Surgical Interventions for Functional Constipation: An Update

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Abstract

Chronic idiopathic constipation, also known as functional constipation, is defined as difficult and infrequent defecation without an identifiable organic cause. Medical management with laxatives is effective for the majority of constipated children. However there is a subset of patients who may need evaluation by a surgeon. As constipation progresses, it can lead to fecal retention and rectal and sigmoid distension, which impairs normal colorectal motility. Surgical interventions are influenced by the results of: a rectal biopsy, transit studies, the presence of megacolon/megarectum on contrast enema, the degree of soiling/incontinence, anorectal manometry findings, and colonic motility evaluation. In this review, we describe the different surgical options available (intestinal diversion, antegrade enemas, sacral nerve stimulation, colonic resections, and Botulinum toxin injection) and provide guidance on how to choose the best procedure for a given patient.

Keywords

- functional constipation
- pediatric colorectal surgery
- colonic motility
- surgery for pediatric constipation

Review

The reported prevalence of severe constipation in children ranges from 0.7 to 30% with a mean female/male ratio of 2.1:1.[1] In most cases, a physiologic cause for constipation is not found and affected children are diagnosed with functional constipation (FC), classically called idiopathic constipation. A subset of patients with FC experience severe and long-lasting symptoms (abdominal pain, distension, early satiety, and soiling) that respond poorly to conventional behavioral, dietary, and/or pharmacological management. These children are considered to have intractable FC, and thus have failed medical management.[2] In tertiary care centers, 50% of children referred to a pediatric gastroenterologist are still symptomatic after 5 years, and 20% still struggle with symptoms after 10 years.[1] These patients are typically the ones referred to surgeons and they may eventually require more invasive alternative therapeutic interventions. It is estimated that approximately 10% of those constipated children who are referred to a pediatric surgeon will need an operation.[2,3]

The most commonly encountered etiological factor in children is a withholding behavior, usually occurring after experiencing a painful or frightening evacuation of stool.[2] Withholding behavior leads to dyssynergic defecation which leads to incomplete evacuation of feces. This can cause fecal impaction, overflow fecal incontinence (FI), and reduced rectal sensation. The accumulation of stool may lead to impaired bowel movements which causes colonic dysmotility due to chronic bowel distension.

Surgeons must understand how constipation can turn into a surgical condition; When they first meet a patient with FC, they usually find that the patient has been treated for several months, sometimes years, with osmotic laxatives (the typical first line of treatment), stimulant laxatives (sennosides and bisacodyl), and sometimes rectal enemas. It is at this point when one needs to assess whether the patient has in fact failed medical management. Unfortunately there is no international standard definition of what failure of medical treatment actually means. To a surgeon practicing in Europe, this may not be the same as for a

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surgeon or a gastrointestinal (GI) physician practicing in the United States.

The choice of what type of surgery and when to perform it should be based on a comprehensive evaluation of the anorectal and colorectal anatomy and physiology, although this evaluation may differ among centers. This means that patients may be referred at different stages of the disease, depending on their setting, and thus the response and postoperative outcomes may be different when deciding on surgical interventions. These aspects of care require that the international community with special interest in these pathologies standardize to unify the interpretation of the published data.[3] Another consideration is that in many countries (mostly European), surgeons, before proposing a surgical intervention offer a transanal irrigation system, and only if it fails propose a surgical intervention. In other countries this system is not available thus more appendicostomies are performed.

In 2015, Siminas and Losty published a very well-designed systematic review on surgical management for constipation in children. They analyzed the different surgical techniques available and included 45 papers (only 2 were randomized controlled trials and 43 [96%] were case series). The authors concluded that surgical management and outcomes for pediatric FC were based on low-quality evidence and no single operation was considered as the "best practice."[4]

It is very important to remember that every patient who has failed medical management and may be a candidate for surgical treatment needs the following (►Fig. 1):

- Contrast enema to evaluate the morphology of the colon (dilated segments, redundancy, strictures, and/or transition zone).
- Evaluation of the anal sphincters with anorectal manometry (AMAN) to assess for the following:

  Absence of a rectoanal inhibitory reflex: if the internal sphincter tightens instead of relaxes in response to rectal distension, the rectoanal inhibitory reflex is absent. It is a very reliable test for Hirschsprung's disease that must prompt a rectal biopsy. If the rectal biopsy shows normal ganglion cells, then the diagnosis would be anal sphincter achalasia and the treatment should be botulinum toxin injection of the anal canal. If the rectal biopsy shows no ganglion cells and hypertrophic nerves, the diagnosis would be Hirschsprung's disease.

