Diagnostic Strategy and Tools for Identifying Defecatory Disorders

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KEYWORDS

• High-resolution anorectal manometry • MRI • Biofeedback therapy • Constipation • Anal sphincter

KEY POINTS

- Among constipated patients who have not responded to laxatives, anorectal tests are necessary to diagnose defecatory disorders, which should be managed with pelvic floor biofeedback therapy rather than with laxatives.
- In such patients, anal manometry and a rectal balloon expulsion test are initially performed, followed by other tests as necessary. Some centers use defecography in lieu of the rectal balloon expulsion test.
- At a high level, the methods for these tests are standardized. However, the details of methods and normal values vary among techniques.
- Anorectal functions are affected by age and sex. Test results should be interpreted with reference to normal values generated by the same technique.

INTRODUCTION

Based on an assessment of anorectal tests and colonic transit, patients with chronic constipation can be classified into 3 groups: normal transit constipation, slow transit constipation, and defecatory disorders (DD).[1] This review focuses on DD, which are a common cause for chronic constipation and result from a disturbance in the rectoanal functions that facilitate normal defecation.[1,2] Diagnostic tests are necessary because (i) symptoms alone cannot discriminate between DD and other causes of chronic constipation[3] and (ii) DD are optimally managed with pelvic floor biofeedback therapy rather than laxatives.[4,5]

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CLINICAL ASSESSMENT

A meticulous clinical evaluation may suggest the presence of a DD. Before the consultation, the authors ask patients to complete a bowel symptom questionnaire.[1] Thereafter, the symptoms can be confirmed during the interview, aided by pictorial stool form scales. Intuitively, some symptoms (eg, anal digitation, sense of anal blockage during defecation, sense of incomplete evacuation after defecation) suggest a DD. When considered in isolation (ie, not together with the findings of a digital rectal examination), symptoms evaluated with a questionnaire do not discriminate between DD and other causes of constipation.[6,7] Questionnaires provide a snapshot of bowel habits at one point in time. Among patients who have varying stool consistency, they do not disclose whether bowel symptoms are related to the stool consistency. This is an important issue because even healthy people may struggle to evacuate hard stools.[8] It is the authors' perception that difficulty with evacuating soft stools, particularly liquid stools or enemas, strongly suggests disordered defecation. Bowel diaries are extremely useful for characterizing the relationship between stool consistency and ease of defecation.

The onset and history of bowel disturbances should be elicited. Upon inquiry, many patients acknowledge that their symptoms have existed for longer than initially acknowledged, perhaps since childhood.[9] Inadvertent withholding, perhaps secondary to an aversion to using public toilets, or constipation after recent surgery, medication changes, or coexistent urinary symptoms is not uncommon. Not infrequently, irritable bowel syndrome (IBS) and pelvic floor dysfunction will coexist.[10]

A careful digital rectal examination is mandatory.[11] Inspection may disclose an anal fissure or hemorrhoids. A digital rectal examination is useful to assess anal pressure at rest, when patients contract or squeeze their anal sphincter and pelvic floor muscles, and during simulated evacuation.[12,13] Normally, simulated evacuation is accompanied by relaxation of the anal sphincter and puborectalis muscle and perineal descent by 1 to 4 cm. Patients with DD may have anismus (ie, high anal resting pressure), reduced or excessive perineal descent (ie, ballooning of the perineum), and/or rectal prolapse. The puborectalis may not relax normally or paradoxically may contract during simulated evacuation. However, relaxation of the puborectalis may not be perceptible even in patients with normal anorectal functions. Therefore, except for patients who have paradoxical puborectalis contraction, abnormal perineal descent, particularly if markedly reduced or absent, is more useful than impaired puborectalis relaxation for identifying DD.

RATIONALE FOR ANORECTAL TESTS

Although pelvic floor dysfunction can often be excluded or confirmed with reasonable confidence by a careful clinical assessment, anorectal testing is required because studies suggest that a clinical assessment alone does not suffice for identifying DD.[6,7] Moreover, many patients are reassured by objective documentation of a DD, and insurance providers require this before covering pelvic floor retraining by biofeedback therapy. In most patients, anorectal manometry and a rectal balloon expulsion test suffice to confirm or exclude DD. In selected circumstances, additional tests may be necessary as detailed in later discussion.

