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REVIEW ARTICLE

Robot-assisted Laparoendoscopic Single-site Myomectomy: Current Status

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ABSTRACT

Introduction: The commercial availability of robotic da Vinci surgical system (Intuitive Surgical inc., Sunnyvale, California, USA) has attracted the gynecologic surgeon's interest due to proposed favorable surgical ergonomics, greater precision in dissection, and easier suturing as well as knot tying. Robot-assisted laparoendoscopic single-site surgery appears to be encouraging for more suture-intensive surgeries like myomectomy as it offers potential in resolving the ergonomic challenges imposed by the restrictive range of motion and vision of conventional LESS.

Aim: The aim of this review is to appraise the available literature on robot-assisted laparoendoscopic single-site (RA-LESS) myomectomy and comment on the feasibility, reproducibility, learning curve as well as financial implications of this technique.

Results: The studied outcome measures of mean operative time, estimated blood loss, and number and type of myomas removed suggest that this is a feasible technique. It was found to be a safe procedure with no reported intraoperative complications or conversions and negligible postoperative complications. The data on financial implication are, however, limited.

Conclusion: Current initial data indicate that RA-LESS is a promising technique. It is a safe and reproducible procedure for performing myomectomy. However, more studies with larger cohorts and long-term follow-ups are needed to conclusively recommend this technique for a wider application.

Clinical significance: With increasing experience in minimal invasive techniques and availability of single-port da Vinci surgical system, more challenging surgeries like myomectomy can be safely performed to optimize clinical benefits to the patients.

Keywords: Myomectomy, Robotic, Single site.

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INTRODUCTION

Minimally invasive surgery for gynecological procedures has gained worldwide acceptance. This specialty is forever optimistically moving forward in hope of performing safe surgical procedures with cosmetically smaller and fewer scars to the patient, as well as improving peri/postoperative surgical outcomes. With the progression in the learning curve, surgeons are now inclined to perform more challenging procedures, such as myomectomy via the minimally invasive route.

Clinical advantages of conventional multiport laparoscopic myomectomy over abdominal myomectomy in young women seeking fertility preservation are now well proven.[1-3] Furthering the minimally invasive approach, laparoendoscopic single-site surgery (LESS) has been adopted by the surgeons due to better cosmetic acceptance by the patients.[4,5] Additionally, the wider umbilical access associated with LESS provides for an alternative to electromechanical morcellator for contained mechanical tissue extraction. This feature becomes more relevant to gynecologic surgeons owing to the recently imposed ban by US Food and Drug Administration (FDA) on the use of electromechanical morcellators.[6] However, the use of LESS for myomectomy has not gained wide popularity due to intensive reconstruction and suturing required as well as lack of proven robust surgical benefits when compared with conventional multiport myomectomy.[7-9] Other challenges posed by LESS like manipulation of three articulating instruments through one access port, lack of triangulation, instrument crowding or clashing, poor ergonomics, and a long learning curve make it a less favored choice for a demanding surgery, such as myomectomy.

The commercial availability of robotic da Vinci surgical system (Intuitive Surgical inc., Sunnyvale, California, USA) has attracted the gynecologic surgeon's interest due to proposed favorable surgical ergonomics, greater precision in dissection, and easier suturing as well as knot tying. Robot-assisted laparoscopic myomectomy has shown similar surgical outcomes as conventional laparoscopy and has gained acceptance as a safe and reproducible operation.[10-13] Robot-assisted laparoendoscopic single-site surgery appears to be encouraging for more suture intensive surgeries like myomectomy as it offers potential in resolving the ergonomic challenges imposed by the restrictive range of motion and vision of conventional LESS.[14]

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The aim of this review is to appraise the available literature on RA-LESS myomectomy and comment on the feasibility, reproducibility, and learning curve as well as financial implication of this technique.

