The Evaluation of Constipation

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ABSTRACT

Constipation is a major medical problem in the United States, affecting 2% to 28% of the population. Individual patients may have different conceptions of what constipation is, and the findings overlap with those in other functional gastrointestinal disorders. In 1999, an international panel of experts laid out specific criteria for the diagnosis of constipation known as the Rome II criteria. When patients present with complaints of constipation, a complete history and physical examination can elicit the cause of constipation. It is imperative to rule out a malignancy or other organic causes of the patient's symptoms prior to making the diagnosis of functional constipation. Many patients' symptoms can be relieved with lifestyle and dietary modification, both of which should be implemented before other potentially unnecessary tests are performed.

Functional constipation is divided into two subtypes: slow transit constipation and obstructive defecation. Because many different terms are used interchangeably to describe these subtypes of constipation, physicians need to be comfortable with the language.

Slow transit constipation is due to abnormal colonic motility. The diagnosis is made with the use of a colonic transit study. We continue to use a single-capsule technique as first described in the literature, but modifications of the capsule technique as well as scintigraphic techniques are validated and can be substituted in place of the capsule.

Obstructive defecation is a much more complex problem, with etiologies ranging from rare diseases such as Hirschsprung's to physiologic abnormalities such as paradoxical puborectalis contraction. To fully evaluate the patient with obstructive defecation, anorectal manometry, defecography, and electromyography should be utilized. The different techniques available for each test are fully covered in this article.

When evaluating each patient with constipation, it is important to keep in mind that the disease may be specific to one subtype or a combination of both subtypes. Because it is difficult to differentiate the subtypes from the patient's history, we feel it is imperative to evaluate patients fully for both slow transit and obstructive defecation prior to any surgical intervention. Furthermore, we have described many tests that need to be applied to one's population of patients on the basis of the capabilities and expertise the institution offers.

KEYWORDS: Constipation, physiologic testing, manometry, defecography, colonic transit study

Objectives: Upon completion of this article, the reader should be familiar with the options available to evaluate constipated patients.

Constipation is a major medical complaint in the United States. It results in ~2.5 million medical visits each year,¹ supports a huge pharmaceutical sector, often results in a poor quality of life for patients, but is rarely associated with life-threatening problems. Constipation is one of many functional bowel disorders whose symptoms greatly overlap. For this reason, it is difficult to determine the exact prevalence of the disease, and it is most likely the reason that national surveys show such wide variations of incidence and prevalence.²⁻⁵ The most recent surveys in the United States were collected in 1987 and calculated the overall prevalence of constipation to range between 2% and 28%, with women afflicted 5- to 10-fold more than men.^{4,6,7}

DEFINITION

The term constipation has different meanings to individual patients. Symptoms include infrequent bowel movements, small stool bulk, "excessive" straining, hard stools, and a feeling of incomplete evacuation. When otherwise healthy young adults were asked to define constipation, they reported in decreasing order a need to strain to defecate, having hard stools, the inability to defecate at will, and, least commonly, the infrequent passage of stools.^{1-4,8-14} In 1999 an international committee developed criteria for each functional bowel disorder including constipation. The Rome II Consensus for constipation states that patients must have two or more of the symptoms listed below for more than 12 weeks over the past year. Imperative to making the diagnosis is that there are insufficient criteria to meet the diagnosis of irritable bowel syndrome (IBS) (Table 1) and that loose stools are not present.^{15,16}

Rome II Criteria for Constipation

1. Straining in greater than 25% of defecations
2. Lumpy or hard stools in greater than 25% of defecations

3. Sensation of incomplete evacuation in greater than 25% of defecations
4. Sensation of anorectal obstruction/blockage in greater than 25% of defecation
5. Manual maneuvers to facilitate greater than 25% of defecation
6. Less than three defecations per week

