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ORIGINAL ARTICLE

Route of hysterectomy during minimally invasive sacrocolpopexy does not affect postoperative outcomes

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Abstract

Introduction and hypothesis Hysterectomy can be performed during sacrocolpopexy, but there are limited studies comparing the effect of route of hysterectomy on adverse events. We hypothesized there would be no difference in adverse events or patient-reported outcomes in women who underwent minimally invasive sacrocolpopexy with either vaginal or supracervical hysterectomy.

Methods This was a retrospective chart review with a cross-sectional survey component sent to all consenting patients. Patients were identified by procedure code for sacrocolpopexy and hysterectomy from January 2005 to June 2016.

Results Of the 161 subjects meeting the inclusion criteria, 116 underwent supracervical and 45 vaginal hysterectomy. Overall incidence of perioperative adverse events was low. Vaginal hysterectomy cases were faster (276 vs. 324 min, $p < 0.001$) and had higher rates of postoperative stress incontinence (22 vs. 9%, $p = 0.03$). Thirty-one (19%) of all subjects had recurrent prolapse; 10 (6%) underwent repeat surgery. Three (1%) subjects had a mesh exposure (no difference between groups), all treated conservatively. Ninety-six (60%) subjects responded to the survey with a median follow-up of 56 (9–134) months. Ninety-one percent (87) of respondents reported being better since surgery, and 91% (87) reported they would choose the surgery again. Twenty-eight percent (27) reported a surgery-related complication including pain, urinary and bowel symptoms; 8% (8) reported evaluation for recurrent prolapse symptoms, all treated conservatively; 4% (4) of respondents reported a mesh exposure.

Conclusions Incidence of adverse events is low and not different between patients undergoing minimally invasive sacrocolpopexy with concurrent supracervical or vaginal hysterectomy. One in three patients report pelvic floor symptoms postoperatively, but long-term satisfaction is high.

Keywords Minimally invasive hysterectomy · Patient-reported outcomes · Prolapse · Sacrocolpopexy · Vaginal hysterectomy

Introduction

Sacrocolpopexy (SCP) is considered by some to be the gold standard surgery for vaginal apex prolapse, and now with minimally invasive advancements, it is often performed either laparoscopically or robotically. Sacrocolpopexy is often performed for post-hysterectomy prolapse but is also performed for uterovaginal prolapse with concurrent hysterectomy.

Studies looking at long-term outcomes following minimally invasive sacrocolpopexy have shown a low incidence of prolapse recurrence following the procedure and a predicted incidence of mesh exposure of 10% [1]. Prior work has also shown that that adverse events after minimally invasive sacrocolpopexy are low even when concurrent hysterectomy is performed [2]. A few studies have looked at the outcomes of minimally invasive sacrocolpopexy by route of concurrent hysterectomy. Some authors suggest that performing laparoscopic supracervical (versus total) hysterectomy may reduce the risk of mesh erosion as a portion of the mesh is sutured onto the retained cervix avoiding attachment close to the colpotomy incision [3, 4]. Conversely, another study showed no difference in mesh erosion or prolapse recurrence between concurrent laparoscopic supracervical

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hysterectomy and total vaginal hysterectomy performed at the time of sacrocolpopexy [5].

In 2014 there was a de facto change in practice patterns in many institutions as a result of the ban placed on power morcellation, commonly used for extraction of the uterine specimen after minimally invasive supracervical hysterectomy (MI-SCH). Providers performing minimally invasive sacrocolpopexy were left with the following options for concurrent hysterectomy: supracervical hysterectomy with extraction through an extended abdominal incision with or without morcellation, total laparoscopic hysterectomy, and vaginal hysterectomy.

Differences in perioperative adverse events associated with these routes of surgery are important, as are long-term outcomes such as patient-reported symptoms, the incidence of mesh erosion, and need for repeat surgery. Because the existing data comparing vaginal hysterectomy and supracervical hysterectomy at the time of minimally invasive sacrocolpopexy are mixed, providers performing these procedures do not have enough evidence to help guide them in choosing a route for hysterectomy. Therefore, the primary aim of this study is to compare the incidence of perioperative adverse events after minimally invasive sacrocolpopexy between routes of concurrent hysterectomy. Our secondary aim is to compare patient-reported outcomes between the routes of hysterectomy including patient reported outcomes between routes symptoms of recurrence, patients' impression of improvement, and presence of bothersome pelvic floor symptoms. Our hypothesis was that there would be no difference between groups.

