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Bowel management in children: how to keep children clean

Viktoria A. Pfeifle and Stefan Holland-Cunz

Objective **The term bowel management refers to an individualized program for fecal incontinent patients. The main principle is the administration of fluid to wash out the colon, either transanally or antegrade through a stoma.**

Method **A literature search was performed to find the best method to keep fecal incontinent children clean.**

Results **Bowel management with an individually determined amount of fluid, either by abdominal radiographs or hydrosonography, showed better success rates compared with transanal enemas with an estimated amount of fluid. Furthermore, transanal enemas had higher success rates compared with bowel management with antegrade continence enemas and showed fewer complications.**

Conclusion **To improve a child's quality of life an antegrade continence enema can be considered. Before surgery it has to be shown that a bowel management with rectal irrigations works. The indication for a surgical approach for bowel management has to be set carefully. Conservative measures must be tried first.** ***Ann Pediatr Surg*** **13:175–181 © 2017 Annals of Pediatric Surgery.**

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Keywords: anorectal malformation, antegrade continence enema, bowel management, fecal incontinence

Department of Pediatric Surgery, University Children's Hospital UKBB, Basel, Switzerland

Correspondence to Viktoria A. Pfeifle, MD, Department of Pediatric Surgery, University Children's Hospital UKBB, Spitalstrasse 33, 4056 Basel, Switzerland
Tel: +41 61 704 2245; fax: +41 61 704 1247; e-mail: viktoria.pfeifle@ukbb.ch

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Introduction

What is fecal incontinence?

Fecal incontinence is an often underestimated problem, as it has a big social and psychological impact on patients and also their parents. The question of how to define fecal incontinence has been widely discussed. The key element of current definitions is the defecation in inappropriate places at least once per month in individuals with a developmental age of at least 4 years. The limitation of age is reasonable, as 18% of girls and 46% of boys who are 3 years of age still loose stool in an uncontrolled manner, whereas the prevalence of incontinence in children 4 years of age decreases to 1% in girls and 8% in boys [1]. To define the terms used in pediatric gastrointestinal disorders for a better evaluation of data, as well as comparing studies, a group of pediatric gastroenterologists met in 2004 to establish the Paris Consensus on Childhood Constipation Terminology Group. The Paris Consensus on Childhood Constipation Terminology Group recommended the definition of fecal incontinence as passage of stools in an inappropriate place. It can further be subdivided into organic and functional incontinence; the latter can be constipation-associated or nonretentive [2].

What causes fecal incontinence in children?

The main causes for fecal incontinence in terms of an organic reason during childhood are congenital anorectal malformations (ARM) and spina bifida. However, patients operated on for Hirschsprung disease [3], sacral agenesis [4], and patients with sequelae after trauma or tumors [5,6] might suffer from that devastating problem of fecal incontinence. Patients with an ARM who are fecally incontinent are mostly those patients who have a poor functional prognosis. Of 1192 patients with ARM who were operated by Pena and Hong [7], 25% of the children suffered from fecal incontinence. Depending on the type of malformation, the percentage of patients who are continent varies from 0% for bladder neck fistula, 20% for prostatic fistula, to 100% for perineal fistula [7]. However, children with a good prognosis type of malformation and a correct surgical anatomic repair might show symptoms of incontinence. In these cases, overflow pseudoincontinence due to severe constipation without appropriate treatment must be ruled out [8].

The most recent study of the prevalence of fecal incontinence in children with ARM with data of 123 patients assessed by independent researchers of the German multidisciplinary network for congenital urorectal malformations revealed a more disappointing result. A total of 74% of the analyzed patients presented with soiling and only 49% practiced a bowel management, where only 19% reached full continence [9]. These numbers demonstrate the urge of an intensified follow-up of these patients and an establishment of a successful bowel management to improve the quality of life of these children.

What is bowel management?

The term bowel management is usually used for the treatment of fecal incontinence and refers to an individualized program with the aim to keep the patient artificially clean in the underwear [10].

The main principle of bowel management is the administration of fluid to wash out the colon, so that the child can stay clean in the underwear in between two treatments, meaning there are no incidences of soiling. The washout can be achieved by means of a retrograde enema, also called transanal irrigation, or by means of an antegrade continence enema, which naturally requires surgery to make an artificial opening.

