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Original Article

Correlation of severity of pelvic organ prolapse with lower urinary tract symptoms

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ABSTRACT

Objective: Relationships between pelvic organ prolapse (POP) staging and lower urinary tract symptoms (LUTS) are controversial. In this study, we evaluated correlations of POP staging with LUTS in different compartments.

Materials and methods: From January 2016 to December 2017, 250 consecutive patients with urogynecologic complaints who were referred to our urodynamic unit were recruited into this study. Different stages of different compartments (anterior, central and posterior) of POPs according to IUGA and ICS terminology were re-grouped into four categories as stage 0, 1, 2, and 3 (including stage 4 because of a limited number of patients in stage 4). Pearson correlation coefficient and general linear regression were used for correlations of POP staging in different compartments and LUTS (stress urinary incontinence, overactive bladder and voiding symptoms) as well as their associated factors.

Results: Only OAB had a moderate correlation with different compartments of POP (anterior vaginal wall: −0.3116; cervix: −0.2954 and posterior vaginal wall: −0.3779; all $p < 0.05$). Stage 1 AVWP significantly increased (39.6%) the occurrence of OAB compared to no prolapse. Posterior compartment (stage 1–3) prolapse reduced the occurrence of OAB.

Conclusion: Only stage 1 AVWP is associated with an increase in OAB, and posterior compartment prolapse may reduce the occurrence of OAB.

Introduction

The pelvic cavity has been divided into three compartments from an anatomical point of view: anterior, central and posterior. These compartments are closely correlated to each other as uterine prolapse is often associated with both anterior and posterior vaginal wall prolapse. Pelvic organ prolapse (POP) is commonly related to complex symptoms of the organs involved in the anatomic compartment involved. For example, anterior vaginal wall prolapse might be associated with lower urinary tract symptoms (LUTS) such as urine leakage, frequency, or voiding dysfunction. Difficulty in defecation might be related to severe posterior vaginal prolapse [1]. However, some researchers have found that women with POP experience specific symptoms that do not correlate well with compartment-specific prolapse [2,3].

In the past two decades, prevalence of LUTS in relation to POP has been investigated in hospital-based patients [1–6] and community-based women [7–11]. The results have been controversial. Our community survey found that symptoms of pelvic organ prolapse (POP) are an independent risk factor for women with symptomatic OAB syndrome [12]. Most women with POP not only experience specific symptoms that do not correlate well with compartment-specific prolapse, but their LUTS might also have little or no relation to prolapse in a specific compartment [2,3]. The majority of studies have revealed a higher prevalence of urinary symptoms in women with POP or a higher co-occurrence of stress urinary incontinence (SUI)/overactive bladder (OAB) symptoms and POP. These two symptoms or syndromes seem to more closely associated with stage I and II prolapse [10,13] compared to advanced stages of POP, since severe POP (stage III or more) might mask SUI and cause obstructive urinary symptoms [1,4–6,14].

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OAB syndrome has also been reported to have a higher prevalence [14–16] or often coexists [7,17] in patients with POP in hospital-based studies. However, whether OAB correlates to specific compartments or to the severities of prolapse is unclear and only two studies have addressed the prevalence of OAB per prolapse compartment and its stages [9,13]. Miedel et al. found that OAB symptoms are directly related to anterior and posterior compartment prolapse in contrast to central compartment prolapse [9]. Another study did not identify these correlations [13]. The possible pathophysiology of OAB in POP is still controversial [14] because different severities in POP might cause divergent effects on the urethra and/or bladder function.

In order to identify the relationship between LUTS and POP including its location and severity, we used hospital-based consecutive data from a single physician to evaluate: 1) the relationship between LUTS and location of POPs. 2) the occurrence of LUTS present with different severities of POPs. 3) the associated factors that contribute to LUTS presenting in POPs.

Materials and methods

From January 2016 to December 2017, there were 286 consecutive patients with urogynecologic complaints, including every stage of every compartment of pelvic organ prolapse and/or lower urinary tract symptoms, referred to our urodynamic unit." (G.D.C.)

