Appendicovesicostomy as an Alternative Procedure for Patients with Complex Urethral Distraction Defects

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INTRODUCTION

Urethral stricture and posterior urethral defects are an important clinical problem in male patients. Road traffic accidents, iatrogenic injuries, and inflammatory disorders are common causes of urethral strictures. In previous studies, the incidence of posterior urethral stricture after pelvic fracture was predicted to be 5-10% (1,2). The surgical management of urethral stenosis varies based on etiology, position, length, and thickness of the lesion in addition to the extent of fibrosis involving the surrounding tissues (3,4). Treatment of stenosis of the bulbular part of the urethra includes excision and end-to-end urethroplasty or a short patch onlay substitution anastomosis (5,6). However, in some patients the urethral defect is so long that it cannot be managed with extensive releasing of urethra from the surrounding fibrosis, inferior pubectomy, and even re-routing maneuvers (7,8). Various approach have been used to overcome this problem depending on the location and length of the stenosis including oral mucosa graft, enterourethroplasty, and the combination of dorsal graft with ventral penile flap. However, many complications have been related to these techniques (9,10). In patients with severe and complicated urethral injury, salvage procedures such as perineostomy or suprapubic tube could be performed (11,12). Patients with a history of past surgical procedures, stenosis longer than 3 cm, accompanying perineal and GI fistulas, presence of diverticulitis adjacent to the duct, and a non-competent bladder neck are defined as complex cases and are not suitable candidates for urethroplasty (13,14). Although the design of a concealed and easily catheterizable stoma in cases with unreconstructable urethral disease was considered a good practical method, the clinical management of these patients still remains to be a dilemma (15). In 1980, Mitrofanoff introduced an alternative procedure for continent diversion in which one end of the appendix was brought to the skin surface as a catheterizable stoma and the other end was tunneled into the bladder wall (16-19). Here, we have reported our experience with this surgical procedure in terms of safety and efficacy.

MATERIALS AND METHODS

Patient Inclusion

Five male and one female patient aged 20 to 70 years old (mean age= 40.1) who had underwent urinary diversion using the appendix during 2015 to 2019 at Shohada-E-Tajrish Hospital, Tehran, Iran were included in the study. All patients had a history of one or more previously failed surgical attempts of urethral reconstruction and had an long urethral defect involving different anatomical segments of the urethra, or were at risk of urinary incontinence after urethroplasty of membranous urethra because of insufficient proximal sphincteric mechanism or patient’s denial to undergo surgery (Figure 1).

The main results and conclusions of our study, Mitrofanoff’s technique is a valuable procedure for managing patients with serious complicated urethral strictures who cannot be treated with common standard approaches.

Keywords: appendix diversion; Mitrofanoff’s appendicovesicostomy; urethral stricture; urinary diversion

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they would need ART (assistance reproductive technology) in case of plans for paternity in the future and then informed consent were obtained from all patients. This study was approved by the Ethics Committee of Shohada- E-Tajrish hospital.

Surgical Technique
A lower midline incision was performed to allow simultaneous access to the bladder, ileocecal junction, and the appendix. After locating the appendix, it was cut separate from the cecum while preserving its mesentery. Then, an opening was created as the blind end and washed. After passing a 14F catheter down the appendix to check for patency, it was implanted into the bladder through a submucosal tunnel of at least 4 cm length to achieve an anti-reflux effect (Figure 2). During surgery, the appendix was dilated with a 14F catheter and the catheter was left in-situ for three weeks. The appendix was then secured with absorbable sutures to the bladder muscle and mucosa. The stomal site was prepared based on pre-operative counselling for site selection and the stoma was placed at a level proximal to the bladder so that gravity would assist in achieving continence (Figure 3). Also, a cystostomy tube was inserted for all cases to increase safety measures. Patients were usually discharged 3-5 days after surgery, as soon as they could tolerate solid food. After about 3 weeks, the Mitrofanoff or pouch catheter was removed and the supra pubic catheter was left clamped-off. The patient was taught how to catheterize his pouch/Mitrofanoff (clean intermittent catheterization) every 3 hours by using a 12 or 14F Nelaton catheter. Occurrence of urinary leakage throughout the period was considered as the patient being incontinent. As for the night, a catheter was inserted and secured in place to allow for free urine drainage. If there was no difficulty in catheterization, the suprapubic catheter was removed after 3 days. After that, cases were frequently followed-up at 3, 6, 18 and 24 months, with special consideration given to patients having difficulties with catheterization and incontinence. Follow-up plan included: stoma evaluation, upper urinary tract ultrasonography, measurement of post-catheterization urine residue, serum creatinine level, and catheter size.

