Urodynamic changes in women with pelvic organ prolapse

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Aim
To study the prevalence of urodynamic changes associated with female having pelvic organ prolapse (POP) and to correlate these changes with symptoms.

Patients and methods
A cross-sectional hospital-based study was performed on 29 women with POP seeking care at a Female Urology Clinic, Urology Department, Assiut University Hospital, Assiut, Egypt. A questionnaire was administered to gather information about symptoms. Urine analysis, abdominal ultrasound, and urodynamic study were done.

Results
Overactive bladder was more common in cystocele. Hydronephrosis was present in 24.1% of POP cases; all of them were fourth degree. As the degree of POP increases, overactive bladder decreases and infravesical obstruction is more likely.

Conclusion
Urodynamic and clinical findings are common among women with POP.

Keywords:
detrusor overactivity, overactive bladder, pelvic organ prolapse, urodynamic changes

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Introduction

Prolapse literally means 'to fall out of place'. Pelvic organ prolapse (POP) is defined as the descent of one or more of the anterior vaginal wall, posterior vaginal wall, uterus (cervix), or the apex of the vagina (vaginal vault or cuff scar after hysterectomy). This descent may result in protrusion of the vagina, uterus, or both.

There are three levels of pelvic organ support. Breaking of any one of them leads to different types of prolapse [1].

Level 1: the cardinal-uterosacral ligament complex provides apical attachment of the uterus and vaginal vault to the bony sacrum.

Level 2: the arcus tendineous fascia pelvis and the fascia overlying the levator ani muscles provide support to the middle part of the vagina.

Level 3: the urogenital diaphragm and the perineal body provide support to the lower part of the vagina.

The etiology of POP includes (a) parity: the strongest risk factor for the development of POP according to Oxford Family Planning; (b) age: the Swedish prolapse study provided evidence for progressive decreases in pelvic floor muscle strength with increasing age and parity; (c) increased intra-abdominal pressure: as constipation; (d) hysterectomy; and (e) obesity.

POP is mainly thought to result from a loss or weakness of the musculofascial pelvic support structures, allowing the pelvic viscera to descend. One of the main contributory factors in this process is dysfunction of the levator ani muscle complex [2].

Urodynamic changes in pelvic organ prolapse

In addition to diagnosing detrusor overactivity and outflow obstruction, urodynamic assessment is useful to exclude stress incontinence, which may be masked by anterior compartment prolapse owing to kinking of the urethra.

Multiple studies have been done on the correlation between urodynamic detrusor overactivity and different types of POP before and after surgery with its different types. Liang *et al.* [3] performed vaginal hysterectomy and anterior and posterior colporrhaphy for 47 patients with stages III–IV POP. Detrusor overactivity was found in 4.3% (2/47) and decreased to 2.1% (1/47) after operation. Digesu *et al.* [4] performed fascial anterior compartment repair for 93 patients (77 of them had done concomitant surgery: vaginal hysterectomy and/or posterior repair) with stage more than or equal to II POP. Detrusor overactivity was found in

91% (85/93) of patients and decreased to 57% (53/93) after repair. Natale *et al.* [5] performed vaginal apex for 272 patients with stage more than or equal to II POP. Detrusor overactivity was found in 29.8% (81/272) of patients and decreased to 19.1% (52/272) after repair. Basu and Duckett [6] performed anterior, posterior, vaginal hysterectomy, and vault suspension for 67 patients with anterior wall prolapse grade II or above. Detrusor overactivity was seen in 100% (67/67) of patients and decreased in 75% (30/40) of patients. Serati *et al.* [7] found that detrusor overactivity was found in 18.7% in patients with POP; moreover, they found that urodynamic stress incontinence was found in 33.8% of cases. Araki *et al.* [8] found that 18% of cases have detrusor overactivity. Panicker and Srinivas [9] found that 68% of patients with advanced POP (≥stage III) have urodynamic features suggestive of mild bladder outlet obstruction.

