

## Original Research Article

# Ten years' experience of augmentation cystoplasty for varied indications and its outcome

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### ABSTRACT

**Background:** The aim of the study was to evaluate long term efficacy and complications of augmentation cystoplasty in patients with bladder dysfunction.

**Methods:** Our series comprises of 30 patients undergoing enterocystoplasty from March 2009 till December 2019. Clinical findings and investigations result along with surgical techniques used were noted for these patients. Postoperative complications along with urinary continence and renal outcome were evaluated.

**Results:** Mean age of patients was 7 years and their mean follow up was for 4 years. Major complications occurred in 5 patients which were successfully managed and minor complication in 8 patients. Of these 16 patients were with neurogenic bladder and 14 with non-neurogenic bladder. The primary etiology of non-neurogenic bladder was extrophy epispadias complex (10 patients), posterior urethral valves (2 patients), anterior urethral valve (1 patient), and bilateral ectopic ureter (1 patient). The primary etiology of neurogenic bladder was meningomyocele (4 patients), anorectal malformation with vertebral anomalies (7 patients), partial sacral agenesis (4), nonneurogenic neurogenic bladder (1 patient). Relative continence was achieved in 97%. The preoperative serum creatinine and blood urea nitrogen (BUN) at the time of bladder augmentation (termed creatinine-1 and BUN-1) and the serum creatinine and BUN at the last follow up after bladder augmentation (termed creatinine-2 and BUN-2) were sought and compared using chi square test showed statistically significant improvement ( $p < 0.01$ ).

**Conclusions:** Augmentation cystoplasty is a necessary and safe procedure to increase the functional capacity of small contracted and poorly compliant bladder and allows patients to achieve relative continence and preserves renal function.

**Keywords:** Augmentation cystoplasty, Bladder dysfunction, Continence

### INTRODUCTION

The primary purpose of any reconstructive procedure is to provide the better quality of life with the lowest risks of complications. Since the initial report of Mikulicz, the indications for enterocystoplasty using various segments of the intestinal tract have expanded.<sup>1</sup> Continent reconstruction of the lower urinary tract is

often the procedure of choice for patients who have congenital anomalies of the bladder and have undergone multiple prior reconstructive procedures.<sup>2-5</sup> Indicated patients should be initially trained for clean intermittent catheterisation and kept on necessary pharmacotherapy prior to surgical intervention. Prevention of urinary tract infection by providing unobstructed drainage of the upper urinary tract through effective bladder evacuation is of utmost importance along with achieving urinary

continence. In our study we test the long-term efficacy and record the complication rate along with final continence outcome and preservation or improvement in renal function in children undergoing augmentation cystoplasty.

## METHODS

We retrospectively collected data from the medical records of all children of our institute (JJ hospital and college, Mumbai) grant medical who underwent augmentation cystoplasty from march 2009 to December 2019. Written informed consent was obtained from the patients for publication and accompanying images. Demographic data, underlying etiology, augmentation type, associated concurrent procedures and type of surgical revision were also collected. Indications of augmentation cystoplasty were patients with low bladder capacity based on expected capacity of age, poor detrusor compliance, incomplete emptying. Medical management with anticholinergics was started in indicated patients and clean intermittent catheterisation (CIC) was implemented preoperatively in all patients. The preoperative investigations included renal function test, micturating cystogram for bladder capacity and leak point pressure, renal ultrasonography and radionuclide nephrography (DTPA scan) for upper tract status. Patients also underwent urodynamic study to assess end filling pressure and bladder compliance.

### Operative technique

Our technique of illeocystoplasty consists of isolating around 30 cm of ileum 15 cm proximal to the illeocaecal valve (Figure 1) and restoring bowel continuity by end to end anastomosis. Illeal segment is reconfigured into U shape. Native bladder is opened in clam shaped from bladder neck ventrally to trigone posteriorly in cases where bladder disconnection is required and transversely in other cases. The reconfigured bowel is anastomosed to the opened native bladder Appendix was used in 25 patients to create a continent stoma by Mitrofanoffs procedure. In 4 patients where the appendix was unsuitable or used to access the colon via the antigrade colonic enema (ACE) procedure, illeum was used by Monti's principle (Figure 2) and in one patient native ureter was used to create the continent stoma.

