



# Laparoendoscopic Single-Site Technique Contrasted with Conventional Laparoscopy in Cystectomy for Benign Ovarian Cysts

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## ABSTRACT

**Objective:** To compare the laparoendoscopic single-site (LESS) technique with conventional laparoscopy in cystectomy for benign ovarian cysts.

**Materials and methods:** A retrospective analysis was performed at Yixing People's Hospital from April 2020 until December 2021.

**Results:** Thirty-seven patients using the LESS technique were compared with a control group of 45 patients who underwent a traditional laparoscopic ovarian cystectomy. There was no statistically significant difference in the perioperative hemoglobin level changes, cyst rupture rate, postoperative recovery of exhausting time, or pain score at 24 hours after surgery between the 2 groups ( $P > 0.05$ ). The mean operating time was significantly longer in the LESS group than that of the control group ( $88.38 \pm 30.57$  minutes vs  $59.44 \pm 24.22$  minutes;  $P = 0.001$ ). However, the length of postoperative hospital stay was significantly shorter in the LESS group ( $3.70 \pm 0.57$  days vs  $4.38 \pm 0.86$  days;  $P = 0.001$ ). In addition, total hospitalization expenses were higher in the LESS group ( $14,709.78 \pm 1618.63$  yuan vs  $12,676.73 \pm 1411.78$  yuan;  $P = .001$ ) and the satisfaction score was also significantly higher in the LESS group ( $z = -2.272$ ;  $P = 0.023$ ). After a follow-up time of 12 to 24 months, no patient in either group showed wound infection, umbilical hernia, or recurrent cysts.

**Conclusions:** The LESS technique for benign ovarian cystectomy is safe, feasible, and equally effective compared with the multiport laparoscopic oophorocystectomy. Although it currently costs more, patients with benign ovarian cysts are highly satisfied with the LESS technique.

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## Introduction

Ovarian tumor, among the common gynecological tumors, occurs in people of any age.<sup>1</sup> Its tissue composition is complex and associated with complications such as pedicle torsion, rupture, infection, and malignant degeneration.<sup>2</sup> Surgery is the main treatment for ovarian tumors, and oophorocystectomy is widely used for benign ovarian cysts.<sup>2</sup> With the development of minimally invasive technology, laparoscopic surgery has gradually dominated gynecological operations due to its advantages of less invasion during the procedure, smaller interference to abdominal organs, and quicker recovery.<sup>3</sup>

Since the application of laparoendoscopic single-site surgery (LESS) in tubal ligation was first reported by Wheeler<sup>4</sup> in 1969,

the technique has been applied successively to hysterectomy,<sup>5</sup> oophorocystectomy,<sup>6–8</sup> salpingectomy,<sup>9</sup> and so on. The development of LESS was once hindered by factors such as the limitation of instruments, the difficulty of operation, and the increased operation risk.<sup>10</sup> However, the LESS technique is becoming increasingly mature with the update of equipment, improvement of surgical techniques, and change of therapeutic concept. Meanwhile, LESS is gradually becoming more popular in treating gynecological benign diseases because of its minimally invasive and cosmetic effect. However, whether or not LESS has added value for ovarian cystectomy over the conventional laparoscopic (CL) technique remains debatable. This study aimed to compare surgical outcomes of the 2 techniques (LESS and CL) for ovarian cystectomy in patients with benign disease.

## Materials and Methods

The Institutional Review Boards at Yixing People's Hospital approved the study. In addition, we searched patients who under-

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went laparoscopic ovarian cystectomy due to unilateral benign disease from April 2020 to December 2021.

#### Inclusion criteria

- Age between 18 and 50 years,
- Body mass index (BMI)  $\leq 35$ ,
- No acute infection or serious chronic disease,
- Maximum diameter of the ovarian cyst no more than 15 cm, and
- The same surgeon and assistant performed the operative cases.

#### Exclusion criteria

- The patient was pregnant or lactating,
- The surgery was performed for an emergency,
- Additional procedures were performed meanwhile,
- The patients had bilateral ovarian cysts, and/ or
- The pathology report showed a malignant tumor.

