Robotic sacrocolpopexy

Teresa L. Danforth, Monish Aron, David A. Ginsberg

Department of Urology, Keck School of Medicine, University of Southern California, Los Angeles, California, USA

ABSTRACT

Pelvic organ prolapse (POP) is a prevalent condition with 1 in 9 women seeking surgical treatment by the age of 80 years. Goals of treatment are relief and prevention of symptoms, and restoration of pelvic floor support. The gold standard for surgical treatment of POP has been abdominal sacrocolpopexy (ASC). However, emerging technologies have allowed for more minimally invasive approach including the use of laparoscopic assisted sacrocolpopexy and robotic assisted sacrocolpopexy (RASC). We performed a PubMed literature search for sacrocolpopexy, "robotic sacrocolpopexy" and "RASC" and reviewed all retrospective, prospective and randomized controlled trials. The techniques, objective and subjective outcomes and complications are discussed. The most frequent technique involves a polypropylene Y mesh attached to the anterior and posterior walls of the vagina with the single arm attached to the sacrum. Multiple concomitant procedures have been described including hysterectomy, anti-incontinence procedures and concomitant vaginal prolapse repairs. There are few studies comparing RASC to ASC, with the longest follow-up data showing no difference in subjective and objective outcomes. Anatomic success rates have been reported at 79-100% with up to 9% of patients requiring successive surgery for recurrence. Subjective success is poorly defined, but has been reported at 88-97%. Most common complications are urinary retention, urinary tract infection, bladder injury and vaginal mucosal injury. Mesh exposure is reported in up to 10% of patients. RASC allows for a minimally invasive approach to treatment of POP with comparable outcomes and low complication rates.

Key words: Pelvic organ prolapse, robotic, sacrocolpopexy

INTRODUCTION

Pelvic organ prolapse (POP) is a common condition among aging women with one in nine women estimated to undergo surgical repair by the age of 80 years and one-third of these women requiring a subsequent surgery for recurrence or treatment of new symptoms like stress urinary incontinence.[1] There are multiple approaches, surgical and non-surgical to treat POP. The goals of treatment should be aimed at relief of symptoms, restoring pelvic floor support, prevention of new symptoms and management of concomitant urinary, bowel and sexual dysfunction.

ANATOMY AND INDICATIONS

The pelvic floor is divided into three levels of support, which include structures such as bone, muscles, ligaments and fascia.[2] The first level of support is at the apex of the vagina where the paracolpium suspends the uterus [Figure 1]. Level II support is along the lateral vagina and consists of the arcus tendineus fascia pelvis. Level III support is the most distal where the vagina fuses to the urogenital diaphragm. Loss of Level I or apical support is what generally leads to POP, which can be in combination with the loss of Level II support. Loss of Level III support is what leads to urethral hypermobility.

The most common symptom associated with POP is a vaginal bulge in 94-100% of patients.[2] Other symptoms include pelvic pain or pressure, back pain, dyspareunia, urgency, frequency, incontinence and bowel symptoms. It is important to take a good history from patients and fully examine for prolapse in all compartments (anterior, apical and posterior) as well as examination for occult stress incontinence. This will then allow the surgeon to appropriately plan for concomitant procedures and counsel patient as to their expectations.

For correspondence: Dr. Teresa L. Danforth, Department of Urology, Keck School of Medicine, University of Southern California, 1441 Eastlake Avenue, Suite 7416, Los Angeles, California 90089-9178, USA.
E-mail: danforth@buffalo.edu
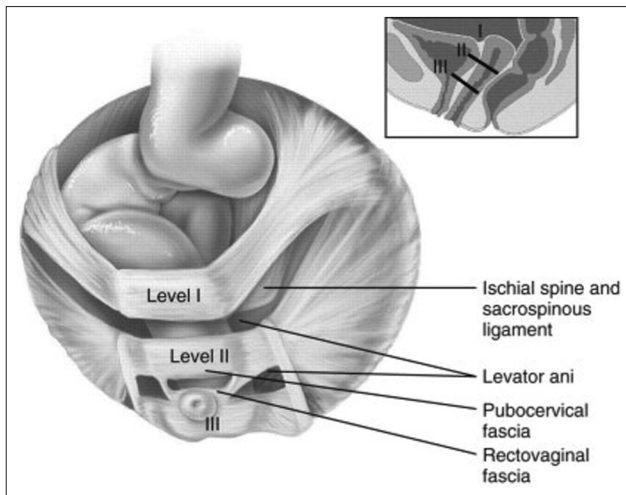
Figure 1: Vaginal and visceral supportive structures as defined by DeLancey Level I support spreads vertically and posteriorly via the paracolpium suspending the uterus. Level II support supplies the mid-vagina to the arcus tendineus fascia pelvis. Level III support fuses directly into the urogenital diaphragm (adapted from DeLancey Anatomic aspects of vaginal eversion after hysterectomy[2])