Postoperatively patients were followed up with renal function test; ultrasonography and DTPA scan to see for the renal status. While serum creatinine and blood urea nitrogen (BUN) estimations have been made on many occasions both preoperatively and postoperatively, 2 critical values were sought for each child; the preoperative serum creatinine and BUN at the time of augmentation cystoplasty (termed creatinine-1 and BUN-1) and the serum creatinine and BUN at the last follow up after augmentation cystoplasty (termed creatinine-2 and BUN-2) and was analysed using the chi square test.

Social continence and dry interval period between clean intermittent self-catheterizations were also noted.



Figure 1: Ileal segment isolated for illeocystoplasty.



Figure 2: Ileal Monti to use as Mitrofanoffs in an augmented bladder.

## RESULTS

Patients undergoing augmentation cystoplasty (AC) were followed for a mean period of 4 yrs (1 yr to 10 yrs). Out of 30 patients, 14 were male and 16 were female; with a mean age of 7 yrs (4 yr-16 yrs). The primary etiologies of bladder dysfunction are represented in (Table 1).

Table 1: Primary etiology of bladder dysfunction.

Etiology of bladder dysfunction	No. of patients
<b>Neurogenic bladder</b>	16
Meningomyocele	4
Anorectal malformation with vertebral anomalies	7
Non-neurogenic neurogenic bladder	1
Partial sacral agnesis	4
<b>Non-neurogenic bladder</b>	14
Extrophy epispadias complex	10
Posterior urethral valves	2
Anterior urethral valve	1
Bilateral ectopic ureter	1

The most common technique used for augmentation with continent diversion were illeocystoplasty (17), ileo ascending cystoplasty (9) and sigmoid cystoplasty (4) (Table 2).

**Table 2: Types of augmentation procedures performed.**

Augmentation	No. of patients
Illeal	17
Illeocecal	9
Sigmoid	4

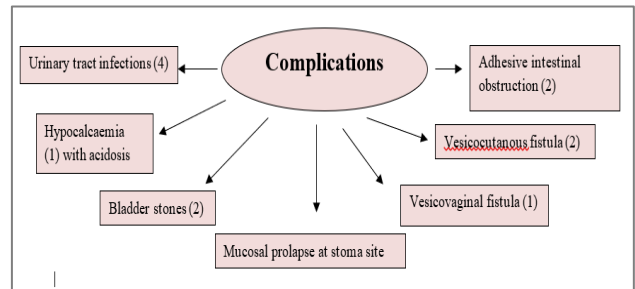
13 patients underwent bladder neck disconnection; 3 patients underwent tightening of the bladder neck using the rectus muscle sling. 2 patients with preoperative bilateral 5 vesicoureteric reflux and history of multiple urinary tract infections underwent ureter reimplantation along with augmentation (Table 3).

**Table 3: Combined procedures along with augmentation cystoplasty.**

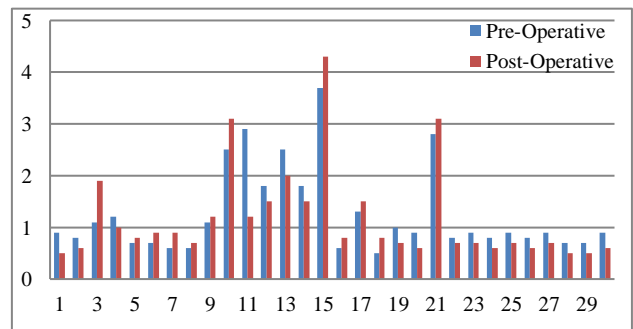
Procedures	No. of patients
Bladder neck disconnection	13
Rectus muscle sling of bladder neck	3
Ureteric reimplantation	2

Out of the 30 patients, 29 (97%) were dry during the day and night on 2-3 hourly intermittent catheterisation and 1 patient has intermittent dribbling with stress incontinence and occasional episodes of nocturnal wetting. Cystoscopy done in this child revealed wide bladder neck and is awaiting rectus sling surgery. 25 children are performing CIC with ease themselves while in 5 children below 5 years old had one of their parents doing CIC, mostly the mother. Children are using 10no infant feeding tube for CIC. As patients cannot afford disposable catheters, the catheter is washed from outside and flushed from inside and dried well after every use. In this manner our patients are able to use 10 catheters for 1month without increase in risk of colonization of catheters and urinary infection. Major postoperative complications Included mechanical bowel obstruction in 2 patients who underwent exploratory laprotomy; vesicocutaneous fistula in 2 patients and vesicovaginal fistula in a girl with b/l ectopic ureter which were repaired. On follow up 4 patients developed symptomatic urinary tract infection, 2 patients developed vesical calculi and 1 patient developed mucosal prolapsed at the stoma site. Hypocalcemia with metabolic acidosis developed in 1 patient requiring supplements. These complications are summarized in (Figure 3). Serum creatinine 1 and 2 values and BUN 1 and 2 values were plotted in a bar diagram (Figure 4 and 5). 24 patients out of 30patients of had successful stabilization of their serum creatinine and BUN values after bladder augmentation. One patient (patient no.17) with normal