  Anismus/pelvic dyssynergia: when the external sphincters or pelvic floor muscles are too tight and fail to relax, the patient will need pelvic floor therapy

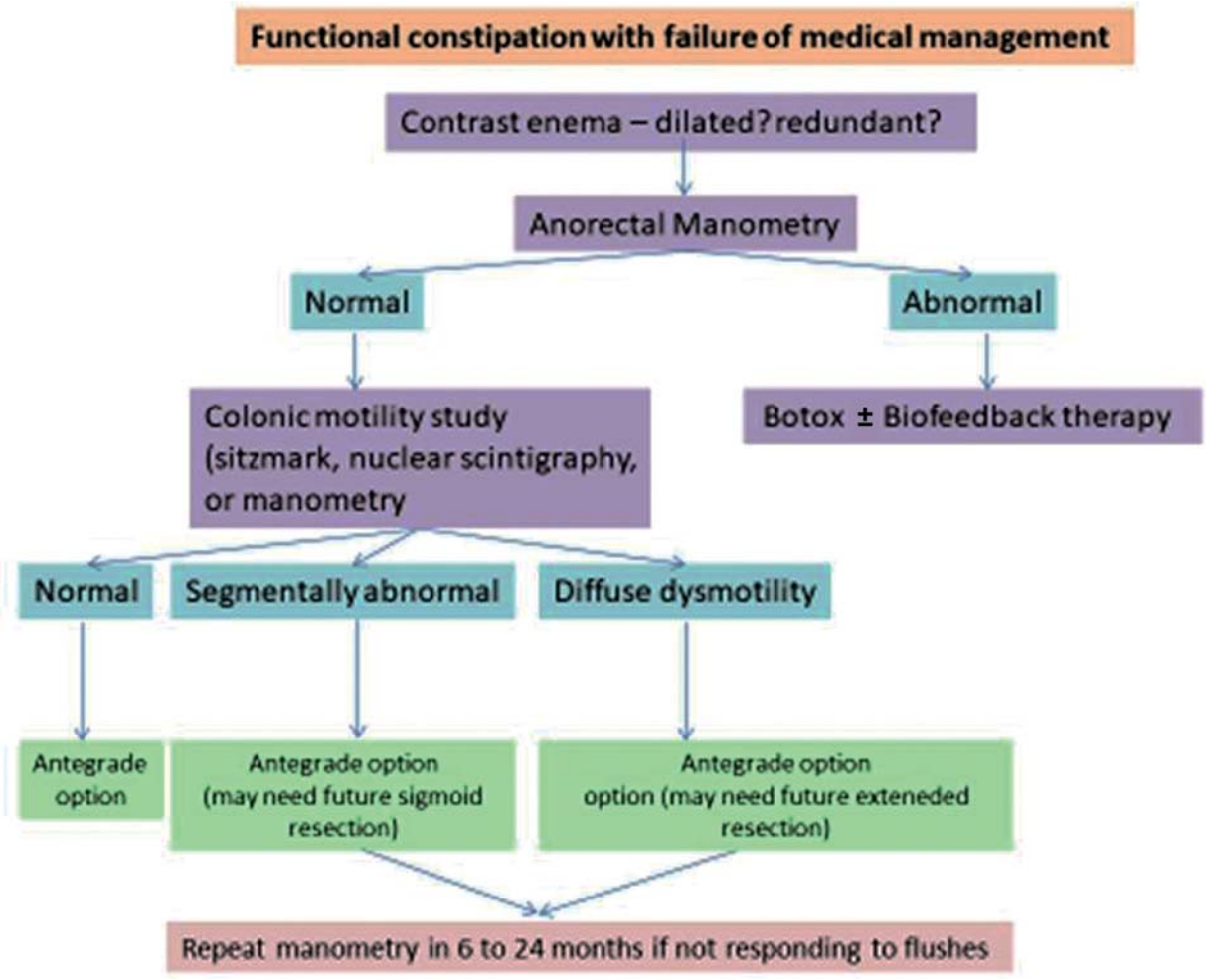

Fig. 1 Medical and surgical treatment algorithm in children with failure of medical management in functional constipation.

with biofeedback and/or botulinum toxin injection of the anal canal depending on the pressure of the sphincters.

