Original Article

Laparoscopic appendicovesicostomy and ileovesicostomy: A step-by-step technique description in neurogenic patients

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Abstract

Aims: This study aims to describe our surgical technique and report our preliminary experience with laparoscopic ileal or appendicovesicostomy in adult patients with neurogenic bladder caused by spinal cord injury.

Subjects and Methods: From January 2014 to March 2017, seven patients were submitted to an appendicovesicostomy under Mitrofanoff procedure and two patients to an ileovesicostomy under Yang-Monti procedure by laparoscopy. Clinical indications were patients with a history of neurogenic bladder secondary to spinal cord pathology, with proper dexterity and willing to have a more accessible continent derivation. Surgical steps include: (1) identification and mobilization of appendix; (2) ligation of appendix' base; (3) endoloop reinforcement of proximal end; (4) silicon catheter insertion in appendix' lumen; (5) mesoappendix dissection; (6) Retzius space opening; (7) posterior bladder dissection; (8) anterior transcutaneous bladder dome fixation; (9) vertical midline detrusor incision; (10) opening of bladder mucosa; (11) excision and espatulation of appendix tip; (12) appendico vesical anastomosis; and (13) exteriorization of appendix through umbilicus and creation of catheterizable stoma. In the two patients submitted to a Yang-Monti diversion, the ileum reconfiguration and calibration was done extracorporeally. One patient had simultaneous bladder augmentation.

Results: The mean follow-up was 21.5 ± 11.9 months. The mean operative time was 161 min (123–220). There was no conversion to laparotomy and no need of postoperative blood transfusion. The mean hospitalization length was 4 days. No early postoperative complication was registered. Late postoperative complications were: one surgical stoma revision, one false-passage (solved by transient catheterization), and one bladder stone (solved by endoscopic approach). All patients are continent.

Conclusions: This series presents our laparoscopic technique for continent urinary diversions, showing that it is feasible and safe in adult patients with neurogenic bladder.

Keywords: Continent urinary diversion, laparoscopy, mitrofanoff, neurogenic bladder, quality of life

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INTRODUCTION

Neurogenic bladder resulting from spinal cord injury places patients at increased risk of upper urinary tract higher pressures and infections resulting in progressive

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renal damage. In some of these patients, efficient bladder emptying can only be achieved by intermittent urethral catheterization (IC). When IC drainage is difficult (namely, when dexterity is partially impaired, in female patients in wheelchair or because of an elevated bladder neck or sensate urethra), an appendicovesicostomy utilizing the Mitrofanoff principle or Yang_Monti conduit presents a useful option. This option allows for social continence while reliably emptying the bladder through catheterization of an abdominal stoma.[1]

Mitrofanoff appendicovesicostomies, described for the first time in 1980, were historically performed by a transabdominal approach and have demonstrated their structural and functional durability after long-term follow-up.[2,3] Open continent diversion techniques have few intraoperative complications but subjecting the patient to the morbidity of a large midline or Pfannenstiel incision. In 1993, Jordan and Winslow described the first laparoscopic-assisted appendicovesicostomy.[4] That procedure involved laparoscopic mobilization of the colon and appendix followed by implantation of the appendix in the bladder using a lower abdomen incision. Just in 2004, the first completely laparoscopic Mitrofanoff appendicovesicostomy was reported.[5]

Although most of the literature on ileal or appendicovesicostomies relates to open procedures, there is a growing body of literature on the use of not only conventional laparoscopic procedures but also robot-assisted laparoscopic procedures. To date, only few case reports, small isolated or comparative series have been reported, and most of them in pediatric age.[6-9]

We aim to describe step-wisely our technique and report our preliminary experience with laparoscopic ileal or appendicovesicostomy in adult patients with neurogenic bladder caused by spinal cord pathology.

