CYSTOPLASTY — RESULTS AND EVALUATION OF ALTERNATIVE METHODS

ARTHUR JACOBS, F.R.F.P.S.G., F.R.C.S. (EDIN.)

Surgeon in Charge, Urological Department, Royal Infirmary, Glasgow; Urological Consultant, Robroyston Hospital, Glasgow; and Clinical Lecturer in Urology, University of Glasgow

Uniting an intestinal graft to a bladder which as a result of disease has become incapable of acting as an adequate urinary reservoir is now established as a method of restoring useful function. The main indication for this type of reconstructive operation is vesical contracture following healed urinary tuberculosis or intractable interstitial cystitis. The frequency and incontinence arising from these conditions, and in cases of interstitial cystitis the pain associated with micturition, formerly compelled resort to urinary diversion in some cases. This was a worth-while and beneficent expedient for the relief of symptoms sometimes hardly to be borne. I have patients on whom ureterocolic anastomosis was carried out for tuberculous vesical contracture and interstitial cystitis alive and well today after periods of up to 18 years.[1] Cystoplasty is however a preferable alternative. Although enlarging the bladder by this method involves the incorporation of intestine into the urinary tract, no admixture of the contents of the two systems results. Sequelae such as may follow ureterocolic anastomosis are thus avoided, for the risks from upper urinary tract infection and from absorption of urinary constituents with consequent electrolyte imbalance have proved to be minimal. Furthermore, the patient is left with controlled micturition through the normal urethral channel.

Union between the bladder and an isolated segment of bowel can be obtained in a variety of ways. A graft may be fashioned from a segment of ileum or from colon and may be used in the form of either a closed or opened loop. During the past 9 years I have carried out 48 cystoplasties; in the first 30 operations the ileum in all but one instance was anastomosed to the bladder as a closed loop. In 12 a solitary ureter was detached from the contracted bladder and implanted into the loop (Table I).

TABLE I. CYSTOPLASTIC OPERATIONS

Ileocystoplasty with closed loop	19
Uretero-ileocystoplasty with closed loop	12
Ileocystoplasty with opened loop	8
Colocystoplasty with opened loop	8
Uretero-colocystoplasty with closed loop	1
Total	48

ILEOCYSTOPLASTY WITH CLOSED LOOPS

My method of anastomosing a closed loop of ileum to the bladder has varied through the years.[2] Initially the mid-

portion of a coil of isolated lower ileum, about 15 cm. in length, with each end closed off, was joined to the bladder as a tubular graft. When, because of stricture or reflux, diversion of a ureter into the bowel graft was indicated, the implant was made into the corresponding end of the loop. Hanley's studies[3] with the X-ray image amplifier on the emptying mechanisms of different varieties of ileal loops showed the desirability of employing the distal end for the anastomosis in order to permit maximum bowel peristalsis for the propulsion of urine into the bladder, while leaving a minimum of dead space for residual urine. A complete elimination of this dead space proved possible by suturing the distal end to the right extremity of the bladder opening (Fig. 1).