Materials and methods

This is a retrospective cohort study with a cross-sectional survey component of all patients who underwent minimally invasive sacrocolpopexy with concurrent hysterectomy between January 1, 2005, and June 30, 2016. Institutional Review Board approval was obtained for this study. Subjects were identified by their Current Procedural Terminology (CPT®) code for laparoscopic colpopexy (57425) and were included if they underwent concurrent laparoscopic or vaginal hysterectomy. The following concurrent hysterectomies were performed: laparoscopic or robotic supracervical hysterectomy (MI-SCH), laparoscopic total hysterectomy (TLH), and vaginal hysterectomy (VH). Patients were also included if they underwent concurrent prolapse and/or anti-incontinence procedures (i.e., anterior and/or posterior repair, midurethral sling) but were excluded if they underwent concurrent non-urogynecologic procedures (i.e., hernia repair, rectal prolapse surgery).

Once subjects were identified, the electronic medical record was queried for data extraction. Demographic, peri-, and postoperative data were collected by study investigators. Definitions of perioperative complications were determined a priori to data collection and included intraoperative visceral injury, readmissions and reoperations, mesh exposures, prolapse recurrence, and significant postoperative complications (listed in Table 2). Recurrent prolapse was defined as anatomic recurrence (≥ stage 2 prolapse on physical examination) and/or retreatment with either a pessary or surgery. Recurrence of prolapse, urinary symptoms, and mesh exposure were assessed objectively through the retrospective chart review and through the subjective survey described below.

For the cross-sectional survey component of the study, a letter describing the study was sent to all subjects who met the above inclusion criteria. Informed consent for the survey was obtained by offering subjects the option to call to decline participation. Subjects who did not decline were called by research personnel 2 weeks after the letters were mailed. Subjects were given the option to complete the survey over the phone, by email, or by hard copy. The survey was composed of questions specific to postoperative treatments and symptoms within each of the five following domains: pain, bowel issues, urinary symptoms, vaginal issues, and mesh complications. Subjects' pelvic floor symptoms were assessed using components of the following validated assessments: the Patient Global Impression of Improvement scale (PGI-I) [6, 7], the Pelvic Floor Distress Inventory short form (PFDI-20) [8], the Incontinence Severity Index (ISI) [9], and the Pelvic Organ Prolapse/Incontinence Sexual Questionnaire (PISQ-IR) [10]. The PGI-I responses were grouped as "better," "no change," or "worse" after surgery.

Data were collected and managed using the REDCap electronic data capture tool [11]. Only three concurrent TLHs were performed at the time of laparoscopic or robotic sacrocolpopexy, and an a priori decision was made to exclude these cases from the analysis. Categorical variables are presented as % (n); continuous variables are presented as mean (±SD) or median (range). Comparisons between groups (MI-SCH versus VH) were performed using the $\chi 2$ test for categorical variables and the Student's t test (normal distribution) for continuous variables. A p value ≤ 0.05 was considered statistically significant for all analyses. Data were analyzed using the JMP 13.0 statistical package [12].

Results

One hundred sixty-one patients met the inclusion criteria during the study period. Of these subjects, 72% (116) underwent concurrent MI-SCH, and 28% (45) underwent VH at the time of minimally invasive sacrocolpopexy. Figure 1 shows the trend in hysterectomy route over time. Prior to 2014, the majority of hysterectomies were MI-SCH. Between 2014 and 2015, the majority of hysterectomies were performed vaginally (VH). In 2015 and 2016, fewer concurrent hysterectomies

