

REVIEW

Paediatrics: how to manage functional constipation

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Abstract

Background: Despite being a common problem in childhood, functional constipation is often difficult to manage. This article provides a narrative updated review on the evaluation, diagnosis and management of childhood functional constipation.

Methods: A PubMed search was performed with Clinical Queries using the key term 'functional constipation'. The search strategy included clinical trials, meta-analyses, randomized controlled trials, observational studies and reviews. The search was restricted to the English literature and to the paediatric population. The information retrieved from the above search was used in the compilation of the present article.

Results: A detailed history and thorough physical examination are important in the evaluation of a child with constipation to establish the diagnosis of functional constipation as per the Rome IV criteria and to catch 'red flags' suggestive of organic causes of constipation. These 'red flags' include delayed passage of meconium, ribbon stool, rectal bleeding/blood in the stool unless attributable to an anal fissure, failure to thrive, severe abdominal distension, absent anal wink/cremasteric reflex, tight and empty rectum on digital examination and explosive expulsion of liquid stool and gas on withdrawal of the finger, hair tuft/dimple/lipoma/haemangioma in the

lumbosacral area, and an anteriorly displaced anus. For functional constipation, pharmacological therapy consists of faecal disimpaction and maintenance therapy. This can be effectively accomplished with oral medications, rectal medications or a combination of both. The most commonly used and most effective laxative is polyethylene glycol. Non-pharmacological management consists of education, behavioural modification and dietary interventions. The combination of pharmacological therapy and non-pharmacological management increases the chance of success.

Conclusion: Polyethylene glycol is the medication of first choice for both disimpaction and maintenance therapy. If polyethylene glycol is not available or is poorly tolerated, lactulose is the preferred alternative. Other laxatives may be considered as second-line therapy if treatment with osmotic laxatives fails or is insufficient. Maintenance treatment should be continued for at least 2 months. Early treatment will result in a faster and shorter treatment course.

Keywords: bulky stools, hard stools, infrequent defecation, laxatives, painful defecation, polyethylene glycol.

Citation

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Introduction

Constipation is a common problem in children, accounting for 3–5% of paediatric primary care visits and 10–25% of paediatric gastroenterology consultations.^{1–6} In children, constipation generally refers to passage of unusually large calibre and/or hard stools, a stool frequency of less than three per week, or painful defecation.^{4,7} Functional constipation refers to constipation for at least 1 month without an organic cause, be it structural or biochemical.^{3,5} Besides causing discomfort, functional constipation is often negatively perceived by peers and poses a

significant burden on both the child and parents. Without early treatment, functional constipation is likely to result in stool-holding behaviour, faecal impaction, psychological problems, and reduced quality of life.⁸

Methods

This article provides an updated review on the evaluation, diagnosis and management of functional constipation in children. A PubMed search was performed in October 2020 with

Clinical Queries using the key term ‘functional constipation’. The search strategy included clinical trials, meta-analyses, randomized controlled trials, observational studies, and reviews published within the past 10 years. The search was restricted to the English literature and the paediatric population. The information retrieved from the above search was used in the compilation of the present article.

Epidemiology

Beyond the neonatal period, functional constipation accounts for more than 95% of cases of constipation in children.⁵ Worldwide, functional constipation has a pooled prevalence rate of 9.5% (95% CI 7.5–12.1).⁹ The peak prevalence is during the preschool years and is particularly common around the time of transition to solid foods, toilet training and school entry.^{10,11} The median age of onset is 2.3 years.^{11,12} Functional constipation is slightly more common in girls.⁹

Aetiopathophysiology

The aetiopathophysiology of functional constipation is multifactorial and the various causes are not mutually exclusive.

Painful defecation

In most cases, the initiating event is a painful defecation, which leads to voluntary withholding of stools by the child in an attempt to avoid the unpleasant defecation experience.⁶ The withholding of stools can be achieved through voluntary contraction of the external anal sphincter and the puborectalis muscle, which leads to constriction of the anal canal. The prolonged retention of stools in the large colon results in larger, harder stools due to the absorption of water by the colonic mucosa. The passage of these larger, harder stools causes more pain, which results in additional withholding behaviour.¹³ Over time, the patient may lose the supposed response to normal stool volume and the retained stool in the colon may be too hard to expel.^{11,14} Eventually, the rectum stretches to accommodate the retained faecal mass and becomes grossly dilated and redundant with accompanying loss of rectal sensitivity and the sensation of ‘needing to go’ when the rectum is full – a condition referred to as the lazy bowel syndrome. In one study of 212 children attending day-care centres, functional constipation was found in 18 (8.5%) children.¹⁵ Multivariate logistic regression analyses showed that a history of painful defecation before 1 year of age (OR 4.1; 95% CI 1.1–101.3) and a history of painful defecation during toilet training (OR 28.8; 95% CI 1.9–423.8) were powerful predictors of functional constipation in young children ($p < 0.05$).¹⁵

