

Long-Term Results and Complications Using Augmentation Cystoplasty in Reconstructive Urology

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One hundred and twenty-two augmentation cystoplasties performed over an 8-year period were reviewed. Mean age at surgery was 37 years (range 2-82 years). There were 82 female patients. The primary urodynamic diagnosis was reduced compliance in 92 (77%) patients and detrusor hyperreflexia/instability in the remainder. The clinical diagnostic groups were: spinal cord injury/disease in 32 (27%), myelodysplasia in 27 (22%), interstitial cystitis in 21 (17%), idiopathic detrusor instability in 13 (11%), radiation cystitis in 8 (7%), Hinman-Allen syndrome in 5 (4%), and miscellaneous in 11 (9%). A detubularized, ileal augmentation was used in 82 (67%) patients. In 36 (30%) a detubularized ileocecocystoplasty was fashioned and in the remainder detubularized sigmoid was used. In 19 patients augmentation accompanied undiversion. Sixteen patients had a simultaneous fascial sling for urethral incompetence. Mean follow-up was 37 months (range 6-96 months). There was no postoperative mortality. During follow-up 4 patients died from unrelated causes, 11 have been lost to follow-up, and 5 patients await planned transplantation. Bladder capacity was increased from a preoperative mean of 108 ml (range 15-500 ml) to 438 ml (200-1,200 ml) postoperatively. Of the 106 assessable patients, 80 (75%) had an excellent result, 21 (20%) were improved, and 5 (5%) had major ongoing problems.

During the period of follow-up, 17 (16%) patients underwent revision of their augmentation. Twenty-four (21%) patients developed bladder stones and 30% of these did so more than once. Urinary incontinence became manifest in 15 (13%) patients but required surgical treatment in only half of these. Pyelonephritis occurred in 13 (11%) patients. Five patients developed small bowel obstruction following discharge from hospital. There were 7 instances of reservoir rupture in 5 (4%) patients. Augmentation cystoplasty has a pivotal role in the treatment of a broad range of lower and upper urinary tract problems. Careful patient selection and close follow-up are essential. © 1995 Wiley-Liss, Inc.

Key words: augmentation cystoplasty, complications, reconstructive urology

INTRODUCTION

Bladder augmentation with bowel segments has virtually replaced urinary diversion in the treatment of both neuropathic and non-neuropathic bladder dysfunction

Received for publication February 7, 1995; accepted April 7, 1995.

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TABLE I. Clinical Diagnosis in All 122 Patients

Clinical diagnosis	No. patients	%
Neuropathic		
Spinal cord injury/disease	32	27
Myelodysplasia	27	21
Total	59	
Non-Neuropathic		
Interstitial cystitis	21	17
Detrusor instability	13	11
Radiation cystitis	8	6
Chronic cystitis	5	4
Hinman-Allen syndrome	5	4
Miscellaneous	11	9
Total	63	

that have not responded to pharmacotherapy nor other intervention [Kay and Straffon, 1986]. In addition, many patients who were previously diverted for unmanageable incontinence can be undiverted with augmentation of the bladder combined with reconstruction of ureteral drainage and the bladder outlet if necessary. Proper patient selection, use of a suitably configured bowel segment, and careful follow-up are mandatory. It has become clear that even patients with non-neuropathic dysfunction must be prepared for a lifetime of postoperative intermittent catheterization if many of the postoperative problems associated with altered voiding dynamics are to be avoided [Sethia et al., 1991]. Whether ileum or colon is used, detubularization will ensure a low pressure, high volume reservoir and an acceptable incidence of postoperative incontinence [Hinman, 1990; Sidi et al., 1986; Goldwasser and Webster, 1986; Light and Engelman, 1985; King et al., 1987]. Knowledge of the probability of complications is crucial in planning reconstruction of the lower urinary tract in individual patients and in formulating rational follow-up protocols. The incidence of long-term complications including stone formation, rupture [Elder et al., 1988; Sheiner and Kaplan, 1988], and neoplasm [Stone et al., 1987; Golomb et al., 1989] is unclear. Thus our aim was to report the short- and long-term outcome, including a detailed analysis of complications, in a large series of patients with diverse clinical diagnoses who had reconstruction of their lower urinary tract using augmentation cystoplasty over an 8-year period.