INITIAL EVALUATION

Evaluating the patient with complaints of constipation is a complex task for the physician. The evaluation includes an exhaustive medical and social history including the patient's psychological status (Table 2), obstetrical history, and a full list of medications that can be strongly associated with constipation (Table 3).^{1,9,12,17-21} It is important to determine the duration of symptoms, the amount of fiber the patient has as part of the diet, and what cathartics or other self-prescribed constipation treatment the patient has indulged in, if any. A complete physical examination with emphasis on the abdomen and perineum is imperative. The abdominal examination may uncover abdominal masses or abnormalities, which can be a potential etiology of the patient's symptoms. We prefer to examine the perineum on a Ritter table with the patient in the prone-jackknife position. This position is well tolerated by the patient and allows good visualization of the perineum, anus, and distal rectum as well as the vagina for bimanual examination. A digital rectal examination can detect masses in the rectum, loss of sensation in a specific dermatomal distribution, and the presence of excessive perineal descent and allows the evaluation of sphincter tone at rest and squeeze. To examine the distal rectum in the office, we ask all patients being evaluated for constipation to take two FleetTM enemas prior to the examination. Many types of anosopes are available, although we prefer the Henkle James SR anoscope, which is a side-viewing slotted anoscope (Fig. 1).

If any abnormal findings are detected during the initial examination, further diagnostic tests are ordered

Table 1 Rome II Diagnostic Criteria for Irritable Bowel Syndrome

Patients need to have abdominal discomfort or pain for 12 weeks or more over the past 12 months with at least two of the following features:

1. Relieved with defecation
2. Onset associated with a change in frequency of stool
3. Onset associated with a change in form (appearance) of stool

The following symptoms are not essential for the diagnosis but one or more are usually present and increase the positive predictive value

1. Abnormal stool frequency (greater than 3 per day or less than 3 per week)
2. Abnormal stool form (lumpy/hard or loose/watery) in more than ¼ of defecations
3. Abnormal stool passage (straining, urgency, or feeling of incomplete evacuation) in more than ¼ of defecations
4. Passage of mucus in more than ¼ of defecations
5. Bloating or feeling of abdominal distention on more than ¼ of days

Table 2 Etiology of Constipation

Neurologic	Physiologic	Metabolic
Hirschsprung's disease	Colonic inertia	Amyloidosis
Chagas disease	Intussusception	Diabetes
Autonomic neuropathy	Rectal prolapse	Hypercalcemia
Cauda equina tumor	Rectocele	Hyperparathyroidism
Meningocele	Sigmoidocele	Hypokalemia
Multiple sclerosis	Abnormal perineal descent	Hypopituitarism
Paraplegia	Paradoxical puborectalis contraction (PPC)	Pregnancy
Resection of nervi erigentes		Scleroderma
Parkinson's disease		Uremia

on a case-specific basis. The role of colonoscopy in the initial evaluation is controversial. A large multicenter study demonstrated that the incidence of neoplasia is no higher in patients with chronic constipation than in an age-matched cohort.²² Until other large studies duplicate these data, we continue to perform a diagnostic colonoscopy on all patients older than 30 years and, as directed by symptoms, on younger patients as part of the initial work-up for constipation. Several ancillary tests can be performed (all of which are discussed later in this article) to help distinguish between subtypes of constipation. Our initial strategy is to forgo further testing and treat the patient's symptoms with lifestyle modifications with or without over-the-counter and prescription medications. Only when the initial treatment of constipation fails to improve the patient's symptoms are further investigational studies indicated.

TYPES OF CONSTIPATION

Functional constipation is divided into two subtypes. One is known as slow transit constipation or colonic inertia and is characterized by a prolonged length of time for stool to pass through the entire colon.²³ The second subtype of constipation is referred to as obstructive defecation but also called pelvic floor dyssynergia, dys-synergic defecation, anismus, or outlet obstruction.²⁴ In

a study of 277 patients complaining of constipation, we found slow transit constipation to be the etiology in 11%, pelvic floor dysfunction in 13%, and a combination of both subtypes in 5% of patients. In the vast majority of cases (71%), the patients had what is described as constipation-predominant IBS.