Irregular bowel habits

The voluntary inhibition of defecation may result from a perception of lack of time or acceptable facilities. Children who

are too absorbed in their play, busy in another activity or in a rush may not find time to go to the bathroom.¹⁶ Children may also be deterred from using public toilets because of a lack of privacy or, more commonly, the absence of toilet paper and poor sanitary conditions.^{17,18} Travelling disrupts the normal toilet routine and toilet facilities may not be easily accessible. A disturbed parent–child relationship and emotional stress may also result in irregular bowel habits in children. If the urge to defecate is repeatedly ignored, the brain may become less responsive to further defecation urges.

Toilet training issues

Toilet training is an important cause of functional constipation as stool toileting refusal occurs in approximately 25% of children during this period.⁵ Initiating toilet training before the child is ready or coercing the child into toilet training can cause undue stress and anxiety for the child with resulting toilet phobia and stool-withholding behaviour.¹⁶

Dietary causes

Case–control studies have shown an association between low dietary fibre and functional constipation.^{7,19} In a study of 5309 children aged 5–6 years in Japan, a higher dietary fibre intake was significantly associated with a lower prevalence of constipation (adjusted OR 0.62; $p < 0.005$).²⁰ A lack of faecal bulk, which may be the result of a lack of roughage in the diet, undernutrition or starvation, may lead to a decrease in mass peristaltic movements of the colon.⁷ A lack of dietary roughage may result from prolonged use of pureed food after infancy, excessive intake of refined sugars, or consumption of a high-protein or high-fat diet.⁷ Constipation is not uncommon when breast milk or formula is switched to whole cow’s milk, presumably because of the greater protein-to-carbohydrate ratio of the whole cow’s milk,^{16,17} and some children have intolerance to cow’s milk protein.^{16,17} In addition, excessive consumption of whole cow’s milk can slow the motility of the intestine and diminish the intake of other foods or fluids, such as vegetables and fruits, that promote soft stools.²¹ Inadequate fluid intake or excessive fluid loss (e.g. from vomiting, diarrhoea or febrile illness) may cause hardening of the stool and is an important cause of constipation, especially in infants.^{20,21}

Physical activity and obesity

Decreased physical activity is a risk factor for functional constipation.²⁰ The effect of obesity on functional constipation is controversial.²²

Psychological and behavioural factors

Functional constipation is more common in children with autism spectrum disorders, attention deficit/hyperactivity disorders, eating disorders, anxiety and depression.^{23–25}

In adolescents with a recent onset of constipation, clinicians should rule out the presence of an eating disorder. Stressful life events such as psychological or physical trauma (including sexual abuse) are more common in children with functional constipation.^{22,26}

Parental factors

Parental low socioeconomic level, low educational level, depression, neuroticism, parental rearing attitudes such as overprotection, and attitudes that foster a high or low level of autonomy increase the risk of functional constipation.^{27,28}

Genetic factors

Children with functional constipation often have a positive family history of constipation.²² In one longitudinal study of 186 children with chronic constipation and soiling, a positive family history of constipation was observed in 55% of children.²⁹ To date, no specific genes linked with functional constipation have been identified.

Clinical manifestations

The most common symptoms associated with functional constipation are infrequent defecation, passage of voluminous and hard stools, and difficult or painful evacuation of stools.⁷ A distended rectum that is full of stool is characteristic. Some children may have rectal impaction and overflow faecal incontinence (encopresis). Most children develop functional constipation as infants and toddlers.³⁰ Children under the age of 2 years may engage in a screaming episode in anticipation of or during defecation.³¹ Common withholding behaviours in young children include crying, flushing, sweating, stiffening of the legs, rocking back and forth, crossing ankles, holding onto furniture, and squatting or hiding in a corner during defecation.¹³ Loss of appetite and abdominal distension may also accompany the condition. Older children with functional constipation may present with intermittent abdominal pain usually localized to the periumbilical area and encopresis.^{7,32} Children with later onset of functional constipation are more likely to have behavioural and/or developmental issues.³⁰