MATERIALS AND METHODS

An electronic search was conducted using relevant keywords and Mesh terms like single port, single incision, single site, laparoscopic myomectomy, robotic assisted. PubMed, Google Scholar, and Cochrane central register for controlled trials databases were searched to identify pertinent studies from 2010 to 2017. Studies where hybrid techniques, that is, robotic assistance combined with any other technique like conventional single site/multiport, mini laparotomy were not included. As RA-LESS is a relatively newer technique, it was decided to include case studies, case series, retrospective as well as prospective cohort studies for analysis. Statistical Package for the Social Sciences software was used for statistical analysis where required.

RESULTS

Lewis et al[15] were the first to publish their experience with robotic single-site myomectomy using the da Vinci Si Surgical System in four patients. This was followed by a step-by-step tutorial of their technique and results from their first series of 10 women.[16] Consecutively, in 2017, two studies were published; one was a retrospective analysis of 61 cases by Choi et al[17] and another a prospective cohort of 21 patients by Gargiulo et al.[18] Comparison of the outcomes is listed in Table 1.

Most of the patients in all the studies had a high body mass index (BMI). The mean size of the largest myoma that was enucleated was 6.73 ± 2.04 cm by Choi et al[17] and 5.7 ± 1.9 by Gargiulo et al[18] and the largest myoma stood at 12.8 cm in diameter. Maximum number of myomas removed from a single patient was 12. All types including intramural, submucosal (International Federation of Gynecology and Obstetrics 2), subserosal, broad ligament, and retroperitoneal as well as anterior,

Table 1: Comparison of included studies

Study	*Lewis et al*[15]	*Gargiulo et al*[16]	*Choi et al*[17]	*Gargiulo et al*[18]
Type	Case series	Surgical video tutorial	Retrospective analysis	Prospective cohort
Technique used	da Vinci RA-LESS with semirigid instruments	da Vinci RA-LESS with semirigid instruments	da Vinci single site platform with specialized silicone port	da Vinci with standard rigid instruments in coaxial arrangement
Surgeon learning curve	Surgeon with >8 years experience with da Vinci, and >1 year with RA-LESS	Not mentioned	>200 cases of robotic surgery and certification program in robotic single-site surgery	Not mentioned
Number of patients	4	10	61	21
BMI in kg/m^2 (mean ± SD, range)	30.75 (25–35)	Not mentioned	22.29 ± 4.05 (17.63–38)	29.4 ± 4.7
Total operative time in min (mean ± SD, range)	Median 210 (202–254)	Median 202 (141–254)	135.98 ± 59.62 (60–295)	154.2 ± 55.2
Blood loss in mL (mean ± SD, range)	Median 103 (75–300)	Median 87.5 (10–300)	182.62 ± 153.02 (10–600)	57.9 ± 53.7
Largest myoma size in cm (mean ± SD, range)	Not mentioned	Median 6 (4–8)	6.73 ± 2.04 (3.0–12.8)	5.7 ± 1.9
Myoma weight in gm (mean ± SD, range)	106.4 (45.0–160.4)	Median 70 (26–154)	Not mentioned	81.6±51
Maximum number (range)	7 (2–7)	8 (1–8)	12 (1–12)	8 (1–8)
Skin incision length in cm (mean ± SD, range)	Not mentioned	Not mentioned	2.70 ± 0.19 (2.4–3.10)	Not mentioned
Intraoperative complication	None	None	None	None
Intraoperative conversion	None	None	None	None
Duration of hospitalization in days	<24 hour	Not mentioned	4.21 ± 0.84 (3–6)	0.57 ± 0.87
Early/late postoperative complication	Temporary urinary retention—one At 4 weeks—none	None	None	Small bowel obstruction—one Superficial cellulitis—one
Patient perception of cosmetic appearance	Satisfied	Not mentioned	Not mentioned	Not mentioned
Financial implication	Not mentioned	Not mentioned	Not mentioned	Difference of $450 between RA-LESS and its multiport counterpart

SD: Standard deviation

posterior, and fundal location of myomas were amenable to enucleation.[15,17,18] The mean operative time in minutes as mentioned by Choi et al[17] was 135.98 ± 59.62 (60–295) and 154.2 ± 55.2 by Gargiulo et al.[18] None of the studies reported excessive blood loss or requirement of intraoperative blood transfusion. There were no major intraoperative complications noticed in any of the series and none of the patients had to be converted to other techniques for completion of surgery.

