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LESS with Suture Suspension for Early-Stage Adnexa Cancer Staging

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ABSTRACT

Background and Objective: Laparoendoscopic single-site surgery has been used in treating gynecologic diseases including early-stage cervical and endometrial cancer, but less so in early-stage adnexal cancer. We aimed to demonstrate the use of laparoendoscopic single-site surgery with suture suspension for staging of early-stage ovarian/fallopian-tube cancer and describe the study results.

Methods: Seven patients with early-stage adnexal cancer underwent staging surgery via laparoendoscopic single-site surgery at West China Second University Hospital of Sichuan University from November 2017 to September 2018.

Results: All cases were successfully staged via this technique. Two patients underwent the high-level para-aortic lymphadenectomy up to the infrarenal vein, and four patients underwent para-aortic lymphadenectomy at the level of the inframesenteric artery; one patient underwent the para-aortic lymph node sampling. The operation time was 305–365 minutes. The estimated intraoperative blood loss was 50–200 mL. No intra-operative complications occurred; one patient developed pneumonia 48 hours postoperation. The number of pelvic and para-aortic nodes was 15–39 and 1–18, respectively. Pain scores 12 and 24 hours postsurgery were 2–3 and 1–2 with the use of butorphanol tartrate, respectively. On 4–14 months followup, the umbilical incision had good cosmesis; no umbilical hernia or vaginal dehiscence and no neoplasm recurrence were noted.

Conclusion: Laparoendoscopic single-site surgery may be a feasible and safe technique for staging early-stage ovarian/tubal cancer. This approach has some advantages included providing easier access to the upper abdominal regions when performing high-level infrarenal para-aortic lymphadenectomy; the 2-cm elastic incision favors fast specimen extraction and colpotomy are avoided. However, the long-term oncologic outcomes need to be further investigated.

Key Words: Single-incision laparoscopy; Suture suspension, Adnexal cancer; Staging surgery.

INTRODUCTION

Over the past 2 decades, minimally invasive surgery has become the standard care for treatment for many gynecologic conditions. Numerous studies have demonstrated that minimally invasive surgery for gynecologic cancers is feasible and safe and offer many advantages for patients, including decreased blood loss, fewer perioperative complications, shorter hospitalization, faster recovery, and oncologic outcomes comparable with laparotomy.[1,2] Laparoendoscopic single-site surgery (LESS) is an advanced, minimally invasive procedure in which the surgeon operates through a single, small skin incision on the umbilicus, which minimizes potential incisional morbidity associated with traditional laparoscopy such as postoperative infection, pain, hernia, and vascular, nerve, and organ injuries. The feasibility, safety, and outcomes associated with the LESS approach to early-stage endometrial and cervical cancer staging surgery are known[3–5]; however, literature regarding the feasibility of LESS for early-stage adnexal cancer staging surgery is limited. In this article, we will describe the LESS staging surgery procedure with the original suture-suspension design for treatment of early-stage adnexal cancer.

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MATERIALS AND METHODS

Ethical approval was obtained from the Institutional Ethics Committee of West China Second Hospital, Sichuan University. LESS staging surgery was performed in seven patients who were suspected with ovarian or tubal cancer from November 2017 to September 2018 at West China Second Hospital, Sichuan University, by the same primary surgeon. The baseline characteristics of the patients are listed in **Table 1**. The inclusion criteria for the patients included no operative contraindication, no nodules at the Douglas's pouch by bimanual/vagino-recto-abdominal examination, no metastases or positive finding by imaging, and no peritoneal carcinosis, diaphragmatic disease, mesenteric disease, omental disease, bowel and stomach infiltration, and liver metastases by laparoscopic examination. Operative duration, defined as the interval between incision start and closure, was recorded electronically by video. Body mass index (mg/kg^2) was categorized according to standard World Health Organization criteria. Intraoperative complications were defined as any injury to the bowel, bladder, ureters, nerves, and blood vessels or estimated blood loss exceeding 300 mL. Perioperative complications were defined as those occurring within the first month of surgery. Postoperative pain scores were recorded according to the validated visual analogue pain scale scored from 0 to 10, with 0 indicating "no pain" and 10 indicating "agonizing pain." Recurrence was defined as the return of high levels of tumor marks or positive findings on imaging or bimanual/vagino-recto-abdominal examination after a remission.

