THE USE OF A MUCOSA-LINED SIGMOID LOOP FOR BLADDER REPLACEMENT

By G.S. Yeoh, M.A., M.B., B.Chir., F.R.C.S. (Eng.), F.R.A.C.S., F.A.C.S.
and
J.E. Choo, M.B., B.S., F.R.C.S. (Edin.)
(Department of Surgery, University of Malaya, Singapore)

Total replacement of the urinary bladder is usually required following its excision for malignant disease. There are, however, the occasional benign and malignant lesions that require bladder substitution, yet allow preservation of the trigone and urethra. In all these conditions, some structure must be fashioned to the edges of the trigone or urethra that will provide an adequate reservoir and will empty itself completely when the desire for micturition requires. Since Simon (1852) first diverted the urinary stream into the rectum for a case of ectopia vesicae[11], a wide variety of technical solutions to this problem have been suggested. [1,6,8,10,12,16,17] There has been a renaissance of interest in such procedures during the past decade. [2,3,7,9,15] The purpose of this paper is to describe the use of an isolated loop of sigmoid colon with its mucosa intact as a new bladder to be attached to the trigone or urethra in a series of seven patients, where all or most of the bladder necessarily had to be removed.

OPERATIVE TECHNIQUE

With the patient in the dorsal decubitus position, the peritoneum is entered through a lower abdominal midline incision. In cases of malignancy, exploration must first exclude evidence of distant or extensive retroperitoneal metastases. If these are absent, the peritoneum is dissected off the fundus of the bladder. The dissection is continued on either side to expose the vasa deferentia and seminal vesicles, and the vasa are then freed and divided between ligatures. In our experience, it has not been found necessary to ligate the anterior division of the internal iliac artery. The bladder is then completely separated from its peritoneal coat and the space of Proust between the prostatic capsule and the fascia of Denonvilliers is identified. The superior vesical and obliterated umbilical vessels are divided between ligatures. The freeing of the bladder from the lateral pelvic walls and the levator ani muscles is continued. The ureters are identified, dissected free and divided near their entry into the bladder, after which the prostate is mobilised down to the triangular ligament. The mobilisation of the anterior aspect of the bladder and prostate is facilitated if care is taken to coagulate each vein as it leaves the peri-prostatic plexus of Santorini. The pubo-prostatic ligaments are now divided, thus completing the freeing of the prostate. The urethra is then divided just below the prostate, and the bladder and prostate removed. Bleeding from the open end of the urethra is free and is controlled by diathermy.

When the trigone can be saved, as in the two cases of bladder gangrene (IV and V), mobilisation of the bladder need only be carried down to the trigone and the ureters left undivided. The bladder is removed just above the trigone under direct vision, maintaining strict haemostasis by the use of the diathermy.

After haemostasis is assured, a 20 to 25 cm. segment of sigmoid colon, adjacent to the cavity left after removal of the bladder, is then selected so that the sites of transection lie above bloodless windows in the mesocolon, and sufficient length of colon is left to make distal anastomosis easy. Non-crushing clamps are placed on the colon to isolate this selected length of bowel and the colon transected between these clamps. Colonic continuity is then re-established by uniting the cut ends of the sigmoid to the right, i.e. medial to, the segment destined to be used as the urinary reservoir. After attaining haemostasis, the isolated colonic loop is cleaned of any residual faecal material and its proximal end closed with two layers of continuous catgut. If the trigone remains, its edges are sewn to the circumference of the distal end of the sigmoid pouch, using interrupted catgut sutures, in two layers, if possible. If the trigone has been sacrificed, the cut ends of the ureters are anastomosed through the taenia coli to the sigmoid, using interrupted catgut sutures into the sigmoid mucosa, and 3 or 4 reinforcing interrupted catgut sutures in the muscular layers. This anastomosis is facilitated by the temporary insertion of a ureteric catheter as a splint. As in all such procedures, great care must be taken to have the pouch and the ureters lie in easy approximation. The distal end of the sigmoid pouch is narrowed sufficiently to fit the proximal end of the urethra by a two-layer closure of part of the lumen. The narrowed stoma is then anastomosed to

the urethra with several interrupted catgut sutures round its circumference.

The artificial bladder is tested for leaks by forcibly injecting saline into it through a large-bore indwelling urethral catheter. The pelvic peritoneum is closed above the artificial bladder, and an extraperitoneal suprapubic drain placed near the distal anastomosis. The incision is closed in the usual way, and the catheter is anchored to the prepuce or labium by a stitch. The bladder is kept empty by continuous suction for 7 days.