Patients and methods

This study was a cross-sectional hospital-based study performed on 29 women seeking care at a Female Urology Clinic, Urology Department, Assiut University Hospital, Assiut, Egypt.

Married women aged 20 years and older who presented to the Female Urology Unit, Urology Department, Assiut University Hospital, with symptoms suggestive of POP were examined. Those who were found to have any prolapse (whatever the type and the grade) were included in the study.

Every patient was required to answer all questions in the questionnaire to inquire about the following symptoms with their degree of affection.

History includes the following:

(1) Lower urinary tract symptoms: symptoms according to UDI-6 questionnaire
   (a) Frequency: increased number of voiding times per day
   (b) Overactive bladder (OAB): wet/dry: presence of urinary urgency, usually accompanied by frequency and nocturia, with or without urgency urinary incontinence, in the absence of urinary tract infection or other obvious pathology
   (c) Stress urinary incontinence: complaint of involuntary loss of urine on effort or physical exertion, or on sneezing or coughing
   (d) Total urinary incontinence: complaint of continuous involuntary loss of urine
   (e) Difficulty (straining to void): complaint of the need to make an intensive effort (by abdominal straining, valsalva or suprapubic pressure) to either initiate, maintain, or improve the urinary stream
   (f) Pelvic pain
(2) Bowel symptoms
   (a) Constipation: complaint that bowel movements are infrequent and/or incomplete and/or there is a need for frequent straining or manual assistance to defecate
   (b) Incomplete defecation: complaint that the rectum does not feel empty after defecation
(3) Obstetric history including the following:
   (i) Number of vaginal deliveries
   (ii) Number of abortions
   (iii) Pelvic operations: as hysterectomy
(4) Neurologic history including the following: history of back trauma or surgery, or any history suggestive of any neurological disorder such as limping and fecal or urinary incontinence.

Pelvic examination

(1) Physical examination was performed with the patient in the lithotomy position
   (a) Vaginal examination:
      (i) Prolapse: POP was described during a maximal valsalva to assess type and degree of POP. The types include the following: uterine/cervical prolapse, vaginal vault (cuff scar) prolapse, anterior vaginal wall prolapse (cystocele), and posterior vaginal wall prolapse (rectocele). The degree of prolapse was assessed by Baden walker halfway scoring system [2], that is, (a) halfway to the hymen; (b) to the introitus, (c) halfway past the hymen; and (d) maximum descent of the vagina (complete eversion)
      (ii) Stress test for stress urinary incontinence: examination for urinary incontinence is best performed with the woman's bladder comfortably full. Positive stress test was defined as observation of involuntary leakage from the urethra synchronous with effort or physical exertion, or on sneezing or coughing
   (b) Digital rectal examination and neurologic assessment: to exclude any neurological deficit
   (c) Focused neurological examination, including the following:
      (i) Testing perineal sensations
      (ii) Bulbocavernosus reflex: involves monitoring internal/external anal sphincter contraction in response to squeezing of the clitoris. This reflex is spinal mediated and involves S2–S4

The investigation included urodynamic studies, that is, uroflowmetry, filling cystometry, and pressure flow studies, according to the standards of the International Continence Society [10].

Results

From February 2015 to July 2016, all consecutive women with symptoms suggestive of POP visiting the Female Urology Outpatient Clinic, Urology Department, Assiut University Hospital, were invited to participate in the study. After evaluation of the patients' symptoms, patients were examined. Those who were found to have POP were involved in the study after obtaining informed consent.

Twenty-nine patients agreed to participate in the study and were enrolled. The mean age of these cases was 48.45 years (range: 23–70 years), the mean number of vaginal deliveries was 5.76 (range: 3–8), and the mean number of abortions was 2.5 (range: 1–6), as shown in Table 1.

