



Colostomy in anorectal malformations: a procedure with serious but preventable complications

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Abstract

Purpose: Colostomy for patients with anorectal malformations decompresses an obstructed colon, avoids fecal contamination of the urinary tract, and protects a future perineal operation. The procedure is associated with several significant complications.

Materials and Methods: The medical records of 1700 cases of anorectal malformations were retrospectively reviewed. A total of 230 patients underwent reconstruction without a colostomy. Of the remaining 1470 patients, 1420 had their colostomy performed at another institution (group A) and 50 did at our institution (group B) using a specific technique with separated stomas in the descending colon.

Results: There were 616 complications identified in 464 patients of group A and in 4 patients in group B, an incidence of 33% vs 8% ($P < .01$). Complications in group A were classified into several groups. The first group was mislocation (282 cases), including 116 with stomas too close to each other, 97 with stomas located too distally in the rectosigmoid (which interfered with the pull-through), 30 with inverted stomas, 21 with stomas too far apart from each other, and 18 with right upper sigmoidostomies. The second largest group was prolapse (119 cases), which occurred mainly in mobile portions of the colon. The third group was composed of general surgical complications after colostomy closure (82 cases), such as intestinal obstruction (47 cases), wound infection (13 cases), incisional hernia (11 cases), anastomotic dehiscence (7 cases), sepsis (3 cases), and bleeding (1 case). Two of the septic patients died. Another group included 62 patients who received a Hartmann's procedure, which we considered to be contraindicated in anorectal malformations. A total of 42 patients suffered from stenosis of the stoma; 29, from retraction.

Conclusions: Most colostomy complications are preventable using separated stomas in the descending colon. Mislocated stomas lead to problems with appliance application, interference with the pull-through, megasigmoid, distal fecal impaction, and urinary tract infections. Loop colostomies lead to urinary tract infections, distal fecal impaction, and prolapse. Prolapse is a potentially dangerous complication that mostly occurs when the stoma is placed in a mobile portion of the colon. Recognizing this makes the complication preventable by trying to create colostomies in fixed portions of the colon or by fixing the bowel to the abdominal wall when necessary. The trend to avoid colostomies is justified; however, colostomy is the best way to prevent complications in anorectal surgery and, when indicated, should be done with a meticulous technique following strict rules to avoid complications.

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Table 1 Locations of the colostomies

Location	No. of cases	Percentage
Sigmoid	483	32.9
Descending colon	312	21.2
Right transverse colon	293	19.9
Left transverse colon	86	5.9
Ileum	35	2.4
Middle transverse colon	12	0.8
Cecum	8	0.5
Unknown	241	16.4
Total	1470	100

Colostomy in children is a time-honored procedure used for several purposes; however, it is mainly used to divert the fecal stream for decompression, under emergency conditions, and to protect the lower colorectal tract after a reconstructive repair. Most patients with anorectal malformations receive a protective colostomy before the main repair to avoid contamination [1-4]. However, during the last 2 decades, more pediatric surgeons advocate the repair of anorectal malformations in a primary fashion without a colostomy. These authors, in justifying this approach, argue that a colostomy itself has significant morbidity [5-7], and the literature supports this stance [8-10]. During the last 25 years, and until upon writing this article, we have operated primarily or secondarily on 1700 patients with anorectal malformations. Most of these patients came to us with a colostomy already performed at another institution. Of these patients, 50 were born at our institution; therefore, we had the opportunity to perform the colostomy. The fact that most of these patients were operated on at other institutions represented a unique opportunity to study colostomy-related morbidity because the series includes a great variety of colostomies created in different locations and with different techniques. A retrospective review of this large series allowed us to learn about the most common complications, evaluate the possible causes of those complications, and derive methods to prevent their occurrence.

1. Materials and methods

A retrospective review of 1700 medical records was performed with institutional review board approval. We evaluated the location (ie, upper abdomen, lower abdomen, right side, left side, left lower quadrant, right lower quadrant, right upper quadrant, or left upper quadrant) and the type (ie, loop, separated stomas, stomas together but divided, or Hartmann's operation) of the colostomies. The colostomy-related complications were evaluated with an attempt to establish a correlation between the type as well as the location of the colostomies and the complication. A total of 230 patients underwent repair of their anorectal malformation without a colostomy. Therefore, this review included 1470 patients who received a colostomy.

