Original Article

Postoperative detrusor contractility temporarily decreases in patients undergoing pelvic organ prolapse surgery

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Objectives: To assess the postoperative lower urinary tract function in patients undergoing pelvic organ prolapse surgery.

Methods: A total of 24 women with advanced anterior vaginal wall prolapse underwent transvaginal repair using a polypropylene mesh. The preoperative, 1-week and 3-month postoperative evaluations were carried out by urodynamics. Maximal flow rate detrusor pressure at maximal flow rate, voided volume and bladder contractility index were measured. A value of $P < 0.05$ was considered to be statistically significant.

Results: The mean age of patients was 73.5 years (range 49–84 years). The mean postoperative maximal flow rate, voiding efficiency and bladder contractility index decreased significantly after the operation compared with the preoperative values ($P < 0.05$). No significant differences were observed between preoperative and 3-month postoperative parameters. Of the patients, 33.3%, 11.1% and 50% were classified as having normal/strong contractility preoperatively, 1 week and 3 months, respectively. The proportion of normal/strong contractility decreased significantly after the operation, and it recovered 3 months postoperatively. The grade of obstruction did not change significantly.

Conclusions: Patients undergoing pelvic organ prolapse surgery present temporary impaired detrusor contractility, which improves significantly during the midterm postoperative period.

Key words: clean intermittent catheterization, pelvic organ prolapse, pressure flow study, tension-free vaginal mesh.

Introduction

Over 10% of women have a risk to undergo POP or SUI surgery in their lifetime.\(^1\) The use of polypropylene mesh for transvaginal repair of POP has become one option for improving outcomes of surgery.\(^2\) One of the common complications related to POP surgery is urinary retention.\(^3\) In most cases, this is usually recovered within 1 month.\(^4,5\) However, this complication is mainly associated with patient distress after POP surgery.\(^6\) Despite an increased effort in urogynecological research to identify the risk associated with POP surgery, there have been few studies investigating the effect on lower urinary tract function using urodynamic studies. By now, the exact mechanisms of these complications remain largely unknown.\(^7,8\) The aim of the present study was to evaluate preoperative and postoperative voiding function by PFS, and to assess the cause of postoperative voiding dysfunction.

Methods

We carried out a retrospective analysis to evaluate patient characteristics and surgical procedures with polypropylene mesh. All patients underwent a thorough history and physical examination that included staging of prolapse and multi-channel urodynamic evaluations.\(^9\) All surgeries were carried out by two urologists (TK and TM) at Hokkaido University Hospital, Japan.

A total of 24 women with advanced vaginal wall prolapse underwent transvaginal repair using a polypropylene mesh (TVM). The surgical procedure was based on that reported by the TVM group.\(^10\) The mesh is cut into a similar shape as that used in the Prolift system (Johnson & Johnson, New Brunswick, NJ, USA). All patients were operated on under general anesthesia, and prophylactic antibiotics were given intravenously. No patient received postoperative epidural analgesia. Postoperative care was standardized for all patients. Immediately after surgery, patients received a transurethral catheter (14-Fr) and vaginal compress gauze. The vaginal gauze was removed on the morning of the first day after surgery, and an indwelling catheter were removed on the third day. Patients with a post-voiding residual volume exceeding 100 mL were
diagnosed as having urinary dysfunction. In these patients, intermittent catheterization was applied by a nurse or the patient herself, which was discontinued when the residual volume was below 100 mL. In the present study, we excluded patients who received SUI surgery.

**Urodynamic examination**

Urodynamic investigation included uroflowmetry with residual urine volume measurement and PFS. Urodyamics was carried out according to the Good Urodynamic Practice Guidelines. All patients were subjected to preoperative, 1-week and 3-month postoperative urodynamics. Preoperative PFS were carried out with prolapse reduction using a ring pessary.

