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ORIGINAL ARTICLE

Association between vaginal parity and rectocele

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Abstract

Introduction and hypothesis Rectocele is common in parous women but also seen in nulliparae. This study was designed to investigate the association between vaginal parity and descent of the rectal ampulla/rectocele depth as determined by translabial ultrasound (TLUS).

Methods This retrospective observational study involved 1296 women seen in a urogynaecological centre. All had undergone an interview, clinical examination and 4D ultrasound (US) imaging supine and after voiding. Offline analysis of volume data was undertaken blinded against other data. Rectal ampulla position and rectocele depth were measured on Valsalva. A pocket depth of 10 mm was used as a cutoff to define rectocele on imaging.

Results Most women presented with prolapse (53%, $n = 686$); 810 (63%) complained of obstructed defecation (OD). Clinically, 53% ($n = 690$) had posterior-compartment prolapse with a mean Bp of −1 [standard deviation (SD)1.5; −3 to 9 cm]. Mean descent of the rectal ampulla was 10 mm below the symphysis (SD 15.8; −50 to 41). A rectocele on imaging was found in 48% ($n = 618$). On univariate analysis, OD symptoms were strongly associated with rectal descent, rectocele depth and rectocele on imaging (all $P < 0.001$). The prevalence of a rectocele seen on imaging increased with vaginal parity ($P < 0.001$). One-way analysis of variance (ANOVA) of vaginal parity against rectal descent and rectocele depth showed a dose–response relationship (both $P < 0.001$).

Conclusions Vaginal parity was strongly associated with descent of the rectal ampulla and rectocele depth. This relationship approximated dose–response characteristics, with the greatest effect due to the first vaginal delivery.

Keywords Posterior compartment · Rectocele · Transperineal ultrasound

Introduction

Posterior-compartment prolapse may be due to different anatomical abnormalities, such as a rectocele visible on sonographic or X-ray imaging (i.e., a diverticulum of the rectal ampulla), perineal hypermobility/excessive distensibility with intact rectovaginal septum, an isolated enterocele or a deficient perineum [1]. Gynaecologists tend to diagnose these disorders by observing surface anatomy (displacement of the posterior vaginal wall on Valsalva), but clinical examination tends to be limited, even in experienced hands [2]. A digital rectal examination may enhance diagnostic yield but is infrequently used [3] in some countries, with ongoing debate over its utility. Defaecation proctography is regarded by some as the gold standard in the diagnosis, but it is costly, unpleasant for the patient and involves radiation. Translabial ultrasound (US) may replace defecation proctography, not the least due to its its lower cost and less patient discomfort [4–8].

Pregnancy and childbirth are considered the primary factors in the aetiology and pathogenesis of female pelvic organ prolapse (POP). This is particularly obvious for anterior and central compartment prolapse, which seem to be at least partly mediated by birth trauma, i.e. hiatal overdistension and

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macroscopic levator trauma in the form of an avulsion [9]. The link between childbirth and prolapse of the posterior compartment is much less clear, with only weak links between levator trauma and posterior compartment descent [10]. Rectocele does occur in young nulliparae [11], although prospective perinatal studies have shown that the prevalence increases with vaginal delivery [12].

The aim of this study was to investigate any association between vaginal parity and posterior compartment anatomy—i.e. position of rectal ampulla, significant rectocele on imaging and rectocele depth—as determined by translabial US, in a large series of symptomatic women.

Materials and methods

This was a retrospective study using 1328 archived data sets of patients seen for symptoms of lower urinary tract and pelvic floor dysfunction at a tertiary urogynaecological unit over a period of 3 years between September 2011 and October 2014. Patients had undergone an interview, Pelvic Organ Prolapse Quantification (POP-Q) examination [13] and 4D translabial US [14], supine and after voiding, using Voluson 730 expert and Voluson S6 systems. As part of a physician-directed interview, symptoms of obstructed defecation (OD) were defined as straining at stool, incomplete bowel emptying and perineal, vaginal or anal digitation, with the patient answering questions with 'yes' or 'no'. The overall bother of OD symptoms was defined with the help of a Visual Analogue Scale (VAS). Imaging acquisition was performed by four subspecialty Fellows and about 20 specialty and subspecialty trainees, all under the direct supervision of the senior author. Offline analysis for rectal ampulla descent and rectocele presence and depth was undertaken at a later date, on a desktop PC by the second author, using proprietary software (4D View v10, Kretz Medizintechnik, Zipf, Austria), blinded against all other data.