SUBJECTS AND METHODS

In January 2014–March 2017, we performed seven appendicovesicostomies under Mitrofanoff procedure and two ileovesicostomy under Yang-Monti procedure [Table 1]. One patient had also a bladder augmentation (owing to refractory overactivity) performed at the same time. Patients were referred to our institution with a history of neurogenic bladder secondary to spinal cord injury (8) or spina bifida (1) and willing to have a continent derivation with an easily accessible way of intermittent self-catheterization. The presurgical selection and workup consisted of a clinical interview and physical examination, ultrasound, and urodynamic study. Manual dexterity to perform ICs by an abdominal stoma was tested and defined as no evidence of cognitive impairment or extremity weakening or tremor. The urodynamic investigations revealed the following abnormalities: detrusor overactivity (in two patients), abnormal compliance (16 and 17 ml/cm H_2O, in two patients), and decreased maximal urethral closure pressure (MUCP) (13, 25, 25, and 34 cm H_2O in four female patients). With the consent of the patients, we planned to perform a continent vesicostomy using the appendix or an ileal segment. All procedures were performed by a single surgeon (PE. B). Previous appendectomy or short appendix and obesity (body mass index >30) were the main determinants to prefer the Yang-Monti procedure.

Table 1: Patients characteristics and surgical data

Variable	Statistics
Sex, *n*	
Male	4
Female	5
Age (years), mean (range)	38 (26-51)
BMI (kg/m^2), mean (range)	26.5 (18.7-39.1)
Previous surgeries, *n*	
Brindley stimulator implantation	2
Type of surgery, *n*	
Mitrofanoff appendicovesicostomy	7
Yang-Monti ileal conduit	2
Operating time (min), mean (range)	161 (123-220)
Mitrofanoff appendicovesicostomy	151 (123-220)
Yang-Monti ileal conduit	179 (175-183)
Blood loss (ml), mean (range)	80 (50-130)
Hospitalisation length (days), mean (range)	4 (3-6)
Follow-up (months), mean±SD	21.5±12

BMI: Body mass index, SD: Standard deviation

Surgical technique

Preparation

Preoperative urine sample microbiological culture examination is performed 1 week before surgery; if positive, targeted antibiotic was started 48 h before surgery. Patients were not typically submitted to previous bowel preparation. Perioperative antibiotics are administered 30 min before the incision. Unless allergies were present, cefazolin (1–2 g) and metronidazole (15 mg/kg) were the antibiotics of choice.

Positioning and port placement

The patient is positioned in lithotomy position with the arms tucked at the side. Appropriate foam padding of the arms and legs is applied to protect injury. The patient is prepped and draped with a Foley catheter placed on the sterile field. Ports placement include a 12 mm port for the camera 2–5 cm above the umbilicus, one median port of 10 mm in the umbilicus (the usual place for the stoma) and four ports of 5 mm in triangulation, two on left and two on right lower abdominal quadrants (the fifth port being optional) [Figure 1].

Operative technique

Pneumoperitoneum is created by a Veress needle insertion in the left hypochondrium (Palmer point). Once pneumoperitoneum is established, diagnostic peritoneoscopy (through the supraumbilical port) and adhesiolysis (with Lower flank ports) allows identification of the appendix and its length assessment. In general, the appendix should have at least 5 cm and capable of accepting a 10–12 Fr catheter to be considered adequate. The appendix is mobilized and dissected from the mesoappendix at its junction with cecum [Figure 2a]. A 3/0 Vicryl® suture is placed at the base of the appendix and the appendix is then sectioned from the cecum [Figure 2b]. An endoloop™ is placed at the appendicular/cecum junction to reinforce its closure [Figure 2c]. A silicone catheter is inserted in the appendix, and the mesoappendix is perfectly dissected to achieve the better capacity of mobilization without compromising the vascularity [Figure 2d].

In the patients, submitted to a spiral Yang-Monti conduit, the ileum was partially exteriorized through an arciform incision of the umbilicus. Manually, at 20 cm from the ileocaecal valve, one 3, 5–4 cm segment [Figure 3a] was isolated and partially divided. This ileal segment was completely detubularized with an incision close to the mesentery [Figure 3b and c]. An end-to-end (mesenteric sides) anastomosis with one running 3/0 Vicryl® suture was performed [Figure 3d]. Afterward, a retubularization and calibration over a 12Fr catheter were performed with one running suture [Figure 3e]. The catheter was fixed to the conduit with resorbable 3/0 Vicryl® sutures, to avoid its accidental displacement.

The bladder was anteriorly dissected from the abdominal wall to open the Retzius space and laterally and posteriorly dissected to achieve the maximum mobility capacity [Figure 4a]. To assist in retraction of the bladder, three stay Vicryl® sutures were placed at the dome of the bladder and retracted anteriorly through the skin using a straight Keith needle [Figure 4b]. After bladder suspension, a vertical detrusor incision of 5 cm is performed in the posterior midline until the mucosa of the bladder is visualized, with the bladder distended with saline [Figure 4c]. The bladder mucosa is then opened approximately 1 cm in length [Figure 4d].

