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MINIREVIEW

Laparoscopic surgical repair of pelvic organ prolapse and female stress urinary incontinence

Panagiotis I Mourmouris, Andreas Skolarikos, Iraklis C Mitsogiannis, Vasileios Migdalis, Athanasios G Papatsoris

Panagiotis I Mourmouris, Andreas Skolarikos, Iraklis C Mitsogiannis, Athanasios G Papatsoris, 2nd Department of Urology, School of Medicine, University of Athens, Sismanoglio General Hospital, 14578 Athens, Greece
Vasileios Migdalis, 1st Department of Urology, School of Medicine, University of Athens, Laiko General Hospital, 14578 Athens, Greece
Author contributions: Mourmouris PI, Skolarikos A, Mitsogiannis IC, Migdalis V and Papatsoris AG contributed to this paper.
Correspondence to: Dr. Athanasios G Papatsoris, 2nd Department of Urology, School of Medicine, University of Athens, Sismanoglio General Hospital, 1 Sismanogleiou Street, 14578 Athens, Greece. agpapatsoris@yahoo.gr
Telephone: +30-210-8044703 Fax: +30-210-8044703
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Core tip: Laparoscopic approaches in urologic surgery have become over the years very popular. Novel laparoscopic expertise is continuously acquired in many different surgical fields such as pelvic organ prolapse (POP). We summarize the relevant literature upon the laparoscopic surgical repair of POP and female stress urinary incontinence.

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Abstract

Pelvic organ prolapse (POP) occurs in a relatively big population of women which is continuously increasing and is associated with a variety of urinary bowel and sexual symptoms. As this problem magnifies, the need for surgical repair is increasing relatively. The main goals of surgical repair for POP include: no anatomic prolapse, no functional symptoms, patient satisfaction and avoidance of complications, goals that cannot always be fully achieved. The decision for the type of surgery depends of various factors such as patient characteristics and prolapsed compartment but also by the surgeon expertise. The laparoscopic approach is already the gold standard procedure for many urologic procedures and can also be used for the treatment of POP and stress urinary incontinence. Herein, we review the literature about the available data concerning laparoscopic surgery techniques for treating POP.

Key words: Pelvic organ prolapse; Laparoscopic; Minimal invasive; Repair

INTRODUCTION

Pelvic organ prolapse (POP) is defined as the descent of one or more of the following: anterior vaginal wall, posterior vaginal wall and apex of the vagina (cervix/uterus) or vault (cuff) after hysterectomy. Absence of prolapse is defined as POP stage 0, while POP can be staged from stage I to stage Ⅳ. POP occurs in up to 50% of parous women and may be associated with a variety of urinary bowel and sexual symptoms[1]. The prevalence of POP is currently increasing and the lifetime risk of requiring surgery for POP is more than 10%[1]. The main goals of surgical repair for POP is to achieve no anatomic prolapse, no functional symptoms, patient satisfaction and avoidance of complications, goals that usually cannot be fully established[2]. The available surgical techniques in correlation with the relevant anatomical compartments are listed in Table 1.

Laparoscopic approach is the gold standard operation for many urological clinical entities. In POP the laparoscopic approach has the advantage of allowing a very good view of the anterior and posterior compartments so that an overall approach for POP is possible by the

same surgical route[3]. There have been described over 100 different approaches for the repair of the POP. The decision for the type of surgery depends on the compartments that are affected and the patient characteristics. The laparoscopic approach for the surgical treatment of POP was introduced to treat the three compartment defects with the objectives of being less invasive than open surgery, of easier magnified access to the pelvis with less blood and shorter postoperative convalescence.

We performed a search at PubMed and Cochrane databases for articles concerning surgery repair of POP and laparoscopic approaches published between 1970 and 2013. We used as key words the terms: POP, laparoscopic, minimal invasive techniques and robotic assisted laparoscopic techniques. We studied all the relevant articles and we analyzed the ones with the biggest series.