ANORECTAL MANOMETRY

Anorectal manometry can be performed with conventional catheters that incorporate water-perfused, air-charged, solid-state sensors or with high-resolution catheters (ie, high-resolution manometry [HRM] or 3-dimensional high-resolution anorectal manometry (3D- HR-ARM).[14–18]

Catheter Design

HRM and HDM catheters have 2 benefits over conventional systems. First, because they have more closely spaced sensors that span the entire anal canal, the entire procedure can be performed without moving the catheter (ie, a pull-through maneuver is unnecessary). Hence, each procedure takes less time, perhaps 15 minutes for selected HRM protocols.[19] Second, HRM catheters provide better spatial resolution. There are differences among HRM catheters made by different manufacturers (**Fig. 1**). Conventional and HRM catheters measure anal pressures with comparable precision. Pressures measured with HRM or HDM are much higher, probably because of the manner in which pressures are analyzed.[20]

The HRM catheters made by Medtronic and Medical Measurement Systems are approximately 4 mm in diameter. These catheters provide a single pressure value at each location along the longitudinal axis of the anal canal, that is, they do not measure pressure topography around the catheter circumference. By contrast, the Medtronic HDM catheter measures pressures at specific locations around the circumference and depicts pressures in 3 dimensions.[21,22] Conceptually, this feature may be useful to identify regional weakness of the external anal sphincter and/or to discriminate between squeeze pressures generated by the puborectalis and external anal sphincter.[21] However, more evidence is necessary to substantiate whether HDM enables these

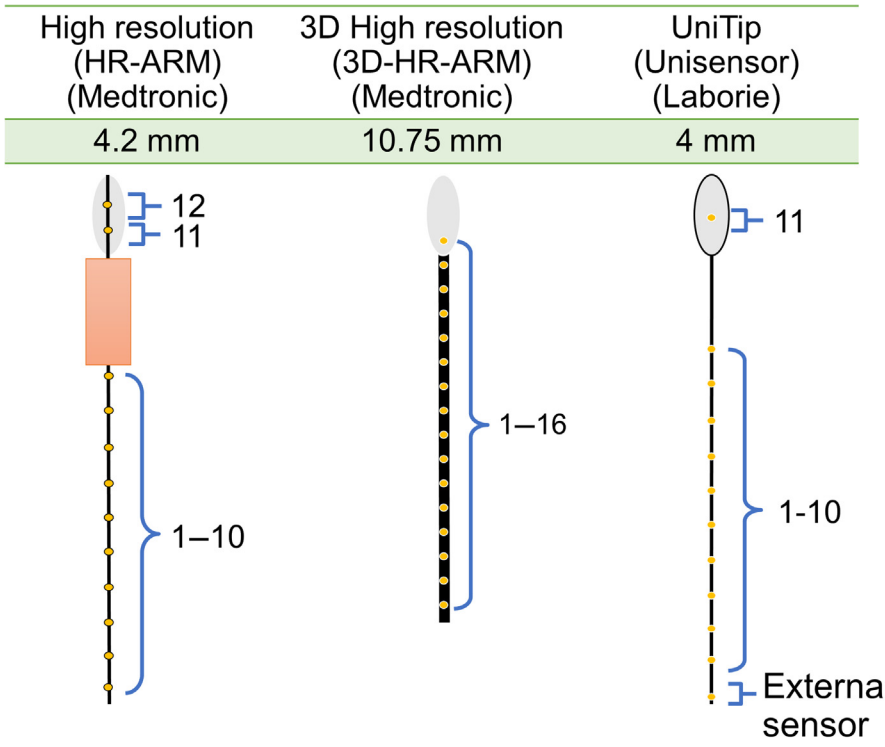

Fig. 1. Comparison of design of selected high resolution anorectal manometry catheters. All 3 catheters have pressure sensors in the rectal balloon and along the shaft. All sensors measure circumferential pressures. The 3D-HR-ARM probe (Medtronic) is much larger (ie, 10.75 mm diameter) than the other 2 catheters shown here. GI, gastrointestinal.

refined assessments. The HDM probe has a diameter of 10.75 mm, which is much larger than other probes.[22] Some patients find this probe uncomfortable. Also, unlike other anorectal manometry probes that are typically 4 to 6 mm in diameter and are flexible, the HDM probe is rigid, does not conform to the anorectal angle, and has to be held by the operator during the test. This "may introduce artifacts, especially if it is not held in the neutral position during maneuvers such as squeeze and bearing down."[22] HRM and HDM catheters are relatively expensive and fragile.

