



Operative Techniques

Creation of an appendicovesicostomy mitrofanoff from a preexisting appendicocostomy utilizing the spilt appendix technique

Brian A. VanderBrink^{a,*}, Marc A. Levitt^b, W. Robert Defoor^a, Shumyle Alam^a^a Division of Urology, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio, USA^b Colorectal Center for Children, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio, USA

ARTICLE INFO

Article history:

Received 12 August 2013

Received in revised form 5 December 2013

Accepted 26 December 2013

Key words:

Mitrofanoff

Malone antegrade continence enema

Appendicovesicostomy

Appendicocostomy

Split appendix

ABSTRACT

Continent catheterizable channels have revolutionized reconstructive surgery to achieve both urinary and fecal continence. The Mitrofanoff and Malone antegrade continent catheterizable channels offer improved quality of life relative to permanent incontinent stomas. A frequently employed surgical option for creating a Mitrofanoff when an existing appendicocostomy exists involves harvesting a separate piece of intestine. If however the Malone has preceded the creation of a Mitrofanoff, we describe a surgical technique that may avoid the need for a bowel harvest and resultant anastomosis. We report our series of patients utilizing a novel alternative strategy in the select clinical circumstance of an existing appendicocostomy to expand the armamentarium of the urologic reconstructive surgeon.

© 2014 Elsevier Inc. All rights reserved.

Continent catheterizable channels have revolutionized reconstructive surgery to achieve both urinary and fecal continence. The Mitrofanoff and Malone antegrade continent catheterizable channels offer improved quality of life relative to permanent incontinent stomas. Stomal continence rates have been reported to be in excess of 90% in reported large series [1,2]. Surgical revisions of these channels may be necessary to address problems associated with their catheterization. At times the revision can require a laparotomy and creation of completely new channel when an assessment is made that the existing channel cannot be salvaged [1,3].

A frequently employed surgical option for creating a Mitrofanoff when an existing appendicocostomy exists or the appendix is otherwise not suitable involves harvesting a separate piece of intestine as described by Monti [4]. Ideally with appropriate planning and collaboration between the urologic and colorectal treatment plans, the Mitrofanoff and Malone can be performed simultaneously. If however the Malone has preceded the creation of a Mitrofanoff we describe a surgical technique that may avoid the need for a Monti procedure. We report our series of patients utilizing a novel alternative strategy in the select clinical circumstance of an existing appendicocostomy to expand the armamentarium of the urologic reconstructive surgeon. We created a functional Mitrofanoff from an existing appendicocostomy by taking down the Malone and dividing the appendix to simultaneously create an appendicovesicostomy and appendicocostomy.

1. Methods

A retrospective review of our case series is presented.

1.1. Patient 1

A.L. has a history of caudal regression and fecal incontinence secondary to neurogenic bowel. At age four she underwent a laparoscopic assisted Malone antegrade continence enema without the use of plication at an outside institution with the stoma placed in the umbilicus. The patient had successful treatment of fecal incontinence with an antegrade enema program [5] and did not experience stomal incontinence. She had persistent urinary incontinence refractory to medical management and clean intermittent catheterization. Comprehensive urologic assessment deemed the urinary incontinence secondary to poor bladder outlet resistance. A bladder neck reconstruction with concomitant Mitrofanoff was recommended and this was performed at age five.

At the time of reconstruction the appendix was taken down from the umbilicus and found to be approximately 6 cm in length. Intraoperative findings were an appendiceal mesenteric blood supply allowing the appendix to be divided with the proximal portion used for appendicocostomy and the distal portion mobilized on its mesentery. (Fig. 1). This division was not equal but rather based upon appendiceal blood supply with the distal appendix which will be the appendicovesicostomy preserved on its blood supply. (Fig. 2) The proximal appendix is supplied from the cecum, and when possible the mesenteric vessels are preserved.

* Corresponding author at: Cincinnati Children's Hospital Medical Center, Division of Urology MLC 5037, 3333 Burnet Avenue, Cincinnati, OH 45229. Tel.: +1 513 636 4975.
E-mail address: brian.vanderbrink@cchmc.org (B.A. VanderBrink).