LAPAROSCOPIC RETROPUBIC SUSPENSION

Laparoscopic techniques for retropubic suspension were introduced by Vancaillie and Schuessler in 1991. They performed a Marshall Marchetti-Krantz urethropexy laparoscopically and since then laparoscopic techniques have been applied to both the Burch procedure and the paravaginal repair. Proposed advantages of the laparoscopic approach include improved intraoperative visualization, less postoperative pain, shorter hospitalization and quicker recover times[4]. Disadvantages include greater technical difficulty, longer operative times and higher operative costs[5]. The procedure may be performed extraperitoneally or transperitoneally and each approach has its proponents. Although extraperitoneal technique may be associated with shorter operating times, easier dissection and fewer bladder injuries[6] the transperitoneal approach provides a larger operating space and the ability to perform concomitant intraperitoneal procedures and apical prolapsed repair[5].

Paraiso *et al*[5] reviewed 13 studies of laparoscopic retropubic suspensions, reported success rates from 69% to 100% with follow up of 1 to 36 mo and these rates are comparable to the outcomes of open procedures. Both retrospective[7] and randomized prospective trials[8] between open and laparoscopic techniques have demonstrated similar short term success rates. However when following patients for a longer time, laparoscopic suspensions tend to fail in comparison with open surgery. McDougall *et al*[9] reported only 30% recovery of stress urinary incontinence (SUI) and 50% cure with a laparoscopic Burch procedure after 45 mo of follow up.

Five trials summarized in a Cochrane review compared laparoscopic with open colposuspension[8,10-13]. Overall, there was a significantly higher success rate after open colposuspension (RR = 0.89; 95%CI: 0.82-0.98) equivalent to an absolute difference of an additional 9% risk of failure after laparoscopic surgery. No significant differences between the two groups were observed for postoperative urgency, voiding dysfunction, or *de novo* detrusor overactivity. A trend was shown toward a higher complication rate, less postoperative pain, shorter hospital stay, and more rapid return to normal function for laparoscopic colposuspension. The operating time tended to be longer, the intraoperative blood loss less, and the duration of catheterization shorter for laparoscopic compared with open colposuspension. Carey *et al*[12] published a randomized trial upon 200 women during 1997 and 1998, with 2-year follow-up available for 83% of participants. The authors found no difference in urodynamic studies outcome, incidence of detrusor overactivity, or patient satisfaction at 6 mo, with an overall objective cure rate of 75%. Detrusor overactivity was recorded in 12% of the women. The overall satisfaction rate was 87%. At 24 mo after surgery there were no significant differences between the two treatment groups with respect to reporting SUI, urgency, and urgency incontinence and a satisfaction score of greater than or equal to 80. Although follow-up information was only available on approximately 80% of all patients by 24 mo, a sensitivity analysis was performed assuming that all women who did not complete the 24-mo follow-up had either occasional or frequent SUI. With these assumptions, cure rates decreased to 61% for open colposuspension and 50% for laparoscopic colposuspension. There were no significant differences between the two treatment groups at 3 to 5 years after surgery. Mean operating time was approximately twice as long for laparoscopic colposuspension, but surgeon's estimates of blood loss and patient's estimates of immediate postoperative pain at rest were significantly less after the laparoscopic procedure with a return to normal activities, 5 d earlier ($P = 0.01$). Kitchener *et al*[14] also found no difference in the objective cure rate (79% for laparoscopic *vs* 70% for open) or subjective cure rate (55% *vs* 54%) between the study arms. The intention-to-treat analysis indicated no significant difference in cure rates between open and laparoscopic surgery.

In a meta-analysis of all of the comparative studies published between 1995 and 2006 of laparoscopic *vs* open colposuspension, 16 studies matched the selection criteria of 1807 patients, of whom 861 (47.6%) underwent laparoscopic and 946 (52.4%) underwent open colposuspension[15]. The length of hospital stay and return to normal life were significantly reduced after laparoscopic surgery. These findings remained consistent on sensitivity analysis. Bladder injuries occurred more often in the laparoscopic group, but only with a marginal statistical significance. Comparable bladder injury rates were found when studies were matched for quality, year, and randomized trials. Cure rates were similar between the two procedures at 2 years follow-up. Table 2 summarizes the available data in laparoscopic retropubic suspension.

