
Introduction

Pelvic organ prolapse (POP) affects an increasing number of women over the age of 50 as the aging population grows in size [1, 2]. An estimated 300,000 procedures to correct this condition are performed annually in the US alone [3]. Over the last several years, interest in uterine-preservation has been on the rise due to a woman's desire to maintain her sense of self, prolong her childbearing potential, and preserve sexual function [4, 5].

The appropriate surgical approach for patients with POP depends on a number of different factors including the degree of prolapse, the patient's general health status, her current physical activity level, desire for sexual function, and the surgeon's experience and skill with the procedure. Vaginal hysterectomy with apical suspension has been the most common approach of correcting POP [6]; however, a hysterectomy does have significant long-term sequelae that some women with POP are not willing to accept.

Reasons to Utilize a Uterine-Sparing Approach

An increasing number of women are opting for uterine-sparing surgery at the time of POP surgery for a multitude of reasons, including their desire to prolong their childbearing years and maintain a sense of self [6, 7]. In a study of 213 women in which surgical outcomes were similar across different procedure types, 36% preferred uterine-preservation, 20% chose hysterectomy, and 44% had no preference. If uterine-preservation was perceived as being superior, then 46% preferred this method compared to 11% for hysterectomy. Interestingly, even when hysterectomy had a higher success profile, uterine-preservation still remained a popular choice at 21%. Importantly, women who believed the uterus was important to their sense of self had increased odds for preserving their uterus (OR = 28.2; 95% CI, 5.00–158.7) [4].

Hysterectomy has been perceived to also have significant effects on a woman's personality and femininity, as well as her postoperative sexual function [8]. Different factors such as nerve damage and shortening of the vagina following a hysterectomy can all lead to a negative impact on a woman's self-esteem and sexual function. Thus, the utilization of uterine-preserving procedures can help to boost a women's body image, her overall self-esteem, and her sexual femininity [9]. It is important to counsel women that a supracervical

B. Chughtai, M.D. (✉) • D. Thomas, B.S.
Department of Urology, Weill Cornell Medicine/
New-York Presbyterian, 425 East 61st Street,
12th Floor, New York, NY 10065, USA
e-mail: bic9008@med.cornell.edu

hysterectomy should not impact either sexual function or hormonal status, as this is a common misconception among women. One disadvantage of preserving the uterus is that women who opt for these procedures are at continued risk for cervical and endometrial cancer [10].

However, because a woman's pelvic anatomy is not altered during uterine-sparing surgery, there are fewer complications such as shorter length of hospital stay, less intraoperative bleeding, and decreased operating times. Studies demonstrating the benefits of uterine-preservation have given momentum to the healthcare field to develop better procedures for POP surgery. The known benefits are faster healing times, less invasive surgery, and a reduction in postoperative risks. In a study by Dietz et al., women were randomized to either undergo a vaginal hysterectomy or sacrospinous hysteropexy [11]. They evaluated recovery time, anatomical outcomes, functional outcomes, and quality of life [11]. Women who did not have their uterus removed took less time to return to work (43 days vs. 66 days, $p = 0.02$) [11]. Both the vaginal hysterectomy and sacrohysteropexy were comparable in terms of functional outcomes and quality of life. However, women who underwent vaginal hysterectomy had a lower incidence of stage 2 uterine descent (3%) when compared to sacrohysteropexy (27%).

Sacrohysteropexy, a uterine-preserving surgical technique, can be achieved via many different surgical approaches including open abdominal, traditional laparoscopy, and robotic-assisted laparoscopy. Despite this, there is no real data explicitly stating which method is superior [9, 10, 12]. When choosing an appropriate technique for a surgical candidate, many factors bear importance such as the surgeon's experience and the patient's general health status.

