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The rectovaginal septum: visible on magnetic resonance images of women with Mayer-Rokitansky-Küster-Hauser syndrome (Müllerian agenesis)

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Abstract

Introduction and hypothesis—Ongoing debate exists about whether the rectovaginal septum (Denonvilliers' fascia) is myth or reality. This study evaluates magnetic resonance images (MRI) of women with Müllerian agenesis for the presence of fascial layers between the rectum and the bladder to test the hypothesis that this layer exists in the absence of the vagina.

Methods—This is a secondary analysis of a study describing MRI aspects in women with vaginal agenesis before and after laparoscopic Vecchietti procedure. Study participants ($n=16$) had a multiplanar pelvic MR scan. Images were evaluated independently by two investigators (MH, JOLD) for the appearance of layers separate from the bladder and rectum in the area of interest, with characteristic anatomical features of the septum.

Results—Participants' mean age was 19.4 ± 2.6 years $\pm$ standard deviation (SD). In 12 of 16 patients (75 %) a distinct layer between rectum and bladder was identified in either the axial (4/16; 25 %) or sagittal (12/16; 75 %) scan or both. Characteristic anatomical features included lateral attachment to the levator ani muscle, cranial fusion to the cul-de-sac peritoneum, and caudal insertion into the perineal body.

Conclusions—Three quarters of women with Müllerian agenesis have a visible layer between bladder and rectum. As none of the participants had a vagina, these results support the existence of a rectovaginal septum, separate from a vaginal adventitia.

Keywords

Denonvilliers' fascia; Mayer-Rokitansky-Küster-Hauser syndrome; Müllerian agenesis; Posterior vaginal wall prolapse; Rectocele; Rectovaginal septum

Introduction

More than 200,000 women undergo surgical pelvic floor repairs in the United States annually [1]. Posterior colporrhaphy is reported to be indicated in >87 % of them [2]. Despite the common nature of this problem, significant differences of opinion exist concerning the pathophysiology of posterior vaginal wall prolapse and the appropriate approach to its surgical correction. Several different approaches have been developed and are currently being compared for rectocele, including site-specific repairs, transanal repair, rectocele repair with graft materials, and the classic procedure of posterior colporrhaphy [3]. Surgical procedures, such as mesh repair, have been developed that are predicated on anatomic theories of disease mechanisms of posterior vaginal wall prolapse [4, 5]. Commonly discussed in this regard is the issue of whether or not the rectovaginal septum (Denonvilliers' fascia) is a crucial structure regarding posterior vaginal wall prolapse [6–10]. Those who doubt the existence of the rectovaginal septum suggest this structure is the adventitia and fibromuscular layers of the vagina, questioning its role in rectocele treatment and pathophysiology [7–10]. Dissection has proven inconclusive, and experts differ on this issue [6–14].

Whether or not the rectovaginal septum is a structure separate from the vaginal wall, as suggested by Richardson [13], could be evaluated by seeing whether a fascial layer between the rectum and the bladder is present in women with vaginal agenesis. One in 4,500 women in the USA suffers from Mayer-Rokitansky-Küster-Hauser (MRKH) syndrome, which is defined by aplasia of the Müllerian-derived portion of the vagina and of the uterus [15]. Magnetic resonance imaging (MRI) is often used to help identifying secondary anomalies related to MRKH syndrome and has become a useful tool in its preoperative diagnostics. Figure 1 shows a comparison of the anatomy of women with and without MRKH syndrome.

Using these MR images, we sought to test the null hypothesis that there is no distinct layer that can be described as a rectovaginal septum in women without a vagina.