The current evidence suggests that in adequately experienced hands there is no difference in overall safety and efficacy between laparoscopic and open colposuspension. Laparoscopic colposuspension shows comparable subjective outcome, but poorer objective outcome

Table 1 Surgical repair of pelvic organ prolapse

Compartment	Prolapsed organ	Vaginal wall site	Abdominal repair
Anterior	Urethra	Distal anterior vaginal wall	Retropubic urethropexy
Anterior	Bladder (cystocele)	Proximal and distal anterior vaginal wall	Paravaginal repair
Middle	Cervix	Cervix	Abdominal sacrocolpopexy
Middle	Small bowel (enterocele)	Ureterosacral scar	Halban culdoplasty
Posterior	Small bowel AP (enterocele)	Proximal posterior vaginal wall	Colpoperineopexy
Posterior	RectumBp (rectocele)	Proximal and distal posterior vaginal wall	NA
Posterior	Perineal body	Perineal Body	NA

NA: Not available.

Table 2 Laparoscopic retropubic suspension overview

Ref.	*n*	Follow up (mo)	Objective cure rate (%)	Satisfaction rate (%)
Paraiso *et al*[5]	150	1-36	69-100	NA
McDougall *et al*[9]		45	30	NA
Carey *et al*[12]	200	24-60	50	87
Kitchener *et al*[14]	291	24	79	NA
Tan *et al*[15]	861	24	NA	NA

NA: Not available.

Table 3 Laparoscopic promontofixation overview

Ref.	*n*	Mean follow up (mo)	Objective cure rate (%)	Recurrence rate (%)
Bacle *et al*[18]	501	20.7	NA	11.5
Ganatra *et al*[19]	1197	24.6	NA	10
Sabbagh *et al*[20]	186	60	92.4	NA
Rivoire *et al*[21]	138	33.7	64	NA
Maher *et al*[23]	108	24	77	5

NA: Not available.

than both open colposuspension and tension-free vaginal tape procedure in the short to medium term follow.

LAPAROSCOPIC PROMONTOFIXATION

The wide spectrum of open and laparoscopic surgical approaches used to treat POP represented the complexity of managing this medical condition[16]. Irrespective of the route or repair chosen by the surgeon, a sound surgical judgment, complete understanding of the pelvic anatomy and the mechanisms involved in POP are required for a successful outcome[17].

Recently, Bacle *et al*[18] studied prospectively 501 consecutive patients that underwent laparoscopic promontofixation (LP) for POP. They reported a 1.7% intraoperative compilations rate and after a mean follow up of 20.7 mo the complications rate was 17.8% and the recurrence rate was 11.5%. Risk factors for recurrence were the prolypropylene mesh when compared with the polyester mesh ($P < 0.0001$), intra-operative hysterectomy ($P = 0.02$) and bleeding ($P = 0.0049$). The authors concluded in a statistically significant improvement in most of the symptoms ($P < 0.001$). Ganatra *et al*[19] reviewed 11 laparoscopic studies that included 1197 patients and reported a 10% recurrence rate for POP. In this study the mean incidence of vaginal erosion was 2.7%. Sabbagh *et al*[20] performed a retrospective study of 186 consecutive women who underwent LP for POP. The median follow up was 60 mo with a success rate of 92.4%, complications rate up to 6% and satisfaction rate up to 91.1%.

Rivoire *et al*[21] performed LP in 138 patients with POP. The follow up was 33.7 mo with a recurrence rate at 11%, while 98% of patients were satisfied with the operation but the postoperative SUI rate was 46%. White *et al*[22] in their study of 30 patients concluded that there was no significant difference with respect to the operative time, blood loss, pain score and duration of hospitalization between laparoscopic and robotic assisted approaches. They concluded that laparoscopic and robotic assisted sacral colpopexy offered comparable efficacy and superior cosmetic results compared to open approaches.

