International Urogynecology Journal (2023) 34:271–278
https://doi.org/10.1007/s00192-022-05403-2

ORIGINAL ARTICLE

Clinical outcomes and complications of laparoscopic sacrocolpopexy with versus without concomitant hysterectomy for pelvic organ prolapse in Hong Kong Chinese patients after median follow-up of 7 years

Joyce Chung Yin Chan[1] · **Chun Hung Yu**[1] · **Wing Wa Go**[1]

Received: 26 July 2022 / Accepted: 14 October 2022 / Published online: 17 November 2022

Abstract

Introduction and hypothesis This retrospective cohort study is aimed at comparing outcomes and complications of laparoscopic sacrocolpopexy (LSC) with or without concomitant hysterectomy in the Hong Kong Chinese population.

Methods Women with stage II or above uterine or apical vault prolapse who underwent LSC with or without concomitant hysterectomy in a regional referral unit from 2007 to 2019 were included. The primary objectives were to compare the anatomical outcomes by pelvic organ prolapse quantification system (POP-Q) and recurrence of apical vault prolapse (≥stage II). The secondary objective was to compare the functional outcomes and complications. Anatomical recurrence and incidence of mesh exposure were analyzed using the Kaplan–Meier method. Cox proportional hazard regression was performed to identify risk factors of anatomical recurrence.

Results Seventy-six women were included for analysis. The recurrence rate of apical vault prolapse was 3.9% after a median follow-up time of 83 months (20–190 months). A significant reduction of POP-Q scores of three compartments in both groups of women were demonstrated ($p<0.001$). There was no difference between the two groups in terms of functional outcomes and complications. 6.6% of women developed mesh exposure. The time to recurrence of apical vault prolapse was shorter in women who had LSC with prior hysterectomy ($p=0.019$). No risk factors were identified for recurrence of apical vault prolapse.

Conclusions Laparoscopic sacrocolpopexy with concomitant hysterectomy is comparable with LSC alone. The recurrence and complication rates are low. We suggest that LSC with concomitant hysterectomy might be offered to women with pelvic organ prolapse, with women's preference taken into account.

Keywords Laparoscopic sacrocolpopexy · Long-term follow-up · Surgical mesh · Concomitant hysterectomy · Treatment outcome

Introduction

Abdominal sacrocolpopexy is the gold standard for apical compartment vault prolapse with reported success rates of 93–99% [1–3]. The incidence of apical compartment vault prolapse was reported to be 11.6% when hysterectomy is indicated for pelvic organ prolapse (POP), and 1.8% when hysterectomy is indicated for other benign diseases [4]. LSC is more favorable nowadays owing to the advantages of less operative blood loss and shorter hospital stay, whereas the outcomes and success rates (92–100%) were comparable with those of abdominal methods [5–8]. A prior publication from our unit reported that LSC is safe, with a 100% success rate after a median follow-up time of 32 months [8]. There is a lack of local data on long-term outcomes and complications of LSC.

Laparoscopic sacrocolpopexy is commonly performed with total hysterectomy for patients with POP in our local setting. The benefits are that future malignancies and regular cervical surveillance can be avoided. Hysterectomy at the time of prolapse repair is associated with a decreased risk of

✉ Joyce Chung Yin Chan
joyceccyj@gmail.com

[1] Department of Obstetrics and Gynaecology, United Christian Hospital, Kwun Tong, Kowloon, Hong Kong

future POP surgery by 1–3% [9]. We are aware that concerns remain about the adverse events following concomitant hysterectomy, especially the risk of mesh exposure. The overall rate of mesh exposure in LSC was reported to be 0.7–2%, which could increase four- to six-fold for patients undergoing concomitant hysterectomy [10–14]. More blood loss, longer operative time, and surgical site infections were also reported [15]. There is a lack of literature comparing women who undergo LSC alone with those who have a concomitant total hysterectomy.

The aim of the study was to compare Chinese women who underwent LSC with concomitant hysterectomy or LSC alone in a regional referral center in Hong Kong. The anatomical and functional outcomes, and the intraoperative, perioperative, and postoperative complications, including mesh exposure, were evaluated.

Materials and methods

This is a retrospective cohort study conducted in a major regional referral center. All patients who underwent LSC for symptomatic uterine prolapse or apical compartment vault prolapse at the Department of Obstetrics and Gynaecology, United Christian Hospital, from January 2007 to December 2019, were included. Patients with a history of prolapse surgery using mesh, planned laparotomy with sacrocolpopexy, and/or an inability to give informed consent were excluded from analysis. This retrospective cohort study was approved by the Hospital Authority Cluster Research Ethics Committee [KC/KE-21-0009/ER-2].

