Continent Appendicostomy in the Bowel Management of Fecally Incontinent Children

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Background: Fecal incontinence is common in children who have anorectal malformations, Hirschsprung's Disease, and spina bifida and can negatively impact their emotional and social development. Enemas have been used as an artificial way to keep children clean and to improve their quality of life. This method is unpleasant for many children, particularly when they reach adolescence. Malone in 1990 described an alternative method in which the appendix is used as a conduit to administer an antegrade enema.

Methods: The authors describe their experience with this new procedure, modified by them, and used in 20 patients. In the original procedure, the base of the appendix is divided, inverted, and reimplanted into the cecum with an antireflux technique. The authors simplify this by plicating the cecum around the appendix to create a one-way valve mechanism but leaving the appendix in its original position. The authors also mobilize the cecum and exteriorize the appendix at the umbilicus to create an inconspicuous stoma. If the native appendix is absent a neoappendix was created from a flap of cecum.

Results: Nineteen of 20 patients (95%) are now completely clean 24 hours a day. Stricture of the stoma occurred in two patients and required revision. Leakage at the appendicostomy site occurred in three patients, and two required a tighter plication.

Conclusions: The technique is used to change the route of enema administration, and is only used in patients for whom bowel management with rectal enemas has been proven successful. The appendix must be preserved whenever possible in patients at risk for fecal incontinence.
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INDEX WORDS: Appendicostomy, anorectal malformation, incontinence, Malone procedure.

FECAL INCONTINENCE can be devastating to the emotional and social development of children.[1] Anorectal malformations affect 1 in 5,000 newborns, and at least 30% of these children will be fecally incontinent after corrective surgery.[2] In addition, approximately one half of children who have spina bifida suffer from fecal incontinence[3] as do some children who have Hirschprung's disease and intractable constipation.[4]

Some patients who have fecal incontinence may improve significantly with an operation.[5] Those who do not improve have three alternatives to deal with fecal incontinence. If nothing is done, the children will soil their clothing or diaper and incur social or psychological sequelae. A diverting colostomy is a second option, in which case the family is burdened by the need for ostomy care as well as the emotional drain inflicted on a child who must live with a colostomy. A third option involves the implementation of a bowel management program whereby, through the use of a daily enema, manipulation of diet, and some medication, children can remain clean 24 hours a day.[5] In our experience, this program has proven effective for the vast majority of fecally incontinent children.[5]

The use of rectal enemas on a daily basis is unpleasant to most children and in many cases intolerable, especially as children get older. In 1990, Malone et al[6] described the use of the appendix as a conduit for the administration of an antegrade continence enema. They created a one-way valve mechanism that allowed for the catheterization of the appendix through the abdominal wall and at the same time prevented stool leakage.

We describe our experience with this new procedure, as well as the technical variations we have incorporated to optimize patient satisfaction. The continent appendicostomy is not a cure for fecal incontinence; rather it is a more pleasant way for children to engage in a bowel management protocol without the need for rectal enemas.

MATERIALS AND METHODS

Between July 13, 1994 and November 1, 1996, 20 patients underwent the continent appendicostomy procedure; 19 of the patients were children ranging in age from 3 to 16 years at the time of operation. One patient was a man, aged 27, with a long history of fecal incontinence

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secondary to Hirschsprung's disease. Among the 19 children, 16 had a history of anorectal malformations exclusively, two had spina bifida exclusively, one had both spina bifida and an anorectal malformation, and one patient suffered from severe intractable chronic constipation. Overall, there were 13 boys and seven girls in the study group. The patients have been followed-up for between 1 and 29 months on an outpatient basis. The operation is now offered only to those patients for whom the bowel management program has proved to be successful.

Surgical Technique

Malone initially created the appendicostomy by dividing the appendix at its base and reimplanting it submucosally in a reverse manner into the cecum. The appendix was then exteriorized through the right lower quadrant creating a stoma for catheterization.[6] More recently, Malone no longer reversed the appendix.[7] In our series, after a routine complete bowel preparation, a continent appendicostomy was created. After our first three cases, we decided to modify Malone's original technique in the following ways:

1. We do not divide and separate the appendix from the cecum but rather leave it in situ. The cecum is then plicated around the appendix using 6-0 silk sutures to create a one-way valve that allows the passage of a no. 8 catheter and also prevents leakage of stool. Before placing the silk sutures, the tip of the appendix is divided and a well-lubricated #8 feeding tube is introduced back and forth into the cecum. As the plicating stitches are placed, the patency of the appendix is tested by passing the plastic tube because it is not uncommon to find that a single stitch kinks the appendiceal lumen and interferes with the catheterization. The surgeon tests the function of the valve by passing saline solution into the cecum through the feeding tube while applying pressure with the fingers to the ascending colon and terminal ileum. Once the cecum is full and tense, the feeding catheter is removed to ensure that there is no leakage of saline solution through the appendix.

