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Original Article

Utility of Mitrofanoff as bladder draining tool: A single center experience in pediatric patients

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ABSTRACT

Objective: Mitrofanoff procedure has been employed commonly as bladder draining tool in patients unable to do clean intermittent self catheterization through native urethera. Single centre experience of pediatric age group patients undergoing Mitrofanoff procedure has been presented here.

Material and methods: It was a retrospective study of 29 children who underwent continent catheterizable conduit (CCC), from January 2009 till March 2017. Charts were reviewed for age, gender, presenting complaints, need for augmentation cystoplasty, Mitrofanoff channel source such as appendix or ileal patch, duration of surgery in minutes, hospital stay in days, per operative and postoperative complications. Preoperative evaluation of the children was done by doing complete blood picture, serum electrolytes, and renal function tests. Radiological evaluation included ultrasound kidney,ureter and bladder, voiding cystourethrography, urodynamic analysis and a nuclear renal scan with 99m Technetium dimercapto-succinic acid or MAG-3 scan. The abdominal end of the conduit was brought through the abdominal wall, and a stoma was fashioned by the V-quadrilateral-Z technique.

Results: Twenty nine children having mean age of 9.54±4.88 years underwent CCC. There were 19 males (65.51%) and 10 females (34.48%). Children who underwent CCC included 18 children having neurogenic bladder, 2 cases of urethral trauma/stricture 3 patients with history of posterior uretheral valve and 6 patients with exstrophy bladder. Augmentation cystoplasty plus mitrofanoff was done in 18 children while only mitrofanoff in 11 children. Stuck catheter was seen in one patient which was removed successfully via normal urethral route under general anesthesia. Stomal stenosis in first year was noted in 4 patients (13.79%).

Conclusion: Continent catheterizable conduit based on Mitrofanoff principle have durable outcome over long term follow up in terms of urinary continence and complications.

Keywords: Children; continent catheterizable conduit; mitrofanoff.

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Introduction

The management of bladder dysfunction can be complex phenomena and patients suffering from it may face many challenges and complications in the pursuit of preservation of continence.[1] If bladder dysfunctions is associated with bladder sphincter dyssynergia, it may cause loss of compliance or reduction of bladder capacity or both. These changes results in increased intravesical pressure and a progressive deterioration of the upper urinary tract. The clinical treatment of this intravesical pressure is by use of anticholinergic drugs and the introduction of clean intermittent catheterization. But long-term urethral catheterization is associated with significant recognized problems such as peri-catheter leak, catheter blockage, colonization by bacterial organisms and urethral trauma/strictures.

When conservative measures of medication and clean intermittent catheterization fails, then surgical treatment consists of the application of botulin toxin to the detrusor, continent catheterizable conduit (CCC) or augmentation of bladder capacity or both bladder augmentation plus CCC.[2-4] CCC provides access to the bladder when the bladder neck is closed or when the urethra is difficult to catheterize (neurogenic bladder, exstrophy-epispadias, and posterior urethral valves). Although the creation of CCC has decreased the number of non-continent urinary diversion in the children age group, the complication rate of this surgical procedure are still significant such as stomal stenosis or leak.[2,3]

After the original description by Mitrofanoff, numerous variations have been reported as the procedure has evolved over the time, but the basic underlying principles of a Mitrofanoff procedure include the creation of a conduit going into a low pressure reservoir, which can be emptied through clean intermittent catheterization via using an easily accessible stoma.[4,5] Some of the important indications for this procedure are (a)refractory neurogenic bladder (with or without myelomeningocele), (b) refractory idiopathic bladder dysfunction, (c)as an adjunct to reconstruction in congenital urogenital abnormalities (cloacal exstrophy, epispadias, posterior urethral valves, and prune belly syndrome) and (d) severe urethral stricture disease.

In this procedure the conduit is attached to the abdominal wall and a stoma is fashioned. Most common sites of stoma for the Mitrofanoff procedure include the umbilicus and lower abdomen.[1,2,5] In obese patients, the umbilicus may be a good site for stoma placement as the abdominal wall width is thinnest at that point. In patients who have undergone previous abdominal surgery, the stoma site should be placed away from abdominal scars to reduce the risk of ischemia.[6,7] Apart from the stoma site the technique of stoma formation is also important. Up till now four main techniques for stoma formation have been explained in the available literature including (a) direct anastomosis, (b) umbilical stoma, (c) tubular skin flap (TSF) and (d) the V-quadrilateral-Z (VQZ) flap technique. In the VQZ technique for stoma a V-flap is created, which is sutured to the spatulated intestinal conduit.[8-12]

Our aim in this study was to report our initial experience with CCC in children as there are very few studies regarding it especially in the developing countries. We wanted to see the safety and efficacy of the technique, in terms of the continence achieved and the complications associated with the procedure.