2. Results

A total of 755 patients received a colostomy with separated stomas. Of these patients, 351 had a loop type of colostomy and 62 were subjected to a Hartmann's procedure, which means that the surgeons opened a proximal stoma and left the distal one closed and dropped into the abdomen. We were unable to find the type of colostomy that patients had in 302 cases. These were redo cases in which the colostomies had already been reversed when they were referred to us.

The locations of the colostomies are shown in Table 1. We were unable to determine the location of colostomies in 241 cases (Table 1).

In group A (colostomies performed at other institutions), 616 complications occurred in 464 patients. To analyze the types of complications that these patients had, we decided to classify the complications into several groups, including mislocated stomas (282 cases), prolapse (119 cases), general complications (82 patients), Hartmann's procedure (62 cases), stenosis (42 cases), and retraction (29 cases) (Table 2). The group of general complications included intestinal obstruction (47 cases), wound infection (13 cases), incisional hernia (11 cases), anastomotic dehiscence (7 cases), sepsis (3 cases; 2 patients died), and bleeding (1 case), all of which occurred after colostomy closure, as shown in Table 3. Of the patients who suffered complications, 230 required a reoperation (Table 4). The indications for reoperation included mislocation, because the mislocation would interfere with the main repair of the malformation; serious general complications after the first procedure; prolapse; and retraction. Twenty-one patients were reoperated on but we were unable to determine the indications.

Of the 91 patients who underwent reoperation for a severe prolapse, 40 had separated stomas; in 32 of those patients, we were able to document that the prolapse occurred in a mobile portion of the colon. These included 12 right transverse colostomies (distal stoma prolapsed), 10 distal sigmoid colostomies (proximal stoma prolapsed), 8 descending colostomies (distal stoma prolapsed), and 2 left transverse colostomies (proximal stoma prolapsed). A retrospective observation allowed us to note that the prolapse consistently occurred in a mobile portion of the

Table 2 Groups of complications

Complication	No. of cases
Mislocation	282
Prolapse	119
General complications ^a	82
Hartmann's procedure	62
Stenosis	42
Retraction	29
Total	616

^a Intestinal obstruction, wound infection, incisional hernia, anastomosis dehiscence (both after colostomy closure), sepsis, and bleeding.

Table 3 General complications

Complication	No. of cases
Intestinal obstruction	47
Wound infection	13
Incisional hernia	11
Anastomosis dehiscence	7
Sepsis	3 ^a
Bleeding	1
Total	82

^a Two deaths.

colon. We were unable to find objective documentation of the portion of the stoma that was prolapsed in cases of loop colostomies, although our impression was that the prolapse also affected the mobile portion of the colon.

Further analysis of the mislocated stoma group (282 cases; Table 5) showed 116 cases in which the stomas were located too close to each other, which did not allow a stoma bag to collect the stool and instead required covering of both stomas (Fig. 1). This conceivably provoked the passing of stool distally, which caused fecal impaction in 51 patients and urinary tract infections in 42 of them. This particular group of patients did not suffer from a urologic condition that could explain the episodes of urinary tract infections. This group of patients with stomas located too close to one another is not part of the group of 351 patients who received a loop colostomy. In the loop group, 223 patients (64%) suffered frequent episodes of urinary tract infections.

In 97 patients, the stoma was located too distally in the rectosigmoid. This represented a serious problem during the main repair because there was not enough length of rectum for the pull-through to be successful (Fig. 2A and B). In 30 cases, the stomas were inverted, meaning that what the surgeon thought was the proximal stoma was actually the mucus fistula and vice versa. These represented an inconvenience because what the surgeon thought was the mucus fistula was actually the functional stoma, frequently located in a place in which it was very difficult to adapt the stoma bag (Fig. 3A and B). In 21 cases, the stomas were separated by a great distance; in addition, at the time of colostomy closure, the involved patients had to be subjected to a wide laparotomy to bring both stomas together. In 18 cases, the surgeon thought that he or she was opening a transverse colostomy but we found that it was actually a sigmoidostomy located in the right upper quadrant

Table 5 Mislocated stomas

Mislocation	No. of cases
Stomas too close	116
Too distal stoma	97
Inverted stomas	30
Stomas far apart	21
Right upper sigmoidostomy	18
Total	282

when we performed a colostogram in those patients (Fig. 4). This type of colostomy (right upper sigmoidostomy) was as inconvenient as the one located too distally because it also interfered with the pull-through of the rectum as the colon was anchored to the abdominal wall.