Patients who were offered the option of LSC were those who presented with symptomatic stage II or above uterine or apical compartment vault prolapse, with or without concomitant anterior and posterior compartment prolapse, no fertility wish, and who were medically fit. The operative procedures were decided by urogynecology fellows. Demographic characteristics including age, parity, body mass index (BMI), information on urinary symptoms (stress incontinence, urge incontinence, voiding dysfunction), bowel symptoms, and urodynamic studies were recorded. Preoperative urodynamic studies were performed only when clinically indicated. Operative details including operative time, estimated blood loss, baseline POP quantification (POP-Q) assessment, and intraoperative complications were documented in the operative records.

All surgical procedures were led and performed by urogynecologist fellows, urogynecology trainees under direct supervision of urogynecologists, and a consultant gynecologist who was experienced in advanced laparoscopic surgery. At the beginning, the anterior longitudinal ligament overlying the sacral promontory was exposed and the peritoneum was incised and extended to the posterior vaginal wall along the right pelvic sidewall. The posterior vaginal wall was dissected from the vaginal vault down to the perineal body as much as possible. Laparoscopic bilateral salpingo-oophorectomy was performed if the patient agreed. For patients with uterine prolapse, vaginal hysterectomy was performed in the usual manner. After closing the vaginal wound, we returned to the laparoscopic procedure.

A polypropylene mesh Ultrapro Advance™ (Johnson & Johnson, Belgium) or Vypro II (Johnson & Johnson, Belgium) was placed to the posterior vaginal wall only. The distal part of the mesh was anchored 2 cm proximal to the perineal body and then the mesh was sutured to the posterior vaginal wall with non-absorbable sutures (Premi-Cron® 0, or Ethibond 0) and Vicryl 0 absorbable sutures. The proximal part of the mesh was anchored to the anterior longitudinal ligament at the level of the promontory without tension by two Ethibond 1 stitches. Finally, the mesh was covered with peritoneum and closed with continuous sutures of Vicryl 2-0. If a cystocele or rectocele was present, colporrhaphy with native tissue repair would be performed. For patients with apical compartment vault prolapse, colporrhaphy with native tissue repair is performed if a cystocele or rectocele is present after finishing the laparoscopic procedure.

Patients were followed up at 1, 6, and 12 months after LSC and then annually. Patients who were lost to follow-up were invited back to the urogynecology clinic for routine assessment with written consent obtained. History taking and physical examinations were performed at all preoperative and follow-up visits by urogynecologist fellows and trainees. Standard questions including painful symptoms, urinary symptoms, bowel symptoms, dyspareunia, vaginal bleeding were asked during history taking. Vaginal examination was performed for POP-Q assessment and examination for mesh complications according to the recommendations by International Continence Society and the International Urogynecological Association [16, 17].

Data including patient demographics and outcome were extracted from territory-wide electronic patient records and local records. Data were analyzed by the SPSS Windows version 25.0 (IBM, Armonk, NY, USA). Descriptive analysis was used on demographic data. Paired *t* test was used for comparison between preoperative and postoperative POP-Q scores. Mann-Whitney *U* test was used for comparison between continuous variables, and Chi-squared test was used for categorical data. Kaplan–Meier method was used to analyze time-to-event data including recurrence of apical compartment vault prolapse (stage II or above). Cox proportional hazard regression was used to investigate associations between recurrence and multiple factors. p values < 0.05 were considered significant.

The aim of the study was to compare the outcomes and complications of LSC with concomitant hysterectomy or

LSC alone, with the null hypothesis being that there were differences between the two groups. The primary outcome measures were the preoperative and postoperative difference in POP-Q scores of three compartments (point C, Ba, and Bp), and the recurrence of apical vault prolapse. Improvement is considered achieved when there was a significant reduction in POP-Q scores ($p < 0.05$). Recurrence was defined as point C ≥ -1 (stage II or above). Secondary outcome measures were the functional outcomes as well as mesh-related and other intraoperative, perioperative, and postoperative complications.

Results

A total of 76 women underwent LSC between January 2007 and December 2019 at the Department of Obstetrics and Gynecology, United Christian Hospital. The median follow-up time is 83 months (range: 20–190 months). Four patients (5.3%) were called back for review after loss to follow-up. The demographic data and preoperative characteristics are shown in Table 1. All our patients are Chinese in ethnicity. Twenty-eight women (36.8%) had prior hysterectomy before LSC and therefore presented with apical compartment vault prolapse, whereas 48 women (63.2%) had uterine prolapse. Women who were offered LSC owing to uterine prolapse were significantly younger than those with apical compartment vault prolapse (p <0.001). There was no significant difference between the groups regarding the parity, body mass index, and pre-existing urinary symptoms.

