*Journal of Pediatric Gastroenterology and Nutrition*
**43:**e1–e13 © September 2006 Lippincott Williams & Wilkins, Philadelphia

Clinical Practice Guideline

# Evaluation and Treatment of Constipation in Infants and Children: Recommendations of the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition

**ABSTRACT**
Constipation, defined as a delay or difficulty in defecation, present for 2 or more weeks, is a common pediatric problem encountered by both primary and specialty medical providers. The Constipation Guideline Committee of the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition (NASPGHAN) has formulated a clinical practice guideline for the management of pediatric constipation. The Constipation Guideline Committee, consisting of 2 primary care pediatricians, 1 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. The Committee developed 2 algorithms to assist with medical management, 1 for older infants and children and the second for infants less than 1 year of age. The guideline provides recommendations for management by the primary care provider, including evaluation, initial treatment, follow-up management, and indications for consultation by a specialist. The Constipation Guideline Committee also provided recommendations for management by the pediatric gastroenterologist. ***JPGN 43:e1–e13, 2006.*** **Key Words:** Constipation—Guidelines. © 2006 Lippincott Williams & Wilkins

## BACKGROUND

A normal pattern of stool evacuation is thought 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 thought by any family member to be normal for children 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 perceived 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 cause for constipation. Beyond the neonatal period, the most common cause of constipation is functional and has been called idiopathic constipation, functional fecal retention, and fecal withholding.

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 breast-fed babies do not have stools for several days or longer (4). After 4 years, the frequency of bowel movements remains unchanged.

Functional constipation—that is, constipation without objective evidence of a pathological condition—most commonly is caused by painful bowel movements with resultant voluntary withholding of feces by a child who wants to avoid 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 the child's postponing defecation because he or she is too busy. Withholding feces 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

Received June 3, 2006; accepted June 5, 2006.
Address correspondence and reprint requests to Executive Director, NASPGHAN, 1501 Bethlehem Pike, PO Box 6, Flourtown PA 19031. (e-mail: naspghan@naspghan.org).
This updated guideline replaces the guideline published originally in 1999 (*JPGN* 1999;29:612–616).
Disclaimer: The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

**TABLE 1.** *Normal frequency of bowel movements*

| Age | Bowel movements per week[a] | Bowel movements per day[b] |
|---|---|---|
| 0–3 Months | | |
| Breast-fed | 5–40 | 2.9 |
| Formula-fed | 5–28 | 2.0 |
| 6–12 months | 5–28 | 1.8 |
| 1–3 years | 4–21 | 1.4 |
| More than 3 years | 3–14 | 1.0 |

Adapted from Fontana M. Bianch C, Cataldo F, et al. Bowel frequency in healthy children. *Acta Paediatr Scand* 1987;78:682–4.
[a]Approximately mean ± 2 SD.
[b]Mean.

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 (5,6). 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 (7). 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 Guideline Committee was formed by the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition (NASPGHAN) to develop a clinical practice guideline.

## METHODS

The Constipation Guideline Committee, which consists of 2 primary care pediatricians, 1 clinical epidemiologist, and

**TABLE 2.** *Summary of recommendations and the quality of the evidence*

| Recommendations | Quality of evidence[a] |
|---|---|
| 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 colon 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 histopathological examination and rectal manometry are the only tests that can reliably exclude Hirschsprung disease. | II-1 |
| In selected patients, measurement of transit time using radiopaque markers can determine whether constipation in present. | II-2 |
| Recommendations for infants | |
| In infants, rectal disimpaction can be achieved with glycerin suppositories. Enemas are to be avoided. | II-3 |
| In infants, juices that contain sorbitol, such as prune, pear, and apple juices 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 can be achieved 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 treat. | II-1 |
| Polyethylene glycol electrolyte solution, given in low dosage, may be an effective long-term treatment for constipation that is difficult to manage. | III |
| Biofeedback therapy can be an effective short-term treatment of intractable constipation. | II-2 |

[a]Categories of the quality of evidence (95):
I: Evidence obtained from at least one properly designed randomized controlled study. II-1: Evidence obtained from well-designed cohort or case–control trials without randomization. II-2: Evidence obtained from well-designed cohort or case–control analytic studies, preferably from more than 1 center or research group. II-3: Evidence obtained from multiple time series with or without intervention. Dramatic results in uncontrolled experiments (such as the results of the introduction of penicillin treatment in the 1940s) 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.

5 pediatric gastroenterologists, addressed the problem of constipation in infants and children who had no previously established medical condition. Neonates less than 72 hours old and premature infants of less than 37 weeks' gestation were excluded from consideration. This clinical practice guideline has been 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 2 or more weeks, and 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.

To develop the initial evidence-based guideline, articles on constipation published in English were found using Medline (8). A search for articles published from January 1966 through November 1997, revealed 3839 articles 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* (9). When this search strategy was run with the term *constipation*, 1047 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 were studies in special populations, such as children with meningomyelocele or Hirschsprung disease, and were eliminated. Ninety-five articles remained and were reviewed in depth. A second search strategy was used 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

