ORIGINAL ARTICLE

Laparoscopic sacrocolpopexy for the treatment of vaginal vault prolapse: with or without robotic assistance

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Objective To assess perioperative and medium-term outcome after laparoscopic sacrocolpopexy with or without robotic assistance for vaginal vault prolapse in a Hong Kong tertiary centre.

Design Retrospective study.

Setting An urogynaecology unit in Hong Kong.

Patients All women who underwent laparoscopic sacrocolpopexy with or without robotic assistance for vaginal vault prolapse from March 2005 to May 2010.

Main outcome measures The perioperative and medium-term outcomes.

Results A total of 36 women underwent the operation during the study period. The mean operating time was 205 minutes, mean blood loss was 144 mL. The median hospital stay was 4 days. Two women required early re-operation but recovered fully. In all, 35 women were followed up for 29 (standard deviation, 19) months. Three of them (9%) had a recurrence of stage II prolapse, but there was statistically significant improvement in the pelvic organ prolapse quantification assessment for all three compartments of the vagina, and the length of vagina was well preserved. There were no mesh exposure or erosions. The overall objective cure rate of 91% (32/35) was high, and 91% (32/35) were satisfied with the operative outcome. Stress incontinence and voiding difficulty were significantly reduced.

Conclusion Laparoscopic sacrocolpopexy for vaginal vault prolapse is safe, although complications arising from concomitant surgery should not be neglected. High rates of objective cures and patient satisfaction were achieved. There were no mesh exposure or erosions. Laparoscopic sacrocolpopexy should be considered an option for women with vaginal vault prolapse.

A video of laparoscopic sacrocolpopexy is available at <www.hkmj.org>.

Key words
Gynecologic surgical procedures; Laparoscopy; Robotics; Pelvic organ prolapse

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Introduction

The reported incidence of vaginal vault prolapse requiring surgical treatment following hysterectomy is around 3.6 per 1000 person-years. The risk is 5.5-fold higher (confidence interval [CI], 3.1-9.7) in women having hysterectomy for pelvic organ prolapse.[1]

Abdominal sacrocolpopexy has a high cure rate, 78 to 100% when defined as lack of apical prolapse, or 58 to 100% when defined as no postoperative prolapse.[2] It is superior to vaginal sacrospinous colpopexy in terms of lower rates of recurrent vault prolapse (relative risk=0.23; 95% CI, 0.07-0.77).[3] However, it has been associated with longer times for the operation and recovery.[4,5] Laparoscopic sacrocolpopexy (LS) was first introduced in 1994.[6] The reported objective success and patient satisfaction rates were 75 to 100% and 79 to 98%, respectively.[7] Robot-assisted laparoscopic sacrocolpopexy (RALS) was introduced in 2004.[8] Short-term outcomes in terms of prolapse recurrence have been promising, although there have only been a few reports.[9,10]

Laparoscopic sacrocolpopexy was first introduced in our centre in 2005 and RALS has been performed since 2007. The aim of this study was to review our experience with these operations and determine the perioperative and medium-term outcomes of women who underwent these operations in a local tertiary centre.

Methods

All women with pelvic organ prolapse including vaginal vault prolapse were assessed prospectively in our urogynaecology clinic according to a standard protocol. Their presenting symptoms, obstetrics and gynaecological history, medical history, and epidemiological data were obtained. Based on a standardised method, they underwent physical examination using a pelvic organ prolapse quantification (POP-Q) scale.[11] They all had a preoperative urodynamic study (uroflowmetry and dual channel cystometry) to evaluate urodynamic stress incontinence with the prolapse reduced by an appropriately sized vaginal ring pessary. Women who had urodynamic stress incontinence also had concomitant continence surgery, that entailed either tension-free transvaginal tape surgery or laparoscopic colposuspension. Other concomitant pelvic floor repair surgery (vaginal or laparoscopic) was performed if indicated. Laparoscopic sacrocolpopexy was performed from 2005 to 2007. Since mid 2007, LS was performed with robotic assistance, necessary equipment became available, with the aim to explore whether the RALS would be an optimal alternative to LS (for both the patients and surgeons). Both LS and RALS were performed by a urogynaecologist or a urogynaecology subspecialty trainee; both were accreditated for advanced level of laparoscopy from the Hong Kong College of Obstetricians and Gynaecologists. Two additional surgeons assisted the chief surgeon at each operation. Their experience ranged from resident trainee to specialist.