Diagnosis

The diagnosis is a clinical one, which is currently based on the paediatric diagnostic Rome IV criteria.³³ Because of the wide variations in the expected frequency of stools in normal healthy children, the Rome IV criteria have included other variables besides stool frequency to define functional constipation in children.⁶ As per the Rome IV criteria, functional constipation in children and adolescents is defined as the presence of two or more of the following in the absence of any organic pathology and the duration has to be of at least 1 month: ≤ 2 defecations/week; history of hard or painful bowel movements; history

of retentive posturing or excessive volitional stool retention; history of large-calibre bulky stools that can obstruct the toilet; presence of a large faecal mass in the rectum; and ≥ 1 episode of faecal incontinence per week.³³ For infants and toddlers, the criteria are modified to reflect age-appropriate toileting skills as follows: ≤ 2 defecations/week; history of hard or painful bowel movements; history of excessive stool retention; history of large-calibre stools (in toilet-trained children, history of large diameter stools that can obstruct the toilet); presence of a large faecal mass in the rectum; and ≥ 1 episode of faecal incontinence per week.²²

Differential diagnosis

Functional constipation should be differentiated from infant dyschezia, dyssynergic defecation and internal anal sphincter achalasia. Infant dyschezia is manifested as straining and crying before successful passage of soft frequent stools in an otherwise healthy infant younger than 6 months of age.¹⁰ Presumably, the condition results from failure of the pelvic floor to relax during defecation.¹⁰ Infant dyschezia tends to resolve spontaneously as the infant matures.¹⁰ Dyssynergic defecation, due to paradoxical contraction or failure of the pelvic muscles to relax when straining to defecate, manifests as incomplete evacuation of the stool from the rectum.¹⁰ The clinical presentation of internal anal sphincter achalasia is similar to that of Hirschsprung disease but with ganglion cells in the rectal mucosal biopsy.³⁴

Organic causes of constipation include anorectal anomalies (e.g. anal fissure, perianal dermatitis, perianal abscess, anorectal abscess, anal stenosis, anterior ectopic anus, imperforate anus), neuromuscular disorders (e.g. Hirschsprung disease, intestinal neuronal dysplasia, visceral neuropathies, cerebral palsy, spinal cord injury, spinal dysraphism, myelomeningocele, sacral teratoma, myopathies, muscular dystrophy, dysautonomia, infantile botulism), hypotonia (e.g. Down syndrome, Prader-Willi syndrome), metabolic and endocrine disorders (e.g. hypothyroidism, diabetes insipidus, multiple endocrine neoplasia type 2, hypercalcaemia or hypocalcaemia, hypokalaemia, pheochromocytoma, acute intermittent porphyria), drugs (e.g. anticholinergic agents, antidepressants, opiates, vinca alkaloids, iron-containing preparations, aluminium-containing antacids), cystic fibrosis (manifested as meconium ileus in neonates; distal intestinal obstruction syndrome in older children), celiac disease, and chronic lead poisoning.^{35–37}

Evaluation

Clinical evaluation

A detailed history and thorough physical examination are important in the evaluation of a child with constipation to establish the diagnosis of functional constipation as per the Rome IV criteria and to catch 'red flags' suggestive of organic

causes of constipation. These red flags include the age of onset and duration of symptoms; frequency of defecation; history of painful bowel movements, retentive posturing, excessive volitional stool retention, hard or large diameter stools, and faecal incontinence; precipitating factors (e.g. low fluid intake, low dietary fibre content, difficulties with toilet training, psychosocial stressors); associated symptoms and signs (e.g. absent cremasteric reflex, hyporeflexia, hyperreflexia, hypotonia); medications that the child is taking, prior use and efficacy of laxatives; and the presence of a large faecal mass in the rectum.³⁸ A digital rectal examination is not routinely necessary but should be performed whenever constipation is doubtful or when an organic aetiology is suspected.³⁹ Constipation that is present from birth or that begins during the neonatal period is most likely organic in origin. Thereafter, functional constipation accounts for more than 95% of cases.⁸

Alarming symptoms suggestive of an organic cause include delayed passage (>48 hours after birth) of meconium (Hirschsprung disease, intestinal neuronal dysplasia, meconium plug syndrome, meconium ileus, congenital anorectal malformation), fever/vomiting/diarrhoea (Hirschsprung disease-associated toxic enterocolitis), ribbon stool (Hirschsprung disease, anal stenosis/congenital anorectal malformation), rectal bleeding/blood in the stool unless attributable to an anal fissure (Hirschsprung disease-associated toxic enterocolitis), and failure to thrive (any organic cause). A positive family history of Hirschsprung disease, hypothyroidism, multiple endocrine neoplasia type 2 or celiac disease would suggest the respective disease.