Lewis et al[15] and Choi et al[16] mentioned the surgical experience of their operating surgeons. Surgeons had more than 8 years of experience of working with the da Vinci surgical system and performing more than 800 robotic surgeries respectively. This suggests a long learning curve required to safely perform this challenging surgery. None of the studies performed a complete cost analysis of the procedure. Only one study[18] compared the cost of robotic-assisted single-site surgery with conventional single-site myomectomy and found an overall cost difference of $450 per surgery that accounted for the use of GelPOINT device for their technique.

DISCUSSION

Since its approval by the FDA in 2013 for hysterectomy and adnexal surgery, RA-LASS for the da Vinci Surgical System has been proved to be a safe surgery.[19-21] Also, it can supposedly overcome some of the limitations like inferior ergonomics, limited maneuverability of instruments, difficult intracorporeal suturing, and limited vision associated with conventional laparoscopic technique. This makes RA-LESS an attractive choice in the armamentarium of gynecologic surgeons for challenging surgeries like myomectomy.

It is notable that high BMI is usually considered a relative contraindication to LESS by some due to associated technical difficulty and higher complication and conversion rates.[22,23] This knowledge may inhibit a surgeon to offer this minimally invasive technique to obese patients thus, limiting their surgical benefits. However, all the studies noticeably had a patient population with a higher BMI. The median BMI reported by Lewis et al[15] was 30.75 kg/m^2 with a range of 25 to 35 kg/m^2, whereas Choi et al[17] reported a mean BMI of 22.29 ± 4.05 kg/m^2 with a range of 17.63 to 38 kg/m^2. This suggests that RA-LESS is feasible and can be safely offered in women with higher BMI without apprehension of conversion. Also, the deep umbilicus in obese women also provides the benefit of cosmetically more acceptable surgical scar. The RA-LESS technique is usually associated with a larger incision when compared with the conventional multiport laparoscopic surgery. One of the studies reported the mean skin incision as 2.70 ± 0.19 (2.4–3.10) cm.[17] With the controversy over the use of electromechanical morcellator and its recent ban by the US FDA, RA-LESS provides a unique opportunity to mechanically retrieve the myoma specimen using knife with the same incision, which, in turn, saves operative time. This seems to be a benefit over the robotic/laparoscopic multiport myomectomy where an additional minilaparotomy/or extension of the incision will be needed to extract the tissue if the use of electromechanical morcellator has to be avoided. All the studies[15-18] in this review combined their technique of RA-LESS with contained endobag mechanical morcellation for tissue retrieval suggesting that this technique can be easily adapted by gynecologic surgeons in the absence of availability of morcellators.

Surgical access to multiple myomas might be a point of concern while considering LESS owing to the technical challenges associated with conventional LESS technique. All the studies, however, suggested that myomas of all types including intramural, subserosal, and submucosal as well as all location anterior, posterior, fundal, broad ligament, and retroperitoneal are amenable to dissection. Choi et al[17] compared total operation time and EBL according to the type and size of myoma. The mean total operation time was 97.50 ± 2.12 minutes for intraligamentary myomas, 140.25 ± 64.97 minutes for intramural myomas, and 178.75 ± 52.66 minutes for mixed myomas and showed no statistical difference (p = 0.178). The mean EBL was 150.67 ± 152.20 mL for subserosal myomas, and 162.50 ± 94.65 mL for mixed myomas, and 195.25 ± 153.63 mL for intramural myomas with no statistical difference (p = 0.755). Currently, there are no available studies comparing RA-LESS directly with conventional LESS to compare if RA-LESS offers any significant advantage in accessing a particular type or location of myoma. The number of myomas also did not seem to be a limiting factor in any of the studies. The maximum weight of the myoma removed was 160.4 g as reported by Lewis et al[15] in their initial experience.

However, the present data are limited to comment on the exact indications or contraindications for this procedure, and patient selection criteria in terms of type, location, or size of myoma will evolve with the growing experience.