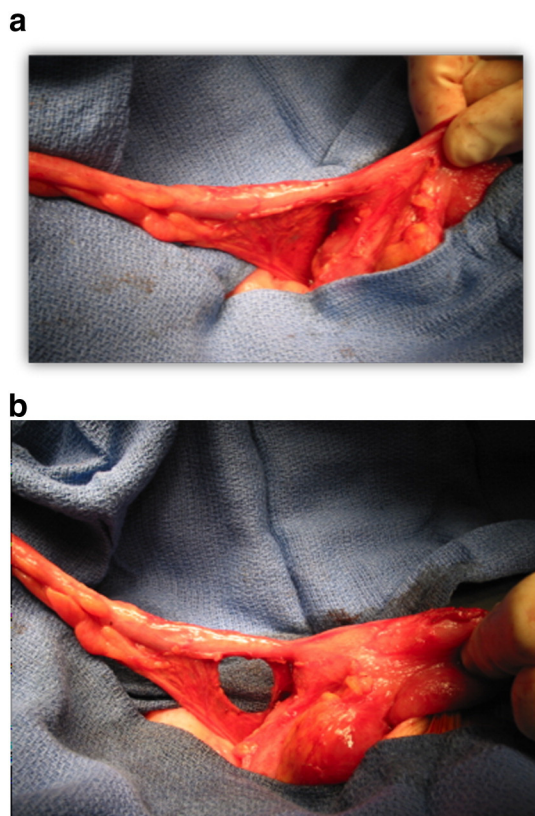


Fig. 1. (a) Intraoperative photograph of appendix demonstrating length and (b) then mesenteric dissection to allow for proximal portion for appendicocostomy and distal portion with adequate mesentery to serve as appendicovesicostomy.

The distal portion of the appendix was implanted into detrusor using an extravesical technique. The appendicovesicostomy stoma was placed into the right lower quadrant utilizing a U flap technique to bring the skin to spatulated appendix and the appendicocostomy sited into the umbilicus. The patient had uneventful convalescence. Both channels are continent, catheterizable, without stomal stenosis and have not needed additional surgery for channel related problems with over two years of follow-up.

1.2. Patient 2

A.B. has a history of spina bifida and fecal incontinence secondary to neurogenic bowel. At age four she underwent a laparoscopic assisted Malone antegrade continence enema without utilizing a plication technique. The patient experienced occasional stomal incontinence prior to reoperation. She had achieved urinary continence with anticholinergics and clean intermittent catheterization. The family had desired creation of a appendicovesicostomy to increase the child's independence as she was unable to catheterize herself per urethra. Given the stomal incontinence, she was scheduled for Malone revision and creation of Mitrofanoff at age six.

At the time of reconstruction the Malone was taken down from the umbilicus, the cecum mobilized and the appendix examined. No appendiceal length was recorded in the operative note however its length and vascular supply when examined intraoperatively were deemed adequate for a split appendix technique. The proximal end of the appendix was functionally lengthened utilizing the stapler and the cecum imbricated over this appendicocecal unit as described by Sheldon et al [6]. (Fig. 3).

In brief after division of the appendix the proximal appendix will sometimes be short and the site for the appendicocostomy stoma will be the umbilicus because stoma location in any other site (i.e.

right lower quadrant) will not be possible due to insufficient appendiceal length to traverse the abdominal wall. The non-cutting stapler allows for functional "lengthening" by imbricating the cecum over the appendicocecal unit for the sole purpose of providing a continence mechanism.

The distal portion of the appendix was mobilized on its mesentery, implanted into the detrusor using an extravesical technique and the appendicovesicostomy stoma was sited in the right lower quadrant utilizing a U flap technique to bring the skin to spatulated appendix. The appendicocostomy was resited into the umbilicus. The patient had uneventful convalescence. Upon over three years of follow-up, both the channels are continent, catheterizable, without stomal stenosis and have not needed additional surgery for channel related problems.

1.3. Patient 3

E.G. has a history of spina bifida with fecal and urinary incontinence secondary to neurogenic bowel and bladder, respectively. At age twelve she underwent an open appendicocostomy and concomitant sigmoid Monti Mitrofanoff at an outside institution to increase the child's independence as she was unable to catheterize herself per urethra. This procedure was complicated by postoperative abdominal wall abscess resulting in a non-functional Mitrofanoff because subsequent healing resulted in obliteration of the subcutaneous portion of the channel rendering it unable to be catheterized. She was then referred to our institution. She had achieved urinary continence per urethra with anticholinergics and clean intermittent catheterization. She was scheduled for Mitrofanoff revision 17 months following her original procedure.