All patients were positioned supine. A uterine manipulator with a colpotomy cup was used to achieve necessary countertraction. A single 2- to 2.5-cm-long vertical incision was made at the base of the umbilicus. A multichannel port, consisting of two 5-mm cannulas, one 10-mm cannula, and one 12-mm cannula was introduced into the incision. Carbon dioxide gas was supplied through the port to create a pneumoperitoneum. An optical imaging system was inserted through one of the 5-mm cannulas. After exploratory analysis of the pelvic and abdominal viscera overall, the patient's position was changed to the Trendelenburg position. The right-handed primary surgeon stood on the left side of the operating table near the head of the patient. The first assistant stood on the patient's right side. The surgeon performed ultrasonic dissection and suturing (45 cm in length) with the right hand and handled common-length laparoscopic instruments such as graspers, aspirator, and energy devices with the left hand. First, all patients underwent cytologic washing of the peritoneal cavity. Cases with complex adnexal masses underwent affected-side salpingo-oophorectomy, and the biopsy sample was placed in a 10-mm EndoCatch bag and extracted through the umbilicus. No intraperitoneal spilling of cyst contents occurred. Due to lack of pathology of malignancy, the affected-side adnexa was sent for first frozen section. When intra-operative pathologic evaluation indicated malignancy, surgical staging was performed. The surgical steps were similar to those of traditional multiport laparoscopy (MPL), and comprehensive surgical staging of ovarian/tubal cancer involved multiple peritoneal biopsies, bilateral salpingo-oophorectomy, hysterectomy, infracolic omentectomy, and pelvic and para-aortic lymph node dissection or para-aortic lymph node sampling. During infrarenal para-aortic lymph node dissection and omentectomy, changing the patient's

Table 1.
Patient Characteristics

Case	Age (years)	BMI (kg/m^2)	Parity	Menopause	Surgical History	Medical History
1	52	20.81	$G2P_1^{+1}$	Y	N	N
2	45	21.29	$G1P_0^{+1}$	N	N	N
3	63	27.74	$G3P_2^{+1}$	Y	N	Hypertension
4	51	23.29	$G2P_1^{+1}$	N	Y	Hypertension
5	51	33.66	$G3P_1^{+2}$	Y	N	Hypertension
6	50	22.21	$G5P_2^{+3}$	Y	N	N
7	48	23.48	$G5P_2^{+3}$	N	N	N

Case 4 underwent the hysterectomy + bilateral salpingectomy by MPL because of cervical neoplasm III (the histopathology confirmed the high grade tubal serous adenocarcinoma), and re-staging via LESS.

BMI, Body Mass Index; N, No; Y, Yes.

position as recumbent, the primary surgeon stood between the legs of the patient, facing the patient's cephalad direction; the first assistant stood on the patient's right side. The pelvic and aortic lymphadenectomy margins were based on the Gynecologic Oncology Group surgical procedure manual. To improve operative efficiency and sufficiently expose the operative field, suture suspension was designed and performed. All biopsy samples were placed in an EndoCatch bag and extracted from the vagina or the umbilical incision. A T-shaped drainage tube was inserted through the vagina, and the vaginal cuff was closed using resorbable barbed suture. The umbilical incision was sutured layer by layer, which included continuous closure of the fascia and peritoneum, interrupted suture of the hypodermis, and continuous intradermal suture of the skin. When the operative time was over 3 hours, the antibiotics were readministered. All patients were administered 4100 U of low-molecular-weight heparin by hypodermic injection to prevent thrombosis 12 hours postoperation.

Suture Suspension of the Vesicouterine Peritoneum

For rapid hysterectomy and to avoid bladder injury, a sterilized 0-Vicryl suture was used to suspend the vesicouterine peritoneum. First, the bladder was pushed down, below the colpotomy cup. Then, the needle was straightened to remove the curve. Under laparoscopic visualization, the needle was inserted at the site of the McBurney point into the abdominal cavity; the vesicouterine peritoneum was sutured with the transverse multipoint; the needle was withdrawn at the left McBurney point through the pelvis; and the suspension line was tensed and fixed with forceps at the abdominal wall (**Figure 1**).

