Diagnostic Testing for Fecal Incontinence

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Abstract

Many tests are available to assist in the diagnosis and management of fecal incontinence. Imaging studies such as endoanal ultrasonography and defecography provide an anatomic and functional picture of the anal canal which can be useful, especially in the setting of planned sphincter repair. Physiologic tests including anal manometry and anal acoustic reflexometry provide objective data regarding functional values of the anal canal. The value of this information is of some debate; however, as we learn more about these methods, they may prove useful in the future. Finally, nerve studies, such as pudendal motor nerve terminal latency, evaluate the function of the innervation of the anal canal. This has been shown to have significant prognostic value and can help guide clinical decision making. Significant advances have also happened in the field, with the relatively recent advent of magnetic resonance defecography and high-resolution anal manometry, which provide even greater objective anatomic and physiologic information about the anal canal and its function.

Keywords

- fecal incontinence
- endoanal ultrasonography
- anal manometry
- pudendal nerve

CME Objectives: On completion of this article, the reader should be able to summarize diagnostic testing available for fecal incontinence.

A wide array of tests is available to assist with the diagnosis and management of fecal incontinence. Imaging tests, physiology tests, and nerve studies have all been described. The overall usefulness and value of any particular test has always been a matter of keen debate, some tests are accepted as more useful than others. Unfortunately, the pace of medical innovation in this field rapidly outstrips the availability of quality studies to evaluate newer and more complicated diagnostic modalities. This article overviews the most common diagnostic tests available and also investigates new developments.

Imaging Studies

Endoanal Ultrasound

Since its introduction in 1989,¹ endoanal ultrasound (EAUS) has secured a firm role in the diagnostic work-up of fecal incontinence. A prospective evaluation of the value of anorectal physiology testing found EAUS to be the most likely test to change a patient's management plan.² It provides an

objective assessment of sphincter integrity, and can readily diagnose injuries or anatomic deficiencies of the internal and external anal sphincters. Ultrasound, however, does require significant training and appropriate technique to obtain good images as it is a user-dependent modality. Information from EAUS can be used to guide decisions for sphincteroplasty versus other therapeutic interventions.

EAUS is performed using a rigid probe which rotates 360 degrees creating a circular image of the anal sphincter complex. Imaging is usually performed at 10 MHz; however, lower frequencies can be used to extend the depth of tissues seen at the cost of lower resolution. The anal canal is visualized from the proximal to distal aspect and has several distinctive findings throughout its length (► **Fig. 1**). The internal sphincter itself appears hypoechoic, whereas the external sphincter, made of skeletal muscle, appears either of mixed echogenicity or hyperechoic. These differences are secondary to the increased connective tissue present in skeletal muscle. The proximal anal canal is readily identified by the prominent puborectalis muscle, which forms a posterior sling around the anal canal. The mid-anal canal is defined by both robust internal and external anal sphincter muscles, whereas the distal anal canal is defined by a thinning to

Fig. 1 Anal canal on endoanal ultrasonography. (A) Proximal anal canal. The arrow points to the prominent hyperechoic puborectalis muscle, which forms a sling around the posterior aspect of the anal canal. (B) Mid-anal canal: Both the internal and external anal sphincters are prominent. The arrow points to the hypoechoic internal anal sphincter. (C) Distal anal canal: The internal anal sphincter thins, whereas the hyperechoic external anal sphincter becomes more prominent.

absent internal anal sphincter. Imaging of the anterior anal canal can be difficult secondary to rectocele; it can be helpful to place a finger inside the vagina to oppose the rectovaginal septum to the ultrasound probe. Muscular defects are seen as breaks in either the hypoechoic band of the internal anal sphincter, or as a break in the hyperechoic band of the external anal sphincter (►**Fig. 2**). Sphincter defects have been shown to be correlated with fecal incontinence, and can be seen in women who did not have a tear at the time of delivery or who underwent a cesarean section.³ Newer machines have the capability of reconstructing the images in three dimensions, which is purported to assist in the visualization of the entire defect. Three-dimensional imaging can also be used in a transperineal fashion, potentially limiting discomfort associated with the exam.⁴

Defecography

Fluoroscopic defecography adds functional imaging to the work-up of fecal incontinence. This can be helpful in detecting

Fig. 2 Anterior defect in external anal sphincter visualized on endoanal ultrasonography, area of disruption of external anal sphincter marked by arrows.