At the time of exploration the existing Mitrofanoff was found to have an obliterated lumen for a length of 3 cm from the stoma proximally. The patient's truncal obesity made this lost length of channel problematic and the existing channel was deemed non salvageable. Prior to harvesting a segment of intestine to create a new Monti Mitrofanoff, we decided based upon our experience with the previous two patients, to examine the appendiceal length. We took down the Malone from the abdominal wall stoma, mobilized the cecum and appendix. The appendix was found to be 8 cm in length with mesentery suitable for a split appendix technique to create appendicocostomy and appendicovesicostomy. The appendicovesicostomy stoma was sited in the right lower quadrant utilizing a U flap technique to bring the skin to spatulated appendix. We minimized the distance between the bladder and anterior abdominal wall by fixing the bladder to the posterior abdominal wall. This step minimizes free mobile intraperitoneal course of the appendicovesicostomy allowing for a straight course of the catheterizable channel and potentially minimizing postoperative catheterization difficulties. The appendicocostomy was resited into the umbilicus. The patient had uneventful convalescence. Upon six months of follow-up, both channels are continent, catheterizable, without stomal stenosis and have not needed additional surgery for channel related problems.

2. Discussion

Urinary incontinence and fecal incontinence secondary to neurogenic bladder and bowel, respectively, are frequently encountered comorbidities in patients with myelomeningocele as well as anorectal malformation. Many of these children will require urinary as well as colorectal reconstruction to achieve fecal and urinary continence. Total continent reconstruction has been increasingly performed as experience grows with various surgical techniques. We present our series of patients that have undergone previous Malone appendicocostomy for treatment of their neurogenic bowel and at a subsequent date needed a Mitrofanoff to assist in urologic care of neurogenic bladder or required revision of nonfunctional existing

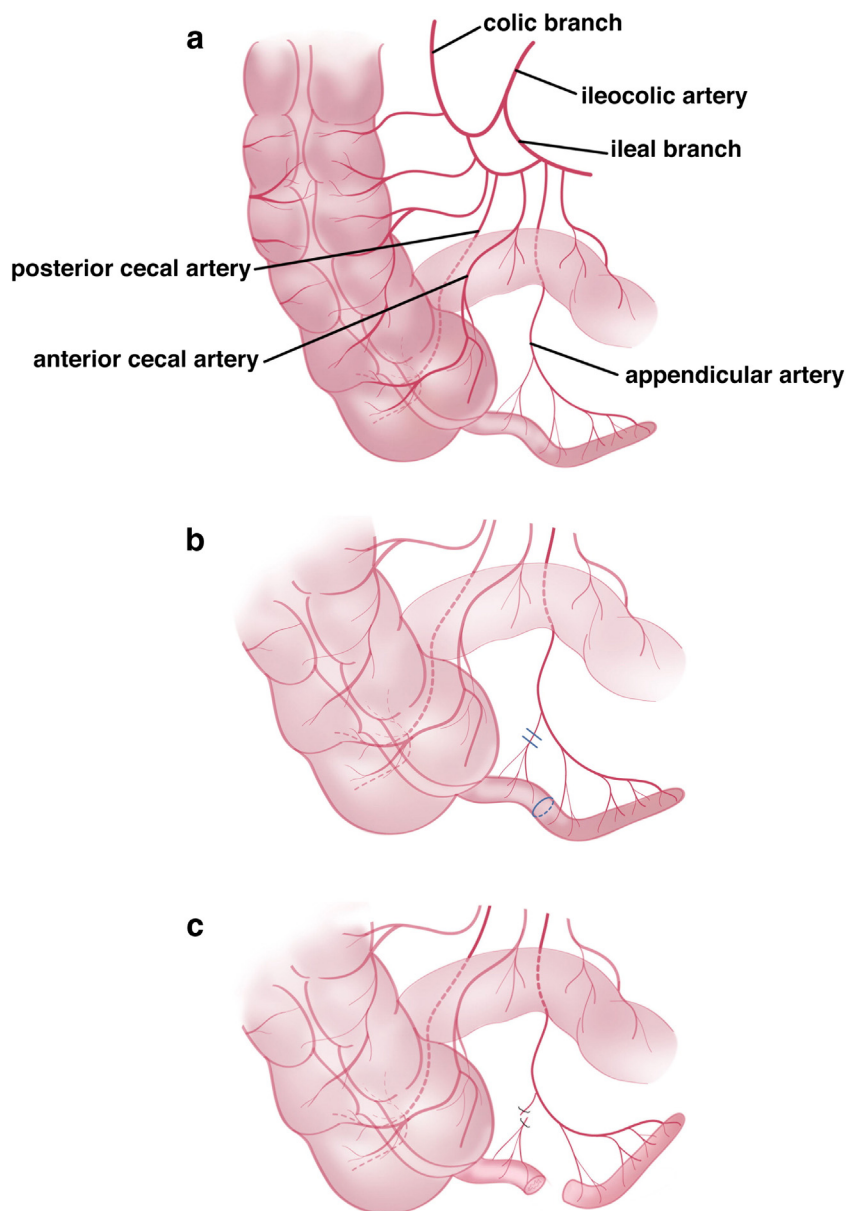


Fig. 2. (a) Illustration of appendiceal and cecal arterial supply. (b) When the appendiceal vasculature is amenable, the appendix can be safely divided while the distal appendix is perfused on the appendicular artery and the proximal appendix is supplied from the cecum or proximal appendicular blood vessel depending upon blood supply.