CASE REPORTS

Seven patients have undergone urinary bladder replacement with a mucosa-lined sigmoid loop according to this technique, as summarised below.

Case I

H.H., 64 year old male Chinese was admitted on 1st. July, 1959, with retention of urine preceded by intermittent haematuria for a year. On cystostomy, he was found to have a carcinoma of the bladder, and so, on 22nd July, total cystectomy and replacement by sigmoid loop was carried out. He began leaking suprapublically on the 6th post-operative day, and continued to do so till the time of his discharge on 14th September, even though he was passing urine well per urethram. Apart from a persistently low potassium, his serum electrolytes returned to normal a fortnight after operation.

He was re-admitted on 29th September with a large recurrence over the symphysis pubis and oedema of his right leg. Nitrogen Mustard was tried without effect, and he died on 17th October.

Pathological Report: Irregular mass of firm tissue, measuring 10 x 6 x 4 cm., with a piece of peritoneum attached; no normal tissue can be detected; whole bladder probably replaced by firm white tumour tissue. Histology shows moderately to poorly differentiated bladder carcinoma invading the muscle coat. It probably arose from a papilloma. The mucosa also shows the same tumour.

Case II

Y.B., 60 year old male Chinese, was admitted on 6th July, 1959, with a history of painless haematuria for one year. He was thin and anaemic and there was radiological evidence of bilateral pulmonary tuberculosis. On cystoscopy, he was found to have a bladder carcinoma occupying the left side of the trigone. On 27th July, total cystectomy, partial prostatectomy and replacement were carried out. He began to leak suprapubically on the 8th post-operative day and later developed a diarrhoea which persisted till his death on 17th August from peritonitis and pyelonephritis. His electrolytes were essentially unchanged.

Pathological Report: Bladder with necrotic cauliflower growth, measuring 6.5 x 6.3 cm. Microscopically, a moderately well differentiated papillary carcinoma of the bladder, infiltrating the muscle wall.

Case III

N.K.C., 69 year old male Chinese, was admitted on 18th June, 1959, with acute retention of urine due to an enlarged prostate, which was relieved by suprapubic cystostomy. On 2nd September, he was re-explored, and was found to have, besides prostatic hypertrophy, a bladder that was small, thickened and hard, simulating malignancy, so total cystectomy and replacement was combined with the prostatectomy. Leakage began the day after operation from the incision, with practically nothing draining from the urethral catheter. On 5th October, on re-exploration, this leakage was found to be from the uretero-sigmoid anastomoses, which were then re-sutured, and a self-retaining catheter was inserted into the closed proximal end of the sigmoid loop through the incision to provide extra drainage. Leakage persisted till 5 weeks later, but he began to pass urine per urethram after two weeks, and he was discharged on 14th November. He has since been seen again, but has refused further cystoscopic or radiological examination. The serum electrolytes have remained within normal limits.

Pathological Report: Benign hypertrophy of the prostate and chronic inflammatory reaction and fibrotic changes of the muscular wall of the bladder with no evidence of malignancy.

Case IV

T.E.S., 25 year old male Chinese was admitted on 17th July, 1959, with haematuria associated with left loin pain. On 30th July, a stone was dislodged from the left ureteric orifice after it had been enlarged with cystoscopic scissors. On 11th August, the bladder was opened for persistent bleeding, but no frank bleeders could be found. He was re-explored on 17th August, and again on 4th September for recurrent bleeding, but, on each occasion,

no obvious bleeding points were found, and the bladder wound showed no signs of healing or union. On 14th September, further operation was carried out. The skin wound had sloughed widely, and there was gangrene of the anterior bladder wall. A subtotal cystectomy was done, leaving a fringe of bladder wall around the trigone, and a sigmoid loop was anastomosed to it in the usual way. Postoperatively, the patient did quite well till the 4th day, when he began to bleed from his wound and, three days later, to pass bloodstained stools as well. His condition rapidly deteriorated, and he died on 23rd September. Repeated thrombocyte counts, bleeding, clotting and prothrombin times were at all times within normal limits, and his liver function tests showed no abnormality. He was given a total of 31 pints of blood, of which 6 pints were fresh blood, but without any effect on the haemorrhage.

Pathological Report: Portion of bladder, measuring 6 x 3 x 4 cm. Cut surface shows a variegated appearance, yellow, orange and white. Sections show an organising granulation tissue with haemorrhage in parts. These changes are non-specific and are situated in the outer bladder wall.

