CONSTIPATION IN INFANTS AND CHILDREN: EVALUATION AND TREATMENT

A medical position statement of the
North American Society for Pediatric Gastroenterology and Nutrition

Running Title: Algorithm for Evaluation and Treatment of Constipation

Susan S. Baker[1], Gregory S. Liptak[2], Richard B. Colletti[3], Joseph M. Croffie[4]
Carlo DiLorenzo[5], Walton Ector[1], and Samuel Nurko[6]

[1]Department of Pediatrics, Medical University of South Carolina, [2] Department of Pediatrics University of Rochester, [3]Department of Pediatrics, University of Vermont College of Medicine, [4]Department of Pediatrics, J Whitcomb Riley Hospital for Children, [5]Department of Pediatrics, Children's Hospital of Pittsburgh, University of Pittsburgh, [6]Department of Pediatrics, Harvard Medical School.

ABSTRACT

Background Constipation, defined as a delay or difficulty in defecation, present for two or more weeks, is a common pediatric problem encountered by both primary and specialty medical providers.

Methods The Constipation Subcommittee of the Clinical Guidelines Committee of the North American Society for Pediatric Gastroenterology and Nutrition has formulated clinical practice guidelines for the management of pediatric constipation. The Constipation Subcommittee, consisting of two primary care pediatricians, a clinical epidemiologist and pediatric gastroenterologists, based its recommendations on an integration of a comprehensive and systematic review of the medical literature combined with expert opinion. Consensus was achieved through Nominal Group Technique, a structured quantitative method.

Results The Subcommittee developed two algorithms to assist with medical management, one for older infants and children and the second for infants less than one year of age. The guidelines provide recommendations for management by the primary care provider, including evaluation, initial treatment, follow-up management and indications for consultation by a specialist. The Constipation Subcommittee also provided recommendations for management by the pediatric gastroenterologist.

Conclusion This report, which has been endorsed by the Executive Council of the North American Society for Pediatric Gastroenterology and Nutrition, has been prepared as a general guideline to assist providers of medical care in the evaluation and treatment of constipation in children. It is not intended as a substitute for clinical judgment or as a protocol for the management of all patients with this problem.

Key Words: Constipation, Encopresis, Infants, Children, Algorithm, Evidence based, Impaction, Guideline

BACKGROUND

A normal pattern of stool evacuation is felt to be a sign of health in children of all ages. Especially during the first months of life, parents pay close attention to the frequency and the characteristics of their children's defecation. Any deviation from what is felt to be normal for children by any family member may trigger a call to the nurse or a visit to the pediatrician. Thus, it is not surprising that approximately 3% of general pediatric outpatient visits and 25% of pediatric gastroenterology consultations are related to a complaint of defecation disorder (1). Chronic constipation is a source of anxiety for parents who worry that a serious disease may be causing the symptom. Yet only a small minority of children have an organic etiology for constipation. Beyond the neonatal period, the most common cause of constipation is functional constipation, which has also been called idiopathic constipation, functional fecal retention, and withholding constipation.

In most cases the parents are worried that the child's stools are too large, too hard, painful or too infrequent. The normal frequency of bowel movements at different ages has been defined (Table 1). Infants have a mean of 4 stools per day during the first week of life. This frequency gradually declines to a mean average of 1.7 stools per day at 2 years of age and 1.2 stools per day at 4 years of age (2,3). Some normal breastfed babies do not have stools for several days or longer (4). After 4 years, the frequency of bowel movements remains unchanged.

In most children constipation is functional, that is, without objective evidence of a pathological condition. Functional constipation most commonly is due to painful bowel movements with resultant voluntary withholding of feces by a child who wishes to avoid an unpleasant defecation. Many events can lead to painful defecation such as toilet training, changes in routine or diet, stressful events, intercurrent illness, unavailability of toilets, or postponing defecation because the child is too busy. They can lead to prolonged fecal stasis in the colon, with reabsorption of fluids and an increase in the size and consistency of the stools.

The passage of large hard stools that painfully stretch the anus may frighten the child, resulting in a fearful determination to avoid all defecation. Such children respond to the urge to defecate by contracting their anal sphincter and gluteal muscles, attempting to withhold stool (5). They rise on their toes and rock back and forth while stiffening their buttocks and legs, or wriggle, fidget or assume unusual postures, often performed while hiding in a corner. This dance-like behavior is frequently misconstrued by parents who believe that the child is straining in an attempt to defecate. Eventually, the rectum habituates to the stimulus of the enlarging fecal mass and the urge to defecate subsides. With time such retentive behavior becomes an automatic reaction. As the rectal wall stretches fecal soiling may occur, angering the parents and frightening the child (6). After several days without a bowel movement, irritability, abdominal distension, cramps and decreased oral intake may result.

Although constipation is a common pediatric problem, no evidence-based guidelines for its evaluation and treatment currently exist. Therefore, the Constipation Subcommittee of the Clinical Guidelines Committee was formed by the North American Society for Pediatric Gastroenterology and Nutrition (NASPGN) to develop a clinical practice guideline.

METHODS

The Constipation Subcommittee, which consists of two primary care pediatricians, a clinical epidemiologist and five pediatric gastroenterologists, addressed the problem of constipation in infants and children without a previously established medical condition. Neonates less than 72 hours old and premature infants less than 37 weeks gestation were excluded from consideration. This clinical practice guideline is designed to assist primary care pediatricians, family practitioners, nurse practitioners, physician assistants, pediatric gastroenterologists and pediatric surgeons in the management of children with constipation in both inpatient and outpatient settings. Constipation was defined as a delay or difficulty in defecation, present for two or more weeks, sufficient to cause significant distress to the patient. The desirable outcome of optimal management was defined as a normal stooling pattern, with interventions that have few or no adverse effects, and with resultant resumption of functional health.

In order to develop evidence-based guidelines, articles on constipation published in English were found using Medline (7). A search for articles published between January 1966 and November 1997, revealed 3,839 documents on constipation. The Cochrane Center has designed a search strategy for Medline to identify randomized controlled trials. This strategy includes controlled vocabulary and free-text terms such as randomized controlled trial, clinical trial, and placebo (8). When this search strategy was run with the term constipation, 1,047 articles were identified, 809 of which were in English, and 254 of which included children.

After letters, editorials, and review articles were eliminated, 139 articles remained. Forty-four of these dealt with special populations, such as children with meningomyelocele or Hirschsprung disease, and were discarded. Ninety-five articles remained and were reviewed in depth. A second search strategy was performed to identify articles on constipation that related to treatment, including drug therapy (75 articles), surgery (64 articles), and "therapy" (144 articles). This added 148 new articles, whose abstracts were reviewed. If the abstracts indicated the article might be relevant, the article was reviewed in depth. Seven additional articles were identified from the bibliographies of the articles already catalogued. A total of 160 articles were reviewed for these guidelines.

Articles were evaluated using written criteria developed by Sackett and colleagues (9,10). These criteria had been used in previous reviews (11,12). Five articles were chosen at random and reviewed by a colleague in the Department of Pediatrics at the University of Rochester who had been trained in epidemiology. Concordance using the criteria was 92%. Using the methods of the Canadian Preventive Services Task Force (13), the quality of evidence of each of the recommendations made by the Constipation Subcommittee was determined and is summarized in Table 2. The Subcommittee based its recommendations on integration of the literature review combined with expert opinion when evidence was insufficient. Consensus was achieved through Nominal Group Technique, a structured, quantitative method (14).

The guidelines were critiqued by numerous primary care physicians in community and academic practices including members of several committees of the American Academy of Pediatrics. In addition, the guidelines were distributed to the membership of the North American

Society for Pediatric Gastroenterology and Nutrition for review and comment and finally were officially endorsed by the Society's Executive Council.

Two algorithms were developed (Figures 1 and 2). The initial discussion is based on the algorithm for children one year and older. The second algorithm is for children less than one year of age. This paper discusses the first algorithm in detail and the second algorithm is discussed only where it diverges from the first.

MEDICAL HISTORY

Based on clinical experience, a thorough history is recommended as part of a complete evaluation of a child with constipation (Table 3). There are no well-designed studies that determine which aspects of a history are pertinent. Important information includes the time after birth of the first bowel movement, what the family or child means by the term constipation (15), the length of time the condition has been present, the frequency of bowel movements, the consistency and size of the stools, whether defecation is painful, whether blood has been present on the stool or toilet paper, and if the child experiences abdominal pain. Fecal soiling may be mistaken for diarrhea by some parents. A history of stool-withholding behavior reduces the likelihood that there is an organic disorder. Medications are an important potential cause of constipation (Table 4).

Fever, abdominal distention, anorexia, nausea, vomiting, weight loss or poor weight gain could be signs of an organic disorder (Table 4). Bloody diarrhea in an infant with a history of constipation could be an indication of enterocolitis complicating Hirschsprung disease.

A psychosocial history assesses the family structure, the number of people living in the child's home and their relationship to the child, the interactions the child has with peers and the possibility of abuse. If the child is in school it is important to learn whether or not the child uses the school bathrooms and if not why. The caregiver's assessment of the child's temperament may be useful in planning a reward system for toileting behavior.