Mitrofanoff. While this clinical scenario is not unprecedented; we describe a novel, previously unpublished, technique of taking down the existing appendicocostomy to divide the appendix thus allowing creation of both appendicovesicostomy and appendicocostomy. Utilizing our approach, the patients in our series enjoyed the benefit of avoiding a small bowel resection and its accompanying risks while still having a functional Mitrofanoff created.

We advocate that the fecal and urinary continence should be managed in continuity. Two of the referenced patients in the case report were managed by pediatric surgeons unfamiliar with bladder management prior to presentation to our center. The third patient had her surgery performed by surgeons unfamiliar with the split-appendix technique. In all three cases secondary surgery may have been avoided by initial multidisciplinary evaluation and treatment.

Prior authors have described the split-appendix technique and have published their experience using this technique for synchronous Malone and Mitrofanoff creation under a single anesthetic [7–9]. The current manuscript describes that same approach when the appendix

has already been utilized for Malone appendicocostomy in a select patient population in both *de novo* creation and revision of appendicovesicostomy. Our institution's current philosophy is to employ a multidisciplinary collaborative approach between the Colorectal and Urology surgeons to coordinate creation of appendicovesicostomy and appendicocostomy under a single anesthetic when continent reconstructive surgery has been deemed indicated. We prefer to use the appendix as our first choice for the Mitrofanoff when a combined urinary and fecal reconstructive surgery is undertaken, while performing a neo-appendix procedure [10] for the appendicostomy when the anatomy does not allow a split appendix technique.

Proper patient selection is a fundamental component of achieving successful operative outcomes for any surgical procedure. Therefore specific application of this innovative operative strategy merits further discussion. The principal purpose of this technique is to avoid a bowel anastomosis when appendiceal anatomy is feasible. Lengthening of the appendicocecal unit to achieve a functional length

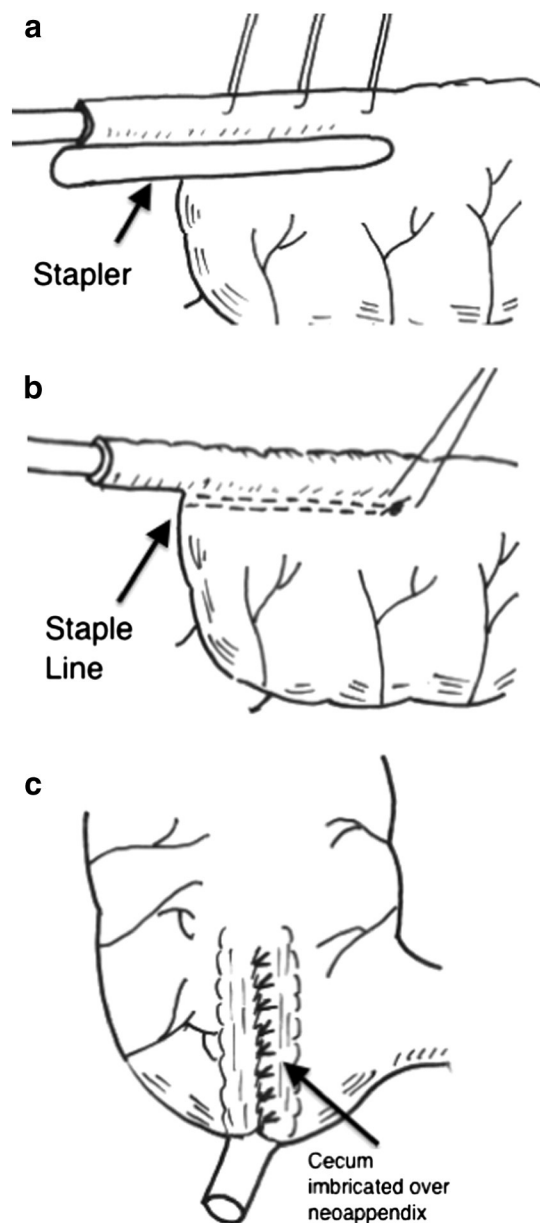


Fig. 3. (a, b) Schematic illustration of the technique utilizing the stapler and the cecum imbricated over this appendicocolic unit. Non cutting TA stapler extends the functional length of the appendix followed. (c) Imbrication of the appendix over the neostoma to provide continence mechanism while maintaining a proximal stump long enough to be exteriorized.