Material and methods

It was a retrospective study that included 29 patients who underwent CCC, from January 2009 till March 2017. Ethical committee approval was taken from the hospital before starting the chart review of the patients. Written informed consent was taken from parents of the children before undergoing the surgery. They were counseled regarding the surgical options and outcomes in terms of complications and success of the procedure. Children were also counseled as much as they could understand their problem to mentally prepare them for post-operative outcome and managing expectations.

Preoperative evaluation of the children was done by doing complete blood picture, serum electrolytes, and renal function tests. Radiological evaluation included ultrasound kidney, ureter and bladder (KUB), voiding cystourethrography (VCUG), urodynamic analysis and a nuclear renal scan with 99m Technetium dimercapto-succinic acid (DMSA) or MAG-3 scan (in case of Vesicoureteric junction obstruction suspicion in case of hydronephrosis in the absence of reflux on VCUG).

Preoperative management

In preoperative management of the children primary approach consisted of treating and preventing urinary tract infection (UTI). Urinary culture was done to see if there was UTI and if present it was treated according to the culture sensitivity report. The decision of augmentation cystoplasty was made according to the circumstances such as a poorly compliant bladder and having low capacity leading to hydroureteronephrosis.

Inclusion criteria consisted of pediatric patients, Upper tract deterioration due to high bladder pressures secondary to neurogenic bladder/small bladder, anatomical abnormalities of trauma and complex strictures, inability of the patient to perform catheterization per urethra because of intact sensation, difficult or impossible access through the child's native urethra. Concomitant bladder augmentation was offered to children with low bladder capacity having poor detrusor compliance. While children having active UTI and adult patients were excluded from the study.

Surgical technique

Access was made via a lower midline or Pfannenstiel incision, allowing access to the bladder as well as the ileo-caecal junction, appendix and ileum if required. The appendix was isolated on its mesentery if it was intact and reasonable in size and caliber (at least 8 cm in length and easily able to accommodate a 10 Fr catheter), and it was disconnected from the caecum, then catheterized with a 12Fr or 14Fr catheter to ensure patency. In case appendix was not available, spiral Monti was constructed from 4 cm ileum distal to the segment harvested for augmentation.

The reservoir end of the appendix or Monti channel was attached either by Lich-Gregoir method (anterior wall/extra vesical tunneling) or directed through an anti-refluxing tunnel into

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the native bladder (through posterior wall of bladder by Leadbetter-Politano technique in cases of bladder augmentation). The tunnel was made in a way that there was a 5:1 ratio of the length of the channel to the lumen diameter of the channel. After creating an adequate length of tunnel, the internal opening of the channel was secured to the bladder muscle and the mucosa with an absorbable suture. It was made sure that there was a smooth catheterization of the channel. The abdominal end of the conduit was brought through the abdominal wall, and a stoma was fashioned by the VQZ technique. For bladder drainage post op suprapubic catheter plus a mitrofanoff catheter was placed for 3 weeks. Anticholinergics were used during this time till the catheters were taken out.

Follow up: Post operatively patients were followed 6 monthly in first year then once a year after first year. Follow up was done with Ultrasound KUB, serum electrolytes, renal function tests, urodynamic studies and urine routine examination. DMSA was done when UTI episodes occurred in children who had mild degree of reflux or dilation of the ureter. The overall mean follow up duration was 58.86±21.64 months in our series.

Statistical analysis

Charts were reviewed for age, gender, presenting complaints, need for augmentation cystoplasty, source of Mitrofanoff channel such as appendix or illeal patch, duration of surgery in minutes, hospital stay in days, per operative and postoperative complications such as bleeding, difficult catheterization of stoma, ileus, bowel obstruction, incontinence, fever, pain, vomiting, UTI, bladder stones, stoma stenosis and stoma revision. These entries were put in SPSS version 16 and data analysis was done. The categorical variables such as gender and complications were presented as frequency and percentage, while continuous variables such as age, operative time and hospital stay were presented as mean ± standard deviation (SD).

