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ORIGINAL ARTICLE

The prevalence of abnormal posterior compartment anatomy and its association with obstructed defecation symptoms in urogynecological patients

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Abstract
Introduction and hypothesis Symptoms of obstructive defecation (OD) are common in women. Transperineal ultrasound (TPUS) has been used for the evaluation of defecatory disorders. The aim of our study was to determine the overall prevalence of anatomical abnormalities of the posterior compartment and their correlations with OD in women seen in a tertiary urogynecology clinic.
Methods This is a retrospective study on 750 women seen at a tertiary urogynecological unit who had undergone a standardized interview, clinical examination, and 4D TPUS. Univariate and multivariate logistic regression analyses were undertaken to study the association between examination findings and symptoms of OD. This study was approved by the local human research ethics committee (Nepean Blue Mountains Local Health District Human Research Ethics Committee, IRB approval no. 13–16).
Results The datasets of 719 women were analyzed. Mean age was 56.1 (18.4–87.6) years. Ninety-seven patients (13 %) reported fecal incontinence, 190 (26 %) constipation, and 461 (64 %) symptoms of OD. On examination, 405 women (56 %) were diagnosed with significant posterior compartment prolapse (POP-Q ≥ stage 2), which was associated with symptoms of OD ($p < 0.0001$). On ultrasound, 103 (14 %) patients had an enterocele, 382 (53 %) a true rectocele and 31 (4.3 %) had rectal intussusception. On multivariate analysis true rectocele ($p = 0.003$) and rectal intussusception ($p = 0.004$) remained significantly associated with symptoms of OD.
Conclusion Both symptoms of OD and anatomical abnormalities of the posterior compartment are highly prevalent in urogynecological patients. Ultrasound findings of a true rectocele and rectal intussusception are significantly associated with obstructed defecation.

Keywords Posterior compartment · Rectocele · Enterocele · Intussusception · Transperineal ultrasound

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Introduction

Constipation (the complaint that bowel movements are infrequent) seems to be more common in women and its prevalence increases with age [1, 2]. It has been reported that about 50 % of patients suffering from chronic constipation referred to tertiary care centers also complained of symptoms of obstructed defecation (OD) [3], such as straining at stool, the need for manual assistance with emptying, i.e., vaginal/perineal or anal digitation and incomplete bowel emptying [4]. It is therefore not surprising that symptoms of OD are frequently elicited in patients presenting to urogynecology clinics for other pelvic floor disorders, such as urinary incontinence or female pelvic organ prolapse [5].

The mechanism of normal defecation is complex, requiring the anatomical and functional integrity of the pelvic floor, and both are frequently compromised in women suffering from urinary incontinence or prolapse [5]. OD may be functional in origin, such as spasm of the pelvic floor muscles resulting in anismus, or anatomical, such as a distended rectum (megarectum), a rectocele, enterocele and/or rectal intussusception/prolapse [6].

Different imaging techniques have been used to study posterior compartment abnormalities and OD, such as videodefecography [7], dynamic magnetic resonance imaging (MRI) [8], and evacuation scintigraphy [9]. However, these tests are not widely available, can be quite costly and are often unpleasant for the patient. Transperineal pelvic floor ultrasound (TPUS) has been studied to evaluate the posterior compartment and defecation disorders [10, 11] for over a decade. It has been suggested as a first-line investigation for the assessment of patients with OD [12]. The aim of this current study was to determine the prevalence of anatomical abnormalities of the posterior compartment in women examined by translabial 3D/4D ultrasound in a tertiary urogynecology clinic, and to investigate correlations between anatomical findings and symptoms of OD.

Materials and methods

This is a retrospective study of all women attending a tertiary urogynecology unit from Sydney and surrounding rural area in NSW, Australia, for the investigation of lower urinary tract or pelvic floor disorders between September 2011 and April 2013, 750 in total. All underwent a routine clinical assessment including an in-house standardized physician-directed interview, clinical examination including ICS POP-Q staging [13], and 3D/4D TPUS using either a GE Voluson 730 Expert or Voluson I system (GE Medical Systems, Zipf, Austria), with RAB 8–4 MHz transducers, as previously described [14]. Ultrasound volume data were obtained in the supine position, after bladder emptying, at rest, on maximal Valsalva, and on pelvic floor muscle contraction (PFMC), allowing visualization of the symphysis pubis, urethra, bladder, vaginal walls, cervix, rectal ampulla, anal canal and levator ani muscle. At least three ultrasound volumes were acquired on Valsalva, with the maneuver standardized to a length of at least 6 s, while avoiding levator co-activation.