We excluded 33 patients who had a hysterectomy for any reason and also excluded 3 patients who had detrusor hypersensitivity with insufficient contractility." The demographic data, LUTS and POP stages of 250 patients were analyzed, in total. The study protocol was approved by the Chung Shan Medical University Hospital Institutional Review Board. Part of the data and abstract was presented at the annual meeting of the International Continence Society 2018.

The severity of prolapse was assessed by having the patient exert using the Valsalva maneuver in the dorsal lithotomy position. We stratified different stages of different compartments based on the most distal portion of prolapse in the uterine cervix, anterior or posterior vaginal wall while asking the patients to push or bear down with maximal effort [8,18,19]. The prolapse of different compartments was not mutually exclusive. Uterine prolapse, anterior or posterior vaginal wall prolapse were classified as stage 0 (no prolapse), stage I, II, III, or IV. Then we re-grouped different compartments of POPs into four categories as stage 0, 1, 2, and 3 (stage 4 had a limited number of patients in stage 4).

The patients' most bothersome LUTS were derived from reviewing medical records. We categorized their LUTS into three groups: stress urinary incontinence, overactive bladder syndrome and voiding symptoms. Voiding symptoms were symptoms which patients experienced during their voiding phase. The definitions of stress urinary incontinence and overactive bladder syndrome were used according to the terminology established by the International Continence Society [19].

Chi-square test was used to check differences in categorical data. One-way analysis of variance was used for testing ordinal data. Pearson correlation coefficient was used to find correlations between different compartments of POP and LUTS. General linear regression was used to evaluate factors associated with the occurrence of overactive bladder. A p value less than 0.05 was considered as a significant difference.

Results

Demographic data and occurrence of POPs in different compartments are shown in Table 1. There were 113 (45.2%) patients without anterior vaginal wall prolapse, 170 (68%) patients without uterine prolapse and 135 (54%) patients with no posterior vaginal wall prolapse. The diversity and occurrence of stress urinary incontinence, OAB syndrome or voiding symptoms in different stages of different compartments are shown in Table 2. The occurrence of OAB syndrome in different stages of different compartments was significantly different from stress urinary incontinence and voiding symptoms. The occurrence of voiding symptoms in different stages of uterine prolapse was significantly different, too.

Table 1
Basic characteristics and distribution of pelvic organ prolapse (N = 250).

Variables	Stage	
Age, years; mean (SD)		55.3 (12.3)
BMI, kg/m^2; mean (SD)		24.2 (4.0)
Parity; median (range)		3 (0–7)
Menopausal status; n (%)		154 (60.9)
Anterior vaginal wall prolapse; n (%)	Stage 0	113 (45.2)
	Stage 1	34 (13.6)
	Stage 2	66 (26.4)
	Stage ≥3	37 (14.8)
Posterior vaginal wall prolapse; n (%)	Stage 0	135 (54.0)
	Stage 1	38 (15.2)
	Stage 2	55 (22.0)
	Stage ≥3	22 (8.8)
Apical prolapse; n (%)	Stage 0	170 (68.0)
	Stage 1	31 (12.7)
	Stage 2	29 (11.6)
	Stage ≥3	20 (8.0)
Urodynamic diagnosis; n (%)	DO	92 (36.8)
	USI	81 (32.4)
	Low urethral pressure	30 (12.0)
	HB	28 (11.2)
	Voiding symptoms	22 (8.8)
	BOO	15 (6.0)

BMI: Body mass index.
DO: Detrusor overactive.
USI: Urodynamic stress incontinence.
HB: Hypersensitive bladder.
BOO: Bladder outlet obstruction.

Pearson correlation was used to check relationships among different compartments of POPs and LUTS (Table 3). Only the Pearson's correlation coefficient for OAB syndrome and different compartments of POP were equal to or less than - 0.3 which is a moderate negative relationship. Both coefficients of the anterior vaginal wall or posterior vaginal wall and OAB syndrome were −0.31 and −0.38. Uterine prolapse and OAB syndrome had a weak negative correlation (coefficient was −0.29).

