Troubleshooting Continent Catheterizable Channels

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Introduction

Cutaneous continent catheterizable channels are effective in facilitating bladder emptying while maintaining body image, cosmetic appearance, and urinary continence [1]. Furthermore, they allow intermittent catheterization for wheelchair-bound patients who might otherwise not be able to catheterize per urethra. Lastly, patients with limited dexterity due to quadriplegia find it easier to catheterize through an abdominal stoma than the native urethra. The components of a continent catheterizable channel are cutaneous stoma, catheterizable conduit from the skin to reservoir, continence mechanism, and reservoir (native or augmented bladder).

Continence is achieved by one of the three mechanisms: (1) flap valve, (2) nipple valve, or (3) hydraulic valve. An example of the hydraulic valve was described by Benchekroun et al. [2]; however, acceptance has been low and this technique will not be discussed further. Paul Mitrofanoff popularized the flap valve technique when he described the creation of a continent appendicovesicostomy by tunneling the appendix submucosally into the bladder and maturing the stoma to the umbilicus [3]. The Mitrofanoff flap valve principle has been modified to fashion continent channels from tissues such as detubularized ileum (Yang-Monti, Casale), colon, ureter, and fallopian tube [4, 5]. Ileal channel cecocystoplasty (ICCC) uses detubularized cecum for bladder augmentation and tapered terminal ileum as the catheterizable channel; the ileocecal valve (Bauhin's valve) is reinforced and serves as a nipple valve for continence [6]. Another well-known example of a nipple valve is the Kock pouch, which uses an intussuscepted ileocecal valve and can be modified for an efferent limb from the native bladder [7].

Complications of continent channels can arise from any of the above mentioned components and include stomal stenosis, conduit stricture, diverticulae, false passage, and stomal incontinence. Patients can either present with difficulty/inability to catheterize (obstruction), leakage of urine from the channel (incontinence), or a combination of the two. Accurate diagnosis and appropriate management is paramount because for many of these patients, clean intermittent catheterization is the only way to empty the bladder. This chapter provides a framework to troubleshoot common complications of continent catheterizable channels.

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Obstruction

Patients with stomal stenosis, channel stricture, or false passage most often present with difficulty or inability to catheterize the channel. Some patients may complain of bleeding at the stoma as a result of traumatic catheterization.

Stomal stenosis is the most commonly reported complication in the literature, with rates ranging from 6 to 39 % for tunneled channels [8]. Most often, the stoma is located at the umbilicus for cosmetic reasons. In some patients, the stoma may be located in the right or left lower quadrant. Typically, a lower quadrant stoma is created if the conduit is made out of ureter so that the conduit can take a direct path from the retroperitoneum to the skin. A lower quadrant stoma may be chosen for an appendiceal Mitrofanoff if the mesentery is too short to reach the umbilicus without tension [9]. Thus far, no study has conclusively established the choice of stoma site as a factor in stomal stenosis. Other than cutaneous continent vesicostomy (CCV), the choice of tissue type for conduit creation does not seem to affect stenosis rates. CCV is associated with higher complication rates including stomal stenosis and channel fibrosis, thereby making it an option to be used only as a last resort [8, 10].

Stomal stenosis occurs relatively early in the postoperative course. Studies that have investigated the timing of channel complications suggest most cases of stomal stenosis occur in the first 20 months after surgery, with a mean duration to stenosis ranging from 7.75 to 13 months [8, 11, 12]. However, patients are known to present with stomal stenosis even as late as 5–6 years after initial surgery [12]. Ischemia at the mucocutaneous junction is hypothesized to be the most likely cause of stomal stenosis [8, 11]. Therefore, at the time of initial surgery, it is important to avoid tension on the channel and to preserve its blood supply as much as possible. In an effort to reduce the incidence of stenosis, the stomal end of the channel is frequently spatulated and a broad-based local skin flap in the shape of a “V” is advanced into the spatulation. Khoury et al. have described a technique which involves excising the umbilical scar and eversion–inversion of the umbilicus during stoma maturation [13]. The stenosis rate with this technique was found to be 8 %. Landau et al. have described a “V-quadrilateral-Z” skin flap for stoma maturation and early results in small number of patients showed no occurrence of stenosis [14].