Anorectal Manometry Protocol

Anorectal pressure measurements depend on the methods for assessing and analyzing anorectal pressures. Most centers assess anorectal pressures at rest, during 2 or 3 squeeze maneuvers, and during simulated evacuation, generally with an empty and subsequently with a filled balloon, typically with air. Thereafter, the rectoanal inhibitory reflex and rectal perception of distention are assessed. Some centers also evaluate pressures when patients cough or do a Valsalva maneuver. Although the precise details (eg, number of squeeze maneuvers, duration of measurements) vary among techniques, the International Anorectal Physiology Working Group has suggested approaches to standardize techniques.[23] Pending studies that compare the diagnostic utility of various anorectal manometry techniques, the impact of relatively minor differences in techniques on the diagnostic utility of manometry is unknown.

Analysis of Anorectal Manometry

Arguably, differences in the methods that are used to analyze and summarize pressures are more important than the relatively minor differences in the methods to assess pressures among techniques.[24] For example, ideally, squeeze pressure should consider the distribution of pressures across the anal length and circumference and the duration over which pressures are summarized. Given these differences and the effects of age and sex on anorectal pressures in healthy people,[19] pressures should be compared with normal values derived in age- and sex-matched controls measured with the same technique. Readers are referred to a review[16] and original reports of the largest healthy cohorts of normal anorectal pressures evaluated with the Medtronic HRM catheter (96 women and 47 men),[19] the Medtronic HDM catheter (42 women and 36 men),[22] the Medical Measurements System (now Laborie) HRM catheter (96 women and 29 men),[25] the Sandhill, now Diversatek catheter (27 women and 27 men),[26] and the Medspira portable catheter (74 women and 34 men).[15,18]

The rectoanal gradient during simulated evacuation is the primary criterion for diagnosing DD by manometry. Other features of DD include a higher anal resting pressure (anismus) and/or reduced voluntary augmentation during pelvic floor contraction.[27,28] Intuitively, it would seem that the rectoanal pressure gradient should be positive (ie, rectal pressure is greater than anal pressure) in asymptomatic healthy people with normal rectal evacuation. However, the rectoanal gradient is negative in a substantial proportion of healthy people.[16,19,22,29] Hence, a rectoanal gradient is abnormal only if it is more negative than the lower limit of normal, which, for the Medtronic HRM catheter is −70 mm Hg in women younger than 50 years of age.[19] Using these stringent criteria, patients with DD have lower rectoanal pressure gradients (rectal-anal pressure) during evacuation than healthy people.[30] The rectoanal pressure pattern can also indicate causes of DD, such as decreased propulsive force, paradoxical contraction, or both.[6,7]

The method for analyzing the gradient during evacuation may at least partly explain why the gradient is negative in asymptomatic healthy people. For example, the highest

anal pressure at each instant (at 10 Hz) is used to summarize anal pressure. First, because the highest, and not the lowest, anal pressure is used to calculate the gradient, the gradient is generally not the greatest pressure difference between the rectum and the anal canal. Second, "the specific sensor that is used to summarize anal pressure often moves over the 20-second evacuation period."[30] Third, the highest anal pressure measurement is prone to artifact, for example, because of catheter impingement.[31] With the Medtronic HRM and HDM catheters, there is pressure drift, which is typically corrected by the software program.[32] Finally, although the rectoanal gradient (RAG) is a useful metric, it ignores the underlying pressure topography pattern that is evident by careful inspection and is used to classify esophageal motility disorders (eg, subtypes of achalasia).[33]

Newer Approaches to Increase the Diagnostic Utility of High-Resolution Manometry

Three newer approaches may improve the utility of HRM for diagnosing DD: seated HRM, refined approaches to analyze pressure topography during evacuation, and an integrated assessment of pressures during evacuation and a Valsalva maneuver.