Ultrasound volume data were analyzed at a later date by the first author (RGR) on a desktop PC using the proprietary software 4D View v 10 (GE Kretz Medizintechnik), blinded to all clinical data. Pelvic organ descent was determined relative to the postero-inferior margin of the symphysis pubis using volume data acquired on maximum Valsalva, i.e., in the ultrasound volume demonstrating the most marked pelvic organ descent [15]. An enterocele was diagnosed when the lower margin of the small bowel or omentum reached or was below the pubic bone. A true rectocele was defined as the presence of a discontinuity in the anterior contour of the internal anal sphincter and anterior anorectal muscularis, resulting in a diverticulum of the ampulla, indicative of a defect of the rectovaginal septum (RVS) [10]. If substantial downwards displacement of the rectal ampulla is seen on imaging (at least 15 mm below the symphysis pubis), without there being an actual rectocele, we diagnose "perineal hypermobility" [16]. A rectal intussusception was diagnosed as the presence of the splaying of the anal canal and inversion of the anterior wall of the rectal ampulla (including the muscularis layer) into the anal canal, without there being an overt rectal prolapse (Fig. 1) [11]. The hiatal area at maximum Valsalva was measured at the plane of minimal dimensions, i.e., the plane where the distance between the posterior symphyseal margin and the anterior margin of the levator ani loop immediately posterior to the anorectal angle is the shortest, using a region of interest (ROI) of 1–2 cm in thickness. Tomographic ultrasound Imaging (TUI) was used to diagnose levator avulsion in volumes acquired on PFMC or at rest (in patients who failed to perform a PFMC). Levator avulsion was diagnosed if slices obtained at the plane of minimal dimensions and 2.5 and 5 mm cranially showed an abnormal muscle insertion on the os pubis as previously described [17].

This study was approved by the local human research ethics committee (Nepean Blue Mountains Local Health District Human Research Ethics Committee, IRB approval no. 13–16). Statistical analysis was carried out with SPSS

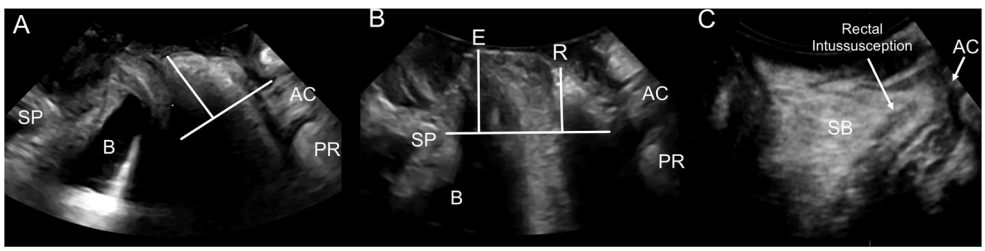

Fig. 1 Sonographically abnormal anatomy of the posterior compartment. **a** Rectocele with depth measurement. **b** Recto-enterocele. **c** Typical appearance of a rectal intussusception. *SP* symphysis pubis, *B* bladder, *PR* puborectalis muscle, *AC* anal canal, *SB* small bowel, *E* enterocele, *R* rectocele

Table 1 The association between posterior compartment descent on clinical examination and any symptoms of obstructed defecation (straining at stool, the need for manual assistance with emptying, i.e., vaginal/perineal or anal digitation and incomplete bowel emptying; $n = 719$)

ICS POP-Q staging for posterior compartment descent	Obstructed defecation symptoms			
	Yes (%)	No (%)	OR (95 %CI)	*p* value
0	79/155 (51)	76/155 (49)	1.00	<0.0001*
1	96/162 (59)	66/162 (41)	1.4 (0.9–2.2)	
2	263/368 (71)	105/368 (29)	2.4 (1.6–3.6)	
3	23/34 (68)	11/34 (32)	2.0 (0.9–4.4)	

*p value relates to POP-Q staging

v12 (IBM Corp, Armonk, NY, USA) and SAS v 9.3 (Cary CR: SAS institute INC, USA) for PC. Univariate and multivariate logistic regression analyses were undertaken to predict symptoms of OD. $p < 0.05$ was considered statistically significant. A test–retest series for all measured parameters conducted before the analysis showed good to excellent inter-observer agreement.

