Original Article

Feasibility and Safety of Laparoscopic Surgery in Large Ovarian Masses

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Abstract

Objectives: To evaluate the feasibility and safety of laparoscopic surgery for large ovarian masses with benign features.
Materials and Methods: Women who underwent laparoscopic surgery for an ovarian mass with benign features between 2017 and 2019 at a tertiary referral center were included in the retrospective study. Based on the size of the ovarian mass, the women were divided into the case and control groups of ≥10 cm and <10 cm, respectively. Clinical characteristics, operative findings, histopathological results, and complication rates of the groups were compared.
Results: A total of 260 women, 64 women with large masses and 196 with small masses were included in the study. The operation time, intraoperative cyst rupture rate, complication rate, and hospital stay were similar in the case and control groups ($P > 0.05$). The cyst aspiration rate (29.7% vs. 5.1%, $P < 0.001$) and the unexpected malignancy rate (7.8% vs. 0.0% $P = 0.001$) were significantly higher in the case group than in the control group.
Conclusion: Laparoscopic surgery was found feasible for the treatment of women with large ovarian masses. However, a higher unexpected malignancy rate requires the careful patient selection and appropriate counseling preoperatively in these cases.

Keywords: Feasibility, laparoscopic surgery, minimally invasive surgery, ovarian cancer, ovarian mass

Introduction

Ovarian masses are common conditions requiring surgery encountered by gynecologists. Approximately 5%–10% of women require surgical treatment for suspected ovarian neoplasm during their lifetimes.[1] The advantages of laparoscopic surgery have made the laparoscopic approach a primary choice in the surgical treatment of benign small ovarian masses.[2,3] Reduced perioperative morbidity, improved cosmesis, decreased length of hospital stay, and less adhesion formation and postoperative pain in laparoscopic surgery improve the quality of postoperative life.[4] However, concerns remain about the feasibility and safety of laparoscopic surgery for large ovarian masses. Some surgeons still refrain from laparoscopic surgery for large masses because of difficult visualization, the risk of damage to intra-abdominal organs, the risk of an unintended rupture of occult malignancy, and the risk of intraperitoneal spillage, and the need for subsequent adjuvant therapy. The study aimed to assess the feasibility and safety of laparoscopic treatment for large ovarian masses that were preoperatively presumed benign.

Materials and Methods

This retrospective study was conducted at the gynecology department of a tertiary care center between January 2017 and December 2019. The study protocol was approved by the institutional review board (2020/01-28) and complied with the

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Declaration of Helsinki and Good Clinical Practice guidelines. Written informed consent for future use of medical records in scientific researches was obtained from all women at the time of hospital admission.

Medical records of women who underwent surgery for an adnexal mass were reviewed. Women who had an ovarian mass with a low risk of malignancy (risk of malignancy index [RMI] <200 or increased serum cancer antigen 125 [CA125] level with typical characteristics of endometrioma and mature cystic teratoma by ultrasonographic examination) and underwent laparoscopic surgery were included in the study. Women who had an extraovarian adnexal mass, underwent laparotomy for the initial surgical approach, and had high-risk malignancy findings (tumors with thick irregular septa, with complex consistency, omental cake, RMI >200 in the absence of typical ultrasonographic characteristics of endometrioma or mature cystic teratoma) were excluded from the study.

As a part of the routine gynecological examination, ultrasonography was performed preoperatively by experienced gynecologists using a 6–10 MHz transvaginal probe (Logiq P5, GE Healthcare Inc., Milwaukee, Wisconsin, USA) with an empty bladder in the lithotomy position. The RMI was calculated using the CA 125 value, postmenopausal status (M), and ultrasonography score (U) (RMI = U × M × CA125), as previously reported.[5] In this scoring method, an ultrasound score was assigned according to the following ultrasound features that suggest malignancy: multilocular cystic mass, solid areas, bilaterality, ascites, and extraovarian tumor. Postmenopausal status was defined as being more than 40 years old with at least 1 year of amenorrhea. CA125 levels were measured by using the Elecsys CA 125 II kit (Roche, Mannheim, Germany).