Fifty-five women (72.4%) complained of urinary symptoms before LSC, including stress incontinence, urge incontinence, urgency, frequency, and voiding difficulties (Table 1). Seventeen women (22.4%) underwent urodynamic studies before LSC, of whom 9 (11.8%) had urodynamic stress incontinence, 2 (2.6%) had detrusor overactivity, 4 (5.3%) had voiding dysfunction, and 2 (2.6%) had decreased bladder compliance. Those with urodynamic stress incontinence underwent concomitant tension-free vaginal tape surgery.

Preoperative POP-Q assessment was performed on all women and is shown in Table 2. All women who underwent LSC had apical compartment vault or uterine prolapse of stage II or above, and 50 women (65.8%) were stage III or above. In the group of uterine prolapse, 38 out of 48 women (79.2%) had uterine prolapse stage III or above. Sixty-six women (86.8%) underwent one or more concomitant surgical procedures at the time of LSC and are shown in Table 3.

The perioperative data are shown in Table 4. Women who had LSC due to uterine prolapse had significantly longer operative time, more blood loss, and subsequently longer length of stay in hospital. For intraoperative complications, there were three cases of bladder injury. Two patients had a 1-cm bladder injury during dissection of the bladder away from the vaginal wall owing to adhesions of prior total abdominal hysterectomy. Both patients made a full recovery without any sequelae after 18 and 20 months' follow-up respectively. One case was due to the insertion of tension-free vaginal tape in a patient with concomitant hysterectomy. The trocar was re-inserted without further bladder perforation. The patient was treated conservatively and made a full recovery without any sequelae after 176 months' follow-up. Immediate postoperative complications included 3 patients with postoperative fever. One woman had vault hematoma and another had wound infection at the vaginal vault after concomitant vaginal hysterectomy. Both

Table 1 Demographic data and preoperative characteristics

Characteristics	Total ($N = 76$)	Apical compartment vault prolapse ($n = 28$)	Uterine prolapse ($n = 48$)	p value
Age, mean (range)	58.5 (41–80)	63.5 (45–80)	55.7 (41–68)	<0.001
Parity, mean (range)	2.7 (1–8)	3.1 (1–8)	2.5 (1–5)	0.190
BMI, mean (range), kg/m^2	25.4 (19.7–32.6)	25.4 (19.8–29.8)	25.4 (19.7–32.6)	0.876
Pre-existing urinary symptoms, *n* (%)	55 (72.4)	21 (75)	34 (70.8)	0.695
Stress incontinence, *n* (%)	27 (35.5)	11 (39.3)	16 (33.3)	0.601
Urge incontinence, urgency, frequency, *n* (%)	23 (30.3)	9 (32.1)	14 (29.2)	0.785
Voiding difficulties, *n* (%)	26 (34.2)	7 (25)	19 (39.6)	0.196
Constipation	0	0	0	
Dyspareunia	0	0	0	
Prior hysterectomy, *n* (%)	28 (36.8)	28 (100)	0	
Total abdominal hysterectomy, *n* (%)	15 (19.7)	15 (53.6)	0	
Vaginal hysterectomy, *n* (%)	12 (15.8)	12 (42.9)	0	
Total laparoscopic hysterectomy, *n* (%)	1 (1.3)	1 (3.6)	0	

BMI body mass index

Table 2 Preoperative Pelvic Organ Prolapse Quantification staging

	Total ($N = 76$)	Apical compartment vault prolapse ($n = 28$)	Uterine prolapse ($n = 48$)
Apical compartment prolapse, *n* (%)			
No prolapse	0 (0)	0 (0)	0 (0)
Stage I	0 (0)	0 (0)	0 (0)
Stage II	26 (34.2)	16 (57.1)	10 (20.8)
Stage III	20 (26.3)	8 (28.6)	12 (25)
Stage IV	30 (39.5)	4 (14.3)	26 (54.2)
Anterior compartment prolapse, *n* (%)			
No prolapse	5 (6.6)	4 (14.3)	1 (2.1)
Stage I	5 (6.6)	4 (14.3)	1 (2.1)
Stage II	26 (34.2)	10 (35.7)	16 (21.1)
Stage III	27 (35.5)	9 (32.1)	18 (23.7)
Stage IV	13 (17.1)	1 (1.3)	12 (15.8)
Posterior compartment prolapse, *n* (%)			
No prolapse	12 (15.8)	6 (7.9)	6 (12.5)
Stage I	3 (3.9)	2 (2.6)	1 (2.1)
Stage II	23 (30.3)	11 (39.3)	12 (25)
Stage III	25 (32.9)	9 (32.1)	16 (33.3)
Stage IV	13 (17.1)	0	13 (27.1)

were treated conservatively by antibiotics. There were no differences in complications between the two groups (see Table 6).