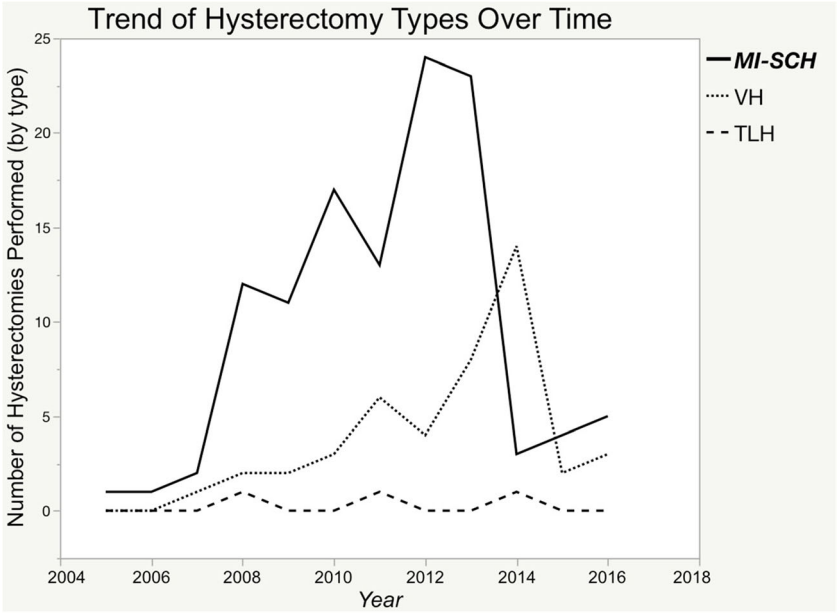

Fig. 1 Number of hysterectomies at time of sacrocolpopexy by route. MI-SCH = minimally invasive supracervical hysterectomy; VH = vaginal hysterectomy; TLH = total laparoscopic hysterectomy

were performed overall, and MI-SCH again became the predominant route.

Patient characteristics for all subjects are presented in Table 1. Subjects undergoing MI-SCH were younger, less likely to undergo posterior repair, and less likely to have stage 4 prolapse compared with the VH group. Of the subjects who underwent VH, 93% (41) had two-layer closure of the vaginal cuff. Attachment of the vaginal mesh was completed vaginally in 11% (5) of the VH sacrocolpopexies, and in the remaining cases (89%, $n = 40$) the mesh was attached laparoscopically.

Table 2 displays peri- and postoperative complications obtained from the chart review. The MI-SCH group had longer case times than the VH group (324 vs. 276 min, $p < 0.0001$). There was no statistically significant difference between laparoscopic and robotic hysterectomy case times, and both were longer than VH cases (data not shown). Complications including mesh exposure were rare and not different between the routes of hysterectomy. The incidence of reported de novo or recurrent stress urinary incontinence was 13% (21) and was higher in the VH group (22 vs. 10%, $p = 0.03$). There

Table 1 Patient characteristics

	All subjects $N = 161$	MI-SCH $n = 116$	VH $n = 45$	p value
Age, mean (± SD)	55 (± 10)	54 (± 10)	58 (± 10)	0.02*
BMI, mean (± SD)	27.3 (5.0)	27.2 (5.2)	27.5 (4.7)	0.70
Vaginal parity, median (range)	2 (0–10)	2 (0–7)	3 (0–10)	0.07
Postmenopausal, % (*n*)	59.0 (95)	55.2 (64)	68.9 (31)	0.11
Current tobacco use, % (*n*)	5.6 (9)	6.0 (7)	4.4 (2)	0.92
Preoperative prolapse stage, % (*n*)				< 0.0001*
Stage 2	32.9 (53)	39.6 (46)	15.6 (7)	
Stage 3	55.3 (89)	55.2 (64)	55.6 (25)	
Stage 4	11.8 (19)	5.2 (6)	28.9 (13)	
Preoperative diabetes, % (*n*)	3.1 (5)	2.6 (3)	4.4 (2)	0.54
Concurrent procedure, % (*n*)				
Anterior repair	11.2 (18)	13.8 (16)	4.4 (2)	0.09
Posterior repair	60.9 (98)	55.2 (64)	75.6 (34)	0.02*
Midurethral sling	67.1 (108)	68.1 (79)	64.4 (29)	0.66

MI-SCH minimally invasive supracervical hysterectomy, *VH* vaginal hysterectomy, *SD* standard deviation, *BMI* body mass index