**Urodynamic parameters**

Before the PFS, a uroflowmetry with residual urine volume measurement were carried out to evaluate non-catheterized voiding function. After uroflowmetry, patients were placed in a lithotomy position and catheterized in order to remove residual urine. After this, 6-Fr double lumen catheter (CDLC-6; Life-Tech, Austin, TX, USA) was placed into the bladder, and a balloon sensor catheter (RPC-9; Life-Tech) was placed in the rectum to obtain bladder and abdominal pressure. DO, Qmax, Pdet at Qmax, voided volume and BCI were measured. The BCI is represented by the following formula: BCI = Pdet at Qmax × 5 Qmax. During the filling phase of PFS, DO was defined as any involuntary rise in detrusor pressure of greater than 5 cm of water.

**Statistical analysis**

The urodynamic data were compared by t-test, one-way ANOVA and χ²-test, with P < 0.05 taken to show statistical significance.

**Results**

**Characteristics of all patients**

The characteristics of all patients are shown in Table 1. The mean age was 73.5 years (range 49–84 years). Findings on a physical examination and TVM procedure were also described. POP grade were based on the Baden and Abdoox quantification system. Again, we excluded concomitant anti-SUI surgery from the present study.

**Uroflowmetry**

Uroflowmetry with residual urine volume measurement are described in Table 2. The mean preoperative and 1-week and 3-month postoperative residual urine volume were 87.2 ± 112.5, 98.5 ± 98.2 and 20.9 ± 37.1 mL, respectively (P < 0.05; preoperative vs 3 months and 1 week vs 3 months). The residual urine volume increased significantly 1 week after the operation. However, after 3 months the residual urine volume decreased significantly. The other parameters were not significantly changed.

**PFS**

The mean preoperative and 1-week postoperative PFS parameters are shown in Table 3. A total of 11 patients were unable to void at 1-week postoperative PFS. The urodynamic data were compared by t-test. The mean postoperative Qmax, voiding efficiency and BCI were decreased significantly after the operation compared with the preoperative values (P < 0.05). The other parameters were not significantly changed.

Patients with a postmicturition bladder volume exceeding 100 mL were diagnosed as having urinary dysfunction. A total of seven (29.2%) patients required intermittent catheterization. Three patients left the hospital after they were taught intermittent self-catheterization. Three weeks after surgery, none of the patients had a residual volume exceeding 100 mL. Table 4 represented the data of patients who could carry out PFS three times. The urodynamic data were compared by one-way repeated measures ANOVA. The mean preoperative and 1-week and 3-month postoperative Qmax were 15.5 ± 9.4, 8.6 ± 4.5 and 14.1 ± 9.8 mL/s, respectively. The BCI were 93.9 ± 51.6, 60.5 ± 28.9 and 90.1 ± 49.2, respectively. Both parameters were once decreased significantly 1 week after the operation (P < 0.05). However, there were no parameters significantly changed preoperatively and 3 months postoperatively. The number of DO was not analyzed statistically because of the small number of cases (Tables 3,4).

**Detrusor contractility according to Schafer’s nomogram**

According to the reclassification pattern of Kuribayashi et al., defining “Normal” or “Strong” as normal contractility, and “Weak” or “Very Weak” as impaired contractility, respectively, 40%, 11.8% and 50% of patients were classified as having normal contractility, respectively. The proportion of normal contractility was decreased significantly after the operation (P < 0.05, χ²-test). However, after 3 months the proportion was increased significantly (P < 0.05, χ²-test; Fig. 1).

**Obstruction grade**

Obstruction grade was also evaluated with the Schafer’s nomogram. Obstruction grade was not significantly changed (Fig. 2).
Table 2  Uroflowmetry data (n = 24)

<table>
<thead>
<tr>
<th></th>
<th>Preoperative</th>
<th>1 week after</th>
<th>3 months after</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voided volume (mL)</td>
<td>261.8 ± 189.0</td>
<td>208.7 ± 118.6</td>
<td>240.9 ± 142.9</td>
<td>NS</td>
</tr>
<tr>
<td>Qmax (mL/s)</td>
<td>20.7 ± 12.7</td>
<td>14.5 ± 6.7</td>
<td>18.3 ± 8.9</td>
<td>0.050</td>
</tr>
<tr>
<td>Residual urine volume (mL)</td>
<td>87.2 ± 112.5</td>
<td>98.5 ± 98.2 *</td>
<td>20.9 ± 37.1</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Values are mean ± SD of data (n = 24). *P < 0.05. Comparison of the voided volume, Qmax and residual urine volume as obtained by preoperative, 1-week and 3-month postoperative uroflowmetry.