SLOW TRANSIT CONSTIPATION

Normal colonic motility is an intermittent daily function quite different from that of other segments of the gastrointestinal tract. Contents in the colon can be propagated in both a forward and retrograde direction. This multidirectional flow is postulated to assist in water absorptive properties of the colon. Normal colonic motility or function is influenced by many factors other than a bolus of food or enteric contents. Motility is regulated by neurotransmitters (acetylcholine and neurokinins) and is influenced by meals, stress, and medical conditions as well as the sleep-wake cycle.^{15,21,25–32} Spinal cord lesions account for 9% of adolescents with intractable constipation, which may be secondary to loss

Table 3 Medicine Associated with Constipation

Antacids containing aluminum or calcium
Antihistamines containing diphenhydramine
Calcium channel blockers
Cough syrups or pain medicine containing codeine or other narcotics
Diuretics
Drugs used in genitourinary disorders
Iron supplements
Sedatives
Antidepressants
Antipsychotics

Figure 1 Henkle James SR anoscope.

of sympathetic coordination of the gastrointestinal tract,^{31,33} and adults with complaints of constipation are much more likely to have endocrine or renal dysfunction or both.³⁴

Manometric studies have demonstrated marked differences in phasic motor activity, the gastrocolic reflex, periodic rectal motor activity, and colonic tone. More recent investigators have demonstrated a reduction in interstitial cells of Cajal and a loss of ganglion cells in myenteric plexus in colonic specimens of patients with colonic inertia.³⁵⁻⁴⁰ Zhao et al showed that there was a reduction of serotonin receptors, and other investigators have demonstrated reduction in estrogen receptors in the left colon of patients with colonic inertia.^{25,30,35-38,41} Unfortunately, most patients undergoing surgery for slow transit constipation have been treated with prescription drugs, cathartics, and enemas for extended periods of time, and it is difficult to know whether the changes seen pathologically are due to the primary disease process or are secondary to long-term effects of treatment.^{26,42}

The diagnosis of slow transit constipation can be made or excluded by performing a Sitzmark (Konsyl Pharmaceutical, Inc., Edison, NJ) transit study. Sitzmarks or radiopaque marker studies for colonic motility were first described by Hinton et al in the late 1960s, and the validity and reproducibility of this test have been demonstrated numerous times.⁴³⁻⁴⁹ This study is performed by having the patient swallow one capsule containing 24 radiopaque markers and then tracking the markers by plain radiographs. To minimize any confusion with the study, we always have the patient take the pill on a Sunday morning and then have one plain radiograph performed on Wednesday (day 3) and Friday (day 5). After ingestion of the capsule, patients are instructed that they may continue with fiber supplements during the study period but are not allowed to use any cathartics or enemas during the test period. In patients with normal motility, at least 80% of the markers have passed through the entire colon and are found in the rectum or completely evacuated by day 5. If five or more radiopaque markers have not reached the rectum by day 5, the study results are consistent with slow transit constipation. This test has been shown by Nam et al and others to be reproducible in 70% of the patients being evaluated for constipation.⁴⁴ Furthermore, one retrospective study suggested that patients undergoing colectomy for colonic inertia had more favorable results if two marker studies demonstrated inertia. We strongly suggest that prior to any definitive surgical intervention a positive Sitzmark study is repeated or other transit studies are used to confirm the diagnosis of colonic inertia.

There have been modifications of the original Sitzmark study. Authors have described the use of one Sitzmark capsule and daily abdominal radiographs not

only to evaluate the overall colonic transit but to determine whether segmental colonic inertia exists.⁵⁰ Metcalf et al developed a technique in which three types of radiopaque markers (2×6 mm circular, 6×6 mm semi-cylindrical, and 1×6 mm cylindrical) are used.^{50a} Twenty of each type are enclosed in a single gelatin capsule. Subjects ingest a single capsule at 9:00 AM on three consecutive days. Daily films are obtained, and the markers of each type are assigned to colonic segments on the basis of landmarks proposed by Arhan et al.⁵⁰ From all the data points collected, total and segmental transit times can be calculated. In the same study Metcalf demonstrated that equivalent information could be obtained with a single film on day 4. Bouchoucha et al have described and validated another similar technique to ascertain segmental and total colonic transit times.⁴⁹ These more complicated marker studies are helpful if one would consider a segmental bowel resection for colonic inertia.