Results

It was a retrospective study of 29 patients who underwent CCC, from January 2009 till March 2017; having mean age of 9.54±4.88 years (Table 1). There were 19 males (65.51%) and 10 females (34.48%). Children who underwent CCC included 18 children having neurogenic bladder, 2 cases of Urethral trauma/stricture, 3 patients with PUV history and 6 patients with exstrophy bladder.

Augmentation cystolplasty plus mitrofanoff was done in 18 children while mitrofanoff only procedure in 11 children. In post-operative complications wound infections were noted in 2 (6.89%) patients, which were treated successfully. In 6 (20.68%) patients catheterization was also done at times via urethra in case of difficulty through the Mitrofanoff channel. No bladder perforation after augmentation was seen in any patient. There was no case of bowel obstruction in postoperative period after using ileum for augmentation. Ileus was seen in 2 (6.89%) patients needing nasogastric tube. No mortality was seen in our series. Post op fever was seen in one patient (3.6%).

Patients had UTI in first year was seen in 9 patients (31.03%). Mild bleeding from the stoma site was seen in 5 (17.2%) children in first few weeks after the surgery. Stuck catheter was seen in one patient which was removed successfully via normal urethral route under general anesthesia. Stomal stenosis in first year was noted in 4 patients (13.79%) initially it was tried to be managed with dilation (Table 2).

Appendix stoma revision was done in 4 (13.79%) patients. One female (3.4%) patient had dribbling of urine through urethra (incontinence), she ultimately underwent bladder neck closure. Bladder stones developed in 4 (13.79%) children (Table 2). Stone developed only in the augmented bladders. For these stones treatment, a pediatric cystoscope was introduced via the mitrofanoff, then under camera vision cannula was inserted percutaneously into the bladder and wire passed in this cannula. A tract was dilated over the wire and then percutaneous stone removal from bladder was done successfully and skin closed with silk 4/0, bladder was drained with a catheter for 10 days which was then removed.

Table 1. Demographics and results

Variable	
Number	29
Male	19 (65.51%)
Female	10 (34.48%)
Age, years	9.54±4.88
Operation time, min	208±31
Hospital stay, days	4.1±0.47
Final continence*	28/29 (96.5%)

*Continence achieved in first year after surgery

Table 2. Complications

Name complications	No (%)
Stomal stenosis	4 (13.79)
Stomal stuck catheter	1 (3.44)
Stomal revision	4 (13.79)
UTI	9 (31.03)
Persistent urine leak	1 (3.44)
Bladder stone	4 (13.79)

UTI: urinary tract infection

Discussion

Continent catheterizable conduit is created to facilitate emptying of bladder by clean intermittent catheterization (CIC). This is good for protection of the upper urinary tract and also improves continence. It is important that the bladder should be of good capacity, low pressure reservoir for a successful Mitrofanoff procedure. Concomitant bladder augmentation is required at the time of a Mitrofanoff procedure in cases such as congenital bladder anomalies (bladder exstrophy, epispadias, and posterior urethral valves with small capacity bladder), inflammatory bladder disorders and small capacity/poorly compliant bladder (loss of compliance with end-filling pressures more than 40 cm H_2O in cases of neurogenic disease or post radiotherapy).[9,10] It has been found that children using Mitrofanoff catheterization were more adherent to treatment and, therefore, had fewer episodes of UTI as compared to children using urethral CIC. This can be explained by the fact that the CIC through continent urinary diversion is easier to carry out by the children and, therefore, improves quality of life in them.[11]

Creation of continent urinary diversion, based on the Mitrofanoff principle is a great milestone in the quest for surgical treatment of congenitally malformed and neuropathic bladders.[13,14] However it is not free from complications. That is the reason that CCC has to be offered to carefully selected children, such as, when CIC per urethra is impossible (cases of Posterior Urethral Valve, bladder exstrophy-epispadias complex) or if CIC through native urethra is affecting the quality of life of the children badly.[12,14] Important and most frequent of these complications are stoma stenosis and leakage and they occur early during the first two years after creation. Leslie et al.[14] mentioned that incontinence were recorded in 65% of CCC cases in the first 3 years after initial operation. After the initial peak of these complications, comes a smooth and a relatively complication-free period. However, late complications do occur on long-term evaluations.[14,15] These late complications are linked probably to wear and tear of the channels and to the anatomical modifications that happen at adolescence commonly due to associated obesity. This is the reason that these children need long-term evaluation with CCC, and a structured transition to specialized adult care is necessary later on in life.[16]

