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Outcome of Modified Laparoscopic Sacrocolpopexy and Its Effect on Voiding Dysfunction

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Background: Because of its low recurrence rate and safety, laparoscopic sacrocolpopexy (LSC) is an increasingly popular treatment for pelvic organ prolapse (POP). Although LSC may improve voiding function, it can also lead to *de novo* stress urinary incontinence. The exact effects of LSC on voiding function, and the mechanisms responsible, remain unclear. Therefore, in this study we prospectively evaluated the impact of LSC on voiding function by performing a pre- and postoperative urodynamic study of patients with stage 3 or worse POP.

Methods: Urinary status was evaluated before and 3 months after LSC. Pre- and postoperative evaluations included medical history, clinical examination, urodynamic studies, chain cystography, and residual urine volume measurement. Urinary symptoms were assessed using the International Prostate Symptom Score (IPSS) and the Overactive Bladder Symptom Score (OABSS).

Results: The nonrecurrence rate at 3 months was 82.3%. All recurrences involved bladder prolapse. In addition to the absence of a significant change in OABSS, the improvement in IPSS suggests that subjective voiding symptoms improved. Although the maximum urinary flow rate did not significantly change, bladder volume at first sensation increased, urinary storage function improved, and residual urine volume decreased. There were no perioperative complications, and no patient reported postoperative difficulty in urination or urinary retention. The retrovesical angle significantly decreased.

Conclusions: The modified LSC in women with POP provides good functional outcomes in terms of IPSS, post-void residual volume (PVR), and urinary storage function.

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Key words: pelvic organ prolapse, laparoscopic sacrocolpopexy, voiding function, urodynamic study, retrovesical angle

Introduction

Pelvic organ prolapse (POP) and urinary incontinence, although not fatal, reduce quality of life (QOL), and surgery is the standard procedure for radical treatment. These conditions are associated with high morbidity, with a lifetime risk of 10-20% in patients undergoing at least one surgery[1,2]. Surgery for POP has a high rate of recurrence. The rate of reoperation is around 30%, and the interval between repeat procedures tends to decrease with each successive repair[1]. Laparoscopic sacrocolpopexy (LSC) is a modified laparoscopic version of conventional sacrocolpopexy and has gained popularity because of its low POP recurrence rate and safety. Although several studies have reported improvement in voiding function after LSC, there have also been reports of *de novo* stress urinary incontinence (SUI)[3–5]. The exact effects of LSC on voiding function, and the underlying mechanisms responsible, remain to be clarified.

Therefore, to evaluate the impact of LSC on voiding function and urethral hypermorbility, as determined by

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retrovesical angle (RVA), we prospectively investigated pre- and postoperative urodynamics and chain cystography findings in patients with stage 3 or worse POP.

Methods

Study Design and Ethical Considerations

This single-center hospital-based comparative study evaluated consecutive patients who underwent LSC between April 2015 and March 2017. Ethical approval was obtained from the ethical committee of Nippon Medical School (No. 26-03-430). All participants provided written informed consent. In addition, all patients consented to the operation and the pre- and postoperative urodynamic studies.

Inclusion and Exclusion Criteria

Eligible patients were women younger than 80 years who opted for surgery for stage 3 or worse symptomatic bladder prolapse. Excluded patients were women for whom general anesthesia was difficult to administer because of complications such as severe diabetes mellitus and those with a diagnosis of neurogenic bladder at urodynamics study (UDS).

Pre- and Postoperative Evaluation

POP staging was recorded in accordance with the POP-Q quantification system. The patients were examined in the Department of Urology at Nippon Medical School Hospital before surgery. Urinary status was evaluated before and 3 months after surgery. Pre- and postoperative evaluations included medical history, clinical examination, UDS, chain cystography, and residual urine volume. Diagnosis of urinary conditions was made by examining clinical history in accordance with the terminology guides of the International Urogynecological Association and International Continence Society[6]. Urinary symptoms were assessed by using the International Prostate Symptom Score (IPSS) and Overactive Bladder Symptom Score (OABSS). SUI and other symptoms were identified through interviews. RVA was measured by chain cystography. In SUI, the bladder neck is enlarged and RVA is enlarged in the lateral view. The normal value is 90-110°; however, in this study, ≤110° was considered normal. If postoperative SUI was present, information regarding pelvic floor muscle therapy, drug therapy, and surgical treatment was obtained. By using the OABSS questionnaire, overactive bladder (OAB) was diagnosed if the patient had a sudden desire to urinate that was difficult to defer and reported a daytime frequency greater than seven times or nocturia at least once.

Multichannel Urodynamic Evaluation

The UDS was performed using Ellipse (EDAP TMS, Tokyo, Japan), including pressure flow cystometry and uroflowmetry, by an independent urologist (A.G.). During cystometry, the bladder was filled with room temperature saline solution at a rate of 50 mL/min with the patient in a supine position. Organ prolapse reduction was performed with gauze packing.