Scintigraphic Defecography

Another modality available to study colonic transit is radionuclide scanning or scintigraphy. Colonic transit scintigraphy was first studied in normal volunteers in 1986 and was found to be safe but at that time required cecal intubation through an orally placed tube.⁵¹ Advances in the ability to use radiolabeled elements in oral preparations have made the test more applicable. The Mayo Clinic developed a new technique and is a major proponent of scintigraphy to evaluate colonic transit. Their institution utilizes a resin-coated capsule containing indium-111 (not commercially available) that is designed to dissolve in a pH milieu of 7.2 to 7.4, which occurs in the distal ileum. In over 90% of cases the indium-111 is released as a bolus in the terminal ileum or cecum. They showed a high correlation between this technique and the standard Sitzmark study in a highly selected group of patients.⁵² Newer techniques using a combination of indium-111 and technetium-99-labeled meals such as those described by Bonapace et al⁵³ are much more applicable to the overall medical community because they can be performed in any nuclear medicine department.^{43,54-58} One advantage of scintigraphy as demonstrated by multiple studies in the literature is that: in addition to colonic transit, gastric emptying and small bowel transit, whole gut transit scintigraphy (WGTS), can be evaluated as part of the same test.

Once the diagnosis of slow transit constipation has been made, one must be cognizant of two special situations associated with this functional disorder. First, slow transit constipation may be part of a diffuse gastrointestinal dysmotility disorder known as panenteric inertia. One may want to perform WGTS, a gastric emptying study, a cholecystokinin hepatic dimethyl-iminodiacetic acid (CCK HIDA) scan, or

upper gastrointestinal small bowel follow-through before surgical therapy is considered because this entity can be seen in up to 30% of patients with colonic inertia. Second, colonic inertia exists concomitantly with obstructive defecation in 15% to 20% of cases. The remainder of this article is dedicated to the diagnosis of obstructed defecation.

OBSTRUCTIVE DEFECATION

Obstructive defecation is defined by difficult and unsatisfactory evacuation of rectal contents. The mechanisms responsible are multiple and range from physiologic to congenital etiologies (Table 2). Normal evacuation requires the involuntary relaxation of the internal sphincter as well as the voluntary relaxation of the external anal sphincter and pelvic floor muscles. Failure of this complex physiologic process may lead to outlet obstruction.

Rectal Anal Inhibitory Reflex

An important factor involved in defecation is the presence of a normal rectal anal inhibitory reflex (RAIR). Under normal circumstances, fecal content enters the rectum and the rectal wall stretches or distends. Sensory fibers in the distal rectum detect this distention and conduct nerve input to the internal anal sphincter (IAS). The IAS immediately but briefly increases its basal tone, followed by IAS relaxation (Fig. 2). A blunted rectal sensation is a common finding in patients with obstructed defecation and is associated with or a result of a megarectum.^{59,60} Megarectum can be an entity of its own or part of a more diffuse megacolon disorder. Less common is a complete absence of rectal sensation and no IAS relaxation.

The lack of RAIR is observed in three different diseases⁶¹; two are secondary to absence of ganglia cells. The congenital form of this disease process is known as Hirschsprung's disease, and acquired agangliosis in the rectum is known as Chagas disease. Hirschsprung's

disease is most commonly seen in neonates, with an incidence of 1 in 5000 births.⁶² It is part of the differential diagnosis when a neonate fails to pass stool within the first 24 hours of life.⁶³ The adult form of Hirschsprung's, usually brought to the attention of a surgeon in late adolescence, is secondary to a delayed presentation and diagnosis as opposed to a different phenotype of the disease.^{64,65} If a careful history is obtained, the majority of patients describe symptoms of constipation since childhood, including the need for enemas to evacuate stool. Chagas disease is rare in the United States but is a major public health problem in Latin America, affecting over 15 million people. The acquisition of the eukaryotic parasite *Trypanosoma cruzi* leads to parasympathetic agangliosis and chronic medical conditions in 30% of the afflicted, most commonly cardiomyopathy, megaeosophagus, and megarectum. Even rarer is the autosomal dominant myopathy of the IAS that has been reported in the literature.^{66,67}

