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Original article

Laparoscopic versus open surgery for adnexal tumor in pregnant women

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ABSTRACT

Objective: To investigate the surgical and obstetric outcomes after adnexal surgery during pregnancy, focusing on the comparison between laparotomic and laparoscopic approaches.
Materials and Methods: We retrospectively reviewed the medical charts for women who underwent surgery for adnexal mass or torsion during pregnancy between November 1991 and November 2011.
Results: In a total of 152 women, the mean gestational age at surgery was 14.8 ± 4.1 weeks, and most operations were performed at second trimester (64.5%). Adnexal torsion was detected in 27 patients (17.8%), and malignant pathology was confirmed in four patients (2.6%). Among 111 patients who were followed up until delivery, postoperative adverse outcomes were observed in only two patients (1.8%) with miscarriage and 16 patients (14.4%) with preterm labor. Comparison between the laparotomy (118 patients, 77.6%) and laparoscopy (34 patients, 22.4%) groups showed that the latter had a shorter postoperative hospital stay and better surgical outcome than the former (5.9 ± 2.5 days vs. 2.4 ± 0.7 days, $p < 0.001$). Regarding obstetric outcomes, there were no significant differences in the risk of miscarriage and preterm labor in multivariate analysis.
Conclusion: Adnexal surgery during pregnancy could be performed in safety for both mother and fetus. The laparoscopic approach particularly offered more benefit than laparotomy in terms of surgical outcome and was shown to be as safe as laparotomy regarding obstetric complications such as miscarriage and preterm labor.

Introduction

Approximately 1 in 500–635 women require nonobstetric abdominal surgery during their pregnancies.[1,2] The most common indications for that surgery are acute appendicitis and symptomatic biliary disease.[3] Another commonly performed procedure in pregnancy is adnexal surgery for adnexal masses that persist beyond second trimester and are >5–6 cm in diameter, have malignant features on imaging work-up, or cause complications such as torsion, infection, or hemorrhage.

The incidence of adnexal masses requiring surgical management in pregnancy has been reported as 1–2.3% of all gestations.[1] Currently, because most pregnant women visit obstetricians from the early weeks of gestation, and ultrasonographic evaluation is now widely used, the detection rate of adnexal masses during pregnancy has increased over time. In addition, low pregnancy rate caused by delayed marriage, increasing rates of divorce, and increases in women's social activity has made the patients pay more attention to the management strategies during their pregnancy. Eventually, a proficiency in surgical skill with utmost care is needed for clinicians to perform adnexal surgery with no harm to both mother and fetus.

Laparoscopy, as one of the minimally invasive approaches, has become increasingly more common since the 1990s in pregnant women. Even though no clear recommendation can be made for using laparotomy or laparoscopy, several researchers have stated that similar to the general population, pregnant women could benefit from the less manipulation associated with laparoscopy.[4] The purpose of this study was to evaluate the clinical outcome after adnexal surgery in pregnancy by comparing the laparotomic and laparoscopic approaches.[5]

Materials and methods

A retrospective chart review identified all pregnant women who underwent nonobstetric adnexal surgery at University of Ulsan

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College of Medicine, Asan Medical Center, Seoul, Korea between November 1991 and November 2011. This study was approved by the International Review Board of the Asan Medical Center.

Women who wanted to preserve their pregnancy after adnexal surgery were included in this study, thus, patients who underwent dilatation and curettage simultaneously with adnexal surgery were excluded. In addition, those patients who had an ectopic pregnancy or adnexal masses at the time of cesarean delivery for other obstetric indications were excluded. Surgery was indicated during any trimester in women under emergency conditions causing acute abdominal pain with suspicion of adnexal torsion or ovarian bleeding. In other cases, adnexal masses that were persistent and > 6 cm in diameter or suspicious of malignancy were removed during the second trimester.

Surgical modality of laparotomy or laparoscopy was determined based on the surgeon's decision. Laparotomy was performed under regional anesthesia through the epidural route or general anesthesia, and all laparoscopic procedures were performed under endotracheal general anesthesia. To create a pneumoperitoneum with CO_2, a Veress needle was optionally used. After insertion of the videolaparoscope through the umbilicus, two or three punctures were made for the ancillary instruments in the suprapubic and left lower abdominal areas. There was no difference for sites of port insertion for different weeks of gestation. Fetal heart monitoring was carried out pre- and postoperatively when the gestational age was available to monitor it. Tocolytics were not used prophylactically, but were considered perioperatively when signs of preterm labor were present.