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For transanal irrigation a rectal catheter is inserted, and the lukewarm enema is then introduced. When the catheter is removed, enema and feces are evacuated. This procedure can take up to 45 min, but the time can vary. An example of commercialized system is the Peristeen System (Coloplast, Humlebaek, Denmark) or the Irrimatic Pump (Braun, Melsungen, Germany). The Peristeen System contains a precoated rectal catheter with a balloon, a bag for water, and a manual pump to control the air inflation of the balloon and the water introduction. The Irrimatic Pump comes with a cone-shaped rectal catheter and a container of water with an electrical pump that automatically pumps in the water. However, if for economical reasons the purchase of a commercial system is not possible, a simple Foley catheter and big bladder syringes can also be used.

For the antegrade administration of the enema, Malone [11] introduced the appendicostomy in 1990. The Malone antegrade continence enema uses the appendix to create a catheterizable channel. The vascularized appendix was detached from the cecum, reversed, and placed into a submucosal tunnel [11]. Since then, many variations of the Malone procedure had been introduced. In case the child does not have an appendix anymore, there is, for example, the possibility to create a conduit using segments of the ileum as it was first introduced by Monti [12,13] or a cecostomy button as described by Shandling *et al*. [14]. As there is also a trend to minimally invasive surgery in the pediatric population, the Malone operation has also been performed laparoscopically, first described by Webb *et al*. [15]. In 2002, a technique to create a left continent colonic access, in which the Monti procedure and the Malone procedure are combined to shorten the duration of the enema, was introduced [16].

However, regardless of the surgical technique that can be used to create the artificial opening, which is necessary to introduce the antegrade enema, the main and underlying principle is the administration of fluid to wash out the colon and to evacuate stool.

What is the purpose of this review?

The question is whether or not it makes a difference if the bowel management is used with retrograde or antegrade enemas. Is one way superior to the other and does it lead to a better outcome? When should we recommend what type of bowel management? The aims of this review of the literature are to outline and describe the problem of a very incoherent way of how clinicians approach to solve the problem of fecal incontinence and to propose a solution of what currently can be the best way of how to help affected patients.

Methods

A literature search was performed to identify articles that reported the outcomes of bowel management in children. The electronic database of PubMed was searched using the combination 'bowel management' AND 'children', as well as 'antegrade continence enema' AND 'children'. Reference lists of identified articles were screened for additional publications of interest. Reviews, case reports, and studies comprising only an adult population and articles written in languages other than German or English were excluded.

Detailed data – for example, patient characteristics, type of bowel management, complications, and outcomes – were extracted and collected in a datasheet using Excel. Of particular interest was the type of bowel management, the success, and complication rate.

Results

Using the above-mentioned items, the literature search produced a total of 163 articles. After applying the exclusion criteria to the abstract review and a further exclusion after full text analysis due to inadequate data or bias, a total of 48 articles were accepted as suitable and therefore included (Fig. 1).

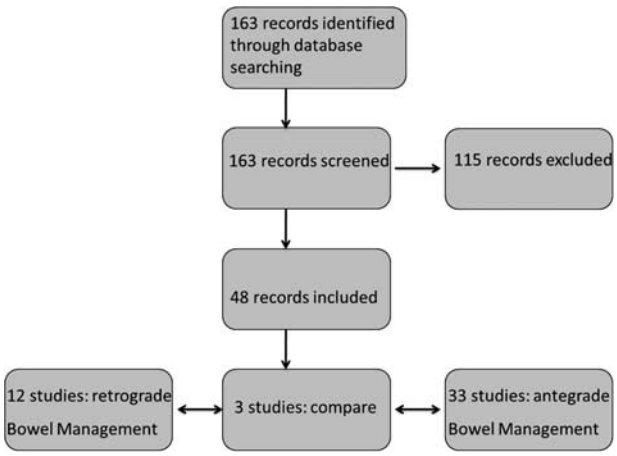
Data of 2630 individuals with a mean age of 10.7 years were collected. The underlying diseases were in most cases spina bifida in 1030 individuals and ARM in 1098 individuals. Further, 193 individuals needed bowel management because of idiopathic chronic constipation, 59 had Hirschsprung disease, and 84 were fecally incontinent because of other reasons, mostly tumor or trauma.