Alarming physical findings suggestive of an organic cause include poor weight gain or weight loss (any organic cause), severe abdominal distension (Hirschsprung disease), absent anal wink/cremasteric reflex (spinal cord anomaly), tight and empty rectum on digital examination and explosive expulsion of liquid stool and gas on withdrawal of the finger, referred to as 'blast' or 'squirt' sign (Hirschsprung disease), hair tuft/dimple/lipoma/haemangioma in the lumbosacral area (spinal dysraphism), anteriorly displaced anus/perianal fistula (anorectal malformation), dry skin/myxoedema/bradycardia/goitre (hypothyroidism), developmental delay (hypothyroidism, lead poisoning), and pallor/bluish line on the gum (lead poisoning).⁷

Laboratory evaluation

Laboratory investigations are usually not necessary unless the initial evaluation raises concern for an organic cause of constipation.⁴⁰ Serum and thyroid-stimulating hormone and free thyroxine levels should be determined if hypothyroidism is suspected. Serum potassium, calcium and lead levels should be determined if hypokalaemia, hypercalcaemia or lead poisoning, respectively, is suspected to be the cause of constipation. Serological testing for celiac disease is indicated in children with functional constipation who have short stature, unexpected weight loss, persistent gastrointestinal

symptoms, or a positive first-degree family history of celiac disease.

Instrumental evaluation

A plain abdominal radiograph to demonstrate an excessive faecal load in the colon is not routinely indicated but may be considered to assess the colonic faecal burden amongst children who are obese (physical examination not reliable) or who refuse digital rectal examination when indicated. A systematic review showed a high variance in sensitivity and specificity of abdominal radiography in the detection of faecal impaction and there was insufficient evidence for a diagnostic association between faecal loading on abdominal radiographs and clinical symptoms of constipation.⁴¹ Radiographs of the lumbosacral spine should be performed in children with neurological impairment of the lower extremities or perianal area or suspected spinal dysraphism.³¹

If Hirschsprung disease is suspected, a barium enema should be performed 'unprepped'.³¹ The barium enema may show proximal dilatation of the colon and the typical narrowing of the aganglionic colonic segment; in other words, the sigmoid is more dilated than the rectum. On the other hand, dilatation of the rectum to the anal verge strongly suggests functional constipation. However, short-segment Hirschsprung disease cannot be excluded without further investigation.

It has been shown that the transverse rectal diameter measured by transabdominal ultrasound is a reliable alternative to digital rectal examination when rectal impaction is suspected.^{42,43} However, as some constipated children do not have rectal impaction, transabdominal ultrasonography is not the sole predictor of constipation.

Anorectal manometry can be helpful in distinguishing functional constipation from Hirschsprung disease and dyssynergic defecation.⁴⁴ In functional constipation, the internal sphincter relaxes reflexively (anorectal reflex) with rectal distension. The absence of internal sphincter relaxation with rectal distension is highly suggestive of Hirschsprung disease or dyssynergic defecation.⁷ A definitive diagnosis of Hirschsprung disease can be made by rectal biopsy. A rectal biopsy, performed by the punch or suction method, which shows absence of ganglion cells in the submucosal and myenteric plexus is diagnostic of Hirschsprung disease.⁸ In dyssynergic defecation, ganglion cells can be seen in the submucosal and myenteric plexus.

A motility test, involving the ingestion of radiopaque markers to evaluate colonic motility, may be considered in patients with no obvious organic cause of constipation but fail to respond to intense treatment of functional constipation.³¹ The test can be useful to discriminate between faecal incontinence associated with functional constipation and that caused by functional non-retentive faecal incontinence.²² It should be noted that segmental colonic slow transit can also result from withholding behaviour in children. Nevertheless, colonic manometry is a

useful tool in children with intractable constipation to exclude neuromuscular motility disorders of the colon associated with slow-transit constipation; however, colonic manometry is performed mostly in academic settings. Colonic scintigraphy and the radiation-free wireless motility capsule are less frequently used methods to evaluate colonic transit time in children.

