The Value of Preoperative Urodynamics in Surgery Decision for Pelvic Organ Prolapse Patients with Occult Stress Urinary Incontinence

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Abstract

This retrospective cohort study aims to explore the clinical value of urodynamics in evaluating lower urinary tract function in pelvic organ prolapse (POP) patients, and to investigate the urodynamic characteristics of POP patients with occult stress urinary incontinence (OSUI) in whom moderate or above postoperative SUI eventually occurred after prolapse surgery. The medical records of 626 advanced POP patients who underwent vaginal pelvic reconstructive surgery were analyzed. The patients with anterior compartment prolapse were more susceptible to urodynamic changes than those with apical or posterior compartment prolapse (95.1% vs. 40.15%). The proportion of patients with urodynamic abnormality was increased with prolapse severity (68.8% vs. 78.6%). After 3 months, the incidence of moderate or severe postoperative urinary incontinence in the OSUI patients was 20%, while it is 2.8% in non-OSUI patients. In subgroup analysis of OSUI patients, the urodynamics of patients with moderate or above postoperative urinary leakage showed significantly lower Valsalva leak point pressure (VLPP), maximum urethral closure pressure (MUCP), maximal bladder volume (MBV) and maximum urine flow rate (MUFR). For POP patients with OSUI, anti-incontinence surgery is only recommended for whom with lower VLPP, MUCP, MBV and MUFR to avoid the risk and costs of secondary surgery or overtreatment.

Introduction

Pelvic organ prolapse (POP) is defined as the falling, slipping, or downward displacement of pelvic organ, mostly referring to the prolapse of uterus or vaginal compartments[1]. It causes not only prolapse symptoms, but also potential prolapse-related lower urinary tract symptoms (LUTS), anorectal dysfunction symptoms, sexual dysfunction symptoms and other associated symptoms, such as urinary incontinence (UI)[1] . LUTS includes hesitancy, slow stream, intermittency, feeling of incomplete (bladder) emptying, position-dependent micturition and so on. Stress urinary incontinence (SUI), defined by the International Continence Society (ICS) as the “involuntary loss of urine on effort or physical exertion or on sneezing or coughing” often coexists with POP[2]. However, up to 80% of POP patients complain of SUI after prolapse surgery, partially because of the recovery of bladder distortion[2]. Recent research has demonstrated that nearly 40% of POP patients report UI after prolapse surgery[3]. Women with POP and coexisting SUI face the highest risk of postoperative SUI[4]. However, women without symptoms of SUI can also develop de novo SUI after prolapse repair. Occult SUI (OSUI) is defined as the presence of SUI on examination, or urodynamic stress incontinence in POP patients with a reduction of prolapse, who have no complain of SUI symptoms with prolapse condition[2]. POP patients with OSUI have higher risk of de novo SUI after POP surgery than those without OSUI [5]. The incidence of postoperative SUI in POP with OSUI and patients without OSUI is 54% and 26% respectively [6].

In order to reduce the postoperative SUI, some surgeons have preferred performing an anti-incontinence procedure at the time of prolapse surgery. It has been demonstrated that the concomitant incontinence surgery reduces both subjective and objective symptoms of incontinence and LUTS[7]. However, such surgery may constitute overtreatment and cause serious adverse events, for example, bleeding, bladder perforation, urinary tract infection, long-term pain and erosion, and incomplete bladder voiding[4,8]. Up to now, there has been no consensus on whether or not prolapse repair and anti-incontinence surgery should be performed concomitantly. Since OSUI is an important cause of postoperative SUI[9], important questions remain regarding appropriate evaluation for, and treatment of, OSUI.