Channel stricture occurs at a rate of 4–20 % in tunneled channels and its timing is similar to that of stomal stenosis [8, 11]. Ischemia plays a role in the development of channel stricture. False passage in the channel can result from traumatic catheterization in the presence of a stricture or due to incorrect catheterization technique [11]. Narayanaswamy et al. have reported a high rate of diverticular pouch formation in double Monti channels [15]. It is recommended to create channels with short extravesical segments in order to prevent subfascial complications such as false passage and diverticulum formation [16].

Incontinence

Incontinence from the stoma can be attributable to the continence mechanism, the reservoir, or both. The reported rates of channel incontinence range from 1 to 22 % and the timing can be variable [8]. However, the definition of stomal incontinence is not consistent among studies.

The continence mechanism in tunneled channels is dependent on creation of an adequate detrusor or submucosal tunnel (Mitrofanoff principle). In ICCC, the continence mechanism is the native ileocecal valve, which can be augmented by plication of the terminal ileum. Early channel incontinence related to the continence mechanism is more likely to be due to technical error, whereas late-onset incontinence might represent dilation of the tunnel with time [8]. Incontinence due to failure of the continence mechanism is typically large volume. On the other hand, incontinence due to the reservoir is typically small volume and can result from primary detrusor overactivity (DO) or secondary causes such as urinary tract infection (UTI) or bladder calculi.

Management of Catheterizable Channel Complications

Some of the principles of troubleshooting complications related to catheterizable channels would be familiar to most adult general urologists. Figures 10.1 and 10.2 provide a framework for stepwise management of the most commonly encountered complications.

Obstruction

Inability to catheterize the channel requires emergent intervention in patients whose bladder neck has been surgically closed or narrowed. In patients with a patent urethra and bladder neck, the situation is less dire. The patient, caregiver or healthcare provider can initiate intermittent urethral catheterization or place an indwelling urethral catheter until the channel obstruction can be addressed. Still, channel access should be re-established within a couple of days; it has been our experience that earlier intervention is more successful than delayed intervention.

The first step in obtaining channel access is a gentle attempt at catheterization using a well-lubricated catheter of the same or lesser size as routinely used by the patient. If the urethra is patent, a urethral catheter should be placed before attempting to catheterize the channel because a distended bladder can complicate catheterization of the channel in a couple of ways: (1) the channel can become kinked as the bladder distends and moves closer to the stoma; (2) the distended bladder will tighten the Mitrofanoff tunnel. If an initial attempt at channel catheterization is unsuccessful, then a second attempt with a hydrophilic guidewire can be helpful. However, before causing too much trauma, the urologist should have a low threshold to perform endoscopy of the channel and place a catheter over a wire. The small diameter of the catheterizable channels usually means that endoscopy should be done with a flexible pediatric cystoscope, flexible hysteroscope, or a flexible adult ureteroscope. A rigid pediatric cystoscope can be better suited for cases of stomal stenosis. When the urethra is patent, endoscopic attempts can be combined with transurethral cystoscopic guidance.