The articles were divided into two groups depending on the way the enema was administered. Twelve studies used retrograde enema, whereas 33 studies used an antegrade way of enema administration, including the need for a surgical approach. Three studies compared the outcome of antegrade with retrograde enema.

'Conservative' retrograde bowel management

The 12 articles dealing with retrograde enema presented a collection of data of 1015 individuals. The largest study involved 348 children with ARM, in which data were reviewed over a period of time from 1985 to 1996 in the Cincinnati Children's Hospital Medical Center, a referral center for ARM [17]. The author emphasized the importance of distinguishing between true incontinence without any voluntary bowel movement and

Fig. 1



Results of the literature search.

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pseudoincontinence due to fecal impaction, as well as classifying the ones with a true fecal incontinence into hypomotility of the bowel tending to constipation and hypermotility with a tendency to diarrhea. According to the classification different treatment is required. True fecal incontinence is treated with daily retrograde enema. The important difference is that the enema is not given in an indiscriminate manner by administrating an amount of fluid that has to be found in a trial and error method, similar to that reported in most studies. Here, the enema is individualized for each patient and the process of determination of the right amount of fluid is supported by radiographic means. Therefore, the patient comes every day for 1 week and undergoes an abdominal radiograph film each day to monitor the amount and distribution of the stool in the colon to modify the volume and concentration of the enema. The aim is to find the volume that completely cleans the colon, so that the patient can be kept clean in the underwear for 24 h. In this group, this aim could be achieved in 93% of the cases. If the patient belongs to the group with hypermotility and tendency to diarrhea, antimotility medication such as loperamide hydrochloride is added to the therapy to slow down colonic motility, thus avoiding the loss of stool in between enemas. This group seems to be harder to treat with a success rate of 88%. If the patient is suffering from overflow pseudoincontinence, the first step is to disimpact by giving enemas, and then an oral laxative medication is started. The right dosage is reached when bowel movements are possible without the need for an enema. This treatment was successful in 97% of the cases [17].

Recently, a new approach to define the right volume of the individualized enema using ultrasound instead of radiography has been introduced [18,19]. The main principle stays the same as reported by Pena *et al.* [17]: first, the patients are subdivided into true fecal incontinence and overflow pseudoincontinence and only the ones who are truly fecal incontinent are included in the program consisting of daily colonic washouts. The right volume was determined according to the amount of fluid that was needed to fill the colon to the cecum. In addition, the motility of the colon can be evaluated with the help of hydrosonography, making it easier to adjust oral medication. Antimotility agents are used in patients presenting with hypermotility and oral laxatives in patients with less bowel motility. The overall success rate, defined by being clean in between enemas, is 98.5% for the group with hypomotility and 59% for the group with hypermotility [18,19].

In other studies in which the volume of the retrograde enema was given in a more indiscriminate manner, either independent of body weight or estimated by 20 ml/kg body weight, a success rate of 70.3% has been reported [20–29]. The underlying pathology was in most cases spina bifida in 602 patients out of 635 children in total, whereas most of the patients who received an individualized volume suffered from ARM (684 patients of 755 children). This discrepancy of different etiologies can be attributed to the fact that the authors who used the bowel management method with an individualized amount of fluid using radiography to evaluate it come from a children's referral center for ARM. They have also been the pioneers in the field of fecal incontinence and were the first ones to establish a standardized bowel management. Therefore, they can present a big number of patients.

Not every article mentioned the time the patient needed for each procedure of bowel management. The studies that used hydrosonography pointed out that the enema was adjusted individually, so that each bowel management procedure did not last longer than 45 min [18,19,30]. Other studies that used an estimated amount of enema mentioned that the defecation process takes 20–30 min [20,23], not including the time they need to administer the fluid. Another study mentioned that most patients needed a range of 15–60 min for the total time spent for the process of bowel management [29]. Therefore, it is not possible to compare the time consuming aspect of the bowel management.