Urodynamic testing (urodynamics), by measuring the relevant physiological parameters, allows the direct assessment of lower urinary tract (LUT) function. According to the recommendations of the ICS and International Consultation for Incontinence (ICI) in 2016[10], LUTS and lower urinary tract dysfunction (LUTD) are accepted indications for assessment by urodynamic studies. The role of urodynamics prior to any surgical intervention for complicated SUI is clearly defined in international guidelines[11,12], and these guidelines recommend the use of invasive urodynamics before surgery in patients with complicated SUI. A recent expert consensus viewpoint on the value of urodynamics in the management of female SUI was published recently in a review article. It concluded that extensive experience and observational studies have demonstrated the dangers of using empiric management for SUI and strongly endorsed the value of urodynamics[13]. The aim of our study was to explore the clinical value of urodynamics in evaluating LUT function in advanced POP patients, and to investigate the urodynamic characteristics of POP patients with OSUI in whom moderate of above postoperative SUI eventually occurs, to help mitigate the risk of developing bothersome postoperative SUI and overtreatment in POP patients with OSUI.

Materials And Methods

With Institutional Review Board (IRB) approval (ID: 2020PS468K), we undertook a retrospective review of patients undergoing POP surgery at the Pelvic Floor Disease Diagnosis and Treatment Center (Liaoning Province, China) between January 2017 and June 2020. The study's methods and definitions all conformed to the standards recommended by the ICS and International Urogynecological Association (IUGA)[2]. The severity of prolapse was evaluated using the standard terminology of Pelvic Organ Prolapse Quantification (POPQ) recommended by the ICS[14]. Inclusion criteria included POP-Q stage 3 or greater on preoperative examination and patients having undergone urodynamic studies. Exclusion criteria included contraindications to pelvic surgery such as a pelvic infection, fistula, congenital or neurogenic bladder disorder, malignancy or being medically unfit. Demographic variables collected included age, gravidity, parity and age of menopause. Clinical parameters included comprehensive urogynecological history, multichannel urodynamic testing, and physical examination including POP-Q, stress test and Bonney test. After surgery, the patients were followed up for 3 months.

Urodynamic testing was performed after reduction of the POP using a pessary. Urodynamics (UDS) was conducted under standardization as follows. Multichannel UDS was performed with the patient in an upright birthing chair at a 60° angle using a Laborie system. Cystometrogram, pressure-flow studies, urethral pressure profiles and electromyography were performed in all patients. An air-charged dual-sensor catheter (Laborie) was placed in the bladder and a water-charged dual-lumen balloon catheter (Laborie) in the rectum. Bladders were filled with room-temperature sterile water at 50 ml/min. Stress test including cough and Valsalva efforts was performed at bladder volumes of 100, 200, 300, and 500 ml (or cystometric capacity)[15]. Urodynamic parameters included the maximal urine flow rate (MUFR, Qmax), average urine flow rate (AUFR, Qave), maximal bladder volume (MBV), maximal detrusor pressure (MDP), voiding time, detrusor pressure at MUFR (Pdet Qmax), maximal urethral closure pressure (MUCP), Valsalva leak point pressure (VLPP) and Post Void Residual (PVR).

In our study, the urodynamic reference of healthy women was as follows: MUFR ≥20 mL/s[16], MBV=250–550 mL[17], MUCP=40–70 cmH_2O[18]. We used a threshold value of Qmax ≤15 mL/s and Pdet Qmax >20 cmH_2O for the diagnosis of bladder outlet obstruction (BOO)[19]. Pdet ≥15 cmH_2O during filling cystometry indicated detrusor overactivity (DO)[20]. Pdet Qmax ≤20 cmH_2O indicated detrusor underactivity[19]. VLPP<90 cmH_2O indicated impaired urethral closure function[21].

The quality of life was assessed pre- and postoperatively with the use of Pelvic Floor Distress Inventory-20 (PFDI-20) questionnaire scores. This questionnaire was composed of 20 POP symptom questions and included three subscales: POPDI-6, CRADI-8 and UDI-6. The higher the scores were, the greater the impact on quality of life.

Statistical analysis was conducted using IBM SPSS version 17.0. The quantitative data were presented as mean ± standard deviation (SD) and the independent-sample t test was employed for comparison of the mean between two groups. The associations between categorical variables were analyzed using the chi-square test. A p-value < 0.05 was considered significant.