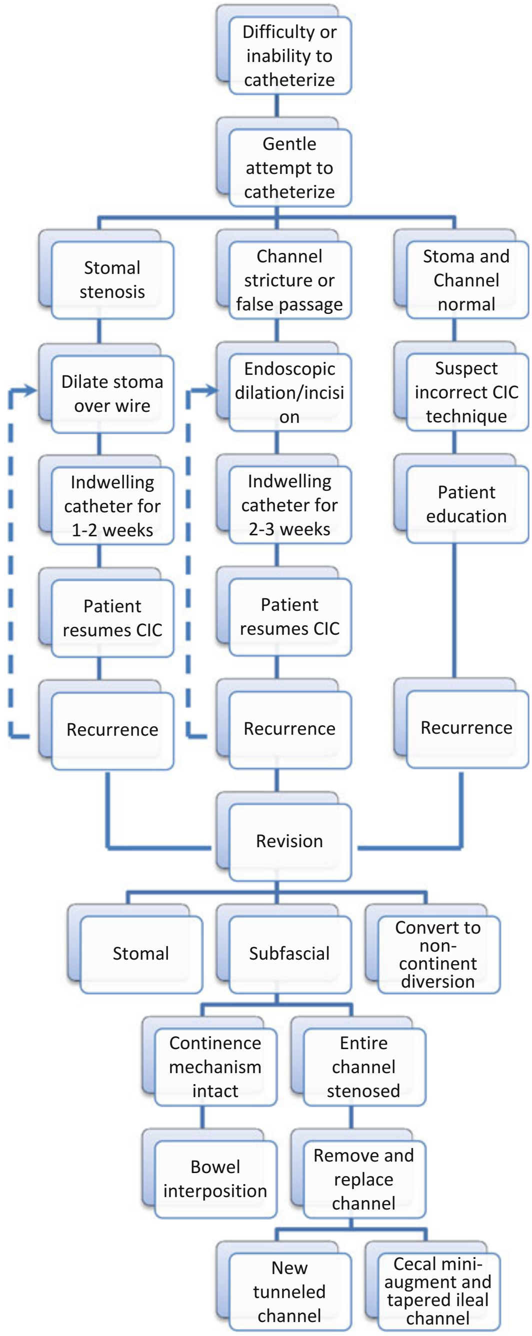

Fig. 10.1 Stepwise approach to troubleshoot obstruction in catheterizable channels