A total of 119 cases suffered from prolapse, and these occurred in 55 of 351 loop colostomies (15.6%; Fig. 5), 10 of 62 Hartmann's procedures (16.1%), and 42 of 755 colostomies with separated stomas (5.6%). In group B, there was no case of prolapse.

Hartmann's procedure, which was performed in 62 patients, was considered a complication for the following reasons: (1) there is no way to perform a distal colostogram to find out the type of malformation that a patient has; (2) it increases the incidence of urinary tract infections because the distal bowel acts like a giant urinary diverticulum; (3) in the case of a very narrow fistula or no fistula, a patient may develop a mucocoele; and (4) it is impossible to irrigate and clean the distal pouch.

All the 50 colostomies performed at our institution were created in the left lower quadrant with separated stomas, just at the takeoff of the descending colon from the left retroperitoneum.

**Fig. 1** Stomas located too close together.**Table 4** Reoperations in colostomies

Indications	No. of cases
Mislocation	137
General complications	115
Prolapse	91
Retraction	18
Unknown	21
Total	230 ^a

^a Some patients had more than one indication.

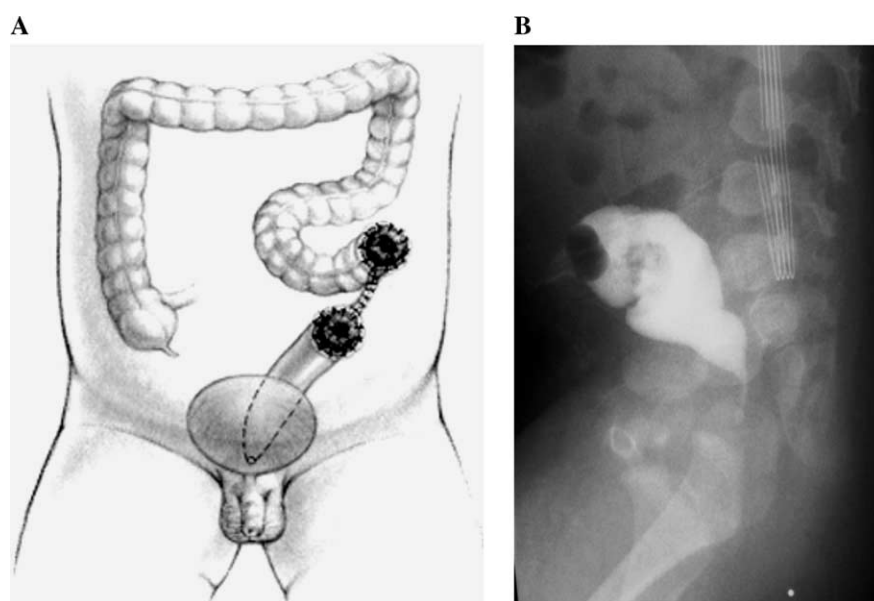


Fig. 2 A, Diagram of colostomy located too distally (which interferes with pull-through). B, Colostogram in a case of a very distal colostomy.

The proximal stoma was everted (matured) and the mucous fistula was made tiny and flat because it was only used for irrigations and injection of contrast material (Fig. 6A and B). By using this technique, there was an 8% rate (4/50 patients) of complication occurrences, including 2 wound infections, 1 anastomotic dehiscence, and 1 small bowel obstruction, all occurring after the colostomy was closed.

3. Discussion

We are aware of the fact that the 2 groups presented here (group A [colostomies performed at other institutions] and

group B [colostomies performed by us]) are not really comparable for many reasons. Group A (1420 colostomies) included patients operated by many surgeons, at different institutions, and during different eras. Group B was a very small group (50 patients) and included patients whose colostomies were done by us following a specific protocol. We believe that, despite these obvious methodological limitations, the data contain valuable information that can be used to try decreasing the morbidity of these operations.