Ethics declarations: Ethics approval (ID: 2020PS468K) for this study was obtained from Shengjing Hospital of China Medical University. We confirmed that our research was conducted in accordance with the Helsinki Declaration. Informed consents were obtained from all patients before participating in the study.

Results

Between January 2017 and June 2020, 626 advanced POP patients were included in our study. Prolapse severity was stage III in 67.1% (420/626), and stage IV in 32.9% (206/626). All patients were 42–85 (64.91±9.29) years old, with an average menopausal age of (46.49±2.58) years, average gravidity of 3.61±1.62, and average parity of 2.55±1.51. A total of 451 patients experienced LUTD, in which 342 patients were also diagnosed with urinary incontinence, while SUI accounted for 31.5% (142/451) of cases, mixed urinary incontinence (MUI) for 10.2% (46/451) of cases, urgent urinary incontinence (UUI) for 10.6% (48/451) of cases, and OSUI for 23.5% (106/451) of cases. Four hundred and twenty patients underwent vaginal pelvic reconstructive surgery only, and 206 cases (including 142 SUI patients, 33 MUI patients and 31 OSUI patients) were offered a mid-urethral sling (MUS) procedure at the same time. Patients were grouped according to the prolapse stage, and no significant difference in patient demographics between the stages was noted. However, significant differences were reported in the PFDI-20 and UDI-6 scores. The subjective symptoms worsened with increase of prolapse severity (Table 1). Those POP patients with subjective LUTS accounted for 67.6% (423/626) of patients.

Urodynamic abnormality was defined as one or more urodynamic parameters beyond the reference parameters of healthy women mentioned in the Material and Methods section. Of the 626 POP patients,

patients with stage III and IV urodynamic abnormality accounted for 46.2% (289/626) and 25.9% (162/626) of cases, respectively; patients with anterior compartment prolapse dominant, and apical or posterior compartment prolapse dominant accounted for 58.1% (364/626) and 41.9% (262/626) of cases, respectively. Of the 451 patients with urodynamic abnormality, the patients with anterior compartment prolapse and apical or posterior compartment prolapse accounted for 76.7% (346/451) and 23.3% (105/451) of cases, respectively. In all, 95.1% (346/364) patients with anterior compartment prolapse experienced urodynamic abnormality, while only 40.15% (105/262) with apical or posterior compartment prolapse patients experienced urodynamic abnormality. And then, 68.8% (289/420) patients with stage III prolapse experienced urodynamic abnormality, while 78.6% (162/206) with stage IV prolapse patients experienced urodynamic abnormality. POP patients had significant changes of urodynamic parameters, and the difference among patients with different stage of prolapse was statistically significant. The patients with anterior compartment prolapse were more susceptible to urodynamic changes than those with apical or posterior compartment prolapse. In addition, the proportion of patients with urodynamic abnormality was increased with the increase of prolapse severity (Table 2).

The 626 POP patients were grouped based on prolapse severity, and the 451 patients with urodynamic abnormality were grouped based on prolapse compartment. Within each group, the MUFR, MDP, AUFR, VLPP, detrusor pressure at MUFR, MUCP, voiding time, MBV and PVR were compared. Parameters of MUFR, MDP, detrusor pressure at MUFR, MUCP, voiding time, MBV and PVR were different between each group and the differences were statistically significant (Table 3).

After 3 months, a total of 554 patients were followed up, including 195 patients who received concomitant anti-incontinence surgery (including 31 OSUI patients) and 357 patients who received POP repair surgery only (including 75 OSUI patients). The follow-up rate was 88.5% (554/626). During surgery, no patients experienced bladder or intestinal perforation, obturator vessel or nerve injury, hematoma or other severe complications; however, 6 cases developed voiding difficulty, 10 cases had inguinal groove discomfort, and 6 cases experienced urinary frequency and urgency at 2 weeks after surgery. After treatment, these symptoms eventually disappeared. After 3 months, 23 cases experienced moderate or above SUI after surgery and these patients were all from the 420 patients who did not receive concomitant anti-incontinence surgery but eventually underwent it and 15 of these were from OSUI group. At follow up, the incidence of moderate or above postoperative SUI in the group who received a concomitant MUS procedure was 0% (0/195), and in the group who received POP repair surgery, was 6.4% (23/357). The proportion of moderate or above postoperative SUI patients in the OSUI group was 20.0% (15/75), while in non-OSUI patients not receiving anti-incontinence surgery, it was 2.8% (8/282). The relative risk of urinary incontinence in OSUI patients was increased 7.1 folds.

