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Laparoscopic Mitrofanoff continent catheterisable stoma in children with spina bifida

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ABSTRACT

Background: In 1980, Mitrofanoff described the creation of an appendicovesicostomy for continent urinary diversion. This procedure greatly facilitates clean intermittent catheterisation in patients with neurogenic bladder. The purpose of our study was to determine the clinical efficacy of the laparoscopic Mitrofanoff catheterisable stoma for children and adolescents with spina bifida. **Materials and Methods:** Review of hospital records revealed that 11 children with spina bifida underwent a laparoscopic Mitrofanoff procedure with at least 1-year of follow-up. A four-port transperitoneal laparoscopic approach was used to create a Mitrofanoff appendicovesicostomy. The child was followed-up in the urology clinic at 6 weeks, 3 months, 6 months, 1-year, and then semiannually after that. Questionnaires were administered to determine, from the children's perspective, the level of satisfaction with catheterisation and the psychosocial implications of catheterisation before and after the creation of the Mitrofanoff continent catheterisable stoma. **Results:** Of the 11 children, six were female, and five were male. The mean age at presentation to Paediatric urological services was 11 ± 3.22 years. Overall the mean operative time was 144.09 ± 17.00 min. Mean estimated blood loss was 37.36 ± 11.44 cc. None of the cases needed conversion to open. Patient satisfaction with their catheterisation was measured at 2.18 ± 0.98 preoperatively, Post-operatively, this improved to 4.27 ± 0.46. Statistical analysis using paired *t*-test showed significance with $P < 001$. **Conclusions:** Laparoscopic Mitrofanoff catheterisable stoma is feasible in children with spina bifida and is associated with reasonable outcome with early recovery, resumption of normal activities and excellent cosmesis.

Key words: Clean intermittent catheterisation, Mitrofanoff, neurogenic bladder, spina bifida, urinary incontinence

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INTRODUCTION

A number of clinical problems seen in paediatric urology are the result of neurologic lesions that affect lower urinary tract function be it congenital or acquired. Urinary diversion was the mainstay of treatment for these children with either intractable incontinence with normal or abnormal upper urinary tracts.[1] The introduction of clean intermittent catheterisation (CIC) in the early 1970s by Lapides *et al*.[2] refinements in techniques of urodynamic studies in children,[3,4] and the development of surgical techniques and modalities in conjunction with CIC to manage incontinence dramatically changed the way this group of children was traditionally managed. Several paediatric urologic centres today consider functional assessment of the lower urinary tract as an integral element in the evaluation process and advocate proactive or early aggressive management in the children who are at risk for urinary tract deterioration based on specific hostile urodynamic parameters.[5]

The most common cause of neurogenic bladder dysfunction in children is abnormal development of the spinal canal and internecine spinal cord.[5] The neurologic lesion produced by the myelomeningocele can be variable, depending on what neural elements, if any, have everted with the meningocele sac. The bony vertebral level often provides little or no clue to the exact neurologic level or lesion produced.[5] The primary goals of management for children with myelomeningocele are preservation of normal renal function and the attainment of social continence. These goals can be achieved for most children with a combination of medical and surgical therapies. Urinary continence is becoming an increasingly important issue that demands attention at an early age. Studies have shown that children who are continent have higher ratings in self-confidence and social acceptance than boys and girls who are wet; thus this issue becomes paramount as the children grow up and attend school.[6] A combination

of CIC and drug therapy designed to maintain low intravesical pressures and a reasonable level of urethral resistance based on specific urodynamic findings are needed to achieve continence. Some children will ultimately require surgical intervention. A persistent poorly compliant or overactive detrusor may be treated either with enterocystoplasty,[7] autoaugmentation,[8] or a combination thereof.[5] Sigmoid, cecum, and small intestine, in that order, have been used to enlarge the bladder.