Further, we controlled parameters such as age older than 65 years, menopause, parity and BMI and found that stage 1 anterior vaginal wall prolapse significantly increased (39.6%) the occurrence of OAB syndrome compared to no prolapse (95% CI: 0.175–0.615, P = 0.004) after with general linear regression model analysis. However, posterior compartment prolapse had a lower occurrence of OAB syndrome, stage 1 reduced by 35.8% (95% CI: −0.579~-0.137, $P = 0.0015$); stage 2 reduced by 31.2% (95% CI: −0.52~-0.103, $P = 0.0034$), and stage 3 reduced by 58% (95% CI: −0.851~-0.31, $P = 0.0001$) compared to no posterior vaginal wall prolapse (Table 4).

Discussion

Our results revealed that only stage 1 anterior vaginal wall prolapse is associated with an increase in OAB syndrome, and posterior compartment (stage 1–3) prolapse may reduce the occurrence of OAB syndrome. Stress urinary incontinence and voiding symptoms had no correlation to any compartments of POPs. These findings are inconsistent with previous reports which indicate that OAB syndrome has a higher prevalence [14–16] or

Table 2
Occurrence of stress urinary incontinence (SUI), overactive bladder (OAB) syndrome and voiding symptoms in different locations and severity of pelvic organ prolapse (POP).

AVWP	No AVWP, n = 113	Stage 1, n = 34	Stage 2, n = 66	Stage ≥3, n = 37	P value
OAB, n (%)	89 (76.7)	31 (91.2)	37 (56.1)	13 (35.1)	<0.0001
SUI, n(%)	42 (36.2)	18 (52.9)	35 (53)	18 (48.7)	0.0934
Voiding symptoms, n(%)	14 (12.1)	5 (14.7)	5 (10.6)	8 (21.6)	0.4204
PVWP	**No PVWP, n=135**	**stage 1, n=38**	**Stage 2, n=55**	**Stage ≥3, n=22**	**P value**
OAB, n (%)	110 (79.7)	27 (71.1)	29 (52.7)	4 (18.2)	<0.0001
SUI, n(%)	55 (39.8)	21 (54.6)	30 (54.5)	7 (31.8)	0.0836
Voiding symptoms, n(%)	20 (14.5)	5 (13.2)	4 (7.3)	5 (22.7)	0.3126
AP	**No AP, n=170**	**stage 1, n=31**	**Stage 2, n=29**	**Stage ≥3, n=20**	**P value**
OAB, n (%)	130 (75.1)	22 (71)	10 (34.5)	8 (40)	<0.0001
SUI, n(%)	74 (42.8)	15 (48.4)	15 (51.7)	9 (45)	0.7989
Voiding symptoms, n(%)	21 (12.1)	2 (6.5)	3 (40)	8 (40)	0.003

AVWP: Anterior vaginal wall prolapse.
PVWP: Posterior vaginal wall prolapse.
AP: Apical prolapse.
Voiding symptoms: includes slow stream, splitting or spraying, intermittent stream, hesitancy, straining, or terminal dribble; any or in combination.
Statistical analysis by Chi-square test.

Table 3
Correlations of occurrence of stress urinary incontinence (SUI), overactive bladder (OAB) syndrome and voiding symptoms in different locations of pelvic organ prolapse (POP).

	AP	AVWP	PWVP	OAB	SUI	Voiding symptoms
AP	1	0.6388	0.5457	−0.2954	0.0446	0.1427
		<0.0001	<0.0001	<0.0001	0.4804	0.0232
AVWP	0.6388	1	0.7985	−0.3116	0.1277	0.0588
	<0.0001		<0.0001	<0.0001	0.0424	0.3516
PVWP	0.5457	0.7985	1	−0.3779	0.0489	−0.0084
	<0.0001	<0.0001		<0.0001	0.4382	0.8938
OAB	−0.2954	−0.3116	−0.3779	1	−0.2867	−0.0949
	<0.0001	<0.0001	<0.0001		<0.0001	0.1321
SUI	0.0446	0.1277	0.0490	−0.2867	1	−0.2141
	0.4804	0.0424	0.4382	<0.0001		0.0006
Voiding symptoms	0.1427	0.0588	−0.0084	−0.0949	−0.2141	1
	0.0232	0.3516	0.8938	0.1321	0.0006	