Case V

S.F.S., 15 year old male Chinese, was first admitted on 17th May, 1959, for a swelling in the right scrotum, which was found to be tuberculous, and the right epididymis and vas deferens were removed on the 18th. He was seen again on 15th and 21st July, when cystoscopy was attempted to confirm the suspicion of tuberculosis of the right kidney, which had been found non-functioning on intravenous pyelography. Cystoscopy was unsuccessful because of the small size of his urethra. On 1st August, he was re-admitted in a very poor condition with lower abdominal distension and anuria. At laparotomy, the bladder was almost unrecognisable because it appeared to be completely gangrenous and there was some peritonitis. Suprapubic drainage was established and the abdomen was closed. His condition slowly improved, and on 14th September, the suprapubic wound was re-opened. The only recognisable part of the bladder was the trigone, so an isolated sigmoid loop was anastomosed to it. After operation, suprapubic leakage began on the 7th day, and persisted for about 4 weeks, and subsequently re-opened intermittently whenever the urine became clogged with mucus. At one stage, a fistula opened at the urethral bulb, but, by the beginning of January, 1960, both fistulae were finally closed and the incision was soundly healed. In February, 1960, intravenous pyelography showed the left kidney slightly hydronephrotic, but functioning well, and the right kidney completely non-functioning. He had put on weight, his general condition was good, he had good voluntary control of micturition, a good urinary stream, and his urine was clear, except for an occasional mucus thread. He refused further cystoscopy. No abnormal values were noted in the serum electrolytes, except for a short spell of hypopotassaemia.

Case VI

H.A.F., 50 year old male Chinese, was admitted on 9th September, 1959, for haematuria and dysuria on and off for two years. Cystostomy on 16th September showed a papillomatous growth occupying almost the whole of the anterio wall of the bladder. On 5th October, total cystectomy and replacement was carried out, but the patient died as the operation was being completed.

Pathological Report: Goblet-shaped bladder measuring 9 x 7 x 5 cm., filled with necrotic cancer, which appears to have arisen from half of the bladder. Section shows a very well differentiated transitional cell carcinoma (Grade I), which appears to have started to invade the muscle wall.

Case VII

G.A.C., 57 year old female Chinese, was admitted on 22nd September, 1959, with haematuria for one year, pain at the external urethral meatus, nocturnal frequency and some difficulty, loss of weight and appetite. Cystoscopy showed a growth on the left lateral wall of the bladder. On 7th October, total cystectomy and replacement were carried out. Suprapubic leakage began on the 2nd post-operative day, and soon accounted for most of the urine passed. A catheter was introduced through the incision and suction applied also to this catheter for several weeks. The suprapubic fistula finally closed on 12th February, 1960, and she was discharged on the 16th with fairly good voluntary control of micturition, a fair urinary stream, but with a frequency of about once an hour. The urine was clear of mucus. The serum remained within normal limits. A recent intravenous pyelogram taken a year after the operation shows functioning, moderately hydrone-

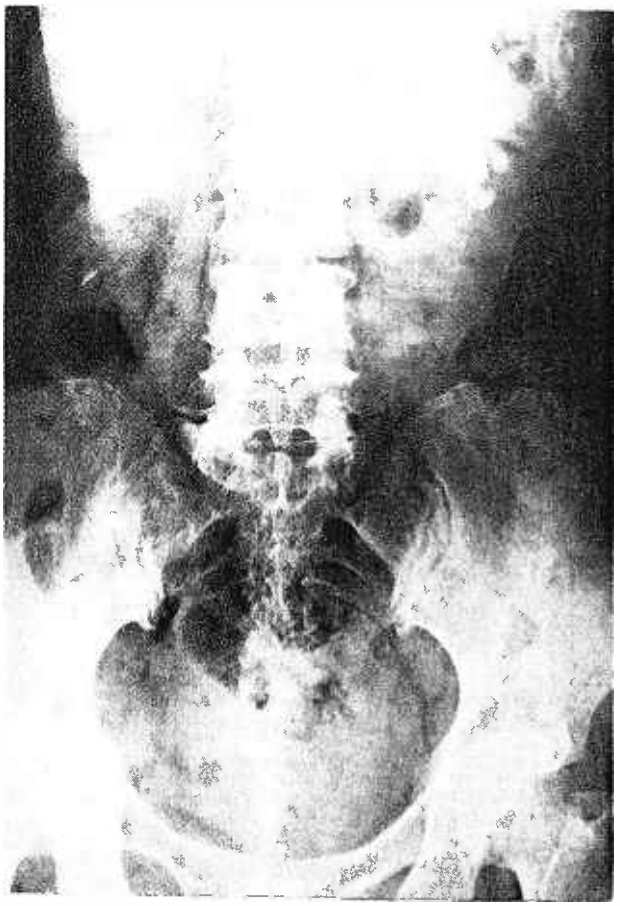

Fig. 1.