After introducing a 12 Fr catheter in the appendix, the tip of the appendix was excised and spatulated around 1 cm. The appendicovesical or ileovesical anastomosis was performed by four mucomucosal absorbable and interrupted stitches. To achieve an anti-reflux system, the detrusor was imbricated through interrupted absorbable stiches creating a tunnel for the appendix or conduit, as proposed by Lich-Gregoir. The appendix or the conduit was then brought up to a point close to the umbilicus, with less pneumoperitoneum to reduce the traction of mesenterium and then a catheterizable stoma was created. A pelvic drain and a urethral catheter were left after surgery.

In the case of simultaneous bladder augmentation surgery, a supratrigonal cystectomy is performed, and an intestinal patch is created after detubularization of a 45 cm intestinal segment.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. For this type of study, formal consent is not required.

All patients provided written informed consent after an explanation on the technique, expected and possible complications.

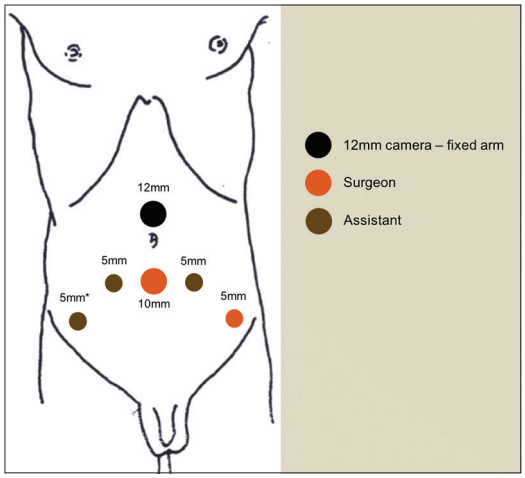

Figure 1: Laparoscopic port placement (*optional port)

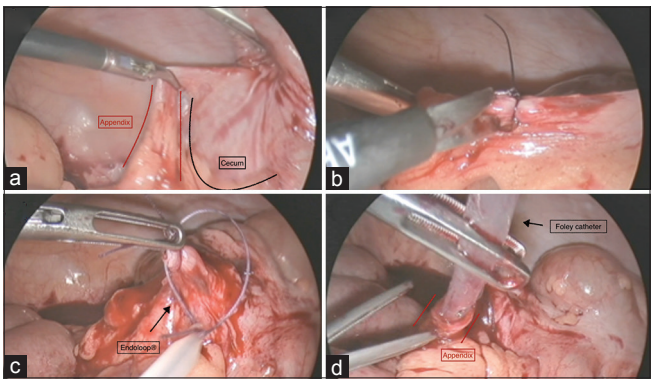

Figure 2: Appendix harvesting and preparation. (a) Mobilization and dissection of appendix; (b) Appendixæ base ligation; (c) Endoloop(™) reinforcement in the appendixæ base; (d) Silicone catheter insertion in the appendix and mesoapendix dissection

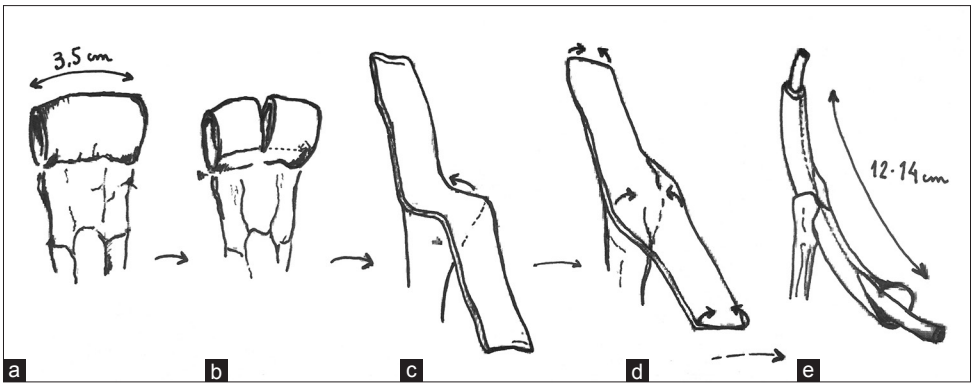

Figure 3: Yang-Monti procedure. (a) Ileum partially exteriorized through an arciform incision of the umbilicus; (b) intestinal segment is isolated, equally divided and detubularized with an incision close to the mesentery; (c) end-to-end (mesenteric sides) anastomosis; (d) and (e) Retubularization and calibration over a 12 Fr catheter

