

Colorectal operations are considered “contaminated procedures” and represent, by definition, cases with a higher risk of infection. Therefore, patients must be subjected to some forms of bowel preparation prior to the operation. In addition, the use of prophylactic antibiotics must be considered.

Through the last 30 years, we have been following the evolution of the concepts related with the different modalities of bowel preparation, as well as the use of different antibiotics by mouth, intravenously, and pre- and postoperatively.

Most of the literature is related with adults. There are an enormous number of publications related to adult conditions. We selected only a few papers representative of the tendency to avoid mechanical bowel preparation [1–4] and antibiotics. Some surgeons found no evidence to support the use of mechanical bowel preparations. Even more, some publications present data indicating that the bowel preparations seem to result in a higher incidence of infections and dehiscence! The incidence of wound infections in the adult literature varies from 4 to 19 % with minor variations in favor of those patients who did not receive preoperative colonic preparation.

The question for us, pediatric surgeons, is if we should change our routines, based on the information obtained from adult data. Our personal answer is no. The incidence of wound infections reported in adult patients with and without bowel preparations is still much higher than in our cases [5]. If we closed 649 consecutive colostomies without a single case of infec-

tion, following preoperative management, we find no convincing reason to change. We understand that perhaps, we could have the same good results without bowel preparation; however, it is not easy to change a routine that resulted in zero infections. We also suspect that a meticulous surgical technique is the key to avoid complications, rather than the bowel preparation or the antibiotics. Interestingly, during the last 30 years, we have changed the type of antibiotics used pre- and postoperatively according to the recommendations of the epidemiology departments of the institutions in which we worked, yet the results were the same: no infections.

According to Breckler et al. [6], the overwhelming majority of pediatric surgeons in the United States still use mechanical bowel preparation and preoperative intravenous antibiotics. Leys et al. [7] found slightly higher number of anastomotic leaks and infections in pediatric patients who underwent a mechanical bowel preparation. Breckler et al. reported 14 % of wound infections in colostomy closures and no differences between those who received antibiotics and those patients who did not [8]. Serrurier et al., also in pediatric cases [9], found significantly higher number of wound infections (14 %) in a series of 272 colostomy closures, of patients who received mechanical bowel preparation, whereas only 5 % of those without preparation suffered from this complication. Similar results were reported by others [10, 11]. Pennington et al. [12] in a retrospective analysis of the series of 42

American Children's Hospitals, (5,473 patients) not surprising, found that only 22.9 % of all patients received an "evidence-based preparation." However, the "evidence-based guidelines" that they allude to are related with adult patients. The question comes again: Should we change our routines based on the adult literature? The question is even more difficult to answer when our results are excellent. In summary, we are not convinced that following adult "evidence-based" routines will benefit our patients.

We are very proud of our excellent record of zero wound infections in colostomy closures. We close all wounds primarily and leave no drains. The patients received irrigations of the proximal stoma, with saline solution and intravenous antibiotics during anesthesia and 48 h postoperatively. On the other hand, we had cases of infections or minor dehiscence anoplasties in cases subjected to primary pull-throughs without a colostomy. Those patients received GoLYTELY® (total bowel preparation). The dehiscences that we have seen occurred usually between the 5 and 8 days postoperatively while the patients are still fasting. We take those patients to the operating room, resutured the dehiscence areas, and prolong the period of fasting for 2–3 more days. A complete dehiscence will receive a colostomy, which is a very unusual event. A question to be answered is if a dehiscence, occurring in a case with bowel preparation, has less serious consequences than in cases without bowel preparation. We believe it does.

The type of colonic preparation that we recommend varies, depending on the type of surgical procedure that the patient is going to receive, as well as the specific circumstances of the patient.

Thus, the bowel preparation required for a newborn baby that is going to be subjected to a primary, major, colorectal procedure without a colostomy is different than the one required for an older patient.

There is plenty of evidence related with the safety of using GoLYTELY®¹ (polyethylene gly-

col electrolyte solution) to clean the entire gastrointestinal tract in pediatric patients [13–18].

7.1 Major Procedures

Major procedures include primary or secondary pull-throughs for anorectal malformations, for Hirschsprung's disease, or for idiopathic constipation, performed without a protective colostomy. Anoplasties and resection of rectal prolapse are also included in this category. These patients must be admitted, most of the time, 24 h before the operation. Severely constipated or fecally impacted patients, sometimes, are admitted 2 days before surgery to be subjected to our protocol of disimpaction before the cleaning of the gastrointestinal tract (See Chap. 25, Sect. 25.7.1). The morning of admission the patient is only allowed to take clear fluids by mouth. Usually around noon time, the administration of GoLYTELY®² is started, at the rate of 25 mL/kg/h until clear. Most of the time, this is administered through a nasogastric tube. Occasionally, some adolescents volunteer to drink GoLYTELY® at the right speed, in order to try to avoid a nasogastric tube. Many of them try, yet, usually the attempt is unsuccessful because they do not drink fast enough or they have nausea, and therefore, they need the nasogastric tube. It usually takes about 4 h for the colon to be completely cleaned. Some patients suffer from nausea and vomiting during the administration of GoLYTELY®. When that happens, the patient benefits from the administration of an antiemetic medication, but we continue the administration of the GoLYTELY®, at a slightly slower rate, because we have seen that most of the GoLYTELY® still goes through the pylorus and through the bowel. During the administration of GoLYTELY®, the patient usually suffers from a certain degree of abdominal distention and cramps. Soon enough, they start passing stool through the rectum. Later on, this becomes liquid stool that becomes more and more clear, until it is free of stool. Patients with Hirschsprung's disease frequently require rectal

¹ GoLYTELY® PEG 3350 236 g, sodium sulfate 22.74 g, sodium bicarbonate 6.74 g, sodium chloride 5.86 g, and potassium chloride 2.97 g (4,000 mL) [regular and pineapple flavor].