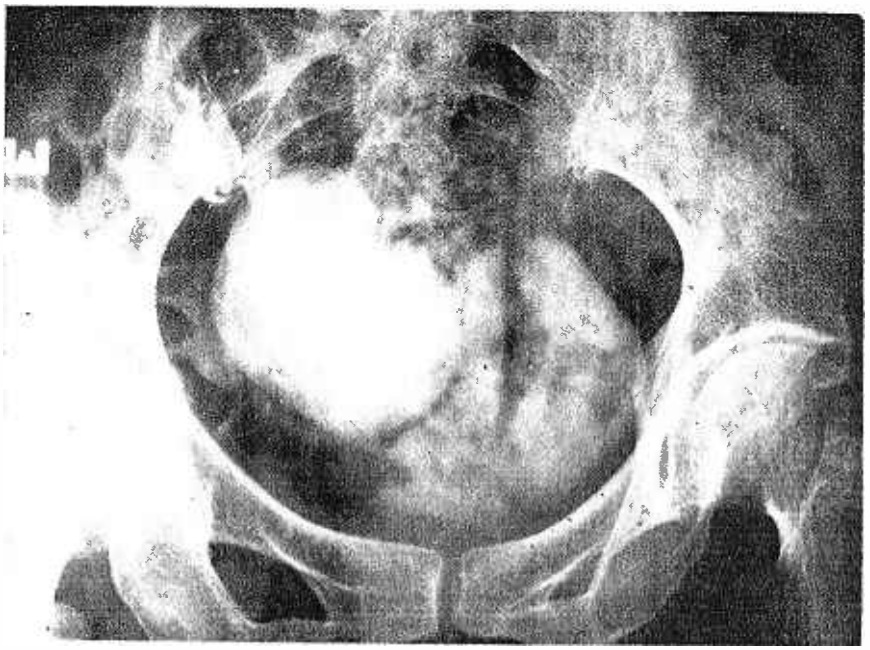

Fig. 2.

phrotic kidneys and a new bladder of adequate size (see X-rays, Figs. 1 and 2).

Pathological Report: Bladder filled by a carcinoma, measuring 5 x 3.5 x 3.5 cm., with haemorrhage and necrosis of the peripheral part of the tumour, which is embedded into 3 cm. of the bladder wall. The cancer has invaded the whole thickness of this portion of the wall. Sections show a moderately well differentiated transitional cell carcinoma invading the entire thickness of the bladder wall and cancer aggregates are seen in the perivesical lymphatic channels.

RESULT

The three surviving patients all had an excellent ultimate post-operative result. Each has returned to an essentially normal life, free from urinary incontinence, and in no way bothered by external bags, fistulae or other mechanical devices as required with other types of external urinary drainage. Of the utmost importance is that the urine in each is clear, with only an occasional mucus shred, and in none has kidney function been seriously impaired. (In Case V, the right kidney was non-functioning even before operation, probably due to the original tuberculous process). The intravenous pyelograms in each are satisfactory and none has bacilluria.

In the immediate post-operative period, frequent bladder washouts with 4.5% Sodium Bicarbonate solution were required to avoid blockage of the urethra by mucus, but, within a few weeks, this threat had diminished sufficiently so that re-catheterisation and washout were no longer necessary. The most remarkable part of this entire experience is the dramatic fashion in which this mucus disappeared from the urine within a few weeks' time.

The most persistent post-operative complication has been the temporary urinary fistula which has confused the early care of each of these patients. In one case, re-anastomosis of the ureters to the sigmoid was required before a good result ultimately was obtained. It is concluded that great care must be used in preserving both ureteric and sigmoid vascularity, and only a few sutures used in the anastomoses. A drain must be left in place until no danger of leak exists.

DISCUSSION

Total bladder replacement is occasionally required in the treatment of both benign and malignant disease, and a huge literature has evolved about its technical performance[1,2,3,6,7,8,9,10,11,12,15,16,17]. The procedure here described is different from the many previous techniques in that the mucosa is left intact within the segment of colon utilised to replace the bladder. As thus used, with either the trigone or the urethra left in situ, the procedure is to be adopted only when these two structures are not involved in tumour, or when a benign condition necessitates total cystectomy.