PATIENTS AND METHODS

Patients

From July 1983 to April 1991, 122 patients underwent augmentation cystoplasty at the University of Michigan. There were 82 female and 40 male patients. Mean patient age at the time of surgery was 37 years (range 2–82 years). Patients were classified according to primary clinical and urodynamic diagnosis. Among the clinical diagnostic group were 59 neuropathic and 63 non-neuropathic cases (Table I). The miscellaneous group includes patients with ectopia vesica, urethral valves, and chemical cystitis. The primary urodynamic diagnoses are given in Table II.

The incidence and complexity of prior surgery in this group of patients were significant. In Table III are listed the problems which influenced the decision for

TABLE II. Major Urodynamic Diagnosis in All 122 Patients

Urodynamic diagnosis	No. patients	%
↓ Compliance/capacity	94	77
Detrusor hyperreflexia	15	12
Detrusor instability	13	11

surgery and the type of surgical procedure carried out. In total, the group had undergone 128 previous urinary tract operations not including suprapubic tube insertion. These included 44 stress incontinence operations, 11 conduit diversions, 9 reimplant procedures, 10 stone procedures, 5 nephrectomies (bilateral in one case), 8 ureterostomies, and 8 vesicostomies. Various fistulae had been treated including one case each of vesicovaginal, urethrovaginal, enterovesical, and urethrocutaneous fistula. Of the 20 patients with problems related to chronic indwelling catheters, 10 had had a suprapubic catheter in place for a mean of 6.3 years (range:1–20 years) and 10 had a Foley catheter in place for a mean of 9.3 years (range:2–20 years).

Preoperative upper tract deterioration was seen in a total of 54 (44%) patients and was usually manifest by bilateral hydronephrosis and/or vesicoureteral reflux. Twenty-two of the 54 had chronic renal failure, defined as serum creatinine >1.5 mg/dl. Of these 22, 9 had end stage renal failure and these patients are described in detail in a recent publication [Zaragoza et al., 1993]. Of the 17 patients with stress urinary incontinence preoperatively, 12 had intrinsic sphincter deficiency (ISD) due to myelodysplasia, 3 were spinal cord injured females with intrinsic sphincter deficiency due to a chronic indwelling catheter, and 2 had Type III stress urinary incontinence in addition to interstitial cystitis. Of the 19 previously diverted patients, 11 had an ileal conduit, 4 had a vesicostomy, and 4 had a ureterostomy.

Surgical Technique

The type of augmentation procedure and ancillary procedures used are listed in Table IV. The commonest augmentation procedure used (Fig. 1) was the McGuire modification of the hemi-Koch procedure [Weinberg et al., 1988]. The ileocystoplasty is fashioned from 25–30 cm of ileum at least 15 cm from the ileocecal valve. The closed ileal segment is then detubularized beginning and ending approximately 2 cm from the stapled ends. The two adjacent borders of detubularized ileum forming what will be the posterior wall of the ileocystoplasty are sutured with running 2–0 chromic catgut. Each stapled end of the ileal segment is undersewn with running 2–0 chromic catgut. The bladder is distended with saline and the overlying peritoneum is stripped from the posterior and superior surface. A transverse "smile" incision (looking posteriorly) is fashioned 3 cm above the ureteral orifices creating an anteriorly-based detrusor flap. The ileal segment is then sewn into the open bladder with a running 2–0 chromic catgut. The upper part of the ileal reservoir is partially closed to allow a better match of the ileal and bladder margins. In 4 patients with hyperactive bladders who could not self-catheterize, the more distal portion of the ileal segment was left long enough to bring to the skin as an incontinent stoma, usually low in the right iliac fossa. In one patient whose urethra had been destroyed, the efferent segment was intussuscepted into the ileocystoplasty to function as a continent catheterizable stoma. However, when the urethra required closure or was unusable, the