2. The cecum is entirely mobilized toward the midline by dividing its fixation to the right gutter. The appendix is exteriorized through the deepest point of the umbilicus and the cecum is fixed to the anterior abdominal wall around the umbilicus. The tip of the appendix is spatulated to create a wide anastomosis with the skin using 6-0 vicryl sutures. Again, after every maneuver, the patency of the appendix is verified to insure that it has not been kinked (Fig 1).

3. In seven of the cases, in which the appendix had previously been removed or was needed for a urologic purpose, a neoappendix was created from the wall of the cecum in a manner similar to a reported technique.[8] The cecum was also plicated around the neoappendix as described above (Fig 2). To create the new appendix, we used the medial portion of the ascending colon, approximately 6 to 8 cm distal to the ileocecal valve. A flap of bowel is developed; the base of the flap must be medially oriented and must be created having one or two of the mesenteric vessels at its base, providing the blood supply of the flap. This is an important technical aspect because the blood supply to the tip of the neoappendix may be compromised if the flap is created in a different manner. The length of the flap is about 6 to 8 cm, and the width must be sufficient to allow tubularization around a #10 feeding tube without tension. The tube itself is created with 6-0 long-term, absorbable, interrupted sutures. The defect in the cecum is repaired in two layers with the same suture material. The neoappendix is then laid down on the colonic wall, which is then plicated around it. It is important to be sure that the sutures of the neoappendix do not lie in contact with the colonic sutures to avoid the possibility of a fistula formation. The cecum is mobilized and the umbilical stoma is created as previously described (Fig 2).

In one patient, a long appendix was divided with the proximal portion used for the bowel management and the distal portion used as a Mitrofanoff conduit for the performance of intermittent catheterization to treat urinary incontinence.[9] Another patient who also required a Mitrofanoff procedure for urinary incontinence had one fashioned from a very short appendix, and a neoappendicostomy was formed to treat her fecal incontinence.

Two weeks postoperatively, the stoma was catheterized in the doctor's office to ensure its patency, but it was not used for irrigation until 1 month after surgery. At 1 month, a daily regimen consisting of different volumes of normal saline was introduced through the appendicostomy via an infant feeding tube while the patient sat on the toilet. Ideally, this should completely clean the colon in approximately 30 to