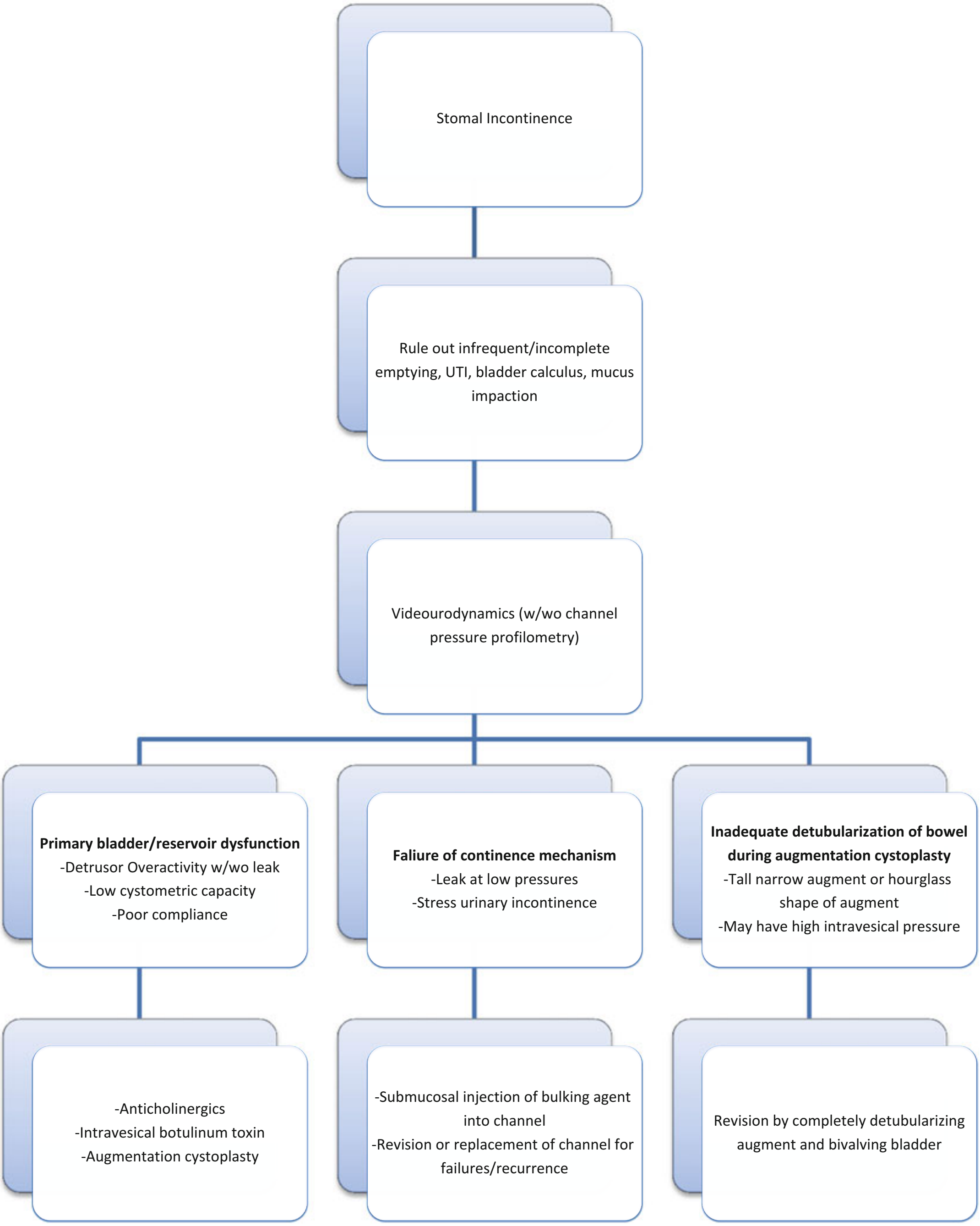

Fig. 10.2 Stepwise approach to troubleshoot incontinence through catheterizable channel

Dilation of the stoma or channel can be performed over the wire. We prefer to do this with a series of successively larger straight catheters over the wire. Dilation should not exceed the normal size of the channel—excessive dilation risks injury to the rest of the channel and the continence mechanism. Welk et al. have reported the use of steroid lubricant after stomal dilation to keep the stoma patent, although the durability of this treatment is not known [8]. Endoscopic incision of channel stricture has been described although we prefer dilation to incision because of the fragile nature of catheterizable channels and the risk of injury to adjacent bowel. Once a catheter is placed, it should be left in place for 1 or 2 weeks following which the catheter can be removed and patient asked to resume CIC.

If initial endoscopic attempts fail and bladder drainage cannot be obtained through urethral catheterization, then suprapubic tube (SPT) placement should be considered. Although percutaneous SPT placement can be performed faster and with local anesthesia, the reconstructed lower urinary tract in many of these patients may necessitate open cystotomy and SPT placement. If the surgeon is facile with ultrasound-guided SPT placement, then this is a less invasive alternative to safely placing an SPT when adjacent bowel is of concern. Definitive management can then be planned on an elective basis, keeping in mind that the solution can be as simple as stomal revision or require removal and replacement of the channel. Mickelson et al., have described an "L-stent" which can be used for refractory stomal stenosis. This can act as a temporizing measure until surgical revision, or in some cases, obviate the need for surgery altogether [17].

Definitive management is indicated if endoscopic attempts fail or if obstruction recurs despite minimally invasive interventions. Stomal stenosis can be corrected by excising the scarred tip and advancing a local skin flap into a spatulated, healthy distal segment, as a Y-V plasty. We perform this with a wire in the channel when possible and dissect circumferentially down to fascia in order to mobilize a healthy segment of channel. This is a relatively minor procedure that can be accomplished in the ambulatory setting. Buccal mucosa graft can also be used for stomal revision as described by Radojicic et al. [18]. If the channel stricture is below the level of fascia, laparotomy is required for revision; unfortunately, this can be hard to predict preoperatively so we prepare all patients for the possibility of a laparotomy.

