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Use of the Mitrofanoff principle in urinary tract reconstruction: Experience with 122 children

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ABSTRACT

Purpose: Use of the Mitrofanoff principle is a valuable adjunct to many reconstructive urological procedures in the pediatric age group requiring clean intermittent catheterization (CIC) especially if the urethra is not easily catheterizable. We present our experience with 122 children and analyze the results of this operation.

Materials and Methods: 133 Mitrofanoff channels (100 appendicular, 31 ureteric and 2 Monti) were constructed in 122 children (93 boys and 29 girls) of mean age 6.3 years over the period from 1997 to 2005. The procedure was part of the reconstructive procedure in patients of neurogenic bladder (n=44), exstrophy-epispadias (n=40), posterior Urethral valve (n=30), and other diseases (n=8). Additional procedures included augmentation cystoplasty (n=90) and bladder neck procedure (n=46).

Results: Mean follow-up was 2.6 years in 109 patients. Overall results were satisfactory. Major complication rates with the Mitrofanoff conduit using appendicular and ureteric channels were 7.4 % in and 25.8%, respectively, most of the ureteric channels due to non-use, there being alternate channels for catheterization. Only six (4.5%) children required re-operation for significant problems with the Mitrofanoff conduit: revision of stoma due to stenosis or kinking (n=4) and closure of stoma due to troublesome leak (n=2). Children and parents were satisfied with the results of the operation and the majority was compliant with regular CIC. All children were socially well accepted and those above 6 years of age were attending regular school.

Conclusions: The Mitrofanoff procedure is a feasible and acceptable option, with a low complication rate, for use as part of complex urinary reconstruction in a developing country. Patient education, family motivation, and cost reduction are important factors for success.

KEY WORDS: Continent urinary diversion, Mitrofanoff principle

INTRODUCTION

The Mitrofanoff procedure can simplify and facilitate clean intermittent catheterization (CIC) in children especially if the urethra is not easily catheterizable. It creates a continent conduit between the bladder and the abdominal wall through which patients with a sensitive, absent, abnormal or traumatized urethra can perform CIC easily. Appendico- vesicostomy was first described by Mitrofanoff in 1980 for continent urinary diversion.[1] In 1997 the Yang-Monti channel using a transversely retubularized ileal segment was introduced as an alternative.[2] The gastrointestinal tract may be avoided with the use of a segment of ureter for creating a stoma.[3,4] Other alternatives available in the absence of the appendix are the fallopian tube, the vas deferens, the detrusor tube, the colonic tube, the gastric tube and so on.

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The two most common complications of the Mitrofanoff operation are leak from the stoma and non-catheterizable channel. Recent reports describe an overall complication rate of 6.2%.[5] Others have reported stenosis in 10-23% and incontinence in 2-7% cases.[6-8] Revision of Mitrofanoff stoma was required in 16-20% cases.[7,8] The ureteric stoma and the continent vesicostomy are more prone to stomal problems.[8-10] Series reporting more than

10 cases are rare from the developing countries.[11-14] In the developed world, CIC entails support from community nurses and use of disposable catheters. In the developing countries, these factors are not economical or feasible. We describe ingenuous modifications for cost reduction as well as patient education and family motivation contributing to the success of this operation in India.

MATERIALS AND METHODS

Patients

All children undergoing the Mitrofanoff operation at the Christian Medical College and Hospital, Vellore between March 1997 and July 2005 were included in this study. The data of 122 children (93 boys and 29 girls) aged 6 months to 28 years (mean age at surgery 6.3 years) were analyzed. Majority of the patients (97.3%) belonged to the middle or lower socio-economic background. Only 41.8% of the children came from Tamil Nadu and the neighboring states, while 8.2% came from outside India. Out of 122, 102 children had urinary incontinence prior to surgery. About 20 children had urinary retention at some point of time, five patients were on vesicostomy, and nine were on catheter drainage. The primary diagnosis was neurogenic bladder (n=44), exstrophy-epispadias (n=40), posterior urethral valve (n=30) and miscellaneous (n=8). Additional procedures included augmentation cystoplasty (n=90) and bladder neck procedure (n=46).

Hydronephrosis on one or both sides was present in 11 out of 33 exstrophy-epispadias patients (33.3%), 36 out of 44 neurogenic bladder patients (87.8%), and all of 30 posterior urethral valve patients. Chronic renal failure (CRF) was seen in two out of 40 Exstrophy-epispadias patients (5%), 10 out of 44 neurogenic bladder patients (22.7%); and 25 out of 30 posterior urethral valve patients (83.3%).

All parents were counseled pre-operatively regarding the need for regular CIC life long especially if bladder augmentation was also planned. Few parents took some time to agree. They were helped by interaction with other patients already doing CIC through the Mitrofanoff port, older children doing it themselves. We proceeded with surgery only if life-long CIC was acceptable.

Indications for the Mitrofanoff procedure

The indications for CIC and catheterizability of the urethra is shown in Table 1.

In seven patients with neurogenic bladder who were already on CIC pre-operatively, three children had lower limb weakness and deformity. One 1 year-old boy had developmental delay and there were three girls in whom self-CIC per urethra might be difficult once they grow older (pre-operation per urethral CIC being done by mother).

