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Laparoendoscopic single-site versus conventional laparoscopic surgery for ovarian mature cystic teratoma

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Objective

To compare the intraoperative and postoperative outcomes of laparoendoscopic single-site surgery (LESS) versus conventional laparoscopic surgery in women with ovarian mature cystic teratoma.

Methods

A retrospective review of 303 women who underwent LESS (n=139) or conventional laparoscopic surgery (n=164) due to ovarian mature cystic teratoma was performed. Intra- and postoperative outcomes were compared between the two groups.

Results

There was no intergroup difference in age, body weight, height, body mass index, comorbidities, tumor size, bilaterality of tumor, or the type of surgery. However, more patients in the LESS group had a history of previous abdominal surgery (19.4% vs. 6.7%, P=0.001). Surgical outcomes including operating time (89 vs. 87.8 minutes, P=0.734), estimated blood loss (69.4 vs. 68.4 mL, P=0.842), transfusion requirement (2.2% vs. 0.6%, P=0.336), perioperative hemoglobin level change (1.3 vs. 1.2 g/dL, P=0.593), postoperative hospital stay (2.0 vs. 2.1 days, P=0.119), and complication rate (1.4% vs. 1.8%, P=0.999) did not differ between LESS and conventional groups. Postoperative pain scores measured using a visual analogue scale were significantly lower in the LESS group at 8 hours (P=0.021), 16 hours (P=0.034), and 32 hours (P=0.004) after surgery, and 32 of 139 patients (23%) in the LESS group and 78 of 164 patients (47.6%) in the conventional group required at least one additional analgesic (P<0.001).

Conclusion

LESS was feasible and showed comparable surgical outcomes with conventional laparoscopic surgery for women with ovarian mature cystic teratoma. LESS was associated with less postoperative pain and required less analgesia.

Keywords: Laparoendoscopic single-site surgery; Laparoscopes; Mature cystic teratoma; Ovary; Single-port

Introduction

Ovarian mature cystic teratoma is a benign tumor of the ovary comprised of ectodermal, mesodermal, and endodermal layers of germ cells. It is one of the most common ovarian tumors accounting for 25% to 40% of all ovarian tumors [1]. Although it can be discovered in postmenopausal women, more than 80% of ovarian mature cystic teratomas are diagnosed during reproductive years and it accounts for approximately 60% of all ovarian tumors in women younger than 40 years [2].

Laparoscopic ovarian cystectomy or salpingo-oophorectomy are the preferred surgical interventions for ovarian mature cystic teratoma [3-5]. Laparoscopic surgery has several proven advantages over open surgery in the management of ovarian mature cystic teratoma, including a significant reduction in operative morbidity, postoperative pain scores and analgesic requirements, hospital stay, and the recovery period [3,5]. Following its development for the surgical management of ovar-

ian tumors, laparoendoscopic single-site surgery (LESS) is now showing increasing popularity [6-18]. It is thought that LESS may be an even less invasive surgical procedure than conventional multi-port laparoscopic surgery. However, it is uncertain whether LESS has comparable feasibility and postoperative outcomes to conventional laparoscopic surgery in the management of ovarian mature cystic teratoma. The aim of this study was to compare the intraoperative and postoperative outcomes of LESS versus conventional laparoscopic surgery in women with ovarian mature cystic teratoma.

Materials and methods

1. Patient population
Following approval by the institutional review board of Asan Medical Center (Seoul, Korea), the medical records of 303 patients who were newly diagnosed with ovarian mature cystic teratoma and underwent laparoscopic surgery between 2009 and 2012 were retrospectively reviewed. A total of 139 patients underwent LESS and 164 patients underwent conventional laparoscopic surgery, and intra- and postoperative outcomes were compared between the two groups. Date was obtained from the patients' medical records as follows: 1) demographic data including age, body weight, height, body mass index, previous abdominal surgery, and comorbidities; 2) surgical data including tumor size, bilaterality of tumor, type of surgery, operating time, transfusion, perioperative hemoglobin level change, length of hospital stay, complications, postoperative pain score and analgesic use; and 3) postoperative outcomes including recurrence.