Based on our subjective impression, we suspected that colostomy was a procedure with significant morbidity. However, the number of complications that we found in

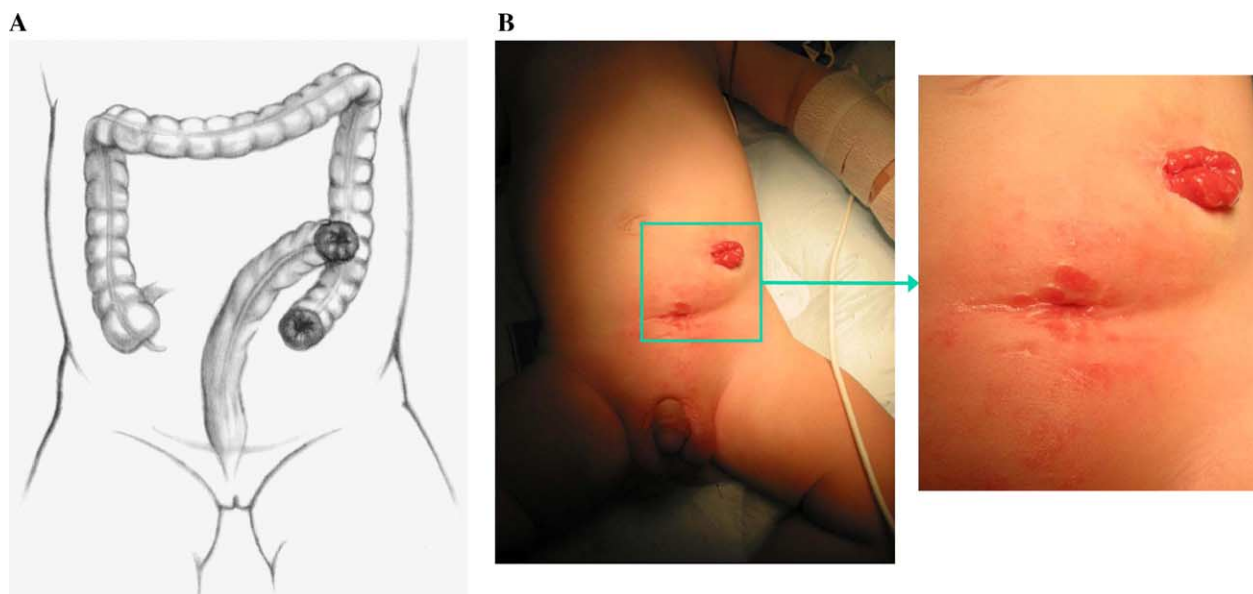


Fig. 3 A, Inverted stomas. B, Proximal stoma is located inadequately (which interferes with the placement of a bag). Proximal stoma was intentionally created very small (strictured) because the surgeon thought that it was the distal stoma (mucous fistula).

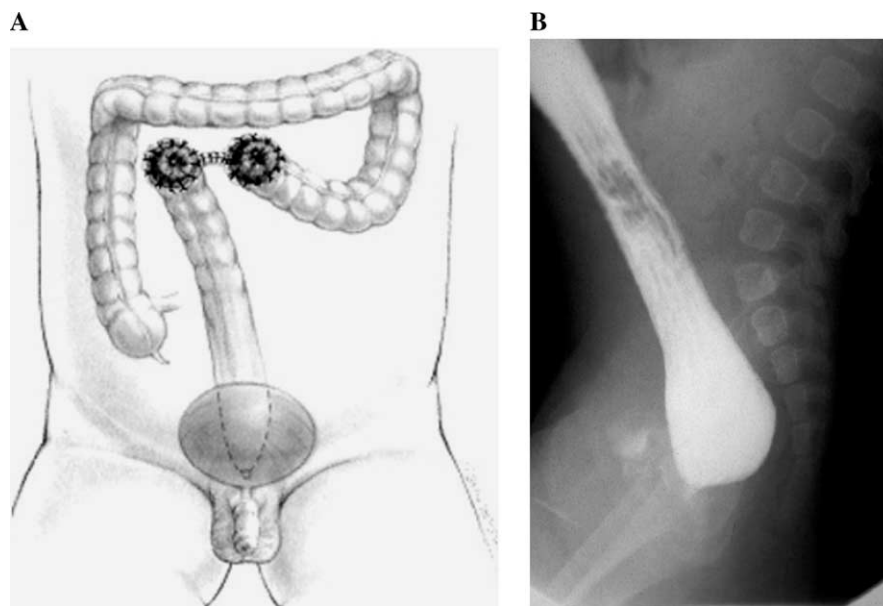


Fig. 4 A, Mislocated stoma (right upper sigmoidostomy). The surgeon thought that a right transverse colostomy was opened. B, Distal colostogram performed in the same patient who received a right upper sigmoidostomy.