Patients' demographic characteristics, including age, BMI, and history of previous abdominal surgery, were obtained from their medical records. Clinical characteristics consisting of the size of ovarian cyst, pelvic adhesion, operating time, cyst rupture during operation, perioperative hemoglobin level changes, recovery of exhausting time, pain score after surgery, histopathological diagnosis, perioperative complications, postoperative hospital stay, and hospitalization expenses were collected. Cyst recurrence, wound infection, umbilical hernia, and satisfaction score were recorded during the follow-up period.

We compared surgical outcomes and follow-up results between the LESS and CL groups. The decision to use the LESS technique or CL was made according to the patient and surgeon's preference. All the patients signed informed consents.

#### Surgical procedures

A full set of laparoscopic systems manufactured by Karl Storz was used during the operation. Patients were positioned at a 15° Trendelenburg position under general anesthesia. A commercially available, 4-channel, single-port system produced by Hangzhou Kangji Medical Instrument Co Ltd was used to perform a LESS ovarian cystectomy. A 15- to 20-mm skin incision was made in the umbilicus, and the single-port system was inserted. Carbon dioxide gas at 12 to 14 mm Hg was used to make pneumoperitoneum. A first assistant handled a 10-mm laparoscope, and the surgeon used the laparoscopic instruments. After coagulating the surface of the ovarian cyst with bipolar forceps, the cortex of the ovary was cut with scissors. Subsequently, the cyst was stripped completely by blunt and sharp dissection. Once the cyst rupture occurred, the cyst contents were suctioned immediately. The ovary wound was sutured using 2-0 catgut. The stripped ovarian cyst was placed in an Medtronic Endo Bag and removed through the multichannel port. The abdominal wall was closed with running suture layer by layer. The intradermal suture was used to close the skin with 4-0 Vicryl (see the [Figure](#)).

For CL ovarian cystectomy, a 10-mm trocar was inserted in the umbilicus. Then, under the guidance of a laparoscope, a 10-mm, and 5-mm trocar was inserted in the left lower quadrant and right lower quadrant of the abdomen, respectively. A fourth trocar was inserted when it was necessary. Aside from the placement of laparoscopic ports, surgical procedures for oophorocystectomy were the same as the LESS approach. A uterus lifting apparatus was placed in none of the surgical cases.

#### Postoperative observation and follow-up

Pain score was measured using the numerical rating scale (0 = no pain to 10 = agonizing pain) 24 hours after surgery.

Patients were followed at least 12 months after surgery through physical examination. The wound healing was recorded. In addition, ultrasonography was used to find whether ovarian cysts recurred.

Satisfaction score was measured using Kiyak's<sup>11</sup> satisfaction rating scale (1 = very dissatisfied, 2 = dissatisfied, 3 = common or unsure, 4 = satisfied, and 5 = very satisfied).

#### Statistical analysis

Student *t* test was used to compare mean values, and the  $\chi^2$  test was adopted to compare frequency distributions. Ranked or disordered classifying data were compared using the rank-sum test. A probability value  $< 0.05$  in 2-sided tests was considered statistically significant. All statistical analysis in this study was performed using SPSS for Windows version 17.0 (SPSS Inc, Chicago, Illinois).

#### Results

Two hundred sixty-nine cases met the inclusion criteria. A total of 187 patients were excluded, comprising 14 who were pregnant; 3 who underwent surgery for acute abdominal pain; 116 who received other surgical interventions such as hysterectomy, hysteromyomectomy, and contralateral adnexal surgery simultaneously; 52 with bilateral ovarian cysts; and 2 whose pathological report indicated a borderline tumor. Several patients met more than 2 exclusion criteria.

