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Vaginal shape at resting pelvic MRI: predictor of pelvic floor weakness?

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ABSTRACT

Objective: The objective was to determine if alteration in vaginal shape seen on nonstraining pelvic magnetic resonance (MR) scans is associated with pelvic floor weakness.
Methods: Two readers classified the shape of the middle third of the vagina on resting T2-weighted axial images as normal or abnormal for 76 women with and without pelvic floor weakness.
Results: The sensitivity and specificity for diagnosing pelvic floor dysfunction were 84% and 68% for reader A and 41% and 91% for reader B. Interobserver agreement was fair (kappa=0.39).
Conclusions: Architectural distortion of vaginal shape on routine pelvic MR imaging may suggest pelvic floor dysfunction but is not diagnostic.

1. Introduction

Pelvic floor dysfunction is a major health issue, with 23.7% of women experiencing symptoms associated with pelvic floor disorders at some point in their lives [1]. An increasing number of women in the United States are suffering from pelvic floor dysfunction including pelvic floor weakness and/or urinary or fecal incontinence due to aging of the population and are estimated to reach 43.8 million by the year 2050 [2]. These numbers most likely underestimate the number of women with pelvic floor dysfunction, as patients tend to underreport symptoms for a variety of reasons. The socioeconomic impact of urinary or fecal incontinence related to untreated pelvic floor weakness is enormous and includes lost work, social reclusion, increased risk of falls, and provider care [3].

Weakness of the pelvic floor can be divided into anterior, middle, and posterior compartments, corresponding to abnormal descent of the bladder, uterus, and bowel, respectively, and usually involves the vagina which is in the center of the pelvic hiatus. Traditionally diagnosed via physical exam, pelvic floor weakness can be further evaluated by dynamic straining magnetic resonance (MR) evaluation to provide noninvasive cross-sectional evaluation of all three compartments of the pelvic outlet [4]. The normal vagina has been described as "H" or horizontal shaped on cross-sectional imaging and is centered within the pubococcygeal sling. The shape of the vagina is related to the paracolpium, which is composed of condensations of the endopelvic fascia that support the vagina [5,6], particularly in the midvagina where the paracolpium attaches the vagina more directly to the lateral pelvic walls and stretches it in the coronal plane. At this level, the pubocervical endopelvic fascia supports the bladder anteriorly to prevent a cystocele and the rectovaginal fascia posteriorly to prevent formation of an enterocele or a rectocele [7]. Damage to the paracolpium contributes to pelvic floor weakness and is known to alter vaginal shape [6]. For example, disruption of the uterosacral ligaments permits descent of the vaginal fornices that result in posterior displacement of the fornix on the disrupted side [5]. Damage to the paravaginal fascia occurs by the same mechanisms, most commonly pregnancy and childbirth, resulting in pelvic floor weakness [8].

Because symptoms of pelvic floor dysfunction are often underreported, we wondered if imaging obtained for other purposes might reveal findings of pelvic floor weakness. MR is a preferred technique for imaging the female pelvis for a wide variety of concerns, including abnormal bleeding, fibroids, gynecologic cancers, and pain. The abdomen and pelvis are the third most common anatomical region imaged by MR in the United States, constituting approximately 6% of all Medicare MR exams in 2010 at a rate of 10.8 per 1000 beneficiaries [9].

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Screening for pelvic weakness with MR would certainly be unwarranted from both a practical and economic perspective. However, being able to suggest to referring physicians that they ask about symptoms of pelvic organ weakness may be another way that radiologists could add value to their imaging reports.

Thus, the purpose of our study was to determine if architectural distortion of vaginal shape seen on routinely obtained resting (i.e., nonstraining) axial T2 pelvic MR scans is associated with pelvic floor weakness. We also evaluated the agreement between experienced readers in assessing alterations in assessing normal or abnormal vaginal shape.

2. Methods

This HIPAA-compliant retrospective study was approved by our institutional review board with waiver of the need for patient informed consent.

2.1. Patient selection

A computer search of our electronic radiology database between 1998 and 2007 identified 32 women (mean age, 63; range, 41–88) who were referred for pelvic MR imaging (MRI) evaluation of pelvic floor weakness and who had diagnostic-quality axial T2-weighted MR images through the vagina using a pelvic phased array coil. For these patients, all available medical records were reviewed, and clinical exam findings, surgical reports, and results of other imaging tests such as defacography or voiding cysturethrography were assessed to confirm the diagnosis of pelvic floor weakness.

To ensure a good proportion of patients without pelvic floor weakness, a second (control) group of pelvic MR examinations of 44 different women (mean age, 49; range, 26–79) with diagnostic-quality axial T2-weighted MR images through the vagina using a pelvic phased array coil was randomly obtained by computer selection from the same time period as above (1998–2007). The indications for pelvic MRI in this group were: fibroids ($n=12$), adnexal mass ($n=8$), nongynecologic cancer or mass ($n=8$), pelvic pain ($n=6$), endometrial evaluation ($n=5$), gynecologic cancer ($n=4$, 3 cervical and 1 ovarian cancer), and rectovaginal fistula ($n=1$, scan was negative for fistula). In total, 76 patients were included in our study.