Figure 2: Pelvic organ prolapse-quantification adapted from Bump *et al*. Six sites (points Aa, Ba, C, D, Bp, Ap) as well as the genital hiatus, total vaginal length and perineal body are all used for quantification of POP (adapted from Bump *et al*., The standardization of terminology of female POP and pelvic floor dysfunction[4])

POP can be staged or graded using the Baden-Walker Classification or the POP-quantification (POP-Q) classification.[3] POP-Q is defined as follows:

- Stage O: No prolapse
- Stage I: Distal prolapse > 1 cm proximal to hymen
- Stage II: Distal prolapse within 1 cm of hymen, either proximal or distal
- Stage III: Distal prolapse >1 cm below hymen without complete eversion
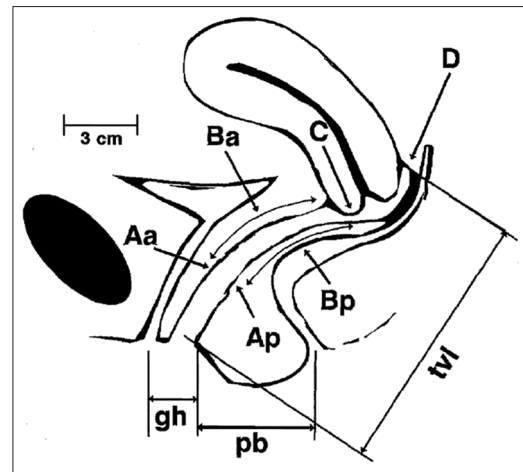- Stage IV: Complete vaginal eversion.

POP-Q uses reference points within the vagina to better characterize the location and level of prolapse [Figure 2].[4]

TREATMENT OPTIONS

The first line treatment for POP is observation. Active treatment is only necessary when patient is bothered enough by her symptoms to desire therapy. A pessary is a non-surgical treatment option for patients wishing to avoid any surgery or for those who wish to see if restoration of support relieves their symptoms prior to considering surgical repair. Surgical options are focused on obliterative versus restorative techniques. The obliterative option is a colpocleisis and reserved for patients who do not wish to maintain any sexual function or want to avoid a more complex repair. Restorative options include transvaginal primary repair with or without mesh, abdominal sacrocolpopexy (ASC), laparoscopic assisted sacrocolpopexy (LASC) and robotic assisted sacrocolpopexy (RASC).[5]

Transvaginal repair
Transvaginal repairs can be performed primarily or with the use of mesh. The vaginal approach uses the sacrospinous ligaments, uterosacral ligaments or iliococcygeus muscles to

regain support of the apex. McCall culdoplasty, first described in 1957, allows for correction of enterocele as well as providing apical support at the level of the uterosacral ligaments with permanent sutures.[6] Sacrospinous ligament suspension can be performed with or without mesh, unilaterally or bilaterally. The apex of the vagina is suspended to the sacrospinous ligament, medially to the ischial spine. Various instruments have been developed to aid in the passage of suture through the sacrospinous ligament, including the Deschamps ligature, Miya hook, Capio™ suture capturing device or the Nichols-Veronikis ligature carrier.

It is important to address all compartments at the time of transvaginal repair. Often when suspending the apex, there is involvement of the anterior and posterior compartments. These compartments often should be addressed at the same time of apical repair.

ASC
The gold standard for the treatment of apical POP has traditionally been ASC. The initial reports of ASC were published by Lane in 1962 where he described using graft material to suspend the vagina from the sacrum.[7] The procedure has been revised to include the attachment of the graft along the full vaginal wall to decrease detachment from the apex of the vagina.[8] Mesh erosions have promoted reduction in the amount of mesh used. The polypropylene Y mesh is the most common configuration now used, allowing for differential tension anteriorly and posteriorly. ASC has been used to treat vaginal vault prolapse as well as perineal descent by extending the posterior arm of the mesh to the level of the perineal body.[9]

Concomitant procedures have become very common during ASC. Culdoplasty is often used to prevent enterocele

and there are reports of concomitant posterior repair by those who do not think they can adequately repair the defect abdominally.[8] Concurrent hysterectomy has been performed with the known increased risk of mesh extrusion at the vaginal cuff. Supracervical hysterectomy can be performed to decrease this risk. The use of concomitant anti-incontinence procedures is discussed later.

Emerging technologies have allowed for more minimally invasive techniques including laparoscopic and RASC. In this article we will focus on reviewing the literature of treatment of POP with RASC, comparing it to outcomes of ASC and transvaginal repair.

MATERIALS AND METHODS

A PubMed literature search was performed using the words "sacrocolpopexy" "robotic sacrocolpopexy" "RASC". Retrospective, prospective and randomized controlled trials in English were reviewed. Meta-analysis criteria could not be applied, as the studies were heterogeneous in their outcomes reporting and length of follow-up. All studies were included regardless of the number of patients.