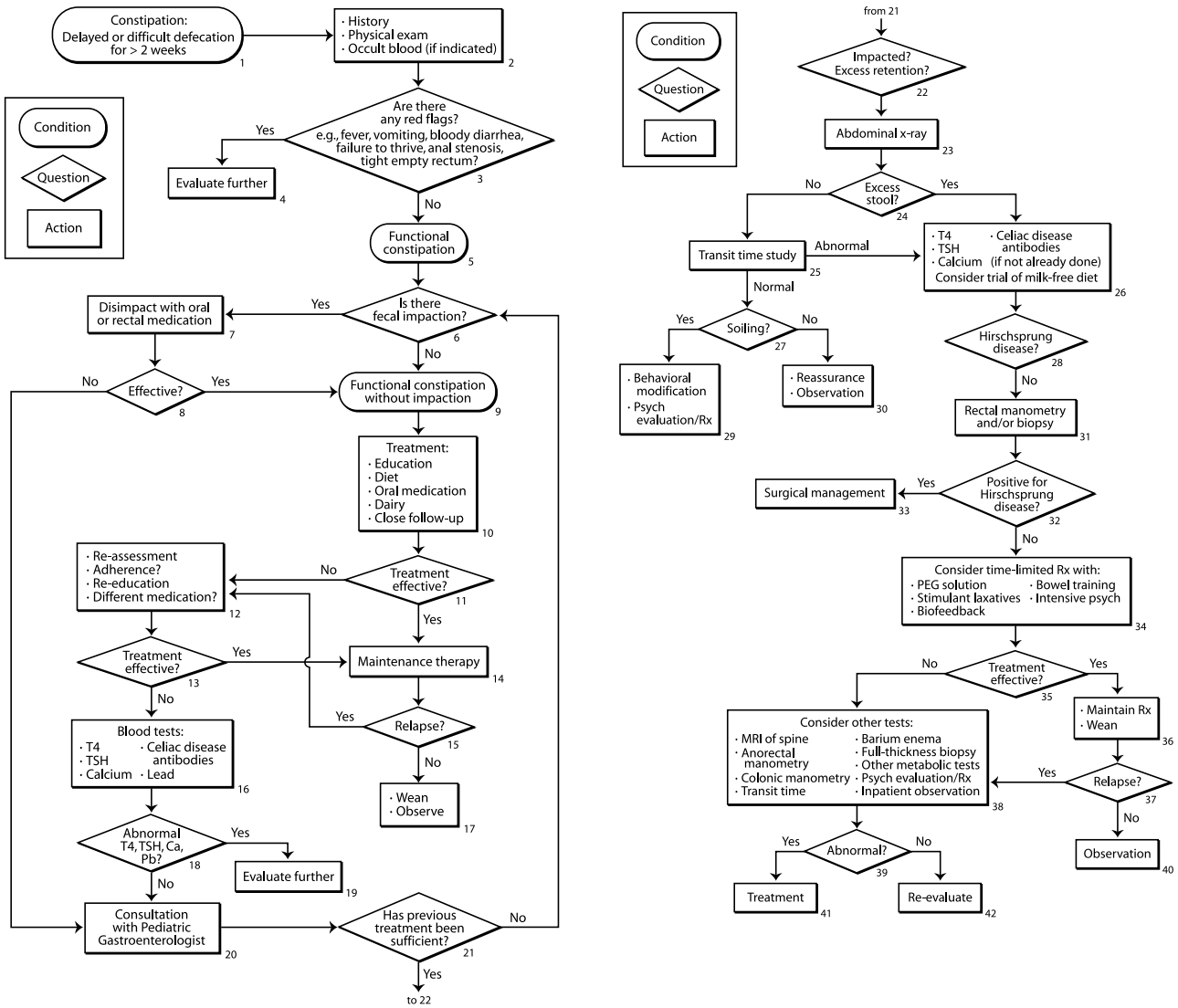


**FIG. 1.** An algorithm for the management of constipation in children 1 year of age and older. T4, thyroxine; TSH, thyroid-stimulating hormone; Ca, calcium; Pb, lead; Rx, therapy; PEG, polyethylene glycol electrolyte; psych, psychological management; MRI, magnetic resonance imaging.

in which the abstracts were reviewed. If the abstract indicated that the article may be relevant, the article was reviewed in depth. Seven additional articles were identified from the reference listings of the articles already cataloged. In total, 160 articles were reviewed for these guidelines.

Articles were evaluated using written criteria developed by Sackett et al. (10,11). These criteria had been used in previous reviews (12,13). Five articles were chosen at random and reviewed by a colleague in the Department of Pediatrics at the University of Rochester (New York, U.S.A.) who had been trained in epidemiology. Concordance using the criteria was 92%. Using the methods of the Canadian Preventive Services Task Force (14), the quality of evidence of each of the recommendations made by the Constipation Guideline Committee was determined and is summarized in Table 2. The Committee 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 (15).

The guidelines were critically reviewed 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 NASPGHAN membership for review and comment and finally were officially endorsed by the society's Executive Council.

Two algorithms were developed (Figs. 1 and 2). The initial discussion is based on the algorithm for children 1 year of age and older. The second algorithm is for children less than 1 year of age. In this article, the first algorithm is discussed in detail, and the second algorithm is discussed only when it diverges from the first.