for continent appendicostomy can be employed to further minimize the risk of bowel harvest. It is critical that there is favorable appendiceal vascular anatomy and enough laxity in the pedicle to allow for separate stomas to be created. Radical mobilization of the appendicular and ileocecal vessels to the root of the mesentery is needed on rare occasion to achieve a tension free result. The amount of tension free mobility and laxity achievable will dictate whether the appendicovesicostomy and appendicocolicostomy will both be in the right lower quadrant or appendicovesicostomy and appendicocolicostomy in the right lower quadrant and umbilicus, respectively. We generally prefer to bring out the Mitrofanoff stoma to the right lower quadrant. This allows us to utilize a segment of appendix for the Mitrofanoff and implant in the native bladder while maintaining the shortest most direct course for catheterization. Therefore an appendix

that may be considered “too short” by some surgeons has not been an issue for the authors.

In our experience appendiceal length is not predictive of successful outcome and the most critical factor is vascular supply. We have noted that a retrocecal appendix can still be utilized however only if the blood supply is easily mobilized. In cases where the mesentery cannot be separated a far distance we recommend siting the appendicovesicostomy and appendicocolicostomy stomas in the right lower quadrants to avoid traction injury to pedicle or ischemia from excessive tension. When selecting a right lower quadrant stoma location, we typically choose a site medial to the anterior superior iliac spine but lateral to the rectus abdominis. This anatomic site is often not as thick as the rest of the abdominal wall to minimize transabdominal distance traversed. In case where truncal obesity is a concern our institution's bias is to allocate the entire appendix for the appendicovesicostomy and create a Malone utilizing a neo-appendix procedure [10].

Additionally two patients in our series had undergone laparoscopic Malone appendicocolicostomy procedure with omission of imbrication sutures. This led us to believe that the appendix was minimally disturbed during the initial procedure and potentially amenable to the split appendix technique. If a plicated appendix is present, the split appendix technique may be more challenging to apply secondary to previous manipulation of the appendiceal mesentery. In two patients, we applied this technique and took down the Malone only to determine intraoperatively that the appendix could not be split due to disturbance of the appendiceal blood supply secondary to plication. The Mitrofanoff in these two patients was created using the Monti technique from harvested intestine and the Malone replaced to its original site.

3. Conclusions

We describe our technique of takedown of existing appendicocolicostomy in order to divide the appendix for simultaneous creation of appendicocolicostomy and appendicovesicostomy when confronted with the clinical scenario of need to create Mitrofanoff instead of harvesting a separate piece of intestine to serve as substrate to create the channel. Our short-term result with this technique has been favorable and resulted in formation of reliable, continent catheterizable channels while enjoying the benefit of avoidance of a bowel anastomosis and its attendant risks.

References

- [1] Bani-Hani AH, Cain MP, Kaefer M, et al. The Malone antegrade continence enema: single institutional review. *J Urol* 2008;180:1106–10.
- [2] Levitt MA, Soffer SZ, Peña A. Continent appendicostomy in the bowel management of fecally incontinent children. *J Pediatr Surg* 1997;32:1630–3.
- [3] Welk BK, Afshar K, Rapoport D, et al. Complications of the catheterizable channel following continent urinary diversion: their nature and timing. *J Urol* 2008;180:1856–60.
- [4] Monti PR, de Carvalho JR, Arap S. The Monti procedure: application and complications. *Urology* 2000;55:616.
- [5] Bischoff A, Tovilla M. A practical approach to the management of pediatric fecal incontinence. *Semin Pediatr Surg* 2010;19:154–9.
- [6] Sheldon CA, Minevich E, Wacksman J. Modified technique of antegrade continence enema using a stapling device. *J Urol* 2000;163:589–91.
- [7] Squire R, Fiely EM, Carr B, et al. The clinical application of the Malone antegrade colonic enema. *J Pediatr Surg* 1993;28:1012.
- [8] Roberts JP, Moon S, Malone PS. Treatment of neuropathic and faecal incontinence with synchronous bladder reconstruction and the antegrade continence enema procedure. *Br J Urol* 1995;75:386.
- [9] Kajbafzadeh AM, Chubak N. Simultaneous Malone antegrade continent enema and Mitrofanoff principle using the divided appendix: report of a new technique for prevention of stoma complications. *J Urol* 2001;165:2404–9.
- [10] Chatoorgoon K, Pena A, Lawal T, et al. Neoappendicostomy in the management of pediatric fecal incontinence. *J Pediatr Surg* 2011;46:1243–9.