2. Surgical technique
Under general anesthesia, patients were placed in the dorsal lithotomy, trendelenburg down position. A uterine manipulator (Cohen cannula) was placed through the uterine cervix for mobilization of the uterus and adnexal tumor during surgery. LESS was performed using a commercially available multichannel, single-port access system. After making a 1.5 cm longitudinal, linear skin incision at the base within the umbilicus, peritoneal access was obtained using an open Hasson technique Fig. 1. After inserting a multichannel, single-port access system through the umbilicus, pneumoperitoneum was created using CO_2 gas at 8 to 12 mmHg. A 0 degree, 5 mm, rigid laparoscope was used. Surgeons stood on the left side of the patients and used the straight laparoscopic instruments with both hands. The first assistant (senior resident) stood on the right side of the patients and

handled the laparoscope and the second assistant (junior resident) stood between the legs of the patients and handled the uterine manipulator. Salpingo-oophorectomy or ovarian cystectomy was performed as planned, and tumor specimens were extracted using endo-pouches. After surgery, the peritoneum and fascia was closed using 2-0 Vicryl suture and the skin was closed using skin adhesive. Operations were performed by multiple experienced laparoscopic surgeons. The selection criteria between LESS and
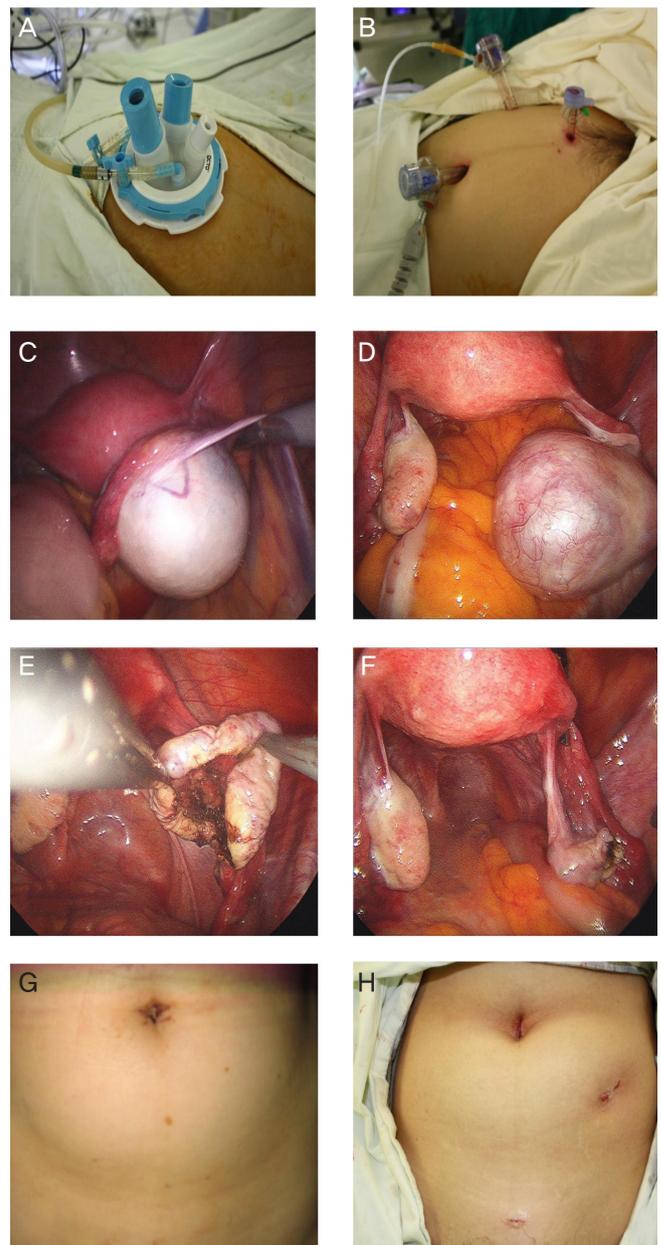

Fig. 1. Laparoendoscopic single-site surgery (left) and conventional laparoscopic surgery (right) for ovarian mature cystic teratoma. Placement of ports (A,B). Ovarian mature cystic teratoma (C,D). Remained ovaries after ovarian cystectomy (E,F). Abdominal wounds after surgery (G,H).

conventional laparoscopic surgery were not clear. It was selected by the attending surgeon after discussion with patient.

