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## Original article

## Does tumor size limit application of laparoscopic surgery to ovarian tumors?

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## ABSTRACT

**Objective:** We have found laparoscopic surgery to be both feasible and safe for large ovarian tumors, which at one time would have been managed strictly by conventional laparotomy. The aim of this study was to evaluate the potential risks and the outcomes of laparoscopic surgery for ovarian tumors on the basis of tumor size.

**Materials and methods:** From among 1248 cases of adnexal tumor treated at our institution between June 2005 and June 2014, we identified 1196 cases of preoperatively diagnosed benign ovarian tumor treated by laparoscopic surgery. We divided the cases into three groups according to the diameter of the tumor:  $\leq 5$  cm (Group A,  $n = 355$ ), 6–9 cm (Group B,  $n = 688$ ), and  $\geq 10$  cm (Group C,  $n = 153$ ) and investigated the incidences of perioperative complications and the rates at which laparotomy was converted to open surgery.

**Results:** Median operation time was 59 minutes, 77 minutes, and 73 minutes ( $p < 0.001$ ) for Group A, Group B, and Group C, respectively. Median estimated blood loss was 7 mL, 16 mL, and 32 mL ( $p < 0.001$ ), respectively. The perioperative complication rate ( $n = 4$ ,  $n = 7$ , and  $n = 4$ , respectively), did not differ significantly between groups nor did the rate of conversion to laparotomy ( $n = 1$ ,  $n = 2$ , and  $n = 2$ , respectively). Tumor size was not a prognostic indicator of perioperative complications (Hazard Ratio (HR), 0.96; 95% confidence interval, 0.79–1.16;  $p = 0.652$ ).

**Conclusion:** Operation time and estimated blood loss were shown to increase with the size of an ovarian tumor. However, we found no relation between tumor size and the perioperative complication rate or the rate of conversion to open surgery. Thus, we conclude that tumor size is not a factor limiting application of laparoscopic surgery to ovarian tumors.

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## Introduction

Laparoscopic surgery is the gold standard for surgical treatment of benign ovarian tumors.<sup>1</sup> However, large ovarian tumors are generally managed by conventional laparotomy.<sup>2</sup> This is because the narrow field of view and the small operating space posed by laparoscopic surgery makes the approach to large ovarian tumors difficult. The difficulties are multiplied in petite women, even for

such procedures as trocar insertion. In addition, there is the perceived higher malignant potential of large ovarian masses.<sup>3</sup>

Panici<sup>4</sup> et al reported the feasibility and safety of laparoscopy-assisted surgery for large ovarian tumors. Does size of the ovarian tumor affect the outcome of laparoscopic surgery? No matter how large the tumor, it may be possible to preserve ovarian function in premenopausal women. The factors that limit a laparoscopic approach to ovarian tumor are not well defined.

## Purpose/aims

We undertook a retrospective, comparative study of outcomes in cases of presumed benign ovarian tumor treated by laparoscopic surgery at our institution to determine the factors that limit application of such surgery to ovarian tumors. Factors were compared on the basis of tumor size.

Conflicts of interest: All authors have no conflicts of interest to declare.

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## Materials and methods

### Case selection

From among 1248 cases of adnexal tumor treated at our institution between June 2005 and June 2014, we identified 1196 cases of supposed benign ovarian tumor treated by laparoscopic surgery. We had been given permission by the patients to use their records (pictures during surgery, etc.) for the purpose of our study. We restricted our selection of cases to those for which preoperative imaging study for a measurable lesion had been performed and no concomitant surgery, such as hysterectomy, transcervical resection, urological surgery, or cholecystectomy had been performed. Also excluded were cases of ovarian tumor accompanied by ascites or swollen lymph nodes, those with irregular septum structures, and those accompanied by gross metastatic disease.<sup>5</sup> All patients had provided general informed consent for their perioperative data to be used for medical research.

We stratified the cases according to tumor size and investigated the incidences of perioperative complications and the rates at which laparotomy was converted to open surgery. All data were extracted from patients' online records, i.e., the perioperative video recording, operative report, and pathology report, and the perioperative period, as defined, extended to 1 month after surgery. The preoperative diagnoses were made by gynecologists and based on pelvic examination, transvaginal ultrasound, pelvic magnetic resonance imaging (MRI), and serum tumor marker (CA125) assessment. An ovarian tumor was judged to be benign on the basis of the following preoperative MRI and ultrasound features: presence of a single cystic tumor, absence of septae, absence of wall thickening, and absence of a solid component.<sup>6</sup> Absence of a solid component was not taken in the strictest sense. If such a component was present, absence of blood flow was taken to indicate a benign tumor. The required serum CA125 level was below or within normal range. Laparoscopic surgery was performed for an ovarian tumor diagnosed preoperatively as a benign tumor. The final diagnosis was determined by one of two pathologists.