Table 3  Pressure flow data

<table>
<thead>
<tr>
<th></th>
<th>Preoperative</th>
<th>1 week after</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. patients</td>
<td>24</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Bladder capacity (mL)</td>
<td>393.8 ± 192.4</td>
<td>389.2 ± 126.4</td>
<td>NS</td>
</tr>
<tr>
<td>No. DO</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Qmax (mL/s)</td>
<td>16.7 ± 8.7</td>
<td>8.9 ± 5.7</td>
<td>0.020</td>
</tr>
<tr>
<td>Pdet at Qmax (cmH2O)</td>
<td>16.9 ± 10.5</td>
<td>16.8 ± 10.3</td>
<td>NS</td>
</tr>
<tr>
<td>Voided volume (mL)</td>
<td>317.0 ± 178.7</td>
<td>216.7 ± 163.8</td>
<td>NS</td>
</tr>
<tr>
<td>Residual urine volume (mL)</td>
<td>91.7 ± 139.1</td>
<td>185.5 ± 139.5</td>
<td>0.050</td>
</tr>
<tr>
<td>Voiding efficiency (%)</td>
<td>82.9 ± 28.9</td>
<td>56.9 ± 37.1</td>
<td>0.020</td>
</tr>
<tr>
<td>BCI</td>
<td>100.3 ± 45.4</td>
<td>63.0 ± 33.0</td>
<td>0.031</td>
</tr>
</tbody>
</table>

Values are mean ± SD of data. The data were compared by one-way ANOVA. *P < 0.05. Urodynamic study parameters of all patients.

Discussion

To the best of our knowledge, the present study is the first study to identify the factors of postoperative voiding dysfunction after the TVM procedure. POP is a major age-related health issue. It has been reported that 11% of women have POP or SUI surgery in their lifetime.1 In the 21st century, recurrence of POP after vaginal prolapse surgery is a very common and critical issue.14 The new surgical technique, the TVM procedure, was one option for improving outcomes of POP surgery based on objective and subjective outcomes.7,15 In the present study, the key finding was that postoperative POP patients have impaired detrusor contractility temporarily, which usually improves after 3 months.

In our hospital, the routine postoperative catheterization period is 3 days. The reason for this period is the concept that overdistention of the bladder might have a negative impact on lower urinary tract function. We showed a high rate of voiding dysfunction in which 29.2% of women who underwent surgery require intermittent catheterization. This rate is relatively higher compared with previous reports. Altman et al. evaluated short-term outcomes after vaginal mesh surgery, and reported that the postoperative urinary retention rate was just 2%.16 Also, Kato et al. investigated TVM procedures, and found that only 0.6% of patients experienced urinary retention.17 Contrary to those reports, Hakvoort et al. reported a much higher rate of urinary retention of 29% of patients who underwent vaginal prolapse surgery.18 The discrepancy of those reports could be explained by varying criteria to define the urinary retention. We apply strict catheterization criteria in order to reduce the risk of urinary retention after hospital discharge. Perhaps lowering the urinary retention criteria to <50% of total volume or a residual urine of 200 mL could significantly reduce our rate of voiding dysfunction. The optimal duration to prevent overdistention of the bladder remains unclear.

