Urinary symptoms and urodynamic findings before and after vaginal surgery for pelvic organ prolapse

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Abstract

To ascertain the difference in urodynamic findings, specifically bladder sensation, and urinary symptoms after vaginal surgery for Pelvic Organ Prolapse (POP). Retrospective data analysis of 126 women who underwent vaginal surgery for POP without simultaneous anti-incontinence procedure from January 2013 to April 2019 at Siriraj Hospital, Thailand. Baseline characteristics, intraoperative details and pre and post-operative urinary symptoms and urodynamic findings were recorded. There was no significant difference in the pre and post-operative first desire to void, at 158±53 mL and 162±64 mL, respectively (p=0.518). Incidence of increased bladder sensation was also unchanged, from 46.0% to 46.8% (p=1.00). Post-operative urodynamic stress incontinence was significantly increased, from 15.9% to 31.0% (p<0.003), as was the incidence of weak bladder contractility index (<100), from 47.3% to 61.8% (p=0.005). Significant improvements in post-operative urge urinary incontinence, urgency and voiding dysfunction were noted, from 50.8% to 31.7% (p=0.001), 63.5% to 38.9% (p<0.001) and 42.9% to 5.6% (p<0.001), respectively. No significant difference in bladder sensation after vaginal surgery for POP repair was noted. However, urinary symptoms significantly improved after surgery.

Introduction

Pelvic Organ Prolapse (POP) is a condition where the pelvic organs and the overlying vaginal segments protrude into the vagina or through vaginal orifice.1 Due to their anatomical association, POP and urinary incontinence have similar risk factors and are often found in conjunction with each other.2 Moreover, Lower Urinary Tract Symptoms (LUTS) such as frequency, urgency, Urgency Urinary Incontinence (UUI), Stress Urinary Incontinence (SUI) and voiding dysfunction are often prevalent in patients with pelvic organ prolapse.3 There are a variety of surgical procedures available for POP repair, for which is suitable, depending on the location and the severity of prolapse, associated symptoms4 and the surgeon’s preferred route of operation. However, 80-90% of the procedures are undertaken via the vaginal route.5,6 Correction of POP can either ameliorate or exacerbate these LUTS. Previous studies focusing on urinary symptoms found a 6-22% incidence of de novo SUI after prolapse repair.7-10 It is suggested that prolapse of pelvic organs can cause urethral kinking, and POP repair restores the normal urethral anatomy unmasking the symptom of SUI that may have been covertly present before the operation.7,11-13 Also, extensive pelvic reconstructive surgery can interfere the lower urinary tract nerve plexuses resulting in the development of de novo SUI.14 Some studies additionally demonstrated an increase in de novo UII,15 whilst others showed improvement postoperatively.15-17 Lastly, voiding dysfunction which often presents with POP tends to improve after POP repair.3,17

Apart from changes in LUTS, several previous literatures comparing pre- and post-operative urodynamic findings in patients undergoing pelvic floor reconstruction for prolapse consistently demonstrated improvement in voiding phase parameters after surgery, such as higher maximum urine flow rate (Q_max), reduced Postvoid Residual Urine (PVR), and disappearance of Bladder Outflow Obstruction (BOO).3,16-18 which resulted from resolution of urethral kinking. However, conflicting data have still persisted when evaluating in terms of filling phase parameters, including bladder sensation. Previous studies assessing urodynamic changes after laparoscopic sacrocolpopexy reported inconsistent results. While Illiano et al.16 found no significant differences in cystometric capacity pre- and post-operatively, Abdullah et al.17 and Kummeling et al.18 showed remarkable improvement in first desire volume, strong desire volume and bladder capacity. Furthermore, when looking at a comparative urodynamic analysis in patients undergoing vaginal operations for POP, Panicker et al.6 failed to demonstrate any difference in bladder sensation before and after surgery. Therefore, due to these contradictory results, our study primarily aimed to ascertain the differences in pre- and post-operative urodynamic filling phase parameters in terms of bladder sensation among patients undergoing vaginal surgery for POP repair.

Secondarily, we planned to investigate changes in both LUTS and other urodynamic parameters.

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Key words: Pelvic organ prolapse; vaginal surgery; lower urinary tract symptoms; urodynamic findings.

Materials and Methods

After approval from the Ethics Committees of Siriraj Institutional Review Board, this study was presented in an oral format at the annual scientific meeting of the Royal Thai College of Obstetricians and Gynaecologists on 17th October, 2019. Availability of data and materials: All data generated or analyzed during this study are included in this published article.