The operating time of LESS surgery is usually longer than that of the conventional multiport laparoscopic surgery.[24] This is further increased in suture-intensive surgeries like myomectomy. This fact is reflected in the high operative times reported in all the studies. Choi et al[17] reported a mean total operative time of 135.98 ± 59.62 minutes with the highest of 295 minutes, and Gargiulo et al[18] reported a similar high mean total operative time of 154.2 ± 55.2 minutes. Choi et al[17] divided their patients into three groups based on the largest myoma

diameter (< 6, 6–10, and >10 cm). The mean myoma diameter was 4.99 ± 0.79 cm in the < 6 cm group, 7.33 ± 0.90 cm in the 6 to 10 cm group, and 11.66 ± 0.99 cm in the >10 cm group. There were no statistically significant differences across the three groups in total operation time. However, the expected blood loss was lowest in the <6 cm group (132.80 ± 122.32 mL) compared with the other two groups (210.97 ± 157.72 mL in the 6 to 10 cm group and 256.00 ± 215.48 mL in the >10 cm group), representing a statistically significant trend (p = 0.078).

It is important to note that robotic myomectomy is a significantly lengthier procedure compared with conventional laparoscopic myomectomy,[13] but the robotic platform allows for a broader range of applications compared with conventional laparoscopy for this indication. Also, the obese can realize the same clinical and quality benefits of minimally invasive surgery as the nonobese at the cost of additional operative time.

One of the aims of this study was to analyze the comprehensive cost of this procedure. However, none of the studies reported on the cost analysis. Only one study compared the robotic modality with its laparoscopic counterpart and found an associated higher cost with the robotic technique.[18] This is an important area that needs to be further studied, especially, to understand if a wider application of this technique is economically feasible. Another limitation is that in all the studies, the surgeries were performed by highly experienced surgeons in the field of minimally invasive and robot-assisted surgery, and it is, therefore, unclear whether these techniques would translate to successful adoption by the larger surgical community.

CONCLUSION

Current initial data indicate that RA-LESS is a promising technique. It is a safe, feasible, and reproducible procedure for performing myomectomy. However, more studies with larger cohorts and long-term follow-ups are needed to conclusively recommend this technique for a wider application. Also, the exact indications for its use and patient selection criteria for optimum outcome still need to be determined.

