Relationship Among Anal Sphincter Injury, Patulous Anal Canal, and Anal Pressures in Patients With Anorectal Disorders

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BACKGROUND & AIMS: **The anal sphincters and puborectalis are imaged routinely with an endoanal magnetic resonance imaging (MRI) coil, which does not assess co-aptation of the anal canal at rest. By using a MRI torso coil, we identified a patulous anal canal in some patients with anorectal disorders. We aimed to evaluate the relationship between anal sphincter and puborectalis injury, a patulous anal canal, and anal pressures.**

METHODS: **We performed a retrospective analysis of data from 119 patients who underwent MRI and manometry analysis of anal anatomy and pressures, respectively, from February 2011 through March 2013 at the Mayo Clinic. Anal pressures were determined by high-resolution manometry, anal sphincter and puborectalis injury was determined by endoanal MRI, and anal canal integrity was determined by torso MRI. Associations between manometric and anatomic parameters were evaluated with univariate and multivariate analyses.**

RESULTS: **Fecal incontinence (55 patients; 46%) and constipation (36 patients; 30%) were the main indications for testing; 49 patients (41%) had a patulous anal canal, which was associated with injury to more than 1 muscle (all $P \leq .001$), and internal sphincter ($P < .01$), but not puborectalis ($P = .09$) or external sphincter ($P = .06$), injury. Internal ($P < .01$) and external sphincter injury ($P = .02$) and a patulous canal ($P < .001$), but not puborectalis injury, predicted anal resting pressure. A patulous anal canal was the only significant predictor ($P < .01$) of the anal squeeze pressure increment.**

CONCLUSIONS: **Patients with anorectal disorders commonly have a patulous anal canal, which is associated with more severe anal injury and independently predicted anal resting pressure and squeeze pressure increment. It therefore is important to identify a patulous anal canal because it appears to be a marker of not only anal sphincter injury but disturbances beyond sphincter injury, such as damage to the anal cushions or anal denervation.**

Keywords: Anorectal Imaging; Diagnosis; Risk Factor; Anal Sphincter Defects.

Anorectal imaging with endoanal ultrasound or magnetic resonance imaging (MRI) is recommended to identify anal injury in patients with fecal incontinence (FI) and anal weakness.[1] Anorectal imaging also guides surgical therapy, for example, surgical repair of anal sphincter defects, in patients with FI.[2] Atrophy of the external sphincter was associated with a worse outcome after anal sphincteroplasty in some,[3] but not all,[4] studies. Although patients with large anal sphincter defects were excluded from multicenter trials of sacral nerve stimulation,[5] smaller studies have suggested that these patients also may benefit from this modality.[6]

The application of anorectal imaging to investigate anal weakness is underpinned by the premise that structural abnormalities (ie, anal sphincter injury) explain anal weakness. Indeed, internal anal sphincter (IAS) and external anal sphincter (EAS) injuries are associated with reduced anal resting and squeeze pressures, respectively, in older women with FI.[7–10] Anal weakness also is associated with anal sphincter defects in postpartum women.[11,12] Moreover, women with IAS and EAS defects have more severe anal weakness and FI than women with isolated EAS defects.[13] Puborectalis

Abbreviations used in this paper: EAS, external anal sphincter; FI, fecal incontinence; IAS, internal anal sphincter; IQR, interquartile range; MRI, magnetic resonance imaging.

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injury also has been associated with anal weakness in FI.[8,14]

There are 3 important questions regarding the relationship between anal sphincter injury and pressures in FI. First, the sensitivity and specificity of manometry to identify sphincter injury has not been evaluated. Second, most studies that have evaluated the relationship between sphincter injury and weakness focused on injury affecting a single rather than multiple muscles. Third, with MRI using a torso rather than an endoanal coil, we have observed that the anal canal often is patulous (ie, not closed), even at rest, in some patients with anorectal disorders. Although a gaping anal canal, which is associated with reduced anal resting pressure, can be identified by physical examination,[15] prior imaging studies have not described a patulous anal canal, perhaps because they were conducted with an endoanal coil, which distorts the anal canal. A MEDLINE literature search for "patulous anal canal" identified only 2 articles in the past 100 years that have described a patulous canal (ie, in association with fecal impaction in children and surgical repair).[16,17] Conceivably, a patulous anal canal results from anal sphincter injury and should predispose to FI. However, the relationship between a patulous anal canal, anal sphincter injury, and anal weakness is unclear.