- Colonic motility studies, such as sitz markers, nuclear scintigraphy, or colonic manometry (CMAN), are all modalities available to evaluate the motility of the colon, and one of these can be chosen based on what is available at a particular institution. The surgeon specifically needs to know if the motility is one of the following situations:
  - Normal.
  - Segmentally abnormal (usually the sigmoid is the problem area).
  - Diffusely abnormal.

In this review, we will summarize the surgical alternatives available, focusing on a recent published data and the authors' experience with these patients (►Fig. 2).

Ileostomy

An ileostomy is rarely needed but could be appropriate for a patient with diffuse colonic dysmotility and failure to thrive. After a time, with the colon diverted, colonic motility may improve and the ileostomy closed, with or without a colonic resection and/or an option for antegrade flushes.[3] Stoma formation specifically in children with constipation is associated with complications in 10 to 25% and a reoperation is needed in up to 30%. The most common complications include stomal prolapse (19%), diversion colitis (6%), skin excoriation (6%), and small bowel obstruction (6%). Given the high morbidity of a stoma, temporary diversion can be only considered as an alternative to antegrade continence enemas (ACE) in select patients.[4]

Antegrade Options: Appendicostomy and Cecostomy

By providing an antegrade route for enema delivery, patients can self-administer enema flushes without using the rectal route. The rectal route is sometimes not well accepted or patients just want to be more independent when doing their bowel management routine.[5]

Appendicostomy and cecostomy are each associated with a unique complication profile, and no precise strategy exists to determine which procedure best suits each individual patient.[5] While appendicostomies are made with the purpose of not having to have an indwelling catheter with better cosmetic results, a cecostomy is made to have an indwelling catheter to avoid leakage, as no continence valve is made.

In the past 10 years, the indication for performing these procedures has been increasing due to, in part, the creation of devoted centers of colorectal diseases, with collaboration between colorectal, surgery, and motility specialists, leading to an improvement in surgical outcomes and decrease in complications.[6] In 2018, Li et al published a meta-analysis comparing both antegrade enema options, appendicostomy, and cecostomy, in more than 150 patients. The most frequent indication was "failure of medical management" without providing what type of laxative treatment was taken, the dose or length of treatment prior to determing that the patient had "failed medical treatment." No mention of whether a megarectosigmoid was present on contrast enema

