

MINIMALLY INVASIVE SURGERY

¹Mohamed Khairy Abdel-Hakeem;² Hossam El-Din Shawki Abdalla;³ Abdel-Baset Fakhry Abdel- Baset;
⁴Haytham Ahmed Bahaa El-Deen;⁵ Kareem Ibrahim Shaheen

Obstetrics and Gynecology Department, Faculty of Medicine, Minia University, Egypt

Hysterectomy is one of the most commonly performed surgeries worldwide. A broad range of surgical approaches exists for hysterectomy, ranging from open to minimally invasive techniques. Under this minimally invasive umbrella, the following techniques are included: vaginal hysterectomy, laparoscopic hysterectomy, and variations of those two techniques, such as laparoscopic-assisted vaginal hysterectomy, robotic-assisted hysterectomy, laparo-endoscopic single-site laparoscopic hysterectomy, mini-laparoscopic hysterectomy, and natural orifice transluminal endoscopic surgery hysterectomy. As hysterectomy is being performed increasingly via a minimally invasive route, it is important that gynecologists are familiar with the established as well as emerging techniques for minimally invasive hysterectomy (MIH). Surgical planning is a complex process, which requires an in depth and informed conversation between a patient and her physician. Patient preferences, surgeon skill and indication for surgery all should be taken into consideration when determining the most appropriate surgical approach.

Recent advances in minimally invasive surgery for gynecologic indications

Over the last two decades, minimally invasive surgery has been widely adopted, and it has become the standard procedure in gynecologic diseases. Considerable evidence indicates that owing to the non-requirement of a large abdominal incision, laparoscopic surgery offers substantial advantages over open surgery, including less postoperative pain, shorter hospital stays, faster postoperative recovery, improved cosmetic outcomes, fewer wound-related complications, and lower costs (*Schmitt et al.,2017*).

An increasing interest in even less invasive surgery has led to the advent of laparo-endoscopic single-site surgery (LESS), which is also called single-port surgery or single-incision laparoscopy. During this procedure, all instruments are inserted through a single skin incision, which is almost invariably made at the umbilicus. Historically, gynecology has played a leading role in the development of LESS. The first reported case of LESS was a tubal sterilization performed by Wheeless in 1969. Approximately 20 years later, Pelosi and Pelosi reported the first case of hysterectomy through LESS. Currently, LESS is used for various surgeries for gynecologic, urologic, and gastrointestinal indications. (*Adamina et al.,2018*).

A single small incision of entry could pose technical problems to the surgeon. However, a growing body of knowledge indicates that the feasibility and safety of LESS are currently evident for more complex procedures than they were in the past, although the clinical advantages of LESS over conventional multiport laparoscopic surgery (MLS) are still under investigation (*Alleblas et al.,2017*).

LESS in benign uterine diseases

Hysterectomy may require a higher level of surgical skill than adnexal surgery does. Nevertheless, LESS is now widely applied for not only laparoscopic-assisted vaginal hysterectomy (LAVH) but also total laparoscopic hysterectomy (TLH). In 2015, a retrospective study reported that 80% of hysterectomies in a single hospital in Korea were performed via LESS (*Kim et al.,2015*).

In 2017, Sandberg et al. published a meta-analysis that included RCTs, and prospective and retrospective cohort studies for evaluating LESS versus MLS for hysterectomy in benign disease. No significant differences were observed in the complication rates, postoperative pain, intraoperative blood loss, and length of hospital stay between the two groups. The complication rate was 5.3% in the LESS group and 5.6% in the MLS group for major complications, and 3.4% in the LESS group and 4.5% in the MLS group for minor complications. No case of port herniation was found. Based on subanalysis specific for LAVH and TLH, no difference in complication rate was observed between the groups. The rate of conversion to open surgery was 1.2% in the LESS group and 0.4% in the MLS group, with no significant difference; however, 3.5% of patients who underwent LESS required an additional port. The operative time was 11.3 minutes longer in the LESS

group than in the MLS group, which is in line with the results of the meta-analysis by Schmitt et al., which evaluated adnexal surgery (*Sandberg et al.,2017*).

In terms of learning curve, previous studies indicated that even well-trained laparoscopic surgeons must perform at least 10 to 15 and up to 40 surgeries using LESS-TLH, in order to acquire sufficient skills. In particular, vaginal vault suture, uterine myomectomy, and LESS hysterectomy for increased uterine weight are considered challenging. In 2017, a review article suggested that minimally invasive hysterectomy for the large uterus is feasible. However, only two RCTs comparing LESS and MLS were included in the analysis; moreover, women with uterine size greater than 18 weeks were excluded (*Kho et al.,2017*).