Complications

Functional constipation is uncomfortable for the patient and disruptive to daily functioning. Chronic functional constipation has a significant impact on the child's well-being and an adverse effect on health-related quality of life of the child and the parents.^{45–47} In a systematic review and meta-analysis of 20 studies that provided health-related quality of life data for 2344 children with functional constipation, pooled total quality of life scores of children with functional constipation were lower than those of children without functional constipation (65.6 *versus* 86.1; $p < 0.01$).⁴⁶ The psychosocial consequences of chronic functional constipation include emotional lability, depression, anxiety and aggression.⁴⁸

An anal fissure may result from the passage of hard and bulky stools. Encopresis or faecal soiling due to overflow may result from longstanding constipation. Chronic constipation can lead to progressive faecal retention, distension of the rectum, loss of rectal sensation and the normal urge to defecate. If neglected, constipation may result in faecal impaction and, in severe cases, large bowel obstruction. Rectal prolapse may be the result of severe chronic constipation.

Nocturnal and daytime enuresis, urinary tract infections, vesicoureteral reflux, and upper urinary tract dilatation are found in a significant number of children with chronic functional constipation.^{49–56} Up to 50% of children seen for dysfunctional voiding have underlying constipation.⁷

Most children with functional constipation have normal growth and development.⁵⁷ However, chronic constipation itself may result in poor growth and stunting in some children.^{58–60}

Childhood constipation has a significant impact on the use and cost of medical care resources such as emergency department visits and specialist care.^{61,62} Healthcare costs for children with functional constipation are considerable and estimated to be at least three times higher than those of children without constipation.^{61,62} The high rate of missed school days amongst children with functional constipation has a negative effect on the parental work and income as well as the child's academic success.⁶¹

Management

Children who have functional constipation will benefit from prompt and thorough treatment interventions, as delineated below. The goal of treatment is passage of soft stools, ideally once a day, without difficulties.⁶³

Dietary interventions

Adequate intake of fluid and fibre (age of the child plus 5–10 g per day) is essential in the prevention and treatment of functional constipation in children.^{22,64,65} On the other hand, evidence does not support the use of extra fluid intake in the treatment of functional constipation. During infancy, this intake can be ensured by adding carbohydrates (corn syrup or brown sugar) and prune juice to the diet. In the older child, large quantities of fluid, prune/apple/pear juice, bran cereal, and fruits and vegetables high in bulk are helpful. Excessive intake of fibre, on the other hand, is of no significant benefit in the treatment of functional constipation and should be avoided in children with faecal impaction and in those with stool-withholding behaviours as it can worsen symptoms.^{5,21,48,66} Limiting the intake of cow's milk may improve constipation in some children especially if the intake of cow's milk is excessive. The idea of limiting the intake of cow's milk is supported by evidence of histological changes in the colonic mucosa in children with chronic constipation indicating inflammation. A 2-week to 4-week trial of cow's milk avoidance should be considered for children with chronic constipation who do not respond to conventional strategies.

Education

Counselling of the parents and child (in an age-appropriate manner) is crucial in the management of childhood functional constipation.⁶² The child should not delay in responding to the call to defecate as the brain may become less responsive to further defecation urges if the call to defecate is repeatedly ignored. Unhurried use of the toilet and privacy cannot be overemphasized. To establish a regular bowel habit, the child should be asked to sit on the toilet for at least 10 minutes around the same time each day, preferably after a meal to make full use of the gastrocolic reflex. Proper positioning during defecation is important. The child should sit with their feet supported and with the knees above the levels of the hips.²¹ The use of a step stool to rest the feet may be necessary to achieve this position.^{7,21} Providing support for the child's feet helps to effectively use the pelvic muscles, relax the pelvic floor, reduce anal pressure, and increase intra-abdominal pressure during defecation.^{21,67} Parents should be advised to make toilet sitting a positive activity.¹¹ To motivate the child for toilet training, a reward system can be introduced to reinforce positive behaviour. When sitting on the toilet, the child may be permitted to listen to the radio or read a story book. If functional constipation develops at the time of toilet training, the training should be temporarily interrupted and not be resumed until the child has a normal stool pattern and is not resistant to sitting on the toilet.^{5,68}

Parents should be advised that the treatment process may take several months for the child to recover from withholding practices.¹⁶ They should be reassured about the safety of long-term use of non-stimulant laxatives.^{16,69}