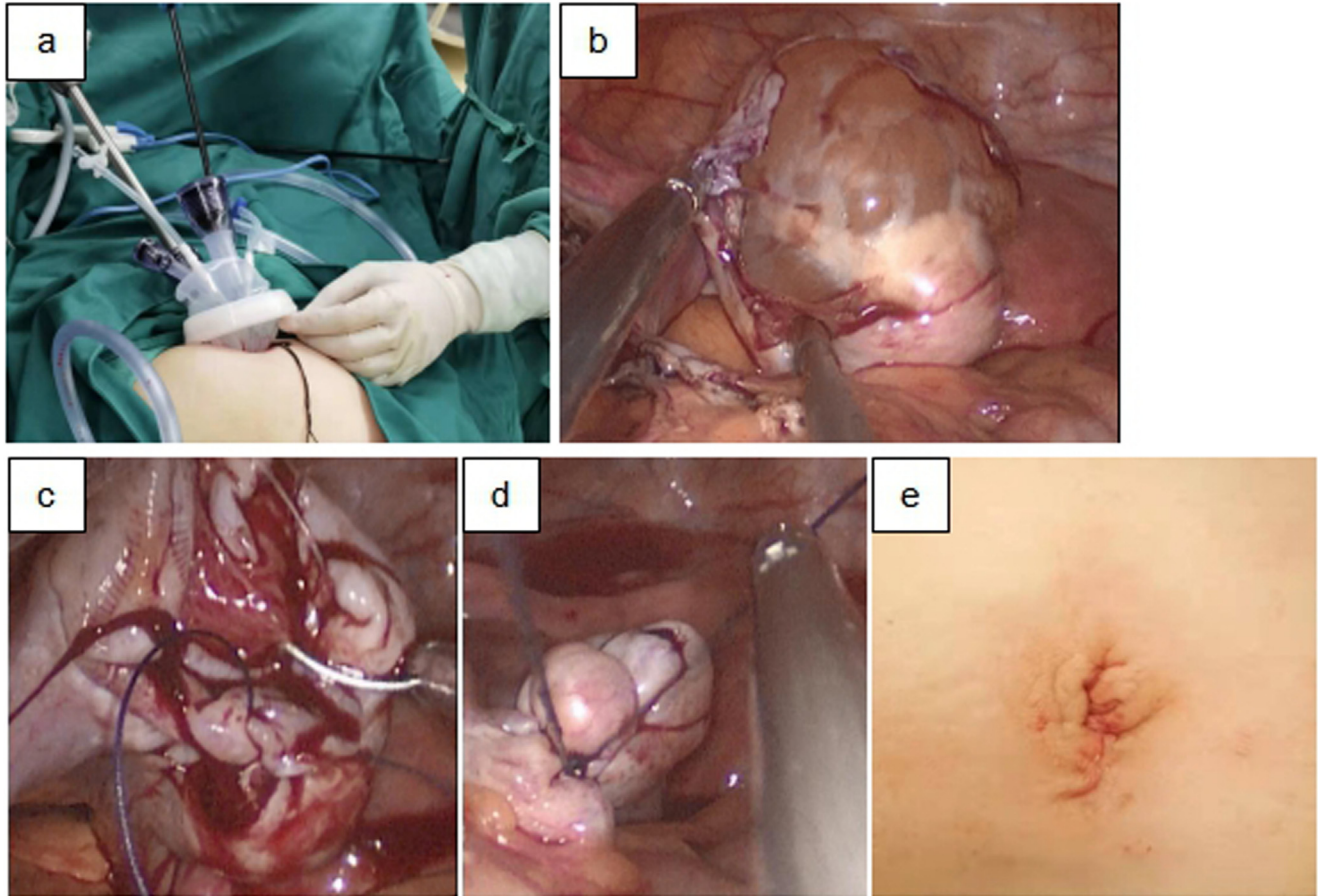
Eighty-two patients were included in this study at last, with 37 patients undergoing LESS cystectomy and 45 undergoing CL cystectomy. The surgery was performed technically successfully in both groups. No patient in either group required additional ports or conversion to laparotomy. No perioperative complication, such as fever, ileus, or deep vein thrombosis, was observed in either group. No patient was given a blood transfusion.

The demographic characteristics were demonstrated similar in both groups. The mean age of patients was  $31.05 \pm 8.28$  years in the LESS group and  $34.11 \pm 7.32$  years in the CL group ( $P = .080$ ). The BMI of the 2 groups was  $21.93 \pm 3.37$  and  $22.46 \pm 3.10$ , respectively ( $P = 0.465$ ). Fourteen patients (37.8%) in the LESS group and 15 patients (33.3%) in the CL group had a history of previous abdominal surgery ( $P = .671$ ). The maximum diameter of the cyst in the LESS group was  $5.86 \pm 3.24$  cm and  $5.91 \pm 1.94$  cm in the CL group ( $P = 0.937$ ). The above comparisons had no statistically significant differences (see the [Table](#)).

There was no statistical difference in the proportion of histopathologic tumor types between the 2 groups ( $P = 0.867$ ). Pelvic adhesion occurred in 12 (32.4%) patients in the LESS group and 20 (44.4%) patients in the CL group ( $P = 0.267$ ) (see the [Table](#)). Therefore, the surgical outcomes were comparable between the 2 groups.