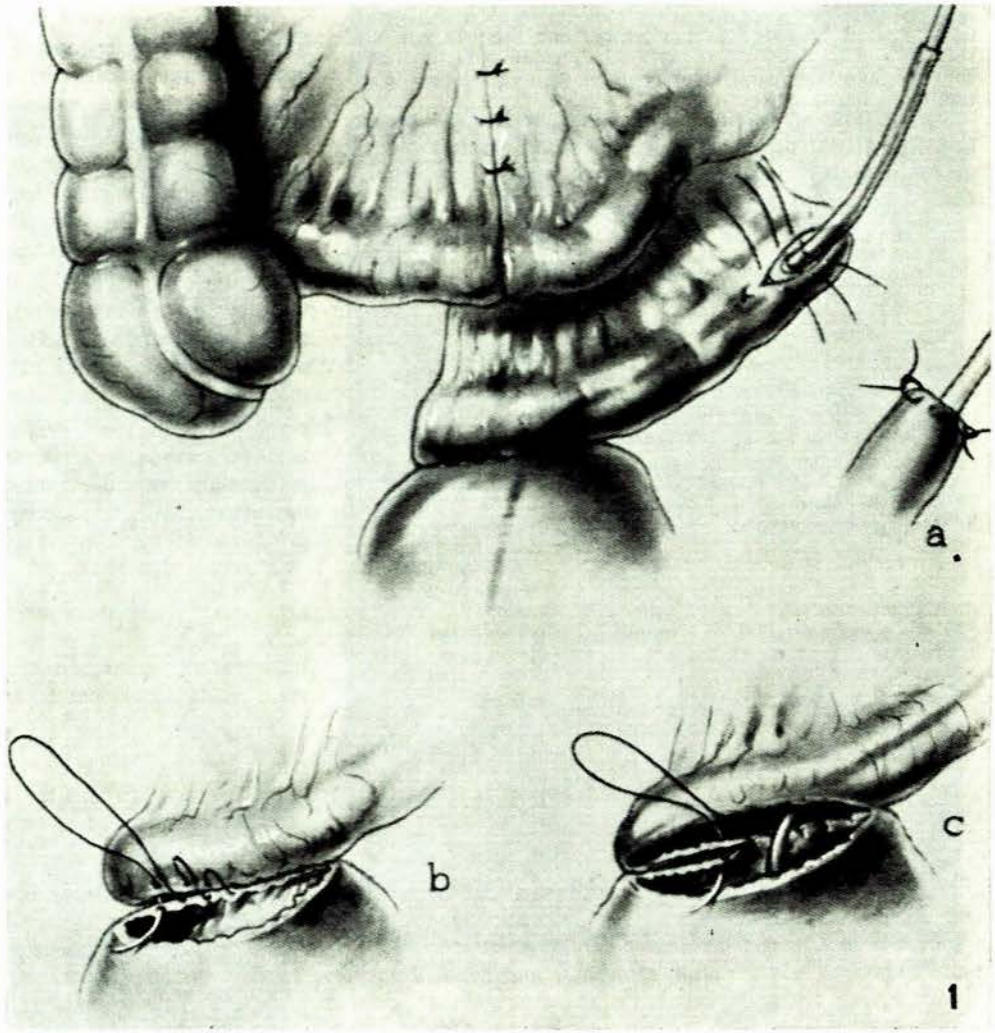

Fig. 1. Diagram illustrating technique of uretero-ileocystoplasty. The distal end of the isolated loop is anastomosed to the bladder in two layers (b and c); the intubated ureter is shown implanted into the proximal portion. Insertion of ureter into an open end is shown at (a). *From the author's contribution to 'Modern Trends in Urology', Second Series (Butterworth). By courtesy of the Editor.*

With a mortality of 2 patients (one on the 11th day from a massive retroperitoneal haemorrhage of undetermined origin following repair of a burst abdomen; and the other in the 9th week from the combined effects of an intractable urinary fistula and uncontrolled urinary tuberculosis) and the death of two others (one after $2\frac{1}{2}$ years as a result of volvulus, and the other after 2 years from intercurrent disease — fulminating influenza), there are available for assessment 25 patients who had an ileocystoplasty with a closed loop 2 - 9 years ago. Of these, 18 had tuberculous contracture, 6 interstitial cystitis, and 1 post-irradiation cystitis. All but one have benefited from the operation. The diurnal intervals with some are up to 4 hours or even longer; less than 2 hours is exceptional (Fig. 2 A, B and C). Many have no nocturnal disturbance, while others require to rise once and a few twice. The act of micturition more often than not is biphasic, a feeling of incomplete emptying being relieved by another voiding, which may take several minutes to complete. The patients who had interstitial cystitis have all been relieved of the pain so characteristic of this lesion. The patient who suffered from irradiation cystitis also had a rectovaginal fistula of like origin, and a colostomy had previously been carried out. The bladder was rested for 10 months by diverting the ureters to an ileal loop. The distal end of the loop was then detached from the abdominal wall and implanted into the bladder, with a satisfactory result. The one patient not benefited was the first in the series.

She was a woman of 26 years who had interstitial cystitis associated with upper-tract dilatation and reflux. After a striking initial improvement, she reverted within 6 months to a 15-30 minute frequency. Ureterocolic anastomosis with resection of the cystoplasty was carried out and today, 8 years later, she continues well.

A phenomenon observed in some is a variable degree of dilatation and elongation of the loop. In only one has this been associated with stenosis at the site of union between bowel and bladder.