Demographic, clinical characteristics, ultrasonography, laboratory, operation, and histopathological reports of all participants were reviewed. Women were divided into two groups based on the diameter of the ovarian mass. A large ovarian mass was defined as ≥10 cm in diameter on preoperative ultrasonographic findings. Women with large masses were included in the case group. The control group consisted of women with ovarian masses <10 cm in diameter. Age, parity, body mass index, menopausal status, history of abdominal surgery, tumor diameter, ultrasonographic findings, CA 125 serum level, surgical procedures, operating time, preoperative and postoperative day one hemoglobin concentration, intra and postoperative complications, conversion to laparotomy, length of hospital stay, and histopathological results of groups were compared.

All surgical procedures were carried out by the experienced gynecological surgical team in a single referral center. Preoperatively, written informed consent was obtained from all participants regarding the use of their medical records for scientific research, frozen section analysis, the risk of complications and unexpected malignancy, and the need for possible conversion to laparotomy or other indicated procedures. Laparoscopy was performed in the lithotomy position under general anesthesia. Pneumoperitoneum was established with a Veress needle or via an open-access technique at pressure settings of 15 mmHg. The initial trocar was inserted umbilically or at the Palmer point (left subcostal mid-clavicular region) in women with suspected intra-abdominal adhesion. Then, accessory trocars were placed in the abdominal cavity in the right and left quadrants. A thorough inspection of the abdominal cavity and adnexal mass was carried out next. A uterine manipulator was used in women with severe pelvic adhesions. Cystectomy or salpingo-oophorectomy was performed depending on the women's age and suspicious appearance of the ovarian mass based on visual inspection. In women with an ovarian cyst exceeding the capacity of the endobag or wholly occupying the abdominal cavity, the cyst content was aspirated by a suction tube. During the aspiration process, intraperitoneal spillage of the cystic contents was carefully avoided. Intraperitoneal spillage was also avoided by sealing the puncture site after aspiration of the cyst content using an electrothermal bipolar vessel sealer (LigaSure Atlas™, Valleylab, Boulder, CO, USA). After the cystectomy or salpingo-oophorectomy, the ovarian masses were placed into a synthetic endobag and removed from the abdominal cavity to prevent spillage into the abdominal cavity. The operating time was defined as the time from the anesthesia induction to the closure of all port sites.

All ovarian masses were sent for frozen pathological examination at the time of the operation. When a malignant or borderline tumor was detected, cases were consulted intraoperatively in the gynecologic oncology unit. Explorative laparotomy with tumor staging was carried out by a gynecologic oncology team if indicated. Further confirmatory paraffin pathological examination was carried out in all histopathological specimens. Borderline tumors were classified as malignant for statistical analysis.

Data were statistically analyzed using SPSS v. 17.0 for Windows (SPSS, Inc., Chicago, IL, USA). The Shapiro–Wilk test was used to test normality for continuous variables. Descriptive statistics are presented as mean ± standard deviation or median (range), based on the assumption of a normal distribution. The Student's *t*-test was used for normally distributed continuous data, whereas the Mann–Whitney U-test was used for data not normally distributed. Pearson's Chi-squared test or Fisher's exact test was used to compare categorical variables. The level of statistical significance was set at $P < 0.05$.

Results

During the study period, a total of 260 women, 64 women with a large mass and 196 without, underwent laparoscopic surgery for an ovarian tumor. As shown in Table 1, the demographic and clinical characteristics of the women with and without large ovarian masses were similar. The serum levels of CA 125 and RMIs were also similar between the two groups ($P > 0.05$). Through ultrasonographic imaging, the median diameter of the ovarian mass was determined to be 11.2 cm (10–22.5 cm) in women with a large mass and 6.8 cm (2.5–9.8 cm) in women without a large mass. Multilocular cystic appearance (45.3% vs. 24.5%, $P = 0.002$) and intra-abdominal ascites (7.8% vs. 1.5%, $P = 0.024$) were more common in women with large ovarian masses. However, the bilaterality rate was lower in this group. While 4 (6.3%) women had bilateral ovarian masses in the large group, 37 (18.4%) women had them in the control group ($P = 0.016$).