To evaluate evidence published since 1997, literature searches using the key word "constipation," limited to English language, and "All Child" (which includes children and adolescents 0–18 years of age) were performed in PubMed on May 5, 2003, August 8, 2003 and August 9, 2004. The Database of Abstracts of Reviews of Effects (DARE) and the Cochrane Database of Systematic Reviews also were searched using the key word "constipation." From this search 90 total articles were identified by this process; 27 applied to children who did not have an underlying chronic condition. The authors

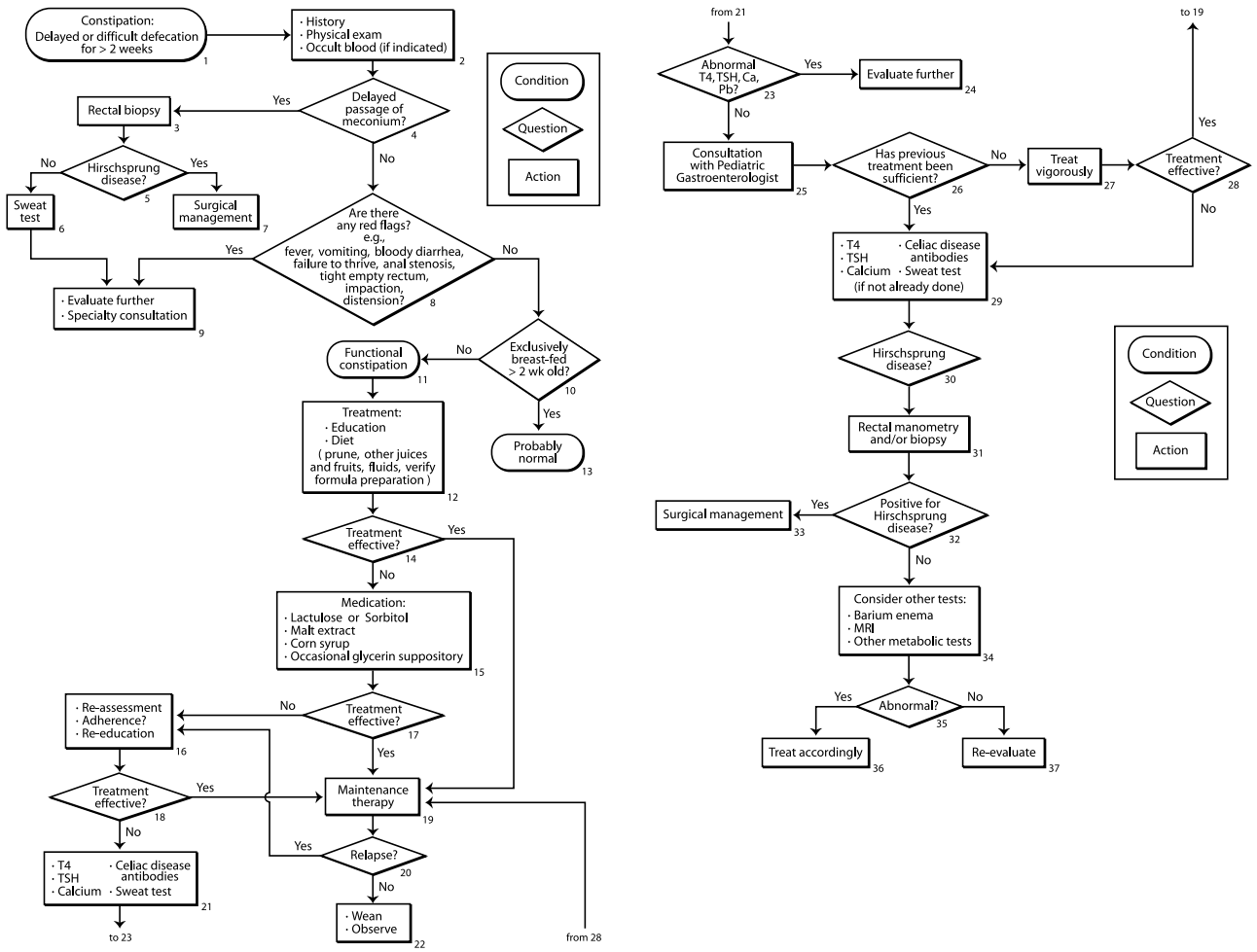


**FIG. 2.** An algorithm for the management of constipation in infants less than 1 year of age. T4, thyroxine; TSH, thyroid stimulating hormone; Ca, calcium; Pb, lead; Rx, therapy; PEG, polyethylene glycol electrolyte; psych, psychological management; MRI, magnetic resonance imaging.

identified an additional 8 articles during the subsequent discussions. The quality of evidence was categorized according to Fisher et al. (16). The papers were reviewed in detail and discussed by the Constipation Guideline Committee until consensus was achieved on whether the original recommendations should be modified based on the new evidence.

## 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 when using the term "constipation" (17), 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 the toilet paper, and whether 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 distension, 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 the child uses the school restrooms and if not, why. The caregiver's assessment of the child's temperament may be useful in planning a reward system for toilet behavior.

**TABLE 3.** *History in pediatric patients with constipation*

- Age
- Sex
- Chief symptom
- 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 or vomiting
  - Weight loss
  - Perianal 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
    - Prior successful treatments
    - Behavioral treatment
    - Results of prior tests
    - Estimate of parent/patient adherence
- Family history
  - Significant illnesses
  - Gastrointestinal (constipation, Hirschsprung disease)
  - Other
    - Thyroid, parathyroid, cystic fibrosis, celiac disease
- Medial history
  - Gestational age
  - Time of passage of meconium
  - Condition at birth
  - Acute injury or disease
  - Hospital admissions
  - Immunizations
  - Allergies
  - Surgeries
  - Delayed growth and development
  - Sensitivity to cold
  - Coarse hair
  - Dry skin
  - Recurrent urinary tract infections
  - Daytime urinary incontinence
  - Other
- Developmental history
  - Normal, delayed
  - School performance
- Psychosocial history
  - Psychosocial disruption of child or family
  - Interaction with peers
  - Temperament
  - Toilet habits at school

## 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 been conducted to determine 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 (Fig. 1, box 4) or has functional constipation (Fig. 1, box 5).