Abdominal Sacrohysteropexy

The abdominal sacrohysteropexy (ASH) may require both transvaginal and transabdominal access [13, 14]. Patients are placed in a low lithotomy position, and a midline infraumbilical

or Pfannenstiel incision is made to enter the peritoneal cavity [15]. As described by Barranger et al., "... a transverse incision was made through the peritoneum between the uterus and the bladder...Polyester fiber mesh, roughly 3–4 cm wide, was then attached to the anterior [vaginal] wall, with four or five stitches of interrupted nonabsorbable suture, which were then passed through the right and left broad ligaments and then attached to the posterior cervix" [15]. Another mesh is attached to the posterior vaginal wall in similar fashion. In the posterior peritoneum, an incision is made over the sacral promontory, and the anterior and posterior meshes are then attached to the ligament overlying the sacral promontory with two nonabsorbable sutures to elevate the vagina and uterus. The original peritoneal incision can then be closed to cover the mesh using a continuous suture. Care should be taken to avoid the mesocolon and the right ureter [15].

Barranger et al. evaluated the long-term efficacy of ASH in women with prolapse. A total of 30 women with an average age of 35.7 years who underwent the uterine-preserving technique were included in the study between 1987 and 1999 [15]. All women simultaneously underwent a Burch procedure and posterior colporrhaphy. Intraoperative and postoperative complications were relatively low in this cohort, at 6.6% and 13.3%, respectively. Mean follow-up was 94.6 months. Two cases (6.6%) presented with recurrent prolapse at the last physical examination, and one of these patients required surgical retreatment because of symptomatic prolapse, specifically the anterior compartment. No other patients presented with recurrent prolapse, nor did they need surgical re-intervention. In conclusion, ASH was demonstrated to be a safe and effective treatment for women with uterine-prolapse who are of childbearing age.

Costantini et al. evaluated the use of sacrohysteropexy for POP, aiming to report on extended follow-up in 55 patients who underwent the uterine-preserving method [14]. All the participants in the study were followed on an annual basis. Voiding and storage symptoms resolved postoperatively in 42 (93.4%) and 30 (83.3%)

patients, respectively. All patients retained sexual activity [14]. De novo stress urinary incontinence was exhibited in four patients. In summary, this procedure was effective in treating not only POP, but it was also effective in preserving postoperative sexual function.

In another series, Leron and colleagues reported on sacrohysteropexy in 13 women [16]. The mean age of the cohort was 38 years. In total, 12 women had second-degree prolapse and one patient presented with third-degree prolapse. There were no reported intraoperative or postoperative complications. Mean follow-up was 16 months, and at this time period, only one woman had first-degree prolapse [16]. Preoperatively, four women (30.8%) reported constipation, and this number increased to seven (53.8%) women postoperatively [16].

An additional study evaluating abdominal sacrohysteropexy reported on the results of 20 women with uterine-prolapse [17]. The mean age of the participants was not mentioned, but mean follow-up was 25 months. Postoperatively, 19 patients expressed that their sexual function had improved, while three of these patients reported dyspareunia [17]. Postoperative quality of life (QOL) and symptom inventory scores were significantly lower (improved) compared to those taken at baseline, indicating that this cohort had a high rate of satisfaction and no symptoms related to prolapse following the procedure.

Although ASH has acceptable reported outcomes, potential complications of abdominal sacrohysteropexy include bowel injury, small bowel obstruction, wound-site infection, and recurrent prolapse [15, 17]. Dietz et al. reported recurrent prolapse in 22% of women [18].

Laparoscopic Sacrohysteropexy

The two main laparoscopic sacrohysteropexy techniques include laparoscopic suture sacrohysteropexy (LSH) and laparoscopic mesh sacrohysteropexy (LMH) [12]. Either laparoscopic technique is very difficult compared to the open abdominal approach. The surgeon has to not only be well-versed in laparoscopy, but also needs to

be very sound with their knowledge of the pelvic as well as the retroperitoneal anatomy.

