Gynecology and Minimally Invasive Therapy 5 (2016) 156–160

Contents lists available at ScienceDirect

Gynecology and Minimally Invasive Therapy

journal homepage: www.e-gmit.com

Original article

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

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ARTICLE INFO

Article history:
Received 5 February 2015
Received in revised form
17 February 2015
Accepted 2 March 2015
Available online 27 May 2015

Keywords:
complication
laparoscopic surgery
large ovarian tumor

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: $\leq$ 5cm (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, 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 ($p < 0.001$), 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.

Introduction

Laparoscopic surgery is the gold standard for surgical treatment of benign ovarian tumors.[1] However, large ovarian tumors are generally managed by conventional laparotomy.[2] 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.[3]

Panici[4] 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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http://dx.doi.org/10.1016/j.gmit.2015.03.004

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 measureable 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.[5] 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 maker (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.[6] 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 ≥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.[7] The pneumoperitoneum pressure was maintained at 10 mmHg.

Comparative study

We divided patients into three groups according to the diameter of the ovarian tumor: ≤ 5 cm (Group A), 6–9 cm (Group B), and ≥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.[8] 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 Man–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 (≤5 cm), 355 patients; Group B (6–8 cm), 688 patients; Group C (≥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	$n = 1196$
Age (y)	34.0 (29.0–40.1)
Body mass index (kg/m^2)	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 (*n*)	
Ovarian conservation	1056
Salpingo-oophorectomy	140
Conversion to laparotomy (*n*)	4

Median (25th–75th percentile) values are shown unless otherwise indicated.

Table 2
Pathologic findings.

Histopathologic diagnosis	No. of patients
Dermoid cyst	556
Endometrioid cyst	454
Serous cystadenoma	68
Mucinous cystadenoma	66
Tubal cyst (paraovarian cyst/hydrosalpinx)	18
Adenofibroma/fibroma	8
Struma ovarii	5
Mesothelial cyst	2
Thecoma	2
Puseudocyst	2
Benign Brenner tumor	1
LMP tumor	10
Malignant tumor	3
Metastatic tumor	1

infection. Conversion to open surgery did not differ significantly between groups. However, postoperative pathologic diagnoses did differ significantly between groups ($n = 3$, $n = 4$, and $n = 7$ borderline or malignant tumors; $p < 0.001$) for Group A, Group B, and Group C, respectively. Malignancy was significantly more prevalent in Group C than in the other two groups ($p < 0.001$). All seven malignancies in Group C were borderline malignancies. Results of multivariate analysis are shown in Table 4. Tumor size did not remain a prognostic indicator of perioperative complications (HR 0.96, 95% confidence interval 0.79–1.16, $p = 0.652$).

Discussion

Laparoscopic surgery for large ovarian tumors is very difficult because the pelvic operating space is quite restrictive. Thus, operation time and estimated blood loss during surgery for a large ovarian tumor were significantly increased in our patient series. However, neither the need for conversion to laparotomy nor the number of complications arising during the perioperative period were significantly increased. Despite the poor intraabdominal conditions, laparoscopic surgery for treatment of a large ovarian tumor was shown to be technically feasible and safe if performed properly.

In 2011, the Japan Society for Endoscope Surgery reported a 0.45% rate of conversion to laparotomy from laparoscopic surgery for ovarian tumor and a perioperative complication rate of 1.3%[9]. Chezzi et al[10] reported attempted laparoscopic surgery in 186 patients with a large ovarian tumor ≥10 cm. Five (2.6%) of these patients required conversion to laparotomy, and three (1.6%) suffered perioperative complications.[10] In our patient series, the conversion rate was 0.33%, and the complication rate was 1.25%, consistent with reported rates.

Table 3
Patient characteristics per study group.

Variable	Group			
	A: ≤5 cm (n = 355)	B:6–9 cm (n = 688)	C: ≥ 10 cm ($n = 153$)	P value
Tumor diameter (cm)	5.0	7.0	10.0	<0.001
Age (years)	34.1	34.0	34.5	0.836
Body mass index (kg/m2)	20.1	20.3	20.3	0.134
Operation time (minutes)	59.0	67.0	73.0	<0.001
Estimated blood loss (mL)	7.0	16.0	32.0	<0.001
Hospital stay (days)	4.5	4.5	4.7	0.140
Perioperative complications (n)	4	7	4	0.256
Conversion to laparotomy (n)	1	1	2	0.078
Borderline or malignant tumor (n)	2	4	7	<0.001

Groups are based on tumor size (diameter). Median values are shown unless otherwise indicated.

Table 4
Risk factors for perioperative complications.