Upon laparotomy, identification of the stenosed portion of the channel is usually straightforward—even the outer wall of the channel is ischemic and fibrotic. Depending on the length of the involved segment, the channel can be revised by interposition of a segment of bowel or the entire channel may need to be removed and replaced (see Fig. 10.1). If only the distal portion of the channel is fibrosed and the continence mechanism is unaffected, then a new channel can be fashioned (e.g., Monti) and anastomosed end-to-end to the healthy end of the existing channel. If the entire channel is fibrotic, it should be resected and a new channel created. Ideally, the new channel is tunneled in the native bladder. However, if bladder size or chronic cystitis and mucosal inflammation preclude formation of a good detrusor tunnel, then a channel using an alternative continence mechanism must be entertained. A rather simple salvage procedure in this case is to add an ICCC to the native bladder or augment, using the ileocecal nipple valve for continence. A more challenging alternative that we reserve for cases in which the ileocecal valve is not available is the intussuscepted ileal flap valve [19].

Incontinence

In a patient with stomal incontinence, it is important to rule out causes such as infrequent catheterization, incomplete bladder emptying, UTI, bladder calculus, or mucus impaction. In the absence of such causes, urodynamic studies (UDS) can help determine the etiology of incontinence. Pressure profilometry of the channel can be performed at the time of UDS; however, there is no standard cut-off below which the value might be considered abnormal. If urethral access is present, the UDS catheter can be placed transurethrally and patient filled and stressed to demonstrate leakage with stress or with bladder filling to a specific volume. Low-pressure leakage, stress urinary incontinence, and the absence of detrusor overactivity (DO) would implicate the continence mechanism as the cause of incontinence. On the other hand, the presence of DO, leak with DO, or impaired compliance implies primary bladder pathology. Treatment can then be directed toward rectifying the cause of the incontinence (Fig. 10.2). If detrusor overactivity is

