephritis. With constant supervision many of these complications are averted, and yet in some cases they occur despite careful management. The majority of these bladders regain efficient function spontaneously, or do so following nerve resection or urological surgical procedures to relieve obstruction, and thus become catheter free. The fact that a certain percentage may require a catheter permanently, is an indication that diversion is occasionally essential, if renal function is to be preserved and factors which threaten renal function are to be avoided. We wish to record our own limited experience in this regard, and to note that in none of the cases where urinary diversion was employed was the previous urological management regarded as efficient.

At the inception of the Spinal Injuries Centre at Conradie Hospital in Cape Town in November 1963, 45 old cases, who had been in hospital for periods ranging from 5 to 20 years, formed the nucleus of our unit and it was from this group that urinary diversion was required in five cases. Up to 30 April this year 210 new cases have been admitted. Table I indicates the classification of these new cases.

TABLE I

Cervical	Complete	43	
	Incomplete	58	
		—	101
1-5 *Thoracic*	Complete	11	
	Incomplete	16	
		—	27
6-12 *Thoracic*	Complete	25	
	Incomplete	22	
		—	48
Cauda Equina	L1-5	18	
	S1-5	16	
		—	34
Total. . . .			210

The discharge rate of this group is divided into individual years as follows:

TABLE II

Total Discharged

Year	Admission	Discharge	%	Deaths	%
1963	21	19	90	3	10
1964	62	49	79	6	10
1965	93	49	52	11	12
1966	37	4	10	5	16

Of this total number already discharged, 78 wear no urinary appliances at all—76 of these are, however, incomplete neurological lesions, the remaining two, both women with complete upper motor neurone lesions, are bladder trained. Forty do wear a urinary appliance, and of these, 12 have required urological surgical procedures to relieve obstruction—nine T.U.R.s and four external sphincterotomies (one patient having had both procedures done). Only one has been discharged with a permanent indwelling catheter.

From our experience, therefore, it is clear that with early and continued management serious urinary complications can be avoided in the majority of cases, and from clinics who have had a more extensive experience, one has learned that the overall result is good when one bears in mind the crippling effect of a neuropathic bladder on the entire urinary tract. Many authors (Guttmann, 1953, 1963; Bors, 1957; Comarr, 1959, 1964; Damanski, 1961, 1963; Band, 1963; Cosbie Ross *et al.*, 1963; Tribe, 1963; Hachler *et al.*, 1965) have drawn attention, however, to the considerable incidence of renal failure in paraplegia and that, in fact, uraemia still is a major cause of mortality. There are cases in whom urological management has been delayed and for various reasons has been inadequate, and some where despite careful urological supervision, infection and obstruction have not been controlled. It has been our experience that the urinary tract does not regularly respond as one would anticipate that it should. Within this group there are, in our opinion, a few cases who could derive benefit by urinary diversion or a bypass procedure (Coetze, 1966).

Early surgical diversion of the urine at the bladder level by doing a vesicostomy has been advocated by Lapides *et al.* (1960, 1965). He and others have maintained that it is a form of diversion which is easily managed and that urinary infection is controlled and the upper urinary tract remains normal. In our view such early diversion cannot be justified in the face of the abundant evidence that the majority of paraplegics regain satisfactory bladder function by more conservative means.

The methods of urinary diversion which are applicable in paraplegia are limited by the fact that the rectal sphincter is also incontinent. This precludes the use of any sort of rectal bladder, and, in fact, any procedure which allows urine to be in contact with a considerable portion of intestine, which would almost inevitably give rise to uncontrolled hyperchloraemic acidosis and uraemia because of the associated pyelonephritis and reduced renal function. This, therefore, leaves a choice of nephrostomy, cutaneous ureterostomy, ileal or colon conduit, vesicostomy and bypass procedures like ileo- or colocystoplasty. Each of these has its inherent advantages and drawbacks and we have used only conduits and partial replacement of bladder with intestine in a total of six cases. This has been done in an attempt to improve urinary drainage in the presence of uncontrolled infection, with success in four cases, failure in one and with one death from an unrelated cause.

The indications to employ urinary diversion have been

(1) Progressive hydronephrosis or pyelonephritis with failing renal function, despite adequate bladder drainage;
(2) a bladder so contracted or trabeculated that it was inefficient as a conduit.