The patient was readmitted to hospital 18 months after a uretero-ileocystoplasty, having voided no urine for the previous 48 hours. An outline of the distended loop could be seen through the abdominal wall; 30 oz. of retained urine were evacuated from its grossly dilated lumen. The ileovesical opening, which on cystoscopy looked like a dilated ureteric

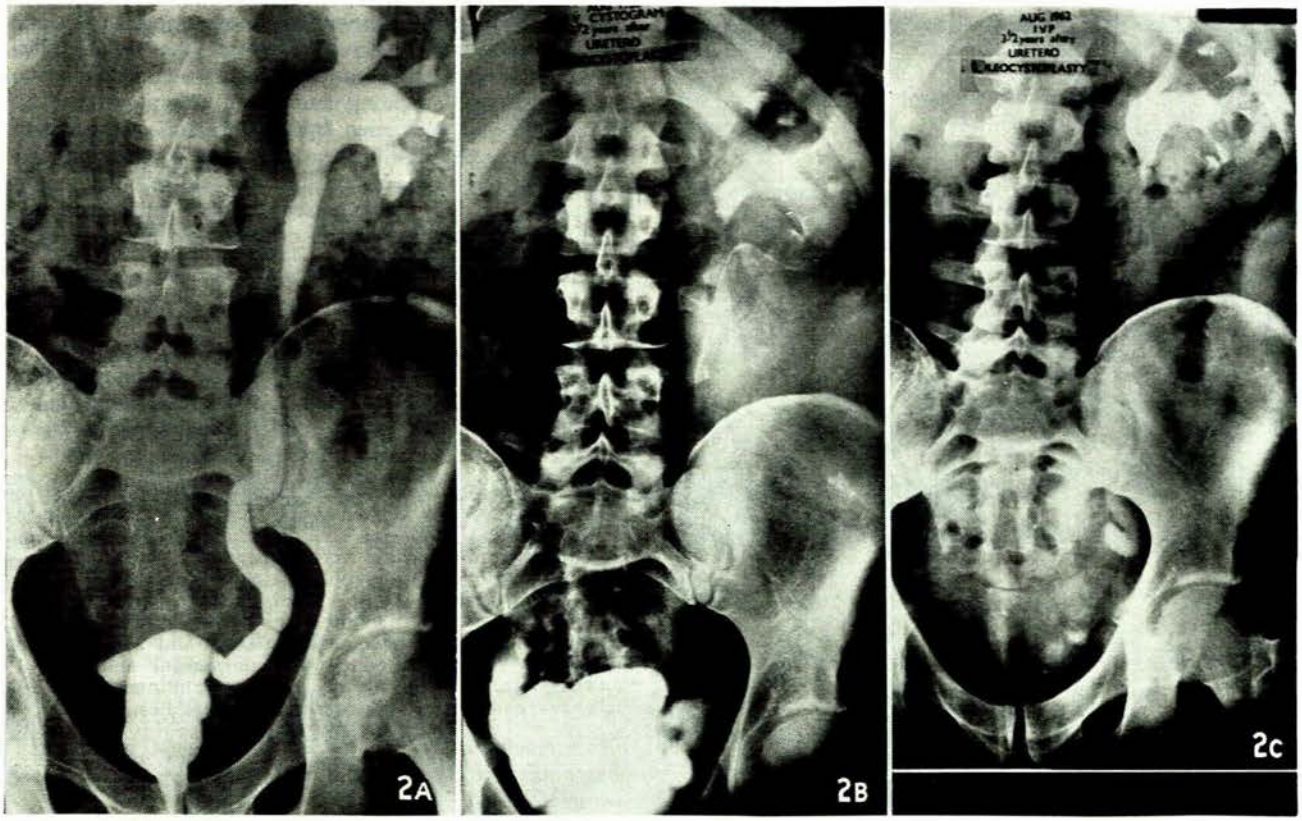

Fig. 2A. Retrograde cystogram (male patient aged 20 years) taken 5 years after right nephrectomy for tuberculosis. The vesical contracture is associated with reflux up the solitary dilated ureter to a hydronephrotic kidney.

Fig. 2B. Intravenous urogram 3½ years after uretero-ileocystoplasty. The hydro-ureter and hydronephrosis (see Fig. 2A) have resolved.

Fig. 2C. Post-voiding urogram demonstrating complete emptying of bladder. (Retrograde cystography showed a bladder capacity of 500 ml. and no reflux.)

orifice, was subsequently incised by transurethral diathermy and voiding from the urethra quickly followed. Now, 4 years later, the patient, a male aged 29, is well and working as a motor mechanic. He passes about 26 oz. of urine at intervals of 4 hours or longer. The act is biphasic, some 14 ounces coming away at once; thereafter several minutes may be required to complete emptying.