Suture Suspension to Exposure the Pelvic Lymph Nodes

Under laparoscopic visualization, the straightened needle was inserted into the pelvis toward the upper 1 cm of the middle site of the symphysis pubis; the bilateral distal atresia of the umbilical artery was stitched; the needle was withdrawn from the insertion site; and the suspension line was tensed and fixed with forceps at the abdominal wall to expose the bilateral obturator lymph nodes (**Figure 2**). To expose the bilateral common iliac artery lymph nodes, the needle was inserted 2 cm below the midline umbilicus, the medial retroperitoneum of the bilateral common iliac artery was stitched, the needle was withdrawn from the insertion site, and the suspension line was tensed and fixed with forceps (**Figure 3**).

Suture Suspension to Expose the Para-Aortic Lymph Nodes

For low-risk ovarian/tubal carcinoma, para-aortic lymphadenectomy was performed at the inferior mesenteric artery origin on the aorta, and high-level para-aortic lymphadenectomy was performed at the point of the renal vein entry into the vena cava in high-risk patients. Both sides of the retroperitoneum of the aortic artery were suspended separately. After inserting the needle at the intersection of the horizontal line 1 cm below the umbilicus and the vertical line of the right middle clavicle, the retroperitoneum was stitched with multipoints to the side of the patient's head; the needle was withdrawn from the junction of the right costal margin and the vertical line of the right middle clavicle; and the suspension line was tensed and fixed with forceps (**Figure 4**). The same approach was used to suspend the left-side retroperitoneum

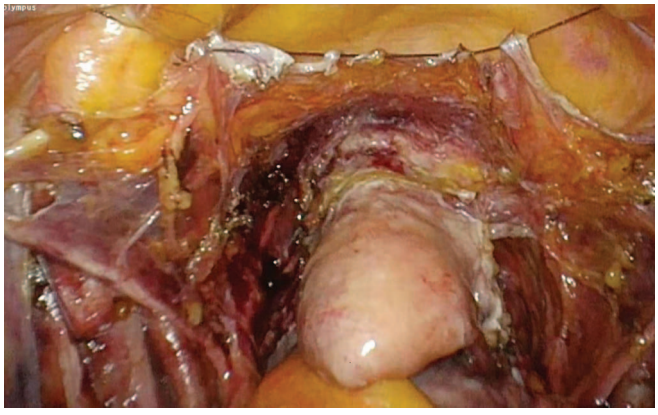

Figure 1. Suture suspension of the peritoneum of the vesicouterine fold.

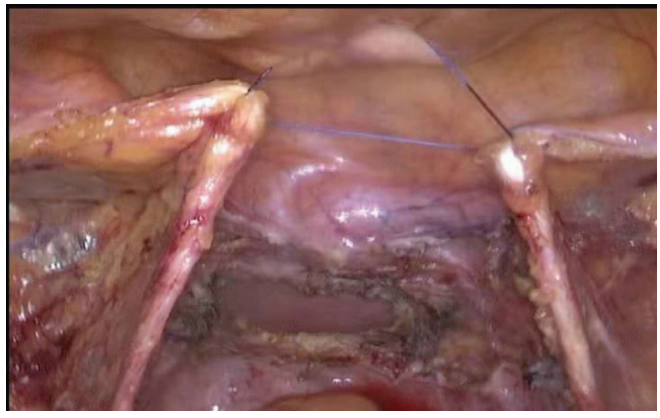

Figure 2. Suture suspension of the distal atresia of the umbilical artery.

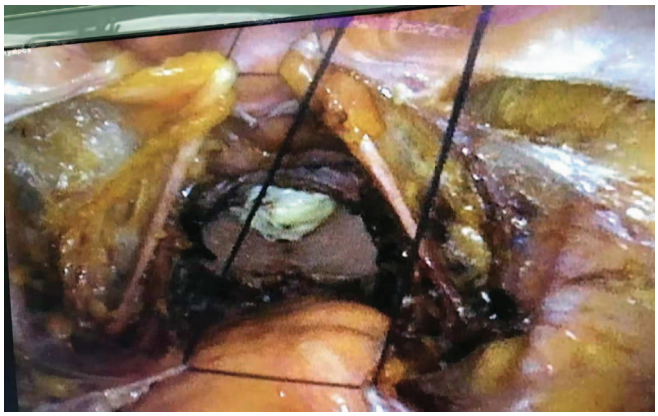

Figure 3. Suture suspension of the medial retroperitoneum at the bilateral common iliac artery.