Legend:
AVWP: Anterior vaginal wall prolapse.
PVWP: Posterior vaginal wall prolapse.
AP: Apical prolapse.
Voiding symptoms: includes slow stream, splitting or spraying, intermittent stream, hesitancy, straining, terminal dribble; any or in combination.
Upper number in grid is correlation coefficient and lower number in grid is p value.
Coefficient between −0.30 and −0.39 is moderate negative relationship.
Coefficient between −0.20 and −0.29 is weak negative relationship.
Coefficient between −0.19 and 0.19 is no or negligible relationship.
Coefficient between 0.20 and 0.29 is weak positive relationship.
Coefficient between 0.3 and 0.39 is moderate positive relationship.
Coefficient between 0.4 and 0.69 is strong positive relationship.

often coexists [7,17] in patients with POP than in patients without POP in hospital-based studies.

The occurrence of OAB at different stages in different pelvic floor compartments are shown in Tables 2 and 4. Prevalence of OAB in patients without prolapse was higher than in patients with different severities and compartments, except in patients with stage 1 anterior vaginal wall prolapse (91.2%). The question is whether there is a relationship between the compartment or stage of POPs and the presence of OAB syndrome. Using Pearson correlation analysis to evaluate which compartment has a relationship with OAB syndrome, we found that prolapse of the anterior and posterior vaginal wall had a moderate correlation with OAB syndrome and uterine prolapse only had a weak negative correlation with OAB syndrome. Previous studies have revealed that OAB syndrome often coexists in women with POP [8,14–17,20]. However, recently, Espuna-Pons et al. reported that there is no correlation between OAB syndrome and POPs [21]. Our results are similar to the report by Ellerkmann et al. [2]. They found that OAB symptoms have only weak correlations with location and severity of POP.

In 2001, Ellerkmann et al. revealed that “women with POP experience symptoms that do not necessarily correlate with compartment-specific defects” [2]. Other studies have shown that parity, age and body mass index might also increase the occurrence of OAB syndrome and POPs in community or population-based studies [7,10,22]. In the current hospital-based study, we further used general linear regression to check what location and severity of prolapse correlates to the occurrence of OAB syndrome after controlling for age (>65 years), menopausal status, parity and body mass index. We found that an increase in occurrence of OAB syndrome only exists in stage 1 anterior vaginal wall prolapse (39.6% higher than stage 0). This finding varies from that of Miedel et al. [8]. They found that the odds ratio of POP at stage 1 was 1.7 and stages 2–4 was 2.5. Our stage 2–4 patients did not have a significantly increasing occurrence of OAB syndrome. Concurrently, they found that the occurrence of OAB syndrome increased with posterior vaginal wall

Table 4
Occurrence of overactive bladder syndrome correlates to severity and location of pelvic organ prolapse after controlling age >65 years, menopausal status, parity and body mass index.

	Beta data	95% C.I.	P value
AVWP, reference: no AVWP			
Stage 1	0.396	0.175–0.615	0.0004
Stage 2	0.105	−0.102–0.313	0.3205
Stage 3	0.053	−0.215–0.321	0.7008
PVWP, reference: no PVWP			
Stage 1	−0.358	−0.579~−0.137	0.0015
Stage 2	−0.312	−0.52~−0.103	0.0034
Stage 3	−0.58	−0.851~−0.31	0.0001
AP, reference: no AP			
Stage 1	0.083	−0.099–0.2644	0.37
Stage 2	−0.19	−0.396–0.0153	0.0697
Stage 3	−0.157	−0.398–0.0844	0.2025

95% C.I.: 95% confidence interval.
AVWP: Anterior vaginal wall prolapse.
PVWP: Posterior vaginal wall prolapse.
AP: Apical prolapse.

prolapse, but not significantly. However, our study showed stage 1–3 posterior prolapse reduce the incidence of OAB compare to no prolapse. We postulate the incidence of OAB decreased in patients with posterior prolapse might be due to mechanical support against posterior decent of the bladder and urethra. Liedl et al. also reported that posterior vaginal wall prolapse does not affect the occurrence of OAB syndrome. In contrast, we demonstrated that posterior vaginal wall prolapse significantly reduces the occurrence of OAB syndrome (from 31.2% to 58%; Table 4).