Owing to inadequate triangulation and instrumental collision, closure of the vaginal cuff is particularly difficult during LESS-TLH. The lack of consensus regarding the best technique for cuff closure is evidenced by the various approaches used by individual surgeons; however, new techniques and materials have currently improved surgical proficiency and the strength of closure. For example, barbed suture, which is a type of knotless suture, has gained popularity as a useful technique during LESS. Several studies have reported a shorter operative time and decreased risks of postoperative vaginal bleeding and vaginal cuff cellulitis in cases where a barbed suture is used, compared with cases where a conventional suture is used, although data from other studies are inconsistent. However, issue about the potential safety of barbed sutures was recently raised by the Government of Canada, which warned about the risk of small-bowel obstruction, probably caused by hooking onto a part of the small intestine by a portion of the barbed suture (*Smith et al.,2017*).

Robotic-assisted LESS (R-LESS) in gynecologic surgery

Although the surgical indication for MLS has slowly extended to more advanced gynecologic pathologies, robotic minimally invasive surgery has been rapidly utilized in various gynecologic diseases. Less than 10 years ago, the first report of R-LESS in gynecology introduced risk-reducing bilateral salpingo-oophorectomy and total hysterectomy performed in a woman with breast cancer. In 2014, the Food and Drug Administration approved R-LESS instruments for use in benign hysterectomy and salpingo-oophorectomy. Recently, R-LESS is becoming more standardized and is increasingly used by surgeons despite a technical limitation attributed to the absence of EndoWrist technology, unlike the robotic MLS platform (*Iavazzo et al.,2018*).

In 2016, a systemic review described the surgical outcomes of 810 cases of R-LESS hysterectomy performed for non-neoplastic disease. Although the operative time of and blood loss associated with the procedure were tolerable, definite conclusions regarding postoperative pain and cosmetic results remained unknown owing to the lack of sufficient information. Complications and conversion to open surgery were reported in 4.9% and 2.8% of the patients, respectively. In terms of learning curve, the study found that a proficiency in vaginal cuff suture can be achieved after 14 cases, and that both large uterus and previous abdominal surgery are limitations of R-LESS hysterectomy (*Lopez et al.,2016*).

A previous study by Lopez et al. retrospectively compared R-LESS and LESS hysterectomy for benign indications in 100 patients. The rate of conversion to multiport procedures was 16% in the R-LESS group and 10% in the LESS group, without a statistically significant difference. Blood loss was equivalent between the two groups; however, the operative time was 24.9 minutes longer in the R-LESS group (*Jallad et al.,2017*).

Several studies have shown the feasibility and safety of R-LESS procedures. However, most of these studies are case series or retrospective cohort studies. Further evidence in this regard is warranted (*Baekelandt et al.,2017*).

NOTES in gynecologic surgery

NOTES is a scarless single-entry surgery, which is an emerging concept in minimally invasive techniques. Although it can be performed via various access routes such as the stomach, esophagus, vagina, bladder, and rectum, the vagina has been focused on almost exclusively, as it might be the safest and most feasible route for clinical application. Reported advantages of NOTES include the absence of a visible abdominal scar, less operative pain, shorter hospital stay, improved operative visibility, and possibly, no requirement of adhesiolysis to expose the pelvic organs (*Koo, 2018*)

In 2013, Yang et al. reported seven cases of transvaginal NOTES for salpingo-oophorectomy. The median tumor size was 6 cm; the estimated blood loss was minimal, and the mean operative time was 45 minutes. No postoperative complication or conversion to standard laparoscopic surgery was reported, suggesting that transvaginal NOTES is feasible and safe for the treatment of adnexal masses (*Zalewski et al.,2018*).

More recently, a meta-analysis evaluated the advantages and disadvantages of NOTES hysterectomy in patients with benign gynecological disease. The study did not find RCTs but included two retrospective cohort studies comparing NOTES hysterectomy with conventional LAVH (either LESS -or MLS-LAVH). It was observed that compared to conventional LAVH, the NOTES group was associated with shorter operative time and hospital stay but higher cost. There were no differences between the groups in terms of intra- or postoperative complications and postoperative pain. No case of conversion to conventional laparoscopy or open surgery was demonstrated. The study concluded that NOTES should be considered as an option for gynecological approaches (*Zalewski et al.,2018*).

Although the use of NOTES in gynecologic surgery is rapidly increasing, technical difficulties that must be overcome still exist. As the limitation of NOTES is mainly related to collision between instruments, a study recommended using a flexible scope or a rigid scope with at least a 30-degree lens (*Boruta et al.,2014*).

So LESS and NOTES are the emerging techniques in the evolution of minimally invasive surgery. Their technical limitations continue to lessen with the recent technological innovations, such as the robotic surgical system, various types of multi-channel ports, and articulating instruments (*Koo,2018*).