Conventional laparoscopic surgery was performed using a three-port system. A 10, 12, and 5 mm trocar was placed using a closed technique on the umbilicus, left lower quadrant, and suprapubic area, respectively Fig 1. Except for the placement of laparoscopic ports, all aspects of the surgical techniques for LESS and conventional laparoscopic surgeries were identical.

3. Postoperative management

Postoperatively, sips of water were allowed on the day of surgery and a normal diet was resumed on postoperative day (POD) 1. Postoperative pain was controlled with parenteral non-steroidal anti-inflammatory drugs (ketorolac, 10 mg) every 8 hours on the day of surgery and oral non-steroidal anti-inflammatory drugs (keotolac, 30 mg) every 8 hours from POD 1. Additional analgesics were given as requested with parenteral non-steroidal anti-inflammatory drugs. The pain score was measured using a visual analogue scale in 8 hours intervals and whenever the patients reported pain that required additional analgesics. A pain score of 0 was defined as "no pain" and 10 defined as "worst imaginable pain." Discharge was allowed when ordinary activities were resumed, pain was tolerable, and there were no symptoms or signs of complications requiring further treatment or reoperation from POD 1. Patients were followed up as outpatients 2 weeks and 1 month after surgery, and then every 6 months thereafter.

4. Statistical analysis

Mean values were compared using Student's t-test and frequency distributions were compared using the chi-square test or Fischer's exact test between groups. A P-value of <0.05 was considered to represent a statistically significant difference. Statistical analysis was performed using IBM SPSS ver. 21.0 (IBM Corp., Armonk, NY, USA).

Results

The demographic characteristics of the two groups are compared in Table 1. There was no difference in age, body weight, height, body mass index and comorbidities between the two groups; however, more patients in the LESS group had a history of previous abdominal surgery.

The surgical outcomes are compared in Table 2. There was no difference in the mean tumor size, bilaterality of ovarian mature cystic teratoma, and the type of surgery between the two groups. No patient in either surgery group required an additional port or conversion to laparotomy to complete the planned surgery. The mean operating time (89.0 vs. 87.8 minutes, P=0.734) and estimated blood loss (69.4 vs. 68.4 mL, P=0.842) of the LESS group were comparable to the conventional laparoscopic surgery group. Three (2.2%) and one (0.6%) patient in the LESS and conventional group, respectively, required transfusion (P=0.336). The mean

Table 1. Preoperative characteristics of patients (n=303)

Characteristics	LESS (n=139)	Conventional (n=164)	*P*-value
Age (yr)	35.5±12.1	32.2±11.4	0.018
Body weight (kg)	58.5±11.3	57.1±9.5	0.249
Height (cm)	159.7±6.1	159.9±5.8	0.762
Body mass index (kg/m^2)	23.12±4.03	22.37±3.59	0.085
Parity			0.601
0	77 (55.4)	86 (52.4)	
1	32 (23)	46 (28)	
≥2	30 (21.6)	32 (19.5)	
No. of previous abdominal surgery			0.001
None	112 (80.6)	153 (93.3)	
1	18 (12.9)	11 (6.7)	
2	9 (6.5)	0 (0)	
Co-morbid medical disease	8 (5.8)	10 (6.1)	0.900

Values are presented as mean±standard deviation or n (%).
LESS, laparoendoscopic single-site surgery.