Several operations have been devised, to make it easier to catheterise those individuals who cannot easily catheterise themselves via their native urethra.[9] Mitrofanoff[10] created a continence mechanism by tunneling one end of the vermiform appendix into the bladder, as if reimplanting the ureter to prevent reflux, with the other end being brought out through the skin as a continent catheterisable stoma. The success rate for achieving continence has been excellent, approaching 85%, primarily owing to the flap valve effect of the intramural tunnel.[5] For this reason, it is now the preferred method for continent urinary diversion.[11] The Mitrofanoff procedure has traditionally been performed using an open surgical technique; however, of late, there have been several reports in the literature where laparoscopic techniques have been applied to this procedure in an attempt to minimise morbidity and improve cosmesis. Nerli *et al*.,[12] reported on the feasibility of Pure laparoscopic Mitrofanoff appendicovesicostomy with early recovery, resumption of normal activities and excellent cosmesis. We report our series of laparoscopic Mitrofanoff procedure in children with spina bifida.

MATERIALS AND METHODS

Review of the neurogenic children's population attending the paediatric urological services at our hospital revealed 11 children with spina bifida who underwent a laparoscopic Mitrofanoff procedure with at least 1-year of follow-up. Preoperative evaluation included voiding cystourethrogram, abdominal ultrasound, urodynamics (to assess bladder pressures, volume, and bladder out-let resistance), and physical and psychological ability to self-catheterise.

For the Mitrofanoff procedure, children were admitted to the hospital 1-2 days prior to their procedure for mechanical and antibiotic bowel preparation. Children were allowed nothing by mouth the evening prior to surgery, with aggressive intravenous hydration. After the child had been anaesthetised and intubated, careful positioning was undertaken to ensure no pressure injuries during the extended surgery. The abdomen and pubic area were shaved, prepped, and draped, including vaginal prep for female children. An 18F silicone Foley catheter was placed, and the bladder was partially filled with normal saline. A four-port transperitoneal laparoscopic approach was used.[12] A 10 mm laparoscopic camera port was placed through the umbilicus and 2, 5 mm laparoscopic ports were placed in the left lower quadrant and right midaxillary line at the level of the umbilicus. A fourth port was placed in the left midaxillary line, also at the level of the umbilicus. The appendix and right hemicolon were mobilised up to the hepatic flexure. The mesentery of the appendix was identified and mobilised to obtain adequate length. The appendix was ligated and divided at its base, and the stump was buried into the caecum using a three-zero silk purse-string suture. The appendix was assessed to determine whether the length was adequate to reach the anterior abdominal wall (approximately 5-6 cm) and whether the diameter was of sufficient calibre to accommodate at least a 12 Fr catheter. This maneuver was done without desufflating the abdomen to allow more room for error in appropriating an adequate distance.

A 5 cm vertical seromuscular incision was made in the right posterior wall of the bladder down to the mucosa. After incision of the mucosa, the appendix was anastomosed to the bladder using 4-zero polyglactin interrupted sutures. The seromuscular layer of the bladder was closed using interrupted 3-zero polyglactin sutures, creating a tunnel for the appendix. The appendix was then brought up to the umbilicus, and a catheterisable stoma was created. Smooth catheterisation through the appendix with full pneumoperitoneum and with the pneumoperitoneum released was performed. A 16 Fr suprapubic catheter was inserted into the bladder, and a 10 Fr stenting catheter was left through the appendix.

The child was started on oral liquid feeds within 6-8 h. The catheter was left indwelling for 3 weeks and was removed after ensuring that the patient or family could catheterise without difficulty. The child was followed-up in the urology clinic at 6 weeks, 3 months, 6 months, 1-year, and then semiannually after that.

Questionnaires were administered to the adolescents in our neurogenic children's program who underwent the Mitrofanoff procedure. The goal of the questionnaires was to determine, from the children's perspective, the level of satisfaction with catheterisation and the psychosocial

implications of catheterisation before and after the creation of the Mitrofanoff continent catheterisable stoma. A five-point Likert-type rating scale was used to assess patient satisfaction. Independence of catheterisation as well as catheterisation duration and position were noted both pre- and post-operatively. In addition, medical complications associated with the procedure were assessed through a chart review. Data analysis was performed with paired *t*-tests using the SPSS Base 8.0 statistical system (IBM Corporation, 1 New Orchard Road, Armonk, New York 10504-1722, United States).

RESULTS

Of the 11 children, six were female, and five were male. The mean age at presentation to paediatric urological services was 11 ± 3.22 years (range 7-19 years). All these children had neurogenic bladder secondary to spina bifida. The indications for a continent catheterisable stoma (Mitrofanoff procedure) included recurrent urinary tract infection in four, difficulty to catheterise (inability to get privacy) via naturalis in four, urethral stricture following improper catheterisation technique in two and urinary incontinence in one [Table 1].