**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 or malnutrition
- Organic
  - Anatomic malformations
    - Imperforate anus
    - Anal stenosis
    - Anterior displaced anus (96)
    - 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 intoxification
    - Botulism
    - Cow's milk protein intolerance

## 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 (Fig. 1, box 6), treat the impaction if present (Fig. 1, box 7), initiate treatment with oral medication, provide parental education and close follow-up, and adjust medications as necessary (Fig. 1, box 10).

### Education

The education of the family and the demystification of constipation, including an explanation of the pathogenesis of constipation, are the first steps in treatment. If fecal soiling is present, an important goal for both the child and the parent is to remove negative attributions. 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 in all aspects of treatment.

**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 and chest
- Abdomen
  - Distension
  - Palpable liver and spleen
  - Fecal mass
- Anal inspection
  - Position
  - Stool present around anus or 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 distension |
| Lack of lumbosacral 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 |

It may be necessary to repeat the education and demystification processes several times during treatment (18).

## Disimpaction

Fecal impaction is defined as a hard mass in the lower abdomen identified during physical examination, a dilated rectum filled with a large amount of stool found during rectal examination, or excessive stool in the colon identified by abdominal radiography (19). Disimpaction is necessary before initiation of maintenance therapy. It may be accomplished with either oral or rectal medication (Fig. 1, box 7). In uncontrolled clinical trials, disimpaction by the oral route, the rectal route, or a combination of the 2 has been shown to be effective (Table 7) (20). There are no randomized studies that compare the effectiveness of 1 with 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, (20–24). 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 (25,26). It is recommended that mineral oil, oral electrolyte solutions, or the listed laxatives be used alone or in combination for initial disimpaction when the oral route is selected.

Rectal disimpaction may be performed with phosphate soda enemas, saline enemas, or mineral oil enemas followed by a phosphate enema (27,28). These enemas are widely used and are effective. The use of soap suds, tap water, and magnesium enemas is not recommended because of their potential toxicity. Rectal disimpaction has also been effectively performed with glycerin suppositories in infants (29) and bisacodyl suppositories in older children.

The Committee discussed the use of digital disimpaction in chronic constipation in the primary care setting. However, there was insufficient literature on the subject, and the Committee 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 recurrence. In the child who has no impaction (Fig. 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 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 juices, can cause increased frequency and water content of stools (30,31). There are conflicting reports about the role of dietary fiber, with evidence that constipated children have a lower, equivalent or higher intake of dietary fiber (32–35). Administration of glucamomannan (36) in addition to laxatives may be beneficial in the treatment of constipation. Until additional studies demonstrate the efficacy of treatment with fiber, the current findings are too weak to support a definitive recommendation for fiber supplementation in the treatment of constipation. A balanced diet that includes whole grains, fruits, and vegetables is recommended as part of the treatment for constipation in children. Forceful implementation of diet is undesirable.

## Behavioral Modification

An important component of treatment includes behavior modification and regular toilet habits (37). 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 taken on visits with the health care provider and can serve as both a diary and a point for positive reinforcement. In cases in which motivational or behavioral problems are interfering with successful treatment, referral to a mental health care provider for behavior modification or other intervention may be helpful.

**TABLE 7.** *Medications for use in treatment of constipation*

| Laxatives | Dosage | Side effects | Notes |
|---|---|---|---|
| Osmotic | | | |
| Lactulose[a] | 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[a] | 1–3 mL/kg/day in divided doses; available as 70% solution. | Same as lactulose. | Less expensive than lactulose. |
| Barley malt extract[a] | 2–10 mL/240 mL of milk or juice | | Unpleasant odor. Suitable for infants drinking from a bottle. |
| Magnesium hydroxide[a] | 1–3 mL/kg/day of 400 mg/5 mL; available as liquid, 400 mg/5 mL and 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[a] | <6 Years, 1–3 mL/kg/day; 6–12 years, 100–150 mL/day; >12 years, 150–300 mL/day; in 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. | |
| PEG 3350 | Disimpaction: 1–1.5 g/kg/day for 3 days<br>Maintanence 1 g/kg/day | | Superior palatability and acceptance by children Safety studies necessary before widespread use is recommended in infants. |
| Osmotic enema | | | |
| Phosphate enemas | <2 Years old: to be avoided; ≥2 years old: 6 mL/kg up to 135 mL | Risk of mechanical trauma to rectal wall, abdominal distention or 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/per 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 hospital admission and nasogastric tube. |
| Lubricant | | | |
| Mineral oil[a] | <1 Year old; not recommended. Disimpaction: 15–30 mL/yr 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 chilled. Anal leakage indicates dose too high or need for clean-out. |
| 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 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 mo after medications discontinued. |
| 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. | |

[a]Adjust dose to induce a daily bowel movement for 1 to 2 months.

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 by office visit is recommended. Some families may need counseling to help them manage this problem effectively.

### 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 (38). 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 toilet habits.

When medication is necessary in the daily treatment of constipation, mineral oil (a lubricant) or magnesium hydroxide, lactulose, sorbitol, polyethylene glycol (PEG) (osmotic laxatives), or a combination of lubricant and laxative is recommended. At this stage in the treatment of constipation, the prolonged use of stimulant laxatives is not recommended. Extensive experience with long-term use of mineral oil (39), magnesium hydroxide (40), and lactulose or sorbitol (40) has been reported. Long-term studies show that these therapies are effective and safe (9,40,41). PEG 3350 appears to be superior to other osmotic agents in palatability and acceptance by children (42–49). Preliminary clinical data in 12 infants suggest that administration of PEG 3350 to infants is effective with no adverse effects noted (50). Further studies are needed before widespread use can be recommended in infants. The doses and potential adverse effects of these medications are found in Table 7. Because 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 (Fig. 1, box 14).