The advantages of laparoscopic sacrohysteropexy over an open approach are shorter recovery, significantly less blood loss, and more readily visible anatomy. Postoperatively, women experience less pain, length of stay (LOS) in the hospital is much shorter, aesthetically the incision is much smaller and less visible, while maintaining sexual function and vaginal anatomy. Furthermore, the number of intraoperative adhesions is relatively low, which can prevent infertility in the future. This procedure is performed similarly to the open sacrohysteropexy described above [15].

Suture Sacrohysteropexy

Suture sacrohysteropexy is a safe and reliable method for women who need an effective treatment for the management of uterine POP, but wish to avoid the use of mesh. This procedure is unique in that the uterosacral ligaments are attached to the cervix following the closure of the pouch of Douglas. Krause et al. describes the procedure by first introducing a 10-mm laparoscope using the Hasson technique. A total of three ports are inserted: one at each iliac fossa and one suprapubically at the midline. The supravaginal portion of the posterior cervix is suspended from the sacral promontory using suture material that is monofilamentous and nonabsorbable. Exact suture type was not described. Another set of sutures are placed at the posterior end of the cervix and at the insertions of the uterosacral ligaments attached to the promontory, where a stitch is employed back towards the cervix [19].

A study by Maher et al. evaluated laparoscopic suture hysteropexy in 43 women [20]. Mean follow-up was 12 ± 7 months and mean operative time was 42 ± 15 min. The mean blood loss was less than 50 mL. During the follow-up period, it was found that 35 (81%) patients had no symptoms of prolapse. Furthermore, 34 (79%) had no evidence of prolapse on exam. Interestingly, two women subsequently sustained pregnancies without prolapse. Both women underwent elective Cesarean delivery. This procedure is very effective in correcting the prolapse

without rendering the cervix incompetent for successful pregnancy.

Krause et al. initiated a prospective study of women who underwent laparoscopic suture hysteropexy [19]. Over the course of 2 years, 81 women underwent this procedure for prolapse. During the follow-up period, a total of 65 (87.8%) women had no symptoms of prolapse. Sixty-four women (82.4%) had a Visual Analog Patient Satisfaction Score (VAS) \geq 80% (VAS: 0–100, 0 = complete failure, 100 = complete success), indicating an overall satisfaction with surgery.

Mesh Sacrohysteropexy

Laparoscopic mesh sacrohysteropexy (LMH) differs from laparoscopic suture sacrohysteropexy (LSH) in that it uses a nonabsorbable mesh to suspend the uterus as opposed to suturing the uterosacral ligaments [5]. This procedure proves to be effective in correcting the prolapse, maintaining normal vaginal axis and sexual function [10]. When contemplating a uterine-preserving procedure for POP, the LMH is usually the preferred method of choice. Often times, this has to do with the surgeon's skill set as well as experience with performing the surgery.

The surgeon introduces four laparoscopic ports, which include two 5-mm lateral ports, one 11-mm suprapubic ports, and one 11-mm umbilical ports [12]. The uterus is then suspended from the sacral promontory using bifurcated polypropylene mesh.

Price et al. investigated the outcomes of LMH using bifurcated polypropylene mesh [12]. A total of 51 women were included in the study, all of whom had uterine-prolapse that was evaluated in two ways: (1) objectively using the Baden-Walker halfway system via vaginal examination as well as pelvic organ prolapse quantification (POP-Q) scale, and (2) subjectively using the International Consultation on Incontinence Questionnaire of vaginal symptoms (ICIQ-VS). The mean age of the patients was 52.5 years. All of the women in this cohort were sexually active, with some expressing a desire to bear children in the future. The procedure was successful for all but one of the patients. This patient had a

symptomatic, persistent grade-2 uterine-prolapse. This patient had to undergo a repeat laparoscopy and mesh was tightened further (shortened) by mesh plication with Ethibond sutures. This helped to reduce the uterine-prolapse significantly. During the follow-up time period, there was significant improvement in the patients' QoL, sexual well-being, and prolapse symptoms. This study demonstrated the feasibility of this procedure in correcting prolapse with overall favorable outcomes.