PHYSICAL EXAMINATION

Based on clinical experience, a thorough physical examination is recommended as part of a complete evaluation of a child with constipation (Table 5). No well-designed studies have determined the aspects of the physical examination that are most important. External examination of the perineum and perianal area is essential. At least one digital examination of the anorectum is recommended. The anorectal examination assesses perianal sensation, anal tone, the size of the rectum and the presence of an anal wink. It also determines the amount and consistency of stool, and its location within the rectum. It is recommended that a test for occult blood in the stool be performed in all infants with constipation, as well as in any child who also has abdominal pain, failure to thrive, intermittent diarrhea or a family history of colon cancer or colonic polyps. Detection of a physical abnormality could lead to the identification of an organic disorder (Table 6).

A thorough history and physical examination is generally sufficient to allow the practitioner to establish whether the child requires further evaluation (Figure 1, box 4) or has functional constipation (Figure 1, box 5).

MANAGEMENT OF CHILDREN WITH FUNCTIONAL CONSTIPATION

The general approach to the child with functional constipation includes the following steps: determine whether fecal impaction is present (Figure 1, box 6), treat the impaction if present (Figure 1, box 7), initiate treatment with oral medication, provide parental education and close follow-up, and adjust medications as necessary (Figure 1, box 10).

Education

The education of the family and thedemystification of constipation, including an explanation of the pathogenesis of constipation, are the first steps in treatment. If fecal soiling is present, an important goal is to remove negative attributions for both the child and the parent. It is especially important for parents to understand that soiling from overflow incontinence is not a willful and defiant maneuver. Parents are encouraged to maintain a consistent, positive and supportive attitude for all aspects of treatment. It may be necessary to repeat the education and demystification processes several times during treatment (16).

Disimpaction

A fecal impaction is defined as a hard mass in the lower abdomen identified on physical examination, a dilated rectum filled with a large amount of stool on rectal examination or excessive stool in the colon on abdominal radiography (17). Disimpaction is necessary prior to starting maintenance therapy. Disimpaction may be carried out with either oral or rectal medication (Figure 1, box 7). In uncontrolled clinical trials disimpaction by the oral route, the rectal route or a combination of the two has been shown to be effective (Table 7) (18). There are no randomized studies that compare the effectiveness of one to the other. The oral approach is not invasive and gives a sense of power to the child but adherence to the treatment regimen may be a problem. The rectal approach is faster but is invasive. The choice of treatment is best determined after discussing the options with the family and child.

Disimpaction with oral medication has been shown to be effective when high doses of mineral oil, polyethylene glycol electrolyte solutions or both are used (18-20). Although there are no controlled trials demonstrating the effectiveness of high dose magnesium hydroxide, magnesium citrate, lactulose, sorbitol, senna or bisacodyl for initial disimpaction, these laxatives have been used successfully in that role (21,22). It is recommended that mineral oil, oral electrolyte solutions, or the above-mentioned laxatives be used alone or in combination for initial disimpaction when the oral route is selected.

Rectal disimpaction may be carried out with phosphate soda enemas, saline enemas, or mineral oil enemas followed by a phosphate enema (23,24). These enemas are widely used and

are effective. The use of soapsuds, tap water and magnesium enemas is not recommended because of their potential toxicity. Rectal disimpaction has also been effectively carried out with glycerin suppositories in infants (25) and bisacodyl suppositories in older children.

The Subcommittee discussed the use of digital disimpaction in chronic constipation in the primary care setting. However, there was insufficient literature on the subject and the Subcommittee could not reach consensus on whether to discourage or recommend its use.

Maintenance Therapy

Once the impaction has been removed, the treatment focuses on the prevention of the re-occurrence . For the child presenting without impaction (Figure 1, box 9) or after successful disimpaction, maintenance therapy is begun. This treatment consists of dietary interventions, behavioral modification and laxatives to assure that bowel movements occur at normal intervals with a good evacuation.

Dietary changes are commonly advised, particularly increased intake of fluids and absorbable and nonabsorbable carbohydrate, as a method to soften stools. Carbohydrates and especially sorbitol, found in some juices, such as prune, pear and apple juice, can cause increased frequency and water content of stools (26-27). No randomized controlled studies were found that demonstrated a proven effect on stools of increasing intakes of fluids, nonabsorbable carbohydrates or dietary fiber in children (28). A balanced diet that includes whole grains, fruits and vegetables is recommended as part of the treatment for constipation in children. Forceful implementation is undesirable.

Behavioral Modification

An important component of treatment includes behavior modification and regular toileting (29,30). Unhurried time on the toilet after meals is recommended. As part of the treatment of constipation, with or without overflow incontinence, it is often helpful to have children and their caregivers keep diaries of stool frequency. This can be combined with a reward system. For example, a child can use a calendar with stickers to record each stool that is passed in the toilet. The calendar can then be brought to visits with the health care provider and serves as both a diary and a point for positive reinforcement. In cases where motivational or behavior problems are interfering with successful treatment referral to a mental health care provider for behavior modification or other intervention may be helpful.

The successful treatment of constipation, especially with overflow incontinence, requires a family that is well organized, can complete time-consuming interventions, and is sufficiently patient to endure gradual improvements and relapses. Close follow-up by telephone and with office visits is recommended. Some families may need counseling support to help them effectively deal with this problem.

Medication

It is often necessary to use medication to help constipated children achieve regular bowel movements (Table 7). A prospective, randomized trial showed that the addition of medications to behavior management in children with constipation is beneficial (31). Children who received medications achieved remission significantly sooner than children who did not. The use of laxatives was most advantageous for children until they were able to maintain regular toileting.

When medication is necessary in the daily treatment of constipation, mineral oil (a lubricant) or magnesium hydroxide, lactulose or sorbitol (osmotic laxatives), or a combination of the two, is recommended. At this stage in the treatment of constipation, the chronic use of stimulant laxatives is not recommended. Extensive experience with long term use of mineral oil (32), magnesium hydroxide (33) and lactulose or sorbitol (33) has been reported. Long term studies show that these therapies are effective and safe (33,34). The doses and potential adverse effects of these medications are found in Table 7. Since mineral oil, magnesium hydroxide, lactulose or sorbitol seem to be equally efficacious, the choice among these is based on safety, cost, the child's preference, ease of administration and the practitioner's experience (Figure 1, box 14).

A stimulant laxative may be necessary intermittently, for short periods of time, to avoid recurrence of an impaction (Figure 1, box 15) (35). In this situation the use of stimulant laxatives is sometimes termed rescue therapy.

Maintenance therapy may be necessary for many months. Only when the child has been having regular bowel movements without difficulty is weaning considered. Primary care providers and families need to be aware that relapses are common and difficulty with bowel movements may continue into adolescence. Long term follow-up studies have demonstrated that a significant number of children continue to require therapy to maintain regular bowel movements (36,37).

CONSULTATION WITH A SPECIALIST

Consultation with a pediatric gastrointestinal specialist becomes necessary when the child fails therapy, when there is concern that an organic disease exists, or when management is complex (Figure 1, box 20). A consultant can re-evaluate the non-responding child, exclude an underlying organic process, perform specialized tests and offer counseling. The pediatric gastroenterologist (Figure 1, boxes 21-23) can review previous therapies, consider using different or additional medications or higher doses of the current medications, and reassess previous management before performing additional studies (Figure 1, box 23).

A careful review by the primary care practitioner of the differential diagnosis (Table 4) of the organic causes of constipation may be helpful at this time in order to determine which laboratory tests are indicated before referring to a specialist. It is recommended that the primary care physician consider whether or not the children who require evaluation by a specialist need to

have blood tests to identify evidence of hypothyroidism, hypercalcemia, celiac disease and lead toxicity (Figure 1, box 16). By having these tests ordered by the primary care provider just prior to referral to a pediatric gastroenterologist, patients who are found to have a medical problem that requires evaluation by a different subspecialist can be referred directly to the appropriate sub specialist. For example, a child with hypothyroidism can be referred directly to a pediatric endocrinologist.

Abdominal Radiograph and Transit Time

An abdominal radiograph is not indicated to establish the presence of a fecal impaction if the rectal exam reveals the presence of large amounts of stool. A retrospective study in encopretic children showed that moderate to large amounts of stool found on rectal examination had a high sensitivity and positive predictive value (greater than 80%) for predicting fecal retention determined by abdominal radiograph, even using the radiologists' subjective interpretation (38). However, the specificity and negative predictive value were 50% or less. When the systematic scoring system developed by Barr (17) was used for the presence of fecal retention on radiograph, the sensitivity of moderate to large amounts of stool on rectal examination improved to 92%, and the positive predictive value was 94%. However, the specificity was still only 71% and the negative predictive value was only 62% (39).

This suggests that, when there is doubt about whether the patient is constipated, a plain abdominal radiograph is reliable in determining the presence of fecal retention in the child who is obese or refuses a rectal exam, or in whom there are other psychological factors (sexual abuse) that make the rectal examination too traumatic. It may also be helpful in the child with a good history for constipation who does not have large amounts of stool on rectal examination (Figure 1, box 23). In a recent study the value of the Barr Score was compared to the colonic transit time. The Barr Score was shown to be poorly reproducible, with low inter-observer and intra-observer reliability, and there was no correlation with measurements of transit time (39).