A stimulant laxative may be necessary intermittently, for short periods, to avoid recurrence of an impaction (Fig. 1, box 15) (51). 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 discontinuation considered. Primary care providers and families should be aware that relapses are common and that 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 (52,53).

## CONSULTATION WITH A SPECIALIST

Consultation with a pediatric gastrointestinal specialist becomes necessary when the therapy fails, when there is concern that an organic disease exists, or when management is complex (Fig. 1, box 20). A consultant can re-evaluate the child with nonresponding constipation, exclude an underlying organic process, perform specialized tests, and offer counseling. The pediatric gastroenterologist (Fig. 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 (Fig. 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 to determine which laboratory tests are indicated before referral to a specialist. It is recommended that the primary care physician consider whether the children who require evaluation by a specialist should have blood tests to identify evidence of hypothyroidism, hypercalcemia, celiac disease, and lead toxicity (Fig. 1, box 16). By having these tests ordered by the primary care provider just before 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 subspecialist. 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 fecal impaction if the rectal examination reveals the presence of large amounts of stool. A retrospective study in children manifesting encopresis showed that a moderate to large amount of stool found on rectal examination has high sensitivity and positive predictive value (greater than 80%) for fecal retention determined by abdominal radiograph, even using the radiologist's subjective interpretation (54). However, the specificity and negative predictive value were 50% or less. When the systematic scoring system developed by Barr et al. (19) 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 remained at only 71%, and the negative predictive value was only 62% (55).

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 examination, 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 (Fig. 1, box 23). In a recent study the value of the Barr score was compared with the colonic transit time. The Barr score was shown to be poorly reproducible, with low interobserver and intraobserver reliability, and there was no correlation with measurements of transit time (55).

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 (56). In these patients an evaluation of colonic transit time with radiopaque markers may be helpful (Fig. 1, box 25) (57). 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 (Fig. 1, box 30). In children who have soiling without evidence of constipation, the best results have been achieved with behavior modification, but in some instances psychological evaluation and treatment may be necessary (Fig. 1, box 29). If the transit study is abnormal or fecal impaction is present, further evaluation is needed (Fig. 1, box 26). When there is objective evidence of constipation and it is refractory to treatment, it is important to consider Hirschsprung disease (Fig. 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 (52,58–60). It is characterized by absence 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 because of the distal obstruction.

The incidence of Hirschsprung disease is approximately 1 in 5000 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 (61,62). Thus, a delayed passage of meconium by a full-term infant raises the suspicion of Hirschsprung disease. Hirschsprung disease can have symptoms of bilious vomiting, abdominal distension, and refusal to feed, all of which are suggestive of intestinal obstruction. Short-segment Hirschsprung disease may go undiagnosed until childhood. Affected children have ribbon-like stools, a distended abdomen, and, often, failure 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 has initial symptoms of sudden onset of fever, abdominal distension, and explosive and at times bloody diarrhea (63,64). 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 1960s to 2.6 months in the 1980s because of physicians' vigilance, anorectal manometry, and early biopsy. However, in 8% to 20% of children, Hirschsprung disease remains unrecognized after the age of 3 years (65,66). Physical examination reveals a distended abdomen and a contracted anal sphincter and rectum in most 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 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 (Fig. 1, box 28), it is recommended that the patient be evaluated at a medical center in which a pediatric gastroenterologist and a pediatric surgeon are available and 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 (67). The biopsies, obtained approximately 3 cm above the anal verge, must be deep enough to include adequate submucosa. The presence of hypertrophied nerves supports the diagnosis. 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 necessary.

Anorectal manometry (Fig. 1, box 31) evaluates the response of the internal anal sphincter to inflation of a balloon in the internal anal sphincter (68). 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 results of radiological or pathological 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 normal sphincter relaxation. In the child with retentive behavior, there may be artifacts caused by 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 results are abnormal, diagnosis should 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 (69). 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 in identifying the location of the transition zone, provided that laxatives or enemas have not been administered before 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 constipation when ultra–short-segment Hirschsprung disease is present.

### Other Medications and Testing

If constipation is not resolved with the treatments outlined above, and Hirschsprung disease has been excluded, other therapies may be considered (Fig. 1, box 34). Clearly, treatment may be necessary for an extended period-months or years. Stimulant laxatives can be added for short periods. There is extensive experience with senna, bisacodyl, and phenolphthalein (70,71). However, phenolphthalein is no longer available in the United States because of concerns about its carcinogenic potential.

For most children with constipation the benefits of cisapride do not outweigh the risks (72–75). The committee does not recommend its use.

Biofeedback therapy has been evaluated in multiple open-label studies in which it was found to be efficacious (76). Results in some recent controlled studies, however, did not demonstrate long-term efficacy. Biofeedback may be beneficial for the treatment of a small subgroup of patients with intractable constipation (77–79). At times intensive psychotherapy may be needed. On rare occasion, hospital admission with behavioral therapy may be necessary.

Many conditions can cause constipation (Table 4). For children who remain constipated despite conscientious adherence to the treatments outlined, other tests may be indicated (Fig. 1, box 38). Magnetic resonance imaging (MRI) of the lumbosacral spine can demonstrate intraspinal problems, such as a tethered cord, tumors, or sacral agenesis (80). Other diagnostic tests such as anorectal manometry, rectal biopsy, colonic manometry, barium enema, and a psychological evaluation can be helpful. Colonic manometry, by providing objective evidence of colonic function, can exclude the presence of underlying neuropathy or myopathy and may guide therapeutic intervention (81–83). 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 serum calcium level, thyrocalcitonin concentration, or thyroid function tests, can detect metabolic causes of constipation (84).