Robotic sacrocolpopexy
Technique
The use of the daVinci robot in urogynecologic surgery has multiple advantages over laparoscopy since its approval in 2005. This system allows for multiple degrees of freedom to improve manual dexterity and essentially eliminates tremors. It also allows for better visualization with a three-dimensional imaging system. All of these factors allow for a faster learning curve for those already doing laparoscopy and desiring to switch to robotics and for those in training. Multiple studies have looked at the learning curve for RASC.[10-14] Akl *et al.* showed a significant decrease in operative time by 25% after the first ten robotic cases.[10] Geller *et al.* looked at specific steps to the procedure and found that after the first 20 cases, there was significant improvements in times to completion of multiple steps of the procedure.[13]

There are multiple variations to the technique of RASC described, but the general principals remain the same.[10-12,15-27] The patient is placed in the dorsal lithotomy position and pneumoperitoneum is obtained. A 12 mm camera port is placed periumbilically followed by two to three 8 mm robotic ports and one to two assistant ports. The configuration has been described most commonly as a "W" configuration[11,26,28] with two robotic ports lateral to the rectus but inferior to the camera port, one 12 mm assistant port subcostally on the right and one 8 mm robotic port subcostally on the left. Regardless of the port configuration it is critical to keep at least 8-10 cm between ports to prevent collision of the robotic arms. After the ports are placed, patient is placed in steep Trendelenburg position and the robot is docked between the legs at the foot of the bed.

The colon can be reflected laterally using a bowel retraction suture on the left abdominal wall as described by Burgess and Elliott[16] The sacral promontory is then exposed with care taken to avoid the middle sacral artery. A vaginal sizer is used to provide counter-traction on the vagina while dissecting the peritoneum off the posterior vaginal wall and peritoneum and bladder off of the anterior vaginal wall. It is important to carry the anterior dissection as distally as possible to allow for mesh placement to provide maximal support.

Different types of mesh and mesh configurations have been used including Marlex, silastic and polyester. Polypropylene Y mesh is the most common type of mesh used. The mesh is brought in through the assistant port and the short arms of the Y mesh are sutured to the anterior and/or posterior vaginal wall with a non-absorbable suture such as Gor-Tex® or a long lasting absorbable suture.

The peritoneal incision can be carried out to the level of the sacral promontory or the mesh can be tunneled underneath the peritoneum to allow for less area of potential mesh exposure. The long arm of the Y mesh is then attached to the sacral promontory with non-absorbable suture. Most of the authors describe closure of the peritoneum to avoid exposure of mesh to the bowel.[10,15,17-23,25,27,29]

Concomitant procedures
Concomitant procedures have been described in many series of RASC and range from 0% to 87.5%.[10,20-22] Few series of RASC purposely excluded patients with concomitant surgeries to focus on the outcomes of RASC alone.[20-22] When included, these procedures are generally divided into three categories: Hysterectomy, anti-incontinence procedures and vaginal prolapse repairs.

Hysterectomy is the most common procedure associated with RASC with up to 92.5% of patients undergoing concomitant hysterectomy.[11] Many times the hysterectomy is supracervical to avoid exposure of the mesh at the vaginal cuff.[10,11,15,19,23,29,30] On the contrary, Mourik *et al.* described the technique of uterine sparing RASC in a series 40 patients to emphasize that for those wishing to keep their uterus, success rates remain high.[25]

Following hysterectomy, anti-incontinence procedures are the next most common concomitant procedure with RASC. The biggest challenge is determining, which patients will need an anti-incontinence procedure if they do not complain of baseline stress urinary incontinence (SUI). Multiple methods have been used to reduce prolapse in attempts to adequately predict the chance of developing de novo SUI; however, none of these methods have been validated.

Brubaker *et al.* described the use of prophylactic Burch procedures during an ASC and its improvement in SUI rates at 2 years using data from the CARE trial. This advantage was noted both for patients with and without evidence of occult SUI during the pre-operative evaluation.[31] No such trials have been performed with RASC and most series do not report their indication for anti-incontinence procedures– i.e. prophylactic versus symptomatic versus occult SUI. Anti-incontinence procedures described include Burch, mid-urethral prolene tape slings (trans-obturator and retropubic) and autologous fascial slings. Mid-urethral slings are the most common procedure and are performed in up to 70% of patients at the time of RASC.[29] Porta *et al.* recently retrospectively reviewed 152 patients who underwent ASC with a concomitant bladder neck sling, retropubic mid-urethral sling or a transobturator sling and found no significant difference in outcome in patients with overt or occult SUI.[32] There is no data at this point to help surgeons decide, which (if any) incontinence procedure should be performed at the time of RASC.

A few studies report the use of concomitant transvaginal prolapse repair at the time of RASC. Matthews *et al.* describe assessment of patient's vault immediately after the robotic repair is performed to evaluate if there is any significant persistent distal defects or need to reapproximate the genital hiatus.[33] When indicated, the most common concomitant vaginal prolapse repair procedure is a posterior repair, with or without perineorrhaphy in 26% of patients followed by anterior repairs in 8.7% of patients.[19,33] At this point, concomitant vaginal prolapse repair is generally left up to the surgeon and patient preference.