Ethics approval and consent to participate: This study was approved by the ethics committee of the siriraj institutional review board [approval code 520/2561 (ec1)]. This study conforms with the helsinki declaration of 1964, as revised in 2013, concerning human and animal rights.

Informed consent: Since the study design was a retrospective chart review, the IRB did not require patient’s informed consent.

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the sensation of bladder filling and a defi-

sion can be classified as “increased” of a sudden and compelling desire to pass

ner storage symptoms, our study mainly

urgency, and “mixed urinary incontinence”

categorized into urinary incontinence, blad-

micturition, including slow stream, inter-

rectum to measure abdominal pressure

urea which is difficult to defer. A female

pelvic floor dysfunction,19 LUTS are

male pelvic floor dysfunction,19 FDV is the first

According to the definition by IUGA/ICS

ituation. Another catheter was inserted into the

were diagnosed with at least stage II symp-

and post-operative POP stage and location,

surgery irrespective of any LUTS experienced.

Urodynamic study was scheduled for every

urgency or 500 ml of instillation. Provocative

maximum flow (P detQmax), and PVR were

there were no sexual intercourses, no new

were offered surgical correction. Vaginal hysterec-

was indicated among those with concurrent

benign uterine pathology (e.g., leiomyoma, adenomyosis, endometrial polyp, etc.) or on

on patients’ request due to their perception of the

of POP was defined as a complaint of involuntary loss of urine (ΔV/ΔPdet; mL/cmH2O), strong bladder contractility was
defined as an index value of more than 150, whereas weak contractility was indicated by the

Three urogynecologists were responsible

for all surgical procedures. Vaginal hysterectomy was undertaken using a standard technique

as practiced by all gynecologists at our center. After having been anesthetized, the patient was placed in lithotomy

position and an indwelling catheter was inserted for bladder drainage. The cervix was grasped with tenaculum, followed by

submucosal injection of saline or sterile water to separate the vaginal fascial layers. Following circumferential incision around

vaginal fornix, blunt dissection into vesico-

vaginal and rectovaginal spaces was achieved to mobilize the bladder and the rectum away from the surgical field. Both

uterosacral and cardinal ligaments were then clamped, cut, and suture-ligated with 1-Vicryl. Peritoneal cavity was entered either via posterior cul-de-sac or vesicouter-

ine pouch. After cutting and securing both ureterine vessels, broad ligaments and adnexal pedicles were also clamped, cut, and

suture-ligated with 1-Vicryl. Vaginal cuff closure was performed after checking and securing all pedicles for hemostasis. Having

completed vaginal hysterectomy, additional pelvic floor reconstructive procedures including anterior colporrhaphy, posterior

colporrhaphy, anterior vaginal mesh repair, apical suspension (uterosacral ligament suspension or sacrospinous fixation), and/or

obliterative total colpocleisis, were carried
Postoperative follow-up was scheduled at 6 weeks, 6 months, and annually after surgery. At each visit, re-evaluation of POP stage and location as well as postoperative LUTS was performed. Urodynamic study was repeated at 6-month postoperative visit as previously mentioned. At 6 months follow-up, POP recurrence was diagnosed according to the NICHD (National Institute of Child Health and Human Development) Pelvic Floor Disorders Network recommendations13 as “Stage 2C - leading edge of POP beyond the hymen.”

The required sample size was based on the urodynamic findings of the FDV values before and after POP surgery from a study by Kummeling et al.18 Due to the non-normal distribution of the data, the standard deviation was calculated from the difference between the maximum and the minimum values. Using a two-tailed hypothesis test with a type I error of 5% and a power of 90%, a minimum sample size of 116 was needed. An addition of 10 percent compensation increased the sample size to 127 participants. Statistical analysis was performed using the PASW statistics software version 18.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to analyze the baseline characteristics of the patients included in the study. Continuous variables were displayed as mean ± standard deviation if normally distributed and expressed as median (range) if not normally distributed. The McNemar test was used to compare categorical data whereas paired Student t-test was applied for continuous variables. A p-value of less than 0.05 was considered as statistical significance.

Results

A total of 291 patients underwent vaginal hysterectomy with concurrent transvaginal reconstructive procedures, except anti-incontinence surgery, at the Urogynecology Unit, Siriraj Hospital during the study period. One hundred and sixty-four patients included in the study. Continuous variables were displayed as mean ± standard deviation or number (%) EBL: estimated blood loss.