Some patients have a history of infrequent bowel movements, but have no objective findings of constipation. The history obtained from the parents and child may not be entirely accurate (40). In these patients an evaluation of colonic transit time with radio-opaque markers may be helpful (Figure 1, box 25) (41). The quantification of transit time shows whether constipation is present and provides an objective evaluation of bowel movement frequency. If the transit time is normal, the child does not have constipation. If the transit time is normal and there is no soiling, the child needs no further evaluation (Figure 1, box 30). For children who have soiling without evidence of constipation the best results have been achieved with behavioral modification, but in some instances psychological evaluation and treatment may be necessary (Figure 1, box 29). If the transit study is abnormal or a fecal impaction is present, further evaluation will be needed (Figure 1, box 26). When a child with objective evidence of constipation is refractory to treatment, it is important to consider Hirschsprung disease (Figure 1, box 28).

Hirschsprung Disease

Hirschsprung disease is the most common cause of lower intestinal obstruction in neonates and is a rare cause of intractable constipation in toddlers and school-age children (42-44). It is characterized by a lack of ganglion cells in the myenteric and submucous plexuses of the distal colon, resulting in sustained contraction of the aganglionic segment. The aganglionic segment begins at the internal anal sphincter, extending orad in a contiguous fashion. In 75% of cases the disease is limited to the rectosigmoid area. The bowel proximal to the aganglionic zone becomes dilated due to the distal obstruction.

The incidence of Hirschsprung disease is approximately 1 in 5,000 live births. The most common associated abnormality is trisomy 21. More than 90% of normal neonates and less than 10% of children with Hirschsprung disease pass meconium in the first 24 hours of life (45,46). Thus, a delayed passage of meconium by a full term infant raises the suspicion of Hirschsprung disease. Hirschsprung disease can present with bilious vomiting, abdominal distension and refusal to feed, symptoms suggestive of intestinal obstruction. Subjects with short segment Hirschsprung disease may go undiagnosed until childhood. They have ribbon-like stools, a distended abdomen and often fail to thrive. In rare cases constipation is the only symptom. Fecal soiling is even more rare and occurs only when the aganglionic segment is extremely short.

Enterocolitis, the most feared complication of Hirschsprung disease, may be its initial manifestation. Enterocolitis presents with the sudden onset of fever, abdominal distension and explosive and, at times, bloody diarrhea (47,48). Occurring most often during the second and third months of life, it is associated with a mortality of 20%. The incidence of enterocolitis can be greatly reduced by a timely diagnosis of Hirschsprung disease.

The mean age at diagnosis decreased from 18.8 months in the 1960's to 2.6 months in the 1980's due to physician vigilance, anorectal manometry and early biopsy. However, 8-20% of children with Hirschsprung disease remain unrecognized after the age of 3 years (49,50). Physical examination reveals a distended abdomen and a contracted anal sphincter and rectum in the majority of children. The rectum is devoid of stool except in cases of short segment aganglionosis. As the finger is withdrawn, there may be an explosive discharge of foul smelling liquid stools, with decompression of the proximal normal bowel. In the older child presenting with constipation, a careful history and a thorough physical examination are sufficient to differentiate Hirschsprung disease from functional constipation in most cases.

Once Hirschsprung disease is suspected (Figure 1, box 28), it is recommended that the patient be evaluated at a medical center with a pediatric gastroenterologist and a pediatric surgeons where diagnostic studies can be performed. Delay in diagnosis increases the risk of enterocolitis. Rectal biopsy with histopathologic examination and rectal manometry are the only tests that can reliably exclude Hirschsprung disease. Rectal biopsies demonstrating the absence of ganglion cells in the submucosal plexus are diagnostic of Hirschsprung disease (51). The biopsies, obtained approximately 3 cm above the anal verge, must be deep enough to include adequate submucosa. Confirmation is obtained when special staining shows hypertrophied nerves.

However, in total colonic aganglionosis there is both an absence of ganglion cells and an absence of hypertrophied nerves. Occasionally suction biopsies are not diagnostic and a full thickness biopsy is required.

Anorectal manometry (Figure 1, box 31) evaluates the response of the internal anal sphincter to inflation of a balloon in the internal anal sphincter (52). When the rectal balloon is inflated, there is normally a reflex relaxation of the internal anal sphincter. In Hirschsprung disease this rectoanal inhibitory reflex is absent; there is no relaxation, or there may even be paradoxical contraction, of the internal anal sphincter. In a cooperative child, anorectal manometry represents a sensitive and specific diagnostic test for Hirschsprung disease. It is particularly useful when the aganglionic segment is short and radiologic or pathologic studies are equivocal. If sphincter relaxation is normal, Hirschsprung disease can be reliably excluded. In the presence of a dilated rectum, it is necessary to inflate the balloon with large volumes to elicit a normal sphincter relaxation. In the child with retentive behaviors, there may be artifacts due to voluntary contraction of the external anal sphincter and the gluteal muscles. Sedation, which does not interfere with the rectoanal inhibitory reflex, may be used in newborns and uncooperative children. If manometry is abnormal diagnosis needs to be confirmed with a biopsy.

Although a barium enema is often performed as the initial screening test to rule out Hirschsprung disease, it is usually unnecessary beyond infancy (53). When stool is present in the rectum to the level of the anus, the barium enema provides no more useful information than can be obtained with a plain radiograph. However, after the diagnosis of Hirschsprung disease has been made, the barium enema may be useful to identify the location of the transition zone, provided that laxatives or enemas have not been administered prior to the study to clean out the colon. The barium enema may not show a transition zone in cases of total colonic Hirschsprung disease, or may be indistinguishable from cases of functional consitpation when ultra-short segment Hirschsprung disease is present.

Other Medications and Testing

If a child with constipation fails to achieve resolution with the treatments outlined above, and Hirschsprung disease has been excluded, other therapies may be considered (Figure 1, box 34). Clearly, treatment may be necessary for an extended period of time, for months or years. Stimulant laxatives can be added for short periods of time. There is extensive experience with senna, bisacodyl and phenolphthalein (54,55). However, phenolphthalein is no longer available in the United States due to concerns about its carcinogenic potential.

The effectiveness of cisapride for the treatment of constipation is controversial. In some open label studies and placebo controlled trials it appears to be effective, but in another placebo controlled study cisapride had no effect (23,56-59). Polyethylene glycol electrolyte solutions have been used to achieve bowel clean out (20-61), and recently it has been suggested that the chronic administration of lower doses may be useful for long term therapy.

Biofeedback therapy has been evaluated in multiple open label studies where it was found to be efficacious (62). Some recent controlled studies, however, failed to demonstrate its long-

term efficacy. Biofeedback may be beneficial for the treatment of a small subgroup of patients with intractable constipation (63-65). At times intensive psychotherapy may be needed. Rarely inpatient hospitalization with behavioral therapy may be required.

Many conditions can cause constipation (Table 4). For children who remain constipated despite conscientious adherence to the treatment outlined above, other tests may be indicated (Figure 1, box 38). Magnetic resonance imaging (MRI) of the lumbosacral spine can demonstrate intra-spinal problems, such as a tethered cord, tumors, or sacral agenesis. Other diagnostic tests such as anorectal manometry, rectal biopsy, colonic manometry, barium enema, and a psychological evaluation can at times also prove helpful. Colonic manometry, by providing objective evidence of colonic function, can exclude the presence of an underlying neuropathy or myopathy (66). Barium enema can be useful to exclude the presence of anatomic abnormalities, or of a transition zone. Full thickness rectal biopsy can be useful to detect neuronal intestinal dysplasia or other myenteric abnormalities, including Hirschsprung disease. Metabolic tests, such as a serum calcium level, thyrocalcitonin concentration or thyroid function tests, can detect metabolic causes of constipation (67).

ALGORITHM FOR INFANTS LESS THAN 1 YEAR OF AGE

The evaluation of infants differs in some aspects from that of older children. Even in infancy most constipation is functional. However, when treatment fails, or there is delayed passage of meconium (Figure 2, box 4), or red flags are present (Figure 2, box, 8), particular consideration of Hirschsprung disease and other disorders is necessary. Hirschsprung disease is described in detail above. In a constipated infant with delayed passage of meconium, if Hirschsprung disease has been excluded, it is recommended that a sweat test be performed to rule out cystic fibrosis (Figure 2, box 6). Constipation can be the presenting manifestation of cystic fibrosis, even in the absence of failure to thrive and pulmonary symptoms.

Special consideration should also be given to breast fed infants in the first year of life. Greater variability in stool frequency occurs among breast fed infants than in formula fed infants (4, 68,69). Unless a suspicion of Hirschsprung disease is present, management of a breast fed infant requires only reassurance and close follow-up if the infant is growing normally, nurses well and has no signs or symptoms of obstruction or enterocolitis,

The treatment of constipation in infancy is similar to that of older children, with important exceptions. Increased intake of fluids, particularly juices containing sorbitol, such as prune, pear and apple, is recommended within the context of a healthy diet. Barley malt extract, corn syrup, lactulose or sorbitol can be used as a stool softeners. Light and dark corn syrups are not considered to be potential sources of *C botulinum* spores (70). Mineral oil and stimulant laxatives are not recommended. Because gastroesophageal reflux and incoordination of swallowing is more common in infants, there is a greater risk of aspiration of mineral oil, which can induce a severe lipoid pneumonia (71-73). Glycerin suppositories can be useful, and enemas are to be avoided.