² See footnote 1.

irrigation to help relieve this distention during the bowel prep. After 4 h of the administration of GoLYTELY®, the nurse or the resident must see what is coming out through the rectum of the patient. A yellow or greenish color represents bile that is excreted in the bowel and is considered acceptable. On the other hand, the presence of particles of fecal matter is considered unacceptable, and therefore, the administration of GoLYTELY® should continue. Subsequently, the resident or the nurse should check what is coming out of the rectum every hour as the prep continues to run, until the goal of a clean colon is achieved. At that point, the nasogastric tube can be pulled out, and the patient is allowed to drink clear fluids. (Clear fluids by mouth are not allowed during the administration of the GoLYTELY® because we were told by the company that produces GoLYTELY® that the glucose contents allow for inflow of fluid into the colon lumen, leading to dehydration.)

Most patients pass clear liquid through the rectum after 4 h, but others require a longer period of time. Occasionally, we see patients that continue having GoLYTELY® through the night, and then come to the operating room, only for us to find out that they are still not clean.

It has been our experience that many patients who received GoLYTELY® the day before an operation come to the operating room suffering from some degree of dehydration and a mild degree of metabolic acidosis. This seems to be more significant in babies. Therefore, it is our routine to administer intravenous fluids during the entire process to patients younger than 2 years of age. In patients older than 2 years of age, intravenous fluids are desirable, but not vital.

In patients with a significant degree of megacolon and chronic fecal impaction, it is very important to go through the process of fecal disimpaction prior to the administration of GoLYTELY®. The administration of GoLYTELY® through a nasogastric tube in patients with fecal impaction and severe megarectosigmoid sometimes makes them feel very uncomfortable. Their abdomen becomes very distended, they complain of severe cramps, and they feel very sick. The protocol of fecal disim-

paction consists of the administration of three enemas per day and daily radiologic monitoring, to be sure that the colon is free of fecal impaction (see chapter on Idiopathic constipation). When this is achieved, the patient can be admitted to follow the protocol of administration of GoLYTELY®.

Once the patient is in the operating room, prior to the operation, we routinely pass a large Foley catheter through the rectum, to evacuate the remaining bowel prep fluid that is in the colon.

Otherwise, this fluid becomes an inconvenience during the surgical procedure. Also, we pass that tube, in order to do a last irrigation before we start the operation. Surprisingly, sometimes, even when it was reported that the patient was clean, we find stool in the colon. Occasionally, we have to cancel a case because we were not successful in cleaning the colon even in the operating room. We are very proud of our postoperative results.

7.2 Primary Procedures for the Treatment of Anorectal Malformation During the Newborn Period

There are some malformations that we repair primarily without a colostomy during the newborn period. It has been our experience that these patients behave better from the point of view of the possibility of infection, dehiscence, and retraction, as compared to older patients. We speculate that, perhaps, due to the fact that the meconium has not been colonized during the first few days of life, the chances of a wound infection may be less.

Full-term, stable newborns, who are otherwise healthy, without major associated defects, born at our institution or nearby and having what we call a “benign anorectal malformation,” receive a primary procedure during the newborn period without a full bowel preparation. These cases include rectovestibular fistulas, recto-perineal fistulas in males and females, anorectal malformation without fistula in both male or female patients, or rectourethral bulbar fistulas. In the

last two types of malformations, we expect to see the distal rectal end, full of gas, located below the coccyx, on the cross table lateral film (See Chap. 25, Sect. 25.7.1), meaning that we will be able to reach the rectum comfortably through a posterior sagittal incision without taking unnecessary risks of injuring the urinary tract. These patients are operated on at our institution usually within the first 48 h of life without bowel preparation.

7.3 Primary Pull-Through in Newborn Patients with Hirschsprung's Disease

When a baby is born at our institution, or is brought during the first days of life, with the diagnosis of Hirschsprung's disease, we first confirm the diagnosis, and then, we introduce a nasogastric tube for gastric decompression and start a program of rectal irrigations, performed as often as necessary to decompress the colon. It is very important for doctors and nurses to understand the difference between a rectal irrigation and an enema. A patient with Hirschsprung's disease has a congenital, intrinsic incapacity to empty the colon due to a severe motility disorder. Therefore, in general, enemas are to be avoided, as they may simply be retained in the colon and can worsen the distention. Irrigation, on the other hand, consists of passing a large-lumen tube, through the rectum and irrigating with small amounts (10 mL) of saline solution at a time. The saline solution is injected with a catheter-tip syringe through the tube just to clear its lumen, to allow decompression of the colonic contents. Characteristically, the patient passes gas and liquid stool in an explosive manner through the lumen of the tube. A dramatic clinical improvement can be observed in these babies after every irrigation. Within a couple of days, the abdomen is usually flat, and what we obtain with the irrigations is only bile. At that point, and provided the diagnosis has been histologically confirmed, the patient is ready to undergo a primary pull-through. We do not administer GoLYTELY® in these kinds of patients. Most of these operations

are performed without a protective colostomy; yet, we request consent for a colostomy in case it is necessary.