OUTCOMES

When examining the outcomes for prolapse surgery; it is important to differentiate anatomical (i.e. objective outcomes) and subjective outcomes. Anatomic outcomes are generally reported using the Baden-Walker scale or POP-Q with the definition of a successful repair defined as Grade 0-1 or Stage 0-1 prolapse at the time of follow-up. Many times the definition of a successful outcome is not defined. Subjective success is even less well-defined than anatomic success. Multiple series have used validated questionnaires to assess patient's symptoms including Pelvic Floor Distress Inventory-20, POP Incontinence Sexual Questionnaire-12, Pelvic Floor Impact Questionnaire-7, Urinary Distress Inventory-6, IIQ-7, EuroQoL questionnaire-5 Dimensions and the Shona Symptom Questionnaire-8.[4,19,25-27,33-36] Other series simply define subjective success as resolution of prolapse symptoms, which could include bladder, bowel and sexual symptoms.[8,9,37-39]

Transvaginal repair
Transvaginal repair in sexually active women is usually performed with native tissue, which most often includes the sacrospinous fixation (SSF) and uterosacral suspension. Due to the increasing concerns over the use of transvaginal mesh, transvaginal repair with mesh has fallen out of favor and generally reserved for non-sexually active patients. A Cochrane review of surgical treatments for POP revealed that treatment of the anterior compartment with native tissue has a higher risk of recurrence than with the use of mesh with a relative risk (RR:2.0).[5] Compared with SSF, ASC has a lower rate of recurrence (RR:0.23) as well as lower rates of dyspareunia (RR:0.39); however, there was no significant difference in reoperation rates between ASC and transvaginal repair.

Maher *et al.* did a prospective randomized trial of 95 women who underwent ASC or vaginal sacrospinous colpopexy (without mesh) looking at 2 years outcomes.[40] Results revealed that subjective success (as defined by no symptoms of prolapse) were similar 94% versus 91% respectively. Objective success defined as no vaginal prolapse beyond the halfway point of the vagina during a Valsalva maneuver, were not significant at 76% and 69%, respectively. Another comparative trial by Lo and Wang looked at 138 patients also did not show a difference in objective outcomes.[41] This is compared with a prospective randomized trial by Benson *et al.* who found that patients who underwent ASC had higher optimal results defined as symptom free and no prolapse beyond the hymen.[42] There are no RCT of RASC compared to transvaginal repair.

ASC
The anatomic success rates of ASC, as defined by lack of apical prolapse, has been reported ranging from 78% to 100% with follow-up ranging from 6 months to 3 years.[43] If one defines success as no apical prolapse, the rates range from 58% to 100%. It is important to understand that these rates are specifically looking at apical prolapse and not the entire vaginal vault. Some surgeons do not address the anterior and posterior compartments at the time of ASC, thus these compartments could potentially have residual prolapse. Anatomic success rates based on patient satisfaction are much more difficult to assess due to inconsistent methods of reporting. The most recent data published by Nygaard *et al.* reported on the long-term outcomes of ASC from the CARE trial.[34] After a median of 7 years of follow-up, the probability of anatomic failure was 0.22-0.27 and the probability of symptomatic failure was 0.24-0.29.

There is limited data on post-operative bowel function after ASC as many times it is not reported and when reported the data is inconsistent. Cundiff *et al.* report when attaching mesh down to the level of the perineal body, about 67% of women had relief of bowel symptoms.[9] Others have shown increased rates of constipation post-operatively from 29% to 52%[37] as well as de novo constipation ranging from 16% to

26%.[38,39] The data on sexual function is also limited and inconsistent with some showing improvement and some showing worsening of symptoms.[37,38] This data is difficult to assess as there are very few patients in these studies.

RASC

There are 18 series that describe anatomical outcomes for RASC [Table 1]. Follow-up is anywhere from 6 weeks to 44.2 months. A few series defined anatomic success on POPQ or Baden-Walker; however, criterion of success were poorly defined in many of these papers.[11,14,19,25,27-29,33] Success rates have been reported at anywhere from 79% to 100%. 2-10% of patients require a concomitant surgery for recurrent prolapse, which can occur anteriorly, apically or posteriorly.[12,18] Furthermore, 1-9% of patients subsequently required an additional procedure for recurrence of POP.[10,12,14,15,18,22,29,33,35,36]

Subjective success and patient satisfaction has been reported to a range between 88% and 97%. It is difficult to compare subjective outcomes with such variability in the use of validated outcomes measures.