Operative technique

When the appendix was used, a wide cuff of caecum was included to provide additional length when needed and to prevent skin level stenosis. Blood supply of the appendix along the meso appendix was carefully preserved. Tortousity in the appendix or ureter was straightened out whenever possible. The stoma was located either at the umbilicus (hidden stoma) or in the flanks. Some patients had the stoma in the midline but in the sub umbilical position due to short length of the conduit. Some exstrophy patients had a stoma at the right end of a transverse incision. A cruciate skin incision was made before fixing the stoma to the skin; again to prevent stenosis at skin level. The V-Q-Z skin flaps were not used in any of our patients. The bladder wall was fixed to the anterior abdominal wall at the point of entry of the Mitrofanoff channel into the bladder, so as to ensure a straight course of the conduit. Excess length of the appendix was trimmed at the distal end. Minimum length of the appendix was left intraperitoneal. In 22 cases it was placed completely extraperitoneal.

In case of the ureteric conduit, patency of the vesico-ureteric junction was confirmed. The refluxing ureteric stump was tunneled extra-vesically only in five out of 26 cases, the remaining were not reimplanted. Easy catheterizability of the Mitrofanoff channel at the end of surgery; checked by different surgeons on several occasions to eliminate any possible kinking; ensured avoidance of post-operative problems with catheterization. When the appendix was absent or not suitable and an adequate ureteric stump was not available, the Monti channel was used (n=2).

Different types of Mitrofanoff conduits created were

Table 1: Indications for clean intermittent catheterization and catheterizability of the urethra

	Impossible to to catheterize	Potentially possible, untried	Possible but Sensate	Easily possible, other disability	Total
Mitrofanoff alone	3	16	10	1	30
Mitr + BN Pr– Aug	3	2	-	-	5
Mitr + Aug ± BN Pr	12	49	20	6	87
Total	18	67	30	7	122

Mitr= Mitrofanoff procedure, Aug= Augmentation, BN Pr= Bladder neck procedure

appendicular ($n=100$), ureteric ($n=31$), both appendicular and ureteric ($n=11$) and Monti ($n=2$). double Mitrofanoff was done in the early phase whenever per urethral CIC was either impossible or anticipated to be difficult in case there were problems with the stoma. Among the 31 ureteric conduits; the urinary tract continuity was re-established by ureteric reimplantation in 12 cases (all except one re-implanted into the colonic segment) and trans-uretero-ureterostomy in 17 cases. In two cases, nephroureterectomy was done.

Augmentation cystoplasty was done in 90 patients (87 done concomitantly, one re-augmented). Various types of augmentation done were colocystoplasty using sigmoid ($n=64$), colocystoplasty using ileocaecum and right colon ($n=8$), ureterocystoplasty ($n=12$), ileocystoplasty ($n=5$) and autoaugmentation ($n=1$).

Intra-operative problems faced with the ureteric Mitrofanoff were tortous ureter in one case, which was straightened out; and stenosis at vesico-ureteric junction (VUJ) in three cases (2 required incision and/or dilatation of VUJ and 1 required reimplantation). The problems faced during construction of the appendicular stoma are summarized in Table 2.

RESULTS

Mean follow up was 2.6 years in 109 patients. Incidence of major problems with the Mitrofanoff conduit was seven out of 94 (7.4 %) in appendicular and eight out of 30 (26.7%) in ureteric channels. Only six (4.5%) children required re-operation for significant problems with the Mitrofanoff conduit: revision of stoma in four cases due to stenosis or kinking and closure of stoma due to troublesome leak in two patients.

Out of the 100 appendicular Mitrofanoffs, 75 had no problems. There were minor problems in 12 channels (4 had occasional leak and 8 required minor dilatation). Major problems in seven channels included significant leak in two patients (both not augmented) and severe stenosis in five patients. Three patients died of CRF and another three patients were lost to follow up.

Among the 31 ureteric channels, 19 had no problems. Minor dilatation was needed in three patients. Major problems ($n=8$) were significant leak in three patients (all three were refluxing megaureters and two patients were also augmented) and severe stenosis in five patients. Out of these, two were stenosed at the vesico-ureteric junction (1 was reimplanted and 1 had VUJ stenosis); and three were stenosed at skin (all due to non-use when there were alternate channels for CIC and catheterization of ureteric channel was painful due to stimulation of the trigone). One child was lost to follow up.

Both patients with Monti channel were lost to follow up (1 child with CRF probably expired).

Among the appendicular conduits, there were 33 umbilical and 67 non-umbilical stomas. None of the umbilical stomas had stenosis, whereas five of the non-umbilical stomas had stenosis.

Other problems encountered were minor bleeding from stoma ($n=2$), stone formation ($n=2$), peristomal pustule ($n=2$), and mucosal prolapse at stoma requiring trimming ($n=1$).