The mean operating time was significantly longer in the LESS group ( $88.38 \pm 30.57$  minutes) than in the CL group ( $59.44 \pm 24.22$  minutes;  $P = .001$ ). Nevertheless, the length of postoperative hospital stay was significantly shorter in the LESS group ( $3.70 \pm 0.57$  days vs  $4.38 \pm 0.86$  days;  $P = 0.001$ ). The total hospitalization expenses were higher in the LESS group ( $14,709.78 \pm 1618.63$  yuan vs  $12,676.73 \pm 1411.78$  yuan;  $P = 0.001$ ), whereas the satisfaction score was also significantly higher in the LESS group ( $z = -2.272$ ;  $P = 0.023$ ) (see the [Table](#)).

There was no statistically significant difference in the perioperative hemoglobin level changes between the 2 groups ( $13.84 \pm$



**Figure.** Laparoendoscopic single-site ovarian cystectomy. (A) The single port system was inserted. (B) The cyst was stripped. (C and D) The ovary wound was sutured using 2-0 catgut. (E) The intradermal suture was used to close the skin.

**Table**  
Patient demographic characteristics, clinic features, and surgical outcomes

	LESS* (n=37)	CL* (n=45)	t/ $\chi^2$ /z value	P value
Age, y	31.05 ± 8.28	34.11 ± 7.32	t = -1.774	0.080
BMI	21.93 ± 3.37	22.46 ± 3.10	t = -.734	0.465
Previous abdominal surgery	14 (37.8)	15 (33.3)	$\chi^2 = .180$	0.671
Maximum diameter of the cyst, cm	5.86 ± 3.24	5.91 ± 1.94	t = -.080	0.937
Adhesiolysis	12 (32.4)	20 (44.4)	$\chi^2 = 1.231$	0.267
Operative time, min	88.38 ± 30.57	59.44 ± 24.22	t = 4.782	0.001
Cyst rupture	17 (45.9)	28 (62.2)	$\chi^2 = 2.172$	0.141
Perioperative hemoglobin level changes, g/L	13.84 ± 8.02	14.00 ± 8.01	t = -.091	0.928
Exhausting time, d	1.49 ± 0.51	1.44 ± 0.50	t = .376	0.708
Pain score	1.59 ± 0.50	1.60 ± 0.50	t = -.049	0.961
Postoperative hospital stay, d	3.70 ± 0.57	4.38 ± 0.86	t = -4.248	0.001
Hospitalization expenses, yuan	14,709.78 ± 1618.63	12,676.73 ± 1411.78	t = 6.074	0.001
Satisfaction score				
3 points	2 (5.4)	1 (2.2)	z = -2.272	0.023
4 points	9 (24.3)	25 (55.6)		
5 points	26 (70.3)	19 (42.2)		
Histopathological diagnosis				
Dermoid cyst	22 (59.5)	21 (46.7)	z = -.168	0.867
Ovarian endometrioma	4 (10.8)	16 (35.6)		
Serous cyst adenoma	3 (8.1)	4 (8.9)		
Mucinous cyst adenoma	4 (10.8)	4 (8.9)		
Others	4 (10.8)	0 (0.0)		

BMI = body mass index; CL = conventional laparoscopy; LESS = laparoendoscopic single-site.

\* Values are presented as mean ± SD or n (%).

8.02 vs 14.00 ± 8.01;  $P=0.928$ ). Cyst rupture rate (17 [45.9%] vs 28 [62.2%];  $P=0.141$ ), postoperative recovery of exhausting time (1.49 ± 0.51 days vs 1.44 ± 0.50 days;  $P=0.708$ ) or pain scores at 24 hours after surgery (1.59 ± 0.50 vs 1.60 ± 0.50;  $P=0.961$ ) did not differ significantly between groups (see the Table).

Wound infection or incision hernia was observed in none of the patients during the follow-up period. Twelve to 24 months after surgery, the ultrasound showed no cyst recurrence in either group.