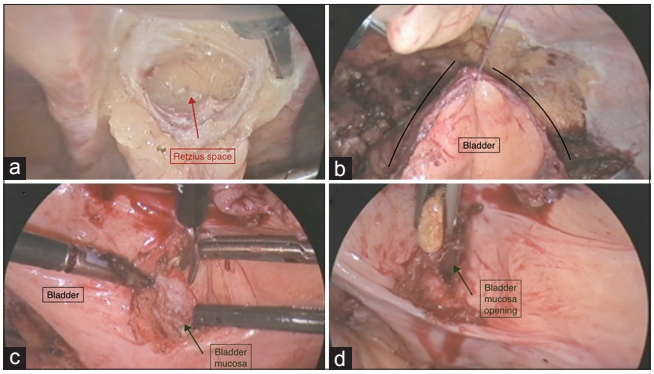

Figure 4: Anterior bladder fixation and anastomosis. (a) Retzius' space opening; (b) bladder dome fixation to the skin through stay sutures; (c) vertical detrusor incision in the posterior midline; (d) bladder mucosa opening

RESULTS

Patients characteristics and surgical details are presented in Table 1. All surgeries were successfully completed with no conversion to laparotomy. The mean operative time was 161 ± 29 min. Comparatively, the mean operative time for appendicovesicostomies (155 min) was 24 min less than ileovesicostomies (179 min), and 65 min less than the patient who also a bladder augmentation procedure. There was no need for blood transfusion and the mean estimated blood loss was around 80 ml. Eight (89%) stomas were placed in the midline very close to the umbilicus and one (11%) stoma was placed in the right iliac fossa owing to low mobility of the appendix.

Patients started oral liquid feeds within 24 h, and the drain was removed after at least 2 days. The pain was easily controlled with acetaminophen with tramadol an as-needed basis. No case of ileus or evisceration was reported. Patients were discharged home 1 day after drain removal if they tolerate a regular diet and pain was well controlled.

The stoma catheter was left indwelling for 2 weeks and was removed in ambulatory after ensuring that the patient could catheterize the stoma easily. No early postoperative complication was registered. All of them resumed their normal daily activities after 4 weeks.

The mean follow-up was 21.5 ± 12 months. Follow-up visits were scheduled at 6, 9, and 12 months, and every 6 months thereafter. When an initial stoma stenosis was identified, the utilization of a silicon plug (stoma stopper) was used, and closer follow-up was taken.

Late postoperative complications were: one (11%) stoma stenosis needing surgical revision, one false-passage (solved by transient catheterization), and one bladder stone (solved by endoscopic approach and increased the frequency of self-catheterization). Three patients needed adjustment in their medical treatment due to bothersome detrusor overactivity. Three patients needed a suburethral sling to control a stress urinary incontinence (SUI) developed postoperatively.

The patient with refractory detrusor overactivity, in whom a bladder augmentation has been performed, became responder to low dose of anticholinergic.

At present, all patients are continent.

DISCUSSION

The introduction of intermittent catheterization by Lapides *et al*., was a revolution in the management of patients with significant bladder dysfunction.[10] However, in patients with an elevated bladder neck or an inaccessible urethra, the reconstruction of an easy catheterizable cutaneous channel to facilitate clean intermittent bladder drainages is an excellent option, mainly for those in wheelchairs as our patients. Historically, performed by laparotomy, we replicated

through laparoscopy the appendicovesicostomy described by Mitrofanoff in 1980 and the reconfigured segment of ileum described by Yang-Monti in 1993. This preliminary successful experience in laparoscopic reconstructive techniques to create catheterizable continent channels shows that this approach is safe, feasible, and effective. This minimally invasive procedure allows the creation of a continent stoma with less risks of intraoperative bleeding, ileus, evisceration, surgical site infection, and postoperative pain. The hospitalization length seems also to be shorter in relation with open approaches.