Overall the mean operative time was 144.09 ± 17.00 min (range 125-175 min). Mean estimated blood loss was 37.36 ± 11.44 cc (range 20-55 cc). None of the cases needed conversion to open. All children had a liquid diet in the evening of surgery or on the postoperative day one. The median duration of hospital stay was 6 days. The mean postoperative follow-up was 34.09 ± 12.16 months (15-54 months). None of these children needed simultaneous bladder augmentation, and all children had the Mitrofanoff procedure performed using appendix as the catheterisable limb. There were no immediate postoperative complications.

The mean time to catheterise preoperatively was 12.09 ± 2.46 min (range 7-15 min), which postoperatively decreased to 3.63 ± 0.92 min (range 2-5 min). Statistical analysis using a paired *t*-test revealed statistical significance at $P < 0.001$. Patient satisfaction with their catheterisation as measured by a five-point Likert-type rating scale was measured at 2.18 ± 0.98 preoperatively (range 1-4), with five being the most satisfied. Postoperatively, this improved to 4.27 ± 0.46 (range 4-5). Statistical analysis using paired *t*-test showed significance with $P < 001$.

Preoperatively, only four of 11 children (36.36%) were able to catheterise themselves, without any help. The other seven patients relied on family members or caregivers. Postoperatively, all 11 were able to perform self-catheterisation, thereby becoming more self-reliant. Preoperatively, only three patients (27.27%) were able to have their catheterisations performed in an upright position (either in their chair or on the toilet) while the others required a supine position. Postoperatively, all children were able to perform catheterisation in an upright position.

Eight (72.72%) of the eleven children experienced complications, including postoperative urethral leakage (4), stomal leakage (3) and stomal stenosis (3). Urethral leakage of urine subsided on itself in three children and needed the use of anticholinergics in the remaining one. Similarly, the stomal leakage stopped on its own in all the three children. Two patients with stomal stenosis required reoperation, one underwent revision of the stoma, and one needed a Monti's procedure due to fibrosis of the appendicular tube. There were no bowel obstructions, no intestinal or urinary leakage, and no deaths attributable to the procedure.

DISCUSSION

Renal damage and renal failure are among the most severe complications of spina bifida. Over the past decades, several comprehensive treatment strategies have been applied that result in minimal renal scaring. In addition, it is also possible that children can be dry for urine by the time they go to primary school. To obtain such results, it is mandatory to treat detrusor overactivity from birth onward, as upper urinary tract changes predominantly start in the 1st months of life. Children with spina bifida should be treated from birth by CIC and pharmacological suppression of detrusor overactivity. Urinary tract infections need to be dealt aggressively and in many children, permanent prophylaxis is indicated. Based on urodynamic findings therapy can be altered as the child grows.[13]

Table 1: Patient demographics

Age (years)	Gender	Indications for Mitrofanoff	Operating time (min)	Blood loss (cc)	Hospitalisation duration (days)
11±3.22	Males - 5 Females - 6	Recurrent UTI in four Difficult to catheterise in four Urethral trauma/stricture in two Urinary incontinence in one	144.09±17.00	37.36±11.44	6±1

UTI: Urinary tract infection

Bowel management is done by retrograde or antegrade enema therapy. Concerning sexuality, special attention is needed to address expectations of adolescent patients.[13] Wheelchair-bound children can manage their bladder more easily with a continent catheterisable stoma on top of the bladder. This stoma provides them extra privacy and diminishes parental burden. The need to transfer from a wheelchair to do CIC is one of the most important indication for a catheterisable stoma. Sometimes in boys, the impossibility of carrying out CIC transurethrally after false routes results in the need for a stoma. Parents increasingly indicate their child's privacy as a reason for asking for a catheterisable stoma.