Paradoxical Puborectalis Contraction

The normal evacuatory mechanism includes voluntary relaxation of the external anal sphincter and the pelvic floor muscles, which in turn increases the anorectal angle. Failure of the puborectalis to relax or paradoxical contraction of the muscle can result in obstructive defecation.^{68,69} The etiology of paradoxical puborectalis contraction (PPC) is not known, but many investigators feel it is an individual finding of a more generalized pelvic floor disorder with a potentially significant psychological component. Patients with PPC typically complain of straining, splinting, the need for digitation during defecation, tenesmus, the feeling of incomplete evacuation, and requiring suppositories and enemas to defecate.^{10,68}

Anatomic Abnormalities

Anatomic abnormalities of the pelvis that may lead to obstructive defecation include rectoceles, sigmoidoceles, enteroceles, prolapse, and intussusception. These

Figure 2 Manometry from a patient with a normal rectal anal inhibitory reflex. The lower tracing is that of the balloon, and the upper tracing is a single-quadrant tracing of the anal sphincter pressures. Immediately following insufflation of the balloon there is an initial increase in anal pressure followed by internal anal sphincter relaxation.

anatomic abnormalities may be better referred to as anatomic variants because they exist in patients with obstructed as well as normal defecation. Yang et al showed a 28% frequency of rectocele, 7% frequency of enterocele and sigmoidocele, and 19% frequency of intussusception in 489 patients undergoing defecography.⁷⁰

ANORECTAL MANOMETRY

Anorectal manometry quantifies anal sphincter muscle tone and the anorectal sensory response to different stimuli and can be very useful in the diagnosis of obstructive defecation. The system requires a manometry catheter and a recording device. Of the many different devices available, we prefer the water-perfused catheter. The manometry study is performed with the patient in the left lateral decubitus position. The catheter is placed through the anal canal and advanced into the rectum. The catheter has multiple openings along its length in which water is perfused while multiple sensors along the catheter interpret resistance in water flow, which is converted into pressure. A complete manometric evaluation includes determination of the resting pressure, squeeze pressure, length of the high-pressure zone, compliance of the rectum, the RAIR, and the ability of the IAS to relax with straining.

As described previously, the RAIR is an important phenomenon in the process of fecal evacuation. RAIR can be evaluated in the anorectal physiology laboratory by inflating a balloon inside the rectum and while the catheter assesses for relaxation of the IAS. The magnitude and duration of IAS relaxation appear to be proportional to the amount of distention produced.⁷¹ Failure of internal sphincter relaxation is seen in patients with the rare diseases mentioned previously and in some patients who have previously undergone a proctectomy with coloanal anastomosis.^{61,72} The lack of a balloon-induced RAIR in the great majority of patients being evaluated for constipation is usually a technical problem. In this population of patients the examiner should repeat the test with larger balloon volumes (megarectum) or use a special spiral catheter that allows simultaneous sensory detection at multiple levels of the sphincter. Anorectal manometry can be useful in diagnosing a rectocele, although the ability to do this is user dependent and not as sensitive or specific as defecography.⁵⁹

BALLOON EXPULSION TEST

The balloon expulsion test was first described by Barnes as a diagnostic tool for obstructive defecation. The test can be performed at the time of manometry. A balloon is placed into the rectum and expanded with air or water to 50 to 60 cm³, after which the patient is asked to evacuate the balloon. Patients with a normal RAIR should be able

to evacuate the balloon without difficulty, and failure to expel the balloon after five attempts is suggestive but not diagnostic of obstructive defecation.⁷³⁻⁷⁶

A simplified balloon expulsion test was described by Beck in 1992.⁷⁷ A latex balloon attached to a 60-cm³ catheter-tipped syringe with hemorrhoid rubber bands is inserted into the patient's rectum. The syringe then inflates the balloon and is withdrawn from the rectum. The rubber bands seal the balloon. The patient is then allowed to sit on a private commode and pass the balloon. The physiologic position and privacy allow this method to more closely approximate normal evacuation. The balloon expulsion test is a functional evaluation. Failure to pass the balloon suggests outlet obstruction and merits additional evaluation.