REFERENCES

1. Mais V, Ajossa S, Guerriero S, Mascia M, Solla E, Melis GB. Laparoscopic versus abdominal myomectomy: a prospective, randomized trial to evaluate benefits in early outcome. Am J Obstet Gynecol 1996 Feb;174(2):654-658.
2. Seracchioli R, Rossi S, Govoni F, Rossi E, Venturoli S, Bulletti C, Flamigni C. Fertility and obstetric outcome after laparoscopic myomectomy of large myomata: a randomized comparison with abdominal myomectomy. Hum Reprod 2000 Dec;15(12):2663-2668.
3. Palomba S, Zupi E, Falbo A, Russo T, Marconi D, Tolino A, Manguso F, Mattei A, Zullo F. A multicenter randomized, controlled study comparing laparoscopic versus minilaparotomic myomectomy: reproductive outcomes. Fertil Steril 2007 Oct;88(4):933-941.
4. Bush AJ, Morris SN, Millham FH, Isaacson KB. Women's preferences for minimally invasive incisions. J Minim Invasive Gynecol 2011 Sep-Oct;18(5):640-643.
5. Goebel K, Goldberg JM. Women's preference of cosmetic results after gynecologic surgery. J Minim Invasive Gynecol 2014 Jan-Feb;21(1):64-67.
6. FDA Safety Communication. Updated laparoscopic uterine power morcellation in hysterectomy and myomectomy. 2014. Available from: http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/ucm424443.htm.
7. Han CM, Lee CL, Su H, Wu PJ, Wang CJ, Yen CF. Single-port laparoscopic myomectomy: initial operative experience and comparative outcome. Arch Gynecol Obstet 2013 Feb;287(2):295-300.
8. Choi CH, Kim TH, Kim SH, Choi JK, Park JY, Yoon A, Lee YY, Kim TJ, Lee JW, Kim BG, et al. Surgical outcomes of a new approach to laparoscopic myomectomy: single-port and modified suture technique. J Minim Invasive Gynecol 2014 Jul-Aug;21(4):580-585.
9. Yoshiki N, Okawa T, Kubota T. Single-incision laparoscopic myomectomy with intracorporeal suturing. Fertil Steril 2011 Jun;95(7):2426-2428.
10. Bendient CE, Magrina JF, Noble BN, Kho RM. Comparison of robotic and laparoscopic myomectomy. Am J Obstet Gynecol 2009 Dec;201(6):566.e1-566.e5.
11. Nezhat C, Lavie O, Hsu S, Watson J, Barnett O, Lemyre M. Robotic-assisted laparoscopic myomectomy compared with standard laparoscopic myomectomy—a retrospective matched control study. Fertil Steril 2009 Feb;91(2):556-559.
12. Advincula AP, Xu X, Goudeau S 4th, Ransom SB. Robot-assisted laparoscopic myomectomy versus abdominal myomectomy: a comparison of short-term surgical outcomes and immediate costs. J Minim Invasive Gynecol 2007 Nov-Dec;14(6):698-705.
13. Gargiulo AR, Srouji SS, Missmer SA, Correia KF, Vellinga TT, Einarsson JI. Robot-assisted laparoscopic myomectomy compared with standard laparoscopic myomectomy. Obstet Gynecol 2012 Aug;120(2 Pt 1):284-291.
14. Eisenberg D, Vidovszky TJ, Lau J, Guiroy B, Rivas H. Comparison of robotic and laparoendoscopic single-site surgery systems in a suturing and knot tying task. Surg Endosc 2013 Sep;27(9):3182-3186.
15. Lewis EI, Srouji SS, Gargiulo AR. Robotic single site myomectomy: initial report and technique. Fertil Steril 2015 May;103(5):1370-1377.
16. Gargiulo AR, Lewis EI, Kaser DJ, Srouji SS. Robotic single site myomectomy: a step by step tutorial. Fertil Steril 2015 Nov;104(5):e13.
17. Choi EJ, Rho AM, Lee SR, Jeong K, Moon HS. Robotic single-site myomectomy: clinical analysis of 61 consecutive cases. J Minim Invasive Gynecol 2017 May-Jun;24(4):632-639.
18. Gargiulo AR, Choussein S, Srouji SS, Cedo LE, Escobar PF. Coaxial robot assisted laparoendoscopic single site myomectomy. J Robotic Surg 2017 Mar;11(1):27-35.
19. Sendag F, Akdemir A, Oztekin MK. Robotic single-incision transumbilical total hysterectomy using a single-site robotic

platform: initial report and technique. J Minim Invasive Gynecol 2014 Jan-Feb;21(1):147-151.
20. Nam EJ, Kim SW, Lee M, Yim GW, Paek JH, Lee SH, Kim S, Kim JH, Kim JW, Kim YT. Robotic single-port transumbilical total hysterectomy: a pilot study. J Gynecol Oncol 2011 Jun;22(2):120-126.
21. Scheib SA, Fader AN. Gynecologic robotic laparoendoscopic single-site surgery: prospective analysis of feasibility, safety, and technique. Am J Obstet Gynecol 2014 Feb;211(2):1.e1-1.e8.
22. Sesti F, Boccia C, Sorrenti G, Baffa A, Piccione E. Single-incision laparoscopic adnexectomy in an obese patient with previous laparotomies. JSLS 2013 Jan-Mar;17(1):164-166.
23. Escobar PF, Bedaiwy MA, Fader AN, Falcone T. Laparoendoscopic single-site (LESS) surgery in patients with benign adnexal disease. Fertil Steril 2010 Apr;93(6):2074.e7-2074.e10.
24. Murji A, Patel VI, Leyland N, Choi M. Single-incision laparoscopy in gynecologic surgery: a systematic review and meta-analysis. Obstet Gynecol 2013 Apr;121(4):819-828.