The content of enema varies. In most studies, normal saline [18,19,23,30] or tap water [20–22,24–27] was used. In the North American articles saline enema with addition of phosphate is reported [17,31] and one article mentioned that they added phosphate to tap water, but only in two cases [27]. As far as the content of the enema is concerned, only complications with the use of phosphate had been reported. Five patients who received a saline enema with phosphate developed a phosphate-induced colitis [31]. When only tap water without the addition of salt was used there were no complications such as electrolyte imbalance or infections being reported. Thirteen children were complaining of mild-to-moderate abdominal pain during the procedure [25,27,28], one child had difficulty maintaining the catheter in the rectum [25], and one child abandoned the system because the balloon burst inside the rectum and it had instilled fear in the child after this incident [27]. One article reported of 11 children who complained of sweating or headache before or after defecation, 19 patients had pain during defecation, and 22 had abdominal pain before defecation and 10 after defecation [29]. However, it is not clearly stated whether the pain only occurs during the procedure of giving enema or whether the defecation process itself is painful. All of those children had spina bifida.

Besides this no other complications are reported when following a bowel management program with retrograde enema. This means 82 children of the 1015 patients who used a retrograde enema experienced some type of discomfort. However, if mild pain or difficulty to maintain the catheter is not regarded as a real complication, only 17 children suffered from a complication (colitis, a burst balloon, and sweating/headache) – this would mean bowel management with a retrograde enema has according to the literature an overall complication rate of 1.67%. Concerning the quality of life, one study including patients with fecal incontinence due to spina bifida reported a mean grade of satisfaction of 7.3 (score 0–10 with 10 being the highest achievable) and an improvement in independence from 28 to 46%, when using the

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Peristeen System for retrograde enema [29]. Another study mentioned that 16% of the children were able to use the Peristeen System completely independently and had a significant improvement in the quality of life [27].

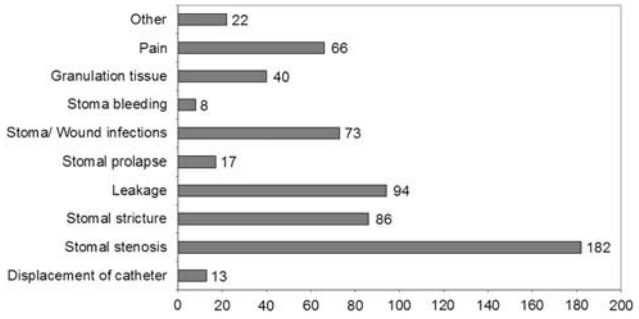
'Surgical' antegrade bowel management

When children become older the daily use of rectal enemas might not be tolerable to them anymore and they might be longing for more independence in administrating their enemas. Data of 1510 patients who underwent surgery for an antegrade continence enema were analyzed. The underlying diseases are most commonly spina bifida in 369 cases, ARM in 396 cases or idiopathic chronic constipation in 185 cases. Only five articles, comprising 270 patients, pointed out that a successful bowel management with rectal irrigation must be established before surgery [32–36]. This means that it has to be proven that enema given in a retrograde manner leads to a sufficient level of continence. Therefore, a surgical approach is only indicated to improve the quality of life of the child – for example, more independence for the child or adolescent as it can administer the enema itself. However, in 13 articles, comprising 388 patients, surgery was indicated when conservative methods such as rectal irrigation failed [37–49].

There were a broad range of postsurgical complications to be reported (Fig. 2). Data of 941 patients were presented. The majority of the complications affected the stoma. The most common complication was stomal stenosis in 182 (19.3%) cases and stomal strictures in 88 (9.3%) patients. A leakage or reflux of the stoma was present in 96 (10.2%) cases, bleeding of the stoma in eight (0.8%) cases, and a prolapse of the stoma in 17 (1.8%) cases. Infections of the wound site or the stoma occurred in 78 (8.2%) cases. Sixty-eight (7.2%) patients reported of pain during the irrigation.

More severe complications such as cecal perforation in one case [42], volvulus in three cases [50,51], bowel obstruction in six cases [32,43,52], and peritonitis in three cases [53] were rarely seen. In two cases a fistula developed [42,46]. One patient suffered from an iatrogenic subcutaneous perforation 4 months postoperatively, which had to be reoperated on [49]. One child died because of gastric perforation [53]. Overall, 163 patients (17%) had to undergo second surgery. The revision was mostly due to stomal stenosis or stricture.

Fig. 2



Postoperative complications following surgery for an irrigation stoma.