There are few studies comparing outcomes of RASC to the gold standard ASC. Geller *et al*. reported the longest comparative outcomes data on RASC versus ASC at 44 months.[19] There was no difference in subjective or objective outcomes in these patients. Siddiqui looked at data from the CARE trial and compared these patients with RASC at 1 year and found no difference in symptomatic or anatomic outcomes.[14]

In 2011, Paraiso *et al*. published the only randomized-controlled trial comparing RASC to LASC. They compared 38 patients who underwent LASC to 40 patients who underwent RASC and found that RASC had longer operative times and increased need for pain medication post-operatively compared to LASC.[26] The two groups did not differ in terms of functional outcomes at 1 year. In contrast, Awad *et al*. retrospectively compared RASC to LASC and found that RASC had no difference in operative time or adverse events and less EBL and shorter hospital stay.[11] In addition, Seror prospectively evaluated these two approaches to sacrocolpopexy and reported less EBL and similar operative time in RASC compared with LASC with no difference in anatomic outcomes at 16 months.[27]

Table 1: Anatomic outcomes

Author	No. patients (lost to f/u)	Follow-up (months)	Success rate %	Success rate criteria	Surgery for recurrent POP	Comments
Awad[11]	40	3	100	POPQ Stage 0-1	0	3 months data only
Bedaiwy[12]	41	3	98	Not defined	2% (anterior)	Study focused on learning curve
Benson[15]	33	38.4	97	Not defined	3% (apical)	
DiMarco[17]	5	4	100	Not defined	0	
Elliot[46]	40	N/A	100	Not defined	0	Cost analysis study
Elliot[18]	30 (9)	24	95	"Speculum exam"	10% (vault, posterior)	
Geller 1[19]	31 (8)	44.2	79-100	POPQ Stage 0-1 Point C ≤−5 Vag length 7	0	ASC versus RASC
Geller[28]	73	1.5	100	POPQ	0	ASC versus RASC
Germain[20]	52	42	90	Not defined	2%	
Göçmen[21]	12	12	100	Not defined	0	
Kramer[22]	21	25.2	95	No recurrent apical prolapse	5% (apex)	Patients underwent apical repair alone
Louis-sylvestre[23]	90	16.5	94	Not defined	0	
Paraiso[26]	40 (8)	N/A	88	Stage 0-1	0	RCT LASC versus RASC
Matthews[33]	85	N/A	94	POPQ	1 (posterior)	
Morena[24]	31	24.5	100	Not defined	0	
Mourik[25]	50 (8)	16	98	BW Grade 0-1	2%	Uterine sparing RASC
Salamon[29]	118	N/A	89	POPQ Stage 0-1	1%	
Seror[27]	20	15	95	BW Grade 0-1	None	LASC versus RASC
Siddiqui[14]	125 (84)	18.3	92	POPQ Point C <−2 Aa, Ba, Ap, BP<0	3.6% (posterior)	ASC versus RASC using CARE trial data

POP=Pelvic organ prolapse, ASC=Assisted sacrocolpopexy, RASC=Robotic assisted sacrocolpopexy, LASC=Laparoscopic assisted sacrocolpopexy, RCT=Randomized controlled trial, CARE=Colpopexy and urinary reduction efforts, POPQ=Pelvic organ prolapse quantification

COMPLICATIONS

Complications can be divided into perioperative complications and long-term complications. Most of the noted complications can occur with transvaginal repair, ASC or RASC and are not specific to technique.

One unique complication to any minimally invasive surgery is the need to convert to an open procedure, which has been shown to be 1-5%.[10,18,20,25-27,33] Interestingly, Paraiso *et al.* reported two cases that were converted to LASC due to robot malfunction.[26]

Most common perioperative complications for RASC are listed in Table 2. The most common reported complication was post-operative urinary retention in Bedaiwy *et al.* series of 41 patients where 15 patients (36%) had urinary retention post-operatively.[12] Of note 66% of these patients underwent a concomitant sling. Other common complications include urinary tract infection (UTI) in 2-14%[12,20,26,27,33] vaginal mucosal injury in 1-14%,[20,23,36] intraoperative bladder injury in 1-10%[10,12,14,20,23,26,28,33] and port site infection in 2-10%.[14,18,20,24,26,28] Kramer *et al.* and Benson *et al.* describe bowel obstructions occurring due to small bowel migrating behind the mesh.[15,22] This prompted a change in their technique to reperitonealize the mesh. Cardio-pulmonary complications have also been described including pulmonary edema, pulmonary embolization, myocardial infarction, arrhythmia and pneumonia.[12,14,24,28,33]

Specifically looking at the elderly population, Robinson *et al.* retrospectively reviewed 136 women over 65 and found that women undergoing RASC tend to be younger with less comorbidities, but similar ASA scores than those who underwent transvaginal repair.[44] Perioperatively the patients who underwent RASC had fewer post-operative complications with similar severity of complications but the overall complication rate was low.