In order to investigate the high risk factors for postoperative SUI in OSUI patients, subgroup analysis was done in the patients in the OSUI group who did not receive a concomitant MUS procedure, according to whether postoperative SUI occurred or not. Patients with moderate or severe postoperative SUI were classified as group A, and those with either no or mild postoperative SUI as group B, and we compared the urodynamic parameters between the two groups. VLPP, MUCP, MBV and MUFR in group A were found to be significantly lower than that in group B (Table 4).

Discussion

Urinary symptoms accompany POP frequently. Symptoms of POP may be experienced as prolapse symptoms including vaginal bulge, pelvic pressure, splinting or digitation. In addition, higher stage utero-vaginal prolapse will usually cause anatomical distortion to surrounding organs, most commonly the bladder, which may cause potential prolapse-related LUTS, including storage symptoms such as urinary frequency and urgency as well as voiding symptoms such as hesitancy, straining to void, and feeling of incomplete bladder emptying. Commonly, those symptoms related to pressure on the surrounding organs are the most troubling to the patient, leading to the eventual diagnosis of POP[1]. In our study, we found that 67.6% patients had subjective LUTS, and the subjective symptoms worsened with the increase of prolapse severity. According to the latest recommendations of the ICS and International Consultation for Incontinence (ICI)[1], lower urinary tract (LUT) function is an accepted indication to perform urodynamic studies. UDS is the gold standard test for assessing LUTS. In our study, those patients with anterior compartment prolapse were more likely to have urodynamic changes than those with apical or posterior compartment prolapse, and the proportion of patients with a urodynamic abnormality was increased with the increase of prolapse severity. In POP patients with anterior compartment prolapse, the MUFR, AUFR, and MBV were all significantly decreased, the voiding time was clearly prolonged, and the PVR was increased. This is consistent with the report of Mueller E et al[22]. Bladder wall hypertrophy, hypoxia, detrusor irritability, and upregulation of spinal reflexes, which are resulted from the bladder outlet obstruction (BOO) is the pathophysiology of bladder voiding and storage symptoms.

Urodynamic studies are frequently performed prior to POP surgery to assess urethral and bladder function. We found that 72.0% patients had abnormal urodynamics and 67.6% patients had subjective LUTS, and the overall coincidence rate was 93.9%. In our study, the prevalence of OSUI was 23.5% when using urodynamics with prolapse reduction, which is equal to that reported in the literature of 23.5%[23]. As was demonstrated in the recent review, urodynamic studies remain a valuable diagnostic test, providing vital information to both the surgeon and patient prior to invasive treatment, with minimal morbidity[24]. In our study, we found 105 patients had OSUI, and 33 patients underwent a concomitant incontinence procedure at the time of prolapse repair. A recent retrospective study demonstrated that 29.4% of POP patients were diagnosed with OSUI by preoperative UDS, and as a result, anti-incontinence procedure was added in 82% of them at the same time with POP surgery[25].

SUI often coexists with POP. A recent research has demonstrated that nearly 40% of POP patients report UI after prolapse surgery. In contrast to POP patients without OSUI, the incidence of postoperative SUI occurred in patients with OSUI increased by 3 folds (60% vs 20%)[3]. Until now, there has been debated on whether anti-incontinence surgery should be performed concomitantly with POP repair or not. There are three approaches to address the potential complications of postoperative SUI: (a) delayed: prolapse repair is performed without an anti-incontinence procedure; (b) universal: an anti-incontinence procedure is performed on all women at the time of POP surgery; (c) selective: an anti-incontinence procedure is performed at the time of prolapse surgery only if SUI was detected[6]. Each approach has each own advantages and disadvantages. The delayed approach however may lead to under-treatment. If bothersome SUI happens postoperatively, a subsequent anti-incontinence procedure will be performed, although it is demonstrated as safe and effective as primary TVT implantation, it will increase the costs and the risks arising from a new surgery[26]. The universal approach may reduce the incidence of postoperative SUI in both symptomatic and asymptomatic POP patients[27,28]. Moreover, both subjective and objective symptoms of incontinence and LUTS were reduced after the combined surgery[7]. Chai et al. have demonstrated that combined surgery did not increase complication rates, and it decreased the risk of objective failure after MUS[29]. On the other hand, combined surgery may lead to overtreatment and cause serious adverse events (SAE)[4,8]. As a result, the selective procedure seems therefore to be more reasonable.