The following is a brief summary of the six cases:

Case 1. A 30-year-old male patient sustained a fracture dislocation of the spine in 1957 in a motor-cycle accident and had a complete neurological level at T10.

Indwelling urethral catheter drainage was used. Dilatation of both ureters was noted one month after injury. Ureteric reflux was present and progressive hydronephrosis and hydro-ureters developed, despite continued catheter drainage and repeated T.U.R.s and sphincterotomy. The unusually wide ureters raised the possibility of a pre-existing congenital anomaly. In 1961 an ileal loop conduit bladder was constructed and the patient was dischared home two months post-operatively. An I.V.P. three years later was normal, but an ileogram of the substitute bladder showed marked right-sided ureteric reflux. This patient has remained clinically well.

Case 2. A 38-year-old female with a complete neurological lesion at T4 level due to a stab wound of the cord 11 years ago. Indwelling urethral catheter drainage was used. Repeated episodes of haematuria, urinary infection and calculus formation with the development of right-sided hydronephrosis resulted in the decision to do a diversionary procedure in 1964. A colon loop conduit bladder was constructed using 6-8 in. of sigmoid colon. A follow-up I.V.P. two years later (fig. 2) compared to a pre-operative I.V.P. (fig. 1) reveals marked improvement—clinically the patient is very well and is awaiting discharge.

FIG. 1

FIG. 2

Case 3. A 28-year-old female patient with a transverse myelitis of 15 years' duration with a complete motor but incomplete sensory loss at T12 level. Suprapubic catheter drainage was utilised for the first three years and thereafter a permanent urethral catheter was applied. She was discharged home in 1956, but was re-admitted two and a half years later. Numerous episodes of urinary infection and haematuria followed and a commencing bilateral pyelonephritis (fig. 3) with a contracted and fibrotic bladder (fig. 4) but no ureteric reflux, resulted in the decision to do a bypass procedure in 1965. A colocystoplasty was done—approximately two-thirds of the bladder was removed leaving the trigone intact and a loop of sigmoid colon was anastomosed to the stump. One

month post-operatively the urethral catheter was removed and bladder training commenced. A cystogram six weeks post-operatively (fig. 5) revealed a bladder of good capacity, no ureteric reflux, and a normal bladder neck. The residual urine was initially high but fluids were taken liberally, and urinary infection was minimal. The residual urine has progressively decreased and bladder control has been achieved with a capacity of 10-12 oz. She claims to be aware of bladder filling.

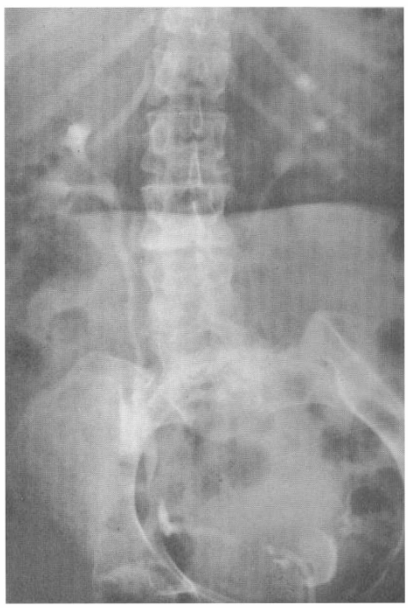
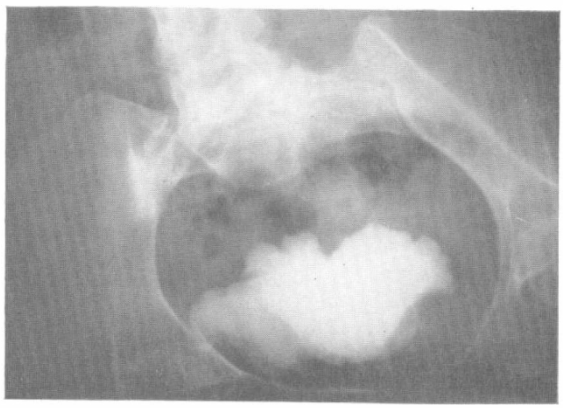


FIG. 3

Case 4. A 28-year-old female with a complete paraplegia at T9 level due to a stab wound of the cord in 1953. Indwelling urethral catheter drainage was used. Numerous episodes of urinary infection, calculus formation and haematuria occurred. Hydro-ureter, hydronephrosis and renal calculi resulted in absent renal function on the right side, and the decision was made in 1965 to do a diversionary procedure. A colon conduit bladder was constructed using sigmoid colon. Both ureters were markedly dilated. Four months later the patient was discharged home. A follow-up I.V.P. this year shows some improvement in the hydronephrosis and the right kidney now has reasonably good function.