this review was much higher than what we suspected. Most of these complications, we believe, are preventable and represent technical errors. It is obviously tempting to use this high morbidity as an argument to favor performing more primary repairs without a protective colostomy. This is a valid argument to a point since these are, for the most part, preventable complications. To be truly objective, one would be obligated to compare the morbidity of colostomy with that suffered by babies subjected to a primary procedure.

Loop colostomies are used by many surgeons perhaps because they can be opened and closed quickly. However, we believe that this type of colostomy has serious inconveniences in anorectal malformations. Occasionally, some of these loop colostomies work well, as we were unable to document urinary tract infections and fecal impaction in the distal colonic pouch in all cases, indicating that for some reason the loop colostomy was totally diverting. However, many other loop colostomies did not work that way, particularly if they were partially retracted. They allowed for passage of stool distally, which produced urinary tract infections and fecal impaction in the distal pouch of the colon (Fig. 7A and B). The fecal impaction in the distal colon produces megarectum, particularly when a patient spends a long time (months) between the opening of the colostomy and the main repair of the malformation. The presence of a megarectum correlates with the severity of constipation that these patients suffer after the repair of the malformation [11].

We do not know why some surgeons still perform a Hartmann's procedure in cases of anorectal malformation. The problems with this type of procedure are loss of access for contrast studies [12,13] and development of mucocèles. The only potential advantages of this type of operation are that it can be performed quickly and that surgeons must deal

with only a single stoma, which technically is much easier. However, the number of inconveniences and potential complications make this stoma problematic.

In patients with an anorectal malformation, the stomas must be separated enough to allow the stoma bag to cover only the proximal stoma, isolating the mucus fistula to prevent contamination (Fig. 6A and B). However, the stoma should not be separated more than necessary so that a big laparotomy can be avoided at the time of colostomy closure. Stomas located one too far from the other may not be considered a complication, but we certainly believe it represents an inconvenience for patients. If this group in



Fig. 5 Prolapse of a loop colostomy.

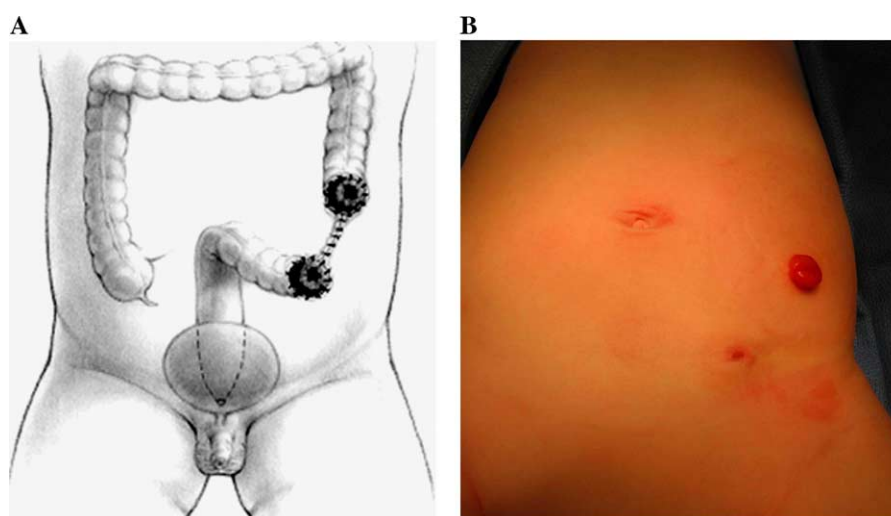


Fig. 6 A, Diagram of an ideal descending colostomy. B, Picture of patient with ideal descending colostomy. The proximal stoma is located in a place where the bag is easy to apply. The mucous fistula is intentionally created small to avoid prolapse.

our study (21 patients) were excluded, then the percentage of complicated cases in group A would decrease from 33% to 31%.

