Original Article

Bladder extrophy: Comparison of anatomical bladder neck repair with innervation preserving sphincteroplasty versus Young-Dees-Leadbetter bladder neck reconstruction

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ABSTRACT

Aim: To evaluate the outcome of innervation preserving sphincteroplasty along with anatomical bladder neck reconstruction (IPS-ABNR) compared to classic Young-Dees-Leadbetter (YDL) bladder neck reconstruction in extrophy with insufficient bladder capacity requiring detubularized-ileocystoplasty. Materials and Methods: Sixteen male patients of extrophy bladder who required ileocystoplasty from 2004 to 2010 were randomized into group A (n = 7) and group B (n = 9). After detubularized-ileocystoplasty with Mitrofanoff stoma and ureteric reimplantation in all, group A received YDL bladder neck repair while group B received IPS-ABNR repair through a midline scrotoperineal approach. Outcome measurement included operative and postoperative problems, continence, and upper tract status. Results: In group A, two had incompetent bladder neck with gross incontinence, while four had a dry interval of more than 3 h without the ability of voiding per urethra. In group B, seven patients had dry interval of more than 3 h with an ability of urethral voiding and midstream holding in five. Conclusions: Exstrophy patients requiring augmentation cystoplasty and repaired with IPS-ABNR can achieve dynamic bladder outlet resistance with adequate leak point pressure and ability to void voluntarily with midstream holding capability. The children had the satisfaction of voiding per urethra with ability to stop in midstream similar to that in normal children.

KEY WORDS: Anatomical bladder neck reconstruction, augmentation cystoplasty, exstrophy bladder, ileocystoplasty, innervation preserving sphincteroplasty, Young-Dees-Leadbetter bladder neck reconstruction

INTRODUCTION

Nature has provided a well-engineered mechanism for bladder outlet resistance to urinary flow that is dynamic as the outlet remains relaxed during emptying and contracted during storage of urine. It comprises of both smooth muscle and striated muscle resistance with intact motor and sensory neural mechanism under cortical control. In conditions, where this natural mechanism of bladder outlet resistance is inadequate to prevent urinary leak, various techniques of bladder neck repair have been described in literature to create urinary outflow resistance.[1] These techniques usually exploit smooth muscle function at bladder neck or provide flap valve mechanism.[5-6] Other methods like placement of artificial or autologous bulking agent
have also been described creating a fixed bladder outlet resistance.\textsuperscript{[7]} Recently, creation of innervation preserving composite outlet resistance similar to the mechanism provided by the nature comprising of smooth as well as striated muscle reconstruction as one unit has been described by us.\textsuperscript{[8]}

In this study, we report the outcome of innervation preserving sphincteroplasty combined with anatomical bladder neck repair (IPS-ABNR) without double breasting of detrusor muscle in comparison to the traditional Young-Dees-Leadbetter (YDL) method of bladder neck repair in those patients of exstrophy where the storage and reservoir function were provided with augmentation cystoplasty using a detubularized bowel segment.

**MATERIALS AND METHODS**

Sixteen male patients of exstrophy bladder, who were candidates for ileocystoplasty and operated from 2004 to 2010 were selected for the study. In these patients, the bladder plate was divided in clam like fashion to eliminate variable detrusor functions such as hyperreflexia and other alterations that may influence the bladder neck function and the storage function was provided by using a segment of detubularized ileum. These patients were randomized into two groups: Group A and group B. Group A comprised of seven exstrophy patients in whom ileocystoplasty with traditional YDL bladder neck reconstruction was done. Group B comprised of nine exstrophy patients in whom with ileocystoplasty, bladder neck reconstruction was completed with the technique of IPS-ABNR\textsuperscript{[9]} that is described below. The age at repair ranged from 3 years to 17 years with mean age of 9.6 years.

Indications of ileocystoplasty were: (i) Classic exstrophy with small fibrotic bladder plate in three (one randomized to group A and two in group B), (ii) inadequate bladder capacity after previous bladder closure in seven (three randomized to group A and four in group B) and, (iii) failed exstrophy repair with loss of bladder plate and scarring in six patients (three randomized to group A and three in group B).

**Technique**

The bladder plate was divided in sagittal plane as done for clam cystoplasty in all the patients of both groups.

In group A patients, after anastomosis of detubularized ileal segment to the bladder remnant, bladder neck is reconstructed over the tubularized posterior urethra using classic YDL bladder neck reconstruction.