References

1. Molnar D, Taitz LS, Urwin OM, Wales JK. Anorectal manometry results in defecation disorders. Arch Dis Child 1983;58:257-61.
2. Nyhan WE. Stool frequency of normal infants in the first weeks of life. Pediatrics 1952;10:414-25.
3. Weaver LT, Steiner H. The bowel habits of young children. Arch Dis Child 1983;59:649-52.
4. Hyams JS, Treem WR, Etienne NL, Weinerman H, MacGilpin D, Hine P, Choy K, Burke G. Effect of infant formula on stool characteristics of young infants. Pediatrics 1995;95:50-54.
5. Partin JC, Hamill SK, Fischel JE, Partin JS. Painful defecation and fecal soiling in children. Pediatrics 1992;89:1007-9.
6. Hyman PE, Fleisher D. Functional fecal retention. Practical Gastroenterology 1992;31:29-37.
7. Medline (online database) Bethesda, MD: National Library of Medicine, 1989. Updated weekly. Available from National Library of Medicine; BRS Information Technologies, McLean, VA: DIALOG Information Services, Inc., Palo Alto, CA
8. Mulrow CD, Oxman AD (eds). Formulating the problem. Cochrane Collaboration Handbook (updated September, 1997); Section 4. In: The Cochrane Library (database on disk and CDROM). Cochrane Collaboration. Oxform: Update Software; 1997, issue 4; Appendix 5c.2; http://www.medlib.com/cochranehandbook/.
9. Sackett DL, Haynes B, Tugwell P. Clinical Epidemiology: A Basic Science for Clinical Medicine, 2nd ed. Boston; Little, Brown, 1991.
10. Evidence-Based Medicine Informatics Project. Evidence Based Medicine; Users' Guides to the Medical Literature. Http://hiru.mcmaster.ca/ebm/userguid/, revised, May, 1997.
11. Liptak GS. Tethered spinal cord: an analysis of clinical research. European J Pediatr Surg 1992;2 (Suppl1):12-17.
12. Liptak GS. Tethered spinal cord: update of an analysis of published articles. European J Pediatr Surg 1995;5:21-23.
13. Canadian Task Force on the Periodic Health Examination. The periodic health examination. Canadian Medical Assoc J 1979;121:1193-1254.
14. McMurray AR. Three decision-making aids. Brainstorming, nominal group, and delphi technique. J Nursing Staff Development 1994;10:62-65.
15. Potts MJ, Sesney J. Infant constipation: maternal knowledge and beliefs. Clin Pediatr l992;3l:l43-l48.
16. Rappaport LA, Levine MD. The prevention of constipation and encopresis: a developmental model and approach. Pediatr Clin North Am 1986;33:859-869.
17. Barr RG, Levine MD, Wilkinson RH, Mulvihill D. Chronic and occult stool retention. A clinical tool for its evaluation in school-aged children. Clin Pediatr l979;l8:674-686.
18. Tolia V, Lin CH, Elitsur Y. A prospective randomized study with mineral oil and oral lavage solution for treatment of faecal impaction in children. Alimentary Pharmacology and Therapeutics 1993;7:523-29.
19. Gleghorn EE, Heyman MB, Rudolph CD. No-enema therapy for idiopathic constipation and encopresis. Clinical Pediatrics 1991;30:667-672

20. Ingebo KB, Heyman MB. Polyethylene glycol-electrolyte solution for intestinal clearance in children with refractory encopresis. A safe and effective therapeutic program. Am J Dis Child 1988;142:340-42.
21. Sutphen JL, Borowitz SM, Hutchison RL, Cox DJ. Long-term follow-up of medically treated childhood constipation. Clinical Pediatrics 1995;34:576-580.
22. Loening-Baucke V. Modulation of abnormal defecation dynamics by biofeedback treatment in chronically constipated children with encopresis. J Pediatr 1990;116:214-222.
23. Nurko SS, Garcia-Aranda JA, Guerrero VY, Woroma LB. Treatment of intractable constipation in children: experience with cisapride. J Pediatr Gastroenterol Nutr 1996;22:38-44.
24. Cox DJ, Sutphen J, Borowitz S, Dickens MN, Singles J, Whitehead WE. Simple electromyographic biofeedback treatment for chronic pediatric constipation/encopresis: preliminary report. Biofeedback & Self Regulation. 1994;19:41-50.
25. Weisman LE, Merenstein GB, Digirol M, Collins J, Frank G, Hudgins C. The effect of early meconium evacuation on early-onset hyperbilirubinemia. Am J Dis Child 1983;137:666-68.
26. Kneepkens CMF. What happens to fructose in the gut? Scand J Gastroenterol 1989;24(suppl 171):1-8.
27. Gryboski JD. Diarrhea from dietetic candy. N Eng J Med 1966;266:818
28. Olness K, Tobin JS, Hanck AB, Goffin H. Chronic constipation in children: can it be managed by diet alone: Dexpanthenol (Ro 01-4709) in the treatment of constipation. Postgraduate Medicine 1982;72:149-154.
29. Lowery SP, Srour JW, Whitehead WE, Schuster NM. Habit training as treatment of encopresis secondary to chronic constipation. J Pediatr Gastro Nutr 1985;4:397-401.
30. Howe AC, Walker CE, Behavioral management of toilet training, enuresis and encopresis. Pediatr Clin North Am 1992;39:413-32.
31. Nolan T, Debelle G, Oberklaid F, Coffey C.. Randomized trial of laxatives in treatment of childhood encopresis. Lancet 1991;338:523-27.
32. McClung HJ, Boyne LJ, Linsheid T, Heitlinger LA, Murray RD, Fyda J, Li Bu. Is combination therapy for encopresis nutritionally safe: Pediatrics 1993; 91:591-4.
33. Loening-Baucke V. Chronic constipation in children. Gastroenterology 1993;105:1557-1564.
34. Clark JH, Russell GJ, Fitzgerald JF, Nagamori KE. Serum β-carotene, retinol, and α-tocopherol levels during mineral oil therapy for constipation. Am J Dis Child 1987;141:1210-12.
35. Nurko SS. Constipation. In: Walker-Smith J, Hamilton D, Walker AW, eds. Practical Pediatric Gastroenterology, Second edition. Hamilton, Ontario: BC Decker, 1996;95-106.
36. Staiano A Andreotti MR, Greco L, Basile P, Auricchio S. Long term follow up of children with chronic idiopathic constipation. Dig Dis Sci 1994;39:561-564.
37. Loening-Baucke V. Constipation in children. Current Opinion in Pediatrics. 1994;6:556-561.
38. Rockney, RM, McQuade WH, Days AL. The plain abdominal roentgenogram in the management of encopresis. Arch Pediatr Adolesc Med 1995;149:623-627.

39. Benninga, MA, Buller HA, Staalman CR, Gubler FM, Bossuyt PM, van der Plas RN, Taminiau JA. Defecation disorders in children, colonic transit vs the Barr score. European J Pediatr 1995;154:277-284.
40. Van der Plas RN, Benninga MA, Redekop WK, Taminiau JA, Buller HA. How accurate is the recall of bowel habits in children with defaecation disorders? European J Pediatr 1997;156:178-81.
41. Papadopoulou A, Clayden GS, Booth IW. The clinical value of solid marker transit studies in childhood constipation and soiling. European Journal of Pediatr 1994;153:560-64.
42. Keinhaus S, Boley SJ, Sheran M, Sieber WK. Hirschsprung's disease: a survey of the members of the surgical section of the American Academy of Pediatrics. J Pediatr Surg 1979; 14: 588-600.
43. Russell MB, Russell CA, Niebuhr E. An epidemiological study of Hirschsprung's disease and additional anomalies. Acta Paediatr 1994;83:68-71.
44. Reding R, de Ville de Goyet J, Gosseye S, Clapuyt P, Sokal E, Buts JP, Gibbs P, Otte JB. Hirschsprung's disease: a 20 year experience. J Pediatr Surg 1997;32:1221-25.
45. Sherry SN, Kramer I. The time of passage of the first stool and first urine in the newborn infant. J Pediatr 1955;46:158-9.
46. Clark DA. Times of first void and first stool in 500 newborns. Pediatrics 1977;60:457-9.
47. Marty TL, Matlak ME, Hendrickson M, Black RE, Johnson DG. Unexpected death from enterocolitis after surgery for Hirschsprung's disease. Pediatrics 1995:96;118-121.
48. Elhalaby EA, Teitelbaum DH, Coran AG, Heidelberger KP. Entercolitis associated with Hirschsprung's disease: a clinical histopathological correlative study. J Pediatr Surg 1995;30:1023-26.
49. Klein MD, Phillippart AL. Hirschsprung's disease: three decades experience at a single institution. J Pediatr Surg 1993;28:1291-4.
50. Swenson O, Sherman JO, Fisher JH. Diagnosis of congenital megacolon: an analysis of 50l patients. J Pediatr Surg l973;8:587-594.
51. Aldridge RT, Campbell PE. Ganglion cells distribution in the normal rectum and anal canal. A basis for diagnosis of Hirschsprung's disease by anorectal biopsy. J Pediatr Surg 1968; 3: 475-489.
52. Rosemberg AJ, Vela AR. A new simplified technique for pediatric anorectal manometry. Pediatrics 1983; 71: 240-245.
53. Taxman TL, Yulish BS, Rothstein FC. How useful is the barium enema in the diagnosis of infantile Hirschsprung's disease? Am J Dis Child 1986; 140: 881-884.
54. Berg I, Forsythe I, Holt P, Watts J. A controlled trial of 'Senokot' in faecal soiling treated by behavioral methods. J Child Psychol Psychiatry 1983;24:543-49.
55. Loening-Baucke VA, Younoszai MK. Effect of treatment on rectal and sigmoid motility in Chronically constipated children. Pediatrics 1984;73:199-205.
56. Murray RD, Li UK, McClung HJ, Heitlinger L, Rehm D. Cisapride for intractable constipation in children: observation from an open trial. J Pediatr Gastroenterol Nutr 1990;11:503-508.