Results

During the inclusion period, 750 patients were seen. Ultrasound data were missing in 19 patients and insufficient in quality for assessment in 8 patients. In another 4 patients, clinical examination was not performed, leaving 719 datasets for the final analysis. The following analysis pertains to this cohort.

A test–retest series of 20 ultrasound volume datasets showed good to excellent inter-observer agreement with regard to levator avulsion (Cohen's kappa, 0.73), hiatal area on Valsalva (ICC 0.71 [0.4–0.87]), rectocele presence (Cohen's kappa, 0.69), rectocele depth (ICC 0.73 [0.44–0.89]), and descent of the rectal ampulla (ICC 0.71, CI 0.41–0.87).

Mean age was 56.1 (range 18.4–87.6) years with a mean body mass index (BMI) of 28.9 (SD ± 6.1) kg/m^2. Median parity was 2 (range 0–9). Ninety-two percent (662 out of 719) were of Caucasian ethnicity. Six hundred and thirty-seven (89 %) patients were vaginally parous and 212 (29 %) had a previous operative vaginal delivery. Two hundred and fifteen (30 %), 122 (17 %), and 67 (9 %) women had previously undergone a hysterectomy, surgery for pelvic organ prolapse, and surgery for urinary incontinence respectively. Three hundred and sixty-nine (51 %) patients reported symptoms of prolapse (dragging sensation or feeling of a lump in the vagina), 94 (13 %) stress urinary incontinence, 93 (13 %) urge urinary incontinence, and 431 (60 %) mixed urinary incontinence. Two hundred and fifty-eight (36 %) individuals complained of symptoms of voiding dysfunction, 97 (13 %) of fecal incontinence, 190 (26 %) of constipation, and 461 (64 %) of OD symptoms, i.e., digitation (vaginal or anal digitation or perineal splinting; $n = 97$; 13 %), straining at stool ($n = 324$; 45 %), and/ or incomplete bowel emptying ($n = 376$; 52 %). On clinical assessment, 422 (59 %) women were diagnosed with significant prolapse (ICS POP-Q stage ≥ 2) in the anterior compartment, 63 (9 %) in the central compartment, and 405 (56 %) in the posterior compartment. Mean Ba, C, and Bp were −0.7 (range −3 to +5) cm, −4.3 (range −9 to +8) cm, and −1 (range −3 to +5) cm. Posterior compartment descent on clinical examination was significantly associated with symptoms of OD (Table 1).

On imaging, 103 (14 %) patients had an enterocele (at or below the symphysis pubis [SP]), and 326 (45 %) were diagnosed with significant descent of the rectal ampulla (≥15 mm below the SP). Mean descent of the rectal ampulla was to 10.4 (range 37.3 to −49.8) mm below the SP. A true rectocele was diagnosed in 382 patients (53 %) at a mean rectocele depth of 16.9 (range 5–47.1) mm. Thirty-one women (4.3 %) had a rectal intussusception. One hundred and sixty-six (23 %) were

Table 2 Univariate logistic regression demonstrating the association between obstructive defecation (OD) symptoms and sonographic findings

Sonographic parameter	Obstructed defecation symptoms			
	Yes	No	OR (95 %CI)	*p* value
Position of the rectal ampulla (mm)	−11.9 (15.2[a])	−7.7 (15.7[a])	0.98 (0.97–0.99[a])	0.0005
True rectocele (yes/no)	269/461 (58 %)	113/258 (44 %)	1.8 (1.3–2.4[a])	0.0002
Rectocele depth (mm)	17.7 (7.1[a])	15.0 (6.5[a])	1.06 (1.03–1.10[a])	0.0008
Enterocele (yes/no)	79/461 (17 %)	24/258 (9 %)	2.02 (1.24–3.28[a])	0.005
Rectal intussusception (yes/no)	29/461 (6 %)	2/258 (1 %)	8.6 (2.0–36.3.3[a])	0.003
Area on Valsalva (cm^2)	27.9 (9.4[a])	13.8 (9.5[a])	1.03 (1.02–1.05[a])	<0.0001
Levator avulsion (yes/no)	118/461 (26 %)	48/258 (19 %)	1.51 (1.03–2.19[a])	0.03

[a] Standard deviation

Table 3 Univariate logistic regression analysis demonstrating the association between "straining at stool" and sonographic findings