Table 2. Comparison of surgical outcomes (n=303)

Characteristics	LESS (n=139)	Conventional (n=164)	P-value
Tumor size (cm)	6.3±2.8	6.8±2.9	0.087
Bilateral	34 (24.5)	49 (29.9)	0.292
Type of adnexal surgery			0.301
Unilateral salpingo-oophorectomy	13 (9.4)	19 (11.6)	
Bilateral salpingo-oophorectomy	11 (7.9)	15 (9.1)	
Unilateral ovarian cystectomy	92 (66.2)	96 (58.5)	
Bilateral ovarian cystectomy	21 (15.1)	34 (2.7)	
Others[a]	2 (1.4)	0 (0)	
Operating time (min)	89±30.9	87.8±31.1	0.734
Estimated blood loss (mL)	69.4±44.2	68.4±45.4	0.842
Transfusion required in	3 (2.2)	1 (0.6)	0.336
Preoperative hemoglobin level (gm/dL)	12.7±1.1	12.8±1.1	0.677
Postoperative hemoglobin level (gm/dL)	11.4±1.2	11.5±1.2	0.447
Hemoglobin level change (gm/dL)	1.3±1	1.2±0.7	0.593
Postoperative hospital stay (day)	2±0.5	2.1±0.4	0.119
Discharge within 1 day after surgery	9 (6.5)	2 (1.2)	0.026
Perioperative complications[b]			0.999
Bowel serosal repair	1 (0.7)	1 (0.6)	
Ileus	0	1 (0.6)	
Wound dehiscence	1 (0.7)	1 (0.6)	

Values are presented as mean±standard deviation or n (%).
LESS, laparoendoscopic single-site surgery.
[a]Unilateral salpingo-oophorectomy and contralateral ovarian cystectomy; [b]Within 30 days after surgery.

Table 3. Comparison of postoperative pain score (n=303)

Characteristics	LESS (n=139)	Conventional (n=164)	P-value
Pain score at			
8 Hours after surgery	5.6±1.7	6±1.7	0.021
16 Hours after surgery	3.3±1.4	3.6±1.3	0.034
24 Hours after surgery	2.7±1.2	2.9±1	0.213
32 Hours after surgery	2.2±0.8	2.5±1.1	0.004
40 Hours after surgery	2±1	2±1.2	0.745

Values are presented as mean±standard deviation.
LESS, laparoendoscopic single-site surgery.

perioperative hemoglobin level change did not differ between the two groups (1.3 vs. 1.2 g/dL, P=0.593). The mean postoperative hospital stay was 2 days and 2.1 days for the LESS and conventional groups, respectively (P=0.119); however, more patients in the LESS group were discharged within 1 day of surgery (6.5% vs. 1.2%, P=0.026). Complications occurred in two (1.4%) and three (1.8%) patients in the LESS and conventional groups, respectively (P=0.999) (Table 2), but these were minor and managed conservatively. No patient required reoperation or readmission due to a complication. In the follow-up ultrasonogram, which was performed between 6 and 12 months after surgery, no patient in either group showed residual or recurrent ovarian mature cystic teratoma.

Postoperative pain scores between the two groups, as measured by a visual analogue scale in 8 hours intervals, are compared in Table 3. Pain scores were lower within 32 hours after surgery in the LESS group, and the differences were statistically significant at 8, 16, and 32 hours after surgery. Between surgery and discharge, 32 of 139 patients (23%) in the LESS group and 78 of 164 patients (47.6%) in the conventional group required at least one additional analgesic (P<0.001). The mean number of

Table 4. Comparison of additional analgesic use (n=303)

Characteristics	LESS (n=139)	Conventional (n=164)	P-value
No. of additional analgesic use at POD 0			0.001
0	115 (82.7)	101 (61.6)	
1	20 (14.4)	57 (34.8)	
2	3 (2.2)	5 (3)	
3	1 (0.7)	1 (0.6)	
No. of additional analgesic use at POD 1			0.001
0	123 (88.5)	117 (71.3)	
1	13 (9.4)	45 (27.4)	
2	2 (1.4)	1 (0.6)	
3	1 (0.7)	1 (0.6)	
No. of additional analgesic use at POD 2			0.035
0	134 (96.4)	148 (90.2)	
1	5 (3.6)	16 (9.8)	

Values are presented as n (%).
LESS, laparoendoscopic single-site surgery; POD, postoperative day.

additional analgesics that were used in these patients was 1.7±0.8 and 1.7±0.8 (P=0.744), respectively. The use of additional analgesics on each POD was compared between the two groups in Table 4. Significantly more patients in the conventional group required additional analgesics at POD 0, 1, and 2.