After a median follow-up of 83 months, significant improvement in all three compartments in terms of POP-Q after LSC was achieved for all patients ($p<0.001$). Similar findings were shown in women who underwent LSC alone ($p<0.05$) and women who underwent LSC with concomitant hysterectomy ($p<0.001$; Table 5).

Three women had recurrence of apical compartment vault prolapse, which was defined as stage II or above. All had prior hysterectomy and underwent LSC alone. The success rate was 96.1%. One woman had stage IV and two women had stage II apical vault prolapse. The first woman who had stage IV apical vault prolapse was identified at 6 months after LSC. She was put on a ring pessary afterwards. The second woman had stage II apical vault prolapse identified at 12 months after LSC. She had repeated anterior and posterior colporrhaphy at 31 months after LSC. The third woman had stage II apical vault prolapse identified at 29 months after LSC. She could tolerate the symptoms and did not require operations or a ring pessary. A total of 2 out of 76 women required surgery for symptomatic recurrent anterior compartment prolapse, resulting in a reoperation rate of 2.6%.

Twenty women had urinary stress incontinence after LSC. Eight women had pre-existing symptoms before surgery, whereas 12 women developed de novo urinary stress incontinence after surgery. One woman who had had pre-existing symptoms underwent a tension-free vaginal tape procedure 9 years after LSC. Fourteen women had urinary urge incontinence, urgency, or frequency symptoms. Nine of them developed the symptoms after surgery. One woman had voiding difficulties with an occasional sense of incomplete emptying. Three women had occasional constipation after surgery without requiring any medical treatments. One woman complained of dyspareunia 6 months after surgery.

Table 3 Perioperative data on concomitant surgery

	Total ($N = 76$)	Apical compartment vault prolapse ($n = 28$)	Uterine prolapse ($n = 48$)
Concomitant surgeries, *n* (%)	66 (86.8)	18 (64.3)	48 (100)
Vaginal hysterectomy, *n* (%)	36 (47.4)	0	36 (75)
Laparoscopy-assisted vaginal hysterectomy, *n* (%)	12 (15.8)	0	12 (25)
Anterior colporrhaphy, *n* (%)	55 (72.4)	9 (32.1)	46 (95.8)
Posterior colporrhaphy, *n* (%)	7 (9.2)	6 (21.4)	1 (2.1)
Tension-free vaginal tape surgery, *n* (%)	13 (17.1)	3 (10.7)	10 (20.8)
Omentectomy and appendectomy, *n* (%)	1 (1.3)	0	1 (2.1)

Table 4 Perioperative data on laparoscopic sacrocolpopexy of women with apical compartment vault prolapse and uterine prolapse

	Total ($N = 76$)	Apical compartment vault prolapse ($n = 28$)	Uterine prolapse ($n = 48$)	*p* value
Mean operating time, mean (range), min	306.5 (206–413)	274.3 (206–403)	325.3 (240–413)	<0.001
Estimated blood loss, mean (range), ml	228.6 (10–2,500)	52.5 (10–200)	331.3 (42–2,500)	<0.001
Mean hospital stay, mean (range), days	4.7 (2–13)	3.7 (2–6)	5.3 (2–13)	0.005

Table 5 Comparison of the preoperative and postoperative pelvic organ prolapse-quantification (POP-Q) scores (mean ± SD) after a median follow-up of 83 months

	Total ($n = 76$)			Apical compartment vault prolapse ($n = 28$)			Uterine prolapse ($n = 48$)		
POP-Q (cm)	Preoperative	Postoperative	*p* value	Preoperative	Postoperative	*p* value	Preoperative	Postoperative	*p* value
C (mean)	2.59±2.41	−5.39±1.91	<0.001	1.15±1.96	−4.48±2.68	<0.001	3.39±2.28	−5.90±1.05	<0.001
Ba (mean)	1.29±2.19	−1.68±1.48	<0.001	0.19±2.20	−0.85±1.79	0.028	1.90±1.95	−2.14±1.04	<0.001
Bp (mean)	1.03±2.53	−2.78±1.05	<0.001	0.19±2.04	−2.37±1.71	<0.001	1.49±2.67	−3.00±0.00	<0.001

Table 6 Functional outcomes and occurrence of mesh exposure of laparoscopic sacrocolpopexy