Subtotal cystectomy with preservation of the trigone obviously will seldom be indicated for carcinoma. Similarly, it is usually unwise to utilise the urethra if there is any chance that tumour may extend into this structure. On the other, such benign conditions as papillomatosis, tuberculosis, ectopia vesicae, or bladder gangrene, may require cystectomy without resection of the trigone. In such benign conditions, both the trigone and the nerve supply controlling the sphincter mechanism. may be left intact, and a diverticulum of sigmoid attached to the trigone may suitably act as a bladder reservoir.

The ideal artificial bladder should possess the following characteristics: (1) Be sufficiently contractile to empty itself completely. (2) Be sufficiently large not to cause frequency. (3) Be under nervous control and thus be continent. (4) For safety of construction, be extra-peritoneal. (5) Should not absorb urea and chlorides to such an extent that electrolyte imbalance is produced. (6) Should not excrete mucus to the extent of impeding urinary drainage in any way. The isolated sigmoid loop with intact mucosa as utilised in this experience appears to fulfil all these criteria, except the last two which deserve further consideration.

Although there is no direct evidence as to the degree of chloride or urea absorption in these patients, there is no reason to believe that they will in any way differ from analogous patients with intra-abdominal sigmoid urinary conduits as employed by Bricker[2], or Pyrah.[9] In none of the patients who have been followed for 6 months or more has any electrolyte abnormality appeared.

Early in our experience, the threat of excessive mucus formation in the sigmoid urinary "bladder" caused some concern. Immediately post-operatively, these patients pass numerous mucus shreds in their urine, and in the first few days it is important to keep the bladder well irrigated, and a large-bore catheter is left

in to avoid plugging. Within a week, however, mucus production begins to diminish, and the urine to clear. At the end of a month, it is surprising how clear the urine is of mucus, and within three months, the urine appears normal. This marked change is much more pronounced than the clearing that occurs when segments of the sigmoid have previously been utilised as urinary conduits in the Bricker procedure.[2] The reason for such a diminution in mucus production is not entirely clear. The most obvious explanation would be that the presence of urine and the absence of faecal irritation and infection might change the mucosal cells lining the sigmoid pouch. Unfortunately, none of our patients in whom this procedure has been employed has consented to post-operative cystoscopic biopsy.

Cases IV and V are of special interest, in that they are cases of massive necrosis or gangrene of the bladder, a very rare condition. Stirling and Hopkins (1934) reviewed 207 cases and reported 2 of their own cases of gangrene of the bladder,[13] and since then, in the English language literature up to 1957, only another 23 cases have been reported. Originally described by Willis in 1650 as exfoliation of the bladder, the condition has been given various names, such as "Gangrene of the Bladder", "Exfoliative Cystitis" and "Cystitis Gangrenosa Dissecans"[5], causing considerable confusion in the reporting of cases. Haultain (1890) first suggested that all these cases be classified under the term "Necrosis of the Urinary Bladder",[4] which would do away with this confusion.

The aetiology of the condition has been classified as follows:—

(1) Poor nutrition of the wall of the bladder (Haultain) caused by:—
  (a) Chronic urinary retention;
  (b) Impacted gravid uterus.
(2) Infection.
(3) Chemical irritants.
(4) Lesions of the central nervous system, i.e. cord bladder.
(5) Mechanical obstructions, e.g. enlarged prostate or urethral stricture.
(6) Circulatory disturbances.
(7) Metastatic necrosis.

In the great majority of cases of gangrenous cystitis, the destructive process is confined to the mucosa and submucosa, but, occasionally, the necrosis extends to involve the muscularis and even the serosa.

A history of profuse haematuria with the passage of pieces of membrane and signs of toxaemia should lead one to suspect, in a case of cystitis, that bladder necrosis may be starting. Cystoscopic examination is usually disappointing, as the view is obscured by the marked haematuria and the masses of loosely attached membrane.

Case IV would appear to be one of necrosis resulting from impaired nutrition due to circulatory disturbances caused by the recurrent massive haemorrhage, but the cause of the haemorrhage itself is obscure. Case V would appear to be bladder necrosis consequent on infection and mechanical obstruction.

SUMMARY

1. The use of an isolated segment of sigmoid colon with intact mucosa to replace the diseased urinary bladder is advocated.

2. The operative procedure is described. Seven cases which were operated on are described and the results given.

3. The rare condition of bladder gangrene is mentioned with reference to two of the cases.

4. The operative procedure is not complicated and the ultimate results are good.

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