Anorectal pressures can be measured in the seated position.[30,34,35] This can be challenging because the catheter may be displaced during evacuation. Catheter displacement can be prevented with a clip attached to the catheter and the inner thigh.[30] A recent study compared existing and newer options to summarize the pressure topography during evacuation in the left lateral and seated positions in 64 healthy and 136 constipated women of whom 52 had a prolonged balloon expulsion time (BET).[30] The gradient was less negative in the seated than the left lateral position. Also, a new approach was used to characterize 4 pressure topography patterns, that is, minimal change, anal relaxation, paradoxical contraction, and transmission (**Fig. 2**). In the seated position, the BET was associated with the pattern, being prolonged in, respectively, 45%, 15%, 53%, and 0% of patients with minimal change, anal relaxation, paradoxical contraction, and transmission. Compared with the existing ManoView RAG in the left lateral position, the integrated analysis (ie, pattern and new gradient) in the left lateral position and the seated ManoView gradient were more effective for discriminating between constipated patients without and with DD. Hence, anorectal HRM ideally should be performed in the more physiologic seated position and analyzed by a 2-tier approach, which incorporates the overall pattern followed by the rectoanal gradient.

It is suggested that patients with DD strain excessively or do a Valsalva maneuver during evacuation, resulting in rectoanal discoordination, which hinders rectal evacuation. A recent study observed that a simultaneous consideration of rectoanal pressures during evacuation and a Valsalva maneuver uncovers rectoanal discoordination and facilitates the diagnosis of DD in selected patients.[36]

RECTAL BALLOON EXPULSION TEST

This simple test is performed in conjunction with an anorectal manometry. The time required to evacuate a balloon filled with warm tap water, typically 50 mL, in the seated position is assessed. The normal values depend on the type of rectal balloon used for the test.[37–39] At most centers, the test is performed with a party or commercial balloon; the upper limit of normal is 1 minute. For a Foley catheter inflated to 50 mL, which is above the manufacturer-recommended limit of 30 mL, the upper limit of normal is 2 minutes.[39] Even with the 2-minute cutoff, 25% of healthy people would be misclassified as abnormal because they require more than 2 minutes.[40]

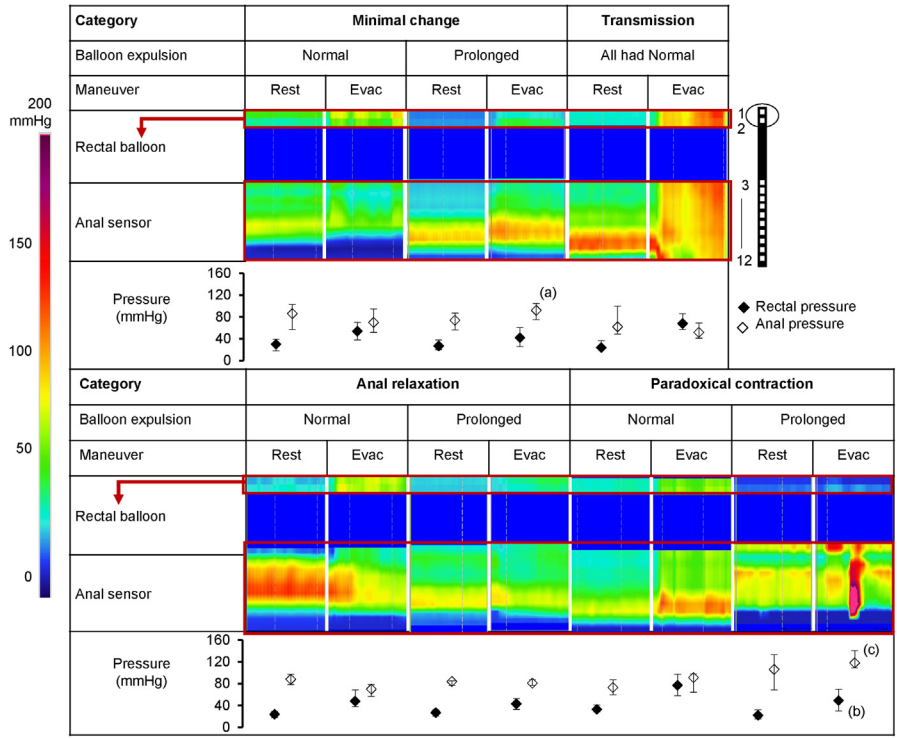

Fig. 2. Median and interquartile values of rectoanal pressures at rest and during evacuation in the seated position in the 4 patterns. Rectoanal pressures were measured by a 12-sensor catheter depicted in the cartoon on the top right. Observe the caudal transmission of pressure from the rectal balloon throughout the anal canal in the transmission pattern. [a] $P < .05$; [b] $P \leq .01$; [c] $P \leq .001$ for comparison of rectal or anal pressure during evacuation in patients with normal versus prolonged BET in the same pattern. Evac, evacuation. (*From* Sharma M, Muthyala A, Feuerhak K, Puthanmadhom Narayanan S, Bailey KR, Bharucha AE. Improving the utility of high-resolution manometry for the diagnosis of defecatory disorders in women with chronic constipation. Neurogastroenterology & Motility. 2020;e13910; with permission.)