不論有機械人輔助與否情況下經腹腔鏡骶骨陰道固定術治療陰道穹窿脫垂

目的 評估香港一所中心內，不論有機械人輔助與否，使用經腹腔鏡骶骨陰道固定術治療陰道穹窿脫垂的圍術期及術後中期結果。

設計 回顧研究。

安排 香港一所婦科泌尿學部門。

患者 2005年3月至2010年5月期間，不論有機械人輔助與否，所有接受經腹腔鏡骶骨陰道固定術治療陰道穹窿脫垂患者。

主要結果測量 圍術期及術後中期結果。

結果 研究期間共有36位婦女接受手術。手術平均時間205分鐘，平均失血量144 mL，住院中位數為4天。兩名病人須再次接受手術，最終完全康復。35位病人的隨訪期平均為29個月（標準差，19個月）。其中3人（9%）出現II期脫垂復發，但用盆腔器官脫垂定量評估三個盆腔則證實有顯著改善，陰道的長度亦可保持不變。並無發現補片暴露於陰道壁或腐蝕的病例。總客觀治癒率高（91%；32/35），91%（32/35）的病人對術後結果感到滿意；壓力性尿失禁及排泄困難亦顯著減少。

結論 雖然不能忽視因手術可能引致的併發症，經腹腔鏡骶骨陰道固定術治療陰道穹窿脫垂仍是安全的。此技術的治癒率及病人術後滿意度高；亦未有補片暴露於陰道壁或腐蝕的病例。所以陰道穹窿脫垂患者可考慮進行經腹腔鏡骶骨陰道固定術。

All women had bowel preparation the day before the operation. One dose of 1.2 g intravenous amoxicillin/clavulanic acid was given prophylactically on induction of anaesthesia. The urinary bladder was catheterized before the operation. In brief the operation entailed the following steps. A Y-shaped polypropylene mesh (Ethicon, Inc, Somerville, NJ; Fig a) was prepared and four ports were used for LS. The sacral promontory was identified. The peritoneum covering the sacral promontory was opened, and the peritoneal incision continued down the sacral curve, medial to the right ureter until the apex of the vaginal vault was reached. Vaginal and rectal probes were inserted to help identify the vaginal vault and assist subsequent dissection, and the peritoneum over the vaginal apex was mobilised. The bladder and rectum were dissected from the vagina (Fig b). The mesh was introduced, with the two distal arms anchored to the anterior and posterior vaginal wall

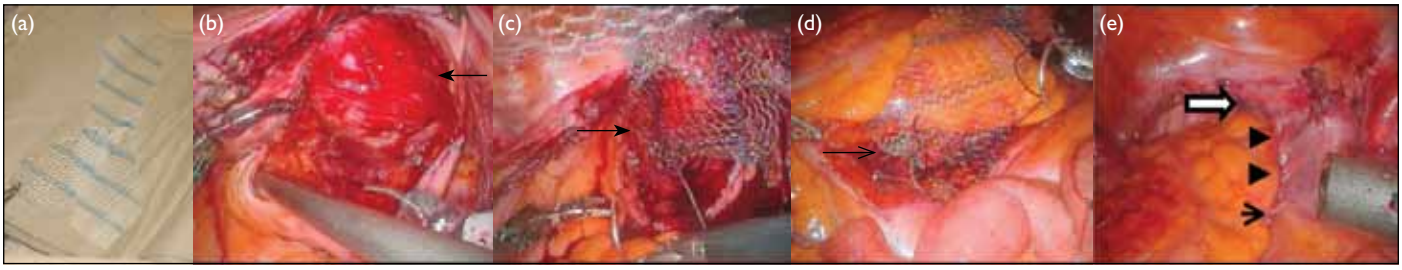

FIG. Operation

(a) A Y-shaped mesh with one proximal arm and two distal arms. (b) The bladder and bowel has been dissected from the vaginal vault (arrow). (c) The distal arm was sutured to the posterior vaginal wall (arrow). (d) The proximal arm was sutured to the sacral promontory (arrow). (e) Re-peritonisation was completed to prevent bowel adhesion to the mesh from vaginal vault (white arrow), along pelvis (arrowheads) and sacrum (black arrow).