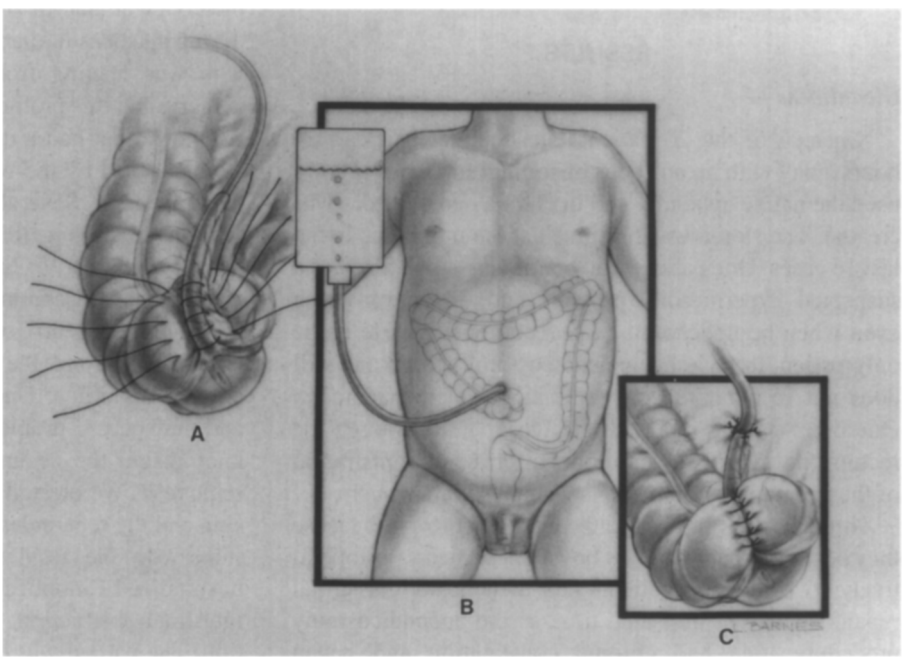

Fig 1. Cecal plication around the native appendix. (A) Appendix overlying cecum. (B) Administration of enema through the umbilicus. (C) Completed plication.

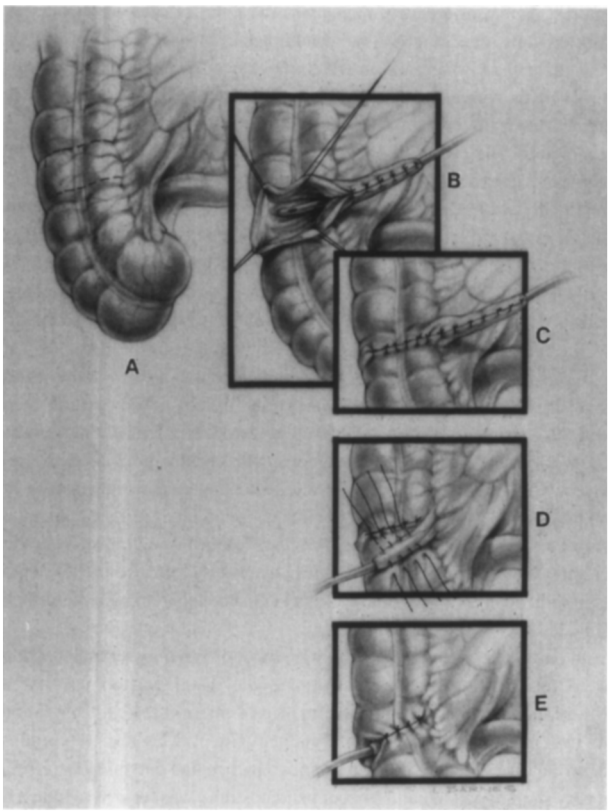

Fig 2. Neoappendicostomy. (A) Flap of cecum with mesenteric vessels at its base. (B) Tubularization of cecal flap over feeding tube. (C) Completed neoappendix. (D) Plication of cecum around neoappendix (neoappendix suture line should not oppose cecal suture line. (E) Complete plication.

45 minutes. A period of trial and error is invariably required, and occasionally Fleet enemas are incorporated into the regimen.

RESULTS

Cleanliness

Nineteen of the 20 patients are completely clean 24 hours a day with no episodes of soiling. In 12 patients we used the native appendix and in eight a neoappendix was created. The stoma was fashioned at the umbilicus in the last 16 cases. One patient who continued to soil also has a suspected hypermotility problem and was never clean even when he underwent daily rectal enemas. He is the only patient to have his appendicostomy closed and still does not respond to conventional bowel management. One other patient reported leakage of fluid through the rectum (not feces) several hours after the administration of the enema, a problem that subsided spontaneously.

Three patients rarely use the appendicostomy because they began having voluntary bowel movements postoperatively (two of these patients had their posterior sagittal repairs redone at the same time as the appendicostomy procedure; one had chronic constipation and began having voluntary bowel movements after the appendicostomy). Each of these patients has chosen to keep the appendicostomy open and irrigate when necessary. None report any problems with the stoma.

Most of the children are able to catheterize themselves, which is an additional advantage over rectal bowel management. A patient required a solution of Golytely to completely clean himself; however, this is the same patient who had the suspected motility problem who did not respond to rectal bowel management preoperatively and had his appendicostomy reversed.

Postoperative Complications

Five postoperative complications arose that could be attributed to the surgery itself. In one patient, the stoma became atretic. The patient underwent reoperation 2 months after the initial procedure, and the lumen of the appendix was found to be located 4 mm below the skin. The umbilical stoma was refashioned, and the patient is now completely clean. Another patient had stomal stricture with inability to pass the catheter. The stoma was revised 2 months later and has remained open for more than 1 year since the reoperation. This patient is also completely clean.