Dilatation and elongation of the loop (Fig. 3) without contracture of the ileovesical anastomosis is attributed to 'the fact that the ileum in the long run cannot withstand the unaccustomed pressure to which it is constantly subjected'[4] after ileocystoplasty. In the 4 cases in my series where marked dilatation of this nature has been demonstrated, the changes have only been discovered on routine follow-up cystographic examination, significant symptoms having been absent. I have not to date considered loop resection necessary for any.

Two female patients, of 33 years, are of especial interest because the operation in each was a revisionary procedure to combat sequelae arising from a previous ureterocolic anastomosis for tuberculous bladder contracture. One, who had undergone transplantation of a solitary grossly dilated right ureter 8 years previously, had been subject to recurring attacks of renal infection and acidosis. The other, who had had transplantation of a solitary right ureter 6 years previously, developed progressive loss of rectal control. In each the ureter was detached from the colon and implanted into the ileal graft. Excellent bladder function followed and there was complete urethral sphincter control. This satisfactory state has continued over the 3 years that have elapsed since the operations.

OPENED BOWEL GRAFTS

In view of the possibility of dilatation and elongation developing in a closed ileal loop after ileocystoplasty, and with the knowledge of continuing excellent function in one of my earliest patients, on whom I had used a flat ileal graft fashioned by the rather complicated technique described by Tasker[5] in 1953, a trial with open grafts was commenced 2 years ago. Because of the better ability of large bowel to withstand a higher pressure I considered it would be informative to compare the results that followed the use of open grafts from the colon with those from the ileum. In 7 patients an open graft has been formed from the ileum and in 8 from the colon. The mode of anastomosis has been similar to that described by Riches[6] and it has been used for both varieties of bowel. The bladder is opened transversely on the dome, the incision being as long as the state of the bladder permits (Fig. 4). In cases of interstitial cystitis as much as possible of the diseased detrusor is removed. In healed tuberculous cases it is sufficient to excise such an amount of

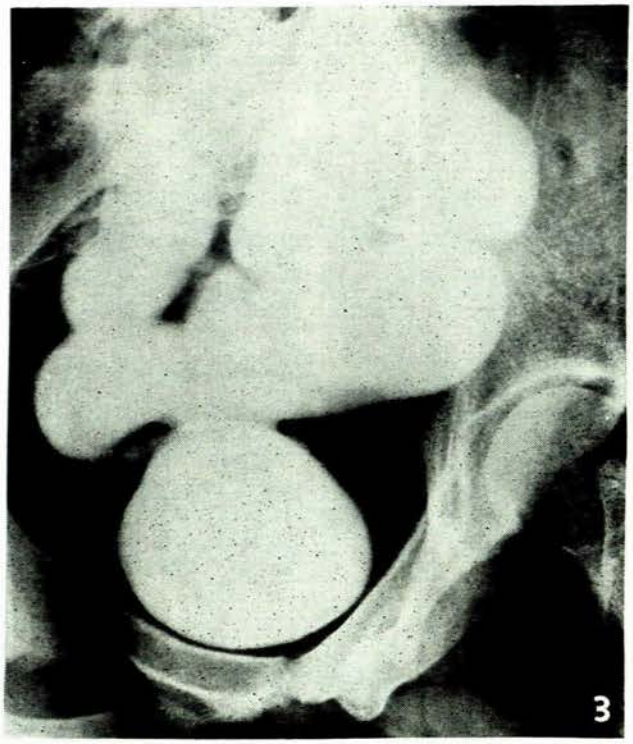

Fig. 3. Dilatation and elongation of the ileal loop in a female patient on whom uretero-ileocystoplasty was performed for tuberculous contracture 6 years ago.

vault as will provide the maximum opening into the contracted bladder. The serosal layer of the isolated ileal or sigmoid loop is attached along its antimesenteric border to the peritoneal covering and outer musculature of the bladder. The loop is then opened up and a mucosa-to-mucosa suture between the two structures is made with fine catgut, which is passed through the entire thickness of the bowel and the inner muscular layer and mucosa of the bladder. The new vault, provided by the bowel, is closed in two layers.

Ileocystoplasty with Opened Loops

Of the 7 patients who underwent an ileocystoplasty by this method, 2, females aged 33 and 60, had tuberculous bladder contractures. The other 5, of whom 4 were females aged 30, 33, 60 and 65 years, and 1 a male aged 71 years, suffered from intractable interstitial cystitis.