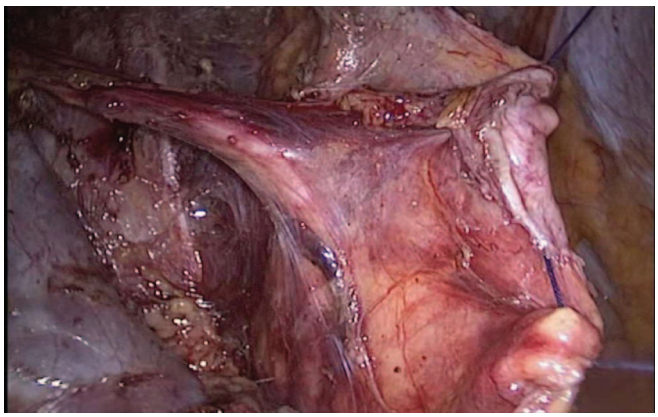

Figure 4. Suture suspension of the right retroperitoneum at the aortic artery.

of the aortic artery, with the entry and exit sites being symmetrical to the right side. If the patient was obese and high-level para-aortic lymphadenectomy was needed, like in cases 3 and 5, the retroperitoneum of the horizontal part of the duodenum was suspended to expose operation field more clearly. The needle was inserted at the junction of the right costal margin and the vertical line of the right middle clavicle; the duodenal retroperitoneum adjacent to the transverse duodenum was stitched transversely; the needle was removed at the contralateral symmetry entry site; and the suspension line was tensed and fixed with forceps (**Figure 5**).

RESULTS

The mean age of the patients was 51.43 (45–63) years. The size of the tumors was 5–20 cm, except one had no tumor mass, and all of the adnexal masses were extracted through the umbilical incision. With suture suspension, all cases were successfully staged via the LESS; no patient required conversion to traditional MPL or laparotomy. Two patients underwent the high-level para-aortic lymphadenectomy up to the infrarenal vein, and four patients underwent para-aortic lymphadenectomy at the level of the inframesenteric artery; One patient underwent the para-aortic lymph node sampling. The operation time ranged from 305 to 365 minutes. No intra-operative complications were observed, except that one patient developed pneumonia 48 hours postoperatively. The estimated intra-operative blood loss ranged from 50 to 200 mL. No intra-operative complications occurred, but one patient developed pneumonia 48 hours after the operation. The number of pelvic and para-aortic nodes ranged from 15 to 39 and from 1 to 18, respectively. The surgery data are shown in **Table 2**. None of the patients had nausea and vomiting without routine use antiemetics and none had thrombosis with the subcutaneous injection of 4100 U low-molecular-weight heparin from 12 hours postoperation to 72 hours postoperation. Postoperative pain scores 12 and 24 hours after surgery were 2–3 and 1–2, respectively. On 4–14 months followup, there was good cosmesis of the umbilical incision, no umbilical hernia or vaginal dehiscence, and no neoplasm recurrence. The details of the postoperative complications are demonstrated in **Table 3**.

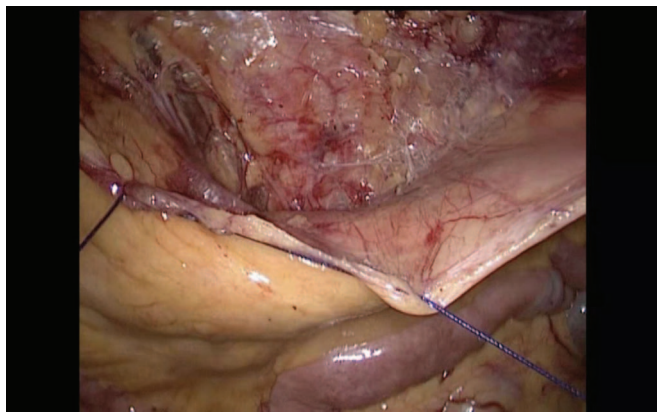

Figure 5. Suture suspension of the transverse duodenal retroperitoneum.