The opening of a sigmoidostomy in the right upper quadrant likely occurs when a surgeon assumes that an incision in the right upper quadrant will facilitate finding the right transverse colon. However, it is important to keep in mind that newborns with anorectal malformations have a very dilated rectosigmoid that sometimes reaches the diaphragm; therefore, the surgeon has to be sure that he or she is opening the colostomy in the intended location.

We recommend the opening of a descending colostomy with separated stomas. The proximal stoma must be located away from both the umbilicus and the iliac crest, thus surrounded by a good portion of normal skin, so that the

stoma bag can be easily adapted. The mucous fistula should be located medially and lower and should be fashioned as small as possible because it is used only for irrigations and diagnostic tests [12,13]. We emphasize our preference for a descending, rather than a sigmoid, colostomy because all cases in which surgeons opened the colostomy too distally (97 cases) occurred in cases in which surgeons performed a sigmoid colostomy in a location that is too distal in the sigmoid. In the type of colostomy that we recommend, the proximal stoma is created using the first mobile portion of the colon immediately distal to the descending colon. The descending colon is normally attached to the left retroperitoneum. The first portion that moves away from this attachment should be connected to the abdominal wall. The fact that it is fixed to the left retroperitoneum guarantees that

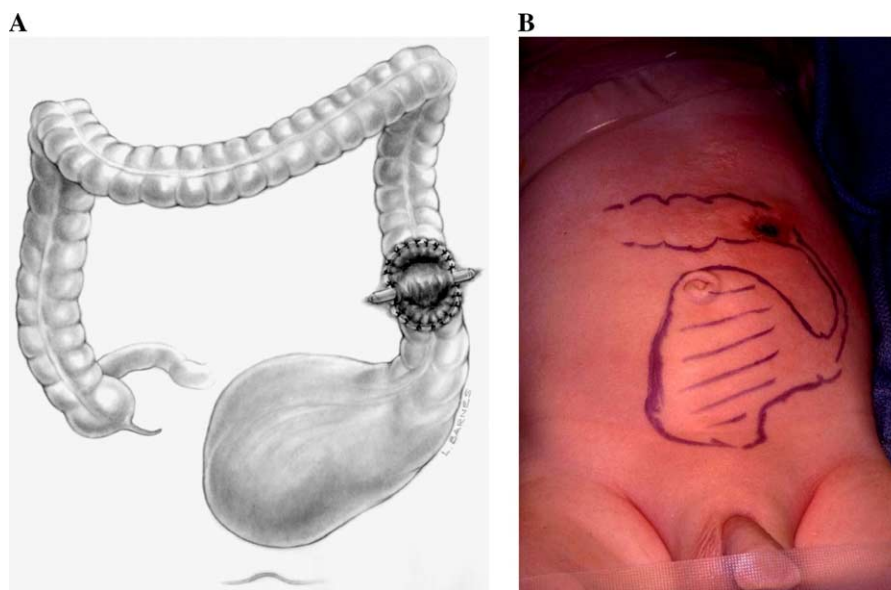


Fig. 7 A, Diagram of an inadequate retracted loop colostomy that produced distal fecal impaction. B, Picture of an inadequate retracted loop colostomy that produced distal fecal impaction.



Fig. 8 Colostogram showing the characteristic findings in a patient with a long-term transverse colostomy (microcolon followed by megarectosigmoid).

a patient will not suffer from prolapse of the proximal stoma. The distal stoma, on the other hand, is located in a more mobile portion of the colon and, therefore, may prolapse. Making the mucus fistula small prevents this problem (Fig. 6A and B).

Some surgeons advocate opening the colostomy at a separate location from the incision, and this is a valid concern as it may decrease the risk of wound infection. We however did not experience this problem in any of our 50 cases using the technique of placing the 2 stomas at opposite ends of the incision. We also like the fact that the colostomy closure leaves a single straight line, producing a better cosmetic result.

Patients with right transverse colostomies, especially those with a long time interval between the opening of the colostomy and the main repair, develop a characteristic

distal microcolon followed by a more distal severe megarectosigmoid (Fig. 8). We observed that the presence of a megarectosigmoid prior to the main repair translates directly into severe constipation after the definitive repair [11]. As in other areas in pediatric surgery, the extreme stretching (dilatation) of a hollow viscus results in the loss of its peristalsis. This can be observed after the repair of intestinal atresias and megaureters. In such cases, even when one releases the obstruction that produced the dilation in the first place, the dilated viscus does not recover its normal peristalsis.