In group B Patients, using the novel midline scrotoperineal approach, as described in our previous paper,\textsuperscript{[9]} external urethral sphincter was identified and dissected with its intact innervation. From the level of external urethral sphincter going cephalad, midline strip of mucosa, equal to the width of urethral mucosal strip at verumontanum, was preserved throughout the posterior urethra, bladder neck and distal half of the trigone. Remaining mucosa lateral to the measured midline mucosal strip was excised on both sides exposing the detrusor at bladder neck and the smooth muscle at posterior urethra [Figure 1a]. At the level of verumontanum on ventrolateral aspect, external urethral sphincter was held in stay sutures, which was already identified and dissected via midline scrotoperineal approach. After completion of dissection, intact innervation to external urethral sphincter was verified using a nerve stimulator or nerve integrity monitor [Figure 1a and b].

Midline mucosal strip of bladder neck and posterior urethra was tubularized to form neourethra. Denuded detrusor at bladder neck and the smooth muscle of the posterior urethra were then approximated in midline as one functional structure in continuity in two layers without double breasting [Figure 1c and d]. The laid open ends of external urethral sphincter were anchored in midline dorsal to the tubularized-neourethra [Figure 1d]. With these steps, an attempt was made to reproduce the anatomy of the bladder neck somewhat similar to what the nature has provided in normal population.

In both groups, Mitrofanoff appendicovesicostomy was done with reimplantation of both ureters. All patients were followed 6 monthly. Minimum follow-up was of 2 years in the last operated patient. Outcomes were measured on the basis of (1) intraoperative problems and complications, (2) early postoperative complications, (3) late complications, (4) assessment of continence with (a) clinical parameters including both daytime and night time continence, duration of dry interval, ability to void per urethra voluntarily and midstream holding, and any uncontrolled leakage, (b) urodynamic study via Mitrofanoff stoma for measurement of bladder capacity, reservoir pressure and, leak point pressure during passive filling and Valsalva manoeuvre, (c) imaging studies, including voiding cystourethrogram to look for configuration of posterior urethra at bladder neck and to see the presence of reflux, and (5) assessment of status of upper tract with renal ultrasound and $^{99m}$Tc-dimercaptosuccinic acid (DMSA) scan.

**RESULTS**

**Intraoperative complications**

The tedious surgical exercise of corporourethral separation and the isolation of external urethral sphincter with the release of the bladder neck from...
fibrosis around inter symphyseal band was technically more controlled and less difficult in group B as compared to that in group A. Excessive bleeding from the detrusor bed was encountered in one patient in group B after excision of triangular mucosal patch. Injury to urethral strip at verumontanum occurred in one patient of group A.

Post-operative complications
There was no case of complete dehiscence in both groups. However, subcutaneous wound dehiscence occurred in four, two in each group, and healed without consequences. Subcutaneous wound infection was noted in seven (four in group A) and resolved.

Late complications
Stone formation occurred in two patients, one in each group. One was managed with intracorporeal lithotripsy through Mitrofanoff stoma and in the other, open surgery was required for removal of stone. Among the failed exstrophy group with scarring, two cases with previous urethral injury developed stricture formation, one in each group, resulting in obliterated urethral passage and absolute dependence on Mitrofanoff stoma. One of the patients with stricture in group A suffered from recurrent acute epididymorchitis. Adhesive obstruction occurred in two patients and was managed conservatively. There was no case of bowel perforation or malignancy in both groups until last follow-up.

Continence
a. Clinical: Among group A patients, persistent urinary leakage necessitating use of pads was noted in two because of an incompetent bladder neck. Out of remaining five, one had stricture urethra with absolute dependence on Mitrofanoff stoma. Remaining four were dry for 3 h followed by dribbling of droplets, but ability to initiate micturition and stop in midstream was present in none. Night time dry interval was longer than 5 h with occasional night leakage in one.

Among group B patients, there was no persistent leakage or continuous dribbling in any of the patients. One had stricture urethra with absolute dependence on Mitrofanoff stoma. One patient had dribbling of droplets at 3 h necessitating use of pads with occasional night time leakage. Dry interval was more than 3 h in seven patients older than 5 years. Five (55%) of these had ability to initiate micturition and stop in midstream.

b. Urodynamic study: Urodynamic study with filling cystometry and leak point pressure measurement was performed in six patients in each group. The bladder capacity ranged from 200 cc to 350 cc with mean capacity of 246 cc in group A and 252 cc in group B. During filling phase in both groups, the reservoir pressure was less than 10 cm of water upto the mean filling capacity of 250 cc of saline. At this volume, the first desire to micturate was noted. In group A, voiding

Figure 1: Technique of ileocystoplasty and innervation preserving sphincteroplasty combined with anatomical bladder neck reconstruction repair in group B; (a) Triangular bladder mucosal patch (1) is marked and excised from verumontanum to midway of trigone on both sides leaving a midline mucosal strip (2) equal in width to that of urethral plate (3) at verumontanum. Periurethral muscle (4) at bladder neck and caudal to it external urethral sphincter (5) with intact innervation are seen on both sides of urethral plate (3),(b) Excision of triangular mucosal patch leaves behind denuded detrusor (6) on both sides. Tubularization of urethral plate and midline mucosal strip done to form neo urethra(7). Clam cystoplasty of bladder plate (8) done for augmentation with detubularized and reconfigured ileal segment (9),(c) Ileocystoplasty completed (10), sutures are preplaced in detrusor muscle (6) and periurethral muscle (4) for simple midline approximation as single unit in two layers over neo urethra for anatomical bladder neck reconstruction (11),(d) After bladder neck reconstruction, external urethral sphincter (5) with intact innervation is anchored over neo urethra.