TABLE III. Associated Problems Which Influenced the Surgical Approach

Problem	No. patients	%
Upper tract deterioration	54	44
Chronic renal failure	22	18
End stage renal failure	9	7
Chronic suprapubic tube or Foley	20	16
Diverted upper tracts	19	16
Stress urinary incontinence	16	13

preferred type of cystoplasty for the patient able to self-catheterize was an ileocecal augmentation using a reinforced ileocecal valve or the appendix (3) as a continent neourethra for catheterization. Aside from these considerations, the choice of right or left colon over ileum was determined chiefly by availability and mobility of the ileum and the preference for a large bowel segment for ureteral reimplantation after undiversion. For ileocecocystoplasty, the right colon and ileum were mobilized and prepared as for an Indiana pouch. When appendix was used as the catheterizable stoma it was left in situ.

Of the 11 conduit undiversions, the ureter or ureters were reimplanted into the augmented bladder in 7. In the others, the ureteroileal anastomoses were left intact and the conduit was implanted into the augmented bladder as a nipple (3) or after tapering (1). Intrinsic sphincter deficiency (17 cases) diagnosed preoperatively was treated with a simultaneous pubovaginal sling in 16 cases. In 6 of the 21 augmentations carried out for interstitial cystitis, a supratrigonal resection of bladder was carried out simultaneously. In 5 cases where the urethra was eroded, simultaneous urethral closure was carried out.

Assessment

Urinary symptoms and drug usage were documented pre and postoperatively. All patients had a serum creatinine estimation, renal ultrasound, or intravenous urogram. Each patient also had cystoscopy and a fluorourodynamic assessment [McGuire et al., 1993] preoperatively. Bladder and abdominal leak point pressures were measured as appropriate. Maximum cystometric capacity, detrusor hyperreflexia, and detrusor instability were defined according to the International Continence Society standard [Abrams et al., 1988]. Some patients had cystoscopy and measurement of bladder capacity under anesthesia. All patients had a postoperative cystogram performed at the time of catheter removal, usually within 2 weeks of surgery. Postoperatively, the majority of patients underwent, at least yearly, renal ultrasound, cystoscopy, and medium-fill saline cystometrogram using a 10F double lumen catheter. Repeat fluorourodynamic study was performed for cases with persistent or recurrent incontinence, hydronephrosis, or urosepsis. In addition, spinal cord injured patients were surveyed according to a previously reported protocol [McGuire et al., 1991].

RESULTS

There was no postoperative mortality. Four patients died at a mean interval of 52 months (range 15–85 months) postoperatively of unrelated causes. Mean fol-

TABLE IV. Type of Augmentation and Ancillary Surgical Procedure(s)

Augmentation type	No. patients	Ancillary procedures	No. patients
Ileal (82)		Undiversion (19)	
Ileum only (McGuire)	75	Ileal conduit	9
Ileum + continent stoma	1	Ureterostomy	4
Ileum + incontinent stoma	4	Vesicostomy	4
Ileal loop (detubularized)	2	Sigmoid conduit	2
Ileocecal (36)		Other (28)	
Ileoecum only	15	Pubovaginal sling	16
Ileocecal + continent stoma	20	Burch suspension	1
Ileocecal + incontinent stoma	1	Urethral closure	5
Sigmoid (4)		Supratrigonal resection	6

low-up was 37 months (range 6–94 months). Eleven patients were lost to follow-up (no contact for more than 1 year) although early follow-up data exist, which in some instances amounted to many years of follow-up. Five patients await transplantation into their cystoplasty. Therefore, the clinical and urodynamic outcome of surgery could be determined in 106 patients with a functioning cystoplasty followed on a regular basis since their augmentation (Fig. 2). Eighty (75%) had an excellent outcome with respect to upper tract function, continence, and comfort. Twenty-one patients (20%) were improved clinically and uroodynamically but still had some problems, usually some degree of incontinence or urgency. Five patients (5%) are unhappy due to major ongoing problems. Of the 5 patients, 3 had interstitial cystitis and developed recurrent frequency, urgency, and pain. One patient with radiation cystitis has persistent bladder pain and urinary leakage. All of these patients, however, have improved bladder compliance and capacity despite their persistent symptoms. Another patient with myelodysplasia stopped intermittent catheterization, discontinued antihypertensive medication, was lost to follow-up for 21 months, and returned in renal failure.