One, the woman aged 60, developed a faecal fistula on the 6th day, a sequel to a haematoma that had occurred at the site of the ileal re-union. The result of the bladder reconstruction was nevertheless very satisfactory, intervals of 3-4 hours between micturition replacing a pre-operative frequency of about 40 minutes within 3 weeks. As the faecal discharge had not ceased after 3 months, the abdomen was reopened, the ileal end-to-end anastomosis resected, and a fresh union made. Her subsequent course was uneventful and now, 19 months since the cystoplasty, she has continued well and the improvement in the bladder function has been maintained.

The results as a whole have been most gratifying. I shall outline the salient features of one as an illustrative example.

A woman, aged 33, suffered from a diurnal frequency of half to one hour and had a maximum interval of 1½ hours at night. The frequency, which had been progressive over the previous 7 years, was associated with almost constant suprapubic discomfort, relieved for a short time after micturition. Examination of the bladder with full relaxation under anaesthesia showed a maximum capacity of 150 ml., this degree of distension causing bleeding from the mucosa, which presented the typical appearances of interstitial cystitis without ulceration. After conservative therapy over a period of 6 months without improvement, ileocystoplasty with an open loop and extensive resection of the bladder detrusor was carried out in October 1961. Now, the diurnal intervals between micturition are 3½ hours, she can sleep for 6 hours without disturbance, and there is no suprapubic pain.

Colosystoplasty with Opened Loops

The results obtained on the 8 patients who had the bladder enlarged with an opened-out loop of sigmoid colon remain to be considered. In this group were 3

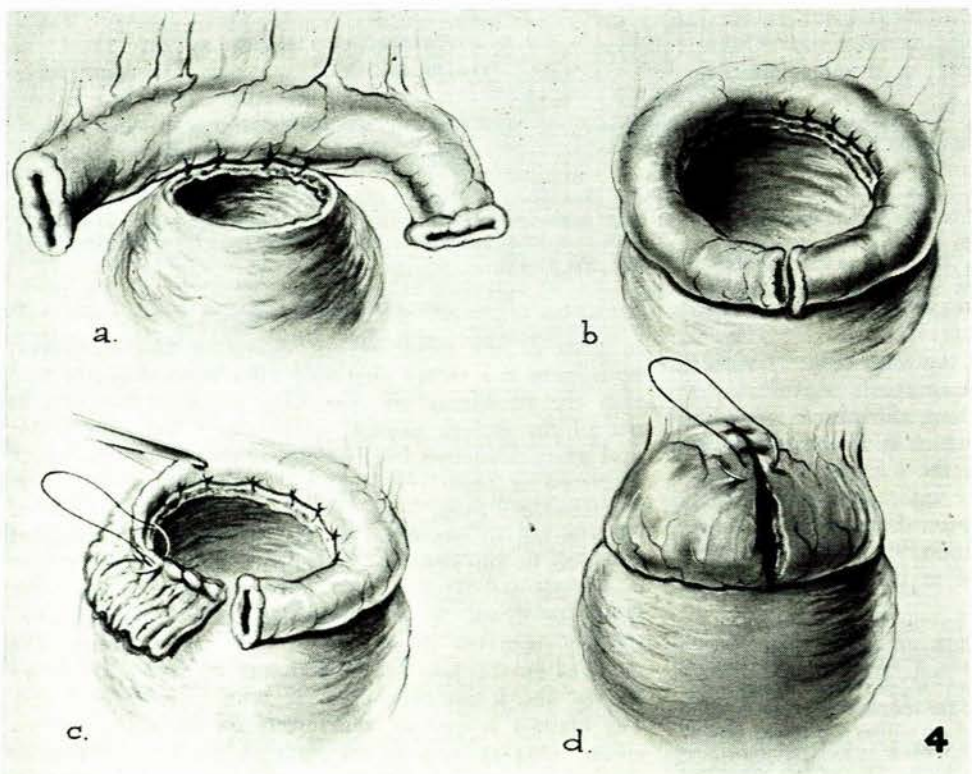

Fig. 4, a and b. Serosal layer of bowel attached to peritoneal covering and outer musculature of bladder. *c.* Suture of opened bowel to inner muscle and mucosa of bladder. *d.* Union of opposite cut edges of bowel.

females, aged 19, 49 and 52, and 1 male, aged 20, who had tuberculous contractures; 1 female, aged 51, who had post-irradiation cystitis following combined radium and external irradiation for carcinoma of the cervix; and 3 females, aged 12, 18 and 43, with interstitial cystitis.