Why is detrusor contractility temporarily impaired by POP surgery? Hakvoort et al. reported that high-grade cystocele, higher intraoperative blood loss, Kelly plication and levator plication appeared to be independent predictors for the occurrence of urinary retention after POP surgery.19 However, their limitation was that they did not carry out preoperative voiding functions. Araki et al. reported that post-void residual urine volume was significantly increased immediately after surgery in patients who had impaired detrusor contractility preoperatively.19 Recently, Kuribayashi et al. reported the changes of voiding function preoperatively and postoperatively.13 However, they carried out PFS 1 month after the TVM procedure, and there are only a few detailed data about the postoperative acute phase. In the current study, we carried out PFS three times to clarify the exact changes of not only the acute phase, but also the midterm postoperative phase. In mass data, the proportion of normal contractility was decreased significantly after the operation, and recovered 3 months postoperatively in the present study. Not all patients with preoperative weak detrusor required intermittent catheterization 1-week postoperatively (breakdown: three normal detrusor contractility patients and four impaired detrusor contractility patients need intermittent catheterization). Such patients recovered after 3 months postoperatively. We could not determine whether preoperative voiding parameters predict postoperative detrusor contractility. This must be an issue in the future. Although the mechanism by which detrusor weakness occurs has remained unclear, we hypothesize that this could be due to some factors, such as temporary lack of blood flow caused by surgical procedure around the bladder, pain and anxiety about the pelvic floor relaxation or iatrogenic injury to the innervations of the bladder. However, several other mechanisms might be considered.

According to previous studies, anti-SUI surgery, such as transobturator or retropubic tension-free vaginal tape surgery, are an effective treatment of the simultaneous correction of POP and SUI.20 However, the previous studies showed that combining anti-SUI surgery in POP patients increases the risk of postoperative voiding dysfunction, mainly obstruction.21-23 In the present study, we excluded the patients with combined anti-SUI surgery to clarify the effect of pure TVM surgery to lower urinary tract function.

Voiding function is determined by both detrusor contractility and BOO in women, as in men. As shown in the present study, postoperative BOO grade by the Schafer’s nomogram stayed at the almost same grade (11/12 patients stayed in grade zero;
Table 4: Pressure flow data

<table>
<thead>
<tr>
<th></th>
<th>Preoperative</th>
<th>1 week after</th>
<th>3 months after</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bladder capacity (mL)</td>
<td>390.3 ± 207.9</td>
<td>372.5 ± 127.0</td>
<td>372.7 ± 112.4</td>
<td>NS</td>
</tr>
<tr>
<td>No. DO</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Qmax [mL/s]</td>
<td>15.5 ± 9.4</td>
<td>8.6 ± 4.5</td>
<td>14.1 ± 9.8</td>
<td>0.020</td>
</tr>
<tr>
<td>Pdet at Qmax [cmH₂O]</td>
<td>16.4 ± 11.8</td>
<td>17.3 ± 11.4</td>
<td>19.6 ± 14.2</td>
<td>NS</td>
</tr>
<tr>
<td>Voided volume [mL]</td>
<td>276.2 ± 183.8</td>
<td>195.5 ± 138.5</td>
<td>255.6 ± 169.4</td>
<td>NS</td>
</tr>
<tr>
<td>Residual urine volume (mL)</td>
<td>133.5 ± 163.3</td>
<td>167.3 ± 151.3</td>
<td>111.2 ± 102.6</td>
<td>NS</td>
</tr>
<tr>
<td>Voiding efficiency (%)</td>
<td>73.2 ± 32.3</td>
<td>53.6 ± 36.2</td>
<td>63.9 ± 33.4</td>
<td>NS</td>
</tr>
<tr>
<td>BCI</td>
<td>93.9 ± 51.6</td>
<td>60.5 ± 28.9</td>
<td>90.1 ± 49.2</td>
<td>0.019</td>
</tr>
</tbody>
</table>

Values are mean ± SD of data, (n = 13). The data were compared by one-way repeated measures ANOVA. *P < 0.05. Urodynamic study parameters of patients who could carry out PFS three times.

![Fig. 1](image1.png)

**Fig. 1** Distribution of detrusor contractility in patients defining “Normal” or “Strong” and “Weak” or “Very Weak” as normal and impaired contractility, respectively. The proportion of normal contractility was decreased significantly after the operation (P < 0.05, χ² test). However, after 3 months the proportion was increased significantly (P < 0.05, χ² test). [Normal contractility] [Impaired contractility].