	Total ($N = 76$)	Apical compartment vault prolapse ($n = 28$)	Uterine prolapse ($n = 48$)	*p* value
De novo urinary symptoms, *n* (%)				
Stress incontinence	12 (15.8)	3 (10.7)	9 (18.8)	0.354
Urge incontinence, urgency, frequency	9 (11.8)	6 (21.4)	3 (6.3)	0.108
Voiding difficulties	1 (1.3)	1 (3.6)	0	0.188
Bowel symptoms, *n* (%)	2 (2.6)	1 (3.6)	1 (2.1)	0.725
Dyspareunia, *n* (%)	1 (1.3)	1 (3.6)	0	0.188
Bladder injury, *n*	3	2	1	0.630
Vault hematoma/infection, *n*	2	0	2	0.274
Mesh erosion, *n* (%)	5 (6.6)	2 (7.1)	3 (6.3)	0.612

Tenderness was detected at the posterior vaginal wall near the introitus at the anchoring site of the mesh (Table 6).

Regarding long-term complications, 5 women (6.6%) developed vaginal mesh exposure. Three out of 5 women underwent concomitant hysterectomy (Table 6). All patients underwent Vypro II mesh insertion. In women who underwent concomitant hysterectomy with LSC, 3 out of 48 (6.3%) developed mesh exposure. In women who had LSC only, 2 out of 28 (7.1%) suffered mesh exposure. The difference in mesh exposure rates between the two groups was not statistically significant (p=0.612).

Mesh exposures presented from 3 to 37 months after surgery. Two women were managed conservatively with topical estrogen cream and 3 women required excision of exposed vaginal mesh. One woman had 1-cm mesh exposure at the vaginal vault, which was diagnosed 3 months after LSC. Excision of the exposed mesh was subsequently performed.

The second woman had 5-mm mesh exposure at the vaginal vault, which was diagnosed 5 months after LSC. She was given topical estrogen cream initially. She developed vaginal bleeding on and off 20 months after LSC. Physical examination revealed granulation tissue growth at the lower edge of the defect. Excision of the exposed vaginal mesh was performed, and she remained asymptomatic afterward.

The third woman presented with vaginal bleeding 35 months after LSC. One-centimeter mesh exposure at the vaginal vault was diagnosed and excision of the exposed mesh was performed. One woman (1.6%) had 2-mm-long non-absorbable vaginal suture exposure at the vaginal vault 2.5 years after LSC. It was diagnosed on routine examination at follow-up and the suture was removed in the clinic.

Figure 1 shows the Kaplan–Meier survival curves for the occurrence of anatomical recurrence of apical compartment vault prolapse and mesh exposure. The time to recurrence of apical compartment vault prolapse was significantly shorter in the group of women who had LSC with prior hysterectomy (p=0.019 by log-rank test). There was no difference between the two groups in the occurrence of mesh erosion (p=0.883 by log-rank test). Cox proportional hazard regression analysis showed that age, BMI, parity, preoperative POP-Q stage (apical compartment), and concomitant colporrhaphy were not significant risk factors for recurrence of apical compartment vault prolapse; Table 7)

Discussion

The success rates for apical compartment prolapse after LSC were reported to be 92–98.5% with follow-up times ranging from 36 to 66 months [7, 18, 19]. The success rate in our cohort of patients is 96.1% after a median follow-up time of 83 months, which is comparable. The follow-up range was broad in our cohort, ranging from 20 to 190 months. Seventy-four percent of women (56 out of 76) completed