Table 1. Patients’ baseline characteristics.

| Baseline characteristics | Value (n = 126) |
|--------------------------|----------------|
| Age (years)              | 69.5±8.2       |
| BMI (kg/m²)              | 24.6±3.6       |
| Parity                   | 3 (0-10)       |
| Menopause                | 124 (98.4)     |
| Hormone use              | 2 (1.6)        |

Table 2. Perioperative outcomes.

| Perioperative variables | Value (n = 126) |
|------------------------|----------------|
| Concurrent procedures  |                |
| Sacrospinous fixation  | 15 (11.9)      |
| Uterosacral vault suspension | 8 (6.3) |
| Total colpoploeksis    | 39 (31.0)      |
| Anterior colporrhaphy  | 15 (11.9)      |
| Anterior vaginal mesh repair | 66 (52.4) |
| Operative time (min)   | 85±37.8        |

| Complication            |                |
| EBL > 500 mL            | 3 (2.4)        |

Table 3. Pre- and post-operative LUTS.

| LUTS                     | Pre-operation | Post-operation | p     |
|--------------------------|---------------|----------------|-------|
| SUI †                    | 46 (36.5)     | 44 (35.0)      | 0.88  |
| UUI †                    | 64 (50.8)     | 40 (31.7)      | 0.001*|
| MUI ‡                    | 37 (29.4)     | 26 (20.6)      | 0.09  |
| Urgency                  | 80 (63.5)     | 49 (38.9)      | <0.001*|

| Voidsing symptoms        | 54 (42.9)     | 7 (5.6)        | <0.001*|

Data presented as number (%), * statistical significance. a. LUTS: lower urinary tract symptoms; b. SUI: stress urinary incontinence; c. UUI: urgency urinary incontinence; d. MUI: mixed urinary incontinence.
significant differences in bladder sensation variables, including FDV (p=0.518), SDV (p=0.385), and urgency or bladder capacity (p=0.287), were detected. When subcategorized according to the cut-off volume into increased and reduced bladder sensation, almost identical proportion of the patients from both groups were found to have increased sensation (46.0% vs 46.8%; p=1.000). Only a few from both groups consistently showed reduced bladder sensation (7.1% vs 7.9%; p=1.000). Less than 5% of the patients presented with poor bladder compliance pre- and post-operatively (4.8% vs 3.2%; p=0.649). This seemed to correspond to the outcome of detrusor function that none of our patients had detrusor overactivity at baseline and only 3 (2.4%) developed it after surgery. However, significant changes were observed when evaluating in terms of urethral function. Urodynamic Stress Incontinence (USI) was highly prevalent among patients having undergone vaginal surgery for POP (postoperative 31.0% vs preoperative 15.9%; p=0.003).

For voiding phase parameters, no statistically significant differences were identified when comparing between pre- and post-operative Q max (19.0±8 vs 18.5±8 mL/sec; p=0.462), P detQ max (21.0±11 vs 19.9±11 cmH 2O; p=0.179), and BOO (41.8% vs 38.2%; p=0.585). Undoubtedly, reduction in PVR was apparently noted in patients who underwent surgical correction for POP (postoperative 29±41 vs preoperative 42±54 mL; p=0.006). However, two-thirds of the patients significantly demonstrated weak BCI after POP repair (postoperative 61.8% vs preoperative 47.3%; p=0.005, Table 4).

Table 4. Pre- and post-operative urodynamic findings.

| Urodynamic findings     | Pre-operation | Post-operation | p     |
|-------------------------|---------------|----------------|-------|
| Filling phase parameters|               |                |       |
| Bladder sensation       |               |                |       |
| FDV (mL)                | 158±53        | 162±64         | 0.518 |
| SDV (mL)                | 263±80        | 256±76         | 0.385 |
| Urgency (mL)            | 348±103       | 358±104        | 0.287 |
| Increased bladder sensation (FDV<150 mL) | 59 (46.0) | 59 (48.8) | 1.000 |
| Reduced bladder sensation (SDV>250 mL) | 9 (7.1) | 10 (7.9) | 1.000 |
| Poor bladder compliance (< 40 mL/cmH 2O) | 6 (4.8) | 4 (3.2) | 0.649 |
| Detrusor function       |               |                |       |
| DO                     | 0 (0)         | 3 (2.4)        | -     |
| Urethral function       |               |                |       |
| USI                     | 20 (15.9)     | 39 (31.0)      | 0.003* |

| Voiding phase parameters | Pre-operation | Post-operation | p     |
|--------------------------|---------------|----------------|-------|
| Qmax (mL/sec)            | 19.0±8        | 18.5±8         | 0.462 |
| Pdet(Qmax) (cmH 2O)      | 21.0±11       | 19.9±11        | 0.179 |
| Weak bladder contractility (BCI < 100) | 52 (47.3) | 68 (61.8) | 0.005* |
| PVR (mL)                 | 42±54         | 29±41          | 0.006* |
| BOO                      | 46 (41.8)     | 42 (38.2)      | 0.585 |

Data presented as mean ± standard deviation or number (%); * statistical significance a: FDV: first desire to void; b: SDV: strong desire to void; c: DO: detrusor overactivity; d: USI: urodynamic stress incontinence; e: Qmax: maximum urine flow rate; f: P detQmax: detrusor pressure at maximum flow; g: BCI: bladder contractility index; h: PVR: postvoid residual urine; i: BOO: bladder outflow obstruction.