Operative details and histopathological results of women with and without large masses are shown in Table 2. Emergent surgery was performed in nine (14.1%) of the women with large ovarian masses due to torsion and 19 (9.7%) of the women without (17 due to torsion and two due to cyst rupture). The salpingo-oophorectomy rate was significantly higher in women with large masses than without (65.6% vs. 44.4%, $P = 0.003$). There was no significant difference in terms of laparoscopy technique, operation time, complication rate, preoperative and postoperative Hb levels, and length of hospital stay between the two groups ($P > 0.05$). While the intraoperative cyst rupture rate of the two groups was similar (26.6% vs. 35.7%, $P = 0.178$), aspiration of the cyst content was performed more commonly in women with large ovarian cysts (29.7% vs. 5.1%, $P < 0.001$). The conversion to laparotomy rate was higher in women with large ovarian masses than without (7.8% vs. 0.0% $P = 0.001$). All the laparotomies were performed in cases with unexpected malignancy. In the large-mass group, one woman (1.6%) who underwent cystectomy had intraoperative bleeding requiring transfusion. The histopathological diagnosis of the cystectomy specimen indicated a mature cystic teratoma. No other intraoperative or postoperative complications occurred in either group.

Table 1: Demographic and clinical characteristics of women with and without large ovarian tumor

Characteristics	Large ovarian tumor ($n=64$)	Small ovarian tumor ($n=196$)	*P*
Age (years)	39.5 (18-61)	41 (23-74)	0.187
BMI (kg/m^2)	28.7 (16.6-38)	27.5 (17-46.5)	0.283
Parity	2 (0-8)	2 (0-9)	0.417
Postmenopausal	9 (14.1)	41 (20.9)	0.227
Menopause duration (years)	6 (1-20)	6 (1-34)	0.704
Prior abdominal surgery	33 (51.6)	86 (43.9)	0.284
Symptom			
Asymptomatic	12 (18.8)	51 (26.0)	0.239
Dysmenorrhea	0	9 (4.6)	0.118
Pelvic pain	45 (70.3)	112 (57.1)	0.061
Abnormal uterine bleeding	7 (10.9)	22 (11.2)	0.950
Postmenopausal bleeding	0	2 (1.0)	>0.99
Ultrasonographic findings			
Tumor diameter (cm)	11.2 (10-22.5)	6.8 (2.5-9.8)	<0.001
Multilocular cyst	29 (45.3)	48 (24.5)	0.002
Solid mass	7 (10.9)	34 (17.3)	0.222
Bilaterality	4 (6.3)	37 (18.4)	0.016
Ascite	5 (7.8)	3 (1.5)	0.024
Extraovarian tumor	-	-	
CA 125 (IU/ml)	15 (4.6-540)	15 (1.7-540)	0.697
RMI	22 (4.6-615)	22 (1.7-540)	0.743
RMI >200	2 (3.1)	10 (5.1)	0.736

Data are median (minimum-maximum) or *n* (%). BMI: Body mass index, CA 125: Cancer antigen 125, RMI: Risk of malignancy index

The histopathological results of women with and without large ovarian masses were different. In benign pathologies, while follicular cysts were the most common pathology in the small-mass group (22.4% vs. 10.9%, $P = 0.044$), the most common pathology in the large-mass group was mucinous cystadenomas (25.0% vs. 9.2%, $P = 0.001$). The unexpected malignancy rate was also significantly higher in the large ovarian mass group. While 5 (7.8%) women had malign or borderline tumors in the large-mass group, no women with ovarian masses smaller than 10 cm in diameter had either malign or borderline tumors ($P = 0.001$). The median RMI was 13.5 (12–540) in women with malignant tumors. The details of malignant cases (four borderline and one malignant ovarian tumor) are shown in Table 3.

Discussion

The study results showed that laparoscopic surgery of large ovarian masses was feasible. The operation time, complication rate, and length of hospital stay were similar in the large and small ovarian mass groups. However, unexpected malignancy risk was higher in women with large masses than without. While there were no malignant cases in women with ovarian masses presumed benign and <10 cm in diameter, five unexpected malignancies were detected in the large-mass group.

Difficulty in the surgical technique is one of the reasons for hesitating in laparoscopic surgery for large ovarian tumors. Secure port insertion, providing safe surgical vision and manipulation of surgical equipment may become more difficult in women with large ovarian masses. However, like previous

Table 2: Operative details and histopathological results of women with and without large ovarian tumor