rectoceles and internal rectal prolapse that may contribute to incontinence symptoms in some patients.⁵ This test is routinely performed in the seated position after radio-opaque material is inserted into the rectum. The patient is then asked to defecate while real-time fluoroscopic images are obtained. Testing can be aided by the addition of oral contrast to evaluate for enterocele. In general, these images require expertise to interpret, and can be misleading at times; it has been shown that interobserver agreement for the findings of intussusception and anismus is low.⁶ For these reasons, there is interest in magnetic resonance (MR) defecography; where real-time cine-MR techniques are used to evaluate the rectum and pelvic organs during the act of defecation (►**Fig. 3**). MR imaging (MRI) has the advantage of revealing other pelvic anatomy, including the vagina, bladder, uterus, and small intestine, which aids in the interpretation of the images.⁷ Criticisms of the MR technique include that it is often performed supine and is not physiologic. Open MR technology solves this issue but is not widely available. Additional advantages of MRI are that it can reveal anatomic information about the anal sphincter muscles, allowing complimentary information compared with EAUS.

Fig. 3 MRI defecography. (A) Anatomy before act of defecation; the bladder appears intense on these T2 images, as does the rectum, which is filled with water-soluble contrast. (B) Internal intussusception as seen as a chevron sign (arrow) observed during the act of defecation. MRI, magnetic resonance imaging.

It has been shown to be helpful in diagnosing anal sphincter muscle atrophy, which is a predictor of poor response to sphincteroplasty.⁸

Physiologic Studies

Anorectal Manometry

Anorectal manometry provides objective data with regard to anal canal pressures, sensations, and the rectoanal inhibitory reflex (RAIR). This information can be helpful in the diagnosis of the etiology of incontinence; however, some argue that it is of little clinical utility as decisions for treatment are largely based on symptoms.⁹ It has also been noted that manometry cannot be used to predict which patients will respond to sphincteroplasty.¹⁰ Others have shown that changes in manometry following interventions for fecal incontinence correlate poorly with incontinence scores.¹¹ Recent advances in anorectal manometry have also expanded the amount of information generated¹²; however, again the clinical utility of high-resolution vector-based manometry remains questionable.¹³

Sphincter pressures are easily assessed with manometry. Measurements of resting pressures as well as squeeze pressures are taken. Normal values for resting pressure vary according to equipment and technique, but are generally thought to be in the 60 to 80 mm Hg range.¹⁴ Men are noted to have higher resting and squeeze pressures than women. Squeeze pressures are evaluated both on absolute force of the squeeze, so-called maximum pressure, as well as duration of the squeeze. Normal squeeze pressures should measure above 120 to 180 mm Hg and should be able to sustain for 20 seconds.¹⁴ Short duration can be a sign of sphincter fatigue; however, the significance of this is uncertain.¹⁵ Traditionally, manometry could only determine the pressure at one point along the anal canal, requiring the user to reposition the catheter several times during study. High-resolution anal manometry employs a system of 36 to more than 100 sensors on a single probe and can determine the pressure throughout the anal canal without repositioning¹⁶ (► **Figs. 4 and 5**). This also allows three-dimensional reconstruction of the anal canal in a visual fashion (► **Fig. 6**). These images can be impressive to look at, but again increased clinical utility is unknown.

Manometry can also be used to determine rectal sensation thresholds. The typical manometry catheter has a balloon on the end which is used to test sensation thresholds as well as elicit the rectoanal inhibitory reflex. Normal sensations are described as 20 mL for initial sensation, 80 to 120 mL for desire to defecate, and 200 to 250 mL for pain.¹⁴ Reduced sensations are frequently seen in fecal incontinence, representing reduced rectal compliance and inability of the rectum to hold a bowel movement.¹⁷ When the rectum can hold a vast quantity of stool, higher thresholds are frequently seen in constipation. Recent studies point to this being an important finding in men with fecal incontinence, where the incontinence is thought to be secondary to long-standing constipation and outlet dysfunction.¹⁸

The RAIR is determined by inflating the balloon on the tip of the manometry catheter to 50 mL and deflating the balloon

Fig. 4 High-resolution anal manometry during a resting maneuver. The pressure is displayed as a color-coded line along the entire length of the anal canal on the y-axis; time is represented on the x-axis. This is a normal study.

Fig. 5 High-resolution anal manometry during a squeeze maneuver. The area of high pressure can be seen at the arrow, which lasts for approximately 5 seconds. This study is consistent both with a weak squeeze, as well as a squeeze of shortened duration.

rapidly (► **Fig. 7**). This simulates the sensation of a stool bolus approaching the anal canal. This should result in a reflexive relaxation of the internal anal sphincter, which can be observed manometrically. The absence of this reflex is rare and is associated with Chaga disease and Hirschsprung disease. A blunted RAIR can be seen in patients with long-standing constipation or neurological disease.¹⁹