The feasibility and safety of LESS for benign gynecologic diseases have been demonstrated. However, the evidence is not strong enough to recommend the use of LESS over MLS, as the definitive superiority of LESS has not been established. Based on the result of the most recently published meta-analysis, the majority of surgical outcomes are equivalent between LESS and MLS, except for the longer operative time required for LESS than for MLS for both adnexal surgery and hysterectomy. Although several studies have been reporting on robotic LESS, NOTES, and LESS for gynecologic malignancy, definite conclusions with regard to their safety and efficacy have not been drawn owing to the lack of information (*Koo,2018*).

The clinically relevant benefits and risks of LESS could vary according to the individual institution or surgeon. The available literature highlights the statistical limitation of the analysis as well as the major differences in the surgical techniques and the equipment used among the studies published (*Koo,2018*).

Extensive experience with minimally invasive surgery, especially MLS, has already been accumulated. However, future well-designed large-scale research is necessary to determine the effectiveness of LESS as well as R-LESS and NOTES for gynecologic malignancies. An indication and absolute contraindication should also be ascertained before the widespread use of these procedures (*Koo,2018*).

References

- Schmitt A, Crochet P, Knight S, Tourette C, Loundou A, Agostini A. Single-port laparoscopy vs conventional laparoscopy in benign adnexal diseases: a systematic review and meta-analysis. *J Minim Invasive Gynecol.* 2017;24:1083–95. [PubMed] [Google Scholar]
- Adamina, M., Buchs, N. C., Penna, M., & Hompes, R. (2018). St. Gallen consensus on safe implementation of transanal total mesorectal excision. *Surgical endoscopy*, 32(3), 1091-1103.
- Alleblas, C. C., De Man, A. M., Van Den Haak, L., Vierhout, M. E., Jansen, F. W., & Nieboer, T. E. (2017). Prevalence of musculoskeletal disorders among surgeons performing minimally invasive surgery: a systematic review. *Annals of surgery*, 266(6), 905-920.
- Kim SM, Park EK, Jeung IC, Kim CJ, Lee YS. Abdominal, multi-port and single-port total laparoscopic hysterectomy: eleven-year trends comparison of surgical outcomes complications of 936 cases. *Arch Gynecol Obstet.* 2015;291:1313–9. [PubMed] [Google Scholar]
- Sandberg EM, la Chapelle CF, van den Tweel MM, Schoones JW, Jansen FW. Laparoendoscopic single-site surgery versus conventional laparoscopy for hysterectomy: a systematic review and meta-analysis. *Arch Gynecol Obstet.* 2017;295:1089–103. [PMC free article] [PubMed] [Google Scholar]
- Kho RM, Abrão MS. In search for the best minimally invasive hysterectomy approach for the large uterus: a review. *Clin Obstet Gynecol.* 2017;60:286–95. [PubMed] [Google Scholar]

- Smith K, Caceres A. Vaginal cuff closure in minimally invasive hysterectomy: a review of training, techniques, and materials. *Cureus*. 2017;9:e1766. [PMC free article] [PubMed] [Google Scholar]
- Boruta DM, Fagotti A, Bradford LS, Escobar PF, Scambia G, Kushnir CL, et al. Laparoendoscopic single-site radical hysterectomy with pelvic lymphadenectomy: initial multi-institutional experience for treatment of invasive cervical cancer. *J Minim Invasive Gynecol*. 2014;21:394–8. [PubMed] [Google Scholar]
- Iavazzo C, Minis EE, Gkegkes ID. Single-site port robotic-assisted hysterectomy: an update. *J Robot Surg*. 2018;12:201–13. [PubMed] [Google Scholar]
- Lopez S, Mulla ZD, Hernandez L, Garza DM, Payne TN, Farnam RW. A comparison of outcomes between robotic-assisted, single-site laparoscopy versus laparoendoscopic single site for benign hysterectomy. *J Minim Invasive Gynecol*. 2016;23:84–8. [PubMed] [Google Scholar]
- Jallad K, Walters MD. Natural orifice transluminal endoscopic surgery (NOTES) in gynecology. *Clin Obstet Gynecol*. 2017;60:324–9. [PubMed] [Google Scholar]
- Baekelandt J, De Mulder PA, Le Roy I, Mathieu C, Laenen A, Enzlin P, et al. Postoperative outcomes and quality of life following hysterectomy by natural orifice transluminal endoscopic surgery (NOTES) compared to laparoscopy in women with a non-prolapsed uterus and benign gynaecological disease: a systematic review and meta-analysis. *Eur J Obstet Gynecol Reprod Biol*. 2017;208:6–15. [PubMed] [Google Scholar]
- Koo, Y. J. (2018). Recent advances in minimally invasive surgery for gynecologic indications. *Yeungnam University Journal of Medicine*, 35(2), 150.
- Zalewski, K., Benke, M., Mirocha, B., Radziszewski, J., Chechlinska, M., & Kowalewska, M. (2018). Technetium-99m-based radiopharmaceuticals in sentinel lymph node biopsy: gynecologic oncology perspective. *Current pharmaceutical design*, 24(15), 1652-1675.