	Large ovarian tumor (*n*=64), *n* (%)	Small ovarian tumor (*n*=196), *n* (%)	*P*
Emergent surgery	9 (14.1)	19 (9.7)	0.328
Operation performed			
Salpingo-oophorectomy	42 (65.6)	87 (44.4)	0.003
Cystectomy	22 (34.4)	109 (55.6)	
Laparoscopy technique			
Verres	56 (87.5)	186 (94.9)	0.051
Open access	8 (12.5)	10 (5.1)	
Initial trocar insertion			
Umblically	61 (95.3)	191 (97.4)	0.411
Palmer point	3 (4.7)	5 (2.6)	
Trocar number	3 (1-4)	3 (2-4)	0.543
Pelvic adhesion	30 (46.9)	93 (47.4)	0.936
Preoperative Hb (g/dl)	12.9 (8.6-15.3)	12.7 (8.5-15.6)	0.256
Postoperative Hb (g/dl)	10.9±1.4	10.8±1.2	0.577
Intraoperative cyst rupture	17 (26.6)	70 (35.7)	0.178
Intraoperative cyst aspiration	19 (29.7)	10 (5.1)	<0.001
Operation time (min)	120 (45-370)	110 (30-330)	0.611
Complication rate	1 (1.6)	0	0.246
Transfusion need	1 (1.6)	0	0.246
Conversion to laparotomy	5 (7.8)	0	0.001
Hospital stay (days)	2 (1-5)	2 (1-5)	0.196
Unexpected malignancy	5 (7.8)	0	0.001
Histopathology			
Follicular cyst	7 (10.9)	44 (22.4)	0.044
Serous cystadenoma	16 (25.0)	39 (19.9)	0.386
Mucinous cystadenoma	16 (25.0)	18 (9.2)	0.001
Mature cytic teratoma	8 (12.5)	40 (20.4)	0.157
Endometrioma	12 (18.8)	50 (25.5)	0.271
Fibroma	0	2 (1.0)	>0.99
Benign brenner tumor	0	3 (1.5)	>0.99
Mucinous cystadenocarcinoma	1 (1.6)	0	0.246
Borderline serous tumor	2 (3.1)	0	0.060
Borderline mucinous tumor	1 (1.6)	0	0.246
Borderline seromucinous tumor	1 (1.6)	0	0.246

Data are *n* (%), mean±SD or median (minimum-maximum). SD: Standard deviation, Hb: Hemoglobin

Table 3: Characteristics of malignant cases

Case number	Age (years)	CA 125 (IU/ml)	RMI	Tumor size (cm)	Multilocular cyst	Solid mass	Bilateral mass	Ascite	Extraovarian tumor	Histopathology
1	41	12	12	13	+	–	–	–	–	Borderline mucinous
2	42	43	43	12	–	–	–	–	–	Borderline seromucinous
3	29	13	13	10	–	–	–	–	–	Borderline serous
4	43	540	540	11.6	–	–	–	–	–	Borderline serous
5	30	13.5	13.5	14	+	–	–	–	–	Mucinous cystadenoca

CA 125: Cancer antigen 125, RMI: Risk of malignancy index

reports, the presented findings showed that laparoscopic surgery was feasible in large adnexal tumors presumed benign. Intraoperative and postoperative complication rates were low in the large-mass group, as previously reported.[6,7] Intraoperative bleeding requiring blood transfusion in a woman with a large ovarian mass was the only complication reported in the study population. The operation time and the length of hospital stay were comparable with those of the control group. On the other hand, in our study, the cyst rupture rate (26.6%) was lower than previously reported. Casarin *et al*.[7] and Ghezzi *et al*.[8] reported an intraoperative spillage rate of more than 50% in women undergoing laparoscopic surgery for an adnexal mass with a size of 10 cm or larger. The reason for these discordant rates may be the controlled cyst aspiration application in our study. The cyst content was aspirated in 29.7% of women with large ovarian masses.

Conversion to laparotomy may be required in some cases during laparoscopic surgery because of intra-abdominal adhesions, difficulties in surgical technique, or malignancy. In a multicenter study, conversion to laparotomy was reported in 12 of 186 (6.5%) women who underwent laparoscopic surgery for an adnexal mass 10 cm in diameter or larger.[8] The reasons for conversion to laparotomy were technical difficulties in seven women and malignancies in five women. In our study, the rate of conversion to laparotomy was slightly higher than in the previous report. Conversion to laparotomy in five women (7.8%) occurred because the frozen section analysis intraoperatively confirmed the pathology as malignant. There was no conversion to laparotomy for technical difficulties or other reasons. In the large-mass group, the unexpected malignancy rate of 7.8% was relatively higher than previously reported. A 5.6% malignancy rate was reported in a review published in 2016.[9] Differences in the patient selection criteria of the studies may be the reason for the higher malignancy rate in our study.