2.2. Pelvic MRI

Pelvic MR images were obtained at 1.5 T (GE Signa or Excite, Milwaukee WI, USA) or at 3 T (GE HDX, Milwaukee, WI, USA) with patients in a supine position using a dedicated pelvic phased array coil. Sagittal T2-weighted sequences were used to identify the corresponding image levels on axial T2-weighted sequences corresponding to the midvagina (defined as Delancey Level II, with Level I corresponding to the cephalic 2 to 3 cm of the vagina, Level III from the hymenal ring to 2–3 cm above, and Level II between Levels I and III) on axial T2-weighted sequences [6]. Imaging parameters for fast spin echo T2-weighted images were repetition time (TR)/echo time (TE) 4000/85 ms, field of view 24–28 cm (sag) and 32–40 cm (axial), frequency matrix 256, phase matrix 192–256, slice thickness: 5 mm/1-mm gap for 1.5 T and TR/TE 4600/130 ms, field of view 24–28 cm (sag) and 32–40 cm (axial), frequency matrix 384, phase matrix 224, slice thickness: 5 mm/1-mm gap for 3 T.

The image numbers corresponding to Delancey Level II were determined by one author and provided to the readers for subsequent scoring of vaginal shape. Patients referred for pelvic floor weakness had additional resting and straining views consisting of static and dynamic single-shot fast spin echo sequences obtained in the sagittal plane.

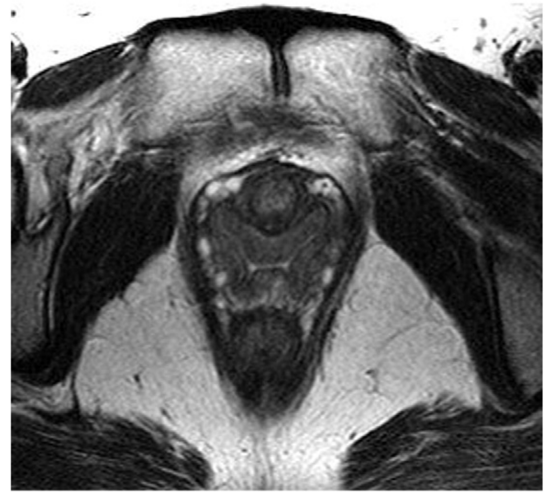

Fig. 1. A 79-year-old woman with pelvic pain but without pelvic floor weakness. Axial T2-weighted image through the midvagina (Delancey level II) demonstrates conventional shape of the vagina, which is a horizontal or "H"-shaped orientation without predominance of an anterior or posterior deviation of the lateral portions of the vagina.

2.3. Image evaluation

The patient list was randomized, and two readers with 11 and 12 years of subspecialty (postfellowship) experience, respectively, blinded to patient diagnosis independently reviewed only the Delancey Level II axial T2-weighted images for each patient and scored the vaginal shape as conventional or distorted. A conventional shape of the vagina was defined as a horizontal or "H"-shaped orientation without predominance of an anterior or posterior deviation of the lateral portions of the vagina (Fig. 1). Architectural distortion was defined, as in a prior publication, as lateral or posterior spill of the vagina, or posterior extension of the space of Retzius [5]. For patients with distorted vaginal shapes, the shape was further categorized as "M" (Fig. 2), "W" (Fig. 3), or other. We hypothesized that, due to disruption of associated perivaginal fascial ligaments, the "M" shape may correlate with posterior weakness or the "W" shape may correlate with anterior compartment weakness. This classification was based on the notion that vaginal shape may be associated with differential weakness in pelvic compartments and the previously published finding that women with anterior compartment weakness are more likely to have architectural distortion [6]. For the purposes of this paper, the compartment of weakness

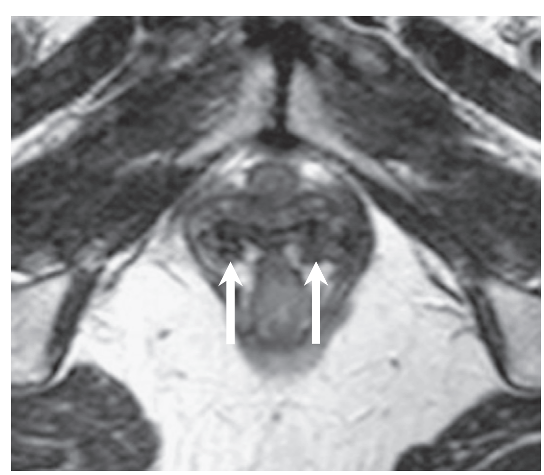

Fig. 2. A 69-year-old woman with prior hysterectomy and pelvic floor weakness. Axial T2-weighted image through the midvagina (Delancey level II) demonstrates a distorted shape of the vagina that was subclassified as "M" shape by both readers. Posterior deviation of the lateral aspects of the vagina is seen bilaterally (arrows).