respectively, using 2 to 3 stitches on each side (Fig c). The proximal arm was anchored to the longitudinal sacral ligament using interrupted absorbable sutures, except that titanium helical tacks were used in two patients (Fig d). The peritoneum was closed using a continuous suture to completely cover the mesh (Fig e). The procedure was followed by other concomitant surgery as indicated. Cystoscopy was performed to assess whether there was bladder injury and patency of ureters was demonstrated. For RALS, a three-arm robot (da Vinci Surgical System; Intuitive Surgical, Sunnyvale [CA], US) was used in 2007 to 2008 and subsequently a four-arm robot (da Vinci Surgical System, Intuitive Surgical) when it became available. A total of four or five ports were introduced. The remaining procedures were performed as described above.

The perioperative information, including operating time, type of operation, intra-operative blood loss, perioperative complications, length of hospital stay, and postoperative complications were recorded.

All women were assessed at 3 months and then annually till 5 years after the operation. During follow-up, symptoms of prolapse, urinary symptoms, and vaginal pain were assessed and per-vaginal examination and POP-Q assessment was performed using the same follow-up datasheet. Objective cure was defined as having a POP-Q assessment showing stage 0 or I prolapse at all compartments and with no symptoms due to prolapse. Satisfaction was evaluated by asking the women to rate their outcome as better, same, or worse than that before surgery.

Statistical analyses

Descriptive analysis was used to study the objective cure rate and women's satisfaction with the treatment. For comparison of frequencies, the Chi squared test, or a two-sided Fisher's exact test were used where appropriate. The pre- and post-operative POP-Q assessment was compared using student *t* test. All analyses were performed with the Statistical Package for the Social Sciences (Windows version 17.0; SPSS Inc, Chicago [IL], US). The significance level was set at a P value of less than 0.05.

Ethics approval

Ethics approval for this study was granted by the local institution (CRE – 2009.584).

Results

From March 2005 to May 2010, 36 women who suffered from vaginal vault prolapse had the operation (20 LS

TABLE 1. Patient demographics, clinical and operative information, and perioperative outcomes*

Characteristic	All (n=36)	Laparoscopic (n=20)	Robotic (n=16)	P value†
Age (years)	66.8 ± 8.2	66.6 ± 9.3	67.4 ± 6.4	0.70
No. of vaginal deliveries	3.9 ± 1.5	4.0 ± 1.5	3.7 ± 1.5	0.60
Previous pelvic floor repair	23 (64%)	11 (55%)	12 (75%)	0.30
Current surgery				
Concomitant pelvic floor repair surgery	30 (83%)	15 (75%)	15 (94%)	0.20
Concomitant continence surgery				
Colposuspension	5 (14%)	4 (20%)	1 (6%)	0.30
TVT‡	6 (17%)	4 (20%)	2 (13%)	
Operating time (min)	205 ± 59	185 ± 64	230 ± 42	0.02
Blood loss (mL)	144.4 ± 86.0	155.0 ± 91.6	131.0 ± 79.3	0.42
Intra-operative and perioperative complications and information				
Bladder injury	6 (17%)	4 (20%)	2 (13%)	0.68
Ureteric injury	1 (3%)	-	1 (6%)	-
Port-site hernia	1 (3%)	-	1 (6%)	-
Postoperative fever and deep vein thrombosis	1 (3%)	-	1 (6%)	-
Hospital stay (days)	5.8 ± 5.2 Median (4)	4.3 ± 2.6 Median (3)	7.5 ± 7.0 Median (5)	0.05
Haemoglobin drop (g)	1.5 ± 1.0	1.4 ± 1.0	1.7 ± 1.0	0.37