*Statistically significant at $p \leq 0.05$

Table 2 Perioperative data by hysterectomy type

	All subjects $N = 161$	MI-SCH $n = 116$	VH $n = 45$	p value
Case time, median (range), min	303 (159–486)	324 (177–486)	276 (159–426)	< 0.0001*
Perioperative complications, % (n)				
Cystotomy[a]	0.6 (1)	0 (0)	2.2 (1)	0.11
Vascular injury	0.6 (1)	0.9 (1)	0 (0)	0.53
Bowel injury	0.6 (1)	0.9 (1)	0 (0)	0.53
EBL > 500 ml	1.9 (3)	2.6 (3)	0 (0)	0.28
Conversion	1.9 (3)	2.6 (3)	0 (0)	0.28
Readmission < 30 days	2.5 (4)	1.7 (2)	4.4 (2)	0.32
Reoperation < 30 days	0.6 (1)	0 (0)	2.2 (1)	0.11
ICU admission	0 (0)	0 (0)	0 (0)	–
Postoperative hematoma	0 (0)	0 (0)	0 (0)	–
Wound infection	4.4 (7)	3.5 (4)	6.7 (3)	0.37
Bowel obstruction	1.2 (2)	0.9 (1)	2.2 (1)	0.48
Ileus	0 (0)	0 (0)	0 (0)	–
VTE	0.6 (1)	0.9 (1)	0 (0)	0.53
Cardiac or pulmonary complication	0.6 (1)	0.9 (1)	0 (0)	0.53
UTI	4.4 (7)	5.2 (6)	2.2 (1)	0.41
Mesh exposure, % (n)	1.9 (3)	1.7 (2)	2.2 (1)	0.83
Recurrent prolapse (≥ stage 2 and/or retreatment for prolapse), %(n)	19.3 (31)	20.7 (24)	15.6 (7)	0.46
Recurrent or de novo SUI, %(n)	13.0 (21)	9.5 (11)	22.2 (10)	0.03*
De novo UUI, %(n)	3.8 (6)	2.6 (3)	6.7 (3)	0.22

MI-SCH minimally invasive supracervical hysterectomy, *VH* vaginal hysterectomy, *EBL* estimated blood loss, *ICU* intensive care unit, *VTE* venous thromboembolism, *UTI* urinary tract infection, *SUI* stress urinary incontinence, *UUI* urgency urinary incontinence

*Statistically significant at $p \leq 0.05$

[a] Cystotomy from retropubic midurethral sling trocar

was no difference in concurrent sling placement between the groups (68% MI-SCH and 64% VH, $p = 0.66$).

Recurrent prolapse was defined as stage 2 or greater prolapse or retreatment with a pessary or surgery. Recurrence occurred in 19% (31) of subjects; 14% (22) had stage 2 or greater prolapse, and 7% (12) required retreatment with surgery or a pessary. This was not different between groups. Prolapse recurrence was most common in the anterior compartment with 58% (14) of recurrences including this compartment. Forty-five percent (11) of recurrences involved the posterior compartment, and there was a single apical recurrence (4%). There was an increased incidence of anterior recurrence in the MI-SCH group compared with the VH group (68 vs. 20%, $p = 0.05$). There was a median of 6 months of retrospective postoperative data available for subjects (range: 0–103 months).

Figure 2 shows the response rate of the survey portion of the study. Sixty percent (96) of subjects responded to the prospective survey. Median time from index surgery to survey was 56 (9–134) months. Respondents were more likely to be post-menopausal (66 vs. 49%, $p = 0.04$); otherwise, there were no significant differences between respondents and non-respondents (data not shown). Table 3 shows results of the survey. Of the 96 respondents, 91% (87) reported that they would choose to have the surgery again, and 91% (87) reported that they were better after surgery. These findings did not differ between the hysterectomy groups. However, among respondents who did not say they were better, subjects who underwent concurrent VH were more likely to report worsening symptoms (2% vs. 0%, $p = 0.02$).