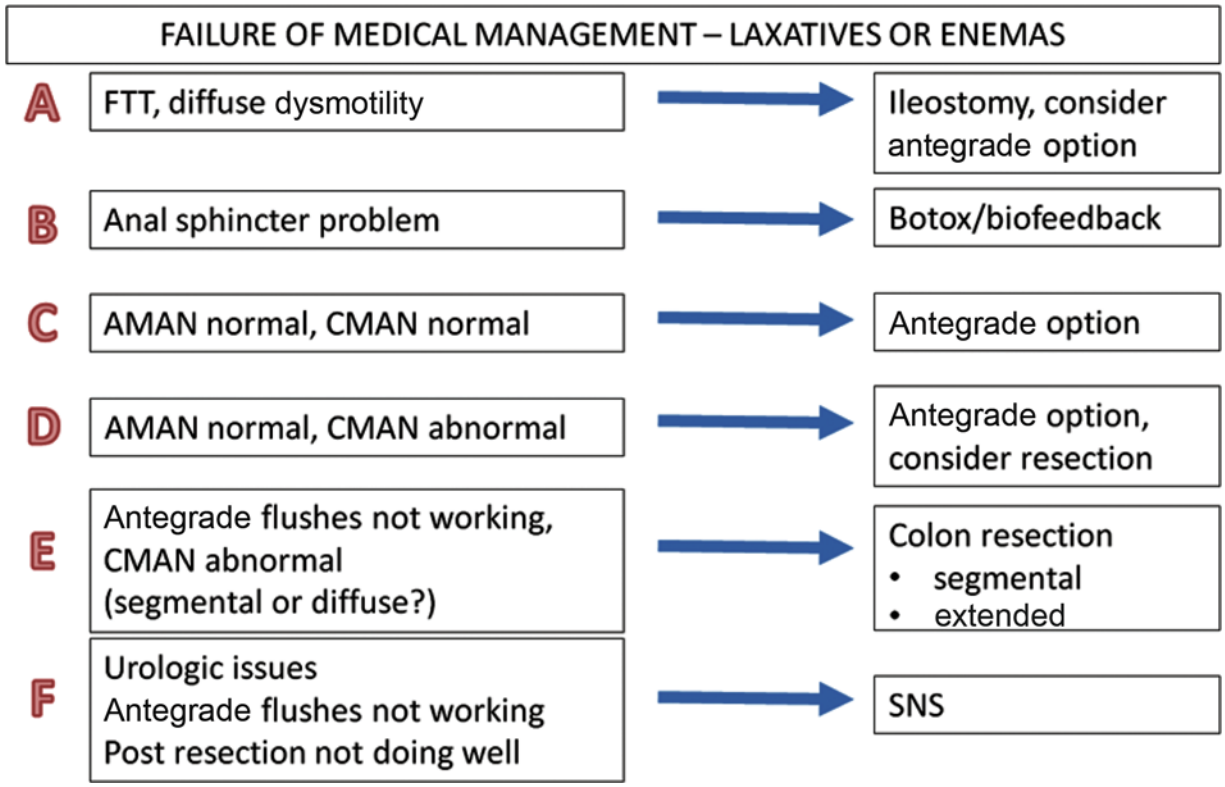

Fig. 2 Surgical alternatives, focusing on recent published data and the authors' experience with patients. AMAN, anorectal manometry; CMAN, colonic manometry; FTT, failure to thrive; SNS, sacral nerve stimulation.

or the results of motility studies were given in the vast majority of these studies. Although the quality of the data was low, one can observe a similar rate of "achieving continence"; 80% for Malone appendicostomy and 70% for cecostomies. The studies found more complications and further surgical revision (especially for stenosis) for those patients undergoing a Malone's appendicostomy (30. vs 12%).[7] Other recent papers reporting outcomes with ACEs describe similar rates of success in terms of decrease of soiling, admission for disimpaction, and good parent and patient satisfaction.[8–12]

It is interesting that some of the papers mention that a subset of patients stopped using their ACE because of restoration of normal bowel movements after a period of time flushing the colon.[10,13] This finding makes us think that chronic constipation can get better once withholding behavior or pelvic floor dyssynergia (they can train their pelvic floor when doing a flush to evacuate it) is improved, or that the underlying motility disorder can change over time when the colon is flushed daily. Some data exist that might support this theory. Dolejs et al report success when follow-up was longer than 2 years with 43% of patients stopping to use their ACE. It has also been shown that dysmotility is potentially reversible and that motility, as measured by CMAN, can improve after decompression of the colon (by an ileostomy) or after successful antegrade irrigations. This suggests that colonic dysmotility may not only contribute to the etiology of FC but may also be a consequence of long-standing FC, possibly because of fecal stasis leading to suboptimal colonic motor function.[10,13–18]

Sacral Nerve Stimulation

Sacral nerve stimulation (SNS) involves low-amplitude electrical stimulation of the sacral nerves. This effect can be administered via transcutaneous stimulation of the posterior tibial nerve, transabdominal stimulation, or via an electrode placed through the sacral foramen. SNS has been shown to be effective in treating both urinary and FI in adults.[19] However, the efficacy of SNS in the treatment of constipation in children remains unclear[20–24].