DEFECOGRAPHY

Defecography provides a real-time video image of the patient defecating. The radiation exposure of this test is ~3 to 7 mSv, which is three times less than that of a standard barium enema.^{78,79} Although the overall dose of radiation to the body is less, the local dose of radiation to the pelvis is higher for cine-defecography. This is important because the majority of patients being evaluated with defecography are women, and although ovarian exposure to radiation is not trivial, it is acceptable when the test is indicated. The purpose of cine-defecography is to provide dynamic characterization of the interaction between the anal sphincter complex and the rectum to help define abnormalities in the pelvic floor.

Before the test is performed, the patient administers a disposable sodium phosphate (phospho-soda) enema (FleetTM, Lynchburg, VA). The patient is then placed in the left lateral decubitus (Sims) position, and barium instillation (50 mL) and air insufflation are performed to delineate the rectal mucosa. Because the contrast medium consistency affects the rectal emptying rate, it is important for the contrast material to simulate stool weight and consistency. Although in the past the barium paste needed to be prepared by the examiner, it is now commercially available. A caulking gun injector is used to introduce 250 cm³ of barium paste into the rectum unless the patient complains of rectal fullness, at which time the introduction of paste is arrested. As the caulking gun is withdrawn, more paste is injected to outline the anal canal. The x-ray table is then tilted to an upright position (90 degrees) and lateral films of the pelvis are obtained at rest as well as when the patient is instructed to squeeze and push on a water-filled specially designed commode. Finally, the patient is asked to evacuate the barium paste, and with the aid of fluoroscopy the dynamic process of defecation is video recorded. As demonstrated by Jorge et al, the position of the patient may affect the sensitivity of the test, and examiners should vary the study on the basis of suspected pathology.⁸⁰

Figure 3 (A) Defecogram demonstrating the normal anorectal angle at rest. (B) Defecogram during the pushing phase. There is a normal change in the anorectal angle along with evidence of a posterior rectocele. (C) Defecogram demonstrating an anterior rectocele.

Static defecography (Fig. 3) is used to measure the anorectal angle (ARA), perineal descent, and puborectalis length at rest, squeeze, and pushing, and the difference between rest and maximal push is calculated for each measurement to assess floor dynamics (Fig. 3). The resting ARA is ~ 90 degrees and ranges from 70 to 140 degrees.^{78–82} The wide range of the ARA reported in the literature is partly due to differences in patients' anatomy and partly due to the differences in the way it is measured by individual examiners.^{83,84} The most common definition of the ARA is the angle between the axis of the anal canal and the distal half of the posterior rectal wall.⁷⁹ Regardless of the technique or the exact angle measured, the ARA becomes more acute during squeeze effort because of the contraction of the puborectalis to defer defecation and more obtuse during relaxation of

the puborectalis. It is not helpful to compare exact values among patients; more important, the test provides a basis for relative comparison of a dynamic process for each individual. Perineal descent is defined by measuring the vertical distance between the position of the ARA and a fixed plane, usually the pubococcygeal line. The normal pelvic floor position can be as much as 1.8 cm below the pubococcygeal line at rest and 3.0 cm during maximal push effort. Therefore, abnormal perineal descent is defined as descent greater than 3.0 cm during evacuation when compared with the level at rest.⁷⁹

Cine-defecography is one of the two tests capable of diagnosing PPC. The criteria to make the diagnosis include failure of the ARA to open, persistence of the puborectalis impression, and poor rectal emptying.^{68,81,85,86} Other findings consistent with PPC

include a capacious rectum, long and persistently closed anal canal, ballooning of the rectum, and the presence of compensatory anatomic abnormalities such as rectoceles.

Defecography is also useful in diagnosing anatomic abnormalities of the pelvic floor, which may or may not be physiologically important. Wexner et al showed that only 12% of patients undergoing defecography had a normal study; the majority of studies demonstrated an anatomic or physiologic abnormality alone or in combination.^{70,78,82,87} The surgeon must determine the role that these abnormalities play in the patient's complaints. For a rectocele to be a significant factor in defecation, dynamic defecography will show with straining that the propulsive forces are directed into the rectocele rather than toward the anus (redirection of forces) and classical postevacuation images will continue to show retained content in the rectocele.