Pharmacological interventions

The doses and side effects of various laxatives used in the treatment of functional constipation are listed in Table 1.^{3,4,6,7,22,63,67,70,71}

Disimpaction

In children with faecal impaction, an initial cleanout is essential prior to the initiation of maintenance therapy so as to increase treatment success.⁴ This can be effectively accomplished with oral medications, rectal medications or a combination of both. In general, the oral route is non-invasive, better tolerated and gives the child a sense of control^{6,67}; however, it can take a few days to work and compliance is an issue.⁶ On the other hand, the rectal approach (enema) is faster (effect occurs within minutes) but invasive and traumatic.⁶ Common side effects of enema include anorectal discomfort and abdominal pain.⁵ The child and caregivers should be involved in the choice of treatment options. Orally, polyethylene glycol (PEG) with or without electrolytes (PEG 3350), 1–1.5 g/kg/day for 3–6 days, is the first-line therapy.^{4,6,45,63} PEG without electrolytes is preferred because it is more palatable than PEG with electrolytes and is better accepted by children. In addition, PEG with electrolytes may have to be administered via the nasogastric route as it is not well tolerated orally.³ Generally, enemas and PEG are equally effective for faecal disimpaction. Other oral medications that have been used with success for disimpaction include lactulose, sorbitol, magnesium hydroxide, bisacodyl and senna.^{13,16,63} Rectal disimpaction can be accomplished with mineral oil, sodium phosphate enema or saline enema.^{7,16,63} In this regard, sodium phosphate enemas are contraindicated in children under two years of age.^{3,67} Glycerine suppositories are a safe and effective choice for infants.⁶⁷ Bisacodyl suppositories can be used for older children.⁶³ Rectal stimulation with a lubricated thermometer can be used, if necessary, for the removal of faecal impaction in the rectum.²¹

Maintenance therapy

If diet and bowel retraining fail and after disimpaction (if necessary) has been achieved, maintenance therapy is required to prevent the re-accumulation of stools. The choice of laxatives in infants and children is similar albeit with some important differences. Infants with functional constipation often respond to the consumption of non-digestible osmotically active carbohydrates, such as sorbitol-containing juices (e.g. prune juice, apple-prune juice, pear juice), and this should be tried first.⁶³ If the above measure fails, consideration should be given for the use of osmotic laxatives and/or glycerine suppositories.⁶³ Magnesium hydroxide and mineral oil are not palatable and because of the risk of lipid pneumonia, mineral oil should not be used in infants.⁶ Additionally, stimulant laxatives and enema are not recommended for use in infants.²¹

In children, the most commonly used and most effective laxative is PEG (0.4–0.8 g/kg/day) with or without electrolytes.^{22,38,45,72} The side effects are usually transient and

mild and include diarrhoea, bloating, flatulence, nausea and abdominal cramps.^{3,4} Lactulose is the preferred alternative if PEG is not available.^{21,67} The oral osmotic laxative should be given on a daily basis and the dose and frequency of administration should be titrated to treatment response.²¹ Other frequently used laxatives for maintenance therapy are listed in Table 1. Studies have shown that PEG is more effective than lactulose, magnesium hydroxide, stimulants and mineral oil in the treatment of functional constipation in children.^{73–79} Stimulants may be considered for the treatment of slow-transit functional constipation. Mineral oil should not be used in children at risk of aspiration such as those with gastroesophageal reflux or neurodevelopment disorders.⁶³

More resistant cases of functional constipation may require judicious use of a stimulating agent such as senna syrup or bisacodyl preparations on a short-term basis.

Weaning

Maintenance therapy should continue for at least 2 months because premature cessation of treatment may lead to recurrence.^{4,5,11} Weaning can be considered when all symptoms of constipation have resolved for at least 1 month.⁶⁷ At that time, the laxative should be gradually reduced, rather than abruptly discontinued, in order to prevent a relapse.⁴ Regular follow-up is essential.