## Discussion

With the rapid development of endoscopy technology and equipment, the era of minimally invasive surgery has arrived.<sup>12</sup> Laparoscopy surgery has become the first choice for various gynecologic diseases because of its advantages, such as little bleeding, small trauma, light pain, and quick recovery.<sup>3</sup> Even so, the risk of bleeding, infection, and damage can be increased by each additional laparoscopic insertion and the cosmetic effect will be decreased.<sup>6</sup> Therefore, the LESS technique has been adopted in gynecologic disease based on safety and effectiveness to enhance the advantage of minimal invasion and cosmesis. Otherwise, several other minimally invasive approaches, such as minilaparoscopy and robotic surgery, have been implemented in gynecology.<sup>13</sup> The techniques also have the peculiarities of nonsizeable abdominal incisions, lowered complications, and reduced blood loss during the operation.<sup>13</sup> Vaginally assisted natural orifice transluminal endoscopic surgery (vNOTES) is also a feasible approach that has no extra visible incision and can overcome some obstacles of vaginal surgeries.<sup>14</sup> Kaya et al<sup>15</sup> reported that vNOTES surgeries offer shorter operation time and hospital stay, less postoperative pain, and better cosmetic outcomes compared with CL. A prospective cohort study conducted by Yassa et al<sup>16</sup> indicated that the vNOTES approach could be the preferred method for opportunistic bilateral salpingectomy in female sterilization. However, the minimally invasive techniques are not appropriate in all cases. Ramirez et al<sup>17</sup> performed a randomized controlled trial that raised warnings concerning the use of laparoscopy in women with early stage cervical cancer. Therefore, high-quality evidence on the surgical approach is needed before achieving definitive conclusions.

In this study, we gathered surgical outcomes for 37 patients who underwent a LESS oophorectomy compared with 45 patients who had a CL cystectomy. Unlike several previous studies, a homogenous patient population undergoing unilateral ovarian cystectomy was included in our study. Therefore, it is appropriate to evaluate the role of LESS in the surgery. Our data show that the mean operating time was significantly longer in the LESS group than that of the CL group, which is as same as reported by Liu et al<sup>8</sup> in a retrospective study. Furthermore, this indicates that the operative difficulty is increased in LESS because of the limitation of the umbilical orifice, which makes the operational position limited and makes it hard to pull, the conflict and distraction of internal and external instruments, and the disappearance of the 3-dimensional structure in the body that makes the instruments coaxial with the light source and increases the difficulty to judge the distance and depth for the operator. Operating an ovarian cystectomy using the LESS approach contains several elaborate actions, such as removing the mass completely, suturing, and tying knots. As a result, it will be harder to perform an oophorectomy than a salpingectomy or an adnexectomy by LESS. A meta-analysis by Lin et al<sup>18</sup> in 2020, the safety, efficiency, and preferred indication of LESS ( $n=744$ ) compared with CL ( $n=798$ ) for benign ovarian masses were evaluated. The analysis showed a similar result in operating time between the 2 groups. And Schmitt et al<sup>10</sup> reported the same outcome in 2017. Although their analyses included some studies in which adnexectomy was performed. Bedaiwy et al<sup>6</sup> and Park et al<sup>7</sup> reported that the operating time did

not differ between LESS and CL groups, but in their studies, the suture of the ovarian capsule was not mentioned. This may demonstrate that more and more practice of operation with selecting the appropriate surgical area and using special equipment may shorten the operating time.

Our results suggest that the hospital stay after the operation was shorter in the LESS group than in the CL group, which means the patients who underwent a LESS oophorectomy received a faster recovery. Similar outcomes were observed in several previous studies.<sup>7,18</sup> As is well known, the hospital stay after a minimally invasive procedure for benign adnexal mass is commonly 1 to 2 days in many countries and some upper-level hospitals in our country. However, we have not achieved it due to the circumstance of the city where our hospital is located. Usually, our patients are discharged with stitches removed, pathological results reported, and without any discomfort. It is also related to our hospital discharge policy. We are trying our best to shorten the hospital stay. Also, patients' satisfaction score was higher in the LESS group than that in the CL group, which was statistically significant. Finally, a previous study<sup>8</sup> corroborated our result. It shows that the LESS technique is more conformed to fast track surgery.

Meanwhile, specimens can be removed more easily and quickly through a 2 to 2.5 cm umbilical incision than a 1.0 cm incision. Therefore, although not statistically significant, our results suggest that the cyst rupture rate was lower in the LESS group than that of the CL group, and using LESS for large ovarian cysts may have unique advantages.<sup>19</sup> In addition, posterior colpotomy can also be used for transvaginal extraction of surgical specimens,<sup>20</sup> through which the patients' need for postoperative rescue analgesics was lower.