Enteroceles and sigmoidoceles are diagnosed when small bowel or sigmoid colon descends into the pelvis during straining. Neither of these entities is an uncommon finding on dynamic defecography, but they typically have no physiologic significance. Rarely, the small bowel or sigmoid colon places pressure on the anterior, lateral, or posterior surface of the rectum, which can narrow the rectum or in extreme cases obliterate the anorectal outlet. Wexner et al were the first to describe a sigmoidocele and developed a classification system to determine their significance.^{70,82,86} Jorge et al found sigmoidoceles to be present in 24 (5%) of 463 consecutive cine-defecography studies performed for constipation, and half of them had impaired rectal emptying. Internal intussusception or internal prolapse in some cases can be the cause of solitary rectal ulcers and constipation, although Shorvon et al showed that a significant number of patients without any complaints of constipation or difficulty in defecation have this radiographic finding with straining.⁷⁸

Some centers have described four-contrast defecography, "pelvic floor-oscopy," to help better define the pelvic anatomy.^{88,89} Patients drink a barium sulfate suspension, the bladder is filled with 150 to 200 cm³ of water-soluble contrast material, and then barium paste is placed in the vagina and rectum. Although this type of defecography may delineate the pelvic anatomy better, no study comparing it with cine-defecography has been performed and it is unclear whether this truly adds much information.

DYNAMIC MAGNETIC RESONANCE IMAGING DEFECOGRAPHY

An alternative to cine-defecography is dynamic magnetic resonance imaging (MRI) defecography. Proponents of MRI believe that there are many advantages, including elimination of radiation exposure, examination of all pelvic compartments, precise relationship to bone

landmarks, and a reduction of interobserver variability. Opponents of the test feel that it is not truly dynamic. Unlike cine-defecography, which is performed in a standard way, MRI is an evolving modality and reports of the test in the literature describe multiple techniques.^{84,90-92} The studies have been performed with both open and closed MRI units with the patient in either the supine or standing position using protocols with and without rectal contrast. All of these differences in protocols make it difficult to compare the two types of modalities as a whole, and the overall correlation between MRI and cine defecography ranges between 50% and 90% depending on the study reviewed. Matsuoka et al compared defecography with MRI defecography and showed that MRI was not as sensitive as standard defecography while costing 10 times as much.⁹² We must keep in mind that as MRI technology improves the results may change, and studies in comparison with cine-defecography may need to be repeated in the future. As MRI becomes more dynamic in the future, it may at some point become the "gold standard."

ELECTROMYOGRAPHY

Surface electromyography (EMG) can be performed by the intra-anal sponge, single-fiber, or concentric needle technique to help diagnose disturbed patterns of anal sphincter and pelvic floor muscle dysfunction associated with constipation, including PPC. The discordant data obtained from the intra-anal sponge technique and single-fiber EMG have made these tests less popular.^{93,94} Concentric EMG is performed with the patient in the left lateral (Sims) position and the needle electrodes are inserted into the subcutaneous external anal sphincter (EAS) in four quadrants. The diagnosis is made when there is failure to achieve a significant decrease in electrical activity of the puborectalis muscle during attempted evacuation. The ability of surface EMG to rule out PPC is good (91% negative predictive value); the positive predictive value is quite low when compared with cine-defecography (30%).^{84,95,96}

CONCLUSION

Most patients presenting to the colorectal surgeon with complaints of constipation have been dealing with the problem for years. When the diagnosis is confirmed, it is imperative to expeditiously rule out any potential malignancy as the cause of their symptoms. One must keep in mind that all of the previously mentioned tests can give tremendous insight into the physiologic or mechanical etiologies of constipation, but they may be unnecessary because many patients improve with simple dietary changes. We prefer the standard single-capsule Sitzmark study, cine-defecography, anal manometry, and concentric EMG to evaluate each patient

with persistent symptomatology. There are certainly other tests that have been described in detail that can be used in lieu of the aforementioned studies. The decision about which tests are ultimately chosen should be governed by the availability of each modality as well as clinical expertise at any given institution.

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