57. Odeka EB, Sagher F, Miller V, Doig C. Use of cisapride in treatment of constipation in children. J Pediatr Gastroenterol Nutr 1997;25:199-203.
58. Staiano A, Cucchiara S, Andreotti MR, Minella R, Manzi G. Effect of cisapride on chronic idiopathic constipation in children. Dig Dis Sci 1991;1991:733-36.
59. Halabi IM. Cisapride in management of chronic pediatric constipation. J Pediatr Gastroenter Nutr 1999;28:199-202.
60. Andorsky RI, Goldner F. Colonic lavage solution (polyethylene glycol electrolyte lavage solution) as a treatment for chronic constipation: a double-blind, placebo controlled study. Am J Gastroenterol 1990;85:261-65.
61. Corazziari E, Badiali D, Habib FI, Reboa GU, Mazzacca G, Sabbatini F. Small volume isosmotic polyethylene glycol electrolyte balanced solution (PMF-100) in treatment of chronic nonorganic constipation. Dig Dis Sci 1996;41:1636-1642.
62. Loening-Baucke V. Biofeedback therapy for chronic constipation and encopresis in childhood: long term outcome. Pediatrics 1995;96:105-110.
63. Loening-Baucke V. Biofeedback training in children with constipation: a critical review. Dig Dis Sci 1996;41:65-71.
64. Van der Plas RN, Benninga MA , Redekop WK, Taminiau JA, Buller HA. Randomized trial of biofeedback training for encopresis. Arch Dis Child 1996;75:367-74.
65. Van der Plas RN, Benninga MA, Buller HA, Bossuyt PM, Akkermans LM, Redekop WK, Taminiau JA. Biofeedback training in treatment of childhood constipation: a randomized controlled study. Lancet 1996;348:776-80.
66. DiLorenzo C, Flores AF, Reddy SN, Hyman PE. Use of colonic manometry differentiates causes of intractable constipation in children. J Pediatr 1992;120:690-05.
67. De Krijer RR, Brooks A, Van Der Harst E, Hofstra RW, Bruining HA, Molenaar JC, Meijers C. Constipation as the presenting symptom in de novo multiple endocrine neoplasia type 2B. Pediatrics 1998;102:405-7.
68. Fontana M Bianchi C, Cataldo F, Conti Nibali S, Cucchiora S, Gobio Casali L, Iacono G, Sanfillippo M, Tone G. Bowel frequency in healthy children. Acta Paediatr Scand 1989;78:682-84.
69. Sievers E, Oldigs H-D, Schultz-Lell, G, Schaub J. Faecal excretion in infants. Eur J Pediatr 1993;152:452-54.
70. Committee on Infectious Diseases, American Academy of Pediatrics. Red Book , American Academy of Pediatrics, Elk Grove Village, 1997, p175.
71. Fan LL, Graham LM. Radiological cases of the month. Lipoid pneumonia from mineral oil aspiration. Archives of Pediatr and Adolescent Medicine 1994;148:205-06.
72. Rabah R, Evans RW, Yunis EJ. Mineral oil embolization and lipid pneumonia in an infant treated for Hirschspring's disease. Pediatr Path 1987;7:447-55.
73. Wolfson BJ, Allen JL, Panitch HB, Karmazin N. Lipid aspiration pneumonia due to gastroesophageal reflux. A complication of nasogastric lipid feedings. Pediatr Rad 1989;19:545-47.

74. Fisher M, Eckhard C (eds). Guide to clinical preventive services: an assessment of the effectiveness of 169 interventions. Report of the U.S. Preventive Services Task Force. Baltimore: Williams and Wilkins;1989:387-8.
75. Bar-Maor JA, Eitan A. Determination of the normal position of the anus (with reference to idiopathic constipation). J Pediatr Gastroenterol Nutr 1987;6:559-61.
76. Iacono G, Cavataio F, Montalto G, Florena A, Tumminello M, Soresi M, Notarbartolo A, Carroccio A. Intolerance of cow's milk and chronic constipation in children. New Eng J Med 1998;339:1100-4.
77. Shulman RJ, Boyle JT, Colletti RB, Friedman R, Heyman MB, Kearns G, Kirschner BS, Levy J, Mitchell AA, Van Hare G. Use of cisapride in children. J Pediatr Gastroenterol Nutr 1999;28:529-33.

Table 1. Normal Frequency of Bowel Movements*

AGE	Bowel Movements per Week**	Bowel Movements per day***
0 to 3 months old		
Breast milk	5 to 40	2.9
Formula	5 to 28	2.0
6 to 12 months old	5 to 28	1.8
1 to 3 years old	4 to 21	1.4
> 3 years old	3 to 14	1.0

* Acta Paediatr Scand 1989;78:682-4
** Approximately mean ± 2 SD
*** Mean

Table 2. Summary of Recommendations and the Quality of the Evidence

Recommendations	Quality of Evidence*
General Recommendations	
A thorough history and physical examination are an important part of the complete evaluation of the infant or child with constipation	III
Performing a thorough history and physical examination is sufficient to diagnose functional constipation in most cases	III
A stool test for occult blood is recommended in all constipated infants and in those children who also have abdominal pain, failure to thrive, diarrhea or a family history of colonic cancer or polyps	III
In selected patients, an abdominal radiograph, when interpreted correctly, can be useful to diagnose fecal impaction	II-2
Rectal biopsy with histopathologic examination and rectal manometry are the only tests that can reliably exclude Hirschsprung disease	II-1
In selected patients, measurement of transit time using radio-opaque markers can determine whether constipation is present	II-2
Recommendations for Infants	
In infants, rectal disimpaction can be carried out with glycerin suppositories. Enemas are to be avoided	II-3
In infants, juices that contain sorbitol, such as prune, pear and apple juice, can decrease constipation	II-3
Barley malt extract, corn syrup, lactulose or sorbitol (osmotic laxatives) can be used as stool softeners	III
Mineral oil and stimulant laxatives are not recommended for infants	III
Recommendations for Children	
In children, disimpaction may be carried out with either oral or rectal medication, including enemas	II-3
In children, a balanced diet, containing whole grains, fruits and vegetables, is recommended as part of the treatment for constipation	III
The use of medications in combination with behavioral management can decrease the time to remission in children with functional constipation	I
Mineral oil (a lubricant) and magnesium hydroxide, lactulose and sorbitol (osmotic laxatives) are safe and effective medications	I
Rescue therapy with short-term administration of stimulant laxatives can be useful in selected patients	II-3
Senna and bisacodyl (stimulant laxatives) can be useful in selected patients who are more difficult to manage	II-1
Cisapride has been shown in some but not all controlled studies to be an effective laxative, and can be useful in selected patients	I
Polyethylene glycol electrolyte solution, given chronically in low dosage, may be an effective treatment for constipation that is difficult to manage	III

Biofeedback therapy can be effective short-term treatment of intractable constipation	II-2

*Categories of the Quality of Evidence (74)

I Evidence obtained from at least one properly designed randomized controlled study.

II-1 Evidence obtained from well-designed cohort or case-controlled trials without randomization.

II-2 Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one center or research group.

II-3 Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of the introduction of penicillin treatment in the 1940's) could also be regarded as this type of evidence.

III Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

Table 3. History in Pediatric Patients with Constipation

- Age
- Sex
- Chief Complaint
- Constipation History
  - Frequency and consistency of stools
  - Pain or bleeding with passing stools
  - Abdominal pain
  - Waxing and waning of symptoms
  - Age of onset
  - Toilet training
  - Fecal soiling
  - Withholding behavior
  - Change in appetite
  - Nausea/vomiting
  - Weight loss
  - Peri-anal fissures, dermatitis, abscess or fistula
  - Current treatment
    - Current diet (24 hour recall history)
    - Current Medications (for all medical problems)
      - Oral, enema, suppository, herbal
  - Previous treatment
    - Diet
    - Medications
      - Oral, enema, suppository, herbal
    - What has helped in the past
    - Behavioral treatment
    - Results of studies performed in the past
    - Estimate of parent/patient adherence
- Family history
  - Significant illnesses
  - Gastrointestinal (constipation, Hirschsprung Disease)
  - Other
    - Thyroid, parathyroid, cystic fibrosis, celiac disease
- Past Medical History
  - Gestational age
  - Time of passage of meconium
  - Condition at birth
  - Acute injury or disease
  - Hospitalizations
  - Immunizations
  - Allergies
  - Surgeries
  - Delayed growth/development
  - Sensitivity to cold

- Coarse hair
- Dry skin
- Recurrent urinary tract infections
- Other

Developmental History
- Normal, delayed
- School performance

Psycho-social history
- Psycho-social disruption of child or family
- Interaction with peers
- Temperament
- Toileting at school