On postprocessing, downwards displacement of the rectal ampulla (or the rectocele, if present) was quantified against the inferior margin of the symphysis pubis; see Fig. 1 [15]. In essence, any descent of any component of the rectal ampulla on Valsalva, whether with or without a rectocele on imaging, was measured against a horizontal reference line. A rectovaginal septal defect (rectocele on imaging) was diagnosed if there was a discontinuity in the anterior contour of internal anal sphincter and anterior anorectal muscularis resulting in a diverticulum of the ampulla, which is how a rectocele is defined radiologically. Measurement of rectocele depth is effected by extending the anterior aspect of the internal anal sphincter in a straight line and determining the depth of the rectocele 'pocket' vertically to that line (Fig. 1), a method that is designed to mimic the radiological assessment of rectocele. A significant rectocele on imaging is diagnosed when rectocele depth is ≥10 mm, a definition that clearly is associated with symptoms of OD [14].

Statistical analysis was performed using SPSS 20 (SPSS, Chicago, IL, USA) and Minitab 16 (Minitab State College, PA, USA). Normality of data was assessed using the Kolmogorov–Smirnov method. Categorical data is expressed as number (%), compared using the chi-square (X^2) test and results expressed in odds ratio (OR) and 95% confidence interval (CI). Normally distributed continuous variables were assessed using two-sample Student's *t* test. Relationships between vaginal parity and rectal ampulla descent and rectocele depth were assessed using one-way analysis of variance (ANOVA). Results were analysed against vaginal parity as stated by the patient. Twin deliveries were coded as one birth. Multivariate analysis was performed controlling for age, body mass index (BMI), previous hysterectomy, previous incontinence/prolapse surgery and vaginal operative delivery. $P < 0.05$ was regarded as statistically significant. As this was a retrospective pilot study, we did not perform power calculations. Human research ethics approval was obtained under reference NBMLHD HREC 13–16.

Results

Of 1328 women seen during the study period, 32 were excluded due to missing US volume data in 30 and missing parity data in one. One patient had had an abdominoperineal resection and was also excluded, leaving 1296 to whom our results apply. Demographic data are shown in Table 1.

On clinical examination, 75.6% ($n = 980$) of patients were found to have POP stage ≥2, and in 690 (53.2%) cases, this affected the posterior compartment. Mean Ba, C and Bp were −0.8 (SD 1.8; − 3 to +3) cm, −4.3 (SD 2.81; − 9 to 8) cm and −1.1 (SD 1.5; − 3 to +3) cm, respectively. Mean Gh + Pb was 7.8 (SD 1.5; 3.5 to 12.5) cm. On imaging, there was significant posterior compartment descent, i.e. rectal ampulla or (if present) rectocele to ≥ 15 mm below the symphysis) in 563 women (43.4%). Mean descent of the rectal ampulla was −10 (SD 15.7; − 50 to 41) mm, that is, to 10 mm below the symphysis pubis. A rectovaginal septal defect (diverticulum of the rectal ampulla into the vagina of ≥10 mm) was found in 618 (47.7%) at a mean rectocele depth of 18.7 (SD 6.8; 10–47.1) mm.

On univariate analysis, symptoms of OD were strongly associated with descent of the rectal ampulla, rectocele depth and rectocele on imaging (all $P < 0.001$ on two-sample *t* test for rectal ampulla/rectocele depth and χ^2 test for rectocele on