Patients with interstitial cystitis had the poorest results. Three of the 5 who had major ongoing problems were in this group and only 10 (56%) of 18 available for follow-up had an excellent outcome. Of interest is the fact that all 6 interstitial cystitis patients who had a simultaneous bladder resection had an excellent outcome. All interstitial cystitis patients had a poor bladder capacity preoperatively and in every case this problem was corrected.

Upper Tract Deterioration

Upper tract deterioration was a major determinant of the need to perform augmentation. In 54 patients (44%) there was evidence of upper tract deterioration preoperatively. Paired pre and postoperative renal function data was lacking in 19 patients, 13 of whom had normal upper tract parameters documented preoperatively. Marked improvement or stability of upper tract function was documented in 99 patients (96%). Unfavorable upper tract changes were documented in 4 patients (4%) only. These consisted of increased serum creatinine in 1 patient, de novo calculus formation in 2 patients, and de novo scarring in 1 patient. The 2 patients with de novo renal calculus formation had improved postoperative creatinine despite the development of a calculus.

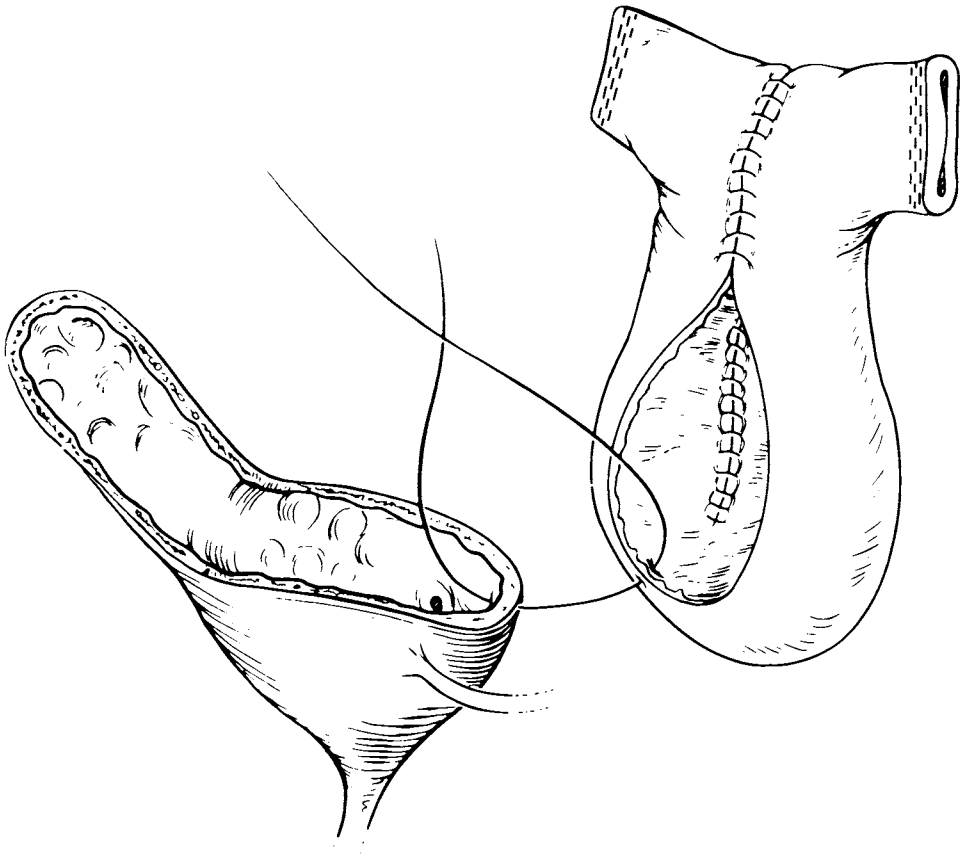


Fig. 1. The McGuire modification of the hemi-Kock augmentation cystoplasty. The antero-inferior portion of the detubularized, reconfigured small bowel is closed only as needed to fit the free margin of the opened bladder. The stapled ends of the small bowel are undersewn with continuous chromic catgut to prevent stone formation on staples.