For each woman, charts were used to collect data regarding demographic information, past surgical history, obstetric history, presenting clinical history, operative reports, progressive notes, and pathological reports. Data regarding obstetric outcome were reviewed only in patients who were followed up until delivery. Statistical analysis between the laparotomy and laparoscopy groups was performed with Student *t* test or χ^2 test for univariate analysis, and logistic regression for multivariate analysis using SPSS version 12.0 (SPSS Inc., Chicago, IL, USA).

Results

A total of 152 patients were identified; 118 (77.6%) with laparotomy and 34 (22.4%) with laparoscopy. In the entire population, the mean adnexal mass diameter was 9.0 ± 3.7 cm on preoperative sonography, and the mean gestational age at surgery was 14.8 ± 4.1 weeks. Adnexal surgery was performed at first or second trimester in all but two (1.3%) women who received an emergency laparotomy for acute abdominal pain at 29.6 weeks and 32.2 weeks gestation.

In most cases (120, 78.9%), surgical indication was a persistent adnexal mass > 6 cm in diameter, suggesting a risk of malignancy. The remainder of the patients (32, 21.1%) underwent surgery due to the presenting symptoms of acute abdominal pain with adnexal mass. During the operation, adnexal torsion was observed in 27 (17.8%) patients.

In the laparotomy and laparoscopy groups, there were no significant differences in demographic characteristics except for gestational age at surgery and mean mass size (Table 1). The laparoscopy group had earlier gestational age at surgery and larger mass than those in the laparotomy group ($p < 0.05$ in both comparisons). The most common pathology was mature cystic teratoma followed by mucinous cystadenoma and serous cystadenoma (Table 2). In the entire population, malignant masses including borderline tumor were observed in four patients (2.6%). One patient underwent a staging operation followed by adjuvant chemotherapy. Two patients received neoadjuvant chemotherapy and underwent a staging operation with cesarean section at term. One patient, with borderline ovarian tumor, did not receive chemotherapy after the staging operation.

Table 1
Demographic characteristics of the patients.

	Laparotomy ($n = 118$)	Laparoscopy ($n = 34$)	*p*
Age (y)	28.4 ± 3.8	29.4 ± 3.7	0.183
Gravidity	1.6 ± 1.0	1.8 ± 1.2	0.328
Parity	0.2 ± 0.5	0.3 ± 0.5	0.357
BMI (kg/m^2)	22.2 ± 3.3	21.8 ± 2.4	0.469
Previous surgical history	7 (5.9%)	5 (14.7%)	0.141
Gestational age at surgery (wk)			
Mean ± SD	15.8 ± 4.1	12.0 ± 3.4	<0.001
1st trimester	27 (22.9%)	25 (73.5%)	
2nd trimester	89 (75.4%)	9 (26.5%)	
3rd trimester	2 (1.7%)	0	
Tumor size (cm)	9.3 ± 3.9	7.7 ± 2.9	0.030
CA 125 (U/mL)	59.4 ± 66.5	45.4 ± 54.3	0.359
Symptoms			
None	84 (71.2%)	27 (79.4%)	0.265
Abdominal pan	31 (26.3%)	7 (20.6%)	
Vaginal bleeding or discharge	3 (2.5 %)	0	

BMI = body mass index; CA = cancer antigen; SD = standard deviation.

In terms of surgical outcomes, the laparoscopy group had a shorter hospital stay, which was less than half that of the laparotomy group (Table 3). There were no significant differences in the surgical method, operation time, and estimated blood loss. Intraoperative rupture of tumor occurred in 23 patients (19.5%) in the laparotomy group and nine patients (26.5%) in the laparoscopy group ($p = 0.379$). Obstetric outcomes in 111 patients who were followed up until delivery are shown in Table 4. There were only two (1.8%) miscarriages encountered; the first was on Day 1 after ovarian cystectomy with laparotomy at 16.3 weeks gestation, and the second was on Day 4 after laparoscopic oophorectomy at 6.5 weeks gestation. Univariate analysis showed that the laparoscopy group had a lower risk of preterm labor requiring tocolytic treatment. However, in multivariate analysis, the difference was not significant after adjusting for other confounding factors, such as gestational age at surgery and adnexal mass size.

Discussion

From our 20 years' experience of surgery in pregnancy, we showed that adnexal surgery was performed in safety with low risk of adverse maternal and fetal outcomes, and in particular, the laparoscopic approach could be used safely compared to laparotomy, regarding both surgical and obstetrical outcomes with low risks of miscarriage and preterm labor.

The incidence of adnexal masses during pregnancy is 2%.[6] Most of these masses are functional ovarian cysts that resolve

Table 2
Pathology on adnexal surgery in pregnancy.