For children unresponsive to conventional medical and behavioral management consideration may be given to a time limited trial of cow's milk–free diet (85–88).

## 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, when there is delayed passage of meconium (Fig. 2, box 4), or when red flags are present (Fig. 2, box, 8), particular consideration of Hirschsprung disease and other disorders is necessary. Hirschsprung disease has been described in detail. 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 (Fig. 2, box 6). Constipation can be an early 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 (4,89,90). Unless suspicion of Hirschsprung disease is present, management of a breast-fed infant requires only reassurance and close follow-up if the infant is growing and breast-feeding normally and has no signs or symptoms of obstruction or enterocolitis.

Some important differences in treatment of constipation in infants include increased intake of fluids, particularly of juices containing sorbitol, such as prune, pear, and apple juices, which is recommended within the context of a healthy diet. Barley malt extract, corn syrup, lactulose, or sorbitol can be used as stool softeners. Light and dark corn syrups are not considered to be potential sources of *Clostridium botulinum* spores (91). Mineral oil, stimulant laxatives and phosphate enemas are not recommended. Because gastroesophageal reflux and incoordination of swallowing are more common in infants, there is greater risk of aspiration of mineral oil, which can induce severe lipoid pneumonia (92–94). Glycerin suppositories can be useful, and enemas are to be avoided.