Sonographic parameter	Straining at stool			
	Yes	No	OR (95 %CI)	*p* value
Position of the rectal ampulla (mm)	−12.1 (15.2[a])	−9.04 (15.6[a])	0.97 (0.96–0.98[a])	0.003
True rectocele (yes/no)	190/324 (60 %)	192/395 (49 %)	1.35 (1.09–1.52[a])	0.002
Rectocele depth (mm)	18.1 (6.6[a])	16.9 (7.04[a])	1.02 (1.01–1.12[a])	0.007
Enterocele (yes/no)	54/324 (16.7 %)	49/395 (12.4 %)	1.51 (1.24–3.11[a])	0.006
Rectal intussusception (yes/no)	24/324 (7.4 %)	7/395 (1.8 %)	8.44 (2.01–35.5[a])	0.002
Area on Valsalva (cm^2)	29.7 (9.6[a])	16.2 (9.4[a])	1.14 (1.04–1.09[a])	<0.0001
Levator avulsion (yes/no)	81/324 (25 %)	85/395 (22 %)	1.22 (0.99–1.42[a])	0.072

[a] Standard deviation

diagnosed with a levator avulsion on TUI: 137 (19 %) on the right and 85 (12 %) on the left. The mean hiatal area on Valsalva was 29.8 (range 8–61.4) cm^2. On univariate analysis all sonographic parameters of posterior compartment descent were significantly associated with OD symptoms (Table 2). However, on multivariate analysis (including all sonographic parameters of posterior compartment descent), enterocele and perineal hypermobility were not independently associated with such symptoms, as opposed to true rectocele ($p = 0.003$) and rectal intussusception ($p = 0.004$), which remained significantly associated with symptoms of OD. The adjusted effect sizes remained similar to those determined for univariate analysis (Tables 3, 4, and 5).

Discussion

In this large series of more than 700 urogynecological patients, OD symptoms were found to be highly prevalent (64 %), as were anatomical abnormalities of the posterior compartment detected on ultrasound, which include enterocele (14 %), true rectocele (53 %), significant descent of the rectal ampulla (45 %), and rectal intussusception (4.3 %). There was a clear association between posterior compartment abnormalities seen on translabial ultrasound (TLUS) and defecatory disorders. Our findings support the need to evaluate the posterior vaginal compartment in women complaining of OD. This study also highlights the need for urogynecologists to actively enquire about symptoms of OD in patients presenting with urogynecological complaints.

On clinical examination, the finding of posterior compartment prolapse is commonly labelled a "rectocele" by clinicians, although a clinical rectocele may be due to a number of different conditions, including enterocele, perineal hypermobility, a true rectocele or rectal intussusception [18]. Only the latter two conditions were found to be associated with OD in this study. Differentiation among these distinct anatomical abnormalities may therefore be important when considering surgery as a treatment option for women with OD. In a previously published imaging study, only 56 % of patients diagnosed with a "clinical rectocele" were confirmed to have a true rectocele on TLUS, suggesting the presence of a defect of the RVS. The remainder were found to have perineal hypermobility, an enterocele, or they were normal on imaging. This highlights the notion that our clinical examination skills are of limited use in differentiating anatomical abnormalities affecting the posterior compartment and suggests that imaging might be useful in the clinical management of such women [10].

Defecation proctography (DP) has generally been regarded as the gold standard for the assessment of posterior compartment anatomy. However, the test is often not easily accessible to gynecologists, even in developed countries. Furthermore, the technique involves irradiation and defecation of barium

Table 4 Univariate logistic regression demonstrating the association between "digitation" and sonographic findings

Sonographic parameter	Digitation			
	Yes	No	OR (95 %CI)	*p* value
Position of the rectal ampulla (mm)	−13.5 (15.4[a])	−10.4 (15.5[a])	0.96 (0.94–0.99[a])	0.007
True rectocele (yes/no)	113/185 (61 %)	269/534 (50.3 %)	1.43 (1.11–1.84[a])	0.0047
Rectocele depth (mm)	18.1 (6.6[a])	16.2 (6.90[a])	1.01 (1.0–1.13[a])	0.01
Enterocele (yes/no)	42/185 (22.7 %)	61/534 (11.4 %)	1.76 (1.34–2.31[a])	0.0002
Rectal intussusception (yes/no)	19/185 (10.2 %)	12/534 (2.2 %)	2.54 (1.86–3.46[a])	<0.0001
Area on Valsalva (cm^2)	29.8 (9.5[a])	15.6 (9.4[a])	1.09 (1.02–1.09[a])	<0.0001
Levator avulsion (yes/no)	49/185 (26 %)	117/534 (21 %)	1.22 (1.03–1.52[a])	0.042