Our results were congruent with the other reports in terms of safety and feasibility. Our patients had no intraoperative complication, an early recovery and with no major complication. Prolonged operative time was considered a potential disadvantage associated with laparoscopic approach; however, we really noted a significant improvement as much as we handle with technical issues, mainly ports positions and stoma mobilization and intraperitoneal catheterization. Our operative time was equivalent to that of other open[11] or laparoscopic series[9,12] and lower in comparison with robotic approaches.[13]

Postoperative complications require commonly a subsequent surgical revision as a consequence of stenosis, prolapse or incontinence, and dilation of appendicovesical or ileovesical stenosis.[3,14,15] In our series, during a follow-up of 21. 5 months, we had the need to perform a single open surgical revision of the stoma (11%) and three mid-urethral slings to solve an SUI. Our stoma revision rate is slightly inferior, to the average but in the range of the rate published by other series (6%–45%), but in longer follow-up periods (22–90 months).[9,14-19] We consider that the lower rate of stoma revision might be a consequence of early identification of initial stenosis, properly solved with a silicon plug.

Given the challenging learning curve, just isolated or short-series of laparoscopic and robot-assisted continent stoma constructions have appeared in the literature, most of them in children. Pure laparoscopic appendicovesicostomy or ileovesicostomy, in comparison with the robotic procedures, might improve the field of dissection and can ease the appendix mobilization to prepare the appendicovesical anastomosis. Surgeon's familiarity with laparoscopic procedures and his skills in performing quicker intracorporeal sutures were the main determinants to explain these reduced operative times. Costs might also be a significant concern when considering the wide-spread adoption of robotic technology.[20] Nevertheless, we might agree that for those with less dexterity, robot-assisted sutures could ease the construction of an anti-reflux appendix or ileal anastomosis.

There is still some controversy regarding the location of appendico/ilealvesicostomy implantation on the bladder wall. The anterior anastomosis is technically easier to perform and reduces the required appendix length needed to reach the umbilicus; however, it seems more related with urinary tract infections and stone formation as a result of poor bladder emptying.[21] That is why we opted to perform a posterior bladder wall anastomosis even if sometimes we had to use a longer ileal or conduit or to place the appendix stoma below the umbilicus. Concerning stoma placement, we tried to choose the umbilicus, but, the priority was to find a site that guarantees a good accessibility for the patient and with the best alignment possible with the conduit with the less risk of edges ischemia. If needed, the stoma can be slightly below the umbilicus (2 cm) to reduce the anastomotic tension.

The decision not to perform bladder neck closure was made considering that it could be useful to have an emergency way of IC through the native urethra or to perform an endoscopic exam in case of complications with the conduit or anastomosis. Overall stomal continence was 100%, however, three patient developed continuous incontinence due to intrinsic sphincter deficiency easily managed with a suburethral sling and another patient needed to perform IC every 1–2 h to reduce overflow incontinence through the urethra. A discussion on the need of simultaneous preventive SUI correction was addressed with patients with a MUCP <35 cm H_2O ($n = 4$), and in all cases, a decision to perform it later, if needed, was made. In three of those four cases (75%), a posterior correction with suburethral sling was performed. In future cases, these data might influence the decision toward a simultaneous correction of SUI.

This preliminary experience is limited in its conclusions as it is retrospective and with a small number of patients. Besides that, the median follow-up is not long enough to predict long-term outcomes for these patients. However, all patients experienced an important increase in their quality of life mainly owing to the autonomization in their self-catheterization, with more frequent bladder emptying and with less number of daily transfers.

Finally, although the laparoscopic approach replicates the open approach, we cannot extrapolate any comparison in terms of functional outcomes and complications without randomized controlled trials, which adequately address these questions.

CONCLUSIONS

Considering this preliminary experience, we are encouraged to generalize this laparoscopic approach to every urological reconstructive technique with the aim of creation of catheterizable stoma. Besides being a technically challenging surgery, it is feasible by laparoscopically-skilled surgeons. We also consider that this technique might also be replicated in a robotic-assisted approach. The functional outcomes and complications are comparable to open and robotic series and might be superior to open approaches in terms of decreased incisional pain and length of stay in hospital.

