



Methods of anorectal physiology

Liliana Bordeianou, Lieba Savitt, Mikhaila Marecki

Section of Colorectal Surgery, Massachusetts General Hospital Pelvic Floor Disorders Center, Harvard Medical School, Boston, MA, USA

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Correspondence to: Lilian Bordeianou, MD, MPH. Section of Colorectal Surgery, Massachusetts General Hospital Pelvic Floor Disorders Center, Harvard Medical School, Boston, MA, USA. Email: lbordeianou@mgh.harvard.edu.

Abstract: Anorectal physiology involves the complex coordination of pelvic muscles and nerves which facilitates appropriate bowel function. There are various anatomical and functional tests available to evaluate anorectal physiology and thereby differentiate underlying causes of a range of anorectal disorders, including fecal incontinence, constipation, and rectal pain. These methods include anorectal manometry (ARM), balloon expulsion test (BET), electromyography, and pudendal nerve latency testing. This article will discuss the components of these tests, how they measure various aspects of anorectal function, and how those results then guide treatment for each disorder. This article will also review the London Classification for Disorders of Anorectal Function, which was established in 2020 by the International Anorectal Physiology Working Group (IAPWG) and has become the gold standard for measuring disorders of anorectal function. The London Classification has standardized the testing protocols and results interpretation of ARM and balloon expulsion testing to assist in the differentiation of specific types of bowel dysfunction. This protocol classifies disorders under four distinct groups: disorders of the rectoanal inhibitory reflex, disorders of anal tone and contractility, disorders of rectoanal coordination, and disorders of rectal sensation. The London Classification not only standardizes ARM testing protocols but also the language used to describe anorectal function, to better define anorectal disorders and treatment guidelines and thereby improve clinical outcomes.

Keywords: Fecal incontinence; pelvic floor; anorectal manometry (ARM); anorectal physiology testing; London Protocol

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Introduction

Anorectal physiology tests are usually utilized in the evaluation of anorectal disorders. Specifically, these tests evaluate the underlying causes of fecal incontinence, constipation and rectal pain by measuring rectal tone and sensation as well as anal sphincter function, both at rest and during simulation of defecatory actions. Etiologies of these disorders can be anatomical in nature (due to rectocele, rectal prolapse or sphincter injury) or functional (related to pelvic floor dyssynergia, rectal spasm or anismus). Often, these etiologies coexist or beget one another. Anorectal

manometry (ARM) is a useful clinical tool commonly used to evaluate patients with symptoms of anorectal dysfunction and to determine etiology.

There are three main types of ARM methods that are widely used: water perfused systems, air pressure, and solid state catheters. Historically, water perfused systems and air pressure were the tools most commonly used for evaluation, and they continue to be used in many settings to assess function and causes of dysfunction. More recently, the technology has evolved and there has been a transition to a more widespread use of the more sophisticated high-

definition and high-resolution anorectal manometry (HD-ARM and HR-ARM, respectively) which typically use a solid state catheter (1).

Different components of testing

Various ARM protocols over time have used different tools and measurements to evaluate anorectal dysfunction. Measurements used are described in greater detail below, and include the following: tone, recto-anal inhibitory reflex (RAIR), sensation, BET. Not all measurements are universally used across various ARM protocols, though each component of the testing may help to form a more accurate diagnosis for the patient. Testing is typically performed in the left lateral position with hip and knees flexed.

Tone

While differing ARM protocols may include different measurements, a test of anal tone is universally included. Tone is typically measured by evaluating changes in relative pressure in the anal canal, though this depends on catheter type. Tone is evaluated when patient is at rest and with squeeze. Both quick and long squeezes are performed to evaluate resting anal tone which correlates with internal anal sphincter function and squeeze anal tone which is more likely to correlate with external anal sphincter function.

RAIR

RAIR is a binary test, with the result being either positive or negative. This is elicited through a rapid installation of air into the balloon catheter to assess for reflexive reduction in anal pressure. Absent or impaired RAIR indicates possible rectal prolapse or Hirschsprung disease, and is sometimes observed in patients who have undergone prior lower anterior resections.

Sensation thresholds

Rectal sensation is evaluated by assessing perception of balloon distention to the following categories: first sensation, first urge to move bowels, and maximum tolerable volume (urgency). Unlike the previously described elements, this is a subjective test and results may vary significantly between patients with both constipation and fecal incontinence depending on underlying causes of symptoms (2).