Surgical Procedure

LSC was performed by a single surgeon. The procedure was based on standard LSC, and sometimes included an additional technique in which the lateral compartment was supported by another mesh (hybrid-LSC). In our technique, mesh augmentation was used only for the anterior vaginal wall, and posterior repair was accomplished by using native tissue repair only. We refer to this technique as the modified LSC since our technique is a hybrid of two techniques. The hybrid-LSC procedure was performed according to Ichikawa et al.[7]. After dissecting between the anterior vaginal wall and bladder, the lower end of the mesh for the anterior vaginal wall was fixed to the upper edge of the vagina, and the upper edge was fixed to the cape angle. For the posterior wall, the upper part of the posterior vaginal wall was supported by continuous sutures on both sides of the rectovaginal fascia of the posterior vaginal wall, and no mesh was used. For hybrid-LSC, an inverted T-shaped mesh with a pair of arms was used for the anterior wall, and a portion of the mesh was fixed to the supravaginal and promontory angles, after which a pair of arms was implanted through the foramen magnum to support the paravaginal defect. The position of the puncture for the arm in hybrid-LSC was in the midline between the first and second punctures in the transvaginal mesh surgery protocol, as described by Debodinance et al.[8]. No concomitant anti-incontinence surgery was performed.

Statistical Analyses

All calculations were performed using JMP 13 (SAS Institute Inc., Cary, NC, USA). Categorical data are presented as absolute numbers and the corresponding percentage values. The Wilcoxon signed-rank test was used to compare pre- and postoperative variables. Statistical significance was set at $p \leq 0.05$.

Results

Of the 24 patients enrolled, 15 were available for evaluation. Five patients did not visit the urologist postoperatively, one was diagnosed with underactive bladder and was excluded, one could not undergo UDS at the appro-

Table 1 Baseline characteristics of the patients

Variable	value
Age (years), median (range)	64 (39-78)
Body mass index (kg/m^2), median (range)	24.3 (21.8-37.1)
Stage of POP (n,%)	
3	14 (93.3)
4	1 (6.6)
Type of operation (n,%)	
Hybrid LSC	1 (11.7)
LSC	14 (88.2)
Operating time (min), median (range)	274 (176-361)

Table 2 Symptoms score and retrovesical angle before and after surgery

Parameter	Preoperative median (range)	Postoperative median (range)	p value
OABSS	3 (1-7)	2 (1-8)	0.414
IPSS	8 (2-21)	2 (0-20)	0.0002
IPSS	3 (0-10)	1 (0-13)	0.1099
Voiding score			
Irritative score	5 (2-16)	2 (0-8)	<0.0001
IPSS QOL	4 (2-6)	2 (1-5)	0.0129
Retrovesical angle	254.9 (138-314)	104.2 (91.3-126.3)	<0.001

Table 3 Pre- and postoperative urodynamic parameters

Parameter	Preoperative median (range)	Postoperative median (range)	p value
Volume at first sensation (mL)	169 (45-500)	216 (61-429)	0.049
Volume at strong sensation (mL)	230 (110-600)	368 (166-483)	0.057
Voided volume (mL)	242.7 (46-404)	319.6 (140-737)	0.05
Post void residual volume (mL)	65 (3-325)	7.5 (2-106)	0.012
Qmax (mL/s)	19.05 (4.5-31.4)	22.6 (8-38.6)	0.528
PdetQmax (cm H_2O)	27.1 (5-60)	21.85 (4.1-59.4)	0.231

priate time because of mechanical failure, and two had incomplete data. The patients' background characteristics are shown in **Table 1**.

Postoperative Outcome

The nonrecurrence rate (defined as stage 1 or better) at 3 months after surgery was 82.3%. All recurrences involved bladder prolapse. There were no perioperative complications, and no patient complained of postoperative difficulty in urination or urinary retention.

Pre- and Postoperative Evaluation

There were no perioperative complications. The IPSS and IPSS-QOL score decreased significantly postoperatively, especially the IPSS irritative subscore. Pre- and postoperative OABSS did not significantly differ. Five patients had SUI preoperatively: three had some improvement in symptoms, and two continued to complain of SUI postoperatively, which was similar to their preoperative rate. Three patients complained of *de novo* SUI, two of whom opted for transobturator tape.

Three patients complained of preoperative urge urinary incontinence (UUI), but none of these patients complained of UUI postoperatively. One patient had *de novo* UUI but requested no therapy. Data on pre- and postoperative urination are shown in **Table 2**. RVA significantly decreased and normalized postoperatively.

UDS

The parameters for the UDS are shown in **Table 3**. Postoperatively, voided volume and volume at first sensation increased significantly. Post-void residual volume (PVR) was significantly reduced, and there were no significant differences between pre- and postoperative volume at strong sensation, maximum urinary flow rate,

and detrusor pressure at maximum flow.