Normally, defecation is preceded by the desire to defecate. Some patients with DD have reduced rectal sensation, hence may not perceive the desire to defecate with a balloon inflated to 50 mL.[41] Alternatively, patients can be asked to expel a balloon that is inflated until patients experience the desire to defecate.[42] Further studies are necessary to compare these 2 techniques (ie, fixed vs variable balloon inflation) of assessing rectal evacuation.

Among 106 patients with functional constipation and 24 patients with DD, the BET identified those with DD, documented with defecography, with 88% sensitivity and 89% specificity; positive- and negative-predictive values were 64% and 97% for diagnosis of DD, respectively.[42] However, this uncontrolled study excluded patients with secondary (such as medication-induced) chronic constipation. The rectal balloon was inflated not to a fixed volume but until patients experienced the desire to defecate, averaging 183 mL, which may compensate for reduced rectal sensation identified in some patients with DD.[41] An abnormal rectal balloon expulsion test predicted the response to biofeedback therapy.[4]

BARIUM AND MAGNETIC RESONANCE PROCTOGRAM

After filling the rectum with barium contrast mixed with psyllium or another thickening agent (barium defecography) or gel (magnetic resonance [MR] defecography), lateral images of the anorectum are obtained at rest, during pelvic floor contraction, and during defecation (**Fig. 3**).[43] Abnormalities include inadequate (such as a spastic disorder) or excessive (such as in descending perineum syndrome) widening of the anorectal angle and/or perineal descent during defecation. Internal intussusception, solitary rectal ulcers, rectoceles, and rectal prolapse may also be identified.[43] When the vagina and small intestine are opacified, enteroceles, bladder, and uterovaginal prolapse can be seen.

Introduced more recently, standardized techniques for defecography[44–46] have partly overcome the limited reproducibility of anorectal measurements in older studies.[47] Barium and MR defecography are respectively performed in the seated and the supine position. By comparison to barium defecography, MRI avoids radiation