### Surgical method

The standard laparoscopic surgery method for ovarian tumor requires insertion of three trocars. We inserted the first trocar above the patient's navel or at the navel by the direct method, and we positioned the two other trocars according to the volume of the ovarian tumor. In cases of extensive adhesion and tumor measuring  $\geq 10$  cm in diameter and thus occupying the pelvis, we added a double balloon trocar at the suprapubic area. To reduce the risk of intraperitoneal spillage, we used a SAND double-balloon catheter (Hakko Medical, Tokyo, Japan), which sandwiches the entire tumor between the two balloons. The catheter tip was used to aspirate the tumor contents and thereby decrease the tumor volume, and the tumor wall was freed from adhesion and removed from normal ovarian tissue under laparoscopic assistance.<sup>7</sup> The pneumoperitoneum pressure was maintained at 10 mmHg.

### Comparative study

We divided patients into three groups according to the diameter of the ovarian tumor:  $\leq 5$  cm (Group A), 6–9 cm (Group B), and  $\geq 10$  cm (Group C). Patient age, patient body mass index (BMI), median tumor diameter, operation time, estimated blood loss, hospitalization time (number of days), perioperative complication rate, number of conversions to open surgery, and number of pathologically identified borderline or malignant tumors were compared between groups. Perioperative complication was defined

as an intraoperative or postoperative complication occurring between the time of surgery and 4 weeks after surgery or hospital discharge.<sup>8</sup> Examples include injury to another organs during surgery, trocar injury requiring treatment, bleeding requiring blood transfusion, and readmission within 1 month after surgery because of postoperative ileus, infection, or wound dehiscence.

### Statistical analysis

Results are shown as median values or percentages of patients. Between-group differences were analyzed by Kruskal–Wallis test, and between group differences were analyzed using the Mann–Whitney *U* test. Factors that were shown by univariate analysis to be potential risk factors perioperative complication were entered into multivariate analysis. Odds ratios for perioperative complications and conversion to laparotomy were calculated with 95% confidence intervals. Statistical significance was set at a  $p < 0.05$ . SPSS II version 12.0 (SPSS Inc., Chicago, IL, USA) was used for all statistical analyses.

## Results

Patients were grouped according to tumor size as follows: Group A ( $\leq 5$  cm), 355 patients; Group B (6–8 cm), 688 patients; Group C ( $\geq 10$  cm), 153 patients. Patient characteristics and surgical details are shown in Table 1. A total of 1056 (88%) patients underwent laparoscopic ovarian functional preservation surgery. Only four patients (0.33%) required conversion to laparotomy for which a Pfannenstiel incision or low vertical incision was made. Two of the conversions were necessitated by perioperative organ injury, one was necessitated by severe adhesion, and one by a large calcification within the tumor.

Surgical pathology results are given in Table 2. All but 14 tumors, i.e., 98.8% of the tumors, proved to be benign. Of the 14 tumors that proved to be malignant, one was considered a metastasis from breast cancer. Eleven of the tumors were borderline malignancies, with eight of these being mucinous tumors, two being stromal carcinoid tumors, and one being a serous tumor.

Clinical and surgical details are shown per group in Table 3. Median operation time was 59 minutes, 7 minutes, and 73 minutes ( $p < 0.001$ ) for Group A, Group B, and Group C, respectively. Median estimated blood loss was 7 mL, 16 mL, and 32 mL ( $p < 0.001$ ) for Group A, Group B, and Group C, respectively. Hospital stay did not differ significantly between groups, nor did perioperative complication rates. No perioperative deaths occurred in this patient series. Two patients experienced severe intraoperative complications—organ injury in both cases. One of the injuries required temporary ileostomy, and the other required laparotomy for bladder repair. Three patients were readmitted for postoperative

**Table 1**  
Patient characteristics and type of surgery.

Variable	<i>n</i> = 1196
Age (y)	34.0 (29.0–40.1)
Body mass index (kg/m <sup>2</sup> )	20.2 (18.7–21.9)
Tumor diameter (cm)	6.0 (5.0–8.0)
Bilateral tumor (%)	352 (30.1)
Operation time (minutes)	66.0 (48.0–97.0)
Estimated blood loss (mL)	16.0 (1–67)
Hospital stay (d)	4.0 (3.0–5.0)
Operative procedure ( <i>n</i> )	
Ovarian conservation	1056
Salpingo-oophorectomy	140
Conversion to laparotomy ( <i>n</i> )	4

Median (25<sup>th</sup>–75<sup>th</sup> percentile) values are shown unless otherwise indicated.

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