	Laparotomy ($n = 118$)	Laparoscopy ($n = 34$)	Total ($n = 152$)
Mature cystic teratoma	57 (47.9%)	19 (55.9%)	76 (50%)
Mucinous cystadenoma	19 (16%)	4 (11.8%)	22 (14.5%)
Serous cystadenoma	12 (10.1%)	1 (2.9%)	13 (8.6%)
Endometrioma	10 (8.4%)	2 (5.9%)	12 (7.9)
Corpus luteal cyst	5 (4.2%)	6 (17.6%)	11 (7.2%)
Follicular cyst	6 (5%)	1 (2.9%)	7 (4.6%)
Other benign masses	5 (4.2%)	0	5 (3.3%)
Malignant	4 (3.4%)	0	4 (2.6%)
Not determined	1 (0.8%)	1 (2.9%)	2[a] (1.3%)

[a] Cases of release of torsion, hence no pathological report.

Table 3
Maternal surgical outcomes after adnexal surgery.

	Laparotomy ($n = 118$)	Laparoscopy ($n = 34$)	p
Adnexal torsion	22 (18.6%)	5 (14.7%)	0.579
Preoperative rupture of mass	7 (5.9%)	1 (2.9%)	0.685
Mass location			
Left	59 (50%)	20 (58.8%)	0.240
Right	44 (37.3%)	12 (35.3%)	
Bilateral	15 (12.7%)	2 (5.9%)	
Emergency surgery	24 (20.3%)	7 (20.6%)	0.975
Surgical method			
Salpingo-oophorectomy	36 (30.5%)	16 (47.1%)	0.704
Oophorectomy	52 (44.1%)	6 (17.6%)	
Cystectomy	21 (17.8%)	10 (29.4%)	
Unilateral salpingo-oophorectomy + contralateral cystectomy	7 (5.9%)	1 (2.9%)	
Others	2 (1.7%)[a]	1 (2.9%)[b]	
Operation time (min)	55.5 ± 25.3	52.0 ± 18.1	0.458
Estimated blood loss (mL)	49.6 ± 47.5	54.7 ± 168.7	0.772
Hb decline on postoperative Day 1	1.4 ± 0.9	1.4 ± 0.7	0.817
Postoperative transfusion	2 (1.7%)	1 (2.9%)	0.535
Hospital stay (days)	5.9 ± 2.5	2.4 ± 0.7	<0.001

Hb = hemoglobin.
[a] One case of release of torsion and the other case of unilateral salpingectomy.
[b] Release of torsion.

spontaneously by the second trimester. Surgical intervention is generally indicated for masses that persist for 16 gestational weeks with a large diameter (>6 cm), are suspicious for malignancy, or are symptomatic (e.g., pain), even though postoperative complications are occasionally lethal for the fetus, such as miscarriage and preterm delivery. The miscarriage rate after surgery for adnexal masses in pregnancy has been reported as 2.8–12%.[7]

The second trimester is known to be the safest time to perform surgery due to a reduced rate of miscarriage and preterm labor, hormonal independence of the corpus luteum of pregnancy, resolution of functional cysts in the vast majority of cases, and less obliterated operative field compared with the uterus in the third trimester.[8] The miscarriage rate is 5.6% in the second trimester compared with 12% in the first trimester.[9] In their retrospective review of 36 pregnancies after adnexal surgery, Balci et al[10] reported only one miscarriage (2.9%), which occurred in the first trimester, and no miscarriage or fetal death in the second and third trimester. In our study, the miscarriage rate was lower than in previous reports at 1.8% in total; 3% in the first trimester and 1.3% in the second trimester. We assume that the possible reason was our hospital position as a tertiary referral center, which could provide advanced equipments and skillful surgeons.

Table 4
Obstetric outcomes in patients who were followed up until delivery after surgery.

Variables	Univariate analysis		
	Laparotomy ($n = 90$)	Laparoscopy ($n = 21$)	p
Delivery mode			0.829
Full term delivery	84 (93.3%)	20 (95.2%)	
Preterm delivery	5 (5.6%)	0	
Spontaneous abortion	1 (1.1%)	1 (4.8%)	
Preterm labor[a]	16 (17.8%)	0	0.039
Adjusting factors in a risk of preterm labor	Multivariate analysis		
	AOR	95% CI	p
Gestational age at surgery	1.034	1.010 – 1.058	0.005
Mass size	1.011	0.882 – 1.160	0.872
Laparotomy vs. laparoscopy	0.000	0.000	0.998

AOR = adjusted odds ratio; CI = confidence interval.
[a] Cases in which tocolytic drug was used.