Not every article named the type of irrigation used for antegrade enema, but data of 527 patients could be evaluated. Most patients received normal saline as enema ($n = 128/24.2\%$) or normal saline plus phosphate ($n = 93/17.6\%$). In 128 (24.2%) cases tap water was used and only in five (0.9%) cases salt was added to the tap water. In 169 (32%) cases glycerinated solution was used, in one case only phosphate was given, and in three cases a mineral oil mix was added to the tap water. Complications as regards the administration of the enema are rare, but still occurred. There were two cases of hyponatremia when using tap water only [47] and four cases of phosphate poisoning [41,52]. As mentioned above, 66 patients suffered from pain during enema. None of the articles used an individually determined amount of volume to effectively clean the bowel, as introduced by Pena *et al.* [17] and by Märzheuser *et al.* [18]. Instead, it seemed to be more a trial and error method to find the sufficient amount of fluid.

Only few studies reported the time spent for the bowel management program and the outcome varies greatly. Some studies reported a mean time of 30 min [34], 39 min [52], and 50 min [36,47,53]. One study mentioned that the administration of the fluid took 45–60 min and the colonic evacuation occurred within 30–60 min [44]. Another study reported a range of 15 min to 3 h with a median of 53 min to perform the enema. Meyer *et al.* [36] compared the outcome of Malone antegrade continence enema implanted in the right or left colon. The aim of localizing the conduit in the left colon was to shorten the duration of the process of bowel management, but interestingly the authors did not find a significant difference with a mean time of 51 min for the group with the implantation in the right colon and a mean time of 49 min for the group with a conduit in the left colon [36].

The overall mentioned success rate of the presented data was 77.4%. However, it is to emphasize that it is difficult to evaluate the real success rate of the antegrade continence enema procedure presented in this collective of data, because there is not a consistent definition of success. The most objective criterion of success is being clean in the underwear between the irrigation. Unfortunately, this criterion has not always been used, in some cases it was not even clarified how success is defined.

In one article it was mentioned that the success rate was higher (80%) in children with previous successful retrograde bowel management compared with children who did not have bowel management before (68%) [53].

Matsuno *et al.* [22] compared the clinical outcome of antegrade with retrograde bowel management by retrospectively analyzing data of 25 patients with spina bifida. They found a success rate of 76.9% in the retrograde group and 75% in the antegrade group, showing that the conservative method is not inferior to surgery. They clearly defined success as not soiling in between enemas. However, 66.7% of the children in the antegrade group

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could perform the procedure independently, whereas only 23.1% of the children in the retrograde group could perform their bowel management by themselves [22].

Discussion

There are many reasons why a child might suffer from fecal incontinence. To help those children, it is the clinician's task to find out what type of incontinence he or she is dealing with, simply by history taking and clinical evaluation. Once the differentiation between true fecal incontinence and pseudoincontinence is clear, a more individualized bowel management program, similar to that first introduced by Pena *et al*. [17], can be started. Besides the differentiation between true fecal incontinence and pseudoincontinence, as well as hypermotility and hypomotility of the colon, it is the use of abdominal radiographs to monitor the success of the enemas that are the key elements of the program [17]. To avoid a child's exposure to radiation a new method with the help of ultrasound was established by Märzheuser *et al*. [18] and Grasshoff-Derr *et al*. [19]. Using hydrosonography it is possible to evaluate a defined volume that is necessary to fully clean the whole colon, as well as characterize the motility pattern of the colon. It is postulated that this method is more successful compared with using an estimated amount of fluid using trial and error. However, a study comparing those two methods has not been made. A preferably randomized prospective trial would be necessary to answer the question whether a clearly defined volume using sonography gives a higher success rate with regard to soiling compared with an estimated volume using the weight of the child.

Another aspect of finding the best way of establishing a bowel management program is to find the type of content of the enema that leads to the best results. In the literature many different contents of the given enema are mentioned. Even within one and the same department different types of enemas are reported. The enema mostly used is just tap water without any additives. In two cases hyponatremia occurred when using only tap water. Therefore, it might be advisable to add salt to the tap water to adapt it to the physiological surrounding. Moreover, one has to keep in mind that using tap water is only advisable in Western countries where it is regarded clean and drinkable. In countries with low sanitary standard this might not be applicable. However, in some western countries, like the USA, where a lot of chlorine is added to the tap water, it is questionable whether this is harmful to the child's health in long term and whether it, for example, influences the child's intestinal microbiota, which could also have undesirable long-term effects.