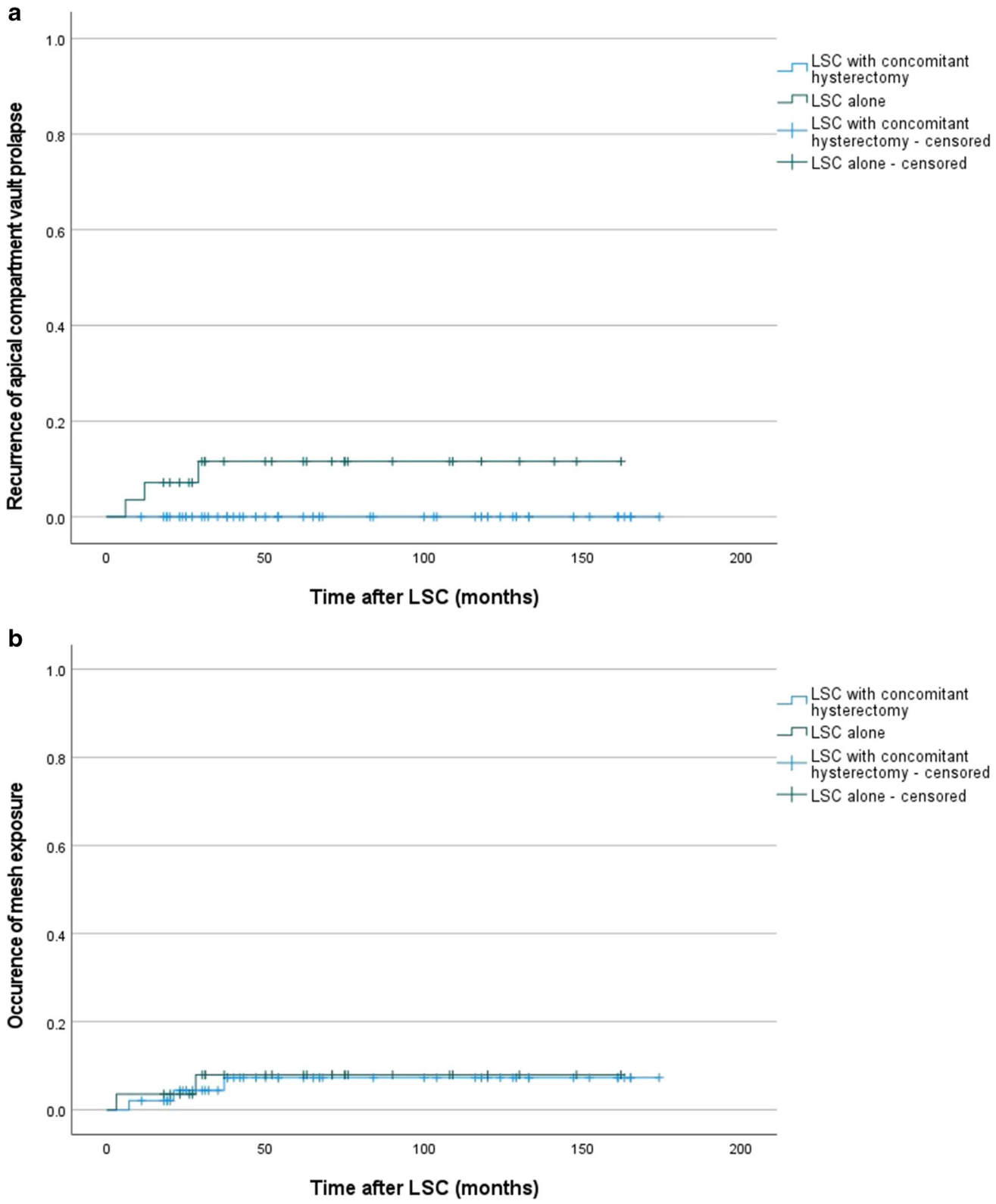

Fig. 1 Kaplan–Meier survival curves for **a** recurrence of apical compartment vault prolapse and **b** occurrence of mesh exposure. *LSC* laparoscopic sacrocolpopexy

Table 7 Cox proportional hazards regression analysis of risk factors in recurrent apical compartment vault prolapse after laparoscopic sacrocolpopexy

Variables	Hazard ratio	95% Confidence interval	*p* value
Age	1.375	0.985–1.920	0.061
BMI	0.979	0.526–1.822	0.947
Parity	1.056	0.317–3.515	0.929
Preoperative POP-Q stage (apical compartment)	1.931	0.765–4.872	0.163
Concomitant colporrhaphy	1.688	0.043–65.757	0.779

POP-Q pelvic organ prolapse-quantification

at least 36 months' follow-up by the end of the study; thus, most women had a long-term follow-up.

The time to recurrence of apical compartment vault prolapse was 6–29 months, which was shorter in the LSC with prior hysterectomy group. Difficult adhesiolysis with suboptimal placement of the mesh and failure of mesh anchoring may have contributed. Pre-existing conditions such as levator avulsion, prolapse stage, and family history were suggested to be risk factors for prolapse recurrence after surgery [20]. The factor of concomitant hysterectomy was not included in the Cox proportional hazard regression analysis as the group has zero events. Thus, univariate analysis log-rank test was performed instead. We failed to identify other risk factors that may contribute to the recurrence, owing to the low incidence and small sample size. We reported a reoperation rate of 2.6% for recurrent anterior compartment prolapse, which is comparable with 2.9% in the prospective cohort study with a mean follow-up of 60 months by Sarlos et al. [18].