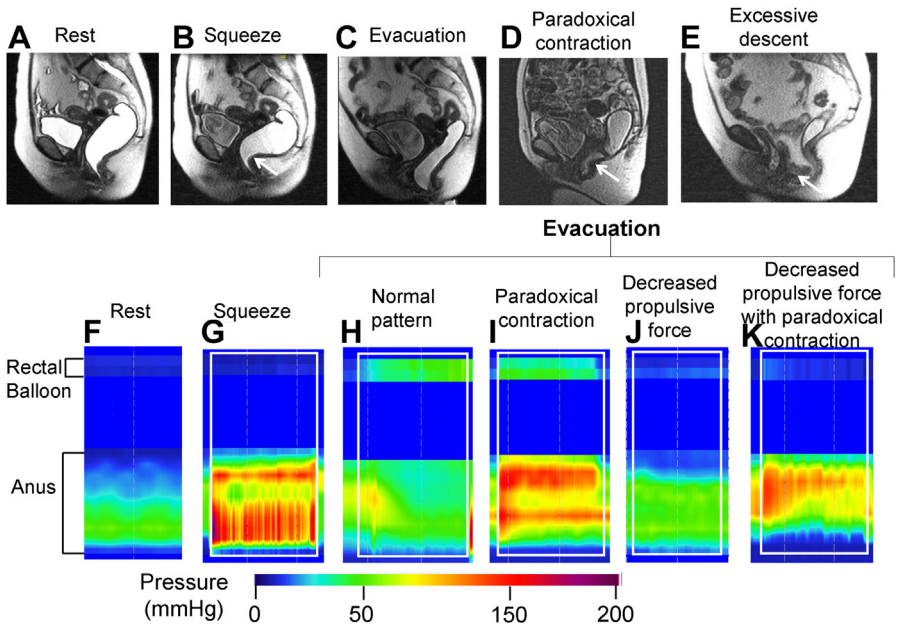

Fig. 3. Normal and abnormal anorectal evacuation. Evacuation was recorded by MRI (*top row*) and HRM (*bottom row*). Relative to rest (*A*), MRI shows increased puborectalis indentation during squeeze (*B*, *arrow*) and normal relaxation of the puborectalis, perineal descent, opening of the anal canal, and evacuation of ultrasound gel during evacuation (*C*). In patients with constipation, during evacuation, there is paradoxical contraction of the puborectalis (*D*, *arrow*) and exaggerated perineal descent with an enterocele (*E*, *arrow*). HRM shows anal pressure at rest (*F*) and increased anal pressure during squeeze (*G*) compared with rest (*F*). The white rectangle demarcates the duration of squeeze (*G*) and evacuation (*H–K*). Note the increased rectal pressure with anal relaxation during evacuation in a healthy person (*H*). By contrast during evacuation in constipated patients, note increased rectal pressure with paradoxical anal contraction (*I*), no change in rectal pressure versus rest (*J*), and no change in rectal pressure with paradoxical anal contraction (*K*). (*From* Bharucha A, Wald A. Chronic Constipation. Mayo Clin Proc. 2019;94(11):2340-2357. https://doi.org/10.1016/j.mayocp.2019.01.031 with permission.)

exposure, more precisely evaluates pelvic organ prolapse and pelvic floor motion,[27,48–50] and is especially useful for uncovering pelvic floor dysfunction in patients who have clinical features of DD with a normal BET; this group includes more than 90% of patients with a large rectocele, enterocele, and/or peritoneocele.[27,51] However, MR defecography is less widely available and more expensive. Most guidelines recommend defecography as a backup test to identify clinically suspected anatomic abnormalities, in patients with persistent symptoms after biofeedback therapy, or when the results of other anorectal tests are inconsistent with clinical findings.[1,52,53] However, some centers where defecography is readily available use this as a first-line test before the BET, perhaps because by contrast to the BET, defecography also depicts structural disturbances and arguably approximates more closely to stool than a rectal balloon.[54]

ASSESSMENT OF RECTAL SENSATION AND DISTENSIBILITY (COMPLIANCE AND CAPACITY)

The awareness of rectal filling is necessary for normal defecation and fecal continence. Some patients with DD have reduced rectal sensation.[55]

Rectal sensation is routinely assessed during anal manometry by manually distending a balloon, secured to a plastic catheter and placed within the rectum with air. In selected patients with DD, for example, when the manometry reveals a profound sensory disturbance, rectal sensation should be evaluated with a barostat, which is not widely available in clinical practice. During balloon inflation, participants are asked about symptoms: first sensation, desire to defecate, urgency, and maximum toleration/pain. The distending volume at each of these sensory thresholds is then recorded. When sensation is evaluated with a barostat, pressure thresholds, and hence compliance is also recorded. Although there is considerable variation between subjects, small studies using manual or barostat techniques suggest that assessments of rectal compliance and sensation within subjects is very reproducible on the same or separate days.[56,57]

Sensory testing may reveal rectal hypersensitivity or hyposensitivity in DD patients. Visceral hypersensitivity, including allodynia and hyperalgesia, abnormal colonic transit, and psychological factors, is associated with IBS symptoms.[58] Among 164 patients with functional gastrointestinal disorders, including 86 IBS patients, rectal barostat distention to 40 mm Hg was 96% sensitive and 72% specific for discriminating IBS patients from normal subjects.[59] Conversely, 18% to 66% of patients with chronic constipation have reduced rectal sensation (rectal *hypo*sensitivity),[9] often allied to an attenuated or absent call to stool; this may be "primary" (owing to direct impairment of afferent pathway function), "secondary," owing to altered biomechanical properties, or both.[60] Biofeedback therapy to correct sensory disturbances is beneficial in fecal incontinence.[61] However, the utility of such therapy in patients with DD has not been evaluated.

Because symptoms alone do not discriminate between DD and other causes of constipation,[6,7] anorectal functions should be evaluated in all patients whose symptoms are refractory to laxatives.[1] Testing should begin with anorectal manometry and a rectal balloon expulsion test.[1] In selected patients, defecography may be necessary as specified above. Some centers use defecography in lieu of the rectal balloon expulsion test.