With the use of phosphate in the enema, some rare cases of phosphate-induced colitis or poisoning have been reported, which makes the addition of phosphate a questionable method and should be avoided, especially as there are safer fluids to use.

There is no evidence why an antegrade enema should work better than the retrograde administration of fluid and still, in many cases, the indication for surgery for an antegrade enema was set when conservative bowel management with rectal irrigation failed. As long as there is no clear evidence that the way of administration matters, it is of great importance to show before surgery that bowel management on the retrograde transanal way works. Malone *et al*. [54] had already pointed out that the ACE is not the first choice of treatment for patients with fecal incontinence. Because of the need for major surgery and the significant complication rates, all conservative measures must be tried first [54]. Pena *et al*. [17] sees the only indication for performing an ACE in children who successfully took part in this bowel management program. An ACE procedure, no matter whether it is an appendicostomy, neoappendicostomy, or a button in the cecum or the descendent colon, implies surgery with the risk for diverse complications; the most common ones are stenosis and leakage of the stoma and sometimes even require second surgery. Therefore, it must be carefully evaluated which patient will benefit from this procedure. If it improves the child's quality of life – for example, it feels more independent because it can administer the enema itself through its stoma or button – a surgical approach for performing bowel management is justified. Furthermore, it might be a good option for those children who are already traumatized due to previous surgery or manipulation of the anal region. These patients often do not tolerate any rectal irrigation, which makes a conservative treatment almost impossible.

In many cases, bowel management is the therapy of choice in children with idiopathic refractory constipation. This was also the indication for performing surgery for an ACE in several cases, as mentioned above. It is to discuss whether a surgical procedure such as the appendicostomy with all listed possible complications is legitimate in a most probably temporarily state of constipation. Those patients do not suffer from true fecal incontinence and often the problem dissolves after a period of time.

As regards the success rate of the different methods, it is difficult to make a comparison, as the definition of success is neither well defined nor consistent. It is to emphasize that it is urgent to set a standardized definition of success in bowel management. It is not enough to ask the patient whether the bowel management is improving his or her situation and it is not tolerable to accept a yes to this question as success. The only objective criterion to define success is soiling. The management program truly successful if the patient was clean in the underwear between enemas. A successful bowel management should then be established early in childhood to avoid social isolation in school and could occur because the fecal incontinent child smells bad or because the child cannot actively participate in sports because of the fear of loose stool.

To provide the best help for those children it might also be advisable to broaden the spectrum of bowel management. A multidisciplinary approach, as it was established in Nijemegen, the Netherlands, might also be an option. The therapeutic team consists of a pediatric surgeon, a physiotherapist, and a psychologist. The pediatric surgeon evaluates the somatic condition of the patient and prescribes oral laxatives or enema to disimpact first and then to facilitate the defecation process. The psychologist teaches the child toilet behavior and manages possible

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motivational problems. The physiotherapist helps the child to learn an adequate straining technique. If the multidisciplinary approach does not lead to success, they start a bowel management program with rectal irrigation [55].

To provide fecal incontinent children who were born with a congenital anomaly and have already been through a lot in their short lives the best method of bowel management with the best success rate and the lowest rate of risks and complications still has to be found by putting more effort into conducting research with randomized controlled and prospective clinical trials.

Conclusion

Fecal incontinence such as soiling in the underwear is a devastating problem for children with different underlying diseases. One can imagine that not being able to be clean of stool has a huge impact on social life. Bowel management is the therapy of choice in children with fecal incontinence and can help these patients to be clean in the underwear. Different methods to perform a bowel management are available. There is no evidence that giving an enema in an antegrade way through a surgically performed continent stoma works better than giving an enema conventionally through the anus. As regards the risks for complications of this surgery the indication for this has to be set carefully. Preferably, before surgery it has to be proven that conventional bowel management is successful. Nevertheless, the therapeutic tools for treating fecal incontinence are very limited. More effort and research has to be directed in finding solutions for innovative therapeutic strategies in this field.

Conflicts of interest

There are no conflicts of interest.

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