Complications related to concomitant surgery were faecal/colovesical fistula ($n=2$), bladder rupture ($n=3$), vesico cutaneous fistula ($n=1$) and post op bleeding ($n=1$). No cases of colovesical fistula occurred after the year 2000 as a tongue of omentum was brought down and wrapped around the colo-colic anastomosis. After November 2003, 22 cases had an extraperitoneal augmentation, which excludes the general peritoneal cavity from the possibility of leak/fistula formation. Two out of 3 patients with bladder rupture were irregular with CIC and one patient had perforation with localized pelvic collection in the immediate post-operative period, which required

Table 2: Problems faced during construction of the appendicular stoma

Problem	Number	Managed by
Curved and tortous	6	Straightened out
Reimplant not possible due to small bladder plate	6	Appendix reimplanted into colon
Short length of appendix	3	Umbilical skin flaps in 1 patient
Long appendix	1	Excess trimmed
Appendix not very mobile	2	Caecum mobilized
Kinking of catheter in the channel	3	Tunneling redone in 1, fixation to abdominal wall redone in 2
Abnormal location of appendix (left hypochondrium)	1	Stoma brought out in Left Flank
Appendix and caecum not identified due to adhesions	1	Monti channel used
Small caliber appendix	2	Monti in 1 and ureteric in 1
Short mesoappendix, blood supply from caecum (pouch colon)	1	Mobilized carefully with caecal blood supply
Blood supply damaged during mobilization	1	Caecal attachement to appendix kept, appendix tunneled through ileal serosa
Total	27	

laparotomy and drainage. The other two patients were managed conservatively with prolonged bladder drainage through Mitrofanoff. Of the 14 patients who were irregular with CIC, two had bladder rupture and three had skin level stenosis with impossible catheterization. All except six patients were using number 8 infant feeding tube for CIC. Three older children were using number 10/12 Nelaton's catheter or K-60 catheter; while the remaining three toddlers were using number six infant feeding tubes. 78 children were performing CIC with ease themselves. 44 children had one of their parents doing CIC, mostly the mother. Only one child in this group was older than 5 years (9 years old), but was still too anxious to do CIC herself. 98.2% children required CIC at 2-4 hours interval. 92 out of 122 patients (75.4%) were using the Mitrofanoff stoma for night drainage also. 82 out of 122 patients (67.2%) were using the Mitrofanoff channel for washing out mucus in the bladder once or twice a day, especially those who had undergone enterocystoplasty.

Cost reduction by encouraging reuse of catheters was also instrumental in better acceptance of CIC; as majority of our patients cannot afford disposable catheters. We have devised an indigenous CIC bag with several longitudinal compartments stitched such that only one side of each compartment is open (on top). The catheter is washed from outside and flushed from inside after one use. Thereafter it is kept in the CIC bag along with 8-10 other catheters making sure that the cap is left open for the catheter to completely dry. The catheters are used sequentially so that by the time a catheter is reused; it has dried up well. Hence colonization of the catheters and urinary infection are unlikely. In this manner our patients were able to use about 10 catheters for 1 month. Social acceptance of the child was assessed by school attendance of children aged more than 5 years. All children above 5 years of age were attending school except for two (n=75). One child had developmental delay and one child was taking tuitions at home though he was dry and doing well. Two children had finished school. One patient who was 28 years old at the time of surgery was pursuing a small business for living. Information regarding school attendance was not available in seven children of school going age as they were lost to follow up.

About 15 children aged 6-18 years (mean age of 10.1 years) were asked about their views on the surgery and how it has affected their life style. The questions asked were:

- Does the child feel satisfied with the operation?
- Does the child perceive any alteration of body image due to the Mitrofanoff stoma?
- Is he/she accepted well at school and among friends?
- Would the child recommend this operation to another child if needed?

The response to these questions is shown in Table 3.

All 15 children were satisfied with the operation. They as well as their parents felt that there was definite improvement in their quality of life when compared to their preoperative state. Six out of 15 children perceived some alteration of body image due to the stoma. All were well accepted at school and among friends; and were playing normally with other children. Only one child aged 9 years said she would not recommend this operation to another child. She was extremely apprehensive especially in the hospital setup and was not doing CIC by herself till date (being done by mother).

DISCUSSION

The Mitrofanoff operation is an essential and useful adjunct to many reconstructive procedures in pediatric urology especially in cases of exstrophy - epispadias, posterior urethral valves, and neurogenic bladder. It provides a safe, effective, and painless route for intermittent catheterization or night drainage. Our experience with 122 children in the period March 1997 to July 2005 shows that the procedure is eminently acceptable and feasible as a part of major urinary reconstruction in the Indian population. Although the concept in relatively new in India, when explained to our patients, it was accepted well and utilized by them. It did not interfere in their school activities and many children were able to do self-catheterization expertly. The appendicular Mitrofanoff gave consistently better results than the ureteric Mitrofanoff although ureteric Mitrofanoff was also fairly effective if used regularly. This is a strong argument against incidental appendicectomies when urinary reconstruction is expected and also for retaining the lower ureteric stump whenever possible.

Table 3: Views on the surgery

Response to question asked	Number of children
Satisfied with the operation	15
Perceive some alteration of body image	6
Well accepted at school and among friends	15
Would recommend this surgery to another child	14

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