* Data are shown as No. (%) or mean ± standard deviation, unless otherwise specified
† Comparison of laparoscopic sacrocolpopexy and robot-assisted laparoscopic sacrocolpopexy
‡ TVT denotes tension-free vaginal tape

TABLE 2. The pelvic organ prolapse quantification (POP-Q) assessment before and after the operation*

	All (n=35)			Laparoscopic (n=20)			Robotic (n=15)		
Follow-up (months)	**29 (19)**			**39 (17)**			**16 (11)**		
POP-Q assessment†	**Pre**	**Post**	**P value**	**Pre**	**Post**	**P value**	**Pre**	**Post**	**P value**
Aa	0.8 ± 1.7	-1.6 ± 1.0	<0.001	0.6 ± 1.8	-1.6 ± 1.2	<0.001	1.1 ± 1.5	-1.7 ± 0.8	<0.001
Ba	0.7 ± 2.0	-1.9 ± 1.1	<0.001	0.2 ± 1.7	-1.8 ± 1.2	<0.001	1.4 ± 2.2	-2.1 ± 0.8	<0.001
C	2.0 ± 2.4	-5.2 ± 1.8	<0.001	1.6 ± 2.2	-5.0 ± 1.9	<0.001	2.1 ± 2.8	-5.7 ± 1.6	<0.001
Genital hiatus	3.2 ± 0.8	3.1 ± 0.5	0.35	3.2 ± 0.9	3.1 ± 0.6	0.45	3.3 ± 0.7	3.2 ± 0.5	0.60
Perineal body	1.7 ± 0.5	2.1 ± 0.3	<0.001	1.6 ± 0.6	2.1 ± 0.3	0.001	1.7 ± 0.4	2.1 ± 0.3	0.01
Total vaginal length	7.4 ± 1.3	7.0 ± 2.7	0.40	7.7 ± 1.1	7.4 ± 0.8	0.47	7.1 ± 1.4	6.4 ± 4.2	0.55
Ap	-0.1 ± 1.5	-1.8 ± 1.0	<0.001	-0.5 ± 1.5	-1.7 ± 1.1	0.001	0.4 ± 1.5	-2.0 ± 0.8	<0.001
Bp	-0.5 ± 2.1	-2.1 ± 0.9	<0.001	-0.9 ± 1.7	-2.0 ± 0.9	0.009	0.0 ± 2.6	-2.3 ± 0.7	0.005

* Data are shown as mean ± standard deviation, unless otherwise specified

† Pre and Post denote assessment before and after the operation respectively; Aa and Ba represent value of anterior compartment, C represents value of the vaginal cuff, Ap and Bp represent value of the posterior compartment

and 16 RALS). The mean (standard deviation [SD]) values for age at the time of operation were 66.8 (8.2) years and for parity were 3.9 (1.5). The majority (55% in the LS group and 75% in the RALS group) had undergone previous pelvic floor repair surgery and thus were suffering from recurrence of pelvic organ prolapse. In all, 11 (31%) of the women were diagnosed with urodynamic stress incontinence and had concomitant incontinence surgery (Table 1).

Operative information and postoperative complications are shown in Table 1. Robot-assisted LS had a significantly longer operating time than LS, but there were no other perioperative differences. There were six bladder injuries, three (8%) were due to the procedure for sacrocolpopexy and three due to other concomitant surgery (one for incontinence and two were paravaginal repairs) after the sacrocolpopexy was completed. All urinary bladder injuries were identified during the operation and repaired. These women had foley catheterization for 3 to 5 days and none endured any long-term complication.

Two (6%) of the women underwent early re-operation. One, who had concomitant laparoscopic bilateral anterior paravaginal repair, suffered from right ureteric kinking, and the suture for the right paravaginal repair was released on day 3 after the operation. She recovered uneventfully. Another had partial intestinal obstruction as a segment of small intestine had herniated at an 8 mm port site. During the RALS, she had concomitant laparoscopic colposuspension and a Robinson drain inserted at an 8 mm port site for postoperative drainage. She developed symptoms and signs of intestinal obstruction the day after removal of the Robinson drain. Subsequently, laparoscopic release of the segment of small intestine was performed and the patient recovered uneventfully.