### NASPGHAN Constipation Guideline Committee

Susan S. Baker, MD, Chair
Buffalo, NY

Gregory S. Liptak, MD
Syracuse, NY

Richard B. Colletti, MD
Burlington, VT

Joseph M. Croffie, MD
Indianapolis, IN

Carlo DiLorenzo, MD
Columbus, OH

Walton Ector, MD
Charleston, SC

Samuel Nurko, MD
Boston, MA

## 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, et al. Effect of infant formula on stool characteristics of young infants. *Pediatr* 1995;95:50–4.
5. Partin JC, Hamill SK, Fischel JE, Partin JS. Painful defecation and fecal soiling in children. *Pediatr* 1992;89:1007–9.
6. Borowitz SM, Cox DJ, Tam A, Ritterband LM, Sutphen JL, Penberthy JK. Precipitants of constipation during early childhood. *J Amer Board Fam Pract* 2003;16:213–8.
7. Hyman PE, Fleisher D. Functional fecal retention. *Pract Gastroenterol* 1992;31:29–37.
8. *Medline* (on-line 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.
9. 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; Available at; http://www.medlib.com/cochranehandbook/.
10. Sackett DL, Haynes B, Tugwell P. *Clinical epidemiology: A basic science for clinical medicine*, 2nd. Boston: Little, Brown, 1991.
11. Evidence-Based Medicine Informatics Project. *Evidence based medicine: Users' guides to the medical literature*. Available at; http://hiru.mcmaster.ca/ebm/userguid/, revised, May 1997.
12. Liptak GS. Tethered spinal cord: an analysis of clinical research. *Eur J Pediatr Surg* 1992;2(Suppl 1):12–7.
13. Liptak GS. Tethered spinal cord: update of an analysis of published articles. *Eur J Pediatr Surg* 1995;5:21–3.
14. Canadian Task Force on the Periodic Health Examination. The periodic health examination. *Can Med Assoc J* 1979;121:1193–254.
15. McMurray AR. Three decision-making aids: brainstorming, nominal group, and delphi technique. *J Nurs Staff Dev* 1994;10:62–5.
16. Fisher M, Eckhard C, eds. *Guide to clinical preventive services: an assessment of the effectiveness of 169 interventions. Report of the US Preventive Services Task Force*. Baltimore: Williams and Wilkins, 1989:387–8.
17. Potts MJ, Sesney J. Infant constipation: maternal knowledge and beliefs. *Clin Pediatr* 1992;31:143–8.
18. Rappaport LA, Levine MD. The prevention of constipation and encopresis: a developmental model and approach. *Pediatr Clin North Am* 1986;33:859–69.
19. 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* 1979;18:674–86.
20. Tolia V, Lin CH, Elitsur Y. A prospective randomized study with mineral oil and oral lavage solution for treatment of faecal impaction in children. *Aliment Pharmacol Ther* 1993;7:523–9.
21. Gleghorn EE, Heyman MB, Rudolph CD. No-enema therapy for idiopathic constipation and encopresis. *Clin Pediatr* 1991;30:667–72.
22. 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;142:340–2.
23. Youssef NN, Peters JM, Henderson W, Shultz-Peters S, Lockhart DK, DiLorenzo C. Dose response of PEG 3350 for the treatment of childhood fecal impaction. *J Pediatr* 2002;141:410–4.
24. Ferguson A, Culbert P, Gillett H, Barras N. New polyethylene glycol electrolyte solution for the treatment of constipation and faecal impaction. *Ital J Gastroenterol Hepatol* 1999;31(Suppl 3):S249–52.
25. Sutphen JL, Borowitz SM, Hutchison RL, Cox DJ. Long-term follow-up of medically treated childhood constipation. *Clin Pediatr* 1995;34:576–80.
26. Loening–Baucke V. Modulation of abnormal defecation dynamics by biofeedback treatment in chronically constipated children with encopresis. *J Pediatr* 1990;116:214–22.
27. 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.
28. 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 Regul* 1994;19:41–50.
29. 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;137:666–8.
30. Kneepkens CMF. What happens to fructose in the gut? *Scand J Gastroenterol* 1989;24(Suppl 171):1–8.
31. Gryboski JD. Diarrhea from dietetic candy. *N Engl J Med* 1966; 266:818–9.
32. Roma E, Adamidis D, Nikolara R, Constantopoulos A, Messaritakis J. Diet and chronic constipation in children: the role of fiber. *J Pediatr Gastroenterol Nutr* 1999;28:169–74.
33. Moaris MB, Vitolo MR, Aguirre ANC, Fagundes-Neto U. Measurement of low-dietary fiber intake as a risk factor for chronic constipation in children. *P Pediatr Gastroenterol Nutr* 1999;29:132–5.
34. Guimaraes EV, Goulart EMA, Penna FJ. Dietary fiber intake, stool frequency and colonic transit time in chronic functional constipation in children. *Brazil J Med Biol Res* 2001;34:1147–53.
35. Speridiao PGL, Tahan S, Fagundes-Neto U, Morais MB. Dietary fiber, energy intake and nutritional status during the treatment of children with chronic constipation. *Brazil J Med Biol Res* 2003;36:753–9.
36. Loening-Baucke V, Miele E, Staiano A. Fiber (glucomannan) is beneficial in the treatment of childhood constipation. *Pediatrics* 2004;113:e259–64.
37. Lowery SP, Srour JW, Whitehead WE, Schuster NM. Habit training as treatment of encopresis secondary to chronic constipation. *J Pediatr Gastroenterol Nutr* 1985;4:397–401.
38. Nolan T, Debelle G, Oberklaid F, Coffey C. Randomized trial of laxatives in treatment of childhood encopresis. *Lancet* 1991;338:523–7.
39. McClung HJ, Boyne LJ, Linsheid T, et al. Is combination therapy for encopresis nutritionally safe. *Pediatr* 1993;91:591–4.
40. Loening–Baucke V. Chronic constipation in children. *Gastroenterol* 1993;105:1557–64.
41. 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;141:1210–2.
42. Staiano A. Use of polyethylene glycol solution in functional and organic constipation in children. *Ital J Gastroenterol Hepatol* 1999;31(Suppl 3):S260–3.
43. Loening-Baucke V. Polyethylene glycol without electrolytes for children with constipation and encopresis. *J Pediatr Gastroenterol Nutr* 2002;34:372–7. 13.
44. Pashankar DS, Bishop WP. Efficacy and optimal dose of daily polyethylene glycol 3350 for treatment of constipation and encopresis in children. *J Pediatr* 2001;139:428–32.
45. Gremse DA, Hixon J, Crutchfield A. Comparison of polyethylene glycol 3350 and lactulose for treatment of chronic constipation in children. *Clin Pediatr* 2002;41:225–9.
46. Pashankar DS, Loening-Baucke V, Bishop WP. Safety of polyethylene glycol 3350 for the treatment of chronic constipation in children. *Arch Pediatr Adolesc Med* 2003;57:661–4.
47. Bell EA, Wall GC. Pediatric constipation therapy using guidelines and polyethylene glycol 3350. *Ann Pharmacother* 2004;38: 686–93.
48. Erickson BA, Austin JC, Cooper CS, Boyt MA. Polythylene glycol 3350 for constipation in children with dysfunctional elimination. *J Urol* 2003;170:1518–20.
49. Pashankar DS, Bishop WP, Loening-Baucke V. Long-term efficacy of polyethylene glycol 3350 for the treatment of chronic constipation in children with and without encopresis. *Clin Pediatr* 2003;42:815–9.
50. Michail S, Gendy E, Preud'Homme D, Mezoff A. Polyethylene glycol for constipation in children younger than eighteen months old. *J Pediatr Gastroenterol Nutr* 2004;39:197–9.
51. Nurko SS. Constipation. In: Walker–Smith J, Hamilton D, Walker AW, eds. *Practical Pediatric Gastroenterology*, 2nd ed. Hamilton, Ontario: BC Decker, 1996:95–106.