Methods

This was a secondary analysis of a parent study describing clinical and MRI aspects in women with MRKH syndrome associated vaginal agenesis before and after a laparoscopic neovagina creation. The study was approved by the local ethics committee. Scans from 16 women were assessed. All women were scheduled for a laparoscopic Vecchietti-based procedure, as performed routinely in our institution [16]. Women who had undergone previous vaginal surgery were not included in the study. Scans were performed with the patient at rest (not straining). Multiplanar, 2D, T2-weighted turbo spin-echo MR images (TE 90 ms, TR at least 4,000 ms) were obtained using a 1.5-T superconducting magnet (Gyroscan Achieva, Philips Medical Systems®, Hamburg, Germany). Axial and coronal rectangular fields of view were each 280 mm and sagittal images 250 mm. All three views had slice thicknesses of 4 mm, with a 0.4 mm gap between slices. Axial and sagittal images were evaluated (MH, JOLD) for the appearance of distinctly visible layers separate from the bladder and rectum in the area of interest, satisfying anatomical criteria for the rectovaginal septum. On axial scans, lateral extent at the coccygeus and levator ani muscles was assessed.

On sagittal scans, cranial fusion to the cul-de-sac peritoneum and caudal insertion into the perineal body were evaluated.

Results

Participants' mean age was 19.4 ± 2.6 years $\pm$ standard deviation (SD). All women were Caucasian. Mean body mass index (BMI) was 22.4 ± 2.5 kg/m² ($\pm$ SD). Image review revealed that in 12 of 16 patients (75 %), a distinct layer between rectum and bladder could be identified in either the axial (4/16; 25 %) or sagittal (12/16; 75 %) scan, or both. Details of the visible rectovaginal septum are shown in the axial and sagittal planes in Fig. 2. Several features of this layer were visible. Cranially, the layer is seen as continuous with the peritoneum at the bottom (caudal extent) of the posterior cul-de-sac. Caudally, it appears as continuous with the cephalic extent of the perineal body. Laterally, the layer blends into the superior fascia of the coccygeus and levator ani muscle. In four of 16 patients (25 %), its identification was not possible in either plane. Figure 3 shows two examples of women with and one without a visible septum. Other anatomic variations that could affect pelvic floor anatomy in these cases could not be recognized.

Discussion

In 75 % women with MRKH syndrome assessed in this study, we identified a distinct layer between the bladder and rectum that was consistent with existing descriptions of a rectovaginal septum, or Denonvilliers' fascia [6, 12]. Specifically, it is contiguous with the peritoneum at the depth of the posterior cul-de-sac, extends to the perineal body, and fuses laterally with the superior fascia of the coccygeus and levator ani muscles. The finding that there is a layer seen on MRI where the Müllerian portion of the vagina is missing is consistent with the existence of a structure separate from the vagina.

Previous discussion has both supported [6] and denied [7–10, 14] the existence of a structure called the rectovaginal septum. The original description by Denonvilliers was of “a thin layer of dense tissue separating the rectum from the bladder, seminal vesicles and prostate in men” [13]. Uhlenhuth and Wolfe show evidence of the existence of the rectovaginal septum and published that “it is to be counted among the structures which constitute the support mechanisms of the genitourinary organs” [6]. Nichols and Milley identified the rectovaginal septum in their surgical dissections [12]. Richardson emphasized the importance of reconstructing certain defects in the rectovaginal septum as a key step in posterior vaginal wall repair [13]. He could even provide histological evidence for the existence of a pubocervical fascia in women with vaginal agenesis [13]. In the surgical field of urology, Denonvilliers' fascia is still a structure of importance [17–19]. Zhai et al. describe the rectovaginal septum as a structure composed of anterior and posterior layers—to be specific, the Denonvilliers' fascia and the fascia proprium of the rectum [11]. Using transperineal 3D ultrasound, Dietz et al. identified a hyperechogenic layer between the vagina and the rectum in 45 of 46 patients but found no correlation with clinical findings [20]. Shobeiri et al. described a 100 % detection rate and interrater agreement in identifying the rectovaginal septum using endovaginal 3D ultrasound. They even correlated their results with histologic dissections showing the rectovaginal septum [21]. Conversely, Kleeman et al. found no

evidence of a specific layer between the posterior vaginal wall and the rectum. They describe the septum as a vaginal adventitia that can be reinforced during rectocele repair. They wrote: “The term fascia, Denonvilliers' fascia, or rectovaginal septum, should not be used to describe any layer in the posterior vaginal or anterior rectal wall because it is inaccurate” [14].