Mesh complications are another concerning complication in prolapse surgery. A Cochrane review reveals that ASC has lower rates of dyspareunia than transvaginal mesh repairs.[5] The authors also reviewed three articles of transvaginal mesh repairs and found an overall mesh erosion rate of 18%, with 9% of these patients undergoing surgical correction. Erosion or extrusion has been reported in 0-10% of patients undergoing RASC.[10,12,14,18,19,23,25,26,30,33,35,36] Most of these patients were treated conservatively with the use of transvaginal hormones as an initial therapy for transvaginal mesh exposure.[19,35] However, 1-10% of all patients ultimately required return to the operating room for mesh removal, which was most often performed transvaginally.[10,12,14,18,23,33,36]

COST

Transvaginal techniques for prolapse repair have been utilized for their decreased operative time, decreased morbidity with a faster return to activities and in turn have been shown to decrease the cost.[40] The Cochrane review determined the procedure time is faster, hospital stays are shorter and the cost is decreased when performing transvaginal repair versus ASC, at the potential burden of poorer outcomes.[5]

Although minimally invasive techniques may provide comparable outcomes to open techniques, a concern with the use of advancing technology is cost. Judd *et al.* reported a cost-minimization analysis in 2010 based on data from previously published studies. The cost of RASC is greater than LASC or ASC despite a shorter hospital stay.[45] The biggest contributing factor was operating room time and cost of disposable equipment for the robot. Similarly, Paraiso *et al.*. used data from their RCT which showed that RASC has a higher cost than LASC, again driven by operating room costs.[26] In contrast, a cost-minimization analysis by Elliot *et al.*. from 2012 showed a 10% cost savings with RwWASC over ASC.[46] The factors that allowed for cost savings were a significantly shorter hospital stay in a hospital with large volume of cases. Of note, the difference in hospital stay between the two groups was 2.3 days and less patients in the RASC had concomitant procedures (89% vs. 58%). A randomized comparative effectiveness trial comparing costs of LASC and RASC (ACCESS trial) data has yet to be published.[47]

CONCLUSIONS

The surgical approach to treatment of POP has expanded with the use of minimally invasive surgery. Transvaginal

Table 2: Perioperative complications of RASC

Complication	Rates reported %
Bladder injury[10,12,14,20,23,26-28,33]	1-10
Bowel injury[10,20,23,25,33]	1-3
Ureteral injury[10]	1.2
Ileus[10,12,14,19,24,26,29]	1-6
Pelvic abscess[10,26]	1-1.2
Port site hematoma[11]	5
Urinary retention[12]	36
Fever[12,14,28]	4.1-5
UTI[12,20,26-27,33]	2-14
Cuff dehiscence[12]	2
Cardio-pulmonary issues[12,14,24,28,33]	1-4.1
Vaginal mucosal injury[20,23,36]	1-14
Bowel obstruction RTOR[15,22]	5-6
Port site infection[14,18,20,24,26,28]	2-10
Transfusion[14,28]	0.8-1.4
Nerve palsy[25]	2

RASC=Robotic assisted sacrocolpopexy, UTI=Urinary tract infection, RTOR=Return to operating room

approaches are less invasive, but that may be offset by lower long-term success rates without mesh and significant complication rates if the mesh is used. The gold standard ASC provides excellent durable anatomic outcomes, but with higher morbidity and increased cost compared to transvaginal repair. RASC allows for comparable outcomes with decreased morbidity; however, there is a question of further increased cost. It is important to discuss all options with patients and manage their expectations appropriately for optimal outcomes.