Regarding the POP-Q scores, our results are comparable with previous studies. There is significant improvement of all three compartments after a median follow-up time of 83 months. Our mean POP-Q score of point C was −5.4, compared with −6.2 after a mean follow-up of 60 months reported by Sarlos et al. [18]. In the randomized study comparing LSC with vaginal mesh surgery after a median follow-up of 2 years by Maher et al., they reported mean POP-Q scores −2.2 and −2.3 for points Ba and Bp, compared with our results of −1.7 and −2.8 respectively [11]. Our results showed that LSC has excellent anatomical outcome, even in the long term.

We found that the overall mesh exposure rate was 6.6% with Vypro II mesh in our cohort, and 6.3% (3 out of 48) in the group of women with LSC and concomitant hysterectomy. Some studies reported similar rates of mesh exposure when concomitant hysterectomy was performed with LSC (4.9–8.6%) [15, 21, 22]. Possible explanations for the higher rate of mesh exposure for concomitant hysterectomy could be the introduction of vaginal flora into the surgical bed and devascularization of the vaginal cuff. We found no significant difference in the rate and occurrence of mesh exposure between the two groups of women. Previous studies suggested supracervical hysterectomy or sacrocolpocervicopexy when hysterectomy is indicated during LSC, but development of cervical dysplasia and elongation has to be considered [14, 22]. Our study may be underpowered to detect a statistical difference in mesh exposure rates, owing to the small sample size and low rate of mesh exposure in each group.

There is increasing concern regarding whether the uterus should be preserved in POP repair surgery. Uterine-preserving surgeries decrease operative time, blood loss, mesh exposure, have no difference, or even better anatomical and functional outcomes than concomitant hysterectomy [23, 24]. The decision on whether the uterus should be preserved depends on the presence of uterine abnormalities, patient's preference, and surgeon's experience. LSC and concomitant hysterectomy in our cohort involve a longer operative time, more blood loss, a and longer hospital stay, although the higher number of concomitant procedures performed in this group of women may have contributed to this. Uterine-preserving LSC can be an option for women in our locality. Future comparative studies on outcomes between hysterectomy and uterine-preserving surgery for our local patients are needed.

The strength of our study is the long-term follow-up. Our study is among those with a long follow-up interval regarding the Chinese population. The standardized follow-up intervals are another strength of our study, and allow us to detect long-term complications in asymptomatic patients. Patients underwent routine history taking and examination by urogynecologist fellows and trainees; thus, the assessment is more accurate and consistent. The techniques for LSC were uniform and consistent among surgeons, as the surgery was led and mainly performed by the urogynecology team.

We are aware of the limitations of our study. The relatively small sample size is limited by the design of single-center study. The length of follow-up can be longer to detect a more accurate mesh exposure rate. LSC has a long learning curve; thus, bias may have been introduced and affected the outcomes. Moreover, we did not apply validated questionnaires during follow-up to assess the functional outcomes and changes in quality of life.

In conclusion, LSC with concomitant hysterectomy is comparable with LSC alone in terms of anatomical and functional outcomes and complication rates. The recurrence and complication rates are low after a median follow-up of 83 months. Our data suggest that LSC with concomitant hysterectomy can be offered to women with pelvic organ prolapse, with women's preference taken into account.

Acknowledgements We thank Dr. Cecilia Willy Cheon and Dr. Cheung Ka Man for comments on the manuscript.

Authors' contribution J.C.Y. Chan: data collection, data analysis, manuscript writing; C.H. Yu: protocol development, data collection, manuscript editing; W.W. Go: protocol development, data collection, manuscript editing.

Declarations

Conflicts of interest None.