Our study also found that hospitalization expenses were significantly higher in the LESS group. It may be that the single-port system is more expensive than the CL trocars. Consequently, LESS is more suitable for the patients with better economic conditions who have higher requirements for beauty in our hospital.

The data in our study indicate that there was no statistically significant difference in the perioperative hemoglobin level changes between the 2 groups, consistent with the outcomes seen in previous studies.<sup>6-8</sup> In addition, there was no significant difference in the postoperative recovery of exhausting time or pain score 24 hours after surgery between the 2 groups in our study. Lin's<sup>18</sup> analysis showed that the pain score at 4 hours after surgery did not differ between 2 groups, but fewer patients in the LESS group had analgesic requirements. Schmitt's<sup>10</sup> analysis reported comparable results regarding pain scores. Casarin and Lagana<sup>21</sup> reported a new approach (minilaparoscopic single-site) for bilateral salpingo-oophorectomy. They only used 2 3-mm trocars placed next to each other through the umbilicus, and the specimens were retrieved through the posterior vaginal fornix. Because the umbilical scar area was reduced, the patient experienced less postoperative pain.

However, there are limitations in our study, including the retrospective design and the selection bias, because patients selected the surgical approach after they were fully aware of the advantages and disadvantages. The low number of patients involved in our study also causes limitations. Although 269 patients met the inclusion criteria, we excluded 187 patients to increase the comparability of outcomes between the 2 groups. Although the proportion of tumor histopathologic types have been compared using the rank-sum test between the 2 groups and there was no significant difference ( $P=0.867$ ), the percentage of ovarian endometrioma that almost always ruptures was significantly higher in the CL group than that of the LESS group (35.6% vs 10.8%;  $P=.009$ ). This is a bias that may influence the comparison of the rupture rate. Meanwhile, some patients included in our study with different degree of pelvic adhesion underwent adhesiolysis, which resulted in

confounding bias. In the future, prospective randomized trials with expanded sample sizes will be required, and patients with pelvic adhesion can be stratified by objective classification to obtain more accurate results.

## Conclusions

Based on the previous literature, our results suggest that LESS ovarian cystectomy is safe and feasible compared with conventional laparoscopic surgery. Although it is more expensive, patients with benign ovarian cysts are highly satisfied with the LESS technique.

## Ethics approval and consent to participate

This study protocol was reviewed and approved by the Institutional Ethical Review Boards at Yixing People's Hospital, approval No. IRB-2021-ARTICLE-086. All methods were carried out in accordance with relevant guidelines and regulations. Informed consent was signed by all the patients.

## Declaration of Competing Interest

The authors have indicated that they have no conflicts of interest regarding the content of this article.

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X. Jiang designed the concept of the study, collected the data, performed the data analyses, and wrote the manuscript. X. Zuo helped collect the clinical data and perform the analysis with discussion. H. Zhu contributed to the verification and supervision of the study. All authors read and approved the final manuscript.