DISCUSSION

The pioneering use of single-incision laparoscopy in gynecologic surgery was for tubal sterilization.[6] However, due to technical limitations, more complex gynecologic procedures are performed using MPL, even laparotomy. Recently, advances in instrumentation have provided the opportunity to revisit the concept of LESS.[7] Currently, the

Table 2.
Baseline Surgery Data

Data of Surgery	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Size of adnexal mass (cm)	5.00	7.00	20.00	0.00	9.00	17.00	6.00
TH + BSO	Y	Y	Y	N	Y	Y	Y
Pelvic lymphadenectomy	Y	Y	Y	Y	Y	Y	Y
Para-aortic lymphadenectomy	Inferior Mesenteric	Infrarenal	Inferior Mesenteric	Infrarenal	N/sampling	Inferior Mesenteric	Inferior Mesenteric
Omentectomy	infracolic	infracolic	infracolic	infracolic	infracolic	infracolic	infracolic
Appendectomy	Y	Y	Y	Y	N	Y	Y
MPB	Y	Y	Y	Y	Y	Y	Y
OT	340	365	325	310	305	325	310
EBL	50	50	50	50	50	200	200
Intraoperative Complications	N	N	N	N	N	N	N
Histopathology	Low-grade Serous Adenocarcinoma	High-grade Serous Adenocarcinoma	Endometrial Adenocarcinoma	High-grade Serous Adenocarcinoma	Granulosa Cell tumor	Clear cell carcinoma	Low-grade Serous Adenocarcinoma
Stage	IA	IIA	IIA	IIA	IA	IA	IA
Number of PLN	17	34	25	15	38	23	26
Number of para-aortic LN	8	18	5	17	1	5	6

Case 4 underwent the hysterectomy + bilateral salpingectomy by MPL because of cervical neoplasm III (the histopathology confirmed the high grade tubal serous adenocarcinoma), and re-staging via LESS.

BSO, bilateral salpingo-oophorectomy; EBL, estimated blood loss; LN, lymph nodes; MPB, multiple peritoneal biopsies; N, no; OT, operative time; PLN, pelvic lymph nodes; TH, total hysterectomy; Y, yes.

LESS technology is generally used in gynecologic surgery, owing to fast recovery, good cosmesis, and less pain and inpatient days.[1,2] Completion of early-stage endometrial and cervical cancer staging surgery using LESS has been reported.[3,4,8] Several retrospective studies on early-stage ovarian cancer have demonstrated that MPL is both feasible and safe,[9–11] but only a few patients with early-stage ovarian cancer have undergone comprehensive staging surgery via LESS.[12,13] To date, our study has the highest number of cases that successfully underwent the staging surgery of early-stage adnexal cancer via LESS although we have only seven cases.

Postoperative pain following gynecologic surgery is influenced by both patient and technical factors. In theory, LESS should minimize incision-related pain in comparison to MPL, given that LESS utilizes only one small skin incision, and some prospective studies have supported this hypothesis.[14–17] However, the studies were focused on hysterectomy or adnexal surgery with a short surgery time. In cancer staging surgery with longer surgery time, whether LESS can relieve postoperative pain needs more clinical trials to verify. In our study, the postoperative pain scores were 2–3 and 1–2 at 12 and 24 hours after the operation, respectively, following the use of the analgesic agent butorphanol tartrate. Furthermore, a study showed that neither postoperative pain 12 hours after surgery nor shoulder pain at any time point differed between surgical approaches.[14] However, our study did not focus on shoulder pain after surgery.

The use of only one incision and the creation of that incision using an open technique may be theorized to result in less morbidity related to incisions such as vascular, gastrointestinal, or nerve injury.[8] Additionally, the umbilical cord feature of a natural scar tissue with few nerves and blood vessel distribution reduces incision-related morbidity. Some retrospective studies have demonstrated

Table 3.
Postoperative Information

Postoperative Complication	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Nausea or Vomiting	N	N	N	N	N	N	N
Thrombosis	N	N	N	N	N	N	N
Infection	Pneumonia	N	N	N	N	N	N
Suppressed Wound healing	N	N	N	N	N	N	N
Hernia	N	N	N	N	N	N	N
Flatus time (h)	48	48	44	54	50	60	45
Pain score (12h/24h)	2/2	2/1	3/2	3/2	2/2	3/2	3/2
Follow-up	7	8	8	14	4	4	4
Recurrence	N	N	N	N	N	N	N

The follow-up deadline: 31, Jan, 2019.

No use of antiemetics.

Routinely used low-molecular-weight heparin from 12 hours after the operation until 72 hours after the operation.

N, no.

that LESS has increased rate of incisional hernia.[18,19] In our study, no patient had incision-related morbidity due to creation of the incision. During follow-up from 4 to 14 months, no incision infection, poor healing, or incisional hernia occurred.

In another study, women in the LESS group reported significantly higher cosmetic satisfaction compared with those in the MPL group, after surgery.[15] LESS has only one incision through the umbilical fossa, which is a natural pouch that would conceal the scar, hence providing satisfactory cosmesis. Additionally, in our experience, anatomical restoration of the fossa layer by layer using anchor-point suture can achieve better cosmesis.