Other disadvantages of transverse colostomies include the fact that it is almost impossible to irrigate and clean the distal colon adequately in preparation for the main repair. Also, the most important diagnostic study needed prior to the main repair is the high-pressure distal colostogram. This requires a significantly high hydrostatic pressure to be able to show the precise anatomy. It is very difficult to perform a good distal colostogram through a transverse colostomy. We are aware of 2 cases in which the colon perforated during the distal colostogram because of the injection of contrast material under high pressure in an attempt to demonstrate the fistula site. Both of these cases had a transverse colostomy. Opening colostomies more proximally (cecum and terminal ileum) only exacerbate these problems. Finally, a longer colonic segment theoretically can allow for more resorption of urine and lead to acidosis.

The opening of a transverse colostomy in patients with cloacas has a degree of good reason and justification because in such patients, particularly those with complex malformations, surgeons not only must repair the rectum but also may need to replace the vagina. The colon is a good substitute for the vagina and perhaps, in cases of a long common-channel cloaca, one could justify the use of a left transverse colostomy. In general, we still prefer descending colostomies because this advantage is far outweighed by the multiple disadvantages.

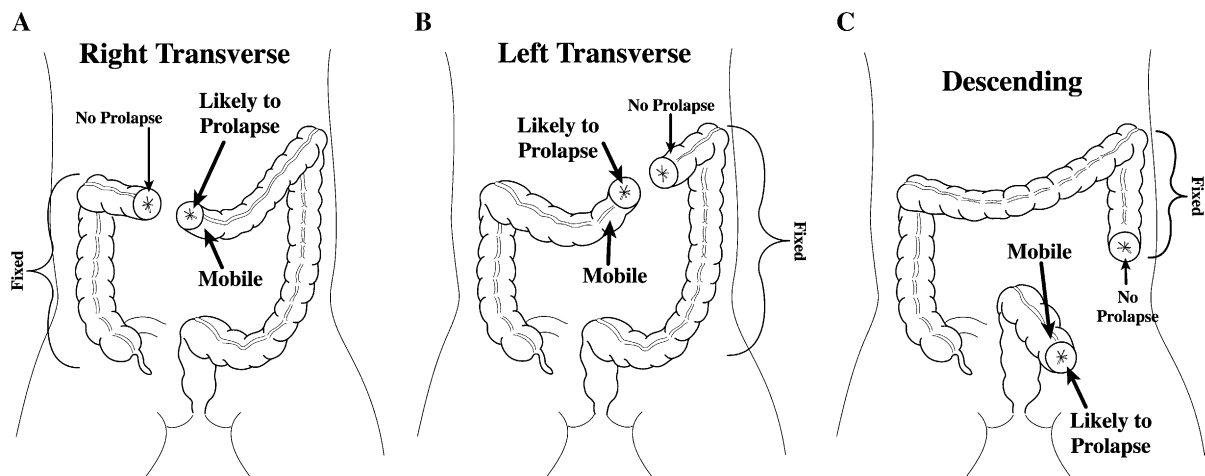


Fig. 9 A, Right transverse colostomy. Distal stoma likely to prolapse. B, Left transverse colostomy. Proximal stoma likely to prolapse. C, Descending colostomy. Distal stoma likely to prolapse.

Stricture of the colostomy, we believe, is caused by a technical problem. The bowel must have suffered ischemia owing to an inadequate manipulation of the colon's blood supply. Dehiscence, infections, and sepsis after colostomy closure are also related to technical problems.

Another lesson learned from this experience is that a patient with a colostomy created at another institution should always undergo a distal colostogram to determine the length of the available colon from the stoma to the distal end to avoid serious misadventures during the main repair of these defects.