There are several limitations to our study design that must be kept in mind. Although our study does reveal a layer distinct from the vaginal wall, it does not provide any information about whether or not this layer has functional significance. That issue must be addressed separately, and basing surgical procedures on these findings is not justified without other objective data to support the safety and success of surgery to repair this layer. Admittedly, our sample size is quite small; however, considering the rarity of this condition, it is a substantial collection of unique images. The unique nature of the anatomy in these women provides important information. As this study was performed in living women, it is not feasible to correlate our morphologic findings using MR images with anatomic dissections. However, we feel confident in our analysis of pelvic floor morphology and anatomy using MRI, as shown in several previous studies [22–27].

Keeping the work of Richardson [13] and Kleeman et al. [14] in mind, the question may arise as to whether our study is just another piece of the puzzle regarding the existence of the rectovaginal septum. Whether or not damage to this layer results in pelvic organ prolapse is not addressed by this study. In their study, Hsu et al. wrote: “Posterior compartment dysfunction is the least understood form of pelvic organ prolapse and many of the surgical treatments for it are empirically derived rather than based on objective, anatomic demonstration of structural abnormalities. [23].”

We emphasize some clinical aspects of our findings. Whereas Richardson described a quite simple pathophysiologic concept of how women develop rectoceles and how those isolated breaks in the rectovaginal septum and their surgical repair are crucial in posterior vaginal wall surgery, at least three different mechanisms of posterior vaginal wall failure have been described in a conceptual model of posterior compartment support and possible reasons for failure [28]. This model includes: (1) loss of apical support, (2) levator ani muscle defects, (3) integrity of perineal body connections [23, 29], and (4) integrity of the posterior vaginal wall itself. Understanding these different defect locations has led to different surgical strategies in addition to the classic posterior colporrhaphy, such as sacrocolpopexy, sacrospinous or uterosacral ligament suspension, or perineal body repair. This research establishes that a rectovaginal septum exists separate from the vaginal wall but cannot establish its contributions to support relative to the other features.

In conclusion, our study shows that a distinct layer separate from the vaginal wall is visible on MRI of women with vaginal agenesis. Whether it is of major, minor, or no importance remains to be clarified.