Of the respondents, 29% (27) reported pelvic floor symptoms since surgery in at least one domain (pain, urinary issues, bowel problems, vaginal issues, and/or mesh complication); 10% (17) reported problems in two or more domains. Twelve percent (8) of respondents reported retreatment for prolapse but all retreatment was non-surgical. Subjects who reported retreatment were more likely to have undergone concurrent MI-SCH than VH, although this difference was not statistically significant (12 vs. 0%, $p = 0.06$). Mesh exposure was reported in four respondents; all exposures were within 2 years of surgery and all occurred in subjects who had undergone concurrent MI-SCH (6%

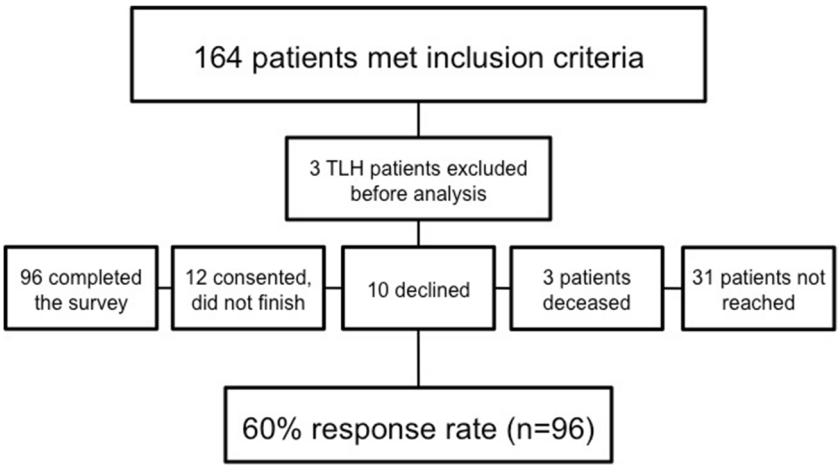

Fig. 2 Results of cross-sectional survey recruitment. TLH = total laparoscopic hysterectomy

vs. 0%, $p = 0.22$). De novo SUI and de novo UUI were reported in 15% (5) and 22% (10) of respondents, respectively.

Discussion

The primary objective of this study was to compare perioperative adverse events after minimally invasive sacrocolpopexy between routes of concurrent hysterectomy. Our secondary objective was to compare patient-reported outcomes between routes including symptoms of recurrence, impression of improvement, and persistent pelvic floor symptoms. We found that concurrent VH was faster to perform, but the overall incidence of peri- and postoperative complications or prolapse recurrence after minimally invasive sacrocolpopexy was not different between routes of hysterectomy. Over 90% of subjects reported improvement after surgery. Still, nearly one third of patients reported postoperative pelvic floor symptoms.

At our institution, a moratorium was placed on power morcellation in 2014. As a result, practice patterns changed, which is evident from our findings in this study. Prior to the ban of the power morcellator, most concurrent hysterectomy and minimally invasive sacrocolpopexy cases were performed via the supracervical route. In 2014, hysterectomies were

Table 3 Subjective outcomes from the cross-sectional survey, % (*n*)

	All respondents $N = 96$	MI-SCH $n = 69$	TVH $n = 27$	*p* value
Change since surgery				
Better	91.6 (87)	91.2 (62)	92.6 (25)	0.02*
No change	6.3 (6)	8.8 (6)	0 (0)	
Worse	2.1 (2)	0 (0)	7.4 (2)	
Would have the surgery again	93.6 (87)	95.5 (63)	88.9 (24)	0.24
Any complication/problems	29.4 (27)	29.2 (19)	29.6 (8)	0.97
Pain	15.6 (15)	15.9 (11)	14.8 (4)	0.89
Bowel symptom	14.6 (14)	14.5 (10)	14.8 (4)	0.97
Urinary symptom	15.6 (15)	13.0 (9)	22.2 (6)	0.27
Vaginal symptom	1.0 (1)	1.5 (1)	0 (0)	0.53
Mesh exposure (complication)	0.6 (1)	0.9 (1)	0 (0)	0.53
Bulge symptoms	9.4 (9)	10.1 (7)	7.4 (2)	0.68
Retreatment for prolapse?	8.3 (8)	11.6 (8)	0 (0)	0.06
Surgery?	0 (0)	0 (0)	0 (0)	–
Erosion/exposure of mesh	4.3 (4)	5.9 (4)	0 (0)	0.22
De novo SUI	14.7 (5)	12. 0 (3)	22.2 (2)	0.46
De novo UUI	22.2 (10)	19.4 (6)	28.6 (4)	0.49