Of the 36 women, only 35 were included in the analysis of operative outcomes, because the remaining one was operated on only within 3 months of this report. Five women completed 5 years of follow-up and had been discharged from the clinic. Two women did not follow-up on schedule; one returned to her home country and the other died of carcinoma of the oesophagus 3 years after the operation. Information at their last follow-up was used for analysis. The mean (SD) follow-up duration for all the women was 29 (19) months (range, 3-60 months); with a longer follow-up in the LS group (39 [17] months vs 16 [11] months; P<0.001) as expected.

TABLE 3. Objective cure and satisfaction rates*

	All (n=35)	Laparoscopic (n=20)	Robotic (n=15)
Follow-up (months)	29 ± 19	39 ± 17	16 ± 11
Objective cure†	32 (91%)	18 (90%)	14 (93%)
Recurrence of stage II prolapse			
Anterior compartment	2 (6%)	1 (5%)‡	1 (7%)‡
Vault (central compartment)	1 (3%)	1 (5%)‡	-
Posterior compartment	2 (6%)	1 (5%)‡	1 (7%)‡
Recurrence of stage III prolapse			
Anterior compartment	1 (3%)	1 (5%)‡	-
Women's satisfaction			
Same	3 (9%)	2 (10%)	1 (7%)
Better	32 (91%)	18 (90%)	14 (93%)

* Data are shown as No. (%) or mean ± standard deviation

† Objective cure = women who have pelvic organ prolapse quantification assessment showing stage 0 or I prolapse at any compartment and with no symptoms due to prolapse

‡ Three women had recurrence of prolapse ≥stage II; one had stage II anterior and posterior compartment prolapse, one had stage II anterior compartment and vault prolapse, and one had stage II posterior and stage III anterior compartment prolapse

The preoperative and postoperative POP-Q assessment was shown in Table 2. Three women had recurrence of stage II prolapse or higher in any one compartment. Two of them had recurrence at 6 months and another one had recurrence at 24 months. One in each LS and RALS group had re-operation by total vaginal mesh repair, and another one preferred to have conservative management. The symptoms and POP-Q assessment at the last follow-up before the vaginal mesh repair was used for the two women with recurrence and re-operation. Despite these recurrences, there was a statistically significant improvement in the POP-Q assessment of all the three compartments and the length of vagina was well preserved. No tenderness, mesh exposure or erosion was detected during the per-vaginal examination. The overall objective cure rate of 91% was high, and 91% of the patients were satisfied with the operative outcome. Both LS and RALS achieved similar results (Table 3).

Together with the concomitant surgery, there was significant reduction in urinary stress incontinence. There was a tendency for improvement in urinary urgency and urge urinary incontinence, though statistical significance was not established (Table 4).

Discussion

Abdominal sacrocolpopexy is considered the gold standard for repairing vaginal vault prolapse with a lower rate of recurrence and less dyspareunia as compared with vaginal sacrospinous colpopexy.[3] Laparoscopic sacrocolpopexy was shown to be safe with a comparable 5-year long-term cure rate of 93%.[7,12] Besides, magnetic resonance imaging confirmed significant improvements in the restoration of vaginal configuration in those who underwent sacrocolpopexy as opposed to vaginal sacrospinous ligament suspension.[13,14]

This study reported the medium-term outcome, with a mean follow-up of 29 months. The short-term result of RALS was also reported, with such information being scarce. The overall perioperative and medium-term outcome of the LS with or without robotic assistance are comparable to other published series.

The operating time was 185 minutes in our LS group. Although the mean operating time of LS in a review of 11 series of more than 1000 patients was 158 (range, 96-286) minutes, the operating time reported was specifically for the LS, and time for concomitant surgery may not be included.[7,12,15] In all, 83% and 30% of the women in our study had concomitant pelvic floor repair surgery and continence surgery, respectively. It was also difficult to compare the RALS operating time with other series as the reported mean operating time ranged from 3 hours to over 5 hours.[9,10] The longer operating time of RALS as compared to LS could be attributed to docking of the robotic machine, especially in the first few cases, and more concomitant pelvic floor repair surgeries performed in that group, though the difference was not statistically different.