Colostomy prolapse is a common complication with serious potential consequences that we believe are mostly preventable. When the prolapse becomes severe, the blood supply of the prolapsed bowel is compromised and patients may lose a significant part of the colon. This is particularly problematic for patients with anorectal malformation who cannot afford to lose a colon, as their capacity to form solid stool impacts their potential for fecal continence, and, if incontinent, are more manageable with constipation than those with a tendency toward loose stools. Interestingly, we observed that prolapse occurs when the stoma is opened in a mobile portion of the colon. Fig. 9A-C shows the parts of the colon that are more prone to prolapse. Knowing this, techniques that surgeons can use to avoid prolapse are to fix the mobile portion of the bowel to the anterior abdominal wall, approximately 6 to 7 cm from the stoma, and to make the mucous fistula tiny and flat.

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Discussion

Dr George Holcomb III (Kansas City, MO): Marc, you've taken a topic that many of us take for granted and shown that there are a lot of complications, so I congratulate you on performing this review. When I construct my colostomies in patients with anorectal malformations, instead of the oblique orientation that you showed, I make them more horizontal. The colostomy and mucous fistula are separated, but they're oriented horizontally. Is that wrong or is that okay?

Marc Levitt, MD (response): No, there's nothing wrong with that at all. In fact, that makes a neat closure because you have a transverse incision.

Dr George Holcomb III (Kansas City, MO): What is the reason that you and Dr Pena prefer the oblique orientation of the stomas?

Marc Levitt, MD (response): No major reason for that.

Dr Dennis Lund (Madison, WI): Doctor Hendren wrote quite a while ago that the level of the anorectal malformation in cloaca patients should influence where one puts the colostomy. He stated that the lower anorectal malformations, which will be easier reconstructions, could have sigmoid colostomies or left lower quadrant colostomies, but he advocated that the high anorectal malformations, where you're likely to use a piece of sigmoid colon to extend the vagina, should get a right transverse colostomy. I wonder what your thoughts are about that.

Marc Levitt, MD (response): I think that's an excellent point. That type of colostomy would be beneficial only for a very specific group of patients, namely cloaca patients, with a very long common channel, in whom a vaginal replacement might be needed during the definitive repair. You can fairly well predict those patients because usually the clitoris is more hypertrophied, and you may scope them in a newborn period and know there's a very long common channel. However, transverse colostomies have significant morbidity as I've

described. Most concerning are the inability to clean out the distal limb, the likelihood of getting urinary tract infections, the occurrence of megarectosigmoid, the possibility of prolapse, and acidosis from absorption of urine into the colon. So a descending colostomy, I think, avoids these problems and also leaves you the entire length of the sigmoid and its arcade for a potential vaginal replacement, which you do not need in most cases. So I think a descending colostomy is more reliable and avoids many, many problems. The transverse colostomy in the unique circumstance you describe is of value; however, there are significant other problems with it, and I think, on balance, it's probably worth avoiding a transverse colostomy.

Dr Cedric Priebe (Stony Brook, NY): Marc, I recognize that most of the things you've said about colostomy formation were taught to me a long time ago by Dr Bill Clatworthy. My question is, were these cases that were referred to you sent mainly from other pediatric surgeons or did they come from general surgeons doing colostomies in babies at institutions without a pediatric surgeon? If so, then this message needs to go to the general surgery community, not so much to pediatric surgeons.

Marc Levitt, MD (response): I wish the latter were true, but unfortunately I don't think it was. We didn't specifically note how many general surgeons there were, but as I

recall, there were very few. The vast majority of the colostomies were done by pediatric surgeons. We were very surprised by the significant amount of morbidity. Everyone knows colostomies have a significant morbidity, but when we really reviewed it and found the numbers and specifically looked for morbidities associated with individual types of colostomies, we were surprised, and therefore thought it was worth reporting.

Dr George Holcomb III (Kansas City, MO): What do you advise regarding early management of the colostomy? Specifically, do you suggest irrigating the distal atretic colon?

Marc Levitt, MD (response): I think that's a very important point. At the newborn colostomy, you have to make a special effort to clean the distal bowel of all of its meconium, which takes 20 or so minutes to do well. This prevents a lot of future problems. It prevents contamination of the urinary stream and avoids the difficulty of doing a distal colostogram under pressure with meconium sitting in the distal limb. So we make very special effort in the operating room to clean that distal limb. On the distal limb, we also make the mucus fistula very tiny and flat, which helps to avoid prolapse. The proximal side won't prolapse because that's tethered to the retroperitoneum, but the distal side could very easily prolapse because the entire loop of the sigmoid is there.