In the past 5 years, there have been three systematic reviews evaluating the role of SNS for constipation in children. They affirm that SNS could be a promising tool in the treatment of FI and constipation in children.[25–27] The results from both, invasive and noninvasive techniques, are encouraging in terms of improvement in constipation symptoms including defecation frequency and abdominal pain. They also seem to show an improved quality of life for both children and their families.[28] However, these studies found that the evidence was based only on small retrospective samples with a lot of heterogeneity between them with only two randomized controlled trials performed.[29,30] Also the outcomes were reported in many different ways such as, increased of number of bowel movement, decrease of abdominal pain, decrease of episodes of FI, improvement of colonic motility, or decrease of laxative dose.

For surgically implanted SNS, the complication rate is high, requiring device revision or removal in 20 to 40% of cases. In 2020, the first report comparing SNS and ACE in children with FC was published and suggested that SNS was more effective in those patients with FI rather than with only FC. ACE increased the number of bowel movements per week and decreased abdominal symptom, and SNS decrease episodes of FI after 2 years of treatment.[31]

It is important to consider how longer term follow-up will be able to provide more information regarding the compliance of the patient, proposed duration of therapy, and the sustainability of a benefit of the neuromodulation while it is in use, and after it is discontinued. It also seems important to highlight that the majority of the published papers on the use of SNS therapy have been published by a single center. In the future, evaluation of other centers' experience, will make it easier to have a better understanding of the results and the outcomes of SNS.[28,31]

Colonic Resection

In severe cases of intractable FC, more aggressive surgical treatment has traditionally been considered a treatment of last resort.[4] A recent study showed that GI physicians and pediatric surgeons world-wide have different surgical indications and procedures for children with intractable FC.[32] The literature provides information on several surgical procedures with segmental resection including proctocolectomy with reservoir and ileoanal anastomosis, Duhamel's operation, transanal Soave's and Swenson's operation, Soave–Georgeson laparoscopic surgery, and laparoscopic/open sigmoidectomy with and without ACE.[33–36] In the pediatric population, partial colon resection (open or laparoscopic) with colocolonic anastomosis is the most common intervention.[4] We prefer a laparoscopic low-anterior resection, with a transection of the upper rectum below the peritoneal reflection after a laparoscopic pelvic dissection and resection of the entire sigmoid, with anastomosis of the upper sigmoid to the upper rectum. Sometimes, the left colon needs to be removed as well, which requires taking down of the splenic flexure. The rectum is preserved that keeps intact the rectal reservoir and thus does not affect continence.[36] It has been our practice to add an antegrade option (Malone's appendicostomy) but often a Malone's appendicostomy or cecostomy is already in place at the time of the resection.

Based on the literature, the variations on technique do not follow any specific rule on dose of laxatives, length of the mega rectosigmoid, or manometry finding to perform the surgery. Even the same authors report different techniques for the same type of patients and report that their decisions on whether to do a colonic resection are based only on the contrast enema findings, without guidance by any motility testing.[34,35]

In the last few years, colonic resection based on motility findings on CMAN is increasing, as this manometric tool has been proposed as a good guide to predict surgical interventions.[32] However, could this dysmotile segment recover over time with mechanical emptying avoiding the resection? As mentioned earlier, it has been shown that dysmotility segments are potentially reversible and can improve after decompression of the colon (with an ileostomy/colostomy, e.g.) or after successful antegrade irrigation.[13–18] Another

factor which is under debate is whether antegrade access should accompany the resection, which may help with emptying in the short term before retrying the colon on a medical regimen.[36] There are still many reports describing major procedures to treat FC with "failure of medical management" in patients for whom an ACE was not tried first.[34,35,37–39] On the other hand, others propose always using an ACE procedure as a first step and these authors only perform more aggressive interventions in those with failure of management with ACE.[33] It is likely that with more uniform motility testing and use of antegrade flushes only, fewer colonic resections will be needed.