Continence and Lower Tract Function

Bladder capacity increased significantly from a preoperative mean of 108 ± 80 ml (SD) to a postoperative mean of 438 ± 192 ml (SD). All patients had improved or acceptable bladder compliance. Eighty patients did not need to use pads, 6 used one mini pad, 2 patients used 2 pads per day, and 3 patients required 4–6 pads per day. One patient required to wear a pad overnight only. One patient has an ileal loop.

Of the 15 patients with stress urinary incontinence postoperatively, 11 were female and 8 were neuropathic (4 myelodysplastic). Two female patients (both neuropathic) had persistent incontinence despite having a sling performed at the time of augmentation and 3 further neuropathic patients had been previously diverted. Of the 15 patients, 6 have only occasional stress leakage which did not require treatment, 5 have been cured with a sling, Raz procedure, or collagen, and 4 await treatment.

TABLE V. Postoperative ISC Status in 63 Non-Neuropaths*

ISC status	Males (%)	Females (%)
Permanent	8 (89)	34 (67)
Temporary (<6 months)	0	10 (20)
Never	1 (11)	7 (13)
No follow-up	2	1
Total	11	52

*ISC, intermittent self-catheterization.

Postoperative Intermittent Catheterization

All 59 neuropathic patients continued or were started on intermittent catheterization postoperatively. Among the 63 non-neuropathic patients, follow-up data is available on 60 and this is shown in Table V. Two-thirds of female patients needed to self-catheterize permanently postoperatively. Male patients were more likely to require continued ISC postoperatively (89%) but the status of 2 of the 11 male patients is unknown.

Complications (Table VI)

Detailed early and long-term follow-up information was available on 116 patients. The mean hospital stay for their augmentation procedure was 14 days (range 10–45). Eighteen (15%) patients were in hospital for more than 20 days after their augmentation. Most of these were stays related to prolonged ileus or persistent urinary drainage from the suture line. Of the 12 patients with prolonged ileus (>5 days), 7 were neuropathic and 5 non-neuropathic. A leak from the suture line was most often detected radiologically at the time of proposed catheter removal. Seventeen leaks occurred, 15 of which spontaneously closed with prolonged catheter drainage. Of the fistulas, 12 were from the augmentation suture line, 4 from the urethral closure site, and 1 from a suprapubic site. All 12 suture line leaks, 1 urethral leak, and the suprapubic site leak closed spontaneously within 2 weeks. Two of the urethral fistulas required surgical closure.

Late complications were analyzed in the same 116 patients available for follow-up. This includes 11 patients who were not seen in the preceding year in whom late complications were documented nonetheless. Stone formation was the commonest long-term complication occurring in 24 (21%) patients. Stones were associated with 14 of 40 (35%) large bowel augmentations and 10 of 80 (12.5%) ileal augmentations. This difference was statistically significant ($P < 0.025$). Combined bladder and renal stone formation was seen in 2 patients. New stones formed in 19 (79%) of the 24 patients and subsequently recurred in 7 (29%, 1 renal). Bladder stones were commonly related to intravesical staples. Stones were removed exclusively endoscopically.

Reservoir perforations occurred in 7 patients. Three reservoir perforations were seen in 1 patient with myelodysplasia in whom an incontinent enterovesicostomy was eventually performed. Four perforations were in large bowel augmentations and 3 were in small bowel augmentations. Five of the 7 perforations were in neuropathic patients. There were no fatalities. No patient developed a carcinoma in the cystoplasty nor symptomatic metabolic acidosis due to the cystoplasty.