Figure 2: Urodynamic evaluation in exstrophy patients after ileocystoplasty with bladder neck reconstruction with innervation preserving sphincteroplasty combined with anatomical bladder neck reconstruction technique. It shows good capacity bladder with low intravesical pressure. Voiding was initiated with increase in abdominal pressure (pabd) while detrusor pressure (pdet) is low even during voiding. Urinary flow (Qura) could not be measured as study was done in lying down position. Detrusor leak point pressure is less than 20 cm of water and abdominal leak point pressure is less than 40 cm of water.
could not be initiated even with an increased abdominal pressure as occurred during Valsalva manoeuvre in four patients, but the leakage of urine was noted at 40-50 cm of water of pressure in them. Remaining two had persistent leakage of urine at pressure less than 10 cm of water. The leak point pressure in group B was recorded between 30 cm and 40 cm of water with ability to initiate the micturition by increasing abdominal pressure and stop in midstream. In group A, there was no ability to initiate the voiding or stop at will in any of the patients [Figure 2].

c. Imaging: Voiding cystourethrogram was done in five patients of group B and three in group A. The indentation of external sphincter activity was seen in all patients of group B but none in group A. Relaxation of posterior urethra during voiding was seen in group B while a narrow posterior urethra was seen in group A. Unilateral vesicoureteral reflux was noted in two, one in each group [Figure 3a and b].

Assessment of upper tracts
Upper tracts were normal in both groups except in two patients who had reflux and renal scarring as evidenced by voiding cystourethrogram and renal ultrasound and DMSA scan. For complete evacuation of postvoid residual urine in augmented bladder, self-clean intermittent catheterization (CIC) was required in all the patients of both groups.

DISCUSSION

Ideally, augmentation of bladder should create a low pressure reservoir with capability of complete evacuation at the completion of voiding without an increase in the pressure and without post-void residual urine. There should not be any vesicoureteral reflux, possibility of infection, stone formation, perforation, or malignancy in long term. This ideal status remains to be achieved. With bowel augmentation cystoplasty, although a low pressure reservoir is achieved, but complete evacuation of urine is not possible; therefore provision of Mitrofanoff stoma becomes necessary and for complete evacuation self clean intermittent catheterization (CIC) becomes part of lifestyle. For prevention of accidental leaks in augmentation cystoplasty, various procedures to augment bladder outlet resistance, associated with their own complications have been described in literature. With the technique described based on the surgical anatomy of urogenital diaphragm in exstrophy bladder, creation of combined resistance with detrusor reconstruction at bladder neck, smooth muscle approximation at posterior urethra and external urethral sphincter reconstruction at verumontanum may provide enough resistance to prevent accidental leak yet the repair remains dynamic enough to permit voiding at will. This technique provides an alternative, bearing resemblance to the natural mechanism and may be preferred over other techniques. With detubularized ileocystoplasty, we cannot achieve complete evacuation of the reservoir via perurethral voiding. The dynamic bladder neck reconstruction possessing the ability to relax and contract allows initiation of voiding with increased abdominal pressure resulting in partial emptying and the interruption of voiding at will in most patients (55%) repaired with IPS-ABNR technique. If male patients can void per urethra standing in urinal with their colleagues and use Mitrofanoff stoma for complete evacuation at an opportune time in privacy, it will be preferred and nearer to ideal situation. With this technique, we can achieve this goal.

There are certain limitations and deficiencies in this
study. Ideally, in urodynamic study, in addition to assessment of reservoir capacity, reservoir pressure, and leak point pressure, there should also be a comparative study of urethral pressure profile along with video urodynamic study in both groups. However, this could not be done for lack of equipment, but it is planned for the future assessments. Besides this, for precise evaluation of merits and demerits of both the techniques, larger number of cases and longer period of follow-up with statistical analysis will be required.

CONCLUSION

Innervation sparing reconstruction of sphincter with anatomical restoration of bladder neck in exstrophy patients requiring augmentation cystoplasty can achieve dynamic bladder outlet resistance with adequate leak point pressure resulting in decreased chances of urinary leak. Voluntary voiding with midstream holding capacity is also achieved. Operative accidents are less likely in these patients because of better visualization of entire anatomy during dissection.

REFERENCES