The colocystoplasty, combined with an extensive detrusor excision, which was carried out on the patient with irradiation cystitis, proved a failure. She developed a urinary fistula on the 14th postoperative day. This closed in a fortnight, but she continued to have hourly frequency night and day, a maximum bladder capacity of 100 ml., bilateral ureter reflux, and severe urethral pain. As there was no improvement after the lapse of 4 months, she was readmitted to hospital and an ileal loop diversion carried out; thick-walled dilated ureters were encountered. Nine months have passed since this operation and I now contemplate diverting the ileal loop into the colocystoplasty.

Another patient, the girl of 18 with an interstitial cystitis, on whom an extensive segmental resection was also carried out, developed extravasation on the 16th postoperative day. On abdominal exploration the right portion of the attached graft was found to have sloughed. Excision of the necrotic area and reconstruction as far as this was possible around a suprapubic tube was carried out. She, too, made a satisfactory recovery and complete closure was obtained within 4 weeks. Now, a year later, the capacity is 500 ml.

The other 6 had uneventful postoperative courses and the functional results in 5 after 18, 13, 11, 10 and 5 months, respectively, are excellent (Fig. 5, A and B).

The remaining patient, a girl of 12, had suffered from half-hourly frequency, nocturnal incontinence, marked pain on micturition and bouts of profuse haematuria for about 2 years. The maximum bladder capacity was 90 ml. and on cystoscopy widespread ulceration was seen to involve the posterolateral walls. Urography demonstrated early back-pressure dilatation in the upper urinary tract. At operation the bladder walls were found to be grossly hypertrophied, with the mucosal lining thickened and oedematous. A wide resection was carried out and an opened loop of colon was united to what was left of the bladder. Histological examination of the resected bladder wall showed that much of the mucosal surface was denuded of epithelium and replaced by a lining of granulation tissue. There was no evidence of tuberculosis. In 3 weeks, by which time the intervals between the acts of micturition were about 2½ hours, a cystogram demonstrated a bladder of normal-like contour, and voiding was painless.

The improvement was short-lived. Within a few months diurnal frequency again manifested itself and at night there was incontinence. The cystogram again exhibited a distorted outline. When 14 months had elapsed after the operation, by which time she was totally incontinent, an ileal loop diversion was carried out. She died 8 days later as a result of uncontrollable ileus and peritonitis.

Histological examination of the cystoplasty showed continuing ulceration of the bladder mucosa and increased thickening of the submucosa due to fibrous tissue that extended between hypertrophied muscle bundles. The colonic graft also showed inflammatory changes, with infiltration of the submucosa by fibrous tissue and hypertrophy of the muscle coats.