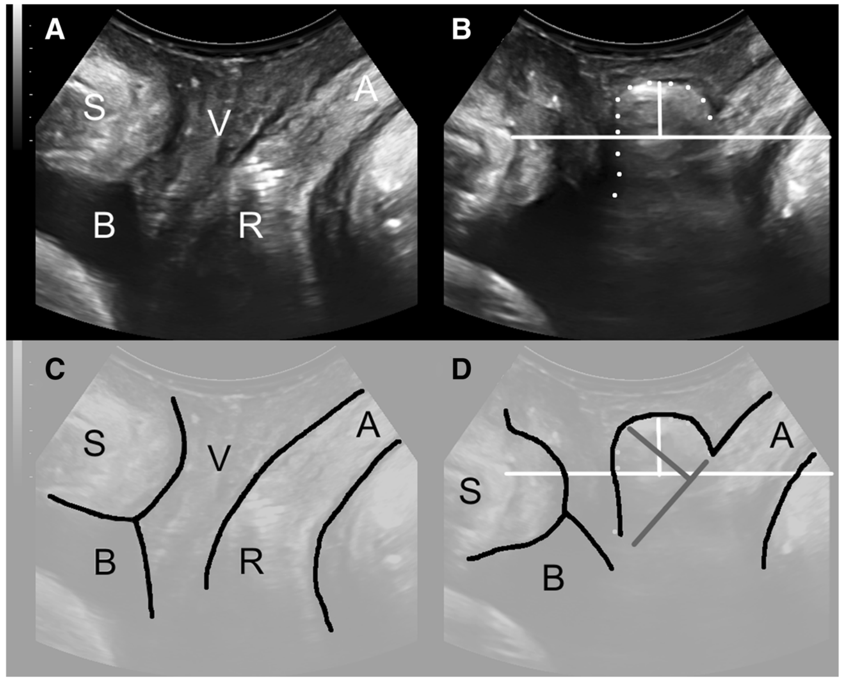

Fig. 1 Sonographically abnormal anatomy of the posterior compartment. **a, c** Midsagittal view at rest and **b, d** on Valsalva showing a rectocele with measurement of its caudad extent (*white vertical lines*) and depth (*gray oblique lines* in **d**). *S* symphysis pubis, *B* bladder, *V* vagina, *R* rectal ampulla, *A* anal canal. *Black lines* (**c, d**) are contours of bladder/urethra and anorectum

imaging). The prevalence of a rectocele on imaging steadily and consistently increased with vaginal parity [$P < 0.001$ on chi-square test (5×2 contingency table)] (Table 2). One-way ANOVA of vaginal parity against descent of the rectal ampulla (Fig. 2a) and rectocele depth (Fig. 2b) showed very similar relationships (both $P < 0.001$). For rectocele depth in Fig. 2b, all individual measurements were used (all patients were included, regardless of the pocket depth reaching the cutoff of 10 mm, which is used to diagnose rectocele on imaging). This analysis was repeated after excluding all women with a history of previous hysterectomy and/or incontinence/prolapse surgery, with near-identical results in that all statistically significant relationships remained highly significant. Multivariate analysis controlling for age, BMI, previous hysterectomy, incontinence/prolapse surgery and vaginal operative delivery confirmed those findings.

Table 1 Demographic data

Parameter	No. (%)	Mean	Standard deviation	Range
Age		56	13.5	17–89
BMI		29	6.3	15–59
Parity		2*		0–9
Vaginal parity		2*		0–9
Instrumental delivery	355 (27.4%)			
Hysterectomy	403 (31.1%)			
Incontinence/prolapse procedures	237 (18.3%)			
Stress urinary incontinence	934 (72.2%)			
Urge urinary incontinence	957 (74%)			
Prolapse symptoms	686 (52.9%)			
Obstructed defecation	810 (62.6%)			

BMI body mass index

*Median

Discussion

Pregnancy and childbirth are considered the main environmental factors in the pathogenesis of female POP and urinary and anal incontinence [16]. The aetiological pathway seems to be most obvious in the case of avulsion, i.e. traumatic disconnection of the levator ani from the pelvic sidewall. This is an anatomical alteration clearly due to vaginal birth that results in an increased likelihood of anterior and central compartment prolapse [9]. In addition, there seems to be microtrauma [17], i.e. irreversible overdistension of the levator hiatus, the largest potential hernia portal in the human body. Both avulsion and microtrauma seem almost exclusively due to the first vaginal birth in that neither avulsion [18–20] nor hiatal overdistension [21] seem to increase in prevalence with subsequent vaginal births.

The pattern observed in this study seems to be fundamentally different from other findings in that, for the posterior compartment, subsequent vaginal births seem to matter much more than for the levator ani. For all three outcome measures—i.e. prevalence of rectocele on imaging, depth of a rectocele and descent of the rectal ampulla or rectocele relative to the symphysis pubis—we found a dose–response-like

Table 2 Vaginal parity vs. diagnosis of rectocele on imaging (i.e. diverticulum of rectal ampulla ≥10 mm in depth)

Parity	0	1	2	3	4	5+	Any
Number	128	138	449	350	136	95	1296
Rectocele on imaging (*n*)	38	60	208	171	78	63	618
Percent	29.7	43.5	46.3	48.9	57.4	66.3	47.7

association with vaginal parity, and this effect remained highly significant after controlling for multiple confounders on multivariate modeling. Hence, it seems plausible that the pathophysiological pathways of anterior/central and posterior compartment prolapse differ in important aspects. This hypothesis is supported by the observation that patterns of prolapse vary substantially between different ethnic groups [22, 23].

Rectocele is an interesting and often incompletely understood condition. Gynaecologists call any prolapse of the posterior vaginal wall a rectocele, while colorectal surgeons and imaging specialists require the presence of a pocket or diverticulum of the rectal ampulla for this diagnosis, which we term rectocele on imaging, to distinguish it from the gynecological diagnosis. Most rectoceles are anterior, i.e. they herniate into the vagina. This herniation occurs through a defect in the rectovaginal septum, or Denonvilliers fascia [24, 25], which is the key to surgical correction [25].

