

Safety and Clinical Efficacy of Laparoscopic Appendectomy for Pregnant Women with Acute Appendicitis

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Abstract

Introduction: The aim of this study was to investigate the clinical efficacy and safety of laparoscopic appendectomy (LA) during pregnancy by comparing the operative and obstetric outcomes of patients who during pregnancy underwent LA performed by an expert gynaecologic laparoscopist (LA group) with those patients who underwent an open appendectomy (OA) by a general surgeon (OA group). **Materials and Methods:** In this retrospective study, we evaluated all patients consecutively who had undergone appendectomy for acute appendicitis during pregnancy from January 2000 to December 2010. Twenty-eight patients underwent OA and 15 were treated by LA. We reviewed the clinical charts and analysed the data for each patient's age, parity, body mass index, gestational age at appendectomy, type of appendectomy, operating time, haemoglobin change, hospital stay, histopathological results, postoperative analgesics, complications, and obstetric outcomes. **Results:** There were no significant differences between the OA and LA groups in terms of clinical characteristics, hospital stay, haemoglobin change, return of bowel activity, complication rates, gestational age at delivery, and birth weight. However, there were significantly shorter operating time and less usage of postoperative analgesics in LA group. **Conclusion:** LA performed by an expert gynaecologist can be a safe and effective method for treating acute appendicitis during the first and second trimester of pregnancy.

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Key words: Laparoscopic appendectomy, Appendicitis, Pregnant women

Introduction

In non-pregnant patients, the advantages of laparoscopic appendectomy (LA) over open appendectomy (OA) are widely known and include decreased postoperative pain, a shorter hospital stay, and an earlier return to work.¹ However, pregnant patients face several potential problems with LA: the possibility of incidental injury to the gravid uterus with a Veress needle or a trocar, direct or indirect effects on the fetus and pregnant patient of the CO₂ gas used to make a pneumoperitoneum, decreased uterine blood flow caused by the pneumoperitoneum, and the securing of a laparoscopic surgical field without damage to the gravid uterus.²⁻⁵ These issues have created reluctance among surgeons to perform LA during pregnancy.

The aim of this study was to investigate the clinical efficacy and safety of LA during pregnancy by comparing the operative and obstetric outcomes of patients who underwent LA performed by an expert gynaecologic laparoscopist (LA group) with those who underwent OA by a general surgeon (OA group).

Materials and Methods

In this retrospective study, we evaluated all the patients consecutively who had undergone an appendectomy for acute appendicitis during pregnancy at Kangbuk Samsung Hospital from January 2000 to December 2010. Before January 2007, all the pregnant patients in our hospital who

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were suspected of having acute appendicitis underwent OA, because at that time pregnant patients were not considered suitable candidates for LA. After January 2007, patients with a gestational age above 28 weeks underwent OA and patients with gestational age 28 weeks or less underwent LA. Forty-three pregnant patients underwent appendectomy for acute appendicitis in the study period. Among them, 28 patients were included in the OA group and 15 patients in the LA group. Three patients who received OA after January 2007 did so because of being over 28 weeks of gestational age: 30 gestational weeks with triplets, 29 weeks with a singleton, and 35 weeks with a singleton.

We reviewed the clinical charts and analysed the data for patients' age, parity, body mass index, gestational age at appendectomy, type of appendectomy, operating time, haemoglobin change, hospital stay, return of bowel activity, histopathological results, use of postoperative analgesics, intraoperative complications, postoperative complications, and obstetric outcomes. Data for patients who subsequently delivered at another institution were obtained by telephone interviews. All cases were assessed by an obstetrician to exclude the presence of any abnormal findings for mother and fetus before and after surgery. The operating time was defined as the time from skin incision to the time of closure of the skin incision or all port sites. The return of bowel activity was defined as the period from the end of general anaesthesia to the first occurrence of bowel gas passage. The haemoglobin change was defined as the difference between the haemoglobin level on the day before surgery and that on the first postoperative day. Two patients in the OA group and one in the LA group were excluded from this study because they chose, due to fears of congenital abnormalities, to have a termination in another hospital after being discharged without any complications. Therefore, 40 patients were included in the obstetric outcomes. This study was approved by Kangbuk Samsung Hospital Institutional Review Board.

All the LA procedures and 3 OAs were performed under general anaesthesia. All LAs were performed by an expert gynaecologic laparoscopist. The direct trocar insertion was performed through the left upper quadrant (LUQ). The placement of ancillary trocars was adjusted according to the uterine fundal height and the trocars were inserted under direct visualisation with a 5 mm telescope. The patients were placed in a left lateral tilt position to shift the gravid uterus off the vena cava, improving venous return, and securing the surgical field. The meso-appendix was desiccated using a harmonic shears (Ethicon Endo-surgery, Cincinnati, OH). The appendicular base was divided using a laparoscopic linear endocutter with a vascular stapler (Endoscopic Linear Cutter with blue cartridge, Ethicon Endo-surgery, Cincinnati, OH). The appendix was cut while the appendiceal

end was held with a grasping forceps using the surgeon's left hand to prevent the resected appendix from falling into the abdominal cavity. The resected appendix was removed in an endobag through the 12 mm port site.⁵

Twenty-five OAs were performed under spinal anaesthesia, and all were performed through a McBurney's muscle-splitting incision. In cases where a large gravid uterus obstructed safe access to the appendix, surgery was performed after the uterus was displaced using a Deaver retractor. The appendix was secured at the base with 3 ligatures and divided between the 2 distal ligatures. The base of the appendix was not invaginated.

Statistical Analysis

Mann-Whitney U and Fisher exact tests were used to compare the OA and LA groups. Significance was defined as $P < 0.05$. All statistical analyses were performed using the SPSS 17.0 software (IBM Co., Chicago, IL).