Table 1. Patients’ characteristics and procedure outcome.

<table>
<thead>
<tr>
<th>No</th>
<th>Age (Year)</th>
<th>Defect Length (cm)</th>
<th>Follow up, month</th>
<th>Cause of Injury</th>
<th>Previous surgical intervention</th>
<th>Reason for appendix diversion candidacy</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>70</td>
<td>6</td>
<td>24</td>
<td>Long urethral stenosis post radical prostatectomy</td>
<td>One attempt of cystolithotomy, several failed attempts of urethral dilation</td>
<td>Urinary incontinency, long urethral defect (from bladder neck to membranous part)</td>
<td>No residual, No stenosis</td>
</tr>
<tr>
<td>2</td>
<td>36</td>
<td>7</td>
<td>27</td>
<td>Pelvic fracture due to entrapment under rubble</td>
<td>Laparotomy cystography and cystostomy, twice end to end urethroplasty, several urethral dilation attempts. One attempt of stent insertion</td>
<td>History of twice failed urethroplasty, long urethral defect</td>
<td>No residual, No stenosis</td>
</tr>
<tr>
<td>3</td>
<td>45</td>
<td>8</td>
<td>36</td>
<td>Pelvic fracture due to motor vehicle injury</td>
<td>Laparotomy and cystostomy, Non-competent bladder neck, internal urethrotomy, pubectomy, failed end to end urethroplasty</td>
<td>Long posterior urethral defect</td>
<td>No residual, No stenosis</td>
</tr>
<tr>
<td>4</td>
<td>41</td>
<td>10</td>
<td>30</td>
<td>Fournier gangrene</td>
<td>Extensive debridement, several plastic surgeries for scrotal and penile defect</td>
<td>History of two failed attempts of urethroplasty</td>
<td>No residual, No stenosis</td>
</tr>
<tr>
<td>5</td>
<td>60</td>
<td>6</td>
<td>24</td>
<td>Pelvic fracture due to motor vehicle injury</td>
<td>Cystostomy insertion, twice failed urethroplasty, orthopedic surgery</td>
<td>History of twice failed urethroplasty, incontinence and long urethral defect</td>
<td>No residual, No stenosis</td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td>3</td>
<td>33</td>
<td>Pelvic fracture due to motor vehicle injury in childhood</td>
<td>Laparotomy, history of once failed urethroplasty, bladder neck closure and cystostomy</td>
<td>History of once failed urethroplasty, risk of incontinence</td>
<td>No residual, No stenosis</td>
</tr>
</tbody>
</table>

Figure 1. Contrast imaging of all of the included patients.
RESULTS

Etiology of urethral defect in our cases included pelvic fracture, post radical prostatectomy urethral stenosis, and necrotic perineal infection (Table 1). The time gap between trauma and Mitrofanoff’s procedure ranged from 18 to 120 months (mean ± SD= 49.3 ± 37.2). Patients’ characteristics and procedure outcome are presented in Table 1.

Sonographic evaluation of upper urinary tract during follow-up did not reveal any pathologic findings. Mean serum creatinine level before surgery was 1.2 mg/dL. Mean surgical time was 2 hours (range= 1-3). Average predicted blood loss was around 150 cc (ranged 50 to 600). There was no need for blood transfusion or adjacent organ injury. All cases were discharged 3-5 days after surgery.

Follow-up duration ranged from 24 to 36 months (mean= 29). Post-operative complications consisting of dehiscence, wound infection, hematoma, necrosis, or perforations of the appendix tube were not detected in any cases during the follow-up period. Catheter size of patients ranged from 12 to 14F. In five of the patients, catheterization was easily performed through the conduit every 2 hours. Over time, the pouch was expanded to hold more urine and the patient needed to catheterize every four to six hours. The only patient who could not easily catheterize underwent flexible cystoscopy and dilation with a 14F catheter. None of the patients had stomal stenosis during the follow-up period. Mild stomal incontinence occurred in only one case who became continent after a few months.