In a retrospective case series, Rosenblatt et al. investigated the clinical outcomes of laparoscopic sacrocervicopexy [21]. A total of 40 women underwent the procedure using synthetic mesh. Preoperatively, the mean C value of the Pelvic Organ Prolapse Quantification (POP-Q) staging system was -1.13 , and at 6 weeks postoperatively, the mean C was -5.28 . At 6 months postoperatively, the mean C value was -5.26 , and at 1 year, it was -4.84 . The authors determined this was an effective treatment for women desiring uterine-preservation.

A benefit of both LSH and LMH is that the complication rates are very low. The most common complications reported are prolapse recurrence, mesh erosion, and large bowel injury (2%) [5]. Generally, the mesh is attached to the posterior surface of the cervix and upper vagina, then sutured distal to the sacral promontory. An issue arises using this approach when the surgeon is faced with a patient who also has anterior wall prolapse because there may be inadequate support of the anterior vaginal wall with LMH. In fact, any anterior defects should be addressed transvaginally at the time of hysteropexy using a posterior-only strip of mesh, as the anterior vaginal wall support is inferior to that of a sacrocolpopexy with both anterior and posterior mesh strips. In this case, there have been reports of bringing the mesh to the anterior cervix and vagina through the broad ligament, similar to that described for open ASH. One concern with this procedure is that it may inhibit uterine expansion during pregnancy in the future due to potential constriction of the uterine vasculature. Vree et al. described a 50 year old multiparous patient who

had mesh placed medial to the uterine vessels during LMH using blunt needles to capture the mesh arms [22]. Whether this is safe in women desiring later pregnancy is unknown.

In summary, laparoscopic sacrohysteropexy is a reliable and effective method for patients with POP who wish to preserve their uteri.

Robotic-Assisted Laparoscopic Sacrohysteropexy

An alternative to traditional laparoscopic sacrohysteropexy for women wishing to undergo a uterine-preserving surgery is robotic-assisted laparoscopic sacrohysteropexy (RALS). Surgeons opting for this method have a three-dimensional view of the pelvic anatomy, which allows for more precise suturing and dissection capabilities [23]. Furthermore, the overall maneuvering capacity is greatly increased. Similar to traditional laparoscopic sacrohysteropexy, RALS also results in shorter LOS in the hospital, less morbidity, and decreased postoperative pain compared with open approaches.

The technique is performed by first positioning the patient similar to that for robotic-assisted sacrocolpopexy as described in previous chapters in this textbook. A total of five incisions are placed in a W-configuration as follows: two 8-mm trocars for the robotic arms, one 12-mm trocar for an assist port, and one 12-mm trocar for the camera above the umbilicus [24]. The uterovesical junction is dissected as well as the peritoneum of the posterior uterus. This is to create tunneling at the broad ligament opening. The surgeon then makes an incision in the peritoneum over the sacral promontory in order to expose the anterior longitudinal ligament. From the promontory, a tunnel is created through the peritoneum until the sacro-uterine ligament region is reached. The posterior vaginal wall and posterior fornix is pushed up by a vaginal retractor. The bladder and the anterior vaginal plane are dissected via the anterior fornix. A nonabsorbable polypropylene monofilament mesh is placed between the vagina and the rectum and a second between the vagina

and bladder. Next, the broad ligament is opened on the right side with the anterior mesh taken through this opening. “The anterior and posterior meshes are then combined and drawn through the peritoneal tunnel. The distal ends of these meshes are then fixed on the anterior longitudinal ligament of the sacrum with one or two nonabsorbable sutures. The peritoneum is then re-approximated over the mesh and closed with absorbable sutures” [24].