BET

The BET is often used in combination with tone and sensation testing to assess for defecatory dysfunction. It tests a patient's ability, based on time, to expel a rectal balloon and helps differentiate between outlet obstruction constipation and functional constipation. Patient should be in a sitting position, ideally on a toilet in privacy. Based on different specificity and sensitivity, the threshold for a positive test may range from 1–5 min. Asymptomatic participants have been shown to be able to expel the balloon within a median timeframe of 50 s (range, 10–90 s), and always within 5 min. Other studies suggest that BET has a sensitivity of 88%, a positive predictive value of 64% for diagnosing pelvic floor dysfunction and a specificity of 89%, with a negative predictive value of 97% for excluding pelvic floor dysfunction (3). While an abnormality in the balloon expulsion testing is suggestive of possible pelvic floor dyssynergia, an abnormal BET alone is not diagnostic of defecatory dysfunction. Instead, it should be considered in the context of the patient's symptoms and other components of the ARM testing, and then followed up with EMG testing for further workup (4,5).

Additional tests

Auxiliary tests that may be performed in conjunction with ARM to help form a complete diagnosis include surface EMG and pudendal nerve latency testing.

Surface EMG

The surface EMG evaluates the electrical activity of the puborectalis muscle to assess for muscle coordination. Paradoxical contraction of puborectalis is often seen in patients with outlet obstruction constipation and anismus. EMG is often one of the mainstays of biofeedback therapy in which surface electrodes are placed in the anal canal, in the vaginal canal, or on the perineum to allow for continuous assessment by biofeedback therapists.

Pudendal nerve latency testing

The pudendal nerve provides motor innervation to the anal sphincter as well as sensory innervation to the anus and perineum. Testing is performed by stimulating the right and left pudendal nerves (typically through surface stimulation). Findings help evaluate for neurologic causes of fecal

incontinence and prior damage to the pudendal nerve.

The London Classification

The London Classification was established by the International Anorectal Physiology Working Group (IAPWG) in response to an awareness of a lack of consistency in research and testing protocols in the evaluation of functional anorectal disorders. The protocol attempts to standardize both testing procedures by establishing standardized clinical measurements as well as results interpretation of ARM, rectal sensation testing and the balloon expulsion testing to define different types of dysfunction. In addition to creating a protocol for testing, it standardizes the language used to describe anorectal disorders.

The protocol is based on the use of HR-ARM systems in order to generate more consistent results and measurements. Despite this, there is no conclusive evidence that the use of HR-ARM systems leads to different diagnoses, treatments, or outcomes and therefore this protocol can theoretically be applied to any ARM system (6,7).

The London Protocol recommends a specific order of testing maneuvers. The first component is a digital rectal exam (DRE) to confirm the absence of any anatomical abnormalities that might preclude testing and to ensure the absence of a large fecal load that may skew results. Once DRE is completed, the catheter is lubricated and inserted into the anal canal to at least a length of 6 cm. The catheter is then stabilized over 3 min to allow the anal tone to return to baseline. After this, tone is measured at rest (for 60 s), followed by three 5 s short squeezes and then one 30 s long squeeze to evaluate for endurance. Patient is then asked to cough twice and then perform three pushes for 15 s each. Sensation testing is started next with a RAIR test where at least 30 ccs of air is rapidly distended. This is followed by rectal sensory testing in which the balloon is inserted into the rectal vault and slowly inflated to test first sensation volume, desire to defecate volume and the maximum tolerated volume. There is also a sustained urgency volume that can be tested but is not a mandatory part of the protocol. The testing is completed with balloon expulsion testing as described above.

Based on the above testing, the London Protocol classifies 4 types of physiologic anorectal dysfunction: disorders of the rectoanal inhibitory reflex, disorders of anal tone and contractility, disorders of rectoanal coordination, and disorders of rectal sensation. They are

further subcategorized as major, minor, or inconclusive as is consistent with prior classification of esophageal motility disorders. Major findings are most likely consistent with physiologic alterations, minor findings may or may not be representative of physiologic alteration, and inconclusive patterns may be seen in patients with symptoms and control subjects. These four classifications of physiological anorectal dysfunction are described below.

Disorders of the rectoanal inhibitory reflex

An absent RAIR is considered a major finding consistent with recto-anal areflexia. This may be found in asymptomatic patients who have undergone rectal resections, ileal pouch anal anastomosis, anal hypotonia or megarectum. However, if these disorders are ruled out further investigation is recommended to exclude aganglionosis (more likely in the pediatric population).