Three children suffered from leakage of stool from the appendicostomy site. (Two of the patients had neoappendicostomies, one had a native appendicostomy.) In all three instances, this complication arose at a time when very loose stools developed in the child for reasons such as gastroenteritis. The parents of two of the children opted for surgical repair of this problem, and a tighter plication was fashioned. Both children are now completely clean and their stomas no longer leak stool even during episodes of diarrhea. The parents of the third child who was leaking from the stoma opted not to have surgery, and this problem has resolved spontaneously.

One patient had a dermatitis rash in the region of the stoma caused by the wetness produced by mucous from the appendix. Several ointments used achieved some success in solving this problem. However, the patient (adult) decided to have his appendicostomy closed. Another patient continues to have difficulty passing the tube, but there is no evidence of stricture seen on physical examination, and the tube passes quite easily in the physician's office. One patient suffered a very unusual and unexpected problem when the catheter developed a knot inside the cecum and the patient was unable to remove it. We elected to cut the tube at the level of the skin and the remainder of the tube was expelled uneventfully with the fecal stream. Finally, one patient was hospitalized 1 month after the surgery with a diagnosis of intestinal obstruction, which resolved without an operation. The patient was discharged 4 days later, and we do

not know whether the continent appendicostomy procedure was responsible for this hospitalization.

Level of Satisfaction

Of the 14 patients who were surveyed, 13 (93%) noted a level of satisfaction of good to excellent. Generally, the procedure has improved self-esteem and confidence among these patients, especially the older ones who face added social pressures. One 9-year-old remarked that her grades in school have improved form "C"s to "A"s and "B"s solely as a result of this procedure. Even the three children who rarely use the appendicostomy (they now have voluntary bowel movements) are happy with the security in knowing that it is available if needed.

DISCUSSION

The results of this procedure have been very satisfactory. Continued follow-up is crucial because other series have noted several late complications.[7,10] Our patient who continued to soil underscores our belief that the continent appendicostomy should not be attempted in those patients in whom traditional rectal bowel management fails. We use the technique only to change the route of enema administration to an easier and more efficient one.

Surgeons must be careful to preserve the appendix whenever possible, particularly in patients who have anorectal malformations, spina bifida, and Hirschprung's disease. The incidental appendectomy should be discouraged, as others have suggested,[11] in light of the advances made in using the appendix to treat fecal incontinence with the Malone procedure[6] and urinary incontinence with the Mitrofanoff conduit.[9]

One must realize that this procedure is not a cure for fecal incontinence; rather it is a way for children to live happier lives. As such, children who are successfully managing their fecal incontinence rectally and remain relatively satisfied with this lifestyle should not necessarily undergo this procedure. Nonetheless, many children, especially as they grow older and enter adolescence, are candidates for an appendicostomy.

Our placement of the stoma in the umbilical fold, rendering it virtually unnoticeable to others, is an important factor in maximizing body image in a very self-conscious age group. The fact that they can catheterize themselves without parental or other aid is also particularly important.

Leakage was more prevalent in the neoappendicostomies. A local revision made the valve tighter, which if done at the first procedure, could help avoid this problem in the future.

A recent report of laparoscopic appendicostomy[12] avoided the use of cecal plication. It has been mentioned that plication may not be necessary because the appendix has a valve mechanism by itself, which may be partially true. But, our case of a native appendix that leaked shows that an antireflux plication may be necessary for at least some appendices. We are convinced of the importance of the plication in the native appendix and recommend its use for the neoappendix.

The operation is relatively simple, but attention to details is very important to avoid ischemia at the tip of the appendix or neoappendix. The surgeon must remember that a simple stitch may kink the lumen of the appendix enough to interfere with catheterization. The design of the neoappendicostomy based on the mesenteric side of the colon and with a mesenteric vessel at its base is a very important maneuver used to avoid devascularization during the tubularization portion of the procedure.

Until a true cure for fecal incontinence is available, we foresee a definite niche for the continent appendicostomy among patients who suffer from fecal incontinence. This technique, as originally described by Malone et al[6] provides a safe and effective route for enema administration in those patients who have successfully managed their fecal incontinence through traditional bowel management, and it will allow these patients the satisfaction of remaining clean without the need for rectally administered enemas.

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