Discussion

At 3 months postoperatively, the nonrecurrence rate was 82.3%, and IPSS and IPSS irritative subscore improved, although there was no significant change in OABSS. RVA significantly decreased and urethral hypermobility, a cause of SUI, normalized. Although Qmax did not change significantly, bladder volume at first sensation increased, urinary storage function improved, and residual urine volume decreased.

Because of its low rate of POP recurrence, LSC is becoming the gold standard treatment. Ganatra et al.[9], Bacle et al.[10], and Moriyama et al.[11] reported low recurrence rates of 8.0%, 11.5%, and 8.0%, respectively. We cannot compare present and past results because of the difference in follow-up duration; however, the recurrence rate remained low at 3 months after surgery in our study.

The purpose of this study was to evaluate prospective voiding function before and after LSC. IPSS was significantly lower postoperatively, but there was no significant difference in OABSS. Nonetheless, preoperative UUI disappeared at follow-up after surgery in all three patients, and *de novo* UUI was observed in one patient who did not require treatment, suggesting that LSC may also improve urinary storage function. There was no difference between pre- and postoperative OABSS, perhaps because the mean score was originally as low as 3 points and therefore did not show a change.

Postoperative voiding functions, such as maximum flow rate and Pdet (Qmax), were comparable to preoperative values. There was no decrease in voiding function after surgery, because of the improvement in residual urine volume. Hence, urodynamic parameters were unchanged or improved, as was the case in a report by Abdullah et al., which noted significant improvements after LSC in urodynamic storage phase parameters (higher volume at first desire, higher volume at strong desire, and larger bladder capacity) and voiding phase parameters (higher Qmax, higher Qave, lower Pdet [Qmax]), as well as increased voided volume and reduced postvoid residual urine volume[12].

Abdullah et al.[12] also reported that preoperative SUI was 24%, 82.4% of which disappeared postoperatively, and that *de novo* SUI was 26.6%. In our study, the rates of preoperative SUI, postoperative improvement, postoperative exacerbation, and *de novo* SUI were 33.3%, 60.0%, 0%, and 20.0%, respectively. By comparison, Narushima et al.[13] reported rates of 67.3%, 61.7%, 14.5%, and 37.8%, respectively, after LSC without surgery for urinary incontinence. In our study, the rate of postoperative improvement was similar, but the *de novo* rate was lower than that reported elsewhere. Because the sample was limited to 15 patients, these patients may have had a low predisposition to SUI. In addition, the timing of the evaluation was different in previous studies. Nomura et al.[14] reported that 63% of patients with *de novo* SUI had improved by the 1-year evaluation, suggesting that the timing of postoperative SUI improvement may vary in relation to surgical technique and whether anti-incontinence surgery was performed concurrently.

Despite the fact that compression of the urethra by the prolapsed organ could predispose a patient to SUI, it might not be present preoperatively. POP surgery aims to improve activities of daily living but sometimes causes *de novo* SUI, which appears suddenly after surgery and can greatly impair QOL. Preoperative identification of patients at high risk for *de novo* SUI would be beneficial. Some studies have focused on maximum urethral closing pressure as a risk factor for *de novo* SUI, but Abdullah et al. found no significant difference in maximum urethral closure pressure before and after surgery[12]. Therefore, the risk factors for *de novo* SUI remain to be identified.

Causes of SUI include urethral hypermobility and intrinsic urethral sphincter deficiency and are diagnosed by urodynamic study or findings of RVA enlargement and open bladder neck on chain cystography and ultrasonography. In our study, all patients underwent chain cystography before and after surgery; those with *de novo* SUI had no preoperative bladder neck open sign, and postoperative RVA normalized in all but one patient. Thus, postoperative SUI in these patients may have resulted from causes other than urethral hypermobility and urethral sphincter insufficiency. Nomura et al. reported that SUI at 6 months postoperatively resolved or improved at 1 year postoperatively. This is because *de novo* SUI caused by release of urethral flexion by surgery may have improved during the follow-up period, as the anatomical position and urethral function improved, resulting in improvement of SUI at 1 year postoperatively[14]. This suggests that improvement in anatomical position and urethral function may be delayed and that some other factor may be responsible for this delay; however, this requires further investigation.

Our study had several limitations, including the small number of cases and inclusion of cases of hybrid-LSC among the LSC cases. Hybrid-LSC was performed in addition to regular LSC to provide better support for

paravaginal defects, and it is unlikely to have a positive effect on voiding function because it is slightly more invasive. To verify our results, similar studies should enroll a large number of patients treated by normal LSC only.

In conclusion, modified LSC provided good functional outcomes in terms of IPSS, PVR, and urinary storage function for women with POP.

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Conflict of Interest: None declared.

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