POTENTIAL FALLACIES IN DIAGNOSTIC TESTING

Several features regarding the interpretation of test results deserve emphasis. First, these tests may be abnormal even in asymptomatic people.[19,49,62] Hence, test results

need to be interpreted in the context of the clinical features. Second, there is no gold-standard diagnostic test for DD. Overall, the results of these tests are correlated with each other.[44,51] However, among individual patients, different tests often provide different answers, which confounds the diagnosis of DD.[45] In order to reduce the possibility of a false-positive diagnosis, the Rome IV criteria suggest that 2 or more abnormal tests are required to confirm a diagnosis of DD.[53] Third, although DD are primarily regarded as disorders of function, a subset of patients has structural abnormalities.[1] In some patients (eg, with a large rectocele that fails to empty during defecation and/or is accompanied by a history of anal digitation), the rectocele is probably contributing to symptoms. In other patients, it can be challenging to determine if the rectocele or other abnormalities are contributing to symptoms. Other abnormalities (eg, rectal intussusception) may be secondary to excessive straining rather than the underlying pelvic floor dysfunction. Fourth, it is the authors' perception that some patients with clinical features of pelvic floor dysfunction have seemingly normal rectal evacuation by testing, perhaps because they strain excessively to overcome increased pelvic floor resistance. Thus, an integrated assessment of clinical features and anorectal tests is necessary to confirm or exclude defecation disorders.

ANAL SURFACE ELECTROMYOGRAPHY

Anal electromyography (EMG), which measures the electrical activity of the external anal sphincter, is used to evaluate anal sphincter tone and relaxation during simulated defecation. Initially, anal EMG was performed with needle EMG. An important early study compared needle EMG activity in 16 healthy controls and 194 constipated patients quantified with the strain/squeeze index.[63] Although paradoxical contraction during straining was observed in 83% of patients versus 82% of controls, a mean index of greater than 50 was more common in patients (24%) than in controls (0%), associated with impaired rectal evacuation during defecography, and reduced rectal sensation. The needle EMG indices in the puborectalis muscle and in the external anal sphincter muscle were correlated. Prompted by the finding that EMG activity recorded by intramuscular and surface electrodes, which were placed bilaterally over the subcutaneous portion of the external anal sphincter,[64] is correlated, surface EMG performed with a cylindrical anal probe[39,65] or cutaneous electrodes is used for diagnostic purposes and to provide biofeedback therapy in DD. During straining, relaxation by 20% of baseline values or greater is considered to be normal.[39] Conversely, when activity during evacuation increases by greater than 20% above resting EMG activity, it is considered abnormal. A response that is between 20% above and 20% below baseline values is considered no change. To the authors' knowledge, these normal values are derived from anal manometry but have not been validated in healthy people. In randomized trials, biofeedback therapy provided with anal surface EMG was better than the control arm in constipated patients.[66,67]

COLONIC TRANSIT

Up to 50% of patients with DD have concurrent slow colon transit.[1] Colon transit influences fecal form.[68] Because it is harder to evacuate hard stools,[8] slow colon transit may aggravate the symptoms of difficult defecation.

It is not necessary to prepare the colon before evaluating colonic transit, which can be measured with 3 methods,[69] that is, ingestion of radiopaque markers using abdominal radiographs, scintigraphy, and the wireless motility capsule (WMC).

The radiopaque marker test is typically performed by administering a single capsule (Hinton method) containing 24 plastic markers on day 1 and by obtaining plain

abdominal radiographs on day 6 (120 hours later).[69] Retention of 6 or more markers at 120 hours is considered abnormal. A more refined approach (Metcalf method) is to have the patient ingest a capsule containing 24 radiopaque markers on days 1, 2, and 3 and count the markers remaining on abdominal radiographs on days 4 and 7; a total of $\leq$68 markers remaining in the colon is normal, whereas more than 68 markers indicates slow transit.[69]

Colonic transit scintigraphy is a noninvasive and quantitative method of evaluation of total and regional colonic transit.[70,71] Here, a radioisotope (^{111}In or ^{99}Tc) is administered in a coated capsule that dissolves in the colon or terminal ileum or encapsulated in a nondigestible capsule with a test meal. At specific time points, gamma-camera images are obtained to track the isotope as it travels around the colon. The result is summarized by the weighted distribution of the isotope in the colon at 24 hours, and if necessary, at 48 hours.[69] The methods used to summarize colonic transit vary among centers.