The rates of miscarriage and preterm labor are also more likely to be higher in emergency rather than elective surgery. This has been documented for appendicitis, which is the most common general surgical cause of fetal loss during pregnancy. In cases of perforated appendix, the rate of fetal loss is up to 20% compared with 1.5% for uncomplicated appendicitis.[11] In a review of the literature reporting more than five cases of surgical management of adnexal masses, Al-Fozan et al reported that the rate of fetal loss was 5.9% in elective surgery and 10% in emergency surgery for adnexal torsion.[9] In accordance with that study, we found that all two miscarriages developed following emergency surgery, in which a threefold increase in preterm labor rate was also seen (10.2% in elective surgery and 30.4% in emergency surgery). With this in mind, patients who have adnexal masses in pregnancy should be adequately informed of the increased risk of adnexal torsion or rupture.

Patton reported in 1906 that the maternal mortality from adnexal mass removed surgically was 4.5%.[12] Although recent advances in surgical techniques and antibiotics have made maternal death rare, one has to pay great attention to achieve a better surgical outcome. Laparoscopic surgery is a minimally invasive tool with decreasing surgical complications and has become increasingly more common compared to laparotomy[13]; however, its safety in pregnant women is still widely debated. The laparoscopic approach in pregnancy offers some advantages, which are similar to those of laparoscopy in the nonpregnant state, such as early ambulation, short hospital stay, low rate of wound infection, and less pain. Our data also demonstrated that there was a significant difference in hospital stay, but not in operation time and estimated blood loss between laparoscopy and laparotomy. In a review of 389 operations in pregnancy, Oelsner et al have found that laparoscopy is associated with a lower rate of postoperative complications including maternal fever and pulmonary embolism.[14] In their review, obstetric outcomes of miscarriage, preterm labor, and intrauterine growth restriction also tended to decrease in laparoscopy but with no statistical significance. The authors therefore concluded that operative laparoscopy seemed to be as safe as laparotomy in pregnancy.

In data from three Swedish delivery registries,[15] 3703 women delivered after surgery in pregnancy; 2181 women with laparoscopy and 1522 women with laparotomy. There were no differences between laparoscopy and laparotomy in the rates of preterm labor, intrauterine growth restriction, still birth, perinatal deaths, or congenital anomalies. More recently, Corneille et al[16] analyzed 94 pregnant women following a nonobstetric operation. All three miscarriages occurred in laparotomy, but none in laparoscopy and, in turn, perinatal complications were seen in 41.7% of the laparotomy group and 36.7% of the laparoscopy group. A similar result was described in a review of 88 pregnant women who underwent adnexal surgery.[17] The tendency was toward a lower rate of miscarriage and congenital malformation in the laparoscopy group, but did not reach statistical significance; 3.7% versus 12.8% in miscarriage and 1.9% versus 5.1% in malformation between laparoscopy and laparotomy.

In accordance with previous studies,[18–20] we found that the rates of miscarriage and preterm labor were prone to be lower in the laparoscopy group than the laparotomy group. However, when several confounding factors of gestational age and adnexal mass size were adjusted based on demographic characteristics, there was no significant difference in the rate of preterm labor, which was significantly low in laparoscopy by univariate analysis, between laparotomy and laparoscopy. To the best of our knowledge, this is the first evaluation of more accurate differences in surgical and obstetric outcomes between laparotomy and laparoscopy that used a multivariate analysis adjusting for other risk factors. However,

there were some limitations to the interpretation of our results. First, because all women that underwent surgery in pregnancy were not followed up until delivery, the estimate of the total number of miscarriages or preterm labor is likely to have been underestimated. Second, no patient in our study was operated upon with the laparoscopic approach in the third trimester, whereby the effect of gestational age at surgery on the postoperative outcomes was unknown.

In conclusion, the present study corroborated the finding that adnexal surgery for mass or torsion could be performed safely during pregnancy, and especially laparoscopic surgery offered more benefit than laparotomy in terms of better surgical outcome with shorter hospital stay. With regard to obstetric outcomes, open surgery was not more beneficial in reducing the rate of miscarriage and preterm labor. Consequently, laparoscopic surgery is as safe as laparotomy in pregnancy. Even though the rate of preterm labor was not significantly lower in laparoscopy with multivariate analysis, it is our belief that laparoscopic surgery might be considered even more advantageous than laparotomy to the fetus in a large prospective study. Further studies should be conducted to formulate a surgical strategy for management of adnexal mass during pregnancy.

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