REFERENCES

1. Olsen AL, Smith VJ, Bergstrom JO, Colling JC, Clark AL. Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. Obstet Gynecol 1997;89:501-6.
2. DeLancey JO. Anatomic aspects of vaginal eversion after hysterectomy. Am J Obstet Gynecol 1992;166:1717-24;1724.
3. Kobashi K. Evaluation of patients with urinary incontinence and pelvic organ prolapse. In: Wein AJ, Kavoussi LR, Novick AC, Partin AW, Peters CA editors. Campbell-Walsh Urology. 10th ed. Philadelphia: WB Saunders; 2012. p. 1896-908.
4. Bump RC, Mattiasson A, Bø K, Brubaker LP, DeLancey JO, Klarskov P, *et al*. The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction. Am J Obstet Gynecol 1996;175:10-7.
5. Maher C, Feiner B, Baessler K, Schmid C. Surgical management of pelvic organ prolapse in women. Cochrane Database Syst Rev 2013;4:CD004014.
6. Karram MM, Walters MD. Surgical treatment of vaginal vault prolapse and enterocele. In: Walters MD, Karram MM, editors. Urogynecology and Reconstructive Pelvic Surgery. 3rd ed. Philadelphia: Mosby Elsevier; 2007. p. 262-87.
7. Lane FE. Repair of posthysterectomy vaginal-vault prolapse. Obstet Gynecol 1962;20:72-7.
8. Snyder TE, Krantz KE. Abdominal-retroperitoneal sacral colpopexy for the correction of vaginal prolapse. Obstet Gynecol 1991;77:944-9.
9. Cundiff GW, Harris RL, Coates K, Low VH, Bump RC, Addison WA. Abdominal sacral colpoperineopexy: A new approach for correction of posterior compartment defects and perineal descent associated with vaginal vault prolapse. Am J Obstet Gynecol 1997;177:1345-53.
10. Akl MN, Long JB, Giles DL, Cornella JL, Pettit PD, Chen AH, *et al*. Robotic-assisted sacrocolpopexy: Technique and learning curve. Surg Endosc 2009;23:2390-4.
11. Awad N, Mustafa S, Amit A, Deutsch M, Eldor-Itskovitz J, Lowenstein L. Implementation of a new procedure: Laparoscopic versus robotic sacrocolpopexy. Arch Gynecol Obstet 2013;287:1181-6.
12. Bedaiwy MA, Abdelrahman M, Deter S, Farghaly T, Shalaby MM, Frasure H, *et al*. The impact of training residents on the outcome of robotic-assisted sacrocolpopexy. Minim Invasive Surg 2012;2012:289342.
13. Geller EJ, Lin FC, Matthews CA. Analysis of robotic performance times to improve operative efficiency. J Minim Invasive Gynecol 2013;20:43-8.
14. Siddiqui NY, Geller EJ, Visco AG. Symptomatic and anatomic 1-year outcomes after robotic and abdominal sacrocolpopexy. Am J Obstet Gynecol 2012;206:435.e1-5.
15. Benson AD, Kramer BA, Wayment RO, Schwartz BF. Supracervical robotic-assisted laparoscopic sacrocolpopexy for pelvic organ prolapse. JSLS 2010;14:525-30.
16. Burgess KL, Elliott DS. Robotic/Laparoscopic prolapse repair and the role of hysteropexy: A urology perspective. Urol Clin North Am 2012;39:349-60.
17. Di Marco DS, Chow GK, Gettman MT, Elliott DS. Robotic-assisted laparoscopic sacrocolpopexy for treatment of vaginal vault prolapse. Urology 2004;63:373-6.
18. Elliott DS, Krambeck AE, Chow GK. Long-term results of robotic assisted laparoscopic sacrocolpopexy for the treatment of high grade vaginal vault prolapse. J Urol 2006;176:655-9.
19. Geller EJ, Parnell BA, Dunivan GC. Robotic vs abdominal sacrocolpopexy: 44-month pelvic floor outcomes. Urology 2012;79:532-6.
20. Germain A, Thibault F, Galifet M, Scherrer ML, Ayav A, Hubert J, *et al*. Long-term outcomes after totally robotic sacrocolpopexy for treatment of pelvic organ prolapse. Surg Endosc 2013;27:525-9.
21. Göçmen A, Sanlıkan F, Uçar MG. Robotic-assisted sacrocolpopexy/sacrocervicopexy repair of pelvic organ prolapse: Initial experience. Arch Gynecol Obstet 2012;285:683-8.
22. Kramer BA, Whelan CM, Powell TM, Schwartz BF. Robot-assisted laparoscopic sacrocolpopexy as management for pelvic organ prolapse. J Endourol 2009;23:655-8.
23. Louis-Sylvestre C, Herry M. Robotic-assisted laparoscopic sacrocolpopexy for stage III pelvic organ prolapse. Int Urogynecol J 2013;24:731-3.
24. Moreno Sierra J, Ortiz Oshiro E, Fernandez Pérez C, Galante Romo I, Corral Rosillo J, Prieto Nogal S, *et al*. Long-term outcomes after robotic sacrocolpopexy in pelvic organ prolapse: Prospective analysis. Urol Int 2011;86:414-8.
25. Mourik SL, Martens JE, Aktas M. Uterine preservation in pelvic organ prolapse using robot assisted laparoscopic sacrohysteropexy: Quality of life and technique. Eur J Obstet Gynecol Reprod Biol 2012;165:122-7.
26. Paraiso MF, Jelovsek JE, Frick A, Chen CC, Barber MD. Laparoscopic compared with robotic sacrocolpopexy for vaginal prolapse: A randomized controlled trial. Obstet Gynecol 2011;118:1005-13.
27. Seror J, Yates DR, Seringe E, Vaessen C, Bitker MO, Chartier-Kastler E, *et al*. Prospective comparison of short-term functional outcomes obtained after pure laparoscopic and robot-assisted laparoscopic sacrocolpopexy. World J Urol 2012;30:393-8.
28. Geller EJ, Siddiqui NY, Wu JM, Visco AG. Short-term outcomes of robotic sacrocolpopexy compared with abdominal sacrocolpopexy. Obstet Gynecol 2008;112:1201-6.
29. Salamon CG, Lewis C, Priestley J, Gurshumov E, Culligan PJ. Prospective study of an ultra-lightweight polypropylene Y mesh for robotic sacrocolpopexy. Int Urogynecol J 2013;24:1371-5.
30. 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;18:86-8.
31. Brubaker L, Nygaard I, Richter HE, Visco A, Weber AM, Cundiff GW, *et al*. Two-year outcomes after sacrocolpopexy with and without burch to prevent stress urinary incontinence. Obstet Gynecol 2008;112:49-55.
32. Porta W, Tubre R, Frilot II CF, Gomelsky A. Optimal sling at the time of open abdominal sacral colpopexy: A comparison of 3 procedures[abstract]. J Urol 2013;189:e231.
33. Matthews CA, Carroll A, Hill A, Ramakrishnan V, Gill EJ. Prospective evaluation of surgical outcomes of robot-assisted sacrocolpopexy and sacrocervicopexy for the management of apical pelvic support defects. South Med J 2012;105:274-8.
34. 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;309:2016-24.
35. Geller EJ, Parnell BA, Dunivan GC. Pelvic floor function before and after robotic sacrocolpopexy: One-year outcomes. J Minim Invasive Gynecol 2011;18:322-7.
36. Belsante M, Murray S, Dillon B, Zimmern P. Mid term outcome of robotic mesh sacrocolpopexy. Can J Urol 2013;20:6656-61.
37. Pilsgaard K, Mouritsen L. Follow-up after repair of vaginal vault prolapse with abdominal colposacropexy. Acta Obstet Gynecol Scand 1999;78:66-70.