## References

- Farghaly SA. Current diagnosis and management of ovarian cysts. *Clinical and Experimental Obstetrics & Gynecology*. 2014;41(6):609–612.
- Legendre G, Catala L, Morinière C, Lacoëuille C, Boussion F, Sentilhes L, et al. Relationship between ovarian cysts and infertility: what surgery and when? *Fertility and Sterility*. 2014;101(3):608–614.
- Aarts JW, Nieboer TE, Johnson N, Tavender E, Garry R, Mol BW, et al. Surgical approach to hysterectomy for benign gynaecological disease. *Cochrane Database of Systematic Reviews*. 2015;2015(8):Cd003677.
- Wheless CR. A rapid inexpensive and effective method of surgical sterilization by laparoscopy. *Journal of Reproductive Medicine*. 1969;3(5):65–69.
- 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(5):1089–1103.
- Bedaiwy MA, Sheyn D, Eghdami L, Abdelhafez FF, Volsky JG, Fader AN, et al. Laparoendoscopic single-site surgery for benign ovarian cystectomies. *Gynecol Obstet Invest*. 2015;79(3):179–183.
- Park JY, Kim DY, Kim SH, Suh DS, Kim JH, Nam JH. Laparoendoscopic Single-site Compared With Conventional Laparoscopic Ovarian Cystectomy for Ovarian Endometrioma. *Journal of Minimally Invasive Gynecology*. 2015;22(5):813–819.
- Liu X, Wen MK, Liu HY, Sun DW, Lang JH, Fan QB, et al. Clinical retrospective control study of single-port laparoendoscopic and multi-port laparoscopic ovarian cystectomy. *Zhonghua fu chan ke za zhi*. 2017;52(10):675–678.
- Marcelli M, Lamourdedieu C, Lazard A, Cravello L, Gamarre M, Agostini A. Salpingectomy for ectopic pregnancy by transumbilical single-site laparoscopy with the SILS system. *European Journal of Obstetrics, Gynecology, and Reproductive Biology*. 2012;162(1):67–70.
- 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. *Journal of Minimally Invasive Gynecology*. 2017;24(7):1084–1096.
- Ostler S, Kiyak HA. Treatment expectations versus outcomes among orthognathic surgery patients. *The International Journal of Adult Orthodontics and Orthognathic Surgery*. 1991;6(4):247–255.
- Childress KJ, Santos XM, Perez-Milicua G, Hakim J, Adeyemi-Fowode O, Bercaw-Pratt JL, et al. Intraoperative Rupture of Ovarian Dermoid Cysts in the Pediatric and Adolescent Population: Should This Change Your Surgical Management? *Journal of Pediatric and Adolescent Gynecology*. 2017;30(6):636–640.
- Laganà AS, Garzon S, D'Alterio MN, Noventa M, Stabile G, Naem A, et al. Mini-Laparoscopy or Single-Site Robotic Surgery in Gynecology? Let's Think out of the Box. *Journal of Investigative Surgery: the Official Journal of the Academy of Surgical Research*. 2022;35(2):440–441.
- Kaya C, Alay I, Cengiz H, Yıldız GO, Baghaki HS, Yasar L. Comparison of hysterectomy cases performed via conventional laparoscopy or vaginally assisted natural orifice transluminal endoscopic surgery: a paired sample cross-sectional study. *Journal of Obstetrics and Gynaecology: the Journal of the Institute of Obstetrics and Gynaecology*. 2021;41(3):434–438.
- Kaya C, Alay I, Cengiz H, Baghaki S, Aslan O, Ekin M, et al. Conventional Laparoscopy or Vaginally Assisted Natural Orifice Transluminal Endoscopic Surgery for Adnexal Pathologies: A Paired Sample Cross-Sectional Study. *Journal of Investigative Surgery: the Official Journal of the Academy of Surgical Research*. 2021;34(11):1185–1190.
- Yassa M, Kaya C, Kalafat E, Tekin AB, Karakas S, Mutlu MA, et al. The Comparison of Transvaginal Natural Orifice Transluminal Endoscopic Surgery and Conventional Laparoscopy in Opportunistic Bilateral Salpingectomy for Permanent Female Sterilization. *J Minim Invasive Gynecol*. 2022;29(2) 257–64.e1.
- Ramirez PT, Frumovitz M, Pareja R, Lopez A, Vieira M, Ribeiro R, et al. Minimally Invasive versus Abdominal Radical Hysterectomy for Cervical Cancer. *New England Journal of Medicine*. 2018;379(20):1895–1904.
- Lin Y, Liu M, Ye H, He J, Chen J. Laparoendoscopic single-site surgery compared with conventional laparoscopic surgery for benign ovarian masses: a systematic review and meta-analysis. *BMJ Open*. 2020;10(2):e032331.
- Wang X, Li Y. Comparison of perioperative outcomes of single-port laparoscopy, three-port laparoscopy and conventional laparotomy in removing giant ovarian cysts larger than 15 cm. *BMC Surgery*. 2021;21(1):205.
- Laganà AS, Vitagliano A, Casarin J, Garzon S, Uccella S, Franchi M, et al. Transvaginal versus Port-Site Specimen Retrieval after Laparoscopic Myomectomy: A Systematic Review and Meta-Analysis. *Gynecol Obstet Invest*. 2022;87(3-4):177–183.
- Casarin J, Laganà AS, Pinelli C, Cromi A, Chezzi F. Minilaparoscopic single-site bilateral salpingo-oophorectomy: a scarless prophylactic procedure. *Minimally Invasive Therapy & Allied Technologies: MITAT: Official Journal of the Society for Minimally Invasive Therapy*. 2022;31(2):313–318.