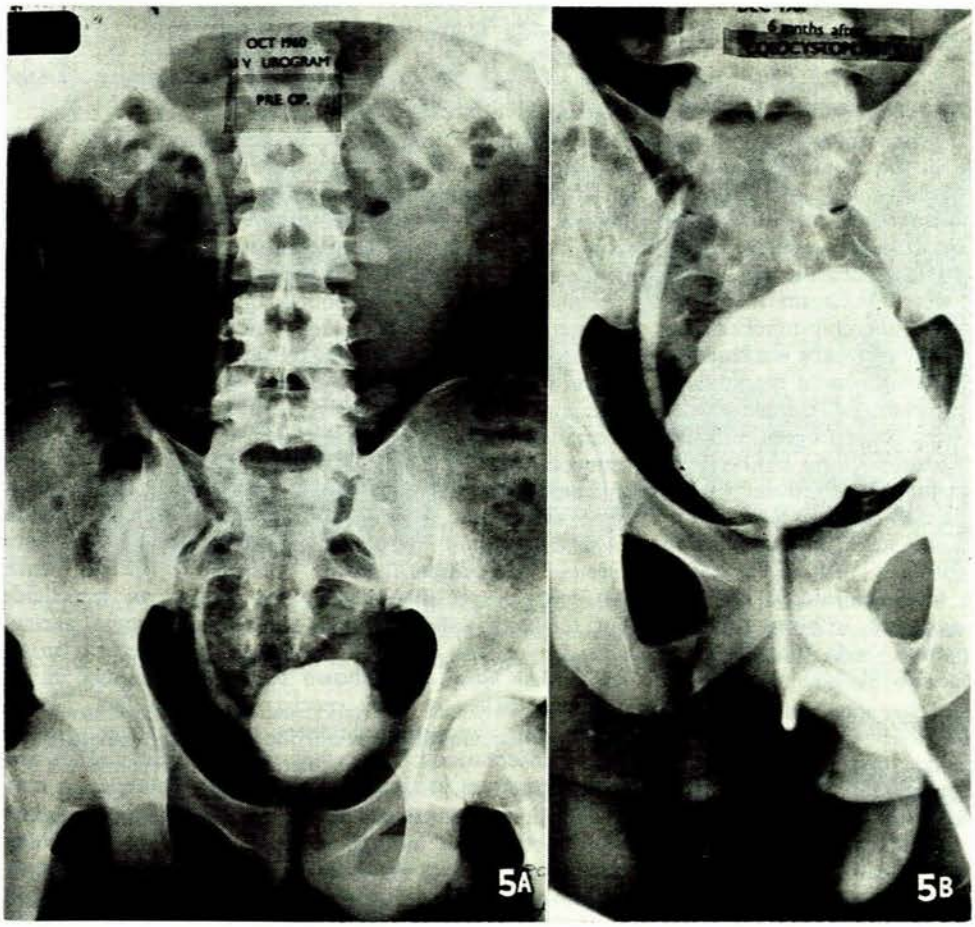

Fig. 5A. Intravenous urogram (male patient aged 20 years) showing bladder contracture 6 months after left nephrectomy for tuberculous disease.

Fig. 5B. Retrograde cystogram after open-loop colocystoplasty; ureteral reflux demonstrated.

Colocystoplasty with a Closed Loop

I have to add to the cases of enlargement of bladder with large bowel one other on whom at operation in July 1962 a closed loop was used.

The patient, a man of 28, had been referred because of half-hourly frequency, and haematuria of 2 months' duration. Cystoscopy showed numerous haemorrhagic mucosal patches scattered over the bladder walls and there was gross dilatation of the ureteric orifices. Intravenous and retrograde pyelography showed markedly dilated and redundant ureters with moderate dilatation in the pelvicalyceal systems. Retrograde cystography showed a bladder contracture associated with reflux up both ureters. Because of the condition of the ureters and the desirability of diverting them into the graft, it was decided it would be best to use a closed loop of large bowel. An isolated segment of unopened colon was anastomosed to the contracted thick-walled bladder and the ureters united to each end of the loop after excising redundant segments; the calibre of the ureters corresponded

almost exactly to that of the sigmoid and a 2-layer end-to-end anastomosis was readily accomplished.

When he left hospital 3 weeks later he could retain urine for periods of up to 3 hours and the improvement has been maintained.

CONCLUSIONS

As a result of my experiences with the different methods of reconstructive bladder operations (Table I), I consider that a more normal-like anatomical outline and better function will follow the use of opened-out grafts from either large or small bowel. A closed loop results in a diverticulum-like addition into which urine may be refluxed during micturition, while an open loop provides a new dome that forms an integral part of the bladder. Because of its thicker wall and bigger lumen it is easier to restore the continuity of large bowel and technically simpler to unite a graft from it to the bladder. The large bowel is also endowed with a better ability to withstand a higher pressure than the ileum. For these reasons it seems preferable to fashion the graft from the sigmoid colon. If, however, a redundant sigmoid loop is not freely available, or if the condition of the bowel wall, such as may arise from old-standing diverticulitis or from a heavy deposit of fat, obviates against the sigmoid as the source of the graft, one from the small intestine can be used with every confidence.

Whatever method an individual surgeon may choose for this type of operation, scrupulous attention to all its details is required. The avoidance of technical defects in the successive steps will best ensure a maximum of uncomplicated and gratifying results.

REFERENCES

1. Jacobs, A. (1962): Urologia (Treviso), **29**, 157.
2. *Idem* (1961): J. Roy. Coll. Surg. Edinb., **6**, 260.
3. Hanley, H. G. (1956): Brit. J. Urol., **28**, 402.
4. Houtappel, H. C. E. M. and Grundemann, A. M. (1960): *Ibid.*, **32**, 255.
5. Tasker, J. H. (1953): *Ibid.*, **25**, 349.
6. Riches, E. (1960): In *Modern Trends in Urology*, 2nd series. London: Butterworth.