In women with prolapse and coexisting SUI, the literature indicates that vaginal prolapse repair should be combined with MUS in 2.5 women to prevent 1 woman needing subsequent MUS after prolapse surgery only (for example the number needed-to-treat (NNT) is 2.5)[4]. The NNT to prevent 1 woman from developing postoperative SUI using the universal approach varies from 6, to 3 to 9[4,8], and for performing a selective procedure in women with occult SUI, the NNT is 3[4,30]. In a prospective cohort study, in patients with POP stage ≥ 3, MUCP<60 cmH_2O and functional urethral length (FUL) <2 cm, the rate of postoperative SUI in the concomitant surgery group was 5% objectively and 10% subjectively, while in the POP surgery group it was 50% and 60%, respectively[31]. Our study showed that the incidence of moderate or above postoperative SUI in OSUI patients who did not receive anti-incontinence surgery was 20.0% (15/75), compared to 2.8% (8/282) in the POP surgery group, indicating the relative risk of postoperative SUI in OSUI patients was increased nearly 7.1 folds. This confirms that OSUI is an important cause of urinary incontinence after POP correction. In other words, preventive anti-incontinence surgery must be performed in 5 OSUI patients to prevent 1 patient from secondary surgery (NNT=5).

Many studies have focused on the incidence of postoperative urinary incontinence in patients with or without OSUI; however, none have specifically investigated those patients who really need subsequent surgery for bothersome postoperative SUI. In order to balance the risk of developing postoperative SUI and overtreatment in POP patients with OSUI, we investigated the urodynamic characteristics of those POP patients with OSUI in whom postoperative SUI eventually occurred. Our study results showed that the VLPP, MUCP, MBV and MUFR in group A were significantly lower than those in group B, suggesting that the patients in group A had more severe urethral closure dysfunction, internal urethral sphincter dysfunction, and BOO, which jointly contributed to postoperative SUI in most clinical cases. It also explains why urinary incontinence symptoms are relieved with the increase of prolapse severity in urinary incontinence patients. Some patients in group B had urethral sphincter dysfunction and BOO before surgery but experienced no SUI or only mild SUI after surgery; this is considered to be related to the postoperative recovery of the pelvic anatomy and the resultant recovery of overall pelvic function, so that these mild SUI symptoms improve naturally and even disappear. So, concomitant incontinence surgery was recommended for OSUI patients with lower VLPP, MUCP, MBV and MUFR, so as to avoid the risk and costs of secondary surgery and overtreatment.

Our study had several limitations. Firstly, our study was a retrospective study. Secondly, the number of the cases in the OSUI group was limited. Thirdly, the follow-up period was only three months. Further research is needed to assist healthcare professionals in the management, diagnosis, and clinical assessment, and in the optimization of the efficacy of the treatment of OSUI.

Conclusions

Most patients with advanced POP have differing degrees and types of LUTS. For POP patients with OSUI, anti-incontinence surgery is only recommended for whom with lower VLPP, MUCP, MBV and MUFR to avoid the risk and costs of secondary surgery or overtreatment.

Declarations

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Author contributions: HX conducted the data analysis and drafted the manuscript; ZX designed the study. QH and YZ contributed to data collection. All authors participated in the discussion and approved the final manuscript.

Data availability: The data used to support the findings of this study are available from the corresponding author upon request.

Competing interests: The authors declare no competing interests.