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Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Ardelt PU, Woodhouse CR, Riedmiller H, Gerharz EW. The efferent segment in continent cutaneous urinary diversion: A comprehensive review of the literature. BJU Int 2012;109:288-97.
2. Mitrofanoff P. Trans-appendicular continent cystostomy in the management of the neurogenic bladder. Chir Pediatr 1980;21:297-305.
3. Liard A, Séguier-Lipszyc E, Mathiot A, Mitrofanoff P. The mitrofanoff procedure: 20 years later. J Urol 2001;165:2394-8.
4. Jordan GH, Winslow BH. Laparoscopically assisted continent catheterizable cutaneous appendicovesicostomy. J Endourol 1993;7:517-20.
5. Casale P, Feng WC, Grady RW, Joyner BD, Lee RS, Mitchell ME. Intracorporeal laparoscopic appendicovesicostomy: A case report of a novel approach. J Urol 2004;171:1899.
6. Gundeti MS, Acharya SS, Zagaja GP, Shalhav AL. Paediatric robotic-assisted laparoscopic augmentation ileocystoplasty and mitrofanoff appendicovesicostomy (RALIMA): Feasibility of and initial experience with the university of Chicago technique. BJU Int 2011;107:962-9.
7. Nguyen HT, Passerotti CC, Penna FJ, Retik AB, Peters CA. Robotic assisted laparoscopic mitrofanoff appendicovesicostomy: Preliminary experience in a pediatric population. J Urol 2009;182:1528-34.
8. Wille MA, Zagaja GP, Shalhav AL, Gundeti MS. Continence outcomes in patients undergoing robotic assisted laparoscopic mitrofanoff appendicovesicostomy. J Urol 2011;185:1438-43.
9. Rey D, Helou E, Oderda M, Robbiani J, Lopez L, Piechaud PT, *et al*. Laparoscopic and robot-assisted continent urinary diversions (Mitrofanoff and Yang-Monti conduits) in a consecutive series of 15 adult patients: The Saint Augustin technique. BJU Int 2013;112:953-8.
10. Lapides J, Diokno AC, Silber SJ, Lowe BS. Clean, intermittent self-catheterization in the treatment of urinary tract disease. J Urol 1972;107:458-61.
11. Lorenzo JL, Castillo A, Serrano EA, González-Blanco S, Andrade C, Moreno J. Urodynamically based modification of mitrofanoff procedure. J Endourol 1997;11:77-81.
12. Nerli RB, Reddy M, Devraju S, Prabha V, Hiremath MB, Jali S. Laparoscopic mitrofanoff appendicovesicostomy: Our experience in children. Indian J Urol 2012;28:28-31.
13. Storm DW, Fulmer BR, Sumfest JM. Laparoscopic robot-assisted appendicovesicostomy: An initial experience. J Endourol 2007;21:1015-7.
14. Harris CF, Cooper CS, Hutcheson JC, Snyder HM 3rd. Appendicovesicostomy: The mitrofanoff procedure – A 15-year perspective. J Urol 2000;163:1922-6.
15. Thomas JC, Dietrich MS, Trusler L, DeMarco RT, Pope JC 4th, Brock JW 3rd, *et al*. Continent catheterizable channels and the timing of their complications. J Urol 2006;176:1816-20.
16. Leslie B, Lorenzo AJ, Moore K, Farhat WA, Bägli DJ, Pippi Salle JL. Long-term followup and time to event outcome analysis of continent catheterizable channels. J Urol 2011;185:2298-302.
17. Van der Aa F, Joniau S, De Baets K, De Ridder D. Continent catheterizable vesicostomy in an adult population: Success at high costs. Neurourol Urodyn 2009;28:487-91.
18. Famakinwa OJ, Rosen AM, Gundeti MS. Robot-assisted laparoscopic mitrofanoff appendicovesicostomy technique and outcomes of extravesical and intravesical approaches. Eur Urol 2013;64:831-6.
19. Welk BK, Afshar K, Rapoport D, MacNeily AE. Complications of the catheterizable channel following continent urinary diversion: Their nature and timing. J Urol 2008;180:1856-60.
20. Seideman CA, Sleeper JP, Lotan Y. Cost comparison of robot-assisted and laparoscopic pyeloplasty. J Endourol 2012;26:1044-8.
21. Berkowitz J, North AC, Tripp R, Gearhart JP, Lakshmanan Y. Mitrofanoff continent catheterizable conduits: Top down or bottom up? J Pediatr Urol 2009;5:122-5.