The WMC and scintigraphy can noninvasively measure not only colonic but also gastric emptying and small bowel transit.[72] With WMC, these transition points are easily identified. An increase in the pH indicates when the capsule passes into the

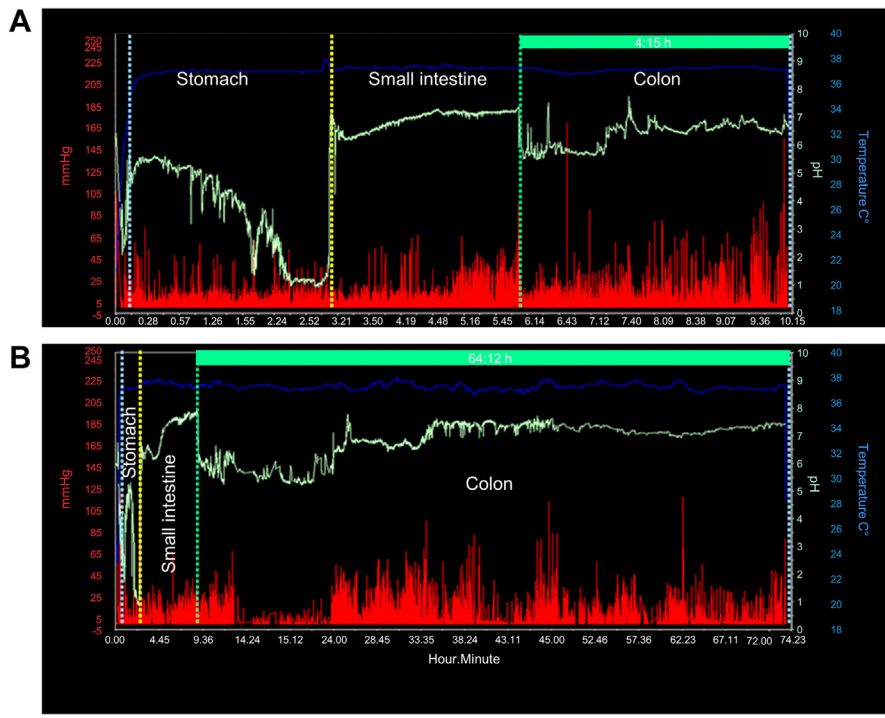

Fig. 4. Representative examples of a WMC in patients with normal (*A*) and slow colon transit (*B*). Pressures, temperature, and pH values are respectively shown in red, blue, and green and measure gastric emptying, small bowel transit time, and colonic transit time. Panel A shows a WMC recording with normal colonic transit time (4:15 hours). In contrast, panel B shows a patient with delayed colonic transit time (64:12 hours). Red = pressure (mmHg); green = pH; blue = temperature (°C); X axis = time (hours:minutes). Stomach = between blue and yellow dotted lines; small intestine = between yellow and green dotted lines; colon = after green line.

small bowel, and a subsequent drop of approximately 1.5 units suggests that the capsule is located in the cecum. The WMC is a sensitive and specific test for identifying slow colonic transit, as defined by a colonic transit time of 59 hours or greater (**Fig. 4**). Among patients with chronic constipation, the overall (ie, positive and negative) agreement versus radiopaque markers was 87%.[73] Similar to scintigraphy, the WMC may uncover disturbances of upper gastrointestinal transit in constipated patients.[74]

SUMMARY

Among constipated patients who have not responded to laxatives, anorectal tests are necessary to diagnose DD. At a high level, the methods for these tests are standardized. However, the details of methods and normal values vary among techniques.

Anorectal functions are affected by age and sex. Test results should be interpreted with reference to normal values generated by the same technique. The choice of tests and their interpretation are guided by the clinical features. The results of these tests guide the management of these conditions.

ACKNOWLEDGMENTS

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DISCLOSURE

Dr A.E. Bharucha jointly holds patents for the anorectal catheter fixation device, anorectal manometry probe, and an anorectal device for fecal incontinence, respectively, with Medtronic Inc, Medspira Inc, and Minnesota Medical Technologies and receives royalties from Medspira Inc. Dr E. Coss-Adame has nothing to disclose.

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