In children with a large bladder capacity for their age, a continent stoma can be constructed from a bladder tube. Children with a normal bladder capacity can be treated by Mitrofanoff cutaneous appendicovesicostomy or by an ileal tube(Monti procedure).[14] Mitrofanoff described the principle of creating a catheterisable, continent abdominal stoma, which could be modified to the individual patient.[10] The procedure involves taking a tubular structure(such as the appendix, small intestine, fallopian tube, or ureter) and anastomosing it to the bladder in a nonrefluxing fashion[10,15,16] Currently, the material of choice is the appendix. The other end of the tube is then anastomosed to the anterior abdominal wall. This creates a conduit through which the urinary reservoir (or bladder) can be intermittently drained. Since its introduction, the Mitrofanoff principle has become widely accepted.[15-17] The results have been favourable, allowing a catheterisation site that is easily accessible, even to patients with limited neurologic function.

Chaviano *et al.*,[18] reported on the clinical efficacy of the Mitrofanoff catheterisable stoma in 12 children and adolescents with spinal cord injury (SCI). Ten of 12 patients were satisfied with the procedure. Mean catheterisation time was decreased from 16.4 to 5.1 min. Preoperatively, only three of 12 were able to perform self-catheterisation, whereas all 12 were independent in catheterisation postoperatively. Patient satisfaction preoperatively was 2.3 (scale 1-5) and improved to 4.5 postoperatively.

The use of laparoscopic and robot-assisted approaches to reconstruct the lower urinary tract has been slowly introduced in the past several years. Jordan and Winslow,[19] and Van Savage and Slaughenhoupt[20] described a laparoscopic assisted appendicovesicostomy where the appendix and right hemicolon were mobilised laparoscopically, and the appendicovesical anastomosis was completed through a Pfannenstiel incision. The most challenging part of the procedure is creating the appendicovesical anastomosis. Intracorporeal suturing is a technically demanding task that requires a significant amount of experience and surgical skill. Nerli *et al.*,[12] reported on six children with a mean age of 12.8years who underwent pure laparoscopic Mitrofanoff appendicovesicostomy. Three of these children had neurogenic bladder secondary to spina bifida. Congruent with the limited published experience, the surgical outcomes have compared favourably with those of an open approach in these selected patients. Parents of children undergoing this minimally invasive procedure were satisfied with the short-term outcomes and postoperative recovery.[21] In our series, the mean operative time was 144.09 ± 17.00 min and the mean estimated blood loss was 37.36 ± 11.44 cc. Postoperatively, all children were able to perform self-catheterisation in an upright position, thereby becoming more self-reliant.

Lendvay *et al.*,[22] reported the techniques of creating both an appendicovesicostomy and an antegrade continent enema colon tube using Robotic-assisted laparoscopic surgery in a 9-year-old female with a neurogenic bladder and bowel secondary to myelomeningocele. They opined that it was useful to use a robot for technically challenging reconstructive procedures owing to the improved suturing capabilities over pure laparoscopic techniques when using fine suture material. Nguyen *et al.*,[23] reported on ten patients who underwent a robotic-assisted laparoscopic Mitrofanoff procedure using the daVinci surgical system. Mean operative time was 323 min. One case was converted to open surgery secondary to an inadequate appendix discovered intraoperatively. Mean estimated blood loss was 48.4 cc. Median hospitalisation was 5 days. Median follow-up was 14.2 months. They concluded that robotic assisted laparoscopic Mitrofanoff procedure was feasible to perform, was associated with satisfactory outcomes and minimal complications, and had the benefits of a minimally invasive approach.

Stomal complications following catheterisation stoma are extremely common and despite the need for revision, the high stoma continence rate supports their use. Greater age at surgery was associated with a significant increase in the stoma-related complications and the need for revision.[24]

CONCLUSIONS

Children with neurogenic bladder secondary to spina bifida can present with a complicated management

situation, from both a physical and psychological perspective. The foremost goals of treatment are the preservation of renal function and urinary continence and the prevention of urinary tract infections. Adolescents are at a stage when body image and independence are very important, and issues regarding continence and self-reliance are particularly important. The creation of a continent catheterisable stoma appears to be a step in that direction, as it can improve patient self-reliance, mobility, and body image. The use of laparoscopic and robot-assisted approaches to create a Mitrofanoff catheterisable stoma has been slowly introduced over the past several years. Pure laparoscopic Mitrofanoff appendicovesicostomy is feasible and is associated with reasonable outcome with early recovery, resumption of normal activities and excellent cosmesis. Postoperatively, all children were able to perform self-catheterisation in an upright position, thereby becoming more self-reliant and with good satisfaction rate.

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