38. Virtanen H, Hirvonen T, Mäkinen J, Kiilholma P. Outcome of thirty patients who underwent repair of posthysterectomy prolapse of the vaginal vault with abdominal sacral colpopexy. J Am Coll Surg 1994;178:283-7.

39. Geomini PM, Brölmann HA, van Binsbergen NJ, Mol BW. Vaginal vault suspension by abdominal sacral colpopexy for prolapse: A follow up study of 40 patients. Eur J Obstet Gynecol Reprod Biol 2001;94:234-8.

40. Maher CF, Qatawneh AM, Dwyer PL, Carey MP, Cornish A, Schluter PJ. Abdominal sacral colpopexy or vaginal sacrospinous colpopexy for vaginal vault prolapse: A prospective randomized study. Am J Obstet Gynecol 2004;190:20-6.

41. Lo TS, Wang AC. Abdominal colposacropexy and sacrospinous liegament suspension for severe uterovaginal prolapse: A comparison. J Gynecol Surg 1998;14:59-64.

42. Benson JT, Lucente V, McClellan E. Vaginal versus abdominal reconstructive surgery for the treatment of pelvic support defects: A prospective randomized study with long-term outcome evaluation. Am J Obstet Gynecol 1996;175:1418-21.

43. Nygaard IE, McCreery R, Brubaker L, Connolly A, Cundiff G, Weber AM, *et al*. Abdominal sacrocolpopexy: A comprehensive review. Obstet Gynecol 2004;104:805-23.

44. Robinson BL, Parnell BA, Sandbulte JT, Geller EJ, Connolly A, Matthews CA. Robotic versus vaginal urogynecologic surgery: A retrospective cohort study of perioperative complications in elderly women. Female Pelvic Med Reconstr Surg 2013;19:230-7.

45. Judd JP, Siddiqui NY, Barnett JC, Visco AG, Havrilesky LJ, Wu JM. Cost-minimization analysis of robotic-assisted, laparoscopic, and abdominal sacrocolpopexy. J Minim Invasive Gynecol 2010;17:493-9.

46. Elliott CS, Hsieh MH, Sokol ER, Comiter CV, Payne CK, Chen B. Robot-assisted versus open sacrocolpopexy: A cost-minimization analysis. J Urol 2012;187:638-43.

47. Mueller ER, Kenton K, Tarnay C, Brubaker L, Rosenman A, Smith B, *et al*. Abdominal colpopexy: Comparison of endoscopic surgical strategies (ACCESS). Contemp Clin Trials 2012;33:1011-8.

Author Help: Reference checking facility

The manuscript system (www.journalonweb.com) allows the authors to check and verify the accuracy and style of references. The tool checks the references with PubMed as per a predefined style. Authors are encouraged to use this facility, before submitting articles to the journal.

- The style as well as bibliographic elements should be 100% accurate, to help get the references verified from the system. Even a single spelling error or addition of issue number/month of publication will lead to an error when verifying the reference.
- Example of a correct style
  Sheahan P, O'leary G, Lee G, Fitzgibbon J. Cystic cervical metastases: Incidence and diagnosis using fine needle aspiration biopsy. Otolaryngol Head Neck Surg 2002;127:294-8.
- Only the references from journals indexed in PubMed will be checked.
- Enter each reference in new line, without a serial number.
- Add up to a maximum of 15 references at a time.
- If the reference is correct for its bibliographic elements and punctuations, it will be shown as CORRECT and a link to the correct article in PubMed will be given.
- If any of the bibliographic elements are missing, incorrect or extra (such as issue number), it will be shown as INCORRECT and link to possible articles in PubMed will be given.