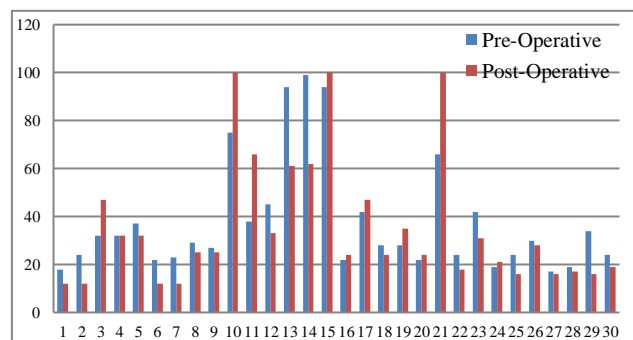
serum creatinine-1 and BUN-1 values had slightly higher serum creatinine-2 and BUN-2 values. Out of 5 patients with raised serum creatinine-1 (>2.5 mg/dl) and BUN-1 (>60 mg/dl) 2 patients (patient no.11 and 13) had decline in serum creatinine-2 and BUN- 2 values while 3 patients had a higher serum creatinine-2 and BUN-2 values eventually requiring dialysis. This difference in outcome was statistically significant (p<0.01 by chi square test).



**Figure 3: Overall complications in patients undergoing augmentation and continent diversion.**



**Figure 4: Comparison of serum creatinine-1 and serum creatinine-2.**



**Figure 5: Comparison of serum BUN-1 and BUN-2.**

**DISCUSSION**

A successful continent urinary diversion requires a low-pressure reservoir, a continent efferent channel and a good cosmetic and non-stenotic skin stoma. The choice of intestinal segment in the construction of the reservoir is made according to each surgeon’s experience, although factors such as incidence of resorption and dyselectrolytemia certainly play a role. We have used

ileum in 17 patients; as it is easier to handle, has relatively mobile mesentery, and had minimal metabolic complications. In 1950, Couvelaire reported the clinical use of caecum for bladder augmentation.<sup>6</sup> The presence of the appendix in illeoceacocystoplasty is a distinct advantage. We have used illeocaecal segments in 9 patients. Sigmoid colon has been used for bladder augmentation since the beginning of the 20th century and was used as a detubularized patch in the 1950s.<sup>7-9</sup> Disadvantages of the sigmoid colon are its strong autonomic contractions and mucus production, and an advantage is the technical ease of anastomosing it to the bladder. We have used sigmoid colon in 4 patients and observed no complications.

Mitrofanoff, using the appendix as a catheterizable stoma, initially described the creation of a continent catheterizable conduit. We used appendix in 25 patients. In 3 patients where the appendix was too short or used to access the colon via the ACE procedure, the ileal Yang-Monti tube was used. In it a 2.0-2.5 cm segment of ileum was detubularized in the para-mesenteric border resulting in a tube of 6-7 cm in length, when transversely retubularized. We have also used ureter in 1 case to create a catheterizable stoma. There was only 1 case of stoma prolapse in our study. On review of literature we found Thomas et al reviewed 68 patients of Mitrofanoff procedure and found 9 patients developed stomal stenosis and 4 had false passages.<sup>10</sup> Narayanaswamy et al, suggested that difficulty with catheterisation was more to occur with a Yange Monti, as opposed to an appendix conduit.<sup>11</sup> In their study 26% with appendico-vesicostomies had problems with CIC whereas 60% of patients with illeovesicostomies had problems with catheterisation. Castellán et al. found no difference in the incidence of complications in Yange Monti channels (23%) versus appendix conduits (21%) at a mean follow up of 4 years.<sup>12</sup> Piaggio et al investigated the influence of type of conduit (appendix vs Yange Monti) and site of implantation (augmentation vs native bladder) in 41 patients with continent vesicostomies, of whom 72% also had a bladder augmentation.<sup>13</sup> There was no significant difference in outcome between different types of conduit (including divided appendix), sites of implantation, or segments used for augmentation (ileum or colon). Similarly, in our study we found no difference in outcome between different types of conduit, sites of implantation, or segments used for augmentation.