Table 4. Differential Diagnosis of Constipation

- Nonorganic
  - Developmental
    - Cognitive handicaps
    - Attention-deficit disorders
  - Situational
    - Coercive toilet training
    - Toilet phobia
    - School bathroom avoidance
    - Excessive parental interventions
    - Sexual abuse
    - Other
  - Depression
  - Constitutional
    - Colonic inertia
    - Genetic predisposition
  - Reduced stool volume and dryness
    - Low fiber in diet
    - Dehydration
    - Underfeeding/malnutrition
- Organic
  - Anatomic malformations
    - Imperforate anus
    - Anal stenosis
    - Anterior displaced anus (75)
    - Pelvic mass (sacral teratoma)
  - Metabolic and Gastrointestinal
    - Hypothyroidism
    - Hypercalcemia
    - Hypokalemia
    - Cystic fibrosis
    - Diabetes mellitus
    - Multiple endocrine neoplasia type 2B
    - Gluten enteropathy
  - Neuropathic conditions
    - Spinal cord abnormalities
    - Spinal cord trauma
    - Neurofibromatosis
    - Static encephalopathy
    - Tethered cord
  - Intestinal nerve or muscle disorders
    - Hirschsprung disease
    - Intestinal neuronal dysplasia
    - Visceral myopathies
    - Visceral neuropathies
  - Abnormal abdominal musculature

- Prune belly
- Gastroschisis
- Down syndrome

Connective tissue disorders

- Scleroderma
- Systemic lupus erythematosus
- Ehlers-Danlos Syndrome

Drugs

- Opiates
- Phenobarbital
- Sucralfate
- Antacids
- Antihypertensives
- Anticholinergics
- Antidepressants
- Sympathomimetics

Other

- Heavy-metal ingestion (lead)
- Vitamin D intoxication
- Botulism
- Cows milk protein intolerance (76)

Table 5. Physical Examination of Children with Constipation

General appearance
Vital Signs
- Temperature
- Pulse
- Respiratory rate
- Blood pressure

Growth Parameters
Head, ears, eyes nose, throat
Neck
Cardiovascular
Lungs/chest
Abdomen
- Distention
- Liver/spleen palpable
- Fecal mass

Anal inspection:
- Position
- Stool present around anus/on clothes
- Perianal erythema
- Skin tags
- Anal fissures

Rectal examination
- Anal wink
- Anal tone
- Fecal mass
- Presence of stool
- Consistency of stool
- Other masses
- Explosive stool on withdrawal of finger
- Occult blood in stool

Back and spine examination
- Dimple
- Tuft of hair

Neurological examination:
- Tone
- Strength
- Cremasteric reflex
- Deep tendon reflexes

Table 6. Physical Findings Distinguishing Organic Constipation From Functional Constipation

Failure to thrive
Abdominal distention
Lack of lumbo-sacral curve
Pilonidal dimple covered by a tuft of hair
Midline pigmentary abnormalities of the lower spine
Sacral agenesis
Flat buttocks
Anteriorly displaced anus
Patulous anus
Tight empty rectum in presence of palpable abdominal fecal mass
Gush of liquid stool and air from rectum on withdrawal of finger
Occult blood in stool
Absent anal wink
Absent cremasteric reflex
Decreased lower extremity tone and/or strength
Absence or delay in relaxation phase of lower extremity deep tendon reflexes

Table 7. Medications for use in treatment of constipation

Laxatives		**Dosage**	**Side Effects**	**Notes**
Osmotic	Lactulose*	1-3 mL/kg/day in divided doses Available as 70% solution	Flatulence, abdominal cramps Hypernatremia has been reported when used in high dosage for hepatic encephalopathy. Case reports of 'nontoxic megacolon' in elderly	Synthetic disaccharide. Well tolerated long term.
	Sorbitol*	1-3 mL/kg/day in divided doses Available as 70% solution	Same as Lactulose	Less expensive than Lactulose
	Barley malt extract*	2-10 mL/240 mL of milk or juice		Unpleasant odor. Suitable for infants drinking from a bottle
	Magnesium hydroxide*	1-3 mL/kg/day of 400 mg/5 mL Available as liquid, 400 mg/5 mL, 800 mg/5 mL and tablets	Infants are susceptible to magnesium poisoning. Overdose can lead to hypermagnesemia, hypophosphatemia and secondary hypocalcemia	Acts as an osmotic laxative Releases cholecystokinin, which stimulates gastrointestinal secretion and motility. Use with caution in renal impairment
	Magnesium citrate*	< 6 years – 1-3 mL/kg/day as QD 6-12 years – 100-150 mL/day >12 years – 150-300 ml/day Single or divided doses Available as liquid, 16.17% magnesium	Infants are susceptible to magnesium poisoning. Overdose can lead to hypermagnesemia, hypophosphatemia and secondary hypocalcemia	

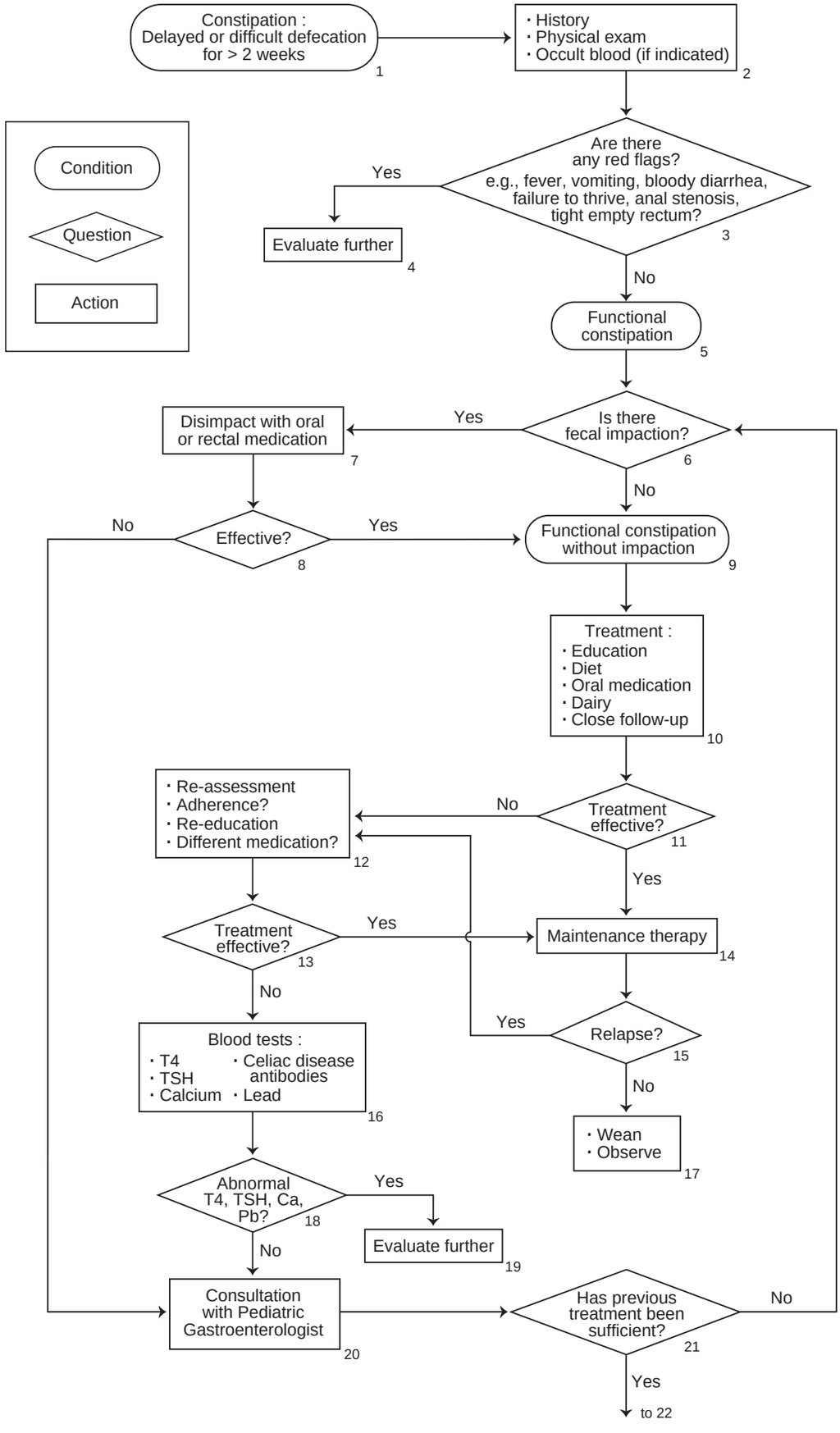
Osmotic *Enema*	Phosphate enemas	<2 year old: to be avoided ≥ 2 years old: 6 mL/kg up to 135 mL	Risk of mechanical trauma to rectal wall. Abdominal distention, vomiting. May cause severe and lethal episodes of hyperphosphatemia hypocalcemia, with tetany.	Some of the anion is absorbed, but if kidney is normal, no toxic accumulation occurs. Most side effects occur in children with renal failure or Hirschsprung disease. .
Lavage	Polyethylene glycol-electrolyte solution	For disimpaction: 25 mL/kg/hr (to 1000 mL/hr) by nasogastric tube until clear Or 20 mL/kg/hr for 4 hr/day For maintenance: (older children): 5-10 mL/kg/day	Difficult to take. Nausea, bloating, abdominal cramps. Vomiting and anal irritation. Aspiration pneumonia Pulmonary edema Mallory Weiss tear Safety of long-term maintenance not well established	Information mostly obtained from use for total colonic irrigation. May require hospitalization and nasogastric tube.
Lubricant	Mineral oil*	< 1 year old: not recommended Disimpaction: 15-30 mL/year of age, up to 240 mL daily Maintenance: 1-3 mL/kg/day	Lipoid pneumonia if aspirated. Theoretical interference with absorption of fat soluble substances, but there is no evidence in the literature. Foreign body reaction in intestinal mucosa.	Softens stool and decreases water absorption More palatable if given cold Anal leakage indicates dose too high or need for clean-out
Prokinetic	Cisapride	0.2 mg/kg/dose, TID or QID. Available as suspension, 1 mg/mL and 5, 10 and 20 mg tablets	Headaches Abdominal pain Diarrhea Urinary frequency Cardiac arrhythmias	Can cause cardiac arrhythmia when given with medications that interact with cytochrome P450 3A4 (77).