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References

1. Boyles SH, Weber AM, Meyn L. Procedures for pelvic organ prolapse in the United States, 1979–1997. *Am J Obstet Gynecol.* 2003; 188(1):108–115. doi:10.1067/mob.2003.101. [PubMed: 12548203]
2. Silva WA, Pauls RN, Segal JL, Rooney CM, Kleeman SD, Karram MM. Uterosacral ligament vault suspension: five-year outcomes. *Obstet Gynecol.* 2006; 108(2):255–263. doi:10.1097/01.AOG.0000224610.83158.23. [PubMed: 16880293]
3. Cundiff GW, Fenner D. Evaluation and treatment of women with rectocele: focus on associated defecatory and sexual dysfunction. *Obstet Gynecol.* 2004; 104(6):1403–1421. doi:10.1097/01.AOG.0000147598.50638.15. [PubMed: 15572506]
4. Debodinance P. Patent for medical device: from design to marketing (example of Prolift(R)). *J Gynecol Obstet Biol Reprod (Paris).* 2010; 39(6):507–508. doi:10.1016/j.jgyn.2010.05.008. [PubMed: 20591581]
5. Murphy M, Holzberg A, van Raalte H, Kohli N, Goldman HB, Lucente V. Time to rethink: an evidence-based response from pelvic surgeons to the FDA safety communication: “UPDATE on serious complications associated with transvaginal placement of surgical mesh for pelvic organ prolapse”. *Int Urogynecol J.* 2012; 23(1):5–9. doi:10.1007/s00192-011-1581-2. [PubMed: 22086260]
6. Uhlenhuth E, Wolfe WM, et al. The rectogenital septum. *Surg Gynecol Obstet.* 1948; 86(2):148–163. [PubMed: 18898946]
7. Ricci JV, Lisa JR, et al. The relationship of the vagina to adjacent organs in reconstructive surgery; a histologic study. *Am J Surg.* 1947; 74(4):387–410. [PubMed: 20266018]
8. Curtis AH, Anson BJ, Beaton LF. The anatomy of the subperitoneal tissues and legamentous structures in relation to surgery of the female pelvic viscera. *Surg Gynecol Obstet.* 1940; 70:643–656.
9. Goff BH. An histologic study of the perivaginal fascia in a nullipara. *Surg Gynecol Obstet.* 1931; 52:32–42.
10. Krantz KE. The gross and microscopic anatomy of the human vagina. *Ann N Y Acad Sci.* 1959; 83:89–104. [PubMed: 14411705]
11. Zhai LD, Liu J, Li YS, Yuan W, He L. Denonvilliers' fascia in women and its relationship with the fascia propria of the rectum examined by successive slices of celloidin-embedded pelvic viscera. *Dis Colon Rec.* 2009; 52(9):1564–1571. doi:10.1007/DCR.0b013e3181a8f75c.
12. Milley PS, Nichols DH. A correlative investigation of the human rectovaginal septum. *The Anat Rec.* 1969; 163(3):443–451. doi:10.1002/ar.1091630307.
13. Richardson AC. The rectovaginal septum revisited: its relationship to rectocele and its importance in rectocele repair. *Clin Obstet Gynecol.* 1993; 36(4):976–983. [PubMed: 8293598]
14. Kleeman SD, Westermann C, Karram MM. Rectoceles and the anatomy of the posteriorvaginal wall: revisited. *Am J Obstet Gynecol.* 2005; 193(6):2050–2055. doi:10.1016/j.ajog.2005.07.096. [PubMed: 16325614]
15. Rall K, Barresi G, Walter M, Poths S, Haebig K, Schaeferhoff K, Schoenfisch B, Riess O, Wallwiener D, Bonin M, Brucker S. A combination of transcriptome and methylation analyses reveals embryologically-relevant candidate genes in MRKH patients. *Orphanet J Rare Dis.* 2011; 6:32. doi:10.1186/1750-1172-6-32. [PubMed: 21619687]