The frequency of symptoms in these cases is listed in Table 2. All the women felt that they had vaginal swelling. Of the 29 cases, 19 patients had cystocele, six patients had uterine prolapse, two cases had rectocele, and two cases had vaginal vault prolapse. Second-degree cases represent 16 (55.2%) cases, third-degree cases represent six (20.7%) cases, and fourth-degree cases represent seven (24.1%). Stress test was found positive in five (17.2%) cases. Hydronephrosis was present in seven (24.1%) cases. These results are shown in Table 3.

The urodynamic findings of women with POP are shown in Table 4. Uninhibited detrusor contractions was present in 20.7% of cases, mean maximum cystometric capacity was 337.24 ml, mean maximum urine flow rate (Q_{max}) was 14.71 ml/s, and the mean detrusor leak point pressure was 13 cm H_2O.

Table 5 shows the urodynamic findings according to the type of prolapse. The maximum cystometric capacity and Pdet at Q_{max} differ according to the type of prolapse.

Table 6 shows urodynamic findings according to the degree of prolapse. Q_{max} decreases with increasing degree of cystocele, but this was not statistically significant. Moreover, Pdet at Q_{max} increases with the increase of the degree of cystocele, but no statistical significance could be seen.

In Table 7, obstructive symptoms are directly related with the degree of prolapse. Moreover, it was observed that as the degree of prolapse increases, OAB symptoms decrease; 57.1% of the patients with fourth-degree POP have urgency, and 71% of such patients have frequency.

Stress urinary incontinence is inversely related to the degree of prolapse; it was present in 93.8% of second-degree POP, 83.3% of third-degree POP, and 57.1% of fourth-degree POP.

OAB symptoms are related to cystocele patient whereas obstructive voiding symptoms are more prominent in patients with uterine prolapse, vaginal vault, and rectocele (Table 8).

Table 1 Demographic data of women with pelvic organ prolapse

Patients	*n*=29 [*n* (%)]
Age [mean±SD (range)]	48.45±10.55 (23.0-70.0)
Residence	
Rural	10 (34.5)
Urban	19 (65.5)
Number of vaginal deliveries	
Mean±SD	5.76±1.24
Range	3-8
Abortion	
Yes	6 (20.7)
No	23 (79.3)
Mean±SD (range)	2.50±2.07 (1-6)
Pelvic operations	
Yes	6 (20.7)
No	23 (79.3)

Table 2 Urinary and other symptoms in women with pelvic organ prolapse

Symptoms	*n*=29 [*n* (%)]
Frequency of micturition	
Absent	4 (13.8)
Present	25 (86.2)
Urgency + urge UI	
Absent	4 (13.8)
Present	25 (86.2)
Stress UI	
Absent	5 (17.2)
Present	24 (82.8)
Mixed UI	
Absent	18 (62.1)
Present	11 (37.9)
Difficulty	
Absent	15 (51.7)
Present	14 (48.3)
Pelvic pain	
Absent	5 (17.2)
Present	24 (82.8)
Constipation	
Absent	8 (27.6)
Present	21 (72.4)
Incomplete defecation	
Absent	13 (44.8)
Present	16 (55.2)

UI, urinary incontinence.

Discussion

OAB was found in 86.2% of cases as shown in Table 2, and this finding is in agreement with Digesu *et al.* [11] and gives good epidemiological evidence that OAB and POP coexist. There are many possible theories regarding the pathophysiology of OAB in relation to POP.

Table 3 Examinations of women with pelvic organ prolapse

Pelvic organ prolapse	*n*=29 [*n* (%)]
Leading edge	
Cystocele	19 (65.5)
Rectocele	2 (6.9)
Uterine prolapse	6 (20.7)
Vaginal vault prolapse	2 (6.9)
Degree of prolapse	
II	16 (55.2)
III	6 (20.7)
IV	7 (24.1)
Stress test	
Positive	5 (17.2)
Negative	24 (82.8)
Hydronephrosis	
Yes	7 (24.1)
No	22 (75.9)
PVR	
Yes	1 (3.4)
No	28 (96.6)

PVR, postvoiding residue.