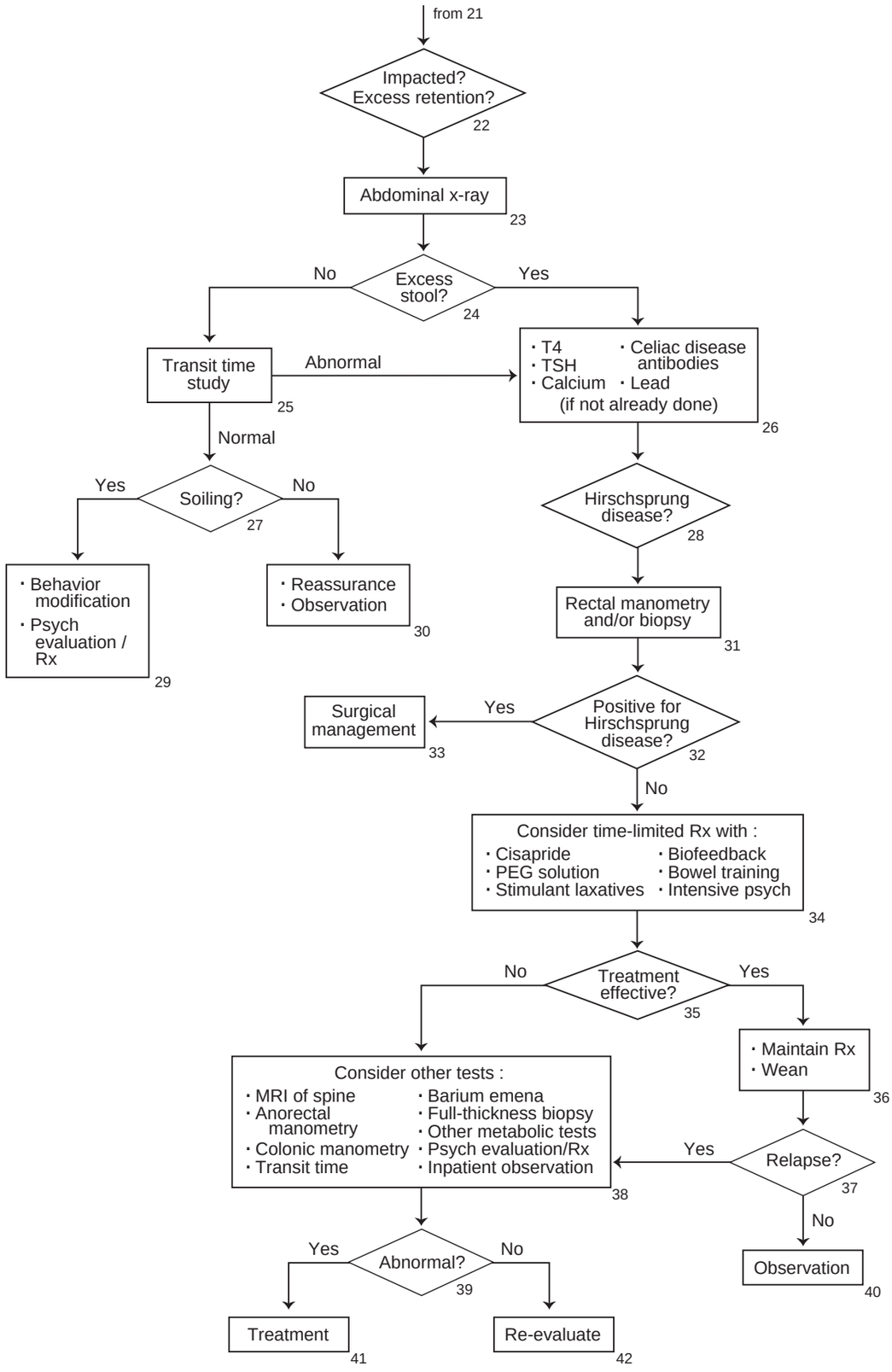
Stimulants			Abdominal pain. Cathartic colon (possibility of permanent gut, nerve, or muscle damage)	Increased intestinal motility
	Senna	2-6 years old: 2.5-7.5 mL/day 6-12 years old: 5-15 mL/day Available as Senokot® syrup, 8.8 mg of sennosides/5 mL. Also available as granules and tablets.	Idiosyncratic hepatitis Melanosis Coli Hypertrophic osteoarthropathy Analgesic nephropathy	Melanosis Coli improves 4-12 months after stopping medications
	Bisacodyl	≥ 2 years old: 0.5-1 suppository 1-3 tablets per dose Available in 5 mg tablets and 10 mg suppositories	Abdominal pain Diarrhea and hypokalemia Abnormal rectal mucosa, and rarely proctitis Case reports of urolithiasis	
	Glycerin suppositories		No side effects	

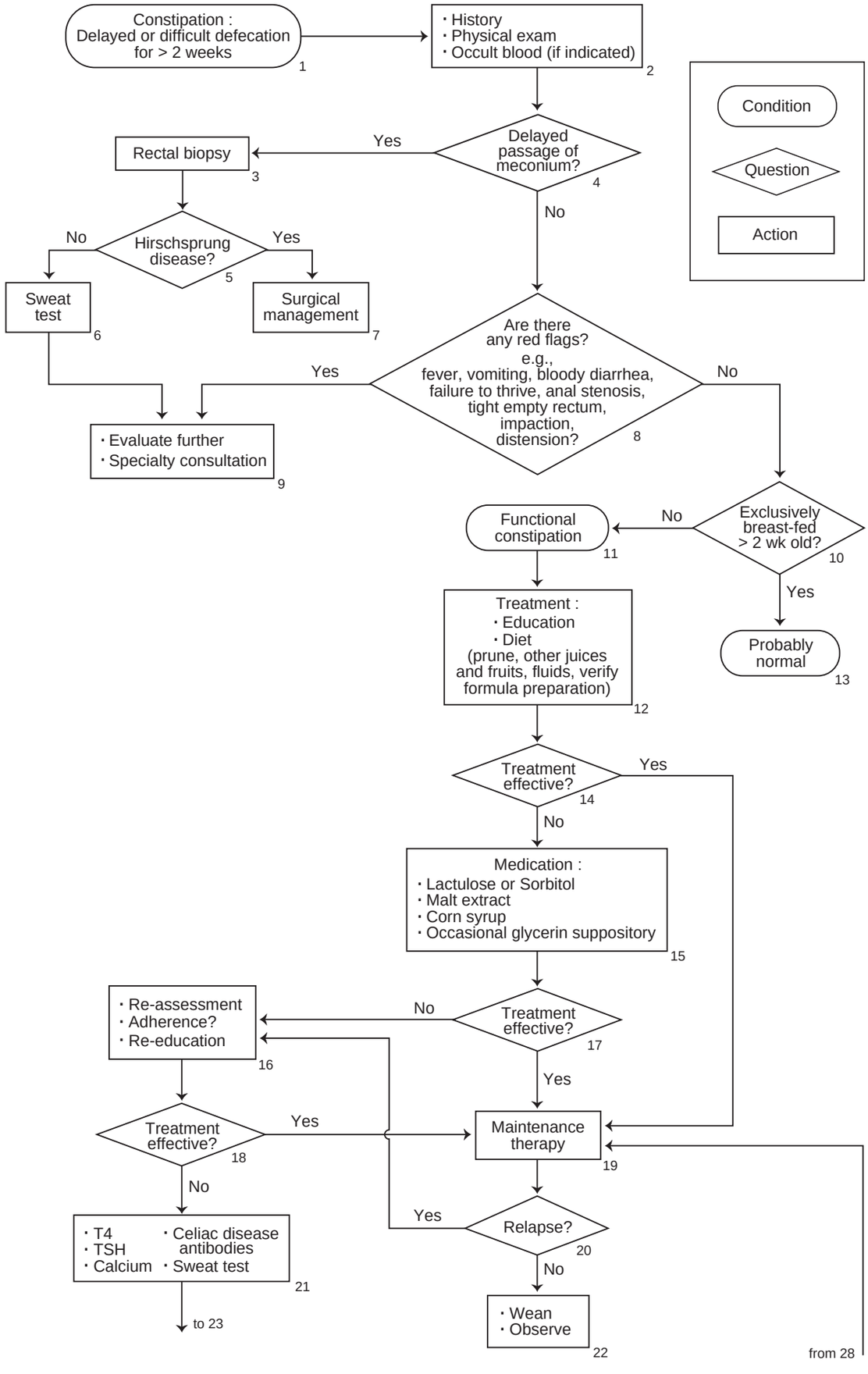
*Adjust dose to induce a daily bowel movement for 1-2 months