52. Staiano A, Andreotti MR, Greco L, Basile P, Auricchio S. Long term follow up of children with chronic idiopathic constipation. *Dig Dis Sci* 1994;39:561–4.
53. Loening–Baucke V. Constipation in children. *Curr Opin Pediatrics* 1994;6:556–61.
54. Rockney RM, McQuade WH, Days AL. The plain abdominal roentgenogram in the management of encopresis. *Arch Pediatr Adolesc Med* 1995;149:623–7.
55. Benninga MA, Buller HA, Staalman CR, et al. Defecation disorders in children, colonic transit vs the Barr score. *Eur J Pediatr* 1995;154:277–84.
56. 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? *Eur J Pediatr* 1997;156:178–81.
57. Papadopoulou A, Clayden GS, Booth IW. The clinical value of solid marker transit studies in childhood constipation and soiling. *Eur J Pediatr* 1994;153:560–4.
58. 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.
59. Russell MB, Russell CA, Niebuhr E. An epidemiological study of Hirschsprung's disease and additional anomalies. *Acta Paediatr* 1994;83:68–71.
60. Reding R, de Ville de Goyet J, Gosseye S, et al. Hirschsprung's disease: A 20 year experience. *J Pediatr Surg* 1997;32:1221–5.
61. 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.
62. Clark DA. Times of first void and first stool in 500 newborns. *Pediatr* 1977;60:457–9.
63. Marty TL, Matlak ME, Hendrickson M, Black RE, Johnson DG. Unexpected death from enterocolitis after surgery for Hirschsprung's disease. *Pediatr* 1995;96:118–21.
64. Elhalaby EA, Teitelbaum DH, Coran AG, Heidelberger KP. Enterocolitis associated with Hirschsprung's disease: a clinical histopathological correlative study. *J Pediatr Surg* 1995;30:1023–6.
65. Klein MD, Phillippart AL. Hirschsprung's disease: Three decades experience at a single institution. *J Pediatr Surg* 1993;28:1291–4.
66. Swenson O, Sherman JO, Fisher JH. Diagnosis of congenital megacolon: an analysis of 501 patients. *J Pediatr Surg* 1973;8:587–94.
67. 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;3:475–89.
68. Rosemberg AJ, Vela AR. A new simplified technique for pediatric anorectal manometry. *Pediatrics* 1983;71:240–5.
69. 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;140:881–4.
70. 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;24:543–9.
71. Loening–Baucke VA, Younoszai MK. Effect of treatment on rectal and sigmoid motility in chronically constipated children. *Pediatrics* 1984;73:199–205.
72. Nurko S, Garcia-Aranda JA, Woron LB, Zlochistry O. Cisapride for the treatment of constipation in children: a double-blind study. *J Pediatr* 2000;136:35–40.
73. Halabi IM. Cisapride in management of chronic pediatric constipation. *Journal of Pediatric Gastroenterology & Nutrition* 1999;28: 199–202.
74. Staiano A, Andreotti MR, Greco L, Basile P, Auricchio S. Long term follow up of children with chronic idiopathic constipation. *Dig Dis Sci* 1994;39:561–4.
75. Odeka EB, Sagher F, Miller V, Doig C. Use of cisapride in treatment of constipation in children. *Journal of Pediatric Gastroenterology & Nutrition* 1997;25:199–203.
76. Loening–Baucke V. Biofeedback therapy for chronic constipation and encopresis in childhood: long term outcome. *Pediatr* 1995;96:105–10.
77. Loening–Baucke V. Biofeedback training in children with constipation: A critical review. *Dig Dis Sci* 1996;41:65–71.
78. 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.
79. Van der Plas RN, Benninga MA, Buller HA, et al. Biofeedback training in treatment of childhood constipation: a randomized controlled study. *Lancet* 1996;348:776–80.
80. Rosen R, Buonomo C, Andrade R, Nurko S. Incidence of spinal cord lesions in patients with intractable constipation. *J Pediatr* 2004;143:409–11.
81. DiLorenzo C, Flores AF, Reddy SN, Hyman PE. Use of colonic manometry differentiates causes of intractable constipation in children. *J Pediatr* 1992;120:690–705.
82. Martin MJ, Steele SR, Mullenix PS, Noel JM, Weichmann D, Azarow KS. A pilot study using total colonic manometry in the surgical evaluation of pediatric functional colonic obstruction. *J Pediatr Surg* 2004;39:352–9.
83. Pensabene L, Youssef NN, Griffiths JM, DiLorenzo C. Colonic manometry in children with defacatory disorders. Role in diagnosis and management. *Am J Gastroenterol* 2003;98:1052–7.
84. De Krijer RR, Brooks A, Van Der Harst E, et al. Constipation as the presenting symptom in de novo multiple endocrine neoplasia type 2B. *Pediatr* 1998;102:405–7.
85. Silva D, Soraia T, Dirceu S, Naspitz CK, DaSilva P, Francy R, Neto UF, MeMorais MB. Cow's milk protein intolerance and chronic constipation in children. *Pediatr Allergy and Immuno* 2001;12:339–42.
86. Iacono G, Cavataio F, Moltalto G, Florena A, Tumminello M, Soresi M, Notarbartolo A, Carroccio A. Intolerance of cow's milk and chronic constipation in children. *N Engl J Med* 1998;339:1100–4.
87. Carroccio A, Montalt G, Custro N, Notarbartolo A, Cavataio F, D'Amico D, Alabrese L, Iacono G. Evidence of very delayed clinical reactions to cow's milk in cow's milk-intolerant patients. *Allergy* 2000;55:574–9.
88. Andiran F, Dayi S, Mete E. Cows milk consumption in constipation and anal fissure in infants and young children. *J Paediatr Child Health* 2003;39:329–31.
89. Fontana M, Bianchi C, Cataldo F, et al. Bowel frequency in healthy children. *Acta Paediatr Scand* 1989;78:682–4.
90. Sievers E, Oldigs H–D, Schultz–Lell G, Schaub J. Faecal excretion in infants. *Eur J Pediatr* 1993;152:452–4.
91. Committee on Infectious Diseases, American Academy of Pediatrics. *Red Book*. Elk Grove Village, IL: American Academy of Pediatrics, 1997:175.
92. Fan LL, Graham LM. Radiological cases of the month. Lipoid pneumonia from mineral oil aspiration. *Arch Pediatr Adolesc Med* 1994;148:205–6.
93. Rabah R, Evans RW, Yunis EJ. Mineral oil embolization and lipid pneumonia in an infant treated for Hirschsprung's disease. *Pediatr Pathol* 1987;7:447–55.
94. Wolfson BJ, Allen JL, Panitch HB, Karmazin N. Lipid aspiration pneumonia due to gastroesophageal reflux. A complication of nasogastric lipid feedings. *Pediatr Radiol* 1989;19:545–7.
95. In: 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 & Wilkins, 1989:387–8.
96. 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.