DISCUSSION

The potentiality of the appendix to be used as a concealed stoma capable of catheterization was discovered in 1980 by Mitrofanoff(21) in an attempt to achieve urinary continence and maintenance of a low-pressure urinary storage reservoir(17). Later variations of this technique were developed such as the Monti technique in which a short part of the ileum was used according to the same principle(13,22).

The benefit of using the appendix instead of an ileum segment is that intestinal anastomosis is not required in appendicular diversion, thereby the risk of intestinal anastomotic leakage is reduced. Also post-operative fasting period is minimized. On the other hand, the physiologic function of the appendix is unknown in adults; therefore, the removal of appendix does not bring a serious harm to the body and does not lead to any impairment in the body’s function. Another disadvantage of the ileum compared to the appendix is the need for tapering and tabularization which increases the likelihood of urinary leakage. Finally, the most important advantage of using an appendix is shortening of operative time since time-consuming procedures such as ileum-ileum anastomosis and tabularizations are not necessary.

The reasons for deciding to create a Mitrofanoff stoma are irreparable loss of the urethra, continence problems, neurogenic bladder with incontinence, unreconstructable bladder (e.g. exstrophy), unreconstructable urethral disease, and congenital anomalies like urogenital sinus (23). The Mitrofanoff principle can also be performed in combination with a bladder augmentation technique.(24)

Appendicular diversion can be used in cases who have complicated urethral trauma after accidents(25). The benefits of appendix diversion include maintaining complete continence; easy catheterization; excellent body image; and rarity of post-surgical complications such as dermatitis and urinary tract infection(26). Regarding the length of appendix, the cutaneous stoma can be placed in the umbilicus or the lower right abdominal quadrant(27). Yang et al. (28) demonstrated that the submucosal tunnel and abdominal wall muscles are critical factors in the success rate of continence.

However, like any other surgery, the Mitrofanoff procedure is associated with some complications such as leakage from the stoma and non-catheterizable channel. Recent reports showed an overall complication rate of...
The incidence of stomal stenosis was 10-23%, incontinence 2-7%, and stoma revision was required in 16-20% of cases. Adherence to the technique which provides ease of catheterization intraoperatively, wide reflection of the cecum to preserve vascularity, and fixation of the bladder to the anterior abdominal wall guarantees a durable achievement. The downside is that the prevalence of catheterization and stomal problems increases with the length of follow-up. Our study enrolled patients with long urethral strictures who had failed attempts of urethroplasty. Thus, the only alternative method that would make them catheter-free and continent was appendix diversion using Mitrofanoff principle. Although these patients need to perform CIC to empty their bladder, it does not interfere with their daily activities.

The patients enrolled in our study suffered from complicated urethral strictures and were dependent on suprapubic catheter for emptying their bladder ever since. After performing appendicular urinary diversion, these patients became catheter-free and did not have any difficulties with intermittent catheterization for over two years. Our study reports a continence rate of 100% with good satisfactory results, consistent with the reports of previous articles. In our study, none of the six patients had stomal stenosis during the follow-up period. This means that our results were more satisfying than other studies. The reason for a lower rate of stomal stenosis in our study might be the preservation of the mesenteric base of the appendix through wide reflection of the cecum with minimal manipulation which helped attain vascularity to decrease inflammation and mucosal dysfunction. Also, a minimum tension was placed on the appendix between the bladder and the skin due to the appropriate selection of the location of the ostoma and, if necessary, the bladder was sutured to the rectus sheath. Using a suitable catheter size for insertion and then catheterization, appendix end speculation at the stoma site, as well as careful training of the catheterization technique could be other reasons.

Although the results of appendix diversion are desirable, sometimes the appendix is not usable because of insufficient length or quality, short mesentery, or histopathologic changes consistent with chronic inflammation or fibrous lumen obstruction. Regarding these situations, techniques such as the Monti method, or using a bladder or cecal flap to partially span the distance between the bladder and abdominal wall are good alternative methods.

CONCLUSIONS

Based on the results of our study, Mitrofanoff technique is a valuable procedure with low incontinence and complication rates and should be considered in cases with unreconstructable urethral damage who cannot be treated with other routine methods to achieve urinary continence and low-pressure reservoir.

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CONFLICT OF INTEREST

The authors report no Conflict of interest in this work.

REFERENCES

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