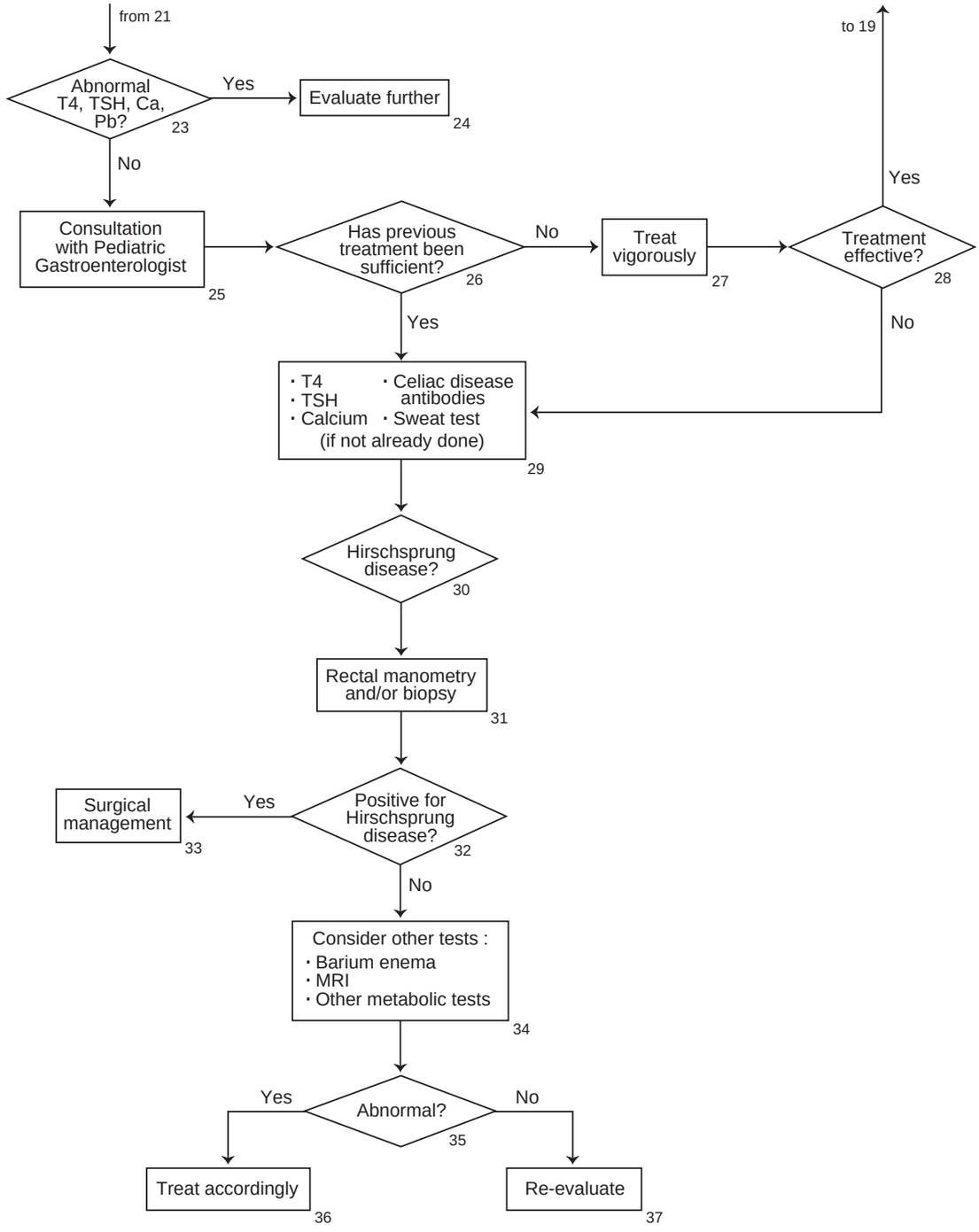
Figure 1. An algorithm for the management of constipation in children one year of age and older. T4 = thyroxine; TSH = thyroid stimulating hormone; Ca = calcium; Pb = lead; Rx = therapy; PEG = polyethylene glycol electrolyte; psych = psychological management; MRI = Magnetic resonance imaging.

Figure 2. An algorithm for the management of constipation in infants less than one year of age. T4 = thyroxine; TSH = thyroid stimulating hormone; Ca = calcium; Pb = lead; Rx = therapy; PEG =polyethylene glycol electrolyte; psych = psychological management; MRI =Magnetic resonance imaging.


Condition
Question
Action
Constipation :
Delayed or difficult defecation
for > 2 weeks
1
・History
・Physical exam
・Occult blood (if indicated)
2
Are there
any red flags?
e.g., fever, vomiting, bloody diarrhea,
failure to thrive, anal stenosis,
tight empty rectum?
3
Yes
Evaluate further
4
No
Functional
constipation
5
Is there
fecal impaction?
6
Yes
Disimpact with oral
or rectal medication
7
No
Effective?
8
No
Yes
Functional constipation
without impaction
9
Treatment :
・Education
・Diet
・Oral medication
・Dairy
・Close follow-up
10
Treatment
effective?
11
No
・Re-assessment
・Adherence?
・Re-education
・Different medication?
12
Yes
Maintenance therapy
14
Relapse?
15
Yes
No
・Wean
・Observe
17
Treatment
effective?
13
Yes
No
Blood tests :
・T4
・TSH
・Calcium
・Celiac disease
antibodies
・Lead
16
Abnormal
T4, TSH, Ca,
Pb?
18
Yes
Evaluate further
19
No
Consultation
with Pediatric
Gastroenterologist
20
Has previous
treatment been
sufficient?
21
No
Yes
to 22


from 21
Impacted?
Excess retention?
22
Abdominal x-ray
23
No
Excess stool?
24
Yes
Transit time study
25
Abnormal
・T4
・TSH
・Calcium
・Celiac disease antibodies
・Lead
(if not already done)
26
Normal
Yes
Soiling?
27
No
・Behavior modification
・Psych evaluation / Rx
29
・Reassurance
・Observation
30
Hirschsprung disease?
28
Rectal manometry and/or biopsy
31
Surgical management
33
Yes
Positive for Hirschsprung disease?
32
No
Consider time-limited Rx with :
・Cisapride
・PEG solution
・Stimulant laxatives
・Biofeedback
・Bowel training
・Intensive psych
34
No
Treatment effective?
35
Yes
・Maintain Rx
・Wean
36
Relapse?
37
Yes
No
Observation
40
Consider other tests :
・MRI of spine
・Anorectal manometry
・Colonic manometry
・Transit time
・Barium emena
・Full-thickness biopsy
・Other metabolic tests
・Psych evaluation/Rx
・Inpatient observation
38
Yes
Abnormal?
39
No
Treatment
41
Re-evaluate
42


Constipation :
Delayed or difficult defecation
for > 2 weeks
1
・History
・Physical exam
・Occult blood (if indicated)
2
Condition
Question
Action
Delayed
passage of
meconium?
4
Yes
Rectal biopsy
3
No
Hirschsprung
disease?
5
No
Yes
Sweat
test
6
Surgical
management
7
Are there
any red flags?
e.g.,
fever, vomiting, bloody diarrhea,
failure to thrive, anal stenosis,
tight empty rectum,
impaction,
distension?
8
Yes
No
・Evaluate further
・Specialty consultation
9
Exclusively
breast-fed
> 2 wk old?
10
No
Yes
Functional
constipation
11
Probably
normal
13
Treatment :
・Education
・Diet
(prune, other juices
and fruits, fluids, verify
formula preparation)
12
Treatment
effective?
14
Yes
No
Medication :
・Lactulose or Sorbitol
・Malt extract
・Corn syrup
・Occasional glycerin suppository
15
・Re-assessment
・Adherence?
・Re-education
16
Treatment
effective?
17
No
Yes
Treatment
effective?
18
Yes
No
Maintenance
therapy
19
Relapse?
20
Yes
No
・T4
・TSH
・Calcium
・Celiac disease
antibodies
・Sweat test
21
to 23
・Wean
・Observe
22
from 28


from 21
Abnormal T4, TSH, Ca, Pb?
23
Yes
Evaluate further
24
No
Consultation with Pediatric Gastroenterologist
25
Has previous treatment been sufficient?
26
No
Treat vigorously
27
Treatment effective?
28
Yes
to 19
No
Yes
・T4
・TSH
・Calcium
・Celiac disease antibodies
・Sweat test
(if not already done)
29
Hirschsprung disease?
30
Rectal manometry and/or biopsy
31
Positive for Hirschsprung disease?
32
Yes
Surgical management
33
No
Consider other tests :
・Barium enema
・MRI
・Other metabolic tests
34
Abnormal?
35
Yes
No
Treat accordingly
36
Re-evaluate
37