[a] Standard deviation

Table 5 Univariate logistic regression demonstrating the association between "Incomplete emptying" and sonographic findings

Sonographic parameter	Incomplete emptying			
	Yes	No	OR (95 %CI)	*p* value
Position of the rectal ampulla (mm)	−12.1 (15.4[a])	−8.4 (14.9[a])	0.98 (0.95–0.98[a])	0.0007
True rectocele >10 mm (yes/no)	229/376 (61 %)	153/343 (45 %)	1.49 (1.29–1.72[a])	<0.0001
Rectocele depth (mm)	18.2 (6.7[a])	15.9 (6.4[a])	1.04 (1.01–1.30[a])	0.001
Enterocele (yes/no)	69/376 (18.4 %)	34/343 (9.9 %)	1.34 (1.15–1.57[a])	0.0013
Rectal intussusception (yes/no)	26/376 (7 %)	5/343 (1.5 %)	1.65 (1.39–1.96[a])	0.0003
Area on Valsalva (cm^2)	27.8 (9.6[a])	14.6 (9.4[a])	1.1 (1.03–1.13[a])	<0.0001
Levator avulsion (yes/no)	101/376 (27 %)	65/343 (19 %)	1.22 (1.06–1.42[a])	0.0119

[a] Standard deviation

paste in a semi-private setting. As a result, patients may find the test rather embarrassing, and there is also the issue of safety. It is not surprising that the technique has been shown to be less acceptable to patients than TLUS, which is safe, simple, and more readily available to gynecologists [12]. While other imaging techniques, such as magnetic resonance (MR) defecography may also be used to evaluate the posterior compartment, the technique shares similar limitations to DP, including availability, cost, safety, and patient acceptance, especially in patients with claustrophobia. To date, several studies have shown moderate to good agreement between TLUS and DP for the detection of true rectocele, enterocele, and intussusception [12, 19–23]. TLUS compared with DP also allows a more comprehensive assessment of the pelvic floor, including the anterior and central compartments, the levator ani muscle [24], and the anal sphincter [25]. Furthermore, it seems that the learning curve for the interpretation of the most commonly used translabial pelvic floor ultrasound parameters for the evaluation of pelvic organ support is less than a week of training or less than 40 cases [26]. In the experience of the authors the time required for the acquisition of volume data is rather short as well, with less than 40 cases needed.

While we found an association between rectocele and rectal intussusception with symptoms of OD, this does not necessarily imply a cause and effect relationship. In a recently published study, however, surgical closure of rectovaginal septal defects using the Cullen–Richardson technique [27] was shown to be associated with resolution of defecatory symptoms in about 50 % of cases [28], confirming that there is indeed a causal relationship between rectocele and OD. The association of rectal intussusception and OD remains to be studied in more detail, however.

There are a number of limitations of our study that need to be acknowledged. First, this is a retrospective study in patients referred to an urogynecology clinic for symptoms of lower urinary tract and pelvic floor dysfunction. Second, the women seen in this clinic were largely Caucasian in ethnic origin. Therefore, our findings may not be applicable to other ethnic groups and the general female population. Furthermore, because of the retrospective nature of this study, we were unable to include validated questionnaire data to objectively evaluate functional impact and quality of life assessments. However, this was not the focus of our study. The large study size of more than 700 women is an obvious strength, and such numbers are much less likely to be reached with radiological techniques such as DP or MRI defecography. The utilization of TLUS conveys obvious advantages, such as low cost and ease of access. The technique has been shown to be highly repeatable, both in volume acquisition and data analysis [26, 29, 30]. It also allows real-time evaluation of pelvic floor dynamics during Valsalva maneuver and PFMC, which is very difficult or impossible with the use of radiological techniques.

In conclusion, both symptoms of OD and anatomical abnormalities of the posterior compartment, including true rectocele, enterocele, and rectal intussusception, are highly prevalent in the urogynecological population. Rectocele and rectal intussusception detected by TPUS are significantly associated with defecatory disorders.

Compliance with ethical standards

Conflicts of interest H.P. Dietz and K.L. Shek have received unrestricted educational grants from GE; R.A. Guzmán Rojas and I. Kamisan Atan report that they have no conflicts of interest.

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