13 patients underwent bladder neck disconnection. The size of the bladder at the time of surgery dictates whether an outlet procedure along with bladder augmentation and continent stoma can be accomplished, or if the bladder neck will need to be transected, and augmentation and a continent stoma required. Also, in patients who have undergone multiple surgical procedures involving the bladder neck muscle quality may be questionable or extensive scarring may exist. This situation does not lend itself to reconstructive efforts. In the series by Ilhami et al, bladder neck closure was performed in 59 patients (65%) as a combined procedure with augmentation and

continent diversion achieving a 93% continence rate on intermittent catheterization in a failed exstrophy population.<sup>14</sup> We also recommend preservation or reconstruction of the bladder neck and urethra whenever possible, and reserve bladder neck disconnection as a last resort when other methods fail, as suggested by above series.

VUR can be eliminated with AC alone and ureteric reimplantation should be performed in patients with low pressure VUR, high grade VUR combined with UVJ stenosis or ureteral tortuosity and adhesions. In our study two patients has undergone ureteric reimplantation simultaneously.

Many complications like metabolic abnormalities, stomal stenosis, leakage, utis, vesical calculi, bladder perforation, hematuria malignancy have been reported in various series. We encountered vesical calculi after AC in 2 patient and 4 patients developed urinary tract infections. Calculus formation occurs in 6-52% of patients with bladder augmentation.<sup>15-17</sup> The etiology of stones after AC includes incomplete emptying, excessive mucus production, metabolic abnormalities and chronic bacteriuria. With generous irrigation of the pouch or augmented bladder at regular intervals, and prompt treatment of UTIs the incidence of calculus formation can be decreased. Two patients had intestinal obstruction requiring exploratory laprotomy. Lack of extraperitonealisation of Mitrofanoff channel due to which Mitrofanoff channel acted as a band caused intestinal obstruction in these patients.

In our study 5 of 30 patients were in renal failure at the time of AC. Out of 5 patients with raised serum creatinine-1 (>2.5 mg/dl) and BUN-1 (>60 mg/dl), 2 patients had decline in serum creatinine-2 and BUN-2 values while 3 patients had a higher serum creatinine-2 and BUN-2 values eventually requiring dialysis. Renal failure in these patients is primarily a consequence of pre-existing renal injury and not the result of the bladder augmentation. Schlomer et al also demonstrated that principal diagnosis was strongly associated with risk of decline in renal function or chronic kidney disease (CKD) after AC.<sup>18</sup> Developing CKD is likely related to primary pathology and not caused by augmentation cystoplasty itself. Fontaine et al showed that lower urinary tract reconstruction was associated with a significant deterioration in renal function in 19% of patients after 10 years of follow-up.<sup>19</sup> Singh et al in their study concluded that glomerular filtration rate  $\leq 4$  ml/min and serum creatinine 1.54 mg/dl at time of surgery could serve as predictors of renal function deterioration in augmentation cystoplasty in paediatric patients.<sup>20</sup> Similarly Bhattia et al suggested that BA, when otherwise indicated, has been beneficial in children with pre-augmentation creatinine up to 2 mg/dl.<sup>21</sup> Thus BA does not reverse renal failure although it can delay the onset of end-stage disease. BA has also been recommended as a method of preparing a dysfunctional bladder prior to renal transplantation, as the bladder could otherwise, in time, destroy the transplanted

kidney, just as it destroyed the native kidneys prior to transplantation.<sup>22,23</sup>

Relative continence was achieved in 97% on follow up. Cost reduction by encouraging the reuse of catheters was also instrumental in better acceptance of CIC as patients cannot afford disposable catheters. All the children were satisfied with the operation and they as well as their parents felt there was definite improvement in their quality of life. All were accepted at school and among friends and older patients on follow up are in college and doing jobs.

## CONCLUSION

Augmentation cystoplasty is a necessary and safe procedure to increase the functional capacity of small contracted and poorly compliant bladder and allows patients to achieve relative continence and preserve renal function with minimal morbidity.

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