As noted above, a permanent intestinal diversion with ileostomy or colostomy is almost never needed. It can have a role in those patients with failure to thrive related to diffuse colonic dysmotility in whom motility does not improve after a temporary diversion with ileostomy.[33]

In general, morbidity is estimated in 15% of patients with a reoperation rate at approximately 10% in surgical procedures for FC.[4,33] Given the difficulties involved in decision making and the high impact of surgical interventions, there is a great need for consensus guidelines for surgical interventions in children with FC. First, there is no consensus on whether surgery which could include a colonic resection should be done only in patients who have been under a mechanical emptying bowel program for a certain time, and second, it is not known if only patients with a proven motility problem should be having an intestinal resection.[32]

Injection of Botulinum Toxin into the Anal Sphincters

Pediatric surgeons have used botulinum toxin A injection to improve constipation and obstructive symptoms in patient with Hirschsprung's disease after surgery.[40] About one-third of patients with chronic constipation have abnormal anal sphincter dynamics on AMAN, such as abnormal sphincter thickness, frequency, and amplitude of internal anal sphincter contraction,[41,42] possibly due to the constant stimulus of stool in the rectum.[43] Also internal anal sphincter achalasia (ISA) could be present, defined by an incomplete rectoanal inhibitory reflex (RAIR), upon rectal distention with normal rectal biopsy[44] and/or high resting pressure, and increased baseline pressures (>45 mm Hg).[45]

Botulinum toxin A is a neurotoxic protein that acts as a muscle relaxant of the anal sphincter by binding of nerve terminals. This may lead to easier and more frequent passage of stool with less pain, particularly in patients with high-resting pressure or lack of normal internal sphincter relaxation during defecation.[46–48] A recent study including 141 patients showed that improvements in passage of stools did not necessarily correlate with AMAN findings. This can explain why some patients with pelvic floor dyssynergia (affecting the external sphincter) also improve with botulinum toxin injection. This may be due to botulinum toxin leading to improved evacuation and diminished rectal distention, thereby allowing recovery of normal rectal sensation and motor function.[49]

Patients with normal and high pressures and those with and without the presence of an RAIR had improved symptoms. Two-thirds of the patients resolved their symptoms with only one injection and only one-third of the patients needed additional injections (range: 3–7).[44]

Basson et al also published a review on children who underwent botulinum toxin injection with good results in 72% of patients; however, the study did not specific whether validated tools were used to measure the outcomes.[50] More than one-third of patients had recurrence of symptoms and eventually 25% needed a surgical procedures (ACE or stoma).

Halleran et al focused on complications related to the botulinum toxin injection, based on his group's own experience and a systematic literature review. The authors did not find any significant complications after analyzing 18 papers which included 881 patients. Minor complications were described as urinary and FI which resolved within days and were related to regional spread to the surrounding tissues.[51]

Regarding the administration technique, ultrasound use has been described and allows for directed sphincter injection under visualization, but the degree to which this technique decreases complications or increases effectiveness of the Botox injection is still unknown. Ultrasound visualization may offer more precise administration into the sphincter complex and therefore decrease the amount of the drug inadvertently injected into the surrounding tissues, thereby decreasing the degree of regional absorption, although this has not been proven.[52]

It is unclear what dose is appropriate for children, although 100 U appears to be used empirically across most studies.[50] The reported literature offers little guidance with regard to safe botulinum toxin dosing in children. It is interesting to note that the highest reported complication rate was seen in children receiving injections of 200 U.[53] Systemic toxicity resulting from direct administration into a blood vessel or systemic absorption by the rich blood supply of the pelvis following injection leading to botulism is a feared complication of Botox use in children, but this complication is not described in the literature so far.[54]

In summary, results for injection of Botox have not been systematically analyzed, the technique, the amount of Botox and dilution, whether to use ultrasound to guide the injection, and the definition of medical failure are not well documented. However, it seems that it can help with symptoms related to the presence of a high-resting pressure on the AMAN or an absent RAIR on AMAN. The rate of recurrence is high in some series, but major complications have not been reported with repeated injections. Therefore we think that this treatment is a good first-line option for those patients not responding to medical treatment.

Conclusion

There is an increase in published data regarding the implication of surgical procedures in the treatment of FC in children. However, the evidence is weak and more studies are needed to identify subgroups of patients who would benefit from one procedure or another. It apears that an antegrade option should be done before proceeding with a

more invasive surgical procedure such as a colonic resection. We propose a treatment plan guided by the philosophy that conservative management for patients with FC is the best before moving to a more dramatic surgical intervention.

Conflict of Interest

None declared.

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