Discussion

Our results suggest that LESS is feasible in the surgical management of ovarian mature cystic teratoma because no patient required additional ports or conversion to laparotomy to complete the planned surgery. The surgical outcomes of LESS, including operating time, estimated blood loss, transfusion requirement, and postoperative hospital stay, were comparable to conventional laparoscopic surgery without increasing perioperative complications. However, the LESS group had a significantly lower postoperative pain score and analgesics requirement compared to the conventional group. Significantly more patients in the LESS group were discharged on POD 1. There was no intergroup difference in the recurrence rate of ovarian mature cystic teratoma.

 Pelosi and Pelosi [19] and Pelosi and Pelosi [20] first reported the use of LESS in gynecology in 1991, but it did not gain popularity for two decades. It is now showing increasing popularity in several surgical departments including gynecology, urology, general surgery, and chest surgery [21]. LESS lends itself well to ovarian mature cystic teratoma because it mainly occurs in adolescent or young women, in who the cosmetic outcomes of surgery are of great importance. Recently, several studies have reported the surgical outcomes of LESS for the management of ovarian tumors [6-17], but these reports included only small study populations and heterogeneous groups of ovarian tumors. The surgical outcomes specific to ovarian mature cystic teratoma have not been previously reported. To our knowledge, the present study, which focused on the surgical outcomes of LESS in the surgical management of ovarian mature cystic teratoma, is the largest case-control study on the outcomes of LESS in the surgical management of ovarian tumor (Table 5) [6-16].

 Previous studies suggested that LESS was feasible for the surgical management of ovarian tumor. In the seven case series and four case-control studies that have been reported, a total of 640 patients underwent LESS surgery for ovarian tumor. Of these, seven patients (1.1%) required additional ports to complete the planned surgery due to adhesion (Table 5) [6-16]. Only three patients required conversion to laparotomy to complete the operation because the frozen-section pathology revealed malignant ovarian tumor [6-16]. In our series, no patient required an additional port or conversion to laparotomy; thus this study adds credence to the argument that LESS is feasible for the management of ovarian mature cystic teratoma.

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Jeong-Yeol Park, et al. Laparoendoscopic single-site adnexal surgery

Table 5. Published studies regarding laparoendoscopic single-site surgery on ovarian tumor