Recently, Maher *et al*[23] compared laparoscopic sacral colpopexy to total mesh placement for vaginal vault prolapsed. In this randomized study of 108 patients the laparoscopic group had a shorter hospitalization period and quicker return to work while the follow up of 2 years showed a 77% success rate at all vaginal site for laparoscopic sacral colpopexy as compared with 43% for total vaginal mesh ($P < 0.001$). The re-operation rate was significantly higher after the vaginal mesh surgery (22%) as compared to the laparoscopic sacral colpopexy (5%) ($P = 0.006$). The authors concluded that laparoscopic sacral colpopexy provided higher success rates and lower perioperative morbidity and re-operation rates in comparison with the total vaginal mesh procedure. The overview of the above results are summarized in Table 3.

LAPAROSCOPIC PLACEMENT OF THE ARTIFICIAL URINARY SPHINCTER FOR SUI

The first clinical report of laparoscopic transperitoneal artificial urinary sphincter (AUS) implantation in women was published by Ngninkeu *et al*[24]. In this study the authors reported their preliminary results (mean follow up 6 mo) of treating four women with SUI due intrinsic sphincter deficiency (ISD) with implantation of the

AMS 800 AUS. The aim was to evaluate the efficacy and safety of the AMS 800 implanted by the transperitoneal laparoscopic approach. The primary inclusion criterion for this study was a negative Marshall test (urine leakage on straining or coughing not corrected with vaginal elevation)[25]. Patients in whom bladder overactivity was diagnosed were excluded from the study. The age of the patients was 50 to 79 years old, while the same surgeon performed all the procedures. Three trocars were inserted into the left iliac fossa, at midline halfway between the umbilicus and the pubis and into the right iliac fossa. The first step was the anterior approach to the bladder followed by dissection of the periurethral fascia and of the bladder neck from the vagina. The next step was the placement of the cuff and the pump. Finally, the balloon was introduced at the left lateral space of the bladder. The connections were performed and the device was deactivated. The activation of the device took place after 6 to 8 wk. All the cases were successfully completed within 2-2.5 h except from one. The urethral catheter remained for 7 d, while in one patient the symptoms persisted and the AUS balloon was replaced. All the patients had functioning devices at the end of the study. None of the patients experienced any preoperative or postoperative complications.

Hoda *et al*[26] used an extraperitoneal laparoscopic approach for the implantation of the AMS 800 sphincter in two women with high body mass index (BMI) and significant co-morbidities. The technique of the surgeon involved the placement of balloon trocars in the preperitoneal space, complete mobilization of the bladder neck, placement of the cuff at the bladder neck, insertion from the same port of the AUS balloon and placement of the pump in a pocket in the right labia major. The urethral catheter remained 2 d but one patient after the catheter removal experienced urinary retention and for 1 wk he performed intermittent self catheterization. The mean operating time was 117 min and patients were discharged after 5-6 d. The activation of the AUS occurred 6 wk after surgery. One patient developed an abdominal wall hematoma which resulted in protrusion of the tubes from the suprapubic incision and secondary healing. Nearly 5 to 8 mo postoperatively both patients were continent. The authors concluded that the laparoscopic AUS implantation is a feasible and safe method but in order to achieve optimal results a careful patient selection must occur.

Rouprêt *et al*[27] reported their preliminary results with the laparoscopic approach for AUS implantation in 12 women with SUI due to ISD. The inclusive criterion for this study was a negative Marshall test associated with a low urethral closure pressure. Nine cases underwent laparoscopic extraperitoneal implantation of AUS and three of them the transperitoneal approach. Three procedures were converted to open and one was abandoned. Eleven patients out of 12 had a history of an anti-incontinence surgery. The extraperitoneal approach was performed with two trocars placed medially to the anterior superior iliac spines and one trocar placed at the midpoint between the pubis and umbilicus. After identifying the bladder neck the surgeon entered the endopelvic fascia on both sides. The next step was the dissection of the bladder neck below the periurethral fascia and the cuff was positioned and pressurized. The balloon was introduced through the iliac fossa mini incision and placed at the right of the bladder and after that the pump was placed into the labia major. The last step was to make the connections and deactivate the device. The mean operative time was 181 min with no significant blood loss. The mean hospital stay was 7 d. The AUS activation was done at a mean period of 40.6 d. During the mean follow up of 12 mo 11 patients had a functioning device and the SUI was resolved in 10 patients. The remaining woman improved, but had a persistent degree of SUI (1 pad/d). Urinary retention occurred in 5 out of 12 patients (45%) and in 3 patients the authors encountered intra-operative injuries (25%). No postoperative erosion or device malfunctions during the follow up. The authors concluded that the laparoscopic implantation of AUS in women appeared to be technically feasible and that the results were promising.