Mourik et al. evaluated the use of RALS as a uterine-preserving technique by assessing the outcomes on the quality of life [24]. This prospective study involved 50 women with uterine prolapse. The quality of life for this cohort was assessed using the Urogenital Distress Inventory (UDI) and Incontinence Impact Questionnaire (IIQ) self-questionnaires designed for Dutch speaking persons [24]. The questionnaires were administered pre- and postoperatively. Follow-up assessments were collected up to 29 months. Preoperatively, overall well-being for the patients was approximately 67.7%, and postoperatively, this improved to 82.1% ($p = 0.03\%$). Furthermore, patients reported that their overall feelings of nervousness, embarrassment, and frustration had significantly reduced following the procedure. The overall satisfaction following the procedure was 95.2%. The mean operating time was 223 min, but with more experience the overall operating time decreased. Mean blood loss was less than 50 mL and the average LOS in the hospital was 2 days.

Geller and colleagues assessed the short-term outcomes of robotic sacrocolpopexy in comparison to ASH. The primary outcome was POP-Q score at 6 weeks [23]. Secondary outcomes included blood loss, length of stay (LOS), bowel obstruction, wound infection, and urinary retention. Seventy-three patients underwent the robotic procedure and 105 patients had ASH [23]. The mean C point for the POP-Q system was slightly better for those who had robotic surgery compared to ASH (-9 vs. -8 , $p = .008$). Furthermore, mean blood loss was also significantly lower (103 ± 96 mL vs. 255 ± 155 mL, $p < .001$) for the robotic approach.

Pregnancy After Uterine-Sparing Surgery

The current information available on pregnancy following uterine-preserving surgery POP is sparse. Furthermore, there is a paucity of data detailing how women of childbearing age who undergo POP surgery are informed about the possible effects of pregnancy and eventual delivery on the reconstruction. A Cochrane review by Maher et al. found that, of 257 women who had received corrective POP surgery, 9.4% [24] had become pregnant following the procedure [1]. Ten of these women delivered vaginally, six by Cesarean delivery, while eight of the pregnancies were terminated for unknown reasons.

Lewis et al. reported a case of a 35-year old woman who had been treated with a laparoscopic sacrohysteropexy [25]. Following the procedure, the woman was able to successfully conceive 6 months later, delivering via Cesarean section. There were no signs of prolapse 12 months postpartum; however, at the 2-year follow-up she had recurrent apical prolapse. Her recurrent prolapse was treated by robotic-assisted laparoscopic supracervical hysterectomy, sacrocolpopexy, and perineorrhaphy. Two years following this procedure, there were no symptoms of prolapse.

Outcomes of Uterine-Sparing Surgery

A major factor when considering this procedure is understanding the recurrence rate post-procedure. Many studies have been conducted in order to understand this phenomenon in comparison to methods that do not spare the uterus, such as hysterectomy. A study by Hefni et al. found no differences in the recurrence rate between women who opted for the uterine-preserving method compared to hysterectomy [26]. Another study by van Brummen et al. found similar results when comparing sacrospinous hysteropexy and vaginal hysterectomy [27]. Despite this, patients undergoing hysterectomy

for POP had a higher risk of “urge incontinence and overactive bladder symptoms compared to sacrospinous hysteropexy; a uterine-preserving procedure” [27].

Conclusions

Sacrohysteropexy has been shown to be safe and effective in women who wish to preserve the uterus, and it allows women to maintain normal sexual activity and potentially bear children in the future [4]. In addition, there is less blood loss, shorter LOS in the hospital, and overall decreased operating times compared to procedures in which the uterus is removed. Furthermore, women undergoing sacrohysteropexy report higher surgery satisfaction, better QOL scores, and overall high self-esteem. Although sacrohysteropexy can be performed in a variety of methods, the robotic-assisted laparoscopic approach has the most literature to support its use. In summary, women with POP who wish to have uterine-preserving surgery can consider sacrohysteropexy a safe and viable option.

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