Novel pharmacologic agents

Novel pharmacologic agents such as linaclotide, lubiprostone, prucalopride, naronapride and plecanatide have shown promise in the treatment of functional constipation in adults.^{4,5,22,63,80} As the pharmacodynamics and pharmacokinetics might differ between adults and children, these medications are presently not recommended for use in children due to a lack of data on the efficacy and safety of these medications in the treatment of functional constipation in children.⁵

Probiotics, prebiotics and synbiotics

Probiotics, prebiotics and synbiotics have been suggested as a potential treatment modality for functional constipation in children, presumably by altering the gut microbiota. Studies on the use of probiotics, prebiotics and synbiotics have yielded conflicting results.^{55,81–90} Currently, there is insufficient evidence to support the use of probiotics, prebiotics and synbiotics in the treatment of functional constipation in children.^{48,63,91–94} As such, the use of these medications in the treatment of functional constipation in children is not recommended until future high-quality randomized controlled trials prove their efficacy otherwise.^{91–94} At that time, the most effective strain of the probiotic as well as the dose and treatment duration of the probiotics, prebiotics and synbiotics have to be determined.

Behavioural modification

Behavioural modification has been suggested as an adjunct to medical therapy to recondition the child to normal bowel

Table 1. Suggested dosages of laxatives for functional constipation in children and their side effects.

Agent	Child's age	Dosage	Side effects
Osmotic laxatives			
Polyethylene glycol without electrolytes	Any age	0.4–0.8 g/kg/day (maximum 17 g/day) 1–1.5 g/kg/day for disimpaction	Diarrhoea, bloating, flatulence, nausea, vomiting, abdominal cramps
Polyethylene glycol with electrolytes	Any age	0.4–0.8 g/kg/day (maximum 17 g/day) 1–1.5 g/kg/day for disimpaction	Diarrhoea, bloating, flatulence, nausea, vomiting, abdominal cramps
Lactulose (70% solution)	Any age	1 mL/kg, once or twice daily (maximum 60 mL/day)	Bloating, flatulence, abdominal cramps, faecal incontinence
Sorbitol (70% solution)	1–11 years	1 mL/kg once or twice daily (maximum 30 mL/day)	Bloating, abdominal cramps
	>12 years	15–30 mL once or twice daily	
Magnesium hydroxide (400 mg/5 mL)	1–11 years	1–3 mL/kg/day in 1–2 divided doses (maximum 60 mL/day)	Hypermagnesaemia, hypocalcaemia, hypophosphataemia (with excess use)
	>12 years	30–60 mL daily	
Magnesium citrate (200 mg/5 mL)	2–5 years	1–3 mL/kg/day (maximum 90 mL/day)	Hypermagnesaemia, hypocalcaemia, hypophosphataemia (with excess use)
	6–12 years	100–150 mL/day	
Rectal laxatives/enemas			
Sodium phosphate/biphosphate enema	2–5 years	32 mL	Rectal discomfort, diarrhoea, abdominal cramps, electrolyte imbalance
	6–12 years	65 mL	
	>12 years	130 mL	
Bisacodyl suppository 10 mg/suppository	2–12 years	0.5–1 suppository/day	Rectal discomfort, diarrhoea, abdominal cramps, hypokalaemia
	>12 years	1 suppository/day	
Saline enema	1–2 years	6 mL/kg	Rectal discomfort, bloating
	3–11 years	30–60 mL	
	>11 years	60–150 mL	
Stimulant laxatives			
Senna (syrup, 8.8 mg sennosides/5 mL; tablet 8.6 mg sennosides/tablet)	1–2 years	1.25–2.5 mL once or twice daily	Idiosyncratic hepatitis, melanosis coli, nephropathy, neuropathy, hypertrophic osteoarthropathy
	3–5 years	2.5–3.75 mL once or twice daily	
	6–12 years	5–7.5 mL or 1–2 tablets once or twice a day	
	>12 years	5–15 mL or 1–3 tablets once or twice daily	
Bisacodyl tablet (5 mg/tablet)	2–12 years	1–2 tablets/day	Diarrhoea, abdominal cramps, hypokalaemia
	>12 years	1–3 tablets/day	
Sodium picosulphate	4–5 years	3 mg/day	Nausea, vomiting, bloating, abdominal cramps, diarrhoea, headache, taste impairment
	>6 years	4–6 mg/day	

(Continued)

Table 1. (Continued)