Intraoperative rupture and spillage risk of an unexpected malignant tumor is the primary concern in laparoscopic surgery of large ovarian masses. Intraoperative rupture of ovarian masses could lead to upstaging of an occult malignancy.[10] Therefore, distinguishing malignant ovarian masses from benign ovarian masses is essential for gynecologists interested in minimally invasive surgery. Various tumor markers and preoperative scoring systems have been used for this purpose.[5,11] The RMI is one of the preoperative scoring systems have been used.[5] Moore *et al*.[12] reported that the RMI had a sensitivity of 84.6% and a specificity of 75% for distinguishing benign ovarian masses from epithelial ovarian cancer. The RMI includes ultrasonographic features of an ovarian mass, menopausal status, and serum level of CA125 but not the mass size. It is known that the risk of malignancy is higher in large ovarian masses,[13] and it is not yet clear whether the predictive value of the RMI for malignancy in large and small ovarian masses is similar. In our study, no malignancy was observed in women with ovarian masses smaller than 10 cm in diameter and RMI <200. However, there were four malignant cases (three borderline tumors and one malignant tumor) with RMI <200 in the large ovarian mass group. Based on these findings, clinicians should avoid intraperitoneal spillage during laparoscopic surgery of large ovarian masses, even if it is preoperatively presumed benign. Purse-string sutures or surgical clips were previously used after cyst content aspiration to prevent intraperitoneal spillage.[6] We used a different technique for this purpose. We sealed the puncture site using an electrothermal bipolar vessel sealer in cases that underwent cyst aspiration.

In our study, intraoperative rupture rates of small and large ovarian masses were not significantly different. Intra-abdominal rupture of the tumor capsule upstages ovarian cancer from IA to IC1 on the International Federation of Gynecology and Obstetrics scale.[14] There is disagreement about the impact of intraoperative ruptures on the prognosis of ovarian malignancy.[15] Whereas some authors reported that an intraoperative capsule rupture worsens the prognosis,[16,17] others did not.[18,19] Vergote *et al*.[16] and Bakkum-Gamez *et al*.[17] reported that intraoperative capsule rupture was associated with lower disease-free survival in stage I epithelial ovarian cancer. However, according to Seidman *et al*.[18] and Ahmed *et al*.,[19] tumor rupture was not an adverse prognostic factor in these patients. More prospective randomized trials are needed to make a definitive decision on this issue.

The cyst aspiration rate of the large-mass group was higher than that of the small-mass group in the study population. Several techniques have been previously described to aspirate and avoid intraperitoneal spillage of large ovarian mass contents during minimally invasive surgery.[20-24] Hicks-Courant *et al*.[20] applied a skin adhesive to the tumor and a surgical glove to the glue area after exposing the tumor wall via mini-laparotomy, then aspirated the cyst content within the glove. Song and Sung[21] covered the large cyst surface with a sterilized vinyl membrane applied with a skin adhesive, then punctured and aspirated cyst contents during laparoscopic surgery. Chong *et al*.[22] discussed the purse-string suture technique before cyst aspiration during single-port assisted extracorporeal ovarian cystectomy. They reported that the macroscopic intraperitoneal spillage rate was significantly lower than with the conventional technique. However, microscopic spillage with these techniques was not reported. There is no evidence yet on whether controlled aspiration causes microscopic intraperitoneal spillage and upstaging of malignant cases. Further studies evaluating the impact of intraoperative aspiration of ovarian carcinoma on the prognosis are needed.

The large cohort and presence of a control group are the strengths of this study. Previous reports about the efficacy of laparoscopic surgery in large ovarian masses are case studies[25-28] or cohort studies,[6-8,29,30] including only patients with large masses and without a control group. However, the limitations of this study include the retrospective design and insufficient data, such as quantitative blood loss and long-term outcomes of malignant cases. Furthermore, preoperative ultrasonographic examinations and malignancy risk assessments were not carried out by a single clinician. This could cause patient selection bias.

Conclusion

Laparoscopic surgery is feasible in women with large ovarian masses. The operation time, hospital stay, and complication rate in women who underwent laparoscopic surgeries for

large masses were comparable to those in women with small masses. However, an increased risk of unexpected malignancy and intraoperative spillage of malignant tumors should be considered in these women. Proper patient selection and appropriate counseling are obligatory before laparoscopic surgery for large ovarian masses.

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Conflicts of interest

There are no conflicts of interest.

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