Table 4 Urodynamic data of women with pelvic organ prolapse

Urodynamic findings	*n*=29 [*n* (%)]
Uninhibited detrusor contractions during filling	
No uninhibited	23 (79.3)
Uninhibited	6 (20.7)
Maximum cystometric capacity [mean±SD (range)] (ml)	337.24±111.37 (75-527)
Q_{max} [mean±SD (range)] (ml/s)	14.71±9.00 (0.0-40.0)
Detrusor LPP [mean±SD (range)] (cm H_2O)	13.01±13.36 (1.0-49.0)

LPP, leak point pressure; Q_{max}, maximum urine flow rate.

The pathophysiology of OAB in women with POP is unclear. Several theories exist [12].

(1) Bladder outlet obstruction: POP can cause bladder outlet obstruction and this is often regarded as an important mechanism for developing OAB in these patients. Several studies found that patients with prolapse have a lower Q_{max} during voiding than patients without aprolapse
(2) By bladder distension, the stretch receptors in the urothelium release various chemical factors such as ATP, Ach, and P2X3. This stimulus reaches the sensory neurons and myofibroblasts in the urothelial and suburothelial region, which conducts these stimuli to the detrusor. Stretching of the bladder wall, which is likely to happen in vaginal prolapse, and this might trigger the stretch receptors with detrusor contractions as a result
(3) A prominent cystocele can put traction on the urethra resulting in an open urethra with urine entering the urethra. This mechanism is known to cause detrusor contractions.

Stress urinary incontinence was present in 82.8% of cases (Table 2), and it is inversely related to the degree of prolapse; it was present in 93.8% of second degree POP, 83.3% of third degree, and 57.1% of fourth degree. This occurred because of the significant 'urethral kinking effect' which results from the large cystocele that is associated with these cases. It is a common observation that some patients develop stress incontinence after surgery for POP, and this is probably owing to the correction of this urethral kinking effect after cystocele is corrected.

Difficulty was present in 48.3% of cases. It was more prominent in uterine prolapse, as was seen in 66.7% of the uterine prolapse cases, whereas it was present in 42.1%

Table 5 Urodynamic data according to leading edge of prolapse

Urodynamic findings	Leading edge (mean±SD)				*P*
	Cystocele	Rectocele	Uterine prolapse	Vaginal vault prolapse	
Maximum cytometric capacity (ml)	366.00±79.74	483.50±51.62	260.67±103.89	147.50±102.53	0.001*
Q_{max} (ml/s)	15.65±9.39	17.85±4.17	13.58±9.48	6.00±4.24	0.512
Pdet at Q_{max} (cm H_2O)	27.94±15.40	61.75±13.08	22.00±15.70	61.75±47.02	0.014*
Detrusor LPP (cm H_2O)	13.01±13.36	23.40±0.57	16.07±31.89	20.50±28.99	0.855

LPP, leak point pressure; Pdet Q_{max}, detrusor pressure at maximum urine flow rate. *Statistically significant $P<0.05$

Table 6 Urodynamic data according to the degree of prolapse [in cystocele (19 cases)]

Urodynamic findings	Degree of prolapse (mean±SD)		*P*
	II	III	
Maximum cystometric capacity (ml)	365.00±86.94	368.17±68.88	0.939
Qmax (ml/s)	17.65±9.91	11.30±6.98	0.177
Pdet Q_{max} (cm H_2O)	23.75±15.23	38.00±11.47	0.081
Detrusor LPP (cm H_2O)	13.09±13.17	12.83±15.03	0.970

LPP, leak point pressure; Pdet Q_{max}, detrusor pressure at maximum urine flow rate.