DeLancey postulated that severity in stages of anterior vaginal wall prolapse might cause divergent effects on urinary continence based on an anatomical and mechanical perspective [23]. However, the impact of POP on the occurrence of stress urinary incontinence is controversial. Digesu et al. revealed that anterior vaginal wall or apical prolapse has a higher occurrence of stress urinary incontinence [1]. Some studies have found that POPs might decrease the occurrence of stress urinary incontinence [2,21]. Schimpf et al. reported that women without anterior vaginal wall prolapse are more likely to report stress urinary incontinence [22]. With the exception of anterior vaginal wall prolapse possibly affecting the occurrence of stress urinary incontinence, some clinical studies have found that stress urinary incontinence is strongly correlated with posterior vaginal wall prolapse (stages 2–4) [3,8]. Our results demonstrated that stress urinary incontinence has no correlation with any compartment of POPs (Table 3).

In addition to stress urinary incontinence and OAB syndrome, POPs, especially anterior vaginal wall and apical prolapse, may coexist with or present various forms of voiding dysfunction because of increasing urethral resistance due to urethral kinking or bladder outlet obstruction [1,4,6,21,24]. However, we could not find voiding symptoms associated with any compartments of POP in our patients (Table 3).

Some possible limitations of the present study are: First, patients were recruited from a single urogynecologist which might attenuate the diversity in patient characteristics. Second, the sample size of some stages or severities of POPs were less than 30. This shortcoming could distort the prevalence of LUTS and POPs. Third, the body mass index of our patients was 24.2 ± 4.0 which is less than most studies of Western women. Fourth, median parity in this study was 3 which might be higher than in other studies. However, the study patients derived from a single clinician might be the strength of this study. Patient clinical data, patient complaints of LUTS and diagnosis of POP could be more consistent than data collected from patients from multiple clinicians or multi-centers. We used different statistical analyses to stratify different locations and severities of POP and discovered that their associations was another strength of this study.

In conclusion, OAB syndrome is only significantly higher in stage 1 anterior vaginal wall prolapse, and posterior compartment prolapse may reduce the occurrence of OAB syndrome. Stress urinary incontinence and voiding symptoms had no correlation to any compartments of POPs. Our results imply that patients with POP experience LUTS that might not correlate with compartment-specific defects. Severity of POP could also affect the presence of its associated LUTS.

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Declaration of competing interest

The authors have declared that no competing interests exist.