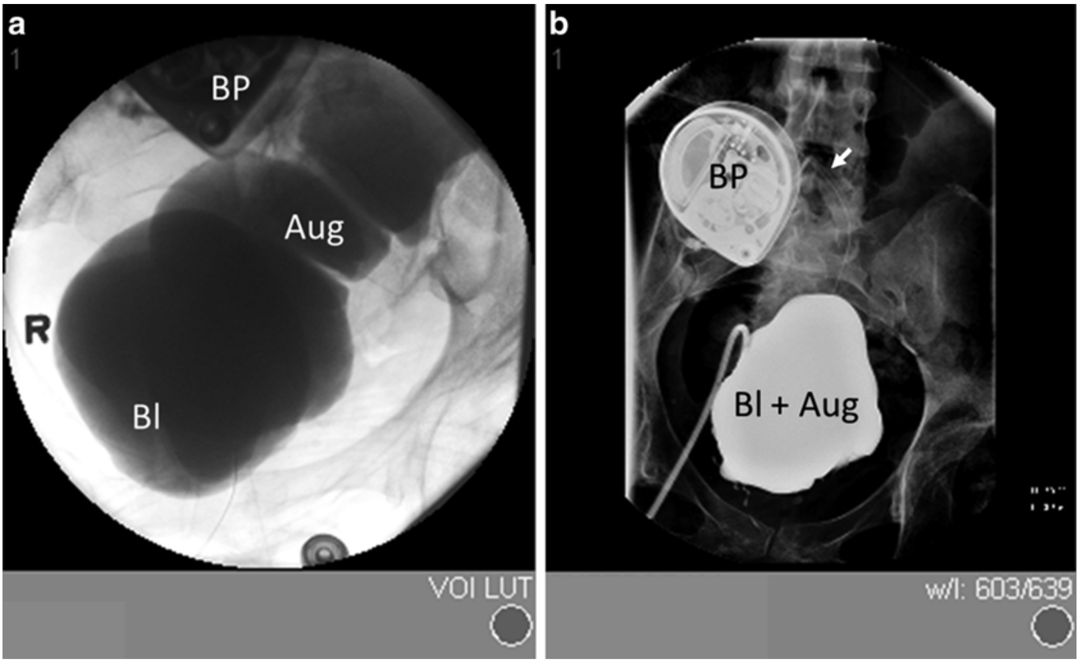

Fig. 10.3 (**a**) Cystogram of a patient with stomal incontinence showing an inadequately detubularized augment (Aug). The native bladder (Bl) is seen in the foreground, and there is a narrow communication between the bladder and augment. (**b**) Postoperative cystogram of the same patient after revision surgery by detubularizing the augment and anastomosing to a widely bivalved bladder. There is no transition between the native bladder and augment. *Arrow* points to the catheter in the continent channel. *BP* Baclofen pump

identified as the cause of incontinence, conservative measures such as anticholinergic medications and intravesical Botulinum toxin-A should be tried first. If the patient does not respond to such measures, he/she may be a candidate for augmentation cystoplasty or revision of an existing augmentation cystoplasty.

Endoscopic injection of bulking agents into the channel can be an effective, minimally invasive method to address failure of continence mechanism. Biomaterials that have been used for this purpose include collagen, PDMS, and dextranomer/hyaluronic acid injection (Deflux®). Prieto et al. have reported success rate of 71 % after a single injection and 79 % after two injections of Deflux in patients who were candidates for surgical revision for stomal incontinence. The mean follow-up duration in this series was 1 year [20]. Longer term studies are necessary to assess the durability of response with bulking agents. If incontinence does not respond to bulking agents, surgical intervention may be necessary. Revision of the existing continence mechanism, or removal and replacement of the entire channel with tunneled detubularized ileum (Monti), ICCC, or intussuscepted ileal flap valve as discussed in the earlier section can be considered. Yachia and Erlich have described the technique of creating a continent stoma by cross-wrapping non-detached strands of rectus muscle around the efferent channel. In their series of 17 patients, 100 % continence was reported after a mean follow-up duration of 32 months. Although described for primary creation of a continent reservoir, this technique can also be used as a salvage maneuver in cases of failure of continence mechanism [21].

In patients who have undergone augmentation cystoplasty, we have encountered instances wherein the incontinence is related to inadequate detubularization of bowel and/or bivalving of the bladder at the time of initial surgery. In such patients, cystogram reveals an "hourglass" configuration of the augmented bladder (Fig. 10.3). Revision of the augment by performing complete detubularization of the bowel segment and maximal anteroposterior sagittal cystotomy has resulted in resolution of incontinence in these instances.

Summary

Most of the complications related to continent catheterizable channels can be resolved by minimally invasive interventions that can be performed by adult general urologists.

Few patients need surgery to revise or replace the channel, and referral to a specialist trained in reconstructive urology would be appropriate in such instances.

Conversion to an incontinent urinary diversion should only be considered as a last resort.