Case 5. A 26-year-old male patient with a complete paraplegia at T9 level due to a gunshot wound in 1957. Suprapubic drainage was used for the first three years, which resulted in a small fibrotic rigid walled bladder. A bypass procedure was decided on in 1961. An ileocystoplasty was done leaving the trigone intact. A post-operative ileogram revealed a low capacity bladder with a 50 per cent. residual urine and a permanent urethral catheter was resorted to despite repeated T.U.R.s.

FIG. 4



Case 6. A 46-year-old male patient with a complete lower motor neurone lesion due to a fracture dislocation of T12/L1 as result of a motor-vehicle accident in 1962. This case was admitted to the Spinal Injuries Centre, Conradie Hospital, three years later for rehabilitative physiotherapy. Urethral catheter drainage was used for the first year, thereafter a urinary appliance. On admission to our centre, routine urological investigation revealed a small rigid and grossly trabeculated bladder and bilateral pyelonephritis, dilated ureters and pelves with markedly diminished right renal function. A colon conduit bladder was advised but the patient would not consent, and a compromise was made by doing a colocystoplasty with transplantation of the ureters in December 1965. Six weeks post-operatively the patient died suddenly. At *post mortem* a ruptured abdominal aortic aneurysm over the original fracture site was found to be the cause of death. The colocystoplasty and transplanted ureters were found to be well healed.

DISCUSSION

In each of these six cases the decision to divert the urine was made because the urinary tract was markedly abnormal and renal function was seriously threatened. Progressive deterioration occurred despite even catheter drainage. These were cases of long standing who had not had the benefit of good management.

This limited experience has shown that an intestinal conduit provides adequate drainage and that reduced renal function due to obstruction can be alleviated. Urinary infection has been clinically improved but not eradicated.

Although a loop of ileum in some cases has provided a very satisfactory substitute bladder, we have found that a loop of colon is preferable: it provides a better conduit because of its better tone. There is no advantage in attempting to provide a reservoir for urine, good drainage is a preferable aim. With the efficient methods of bowel sterilisation available, there is little added risk in operating upon the large bowel.

When the upper urinary tract is dilated and the ureters are wide, a cutaneous ureterostomy may be the safest procedure, but it will generally require two external openings, and with a wide mucosal anastomosis to a loop of bowel, a good conduit with an easily managed stoma is probably more satisfactory.

The use of a bypass operation to replace a bladder which is grossly inefficient

appears to be a satisfactory procedure. A loop of colon reaches easily into the pelvis and can readily be anastomosed to the base of the bladder or the urethra. The tone of the colon is good and as in the colon conduits provides efficient expulsion. This procedure is likely to be more effective in females, but our single experience in a male, who unfortunately died of an unrelated cause, has shown it to be a very feasible surgical procedure, which should allow good drainage without external diversion.

SUMMARY

Urinary diversion has a place, with certain limitations, in the treatment of neuropathic bladders.

If there is deterioration of renal function which cannot be controlled by making the patient totally incontinent or by constant urethral catheter drainage, diversion seems to be essential and has been shown to be beneficial.

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Discussion on Papers of Mr. Cosbie Ross, Mr. Ellison Nash and Dr. Key

Sir Ludwig. I should like to thank Mr. Cosbie Ross and Mr. Ellison Nash very much for their excellent surveys of one of the trickiest problems in paraplegia and also Dr. Key for her report from Conradie Hospital, Cape Town. These papers no doubt, have given a very good basis for discussion. I was particularly impressed by the very selective approach of these highly experienced urologists towards the problem of urinary diversion in paraplegic patients.

According to Mr. Nash's statistics, 2500 babies are born every year with spina bifida, and you will remember that Mr. Guthkelch from Manchester in his paper read at the 1963 meeting of this Society, estimated that by 1980 we shall have about 5000 intelligent but paraplegic spina bifida children of school age. This does not include the many surviving spina bifida children with more or less mental deficiency. The fact remains that these children survive through the modern methods of primary treatment