TABLE VI. Early and Late Complications in 116 Patients

Early complications	No.	Late complications	No.
Fistula	17	Stone	26
Suture line	12	Bladder	20
Urethra	4	Kidney	6
Suprapubic site	1	Perforation	9
Ileus	12	Stomal problems	7
Wound infection	2	Pyelonephritis	4
Miscellaneous	6	Anastomotic stenosis	4
Total	37	Small bowel obstruction	4
Total no. patients (%)	32 (28)	Mucus retention	2
		Total	56
		Total no. patients (%)	51 (44)

Of the 116 patients, 17 (15%) required surgical revision, most commonly for stomal problems (Table VII). Overall, 56 (48%) patients experienced 1 or more complications. There was no significant difference in the incidence of complications between neuropathic and non-neuropathic patients ($P > 0.05$). However, when early and late complications were analyzed separately there was a significantly greater number of long-term complications in the neuropathic group ($P < 0.025$). Surprisingly, neither a history of prior diversion in the neuropathic group nor a history of radiotherapy in the non-neuropathic group significantly affected the complication rate.

DISCUSSION

The indications for using segments of the gastrointestinal tract and other tissues for lower urinary tract reconstruction have expanded dramatically since the report by Mikulicz in 1899 [Mikulicz, 1899]. This is attributable to the advent of clean intermittent catheterization [Lapides et al., 1972], the poor long-term results associated with the ileal conduit [Pitts and Muecke, 1979; Schwarz and Jeffs, 1975] and the ensuing trend for undiversion, the realization of the importance of detubularization [Goldwasser and Webster, 1986], and the demonstration of the importance of the role of bladder storage pressures in determining upper tract function [McGuire et al., 1981]. Augmentation cystoplasty using colon and/or small bowel has become an accepted reconstructive option for intractable incontinence and poor bladder compliance in many neuropathic and nonneuropathic disorders. These include spina bifida, spinal cord injury, multiple sclerosis, idiopathic detrusor instability, and congenital conditions such as exstrophy and its variants. In the case of a destroyed or uncatheterizable urethra, a continent catheterizable or incontinent stoma to the augmented or native bladder can now be provided.

The long-term results of reconstruction in our series, which includes a significant number of complex undiversion procedures, compare very favorably with the few other large reported series [Mitchell and Piser, 1987; Hendren and Hendren, 1990; Nurse et al., 1988; Lewis et al., 1990]. In particular, in a population where 54 patients had some evidence of deteriorating upper tracts preoperatively, following

TABLE VII. Revisional Surgery

Procedure	No. of patients
Stomal revision (stenosis, leak)	7
Anastomotic Y-V plasty	4
Ureteral reimplant (reflux, stenosis)	4
Augmentation reduction	1
Re-augmentation	1
Vesicostomy (recurrent perforation)	1
Total	18
Total no. patients (%)	17 (15%)

successful augmentation this trend was documented in only 4 patients. Outright failure of the reconstructive procedure is uncommon in all series.

Our disappointing results in patients with interstitial cystitis are mirrored by those of other authors [Nurse et al., 1991; Webster and Galloway, 1987]. Although our patients who had a supratrigonal resection at the time of augmentation had an excellent outcome, this experience has not been universal [Webster and Galloway, 1987; Fall and Nilsson, 1982] even when the entire bladder and urethra have been removed [Baskins and Tanagho, 1992]. It would seem that any surgical reconstructive procedure should be undertaken with caution in patients with interstitial cystitis. An improvement in capacity and compliance should translate into improved symptomatology. However, with interstitial cystitis patients this sequence does not necessarily occur. Pain does not directly relate to either compliance or capacity and may persist despite a complication free augmentation.

Another aspect of careful patient selection and preparation is that of compliance with intermittent catheterization. One of the patients with myelodysplasia who had an excellent reservoir suffered 3 perforations and was converted to an enterovesicostomy. The perforations were not consistently related to failure to self-catheterize although this was a factor at least once. All patients were advised preoperatively that they must be competent at self-intermittent catheterization. All neuropathic patients were already on intermittent catheterization or had diverted upper tracts. In voiding non-neuropathic patients, at least 50% can expect to have to catheterize postoperatively. In another series of patients augmented for urge incontinence only, a postoperative self-catheterization rate of just 15% was reported [Mundy and Stephenson, 1985]. However, many of these "spontaneously voiding" patients had residual urine measurements in excess of 200 ml. Our relatively high rate of postoperative self-catheterization is probably a reflection of our significant proportion of non-voiding non-neuropathic patients.