Manometry is also used to assess dyssynergia, which is more associated with constipation than incontinence, but it may contribute to encopresis. In this part of the test, the patient is asked to bear down as if they are having a bowel movement. Relaxation of the anal canal pressures should be noted along with an increase in rectal pressure, if this is able to measure. As a final measure of this, the rectoanal pressure differential can be calculated, and should be a positive number in the normal patient. False negatives are thought to be frequent with this test, secondary to the positioning of the exam—most exams are performed in left lateral decubitus. For this reason, some have advocated performing manometry while seated on a commode.²⁰

Fig. 6 Three-dimensional reconstruction of pressure information from a high-resolution anal manometry catheter. The information is presented in three ways: the arrow points out the same area of anterior pressure deficit in all three images. (A) A two-dimensional radial diagram depicting pressure in 360 degrees around the anus; the line approaches zero in the right anterior area. (B) A three-dimensional reconstruction; each square represents a separate pressure sensor. Again the right anterior defect in pressure is seen at the arrow. (C) A two-dimensional diagram depicting what is seen in picture (B); the three-dimensional image is simply unraveled into a two-dimensional image.

Anal Acoustic Reflexometry

This is a new modality reported that allows a viscoelastic assessment of anal canal function.²¹ This technique uses a thin polyurethane bag which is placed in the anal canal and connected to a digital signal producer and pressure pump via rigid tubing. The signal producer creates acoustic impulses that are reflected by the polyurethane bag in the anal canal, allowing determination of cross-sectional area.²² The pressure pump is then used to inflate the bag within the anal canal. This process allows measurement of opening pressure, squeeze opening elastance, closing pressure, opening elastance, closing elastance, hysteresis, and squeeze opening pressure.²¹ These values have been shown to be different in incontinence patients as opposed to continent patients. This remains a complicated technique which has yet to gain widespread acceptance and use.

Fig. 7 A manometry tracing revealing a normal rectoanal inhibitory reflex. Shortly following inflation of a rectal balloon to 60 mL, a reflexive relaxation of the anal sphincter pressure is noted (arrow).

Nerve Conduction Studies

Pudendal Motor Nerve Terminal Latency

The pudendal nerve is responsible for carrying sensory and motor nerves to the anal canal; it is for this reason that it is an appropriate target of testing. Nerve damage can occur with pregnancy or several medical disorders, such as diabetes mellitus and multiple sclerosis; all of which can lead to a neurogenic source of fecal incontinence. While initially this may appear as an isolated problem, it is often associated with decreased resting and squeeze pressures as lack of innervation leads to muscle atrophy (—Fig. 8).

The test is performed by applying the St. Mark's electrode to a gloved finger, and placing the finger in the rectum on Alcock canal. A small electrical stimulus is applied to the pudendal nerve in this location and results in contraction of the external anal sphincter, which is measured by electrodes on the palm of the St. Mark's device. This is then used to calculate a "latency" or how long it takes the nerve to conduct the stimulus to the time of external anal sphincter contraction. Normal pudendal motor nerve terminal latency (PMTNL) is 2.2 ± 0.2 ms.

Pudendal nerve testing can be difficult to perform accurately and has a significant learning curve. It is estimated that a diagnostician must perform at least 40 exams to become proficient.²³ For this reason, many have advocated leaving it out of the work-up for fecal incontinence; this argument is strengthened by the observation that the results infrequently change patient management. PMTNL testing has been shown to have prognostic value for patients about to undergo sphincteroplasty in one study, where an abnormal PMTNL study was shown to have a significantly higher rate of failure of sphincteroplasty surgery to restore continence.²⁴ This prognostic information may be of value to patients in deciding whether or not to undergo such an invasive procedure. Other authors have demonstrated that pudendal nerve

Fig. 8 Pudendal motor nerve terminal latency test: This test is performed bilaterally. (A) Left pudendal nerve where the latency is marked before the response curve going down; here the latency is noted to be mildly delayed at 2.6 ms. (B) Right side where the latency is marked before the response curve moving up; again the latency is noted to be delayed at approximately 2.8 ms.

testing using a St. Mark's electrode is normal or unilaterally normal 88% of the time and that only the 12% of patients with bilaterally prolonged pudendal motor nerve latency have significantly poorer continence.²⁵

Needle Electromyography

This testing involves direct testing of the external anal sphincter by placing an electrode in the muscle; a surface variant has also been described.²⁶ Given the lack of comfort associated with the exam, it is infrequently used.

Conclusion

All the described diagnostic tests have their individual roles in the diagnosis and management of fecal incontinence and assist in research of this condition as well. It is hoped that in the future, improved diagnostic testing could lead to a more defined prognostic role which could be helpful in choosing the correct path of therapy. This could be especially useful as clinical options for the treatment of fecal incontinence continue to increase.

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