Agent	Child's age	Dosage	Side effects
Glycerine suppository	<1 year	Half a paediatric suppository once daily	Rectal irritation, bloating, abdominal cramps, diarrhoea
Bulk-forming laxatives			
Psyllium	6–12 years >12 years	2.5 g, 1–4 times daily 5 g, 1–4 times daily	Flatulence, abdominal pain, faecal impaction
Malt soup extract	Breast-fed infants Bottle-fed infants	5–10 mL in 60–120 mL of water twice daily 5–10 mL in every second feeding	Flatulence, faecal impaction
Lubricant			
Mineral oil	1–11 years >12 years	1–3 mL/kg daily (maximum 45 mL/day) 15–45 mL once daily	Lipoid pneumonia

movements.⁷ Behavioural interventions may include rewarding the child for defecation and for improved bowel habits such as sitting on the toilet for at least 10 minutes around the same time each day, preferably after a meal to take advantage of the gastrocolic reflex.¹³ A systematic review of 21 randomized trials ($n=1371$ children) showed that there is some evidence that combined behavioural and laxative therapy is more effective than either therapy alone.⁹⁵ The bowel has to be trained in such a way that it becomes conditioned to work on its own, a concept known as 'bowel retraining'.⁶³

Biofeedback/physical therapy

The effect of biofeedback therapy and pelvic physiotherapy for the treatment of functional constipation is controversial.^{95–101} Biofeedback therapy and pelvic physiotherapy are occasionally used as an adjunct to pharmacologic and behavioural therapy for patients with dyssynergic defecation.⁶³ Current evidence does not support the routine use of biofeedback training and pelvic physiotherapy in the treatment of childhood functional constipation.⁹⁵

Surgical interventions

Surgical interventions such as intestinal diversion (colostomy or ileostomy), sacral nerve stimulation with surgically implanted electrodes placed through the sacral foramen and connected to a pulse generator, anal sphincter release through myectomy or botulinum injection, cecostomy for antegrade enema, laparoscopic colectomy with ileorectostomy, and laparoscopic sigmoid resection with Malone appendicostomy may be considered as a last resort for severe, intractable constipation unresponsive to medical management.^{2,48,63,102–105}

Prognosis

Studies have shown that approximately 60% of children with functional constipation are free of symptoms and taken off laxatives after 6–12 months and that 25% of children with functional constipation will continue to have symptoms of constipation as adolescents and young adults.^{67,106,107} Approximately 50% of children with functional constipation have at least one relapse within the following 5 years.^{108,109} It has been shown that improved self-efficacy in children with functional constipation is associated with successful outcomes.¹¹⁰ Poor clinical outcomes at adult age include older age and lower defecation frequency at onset and longer delay between onset and treatment.¹⁰⁶ In addition, the very young age of onset (<1 year of age) and faecal incontinence are also associated with poor long-term prognosis.¹⁰⁹

Conclusion

Childhood constipation is a common problem but is often difficult to manage. Beyond the neonatal period, functional constipation accounts for more than 95% of cases of constipation in children. Functional constipation can usually be diagnosed by a thorough history and physical examination. The condition can be frustrating to both the child and the caregivers. Laxatives are the mainstay of treatment. PEG is the medication of choice for both disimpaction and maintenance therapy. Other laxatives, such as lactulose, can be used if PEG is not available. Non-pharmacological management consists of education, behavioural modification and dietary interventions. Early treatment will result in a faster and shorter treatment course.

Key practice points

- Functional constipation has a variety of aetiologies.
- A diagnosis of functional constipation should be differentiated from constipation secondary to Hirschsprung disease, hypothyroidism, multiple endocrine neoplasia type 2 or celiac disease.
- Functional constipation can be managed through dietary interventions, parental education, pharmacological interventions, behavioural modification, biofeedback/physical therapy and surgical interventions.
- Pharmacological therapy consists of faecal disimpaction (polyethylene glycol with or without electrolytes, 1–1.5 g/kg/day for 3–6 days; lactulose is alternative therapy) and maintenance therapy with oral medications, rectal medications or a combination of both.
- Polyethylene glycol is the most effective laxative for maintenance therapy in children (0.4–0.8 g/kg/day).
- More resistant cases of functional constipation may require judicious use of a stimulating agent such as senna syrup or bisacodyl preparations on a short-term basis.
- Other laxatives may be considered as second-line therapy if treatment with osmotic laxatives fails or is insufficient.
- The use of novel pharmacologic agents such as linaclotide, lubiprostone, prucalopride, naronapride and plecanatide or of probiotics, prebiotics and synbiotics has not been adequately tested in the paediatric population and their routine use is not currently recommended.
- Non-pharmacological management consists of education, behavioural modification and dietary interventions.
- The combination of pharmacological therapy and non-pharmacological management increases the chance of success. Maintenance treatment should be continued for at least 2 months.
- Surgical interventions may be considered as a last resort for severe, intractable constipation unresponsive to medical management.

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