Disorders of the anal tone and contractility

This classification evaluates anal resting and squeeze pressures and evaluates both for anal hypertension, anal hypotension, and normal or hypocontractility. Anal hypertension may be found in those with levator ani syndrome, rectal pain, and some constipated patients. Anal hypotension may be found in patients with differing severities of fecal incontinence.

Disorders of rectoanal coordination

This classification looks at rectal pressures during push, combined with balloon expulsion and can be used to evaluate dyssynergia or general abnormal pattern of rectoanal co-ordination.

Disorders of rectal sensation

This classification evaluates the sensory parameters described above (first sensation, first urge, maximum tolerated volume). This may help to classify patients with rectal hyposensitivity and rectal hypersensitivity.

Defining disorders and determining treatment

The London Classification is helpful in classifying types of dysfunction based on testing results, and its utility in terms of determining treatment is magnified when combined

with patient symptoms and physical findings. Categories of symptoms that are evaluated and better differentiated with manometry include fecal incontinence, constipation, and anal spasm.

Fecal incontinence

Fecal incontinence can be broken into two categories based on symptoms: passive fecal incontinence and fecal urgency. While there may be some overlap in manometry outcomes with these patients, there is also potential for significant differences. ARM testing helps differentiate these patients and therefore better guide treatment options. Passive fecal incontinence can be seen in patients with both disorders of the rectal sensation and disorders of anal tone and contractility. This finding is often in patients with a history of sphincter trauma and low sphincter tone leading to passive loss of both liquid and formed stools. Decreased anal tone and subsequent passive incontinence is also often found in patients with intra-anal intussusception and/or rectal prolapse. There is also a group of patients with passive incontinence defined as “staining or smearing” which can be found not only in patients with decreased anal tones (based on anatomic changes above), but also seen in some patients with elevated anal tone in the context of incomplete evacuation of the bowels and anal hypertension. This is an important distinction as an assumption that all passive incontinence is related to anal hypotension could lead to a recommendation of strengthening exercises that ultimately may worsen symptoms in those with anal hypertension. Often patients with anal hypertension may also be present with rectal hypotension.

While fecal urgency and incontinence may be correlated with anal hypotension or anal hypertension, it is often found in patients with rectal hypersensitivity. Many patients who have undergone lower anterior resections have subsequent rectal hypersensitivity leading to fecal urgency. Patients with ongoing fecal urgency (from diarrhea or other causes) may develop anal hypertension over time, as they are constantly performing anal contractions to avoid episodes of incontinence. This constant effort to contract may lead to eventual anismus. Treatment for these patients is biofeedback with down training and with balloon sensation training. Patients with anal hypotension may also ultimately end up with rectal hypersensitivity as they sensitize themselves to any stool being present in the rectum to avoid incontinence. Management includes strengthening

for patients with anal hypotension, and may include rectal myofascial release and neuromodulation in patients with rectal hypertension.

Constipation

ARM may be helpful in isolating causes of constipation. While both dysmotility and dyssynergia can coexist, ARM can help dictate management. In patients with normal ARM and none of the aforementioned classified disorders, management of functional constipation and dysmotility may be recommended first. Conversely, each of the London Classifications can correlate with constipation symptoms. Most patients with disorders in the rectoanal inhibitory reflexes may have symptoms megarectum or aganglionosis. Patients with anal hypertension are often patients who are unable to appropriately relax the anal sphincter and often also have disorders of rectoanal coordination and dyssynergia. These patients are best managed with biofeedback and myofascial release depending if the dyssynergia or the anal hypertonicity is primary. Patients with anal hypertonicity may also ultimately end up with rectal hyposensitivity and complain of lack of urge to defecate. This may require additional medical management in addition to biofeedback therapy.

Rectal pain

Patients with rectal pain and anismus are often found to have anal hypertension or rectal hypersensitivity. In these patients, management is with biofeedback and rectal/anal myofascial release. In patients with rectal pain and no evidence of either anal hypertension or rectal hypersensitivity, further evaluation of other anatomic or neurologic causes should be pursued.

Conclusions

ARM is recognized as one of the major ways to evaluate and better differentiate anorectal disorders. While it was previously believed that clinical history and physical examination can define the causes, it is clear that ARM offers utility in both differentiating etiologies and helping to guide treatment for these disorders. The London Classification has helped to make significant strides in standardizing testing protocols and classification of dysfunction and ultimately will help to better guide

diagnosis and treatment.

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