The most common long-term problem was incontinence due to sphincter weakness. This was seen chiefly in neuropathic patients. The incidence of postoperative stress urinary incontinence in our series (13%) compares favorably with the 15–44% reported by others [Kreder and Webster, 1992; Robertson et al., 1991]. Explanations for why sphincter weakness incontinence should become manifest postoperatively despite thorough preoperative fluorourodynamic assessment include (1) the difficulty of assessing a poorly compliant bladder which has been defunctionalized by diversion, (2) changes in bladder neck coaptation associated with significantly greater bladder volumes, and (3) contractile activity in the bowel segment especially when

Longterm Outcome of Cystoplasty

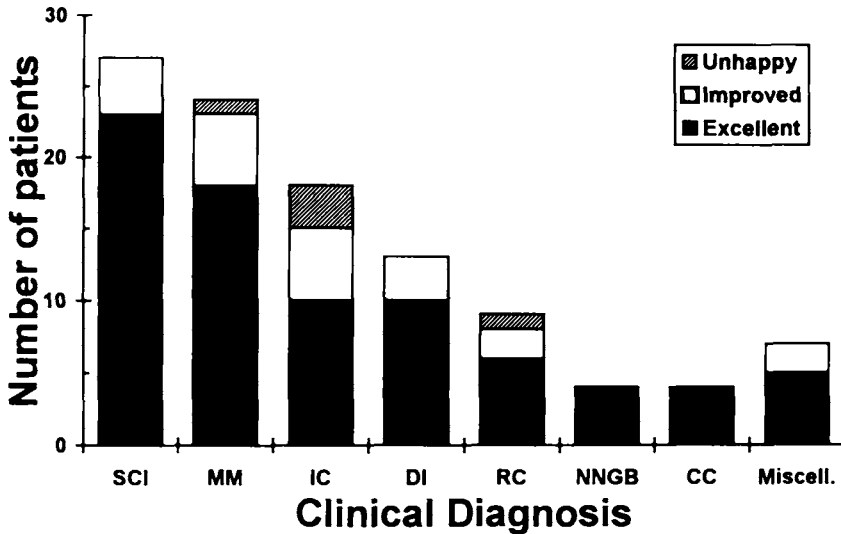


Fig. 2. Long-term outcome of augmentation cystoplasty in 106 patients followed for a mean of 37 months. SCI = spinal cord injury/disease; MM = myelomeningocele; IC = interstitial cystitis; DI = detrusor instability; RC = radiation cystitis; NNGB = nonneurogenic neurogenic bladder; CC = chronic cystitis.

undetubularized bowel is used [Mitchell and Piser, 1987]. It should be noted however, that 6 of our 15 stress incontinent patients did not require surgical treatment of their incontinence. The recent availability of collagen for periurethral or transurethral injection has simplified the problem of management of post cystoplasty stress urinary incontinence.

Urolithiasis in the augmented bladder was the most common long-term complication seen in our series of patients. Our incidence of 21% is similar to the 30% reported by other authors [Hendren and Hendren, 1990; Blyth et al., 1992]. All stones were treated endoscopically, usually by the transurethral route but occasionally by percutaneous access when a continent stoma was present. The majority of new stones form in the bladder and in our series stone formation was often seen in relation to suture line staples. Although not examined in our study, the incidence of stones was previously noted to decrease with time after enterocystoplasty, suggesting that staples or some other perioperative influence might be important [Blyth et al., 1992]. It has been noted previously that enterocystoplasty stones are primarily triple phosphate, suggesting a possible role for urea splitting organisms in their formation [Blyth et al., 1992]. In contrast to others [Hendren and Hendren, 1990; Blyth et al., 1992], we noted a significantly increased incidence of stone formation in large bowel vs. ileum-only augmentations. Recently, the staple lines have been removed and the bowel resutured with absorbable suture or the staple line has been excluded from the reservoir by undersewing with a running absorbable suture in an attempt to decrease the incidence of stone formation.