In all patients with either persistent or newly developed symptoms of urgency, UIUI, and SUI, conservative management with behavioral therapy and pelvic floor muscle training was offered. Anticholinergic agents were prescribed for 7 patients who reported UIUI with severe impact on their quality of life using a four-point scoring scale. For those with persistent or de novo SUI, none required anti-incontinence surgery. Finally, 13 patients having asymptomatic urinary retention were successfully managed with conservative treatment strategies such as double voiding, pelvic floor muscle relaxation, bending over while sitting on the toilet seat, and taking more time during urination.

At 6 months postoperative visit, 18 patients (14.3%) were diagnosed with POP recurrence. Among these, 12 (9.5%) demonstrated stage II while 6 (4.8%) presented with stage III prolapse. Of 6 patients with recurrent stage III POP, 2 were found to have all-compartment prolapse. However, none of our patients required surgical treatment for POP recurrence (Table 5).

Table 5. Postoperative POP stage, POP location, and POP recurrence.

| POP variables | Value (n = 126) |       |       |
|---------------|----------------|-------|-------|
| POP recurrence |                |       |       |

Data presented as number (%); POP: pelvic organ prolapse.

Discussion

Our study did not find any significant changes in most of the urodynamic filling phase parameters after vaginal surgery for POP, except a significantly increased incidence of USI.

There was no significant difference noted when evaluating urodynamic filling phase parameters, such as FDV, SDV, bladder capacity, bladder sensation, and detrusor function. Our results were incompatible with the findings from Abdullah et al. in which substantial increase in first desire volume, strong desire volume and bladder capacity was well established after laparoscopic sacrocolpopexy. When investigating in terms of bladder sensation parameter with regards to the cut-off volume, no significant changes, either increased or reduced bladder sensation, were observed. These reflected the outcome described by Panicker et al. where no difference in bladder sensation was documented after vaginal surgery for POP. Several factors might be responsible for these conflicting results. These included i) patient factors, e.g., severity of POP, co-morbidities, previous pelvic floor surgery and ii) procedure factors, e.g., route and type of surgery, surgical techniques, related complications. Moreover, age-related bladder dysfunction was probably another important factor associated with the insignificant urodynamic changes after POP repair among our patients. According to previous literatures on clinical urodynamic studies, advancing age has been confirmed to be correlated with reduced bladder capacity, loss of compliance, increased detrusor instability, impaired bladder contractility, decreased urine flow rate, and increased postvoid residual vol-

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ume. This decrement in bladder capacity probably explained why 46% of our patients were urodynamically diagnosed with increased bladder sensation (FDV < 150 mL) preoperatively. Since pelvic reconstructive procedures could restore the prolapsed pelvic organs, particularly the bladder and urethra, to their usual position, it was hypothesized that the bladder could resume its normal physiology after surgery. However, our study failed to demonstrate any appreciable effect of transvaginal POP repair procedures on the bladder storage function. Hence, no significant improvement in FDV, SDV, bladder capacity, and bladder sensation was found after surgery.

Finding from this study demonstrated significantly increased incidence of USI. Nevertheless, when specifically looking at the clinical symptom of SUI, no discrepancy was found when comparing between pre- and post-operative outcomes. Since the number of patients with postoperative SUI derived from a combination of those having persistent symptom and those with de novo SUI, this could contribute to the comparable proportion of pre- and post-operative SUI prevalence leading to a non-significant difference between the two groups. These findings somehow reflected the failure of preoperative urodynamic test in identifying occult SUI. The explanation for this is that although prolapse reduction using a pessary could facilitate the detection of covert SUI by restoring the normal urethral anatomy, a poorly fitted or oversized pessary could possibly compress the bladder neck and urethra leading to a lower detection rate of preoperative USI. The 16.7% incidence of de novo SUI in our study was similar to that reported by Lo et al. (11%) who discovered a 3.5-time greater risk of de novo SUI in women undergoing transvaginal mesh surgery. Therefore, it may be assumed that the anterior vaginal mesh repair which was performed in 52.4% of our patients was a possible predisposing factor for the occurrence of de novo SUI. In addition, the second most commonly performed reconstructive procedure, the obliterator total colpocleisis, which involved extensive dissection around the bladder neck could also contribute to the development of de novo SUI due to interference with the lower urinary tract nerve plexuses.14 Urinary urgency with or without UUI was the most prevalent LUTS manifested by two-thirds (63.5%) of the patients preoperatively. This has proved the relationship between POP and overactive bladder (OAB). It is believed that a prominent cystocele can put traction on the urethra which results in opening of the bladder neck with urine entering the urethra subsequently inducing detrusor contractions.26 Hence, significant improvement in urgency and UUI was readily observed after surgical correction for POP due to the disappearance of bladder neck funneling as described by several research works. Remarkable improvement in voiding symptoms was also demonstrated postoperatively. This corresponded with the outcomes reported by the previously mentioned studies,12,27 suggesting that the resolution of urethrovaginal angle distortion and the re-establishment of its normal anatomy could lead to symptom reduction.