7.4 Patients with Hirschsprung's Disease with Enterocolitis After the Neonatal Period

A baby with enterocolitis is an extremely delicate, sick patient. Therefore, he or she must be managed in an expeditious way. The management includes recto-colonic irrigations, adequate aggressive hydration, and administration of metronidazole (intravenously at the beginning, eventually by mouth and later through rectal irrigations). Occasionally we add broad-spectrum antibiotics.

The irrigations are performed as often as necessary to decompress the colon and alleviate the abdominal distention. It is important to keep in mind what is happening in the colon. Stasis occurs, leading to bacterial overgrowth, secretory diarrhea, and dehydration. It is this cycle that must be broken by the irrigations. During the acute stages of enterocolitis, the irrigations will produce a characteristic type of stool that is particularly fetid and frequently with abnormal bacteria, such as *Clostridium difficile*. We keep these patients fasting, receiving parenteral nutrition and with the irrigations per rectum until they become asymptomatic. Fairly soon, the patient has a flat abdomen, no vomiting, and no diarrhea. In addition, the fetid stools disappear and are replaced by clear fluid with bile. At this point, we consider that the patient is free of enterocolitis and therefore ready to be operated on. If we feed these patients, they may develop enterocolitis again. Therefore, we prefer to do the operation at this point. These patients require longer periods of rectal irrigations and fasting than neonates before they are ready for an operation. In fact, some of these patients receive a diverting colostomy when we feel that the patient is not improving with the medical treatment described. Sometimes it takes 1 or 2 weeks for the patient to be ready for the operation to be sure that there is no evidence of enterocolitis. We do not administer GoLYTELY® in these kinds of patients.

7.5 Patients with Hirschsprung's Disease Beyond the Neonatal Period, Without Enterocolitis

Occasionally, we see patients at school age, or even adolescence, who come to us suffering from Hirschsprung's disease. They usually have a very severe megacolon and yet no history of episodes of enterocolitis. We believe that this type of patient suffers from a "benign type" of Hirschsprung's disease. For reasons that we do not know, these patients never had an episode of enterocolitis and behave in a more benign way than the rest of the patients with Hirschsprung's disease. The colon preparation in these patients is the same as the one described for major pull-throughs. In other words, if the patient is fecally impacted, we first disimpact them, and then we bring them to the hospital to administer GoLYTELY®, 1 or 2 days before the operation.

7.6 Colostomy Closures

The preparation of the bowel in these patients is much more simple. The patient has a normal breakfast the day prior to surgery and comes to the hospital thereafter. The rest of the day, the patient is maintained on clear fluids by mouth until 6 h before surgery. During that day, the nurses irrigate the proximal stoma with saline solution. There is no need to irrigate the distal stoma, which is, by definition, clean and free of stool. The patient receives irrigations through a no. 10 Foley catheter with injections of 10–20 mL of saline solution, allowing the saline to come back out through the stoma. This maneuver is repeated as many times as necessary, until the saline solution recovered is clear. We do not use GoLYTELY® for this preparation.

When the patient has two stomas that are located too close one to the other, and both stomas are included under the same stoma bag, it is our routine to irrigate both stomas the day before surgery. The same routine is applied for patients who have a loop colostomy.

We have done over 700 colostomy closures, and we are very proud of the fact that none of our patients suffered from a wound infection [5]. None of the patients had any kind of Penrose drainage left in the wound or in the abdomen, and all wounds were closed primarily including a subcuticular stitch. Only two patients had postoperative complications: one of the patients had an anastomosis dehiscence, and the other patient had a colonic perforation proximal to the anastomosis. We do not have an explanation for that complication.

7.7 Patients with a Colostomy Who Will Have a Repair of an Anorectal Malformation

When the colostomy is totally diverting (completely separated stomas, with the bag covering only the proximal stoma), and the surgeon is sure that the malformation can be repaired from below (perineally or posterior sagittally), it is not necessary to irrigate the proximal stoma. It is only necessary to irrigate the distal one.

Sometimes, even when the rectum is considered reachable from below, the length of the colon available between the distal stoma and the most distal end of the rectum is so short that it is fair to assume that this distance will interfere with the pull-through, making it necessary to mobilize the proximal stoma. In such cases, it is necessary to clean the entire gastrointestinal tract with GoLYTELY® as previously described. In addition, in certain cases that may require a vaginal replacement, a clean colon allows the surgeon to consider the bowel from the proximal stoma as an option for the neovagina.

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