References

[1] Digesu GA, Chaliha C, Salvatore S, Hutchings A, Khullar V. The relationship of vaginal prolapse severity to symptoms and quality of life. BJOG 2005 Jul;112(7):971–6.
[2] Ellerkmann RM, Cundiff GW, Melick CF, Nihira MA, Leffler K, Bent AE. Correlation of symptoms with location and severity of pelvic organ prolapse. Am J Obstet Gynecol 2001 Dec;185(6):1332–7. discussion 1337-8.
[3] Mouritsen L, Larsen JP. Symptoms, bother and POPQ in women referred with pelvic organ prolapse. Int Urogynecol J Pelvic Floor Dysfunct 2003 Jun;14(2):122–7.
[4] Romanzi LJ, Chaikin DC, Blaivas JG. The effect of genital prolapse on voiding. J Urol 1999 Feb;161(2):581–6.
[5] Yalcin OT, Yildirim A, Hassa H. The effects of severe cystocele on urogynecologic symptoms and findings. Acta Obstet Gynecol Scand 2001 May;80(5):423–7.
[6] Bradley CS, Nygaard IE. Vaginal wall descensus and pelvic floor symptoms in older women. Obstet Gynecol 2005 Oct;106(4):759–66.
[7] Lawrence JM, Lukacz ES, Nager CW, Hsu JW, Luber KM. Prevalence and co-occurrence of pelvic floor disorders in community-dwelling women. Obstet Gynecol 2008 Mar;111(3):678–85.
[8] Miedel A, Tegerstedt G, Maehle-Schmidt M, Nyrén O, Hammarström M. Symptoms and pelvic support defects in specific compartments. Obstet Gynecol 2008 Oct;112(4):851–8.
[9] Miedel A, Ek M, Tegerstedt G, Mæhle-Schmidt M, Nyrén O, Hammarström M. Short-term natural history in women with symptoms indicative of pelvic organ prolapse. Int Urogynecol J 2011 Apr;22(4):461–8.
[10] Tegerstedt G, Maehle-Schmidt M, Nyrén O, Hammarström M. Prevalence of symptomatic pelvic organ prolapse in a Swedish population. Int Urogynecol J Pelvic Floor Dysfunct 2005;16(6):497–503.
[11] Fritel X, Varnoux N, Zins M, Breart G, Ringa V. Symptomatic pelvic organ prolapse at midlife, quality of life, and risk factors. Obstet Gynecol 2009 Mar;113(3):609–16.
[12] Chen GD, Lin TL, Hu AW, Chen YC, Lin LY. Prevalence and correlation of urinary incontinence and overactive bladder in Taiwanese women. Neurourol Urodyn 2003;22:109–17.
[13] Bradley CS, Zimmerman MB, Wang Q, Nygaard IE, Women's Health Initiative. Vaginal descent and pelvic floor symptoms in postmenopausal women: a longitudinal study. Obstet Gynecol 2008 May;111(5):1148–53.
[14] de Boer TA, Slieker-ten Hove MC, Burger CW, Vierhout ME. The prevalence and risk factors of overactive bladder symptoms and its relation to pelvic organ prolapse symptoms in a general female population. Int Urogynecol J 2011 May;22(5):569–75. https://doi.org/10.1007/s00192-010-1323-x. Epub 2010 Nov 23.
[15] de Boer TA, Salvatore S, Cardozo L, Chapple C, Kelleher C, van Kerrebroeck P, et al. Pelvic organ prolapse and overactive bladder. Neurourol Urodyn 2010;29(1):30–9. https://doi.org/10.1002/nau.20858.
[16] Yuan Z, Shen H. Pelvic organ prolapse quantification in women referred with overactive bladder. Int Urogynecol J 2010 Nov;21(11):1365–9. https://doi.org/10.1007/s00192-010-1209-y. Epub 2010 Jun 25.
[17] Liedl B, Goeschen K, Sutherland SE, Roovers JP, Yassouridis A. Can surgical reconstruction of vaginal and ligamentous laxity cure overactive bladder symptoms in women with pelvic organ prolapse? BJU Int 2018 Jun 16. https://doi.org/10.1111/bju.14453 [Epub ahead of print].
[18] Bump RC, Mattiasson A, Bø K, Brubaker LP, DeLancey JO, Klarskov P, et al. The standardisation of terminology of female pelvic organ prolapse and pelvic floor dysfunction. Am J Obstet Gynecol 1996;175:10–7.

[19] Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, Ulmsten U, et al. Standardisation Sub-committee of the International Continence Society. Neurourol Urodyn 2002;21(2):167–78.
[20] Ali P, Higgs P, Smith A. Correlation between urogenital symptoms and pelvic organ prolapse quantification (POP-Q) findings in women. Neurourol Urodyn 2006;25:523–4.
[21] Espuña-Pons M, Fillol M, Pascual MA, Rebollo P, Mora AM. Female Pelvic Floor Dysfunction Research Group (Grupo de Investigación en Disfunciones del Suelo Pélvico en la Mujer-GISPEM). Pelvic floor symptoms and severity of pelvic organ prolapse in women seeking care for pelvic floor problems. Eur J Obstet Gynecol Reprod Biol 2014 Jun;177:141–5. https://doi.org/10.1016/j.ejogrb.2014.03.050. Epub 2014 Apr 13.
[22] Schimpf MO, O'Sullivan DM, LaSala CA, Tulikangas PK. Anterior vaginal wall prolapse and voiding dysfunction in urogynecology patients. Int Urogynecol J Pelvic Floor Dysfunct 2007 Jul;18(7):721–5.
[23] DeLancey JO. Structural support of the urethra as it relates to stress urinary incontinence: the hammock hypothesis. Am J Obstet Gynecol 1994;170:1713–20.
[24] Patil Avanti, Duckett Jonathan. Effect of prolapse repair on voiding and bladder overactivity. Curr Opin Obstet Gynecol Oct 2010;22(5):399–403.