Table 7 Symptoms according to the degree of pelvic organ prolapse

Symptoms	Degree of prolapse [*n* (%)]		
	II (*n*=16)	III (*n*=6)	IV (*n*=7)
Frequency of micturition	15 (93.8)	5 (83.3)	5 (71.4)
Urgency urge UI	15 (93.8)	6 (100.0)	4 (57.1)
Stress UI	15 (93.8)	5 (83.3)	4 (57.1)
Mixed UI	8 (50.0)	1 (16.7)	2 (28.6)
Difficulty	6 (37.5)	3 (50.0)	5 (71.4)
Pelvic pain	11 (68.8)	6 (100.0)	7 (100.0)
Constipation	10 (62.5)	4 (66.7)	7 (100.0)
Incomplete defecation	7 (43.8)	3 (50.0)	6 (85.7)

UI, urinary incontinence.

Table 8 Symptoms according to leading edge of pelvic organ prolapse

Symptoms	Cystocele [*n* (%)]	Rectocele [*n* (%)]	Leading edge [*n* (%)]	
			Uterine prolapse	Vaginal vault prolapse
Frequency of micturition	18 (94.7)	1 (50.0)	6 (100.0)	0 (0.0)
Urgency urge UI	19 (100.0)	1 (50.0)	4 (66.7)	1 (50.0)
Stress UI	18 (94.7)	1 (50.0)	4 (66.7)	1 (50.0)
Mixed UI	7 (36.8)	1 (50.0)	2 (33.3)	1 (50.0)
Difficulty	8 (42.1)	1 (50.0)	4 (66.7)	1 (50.0)
Pelvic pain	16 (84.2)	0 (0.0)	6 (100.0)	2 (100.0)
Constipation	13 (68.4)	0 (0.0)	6 (100.0)	2 (100.0)
Incomplete defecation	10 (52.6)	0 (0.0)	4 (66.7)	2 (100.0)

UI, urinary incontinence.

of patients with cystocele. It could not be adequately studied for other prolapsed compartment owing to low number of cases. Moreover, it was found prominent in fourth-degree POP with 71.4% of cases (Table 7). This supports the theory that advanced prolapse obstructs voiding, which is in agreement with Yalcin *et al.* [13].

Hydronephrosis is present in 24.1% of cases (Table 3) where all of them are fourth-degree prolapse. The mechanism of hydronephrosis in patients with POP was not purposely examined in our study. Previous investigators had suggested that hydronephrosis may be owing to kinking of ureters by the extrinsic compression of prolapsed uterus in patients with uterine prolapse, whereas in patients with vaginal vault prolapse, the cause of hydronephrosis would be weakening and disintegration of the cardinal ligaments after hysterectomy. Hui *et al.* [14] reported 10.3% of POP cases that were stage III and IV at 2011.

As illustrated in Table 4, detrusor overactivity was found in 20.7% of POP cases and all of them were cystocele. These represent good evidence of a relationship between cystocele and detrusor overactivity. These data are in agreement with Serati *et al.* [7] who observed it in 18.7% of POP. This might be owing to bladder outflow obstruction which was previously described.

As shown in Table 4, the mean of maximum cystometric capacity for POP is 337.24 ml. It varies according to the prolapsed compartment. In case of cystocele, the mean was 366 ml whereas in case of uterine prolapse, the mean was 260.67 ml. Although having a low number of vaginal vault prolapse, it should be regarded that the mean was 147.5 ml (all cases are fourth-degree prolapse) (Table 5). *P* value in this case was 0.001 (which is significant).

Conclusion

(1) OAB is found in a large percent of patients with POP. OAB and POP often coexist
(2) Frequency of micturition, stress urinary incontinence, and mixed urinary incontinence are present in a large percent of POP cases. Moreover, these irritative storage symptoms decrease with increase in the degree of prolapse
(3) Urodynamics is an important preoperative investigation before reconstructive surgery for patients with POP as follows:
    (a) Detrusor overactivity is recorded in patients with cystocele
    (b) Qmax decreases as the degree of prolapse increases
    (c) Pdet at Q_{max} and Q_{max} differ according to the prolapsed compartment
    (d) Infravesical obstruction is more likely to be present with increased degree of prolapse.

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Conflicts of interest

There are no conflicts of interest.

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