Recently, Mandron *et al*[28] published the results in 25 patients that underwent laparoscopic implantation of AUS for SUI with ISD. This study is the largest in terms of patients (25 patients) and follow up (26.1 mo). The mean BMI was 26.8 and all patients had a negative Marshall test. All patients had a history of anti-incontinence and or pelvic surgery. All operations started with the placement of one 10 mm trocar for the laparoscope followed by a 10 mm trocar midway between the umbilicus and the pubic symphysis, and two 5 mm trocars 2 cm medially to each superior iliac crest. The next step was the incision of the peritoneum and the dissection of the lateral attachments of the bladder neck. Next were the dissection of the urethra from the vaginal wall and the placement of the AUS measuring tape and cuff. After the placement of the cuff around the urethra the AUS balloon reservoir with the relevant volume of fluid was inserted. Finally, after progressive dilatation (up to 14 F) the AUS control pump was pocketed in the major labia and after the connection were made and placed in the Retzius place, the device was deactivated. The authors significantly reduced the operative time (mean 92 min) and hospital stay (mean 4 d). The urethral catheter remained for 2 d and the success rate (92%) was comparable to the open AUS implantation. There were no perioperative complications except for one vaginal perforation which was repaired during the operation in two layers with absorbable sutures. The device was activated 6 wk after the surgery. Five out of 25 patients (20%) developed urinary retention and after surgery four patients were diagnosed with a urinary tract infection. Vaginal erosion was diagnosed in two patients during the first appointment. There was no need for blood transfusion. Out of 25 patients, 23 reported continence and functional devices, 19 of which had no need for pads per day and 4 needed 1 pad/d.

The results of the above mentioned studies upon the

Table 4 Results of the studies upon laparoscopic implantation of the artificial urinary sphincter

Ref.	*n*	Mean follow up (mo)	Success rate (%)	Operative duration (min)	Hospital stay (d)
Ngninkeu *et al*[24]	4	6	80	150	8
Hoda *et al*[26]	2	6	100	120	6
Rouprêt *et al*[27]	12	12.1	88	180	7
Mandron *et al*[28]	25	26.1	92	92	4

laparoscopic implantation of the AUS are summarized in Table 4.

LAPAROSCOPIC AND ROBOTIC ASSISTED LAPAROSCOPIC SACROCOLPOPEXY

Since sacral colpopexy is considered to be the most effective operation for the treatment of vaginal vault prolapse it was inevitable that laparoscopic approach would be attempted in order to minimize morbidity and reach higher cure rates. The largest series on this approach was reported by Stepanian *et al*[29] who studied 446 patients. They formed 2 groups, one with patients undergoing concominant hysterectomy and one with history of hysterectomy. The risk for mesh related complications was 1, while no differences were found between the two groups. The median follow up was 12 mo. Although the study was the largest in this type of procedure it was a cohort study that used questionnaires and chart reviews[29].

Robotic assisted laparoscopic procedures for the treatment of POP are relatively novel procedures. Although this type of procedure is performed transabdominally with increased morbidity compared with the vaginal repairs the complication and recurrence rates are low. Elliott *et al*[30] reported low complication rates and only one patient with recurrent grade 3 rectocele but the mean follow up was relatively short (5 mo). Di Marco *et al*[31] followed 5 patients for 4 mo and found no relapse in any of the 3 compartments and no complications except one patient that experienced vaginal bleeding. They concluded that robotic assisted techniques may provide the same long term durability with open sacroclpopexy[31]. The need for largest randomized studies is important in order to reach safe results.

CONCLUSION

Laparoscopic surgical repair of POP is safe and efficient and it can be used from surgeons that are familiar with the anatomy of the pelvic floor. Many different laparoscopic techniques have been published with relatively good results that are equal with open surgery. However, the number of patients is these studies are still small and better studies with bigger number of patients are warranted.

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