MI-SCH minimally invasive supracervical hysterectomy, *VH* vaginal hysterectomy, *SUI* stress urinary incontinence, *UUI* urgency urinary incontinence

*Statistically significant at $p \leq 0.05$

performed vaginally with subsequent mesh placement. In 2015, the overall rate of concurrent hysterectomy decreased, and, in some cases, supracervical hysterectomy was still performed but using an alternative method to extract the specimen. At our institution, the shift toward fewer concurrent hysterectomies at time of minimally invasive sacrocolpopexy may be directly related to practice pattern changes associated with the ban of the morcellator. However, other influences may be at play as well, including changing attitudes regarding uterine preservation and a possible rise in hysteropexy procedures and/or a shift toward choosing vaginal native tissue repairs for primary prolapse procedures and less mesh-augmented primary surgery.

We found that minimally invasive sacrocolpopexy with supracervical hysterectomy was associated with a higher incidence of prolapse recurrence than vaginal hysterectomy. This finding has been previously reported by Myers et al. who showed that following robotic sacrocolpopexy with either concurrent supracervical or total hysterectomy, patients who underwent supracervical hysterectomy also had higher rates of anatomic recurrence [13]. It is possible that mesh placement higher on the vagina with a retained cervix may predispose patients to recurrence in the anterior and/or posterior compartments. No studies have investigated compartment-specific recurrence and risk factors associated with these types of recurrences, but, theoretically, the non-mesh-augmented portion of the vagina could be at risk for persistent or recurrent prolapse. Additionally, it is possible that the mesh is attached more distally toward the trigone anteriorly and rectum posteriorly during concomitant vaginal hysterectomy as a result of more extensive dissection.

In this study, minimally invasive sacrocolpopexy with SCH was associated with a higher incidence of mesh exposure although this was also not statistically significant. This is in contrast to previously published work that showed an increased incidence of mesh exposure in vaginal hysterectomy patients compared with those who underwent supracervical hysterectomy. Other reports looking at mesh complications have shown no differences between the types of hysterectomy routes [4, 5]. Similar to these previously published studies, our study could not reach adequate power to detect a difference in mesh exposure given this rare outcome, but our data further augment the literature on this important subject matter and may help guide clinical decision-making and patient counseling. Overall, the incidence of mesh exposure in our retrospective review and our cross-sectional analysis was low, and, regarding this outcome, both VH and MI-SCH are appropriate routes for concurrent hysterectomy at the time of minimally invasive sacrocolpopexy.

Overall, our patients undergoing minimally invasive sacrocolpopexy with hysterectomy were satisfied after surgery. However, up to one third of patients reported some degree of bothersome pelvic floor symptoms that were persistent, recurrent, or new. This speaks to the complex nature of pelvic floor disorders and may provide us with important information regarding counseling patients before surgery. Patients may be advised that vaginal suspension may not resolve all pelvic floor symptoms and that surgery in the pelvis may worsen underlying baseline symptoms or cause new symptoms that may need to be addressed after surgery.

The major strength of this study is our assessment of long-term, prospective, patient-reported outcomes, which helps to reduce the potential of bias related to loss of follow-up. Another strength is the number of subjects and good survey response. The limitations of the study include those inherent to a retrospective study design. We attempted to mitigate this limitation by creating strict definitions for all of our outcomes before the data collection phase of the study and utilizing thorough chart reviews for each patient and not automated data extraction. However, we recognize the ascertainment bias in patients who did not follow-up for recurrences or complications, which is why we included the cross-sectional survey in the study design. Another major limitation is one inherent to the survey component of the study. It is hard to control for the potential cognitive bias of survey respondents; therefore, some of our results may be over- or underestimates. We also cannot account for our non-respondents, and while we showed that there were few differences between the respondents and non-respondents, we cannot report on the outcomes of those patients who did not participate in the survey portion of the study. Lastly, there may be a limitation in the study's generalizability regarding mesh complication rates as the study was not powered for this rare outcome, and the incidence of mesh exposure reported in this study was significantly lower than that reported in previous prospective analyses [1]. Interestingly, our low incidence of mesh erosion was similar to the one reported in a recent large European series of patients undergoing laparoscopic sacrocolpopexy [14]. These lower incidences may reflect changes in the types of mesh and suture used over time.