References

1. Maher C, Feiner B, Baessler K, Christmann-Schmid C, Haya N, Brown J. Surgery for women with apical vaginal prolapse. Cochrane Database Syst Rev. 2016;10:CD012376.
2. Snyder TE, Krantz KE. Abdominal-retroperitoneal sacral colpopexy for the correction of vaginal prolapse. Obstet Gynecol. 1991;77(6):944–9.
3. Timmons MC, Addison WA, Addison SB, Cavenar MG. Abdominal sacral colpopexy in 163 women with posthysterectomy vaginal vault prolapse and enterocele. Evolution of operative techniques. J Reprod Med. 1992;37(4):323–7.
4. Marchionni M, Bracco GL, Checcucci V, et al. True incidence of vaginal vault prolapse. Thirteen years of experience. J Reprod Med. 1999;44(8):679–84.
5. Coolen AWM, van Oudheusden AMJ, Mol BWJ, van Eijndhoven HWF, Roovers JWR, Bongers MY. Laparoscopic sacrocolpopexy compared with open abdominal sacrocolpopexy for vault prolapse repair: a randomised controlled trial. Int Urogynecol J. 2017;28(10):1469–79.
6. Freeman RM, Pantazis K, Thomson A, et al. A randomised controlled trial of abdominal versus laparoscopic sacrocolpopexy for the treatment of post-hysterectomy vaginal vault prolapse: LAS study. Int Urogynecol J. 2013;24:377.
7. Higgs A, Chua HL, Smith AR. Long term review of laparoscopic sacrocolpopexy. BJOG. 2005;112:1134–8.
8. Chan CM, Liang HH, Go WW, To WW, Mok KM. Laparoscopic sacrocolpopexy for uterine and post-hysterectomy prolapse: anatomical and functional outcomes. Hong Kong Med J. 2011;17(4):301–5.
9. Dallas K, Elliott CS, Syan R, Sohlberg E, Enemchukwu E, Rogo-Gupta L. Association between concomitant hysterectomy and repeat surgery for pelvic organ prolapse repair in a cohort of nearly 100,000 women. Obstet Gynecol. 2018;132:1328–36.
10. Baines G, Price N, Jefferis H, Cartwright R, Jackson SR. Mesh-related complications of laparoscopic sacrocolpopexy. Int Urogynecol J. 2019;30(9):1475–81.
11. Maher CF, Feiner B, DeCuyper EM, Nichlos CJ, Hickey KV, O'Rourke P. Laparoscopic sacral colpopexy versus total vaginal mesh for vaginal vault prolapse: a randomized trial. Am J Obstet Gynecol. 2011;204(4):360.e1.
12. Cundiff GW, Varner E, Visco AG, Zyczynski HM, Nager CW, Norton PA, et al. Risk factors for mesh/suture erosion following sacral colpopexy. Am J Obstet Gynecol. 2008;199(688):e1–5.
13. Tan-Kim J, Menefee SA, Luber KM, Nager CW, Lukacz ES. Prevalence and risk factors for mesh erosion after laparoscopic-assisted sacrocolpopexy. Int Urogynecol J. 2011;22:205–12.
14. Maher C, Baessler K, Barber M, et al. Surgical management of pelvic organ prolapse. In: Abrams P, Cardozo L, Khoury S, Wein A, (eds) 5th International Consultation on Incontinence. Paris: Health Publication. 2013.
15. Winkelman WD, Modest AM, Richardson ML. The surgical approach to abdominal sacrocolpopexy and concurrent hysterectomy: trends for the past decade. Female Pelvic Med Reconstr Surg. 2021;27:e196–201.
16. Toozs-Hobson P, Freeman R, Barber M, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for reporting outcomes of surgical procedures for pelvic organ prolapse. Int Urogynecol J. 2012;23:527–35.
17. Haylen BT, Freeman RM, Swift SE, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint terminology and classification of the complications related directly to the insertion of prostheses (meshes, implants, tapes) & grafts in female pelvic floor surgery. Int Urogynecol J. 2011;22:3.
18. Sarlos D, Kots L, Ryu G, Schaer G. Long-term follow-up of laparoscopic sacrocolpopexy. Int Urogynecol J. 2014;25(9):1207–12.
19. Liang S, Zhu L, Song X, Xu T, Sun Z, Lang J. Long-term outcomes of modified laparoscopic sacrocolpopexy for advanced pelvic organ prolapse: a 3-year prospective study. Menopause. 2016;23(7):765–70.
20. Friedman T, Eslick GD, Dietz HP. Risk factors for prolapse recurrence: systematic review and meta-analysis. Int Urogynecol J. 2018;29(1):13–21. https://doi.org/10.1007/s00192-017-3475-4.
21. De Tayrac R, Sentilhes L. Complications of pelvic organ prolapse surgery and methods of prevention. Int Urogynecol J. 2013;24:1859–72.
22. Warner WB, Vora S, Hurtado EA, Welgoss JA, Horbach NS, von Pechmann WS. Effect of operative technique on mesh exposure in laparoscopic sacrocolpopexy. Female Pelvic MedReconstr Surg. 2012;18(2):113–7.
23. Meriwether KV, Antosh DD, Olivera CK, et al. Uterine preservation vs hysterectomy in pelvic organ prolapse surgery: a systematic review with meta-analysis and clinical practice guidelines. Am J Obstet Gynecol. 2018;219(2):129–146.e2.
24. Schulten SFM, Detollenaere RJ, Stekelenburg J, et al. Sacrospinous hysteropexy versus vaginal hysterectomy with uterosacral ligament suspension in women with uterine prolapse stage 2 or higher: observational follow-up of a multicentre randomised trial. BMJ. 2019;366:l5149.