Late reservoir perforation is a concern for both neuropaths and non-neuropaths following augmentation cystoplasty. Our incidence of 6% is similar to that reported previously [Braverman and Lebowitz, 1991]. In our series, 5 of the 7 perforations occurred in neuropathic patients. A mortality rate of 17–33% has been reported [Sheiner and Kaplan, 1988]. Death usually results from unrecognized perforation and ensuing peritonitis. Fortunately, there was no mortality in our series. A high index of suspicion is probably the most important factor in avoiding mortality.

Our high overall late complication rate of 44% reflects a very thorough review over a long period of follow-up of a large series of patients, many of whom had complex reconstructions, with a relatively small number of patients lost to follow-up. Although some of the long-term complications were life threatening, e.g., perforation, the vast majority were transient only. It is worth noting that only one patient had documented hyperchloremic acidosis and this was not a clinically significant problem. There was no case of a benign or malignant tumor arising in the augmented bladder. However, the mean time for detection of carcinoma in 14 cases reported in the literature [Golomb et al., 1989] was 16 years so that continued careful follow-up with yearly cystoscopy is indicated.

An alternative to augmentation cystoplasty with a continent catheterizable stoma is continent urinary diversion, many variations of which are described [Rowland and Kropp, 1994; Thuroff et al., 1988; Stein et al., 1994]. In the present series, 21 patients had augmentation cystoplasty (20 ileocecal) performed with a continent catheterizable stoma. Eighteen of these patients were neuropaths, 2 had exstrophy, and 1 female had intractable detrusor instability. Five of these patients required simultaneous urethral closure as a result of prior urethral destruction. The advantages of our approach over continent diversion in these 21 patients are (1) preservation of an alternative access site to the bladder (in the absence of a need for urethral closure) which may be important in dealing with complications such as stones, (2) preservation of the ureterovesical junction (if not previously diverted) with its natural antireflux mechanism and provision of easy access to the ureters and kidneys for dealing with complications, (3) avoidance of the need for ureteroenteric anastomosis, a well-recognized source of early and late complications [Arai et al., 1993; Wilson et al., 1994], and (4) avoidance of the problem of pyocystitis or need for cystectomy.

Furthermore, the convenience of a continent umbilical catheterization site is also provided with our approach. The disadvantages of augmentation cystoplasty with a continent catheterizable stoma over continent diversion are (1) the presence of a urethra which may leak, and (2) the presence of a bladder which may give rise to incontinence secondary to detrusor overactivity. However, the former cannot occur after successful urethral closure and in our 16 patients noted above who did not have simultaneous urethral closure, only 3 had postoperative urinary leak. One was cured with a sling, 1 with collagen, and 1 by urethral closure.

In the male patient with normal or near normal urethral sensation, fear of discomfort during intermittent catheterization might be a consideration with respect to performing a continent stoma rather than using the native urethra. However, it is important to note that (1) not all males will require self-intermittent catheterization after augmentation, (2) 3 of 10 men who fell into this category were already catheterizing without difficulty preoperatively, (3) postoperative problems related to the stoma were the commonest indication for revisional surgery in this series, and (4) a dry stoma is still a stoma and may be unacceptable to some patients with a normal,

catheterizable urethra. Therefore, in men with normal urethral sensation, a continent catheterizable stoma should only be considered if, preoperatively, the patient demonstrates an unwillingness or inability to perform urethral self-catheterization.

CONCLUSION

This large series of patients with a variety of etiologies and complex, usually compromised, preoperative status underwent a variety of reconstructive procedures aiming to address every aspect of the preoperative problem. The need to perform fine-tuning procedures for stress incontinence and stomal difficulties is relatively common in the long term. Of critical importance is the lack of mortality due to the procedure in both the short and long term. This type of surgery requires considerable preoperative planning as well as careful follow-up to optimize continence, upper tract preservation, and quality of life in a group of patients who often appear to have unsalvageable urinary tracts at the time of presentation.

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