Variable	Complications (n)	n	Univariate Hazard ratio (95%CI)	p value	Multivariate Hazard ratio (95%CI)	p value
Tumor diameter						
≤ 10 cm	4	153	2.52 (0.79–8.01)	0.118	0.96 (0.79–1.16)	0.652
>10 cm	11	1043	Reference		Reference	
Age						
≤ 34 y	9	613	1.43 (0.51–4.08)	0.498		
>34 y	6	583	Reference			
Obesity						
Yes	0	30	0.01 (0.01–2.35)	0.789		
No	15	1151				
Bilateral tumor						
Yes	5	352	1.02 (0.41-3.54)	0.739		
No	10	844				
Operation time						
≤ 62 min	12	649	3.42 (0.95–12.1)	0.058	2.31 (0.62–13.7)	0.211
>62 min	3	547	Reference		Reference	
Estimated blood loss						
≤ 16 mL	12	600	4.03 (1.13–14.3)		3.53 (0.91–13.7)	
>16 mL	3	596	Reference	0.031	Reference	0.068
Hospitalization						
≤ 4 d	8	540	1.84 (0.65–5.19)	0.252		
>4 d	7	656	Reference			

n, number of patients.
Obesity, body mass index ≧30 kg/m^2.

Our study further supports the existing data showing that laparoscopic surgery for a large ovarian tumor, i.e., ≥10 cm, is feasible and safe.[11] Previously reported studies included only pathologically similar tumors, and most of the laparoscopic surgeries reported were salpingo-oophorectomies,[12] and the patient's ovary could not be conserved.[7,11,13] We conducted a comparative study in which cases were categorized according to the tumor diameter, as measured on preoperative images, and we assessed the feasibility and safety of laparoscopic surgery in each size category. By including tumors of various sizes and pathologic types that had all been judged to be benign preoperatively, we explored factors that could possibly limit laparoscopic surgery for this clinical entity. We found no significant difference in the perioperative complication rate or the risk of conversion to open surgery based on size of the ovarian tumor.

We investigated factors related to complications that occurred in the perioperative period. Operation time, estimated blood loss, and tumor diameter were shown by univariate analysis to be potential predictive factors for perioperative complications. However, tumor diameter did not hold up under multivariate analysis as a risk factor for perioperative complications. We also examined factors potentially predictive of conversion to laparotomy, but no factors we examined were shown to be statistically significant. This could be because the number of events was too small for uncovering predictive factors. Nevertheless, transition to laparotomy was not associated with tumor size.

Large ovarian tumor remains a treatment dilemma for gynecologists. A large ovarian tumor that is diagnosed as benign by preoperative examination can prove to be malignant upon postoperative pathology examination.[4] In a survey conducted by the American Association of Gynecologic Laparoscopists, unsuspected ovarian cancer was found in only 0.04% of 13,739 cases of ovarian cyst treated by laparoscopic surgery.[14] Another group estimated the risk to be between 0.9% and 13%.[15] In cases of unexpected malignancy, there is a risk of tumor rupture and spillage during laparoscopic surgery, and this of course could advance the tumor stage. It remains uncertain whether intraoperative rupture affects prognosis.[16] Matsushita et al[17] reported discovery of unexpected ovarian malignancy in 1.5% of patients treated laparoscopically and that the presence of an early-stage unexpected ovarian malignancy did not alter prognosis. These data remind us that surgeons must use good judgment and be selective when choosing cases for laparoscopic management.

As diagnostic MRI and ultrasonography continue to develop and accuracy continues to improve, few cases of malignancy are diagnosed postoperatively.[17,18] We always perform MRI and a tumor marker test preoperatively, but the possibility of malignancy is never fully resolved before surgery. A final postoperative pathologic diagnosis is always provided.

Despite our preoperative tests, we had 10 cases of borderline ovarian tumor, three cases of carcinoma, and one metastasis from breast cancer. Radical surgery was eventually performed for our four malignancies. Laparoscopic adnexectomy and a detailed search of the peritoneal cavity were performed for the 10 borderline tumors. We removed these tumors in retrieval bags to prevent spillage and port-site metastasis. No recurrence or death from the disease has occurred during the median follow-up of 914 days (interquartile range: 171–2159 days).

Timmermann et al[19] reported the size of an adnexal mass to be an independent predictor of malignancy. According to our study, the malignancy rate was significantly increased among tumors ≥10 cm in diameter. Therefore, the potential risk of malignancy rather than the tumor size itself should be considered a factor limiting laparoscopic surgery.

Tumor size did not appear to be related to the risk of complications or the need for conversion to laparotomy in our series. If diagnosis by laparoscopic surgery is possible, unnecessary laparotomy is avoidable. Even if the surgical specimen is found to be malignant, additional treatment can be provided in the early postoperative period because laparoscopic surgery is minimally invasive and leads to early recovery. Even when precautionary laparoscopic adnexectomy is performed for a large ovarian tumor, fertility can be preserved.

As this study was retrospective, the possibility of selection bias must be taken into account. However, our institution specializes in laparoscopic surgery, and >2000 laparoscopic procedures are performed every year. In addition, all patients we treat are referred to us by other hospitals. If, through preoperative study, we suspect a malignant ovarian tumor, we refer the patient to an institution that treats malignancies.

Operation time and estimated blood loss increase with the size of the ovarian tumor. However, we found no relation between the perioperative complication rate or rate of conversion to laparotomy and tumor size in our patient series. The only difference was in the prevalence of unexpected malignancies, which was greater among patients with a large ovarian tumor. 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. We observed that laparoscopic surgery was both feasible and safe for large ovarian tumors, which at one time would have been managed strictly by conventional laparotomy. Tumor size was not identified as a factor limiting application of laparoscopic surgery. Our findings may contribute to the expansion of indications for laparoscopic surgery to include large ovarian tumors.

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