In this study we found that the incidence of adverse outcomes after minimally invasive sacrocolpopexy with concurrent hysterectomy was low. There were no differences in outcomes based on route of hysterectomy. Surgeons performing minimally invasive sacrocolpopexy for the treatment of uterovaginal prolapse should feel confident in the outcomes associated with both concurrent laparoscopic supracervical hysterectomy and vaginal hysterectomy.

Compliance with ethical standards

Conflicts of interest The authors report no relevant conflicts of interest or disclosure for this work. Our full list of disclosures is listed below for full transparency.

- Dr. Davidson is an independent consultant for the International Academy of Pelvic Surgery.
- Dr. Thomas is an author for and receives royalties from UpToDate®.
- Ms. Lampert has no conflicts of interest.
- Dr. Paraiso is an author for and receives royalties from UpToDate® and has unrestricted research grants from Coloplast and Caldera.
- Dr. Ferrando is an author for and receives royalties from UpToDate® and has unrestricted research grants from Coloplast and Caldera.

References

1. Nygaard I, Brubaker L, Zyczynski HM, Cundiff G, Richter H, Gantz M, et al. Long-term outcomes following abdominal sacrocolpopexy for pelvic organ prolapse. JAMA. 2013;309(19): 2016–24.
2. Unger CA, Paraiso MF, Jelovsek JE, Barber MD, Ridgeway B. Perioperative adverse events after minimally invasive abdominal sacrocolpopexy. Am J Obstet Gynecol. 2014;211(5):547 e1–8.
3. Osmundsen BC, Clark A, Goldsmith C, Adams K, Denman MA, Edwards R, et al. Mesh erosion in robotic sacrocolpopexy. Female Pelvic Med Reconstr Surg. 2012;18(2):86–8.
4. 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(2):205–12.
5. Nosti PA, Carter CM, Sokol AI, Tefera E, Iglesia CB, Park AJ, et al. Transvaginal versus transabdominal placement of synthetic mesh at time of sacrocolpopexy. Female Pelvic Med Reconstr Surg. 2016;22(3):151–5.
6. Srikrishna S, Robinson D, Cardozo L. Validation of the patient global impression of improvement (pgi-i) for urogenital prolapse. Int Urogynecol J. 2010;21(5):523–8.
7. Yalcin I, Bump RC. Validation of two global impression questionnaires for incontinence. Am J Obstet Gynecol. 2003;189(1):98–101.
8. Barber MD, Walters MD, Bump RC. Short forms of two condition-specific quality-of-life questionnaires for women with pelvic floor disorders (pfdi-20 and pfiq-7). Am J Obstet Gynecol. 2005;193(1): 103–13.
9. Sandvik H, Espuna M, Hunskaar S. Validity of the incontinence severity index: comparison with pad-weighing tests. Int Urogynecol J Pelvic Floor Dysfunct. 2006;17(5):520–4.
10. Rogers RG, Espuña Pons ME. The pelvic organ prolapse incontinence sexual questionnaire, IUGA-revised (pisq-ir). Int Urogynecol J. 2013;24(7):1063–4.
11. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (redcap)—a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009;42(2):377–81.
12. SAS Institute I. Jmp®. 14 ed. Cary, NC1989-2007.
13. Myers EM, Siff L, Osmundsen B, Geller E, Matthews CA. Differences in recurrent prolapse at 1 year after total vs supracervical hysterectomy and robotic sacrocolpopexy. Int Urogynecol J. 2015;26(4):585–9.
14. Vandendriessche D, Sussfeld J, Giraudet G, Lucot JP, Behal H, Cosson M. Complications and reoperations after laparoscopic sacrocolpopexy with a mean follow-up of 4 years. Int Urogynecol J. 2017;28(2):231–9.