References

1. Horowitz M, Kuhr CS, Mitchell ME. The mitrofanoff catheterizable channel: patient acceptance. J Urol. 1995;153(3 Pt 1):771–2.
2. Benchekroun A, Essakalli N, Faik M, Marzouk M, Hachimi M, Abakka T. Continent urostomy with hydraulic ileal valve in 136 patients: 13 years of experience. J Urol. 1989;142(1):46–51.
3. Mitrofanoff P. Trans-appendicular continent cystostomy in the management of the neurogenic bladder. [Cystostomie continente trans-appendiculaire dans le traitement des vessies neurologiques]. Chir Pediatr. 1980;21(4):297–305.
4. Cain MP, Casale AJ, King SJ, Rink RC. Appendicovesicostomy and newer alternatives for the mitrofanoff procedure: results in the last 100 patients at riley children's hospital. J Urol. 1999;162(5):1749–52.
5. Castellan MA, Gosalbez Jr R, Labbie A, Monti PR. Clinical applications of the Monti procedure as a continent catheterizable stoma. Urology. 1999;54(1):152–6.
6. Sarosdy MF. Continent urinary diversion using cutaneous ileocecocystoplasty. Urology. 1992;40(2):102–6.
7. Kock NG, Nilson AE, Nilsson LO, Norlen LJ, Philipson BM. Urinary diversion via a continent ileal reservoir: clinical results in 12 patients. J Urol. 1982;128(3):469–75.
8. 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(4 Suppl):1856–60. doi:10.1016/j.juro.2008.03.093.
9. Van Savage JG, Khoury AE, McLorie GA, Churchill BM. Outcome analysis of mitrofanoff principle applications using appendix and ureter to umbilical and lower quadrant stomal sites. J Urol. 1996;156(5):1794–7.
10. Castellan MA, Gosalbez R, Labbie A, Ibrahim E, Disandro M. Outcomes of continent catheterizable stomas for urinary and fecal incontinence: comparison among different tissue options. BJU Int. 2005;95(7):1053–7. doi:10.1111/j.1464-410X.2005.05465.x.
11. Thomas JC, Dietrich MS, Trusler L, DeMarco RT, Pope 4th JC, Brock 3rd JW, et al. Continent catheterizable channels and the timing of their complications. J Urol. 2006;176(4 Pt 2):1816–20. doi:10.1016/S0022-5347(06)00610-0; discussion 1820.
12. Harris CF, Cooper CS, Hutcheson JC, Snyder 3rd HM. Appendicovesicostomy: the mitrofanoff procedure-a 15-year perspective. J Urol. 2000;163(6):1922–6.
13. Khoury AE, Van Savage JG, McLorie GA, Churchill BM. Minimizing stomal stenosis in appendicovesicostomy using the modified umbilical stoma. J Urol. 1996;155(6):2050–1.
14. Landau EH, Gofrit ON, Cipele H, Hardak B, Duvdevani M, Pode D, et al. Superiority of the VQZ over the tubularized skin flap and the umbilicus for continent abdominal stoma in children. J Urol. 2008;180(4 Suppl):1761–5. doi:10.1016/j.juro.2008.04.070; discussion 1765–6.
15. Narayanaswamy B, Wilcox DT, Cuckow PM, Duffy PG, Ransley PG. The yang-monti ileovesicostomy: a problematic channel? BJU Int. 2001;87(9):861–5.
16. Leslie JA, Cain MP, Kaefer M, Meldrum KK, Dussinger AM, Rink RC, et al. A comparison of the monti and casale (spiral Monti) procedures. J Urol. 2007;178(4 Pt 2):1623–7. doi:10.1016/j.juro.2007.03.168; discussion 1627.
17. Mickelson JJ, Yerkes EB, Meyer T, Kropp BP, Cheng EY. L Stent for stomal stenosis in catheterizable channels. J Urol. 2009;182:1786–91.
18. Radojicic ZI, Perovic SV, Rados DP, Petar VM. Buccal mucosa grafts for repair of stenotic catheterizable continent stoma. J Urol. 2008;180:1767–9.
19. Thuroff JW, Gillitzer R, Franzaring L, Hampel C, Melchior S. Intussuscepted ileal flap valve for revisional surgery. BJU Int. 2005;96(9):1425–37. doi:10.1111/j.1464-410X.2005.05948.x.
20. Prieto JC, Perez-Brayfield M, Kirsch AJ, Koyle MA. The treatment of catheterizable stomal incontinence with endoscopic implantation of dextranomer/hyaluronic acid. J Urol. 2006;175(2):709–11. doi:10.1016/S0022-5347(05)00185-0.
21. Yachia D, Erlich N. The hadera continent reservoir: a new appendico-umbilical continent stoma mechanism for urinary diversion. J Urol. 2001;165(5):1423–6.