Author	Year	Surgery group	No. of ports	No. or pa-tients	addition-al ports	Conver-sion to laparoto-my	Tumor size (cm)	Operating time (min)	EBL (mL)	Hb change (gm/dL)	Transfu-sion	Hospital stay (day)	Compli-cation
Lim et al. [6]	2009	LESS	1	12	0	0	4 (3–9)	73 (25–110)	10 (5–100)	NR	NR	2 (2–3)	0
Kim et al. [7]	2009	LESS	1	24	1 (4.2%)	1 (4.2%)	5 (3–12)	70 (40–128)	10 (10–100)	NR	NR	1 (1–3)	0
Escobar et al. [8]	2010	LESS	1	9	1 (11.1%)	0	NR (2.8–9)	NR	NR (mini-mal–75)	NR	NR	NR (0–1)	0
Jung et al. [9]	2011	LESS	1	86	2 (2.3%)	0	5.6 (1.2–30)	64.5 (21–176)	10 (10–300)	NR	NR	2 (1–7)	4 (4.7%)
Kim et al. [10]	2011	LESS	1	94	1	1	6.3 (1–16.6)	50.3 (30–105)	83.4 (50–200)	NR	NR	1.9 (1–3)	2 (5%)
Tateda et al. [11]	2011	LESS	1	100	0	0	6.9 (1–24.2)	55 (16–153)	10 (10–690)	NR	NR	4 (2–9)	0
Roh et al. [12]	2012	LESS	1	96	0	0	6.3 (3.1–18.9)	70 (27–185)	105 (10–500)	1.3 (0.2-3.5)	8 (8.3%)	2 (2–6)	3 (3.1%)
Lee et al. [13]	2010	LESS	1	17	0	0	5.6 (2.3–14)	64 (33–148)	80 (10–200)	1.3±0.9	0	2 (1–4)	0
		Conven-tional	4	34	0	0	6.2 (2.9–10.5)	57.5 (30–117)	10 (10–300)	1.1±0.9	0	2 (1–6)	0
		P-value					0.648	0.252	0.075	0.64	>0.999	0.516	
Fagotti et al. [14]	2011	LESS	1	30	2 (2.6%)	0	4.7 (2.5–9)	38.5 (20–115)	20 (10–50)	NR	NR	1 (1–3)	3 (10%)
		Conven-tional	4	58	0	0	4.4 (2.2–9.4)	54 (20–144)	30 (10–150)	NR	NR	2 (1–2)	7 (12%)
		P-value					0.039	0.09	0.008			0.03	0.2
Bedaiwy et al. [15]	2012	LESS	1	28	0	0	NR (3.8–8)	45±19.5	20±10	NR	0	<1	0
		Conven-tional	NR	50	0	0	NR (3.8–8)	46.4±18.3	25±5	NR	0	<1	0
		P-value						0.08	0.08				
Yim et al. [16]	2013	LESS	1	110	0	0	5 (4–7)	57.5 (41–91.3)	5 (5–50)	1.8±0.8	0	2.1±0.8	4 (3.6%)
		Conven-tional	4	107	0	0	6 (4–7)	53 (39–79)	100 (20–100)	1.9±0.8	1 (0.9%)	2.7±1.0	3 (2.8%)
		P-value					0.917	0.159	<0.001	0.19	0.493	<0.001	0.491

Values are presented as median (range), mean±standard deviation, or n (%) otherwise specified.
EBL, estimated blood loss; Hb, hemoglobin; LESS, laparoendoscopic single-site surgery; NR, not reported.

In four previous case-control studies, the operating time of LESS was similar to that of conventional laparoscopic surgery (Table 5) [13-16]. Three of the four studies reported significantly less estimated blood loss in the LESS group, and two studies showed a trend towards shorter hospital stays for LESS patients. There was no difference in the occurrence of complications in these studies. In our series, the surgical outcomes of LESS were similar to those of conventional laparoscopic surgery, in agreement with previous studies.

In our series, postoperative pain scores measured by visual analogue scale were significantly lower in the LESS group, although the magnitude of the difference may have limited clinical relevance. It seems certain that LESS has advantages in postoperative pain because these patients had lower pain scores than the conventional group, despite receiving fewer analgesics. Two previous studies also reported that LESS patients required less analgesics than conventional laparoscopic patients [15,16]. Theoretically, postoperative pain is mainly of parietal origin, originating from incised skin, fascia, or muscle of the abdominal wall, which is in contrast to visceral pain, which originates from the peritoneal cavity. Therefore, the reduction in the abdominal incision in LESS may be associated

with decreased postoperative pain.

Our study is limited due to its retrospective design and thus there is a possibility that bias may have been introduced. However, the demographic characteristics of patients were not significantly different between the LESS and conventional groups except age and the number of previous abdominal surgery. Although the mean age was younger for conventional laparoscopic surgery group, the difference of 3 years seems not clinically significant. A notable strength of this study is that it is the largest case-control study of LESS for ovarian tumors, and the first report on the surgical outcomes of LESS performed exclusively for treatment of ovarian mature cystic teratoma. We used three ports for conventional laparoscopic surgery in our study dislike previous studies which used four port for conventional laparoscopic surgery. Our study is the first one showing the reduced pain score which was measured using a Visual Analogue Scale in regular time intervals in LESS group after adenxal surgery.

In conclusion, LESS was feasible and showed comparable surgical outcomes with conventional laparoscopic surgery for women with ovarian mature cystic teratoma, with no increase in perioperative complications or recurrence after surgery. However, LESS was associated with less postoperative pain and required less analgesia.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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