The median hospital stay of the women in the RALS group was 5 days and there was no statistical difference as compared to the LS group. There were four women who had hospital stays of more than 7 days; three in the RALS group and one in the LS group. Two were those who had re-operations, one because of adjustment of anticoagulants for the management of deep vein thrombosis and one in the LS group for bladder training (result not reported). The risk of trocar site hernia might have been avoided had another site (without extensive manipulation through the site) been used when the abdominal drain became necessary. It is also recommended that all port sites (even 8 mm) should be repaired during the operation.[16] Ureteric injury is not uncommon owing to the nature of the surgery and intra-operative cystoscopy to demonstrate bilateral ureteric jets. As in our experience however, this might not completely exclude ureteric kinking. The ureteric kinking was more likely to be related to the paravaginal repair rather than sacrocolpopexy. Three (8%) of the bladder injuries ensued during the sacrocolpopexy, which was comparable to values of 1.4 to 11% reported from other centres.[15,17] Concomitant continence surgery or paravaginal repair are also associated with risk of bladder injury and should not be overlooked.[18] Since such injuries were found in the dome of the bladder, prolonged catheterization is not necessary.[18]

The medium-term outcome of LS and RALS was good, as the women's urinary symptoms improved. Both cure and satisfaction rates were high, and comparable to objective cure rates of 75 to 100% and patient satisfaction rates of 79 to 98% reported in other centres.[7] The vaginal length was preserved

TABLE 4. Preoperative, postoperative, and de-novo symptoms

Symptoms	No. (%)			P value
	Pre-op	Post-op	De-novo†	
Protusion	35 (100)	3 (9)	0	-
Stress incontinence*	23 (66)	5 (14)	1 (3)	<0.001
Urinary urgency	13 (37)	6 (17)	2 (6)	0.11
Urge incontinence	18 (51)	10 (29)	3 (9)	0.09
Voiding difficulty	11 (31)	2 (6)	0	0.01
Faecal incontinence	2 (6)	0	0	-

* 11 of them were diagnosed urodynamic stress incontinence with concomitant continent surgery performed

† De-novo represents women who did not have the symptom prior to surgery. They were also included in the postoperative column

and the central compartment (vaginal vault) was well supported; there being only one stage II recurrence of vaginal vault prolapse, which was comparable to result in other series.[15] We nevertheless intend to conduct long-term follow-up of these patients, which may well reveal a higher recurrence rate. During a long-term (5-year) follow-up of 43 patients, however, Ross and Preston[12] reported that the three who had recurrence had them after 6, 14 and 15 months. This suggests that the recurrences usually occur early, which was also consistent with our experience.

Recent randomised controlled trials have demonstrated that the use of anterior vaginal meshes reduces the risk of anterior compartment prolapse recurrence. There is no level I evidence to support the use of vaginal polypropylene mesh for apical (vaginal vault) or posterior compartment prolapse.[3,19,20] Vaginal mesh repair surgeries have their problems, especially in young sexually active women. Besides, 10% of anterior repairs with polypropylene mesh result in mesh erosion.[3] Other complications (vaginal pain, dyspareunia, tenderness over the contracted portions of mesh and shortening of vagina) have also been reported.[21] Until findings from studies with adequate power to compare LS and vaginal mesh repair are available, LS should remain an option for women with vaginal vault prolapse.

One limitation of the current study was the lack of information on quality of life and sexual function. Urogynaecological conditions and their treatment are often associated with a significant impact on sexuality and quality of life for the women concerned.[22] This study was mainly based on symptom evaluation, anatomical outcomes and women's satisfaction, and did not address sexual aspects. The use of condition-specific quality-of-life questionnaires might have provided more objective results. Moreover, validated Chinese questionnaires for pelvic organ prolapse are not available for the time being.

Conclusion

Using LS with or without robotic assistance to treat vaginal vault prolapse achieved high rates of objective cure and patient satisfaction in the medium term. There was no vaginal tenderness, mesh exposure or erosion. This procedure should be considered an option for women with vaginal vault prolapse.

Declaration

The authors have no conflict of interest to declare.

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