Prompted by these questions, the objectives of this study were to investigate the relationship between anal sphincter and puborectalis injury, anal canal integrity, and anal weakness in patients with anorectal symptoms.

Methods

Study Subjects

This was a retrospective audit of all consecutive patients in whom anal anatomy and pressures were evaluated by MRI and manometry, respectively, between February 2011 and March 2013. Of 122 patients, 3 patients with a history of anorectal surgery, which was the only exclusion criterion, were excluded. Of the remaining 119 patients, 107 were women, with a median age of 58 years (interquartile range [IQR], 43–65 y). This audit was approved by the Mayo Clinic Institutional Review Board. All patients consented to use of their medical records for research.

Assessment of Clinical Features

The demographic and clinical features were abstracted from the medical records by a gastroenterologist (D.P.). Among individuals who had more than 1 indication for anorectal testing, the primary indication for anorectal testing for the analysis was determined by a hierarchy (ie, FI, constipation, rectal prolapse without FI or constipation, and other indications [ie, anal fissures, fistulae, rectal urgency, or rectocele without constipation or FI]), which was based on the recognition that constipation and FI are the main indications for anorectal testing. Among patients with constipation and FI, FI is more likely to be associated with anal injury and weakness than patients with constipation alone. FI severity was graded by the Fecal Incontinence and Constipation Assessment system.[18,19]

Anorectal Manometry

Anal pressures were assessed by a high-resolution anorectal manometry catheter (Sierra Scientific Instruments; Los Angeles, CA) that has 10 sensors at 6-mm intervals along the anal canal and 2 sensors in the rectal balloon. At each level, pressures are averaged across 36 circumferentially oriented, pressure-sensing elements that detect pressure over a length of 2.5 mm. Rectoanal pressures were evaluated at rest and during squeeze.[20,21]

Magnetic Resonance Imaging of Anal Sphincters, Puborectalis, and Anal Canal

Patients underwent endoanal imaging of the anal sphincters followed by MR proctography. After a 3-plane scout, the anal sphincters were imaged orthogonally with respect to the anal canal in 3 planes using a disposable endorectal coil (MRInnervu; Medrad, Inc, Indianola, PA) in conjunction with a torso phased-array coil.[8] Anal sphincter imaging parameters are detailed in the Supplementary Methods section.

Consistent with previous studies, the appearance of the EAS and IAS was characterized as normal or abnormal (injury). The designation of *abnormal* includes the following: (1) mild focal thinning; (2) marked focal thinning, scar, or tear; (3) atrophy; (4) atrophy and tear; or (5) global thickening.[8,22,23] Puborectalis abnormalities were characterized as follows: (1) asymmetry, (2) unilateral atrophy, (3) bilateral atrophy, or (4) tear.

After removing the endoanal coil, 180 mL of ultrasound gel was instilled in the rectum. By using only the external torso phased-array coil and a 3-plane scout, an oblique midsagittal plane bisecting the anorectum, which included the pubis and sacrococcygeal junction, was identified. Anal canal integrity was evaluated on dynamic true–fast imaging with steady-state precession images (5 mm slice, 24 × 30 cm field of view over 30 seconds) at rest in the midsagittal plane. A patulous canal was defined by separation of the anterior and posterior anal mucosa by ultrasound gel for the entire length of the anal canal. The narrowest distance between the anterior and posterior walls of the anal canal, usually near the midpoint of the anal canal, was measured on an image obtained at rest.[24]

Statistical Analysis

The associations between anorectal parameters and clinical features, or between sphincter injury for 2 muscles (eg, IAS vs EAS), was evaluated by the Fisher