![Fig. 2](image2.png)

**Fig. 2** Change of obstruction grade (n = 3). Obstruction grade according to the Schafer’s nomogram preoperatively, 1 week and 3 months postoperatively.

Fig. 2. Therefore, postoperative acute voiding difficulty was as a result of impaired detrusor contractility. In the PFS, 11 patients were unable to void at 1 week postoperatively. We analyzed Qmax and residual urine volume in uroflowmetry data of 11 patients (this is a part of Table 2). The mean preoperative, 1-week and 3-month postoperative Qmax were 21.4 ± 14.7, 15.1 ± 6.7 and 18.2 ± 7.9 mL, respectively. The mean preoperative, 1-week and 3-month postoperative residual urine volume were 90.0 ± 105.9, 92.3 ± 99.7 and 22.6 ± 22.8 mL, respectively. These parameters were not significantly changed. It is impossible to determine the reason for not voiding during PFS, whether they have detrusor weakness or other psychological factors, such as pain and postoperative anxiety, that contribute to this complication.¹⁸ The size of the study group could be small, there is a need for a prospective randomized controlled trial focused on voiding difficulties to determine this issue. The number of patients who could carry out PFS three times was 13 in the present study (Table 4). Among 13 patients, detrusor contractility decreased in 12 patients and one patient had increased detrusor contractility 1 week after the TVM procedure. Therefore, we conclude that patients undergoing POP surgery have impaired detrusor contractility temporarily. The present results reflect the clinical practice in POP patients.

For now, there is no validated PFS nomogram for women.²⁴ Blaivas and Groutz divided the severity of obstruction into four zones.³⁻²⁶ Kim et al. presented Qmax of 12 mL/s or lower and detrusor pressure at Qmax of 20 cmH₂O or higher as diagnostic criteria for female BOO.³⁰ The definitions for female voiding dysfunctions are dependent on each researcher, so it is necessary to establish the nomogram for women. Patients with POP have a higher prevalence of detrusor underactivity.⁷,¹³ Furthermore, any relation of POP stage to detrusor underactivity was not shown; however, preoperative detrusor underactivity is related to postoperative voiding dysfunction.¹³

In the present study, a PFS were carried out after placement of a temporary vaginal pessary. The possible change in urodynamic voiding parameters after vaginal pessary placement is still controversial. Recent studies reported that parameters of detrusor pressure were not changed after vaginal pessary placement.²⁷,²⁸ Kuribayashi et al. showed that women with untreated POP have impaired detrusor and BOO, which improve significantly after the TVM procedure. Their focus of study was not the chronological change of detrusor contractility, but the change of urethral obstruction. Araki et al. were carrying out PFS with prolapse reduction, and they reported that poor detrusor contractility was the best predictor of voiding dysfunction after the TVM procedure.¹⁹ Similar to their main goal of PFS, our goal is detecting the changes of detrusor contractility. In the present study, we used a vaginal pessary during PFS. In the uroflowmetry (without catheter urodynamics) data, there is no significant difference in Qmax preoperatively and postoperatively, this could depend on the
condition of POP during examination. PFS with a vaginal pessary could become a more noticeable difference of voiding function. In the present study, the distribution of TVM procedure type was almost homogeneously distributed. Unfortunately, our numbers were too small to reliably analyze these subgroups. We found that patients who underwent only a posterior repair with mesh did not have detrusor weakness after operation (data not shown). In previous studies, there is no evidence that preoperative voiding parameters predict postoperative urinary retention. This must be an issue in the future. Furthermore, future research should focus on predicting the duration of postoperative catheterization based on urodynamics parameters.

In conclusion, patients undergoing POP surgery have impaired detrusor contractility temporarily, which improves significantly after the midterm postoperative period.

Acknowledgment

Mayuko Tsukiyama assisted during all pressure flow studies.

Conflict of interest

None declared.

References