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Tables

Table 1. The demographics data and subjective questionnaire scores

	POP-Q		P
	stage III (n=420)	stage IV (n=206)	
Age	64.72± 9.19	65.26± 9.41	0.493
Menopausal age	46.62±2.82	46.30±2.63	0.173
Gravidity	3.55±1.65	3.75±1.82	0.169
Parity	2.49±1.45	2.73±1.74	0.126
PFDI-20 scores	106.57±45.45	175.55±57.32	<0.001
UDI-6 scores	59.42±19.68	72.75±16.40	<0.001

POP-Q: pelvic organ prolapse quantification; PFDI-20: pelvic floor distress inventory-20; UDI-6: Urinary distress inventory 6

Table 2. Comparison of the urodynamics based on prolapse severity and predominant prolapse compartment

	Prolapse severity (POP-Q)		P	Prolapse compartment		P
	stage III	stage IV		Anterior	Apical or posterior	
Urodynamic normality	131	44	0.010	18	157	<0.001
Urodynamic abnormality	289	162		346	105	

POP-Q: pelvic organ prolapse quantification

Table 3. Comparison of urodynamic parameters based on prolapse severity and predominant prolapse compartment

	Prolapse severity (POP-Q)			Predominant prolapse compartment		
	stage III (n=420)	stage IV (n=206)	P	Anterior (n=346)	Apical or posterior (n=105)	P
MUFR (mL/s)	21.08±10.92	18.93±8.09	0.012	16.85±11.37	25.58±12.18	<0.001
MDP (cmH_2O)	38.27±10.14	32.82±11.43	<0.001	33.12±10.18	38.25±9.12	<0.001
AUFR (mL/s)	12.42±6.65	11.77±7.28	0.266	9.15±6.14	13.26±6.53	<0.001
VLPP (cmH_2O)	88.26±30.56	83.96±25.31	0.081	83.65±28.26	89.23±34.55	0.094
Detrusor pressure at MUFR (cmH_2O)	31.35±9.53	27.51±10.48	<0.001	28.25±11.75	32.85±10.41	<0.001
MUCP (cmH_2O)	62.78±20.88	55.11±17.44	<0.001	54.35±16.15	65.42±12.63	<0.001
Voiding time (s)	65.24±17.29	71.75±13.90	<0.001	72.77±66.10	53.22±23.56	0.003
MBV (ml)	474.36±176.34	448.43±184.72	0.089	460.77±183.95	543.25±187.39	<0.001
PVR (ml)	33.62±37.43	48.42±50.58	<0.001	55.43±63.64	38.42±58.85	0.015

POP-Q: pelvic organ prolapse quantification; MUFR: maximal urine flow rate; MDP: maximal detrusor pressure; AUFR: average urine flow rate; VLPP: valsalva leak point pressure; MUCP: maximal urethral closure pressure; MBV: maximal bladder volume; PVR: post void residual

Table 4. subgroup analysis in patients without concomitant MUS procedure in OSUI group

	Group A (n=15)	Group B (n=60)	P
MUFR (mL/s)	13.42±5.62	18.12±4.33	<0.001
MDP (cmH_2O)	38.22±11.52	37.72±12.55	0.889
AUFR (mL/s)	7.88±3.06	8.32±2.69	0.583
VLPP (cmH_2O)	72.90±3.55	94.19±33.12	0.016
Detrusor pressure at MUFR (cmH2O)	30.71±11.19	29.91±10.31	0.792
MUCP (cmH_2O)	42.9±9.21	54.05±17.88	0.023
Voiding time (s)	74.99±36.02	68.43±42.98	0.588
MBV (ml)	355±91.37	445.15±18.08	<0.001
PVR (ml)	41.70±13.31	36.73±14.66	0.236

POP-Q: pelvic organ prolapse quantification; MUFR: maximal urine flow rate; MDP: maximal detrusor pressure; AUFR: average urine flow rate; VLPP: valsalva leak point pressure; MUCP: maximal urethral closure pressure; MBV: maximal bladder volume; PVR: post void residual