16. Brucker SY, Gegusch M, Zubke W, Rall K, Gauwerky JF, Wallwiener D. Neovagina creation in vaginal agenesis: development of a new laparoscopic Vecchietti-based procedure and optimized instruments in a prospective comparative interventional study in 101 patients. *Fertil Steril*. 2008; 90(5):1940–1952. doi:10.1016/j.fertnstert.2007.08.070. [PubMed: 18061172]
17. Hinata N, Sejima T, Takenaka A. Progress in pelvic anatomy from the viewpoint of radical prostatectomy. *Int J Urol*. 2012 doi:10.1111/iju.12021.
18. Ficarra V, Gan M, Borghesi M, Zattoni F, Mottrie A. Posterior muscolofascial reconstruction incorporated into urethrovesical anastomosis during robot-assisted radical prostatectomy. *J Endourol / Endourological Soc*. 2012 doi:10.1089/end.2012.0554.
19. Weber DC, Zilli T, Vallee JP, Rouzaud M, Miralbell R, Cozzi L. Intensity modulated proton and photon therapy for early prostate cancer with or without transperineal injection of a polyethylen glycol spacer: a treatment planning comparison study. *Int J Radiat Oncol Biol Phys*. 2012; 84(3):e311–318. doi:10.1016/j.ijrobp.2012.03.028. [PubMed: 22999271]
20. Dietz HP. Can the rectovaginal septum be visualized by transvaginal three-dimensional ultrasound? *Ultrasound Obstet Gynecol*. 2011; 37(3):348–352. doi:10.1002/uog.8896. [PubMed: 21337655]
21. Shobeiri SA, White D, Quiroz LH, Nihira MA. Anterior and posterior compartment 3D endovaginal ultrasound anatomy based on direct histologic comparison. *Int Urogynecol J*. 2012; 23(8):1047–1053. doi:10.1007/s00192-012-1721-3. [PubMed: 22402641]
22. Margulies RU, Hsu Y, Kearney R, Stein T, Umek WH, DeLancey JO. Appearance of the levator ani muscle subdivisions in magnetic resonance images. *Obstet Gynecol*. 2006; 107(5):1064–1069. doi:10.1097/01.AOG.0000214952.28605.e8. [PubMed: 16648412]
23. Hsu Y, Lewicky-Gaupp C, DeLancey JO. Posterior compartment anatomy as seen in magnetic resonance imaging and 3-dimensional reconstruction from asymptomatic nulliparas. *Am J Obstet Gynecol*. 2008; 198(6):651, e651–657. doi:10.1016/j.ajog.2007.11.032. [PubMed: 18241813]
24. Huebner M, Margulies RU, DeLancey JO. Pelvic architectural distortion is associated with pelvic organ prolapse. *Int Urogynecol J Pelvic Floor Dysfunct*. 2008; 19(6):863–867. doi:10.1007/s00192-007-0546-y. [PubMed: 18193147]
25. Huebner M, Margulies RU, Fenner DE, Ashton-Miller JA, Bitar KN, DeLancey JO. Age effects on internal anal sphincter thickness and diameter in nulliparous females. *Dis Col Rec*. 2007; 50(9): 1405–1411. doi:10.1007/s10350-006-0877-7.
26. Hsu Y, Huebner M, Chen L, Fenner DE, DeLancey JO. Comparison of the main body of the external anal sphincter muscle cross-sectional area between women with and without prolapse. *Int Urogynecol J Pelvic Floor Dysfunct*. 2007; 18(11):1303–1308. doi:10.1007/s00192-007-0340-x. [PubMed: 17370027]
27. Margulies RU, Huebner M, DeLancey JO. Origin and insertion points involved in levator ani muscle defects. *Am J Obstet Gynecol*. 2007; 196
28. Lewicky-Gaupp C, Yousuf A, Larson KA, Fenner DE, Delancey JO. Structural position of the posterior vagina and pelvic floor in women with and without posterior vaginal prolapse. *Am J Obstet Gynecol*. 2010; 202(5):497, e491–496. doi:10.1016/j.ajog.2010.01.001.
29. DeLancey JO. Structural anatomy of the posterior pelvic compartment as it relates to rectocele. *Am J Obstet Gynecol*. 1999; 180(4):815–823. [PubMed: 10203649]

Fig. 1.

a Sagittal magnetic resonance imaging (MRI) of a young, healthy woman with normal anatomy. **b** Young woman with Mayer-Rokitansky-Küster-Hauser (MRKH) syndrome (vaginal agenesis) for comparison (the rectovaginal septum is not visible). Note the missing vagina and uterus. *P* pubis, *B* bladder, *U* uterus, *V* vagina, *R* rectum (T2-weighted turbo spin-echo sequence)

Fig. 2.

a Sagittal magnetic resonance image (MRI) of a patient with Müllerian agenesis. *B* bladder, *R* rectum, *P* peritoneum, *PB* perineal body, *AS* anal sphincters. *White arrows* show the distinct layer between bladder and rectum, which is the rectovaginal septum. **b** Axial MRI of a second patient with vaginal agenesis. *White arrows* denote the rectovaginal septum. *CM* coccygeus muscle (T2-weighted turbo spin-echo sequence)

Fig. 3.

Two patients with a visible rectovaginal septum (1, 2) and one without (3). **a** Sagittal slide. *P* pubic bone *B* bladder, *R* rectum, *AS* anal sphincters, *OI* obturator internus muscle, *LA* levator ani muscle. **b** Axial slide at the level of the urethra, **b** Level of the lower bladder, **c** Level of the lower bladder, **d** Level of the higher bladder. *U* urethra *R* rectum *B* bladder. *White arrows* show the rectovaginal septum. Those *arrows* are missing in scans of patient 3 (**a–d**), as the rectovaginal septum could not be identified (T2-weighted turbo spin-echo sequence)