The single umbilical incision has some advantages. The port has an incision-protector, which can protect the incision from tumor cell implantation. The 2- to 2.5-cm umbilical incision with stretching potency favors fast removal of the samples, such as the adnexal mass, the omentum, the lymph nodes, and the appendix, especially in patients who want fertility-sparing staging surgery with no hysterectomy and colpotomy and restaging surgery after vaginal cuff closure, as in case 4. Furthermore, for large adnexal masses of unknown nature, the open technique can avoid the rupture of the mass caused by blind puncture; at the same time, as for the giant adnexal mass, we can suture the ovarian cortex by purse-string, suck the cystic fluid, and tense the suture line to embed the hole through the umbilical incision to avoid tumor rupture and diffusion during surgery; moreover, the biopsy sample was placed in an EndoCatch bag and extracted through the umbilicus. All of these can avoid the spread of the occult tumor and help in attaining the principle of "tumor-free." In our experience, in cases of giant solid adnexal masses and uterine myomas, samples sliced by a cold knife through the umbilical incision could avoid the use of open-power morecellation, which can lead to the diffusion of occult premalignant or malignant tissue which was lead to a tentative diagnosis of benign gynecologic disease. Lastly, the central location of the umbilical incision provides equally useful access to both pelvic and upper abdominal regions. This facilitates proper and thorough intraperitoneal evaluation during comprehensive surgical staging of gynecologic malignancies, and favors high-level para-aortic lymph node dissection by only changing the surgeon's, patient's, and first assistant's positions.

When using LESS for early-stage ovarian/tubal cancer-staging surgery, the major challenge is the difficulty in exposing the operative fields owing to lack of traction by

the assistant. Using effective suspension improved the visibility of the operative field and could free the primary surgeon's left hand from traction to perform electroresection, electrocoagulation, and suction. Our study was the first to elaborate on the procedure of suspending the peritoneum to expose the operative fields in detail.

Additionally, the instruments will clash with each other, as all instruments are inserted through the same port into the pelvis; the collision can be avoided by using different-length instruments or articulating instruments. In our study, we used a longer-length ultrasonic dissector.

Due to the lack of experience with suspension and because the optimal suspension location had to be explored, the operative time was longer; in order to decrease the infection incidence, when the operative time over 3 hours, we added a redose of antibiotics and used prophylaxis antibiotics 48 hours after the operation like in MPL or laparotomy, and only one patient had pneumonia. To avoid postoperative nausea and vomiting, when performing the infrarenal para-aortic lymphadenectomy and omentectomy, the patient's position can be changed from Trendelenberg to supine. No anti-emetics were used routinely and no nausea and vomiting occurred after the operation. Because in cancer, there is a high risk of thrombosis, 24 hours after the operation, we commonly administer 4100 U of low-molecular-weight heparin by hypodermic injection until 72 hours after the operation like in other surgical approaches; no patient had thrombosis. Therefore, although the LESS approach has a longer operative time, the postoperative complications do not increase.

Lastly, the primary surgeon must be well trained when performing the cancer-staging surgery. Our team has experience with more than 200 cases of LESS including staging surgeries for early-stage endometrial and cervical cancer. In this study, all patients successfully underwent the staging surgery, and none required conversion to traditional MPL or laparotomy. However, when the LESS procedure is difficult, for the patient's safety, conversion to MPL or even laparotomy is necessary.

As the technology becomes more commonly used, it is imperative that the technique be critically evaluated to ensure that perioperative morbidity and oncologic outcomes are at least equivalent to those with the traditional surgical approaches. The limitations of this study include the small sample size and short follow-up time. A high number of cases and longer follow-up time are required to assess whether the oncologic outcomes of LESS are better, equivalent, or worse, compared with those of traditional surgical approaches.

CONCLUSION

In conclusion, combined with effective suture suspension, LESS performed by an experienced laparoscopic gynecologist may be safe and feasible for early ovarian/fallopian tube cancer staging surgery. The LESS approach has some advantages included providing easier access to the upper abdominal regions when performing high-level infrarenal para-aortic lymphadenectomy; the 2-cm elastic incision favors fast specimen extraction and colpotomy are avoided. However, the long-term oncologic outcomes need to be further investigated.

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