In studies where appendix or ileum were used as conduit, stomal stenosis rates of 6% were found at a median follow-up of 28 months but this rose to 54% at 126 months.[17,18] It is important here that higher stenosis rates and stomal complications are noted in those patients where conduits are made from ureter, bladder or gastric segments.[19,20] Most of studies have explained the initial management of stomal or conduit stenosis by endoscopic dilatation, but still they had some patients who eventually required stomal revision surgery. In the available literature, overall revision rates range from 8.7% to 32%. In a series by Gowda et al.[17] after the revision surgery, 92% of patients still had a Mitrofanoff conduit, of which 97% were catheterizable and 95% were continent at follow up of 75 months.[17] In other series by Sahadevan et al.[18] 82% of patients still had a catheterizable Mitrofanoff conduit at follow up of 126 months.[18] While in our series stomal stenosis in first year was noted in 4 patients (13.79%) and initially it was tried to be managed with dilation. Appendix stoma revision was done in 4 (13.79%) patient.

In children, continence rates following Mitrofanoff procedures have been reported to be between 79% and 100%. Liard et al.[16] reported a continence rate of 79% in 23 patients.[16] Continence rates in the adult population have been reported to be similar to pediatric patients. Gowda et al.[17] reported continence rates of 96% in a group of 65 patients.[17] Piaggio et al.[21] studied the effect of type of conduit (appendix versus Yang Monti) and site of implantation (augmented versus native bladder). They found no difference in the continence rates between either approach.[21] If continence is not reached with a large capacity and compliant bladder then bladder outlet enhancing procedures such as endoscopic injection of bulking agents, bladder neck reconstructions, and extrinsic compression of the bladder neck/urethra by using slings, artificial urinary sphincter, and bladder neck closure are done. Bladder neck closure is performed as the final resort to achieve dryness, which is an irreversible procedure thus requiring strict compliance with catheterization of a cutaneous stoma.[21,22] We had one female (3.4%) patient who had dribbling of urine through urethra (incontinence), she ultimately underwent bladder neck closure. She gained continence after bladder neck closure.

Urinary tract infections (UTIs) is also an important complication following Mitrofanoff procedures. The risk factors for UTI are the use of clean intermittent self-catheterization and intestinal augmentation. Reduced compliance with regular drainage of the bladder via mitrofanoff has also been reported to be one of the pre-disposing factors for UTI.[22] Patients not emptying their bladder regularly have higher rates of UTI.[23] In our series UTI in first year was seen in 9 patients (31.03%). We treated only those children for UTI falling into the diagnostic criteria used for UTI in such patients over last 10 years in the literature. We had used the symptoms along with the urine cultures to guide the treatment in our series. These symptoms included fever, malaise, lethargy or sense of unease, cloudy urine with increased urine odour, discomfort or pain over the kidney or bladder. These criteria for treating UTI in our series matched most of the studies in literature regarding the said subject. Bladder calculus formation can occur due to incomplete emptying of bladder. In one study there was 22% incidence of bladder stones at a mean follow-up time of 20 years. In other study by Sultan et al.[20] there was

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a lower rate of 4% of bladder calculi.[20] Barroso et al.[24] also reported that there was no significant difference regarding bladder stone rates between those who had an augmented bladder or a native bladder.[24] We had seen bladder stones in 4 (13.79%) children.

Limitations of this study are its retrospective nature and a single center study. It did not take into consideration the children satisfaction with the procedure used. However, our sample size was similar to, or relatively better than the very few studies available in literature especially in the developing countries where pediatric urologists are very rare. Nevertheless this study had some strengths as well, as it was the first of its kind which took into account the UTI rates after CCC over a time span of 1 to 8 years of follow up after surgery (overall mean follow up duration was 58.86±21.64 months in our series). Such long range follow up are not found frequently in literature. Complications and revisions were also assessed. Our results need to be further investigated in larger groups and multicenter prospective studies. Quality of life and follow up into post pubertal outcomes of these procedure are lacking in literature which needs to be done in future.

In conclusion, CCC based on Mitrofanoff principle has durable outcome over long term follow up in terms of urinary continence and complications. Children and their parents should be educated about the importance of regular follow up and the possible complications.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Shifa International Hospital.

Informed Consent: Written informed consent was taken from parents of the children before undergoing the surgery.

Peer-review: Externally peer-reviewed.

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