Our results confirm the hypothesis that vaginal childbirth seems to be a factor in the etiology of rectocele, and this is largely consistent with the (admittedly scant) literature on this subject [12, 26, 27]. One may speculate that the actual process involved does not seem to be a one-time rupture of an anatomical structure, as in levator avulsion, but progressive (at least partly irreversible) dilatation and distension during egress of the fetal head. During distension of the perineum, the rectovaginal septum is likely to be displaced downwards. It is conceivable that this could worsen with each subsequent delivery, without there ever being an actual macroscopic tear.

However, it is understood that the hormonal and mechanical effects of pregnancy, as opposed to the actual birth, may also play a role. It is one of the central weaknesses of this work, that our study design did not allow us to assess the effect of pregnancy as opposed to childbirth. This will require future studies in larger data sets, allowing a distinction between true nulliparae and women delivered exclusively by Cesarean. Several other weaknesses of this study need to be mentioned. We did not use validated questionnaires, as we regard them as too cumbersome in clinical practice. Our population consisted of women presenting to a urogynaecology service, implying potentially significant selection bias and a potentially enriched sample. Hence, our results may not apply to the general population. In addition, most of our patients were of Caucasian origin, which limits extrapolation to other ethnicities. This is particularly important in view of recent observations suggesting large variations in posterior compartment prolapse in different ethnicities [22, 23]. Imaging data was acquired by at least 20 specialty and subspecialty trainees under the direct supervision of the senior author, which may have introduced a degree of inhomogeneity. In addition, this was a retrospective cross-sectional study, which is unable to investigate causative mechanisms. Optimally, the effect of subsequent pregnancies would be investigated in a prospective study.

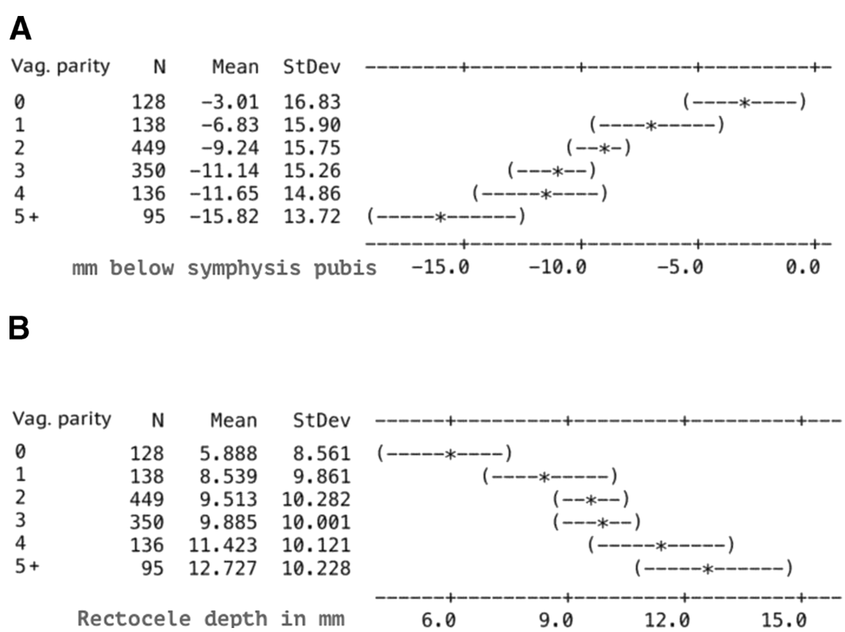

Fig. 2 Analysis of variance (ANOVA) for vaginal parity against **a** descent of the rectal ampulla and **b** rectocele depth, both $P < 0.0001$. In both instances, increased parity is associated with more pronounced anatomical abnormality (higher measurements for rectocele depth and lower measurements for position of the rectal ampulla on Valsalva)

However, this would require at least a decade and very substantial funding. As regards parameters assessed by us, i.e., presence and depth of a rectocele on the one hand, and descent of the rectal ampulla on the other hand, these are not independent of each other, since a large rectocele will inevitably impact on the descent measurement. Finally, our methodology—while described since 2001 in multiple publications, reviews and book chapters—awaits full, independent validation.

Conclusions

In this observational series of 1296 women seen by a urogynaecological service, vaginal parity was strongly associated with descent of the rectal ampulla, presence of a rectocele on imaging and rectocele depth. This relationship showed a dose–response-like association, with the greatest effect due to the first vaginal delivery. This pattern differs from other forms of anatomical alterations due to childbirth, as both hiatal ballooning and levator avulsion largely seem to be due to the effect of a first vaginal birth.

Compliance with ethical standards

Conflicts of interest HP Dietz has received unrestricted educational grants and honoraria from GE Medical. The other authors have no conflict of interest to declare.

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