As discussed earlier, the overactive bladder was associated with symptomatic POP due to prolapse-induced bladder neck funneling. Thus, surgical correction for POP could substantially improve urgency and UUI symptoms postoperatively. In addition, the effect of advancing age on bladder storage function, including loss of compliance and increased detrusor instability, undoubtedly contributed to the escalated prevalence of these OAB symptoms. Therefore, we expected to find similar outcomes when urodynamically assessing the detrusor function. To our surprise, only a few patients were proved to have poor bladder compliance and none were diagnosed with detrusor overactivity preoperatively. Perhaps, geriatric bladder dysfunction, especially impaired bladder contractility,25 was a major contributor to these inconsistent results of subjective OAB symptoms and objective detrusor contraction, yielding insignificant differences between pre- and post-operative urodynamic findings.

Comparative analysis regarding urodynamic voiding phase parameters exhibited a statistically significant decrease in postvoid residual volume after prolapse repair. Our result was analogous to the findings from several previous studies.3,16-17 The decline in PVR was mostly related to the beneficial effect of POP repair procedures leading to the disappearance of urethral kinking. On the contrary, no remarkable changes were observed postoperatively when evaluating in terms of Qmax, Pdet,Qmax, and BOO. Deterioration of detrusor muscle function with subsequent impaired bladder contractility which are commonly found in elderly25 could be responsible for the reduced urine flow rate, thus causing non-significant differences between the pre- and post-operative pressure-flow parameters. Moreover, prolapse reduction with vaginal pessary to accommodate urethral straightening could partly contribute to the lower incidence of bladder outflow obstruction during preoperative urodynamic assessment, resulting in inappreciable discrepancies of BOO percentage after surgery.

Weak bladder contractility was urodynamically detected among half of our patients prior to surgery. This confirmed the negative impact of geriatric changes on micturition physiology.25 When specifically looking at Schafer’s BCI formula (BCI = Pdet,Qmax + SQmax), both decreased urine flow rate (Qmax) and impaired bladder contractility (Pdet) simultaneously accounted for the low BCI values during urodynamic study. Poor bladder contractility became even more prevalent after POP repair procedures, as evidenced by a significant increase in the number of patients having a low BCI value. Extensive dissection around the bladder neck and the vesicovaginal interface during vaginal surgery for prolapse might have caused some damage to the lower urinary tract nerve plexuses leading to defective bladder contractility postoperatively.28

**Strength and limitation**

Results from our study have provided analytic urodynamic assessment in patients having undergone a variety of vaginal procedures, in addition to vaginal hysterectomy. This brings about the generalizability of the data that can be applicable for a broader female population. The information obtained from this study is also useful for patient counseling regarding the choice of operation and the expected urinary outcomes after vaginal surgery for POP repair. However, this study does have some limitations. Although the surgical technique employed for vaginal hysterectomy was relatively homogeneous among the three surgeons, various concomitant vaginal procedures undertaken could yield diverse outcomes on the bladder function. Furthermore, the follow-up period for postoperative urodynamic evaluation was relatively short, as each individual received an assessment 6 months after the operation. A longer follow-up duration is needed to determine the long-term effects of vaginal reconstructive procedures on urinary symptoms and urodynamic findings. At the end of the day, a future research with a larger sample size is required to thoroughly evaluate the effect of an individual vaginal reconstructive procedure on LUTS and urodynamic parameters.

**Conclusions**

Transvaginal prolapse repair procedures do not have significant impact on the urodynamically assessed bladder storage function, except an increased incidence of postoperative urodynamic stress incontinence. No significant improvement in urodynamic-
cally related voiding function can be expected, except a reduction in postvoid residual urine. Finally, significant improvement in overactive and voiding symptoms can be anticipated after surgical correction for prolapse.

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