Results

During this study period, we performed appendiceal ultrasonographic examinations for 76 pregnant women who visited the emergency department of Kangbuk Samsung Hospital with right lower quadrant pain. Among them, 33 women who had no aggravated symptoms and no rise of white blood cells counts were managed without any intervention and, with improved symptoms and no complications, they were discharged. Forty-three women underwent open or laparoscopic appendectomy for women with highly suspected acute appendicitis.

There were no significant differences between the OA and LA groups in terms of clinical characteristics, hospital stay, haemoglobin change, return of bowel activity, complication rate, gestational age at delivery, and birthweight. However, there were significantly shorter operating time and less usage of postoperative analgesics in the LA group (Table 1).

Postoperative complications were noted in 1 patient in the LA group (6.7%) and 7 in the OA group (25.0%). Three patients had 2 types of complications and the total number of complications was 11. Among these patients, 3 had preterm deliveries, 4 had postoperative uterine contractions, 1 had an intraperitoneal abscess, and 3 patients showed postoperative fever. The postoperative uterine contractions and preterm deliveries are described in Table 2. The intraperitoneal abscess was treated by percutaneous drainage and antibiotic therapy. Three patients with fever were managed conservatively. There were no maternal or fetal mortality, conversion to laparotomy, or uterine injury in the LA group. One patient in the LA group is currently ongoing pregnancy without complications. There were no

Table 1. Patient Characteristics and Operative Outcomes

	Laparoscopic appendectomy	Open appendectomy during	<i>P</i> value
	during pregnancy (n = 15)	pregnancy (n = 28)	
	Median (range)		
Age (years)	27.5 (20-34)	30 (24-39)	0.118
Parity	0 (0-1)	0 (0-2)	1.000
Body mass index (kg/m ²)	20.8 (17.4-25.0)	22.5 (16.9-29.3)	0.269
Gestational age at appendectomy (weeks)	15 (5-28)	17 (4-35)	0.924
Hospital stay (days)	4 (3-7)	5 (3-17)	0.102
Operating time (minutes)	27.5 (15-70)	55 (25-80)	0.001
Haemoglobin change (mg/dL)	1.0 (0.2-2.4)	0.8 (0.1-2.1)	0.269
Return of bowel activity (hours)	46 (28-94)	38 (12-139)	0.362
Gestational age at delivery (weeks)	38 (37-41)	39 (32-41)	0.879
Birth weight (g)	3125 (2430-4100)	2780 (1170-3500)	0.262
	Number (%)		
Use of postoperative analgesics	1/15 (6.7)	11/28 (39.2)	0.033
Complications	1/15 (6.7)	7/28 (25.0)	0.224
Postoperative uterine contractions	1	3	
Preterm delivery	0	3	
Intraperitoneal abscess	0	1	
Postoperative fever	0	3	

Table 2. Details of 6 Women who had Postoperative Uterine Contractions or Preterm Deliveries after Appendectomy

Number of patients	GA at operation (weeks)	Type of operation	Postoperative uterine contractions	Tocolytic therapy	Histopathological results	Delivery weeks, mode (birthweight)	Apgar score (1 minute/ 5 minutes)
1	20	LA	Present	Successful	Acute suppurative appendicitis	38 weeks, VD (2800 g)	9/10
2	30	OA	Present	Successful	Acute gangrenous appendicitis with perforation	40 weeks, VD (3000 g)	9/10
3	29	OA	Present	Successful	Acute suppurative appendicitis	38 weeks, Caesarean section due to fetal distress (3750 g)	6/8
4	30	OA	Present	Failed	Acute gangrenous appendicitis with periappendiceal abscess	32 weeks, Caesarean section due to triplet pregnancy (first baby 1530g, second baby 1170g, third baby 1450g)	first baby 7/9, second baby 6/9, third baby 6/7
5	20	OA	Absent	-	Acute appendicitis with perforation	36 weeks, Caesarean section due to fetal distress (2000 g)	8/10
6	8	OA	Absent	-	Acute appendicitis with periappendiceal abscess	36 weeks, Caesarean section due to placenta previa totalis (2400 g)	8/10

GA: gestational age, LA: laparoscopic appendectomy, OA: open appendectomy, VD: vaginal delivery

Table 3. Histopathological results

Histopathological results	LA during pregnancy (n = 15)	OA during pregnancy (n = 28)	P value
	Number (%)		
Histopathological results			0.242
Acute appendicitis	11(73.2)	22 (78.6)	-
Acute gangrenous appendicitis	2 (13.4)	1 (3.6)	-
Acute appendicitis with perforation	2 (13.4)	5 (17.8)	-

negative appendectomies among all cases of surgery. The final histopathological results of both groups are summarised in Table 3.

Discussion

The diagnosis of acute appendicitis during pregnancy is more difficult than in non-pregnant patients and the risk of perforation is increased due to delayed diagnosis. Perforation of the appendix during pregnancy may increase the rates of maternal morbidity and fetal loss.⁶ Therefore, if acute appendicitis is suspected during pregnancy, immediate surgical management is required. Either OA or LA may be performed depending on the experience and preference of the surgeon.^{3, 5-7}

OA can be performed throughout the pregnancy regardless of the gestational age.⁸ However, changes in the position of the appendix and the reduced exposure of the appendix during surgery as the pregnancy progresses are disadvantages to performing OA. OA may increase the possibility of extending the incision and the necessity of uterine manipulation to secure the surgical field; it is known that excessive uterine manipulations increase the risk of postoperative uterine contractions.⁷

The use of laparoscopic surgery during pregnancy has facilitated the identification not only of appendicitis but also of other causes of acute abdomen.^{6, 9} In the case of gynaecologic disease, neither insertion of additional trocars nor extension of the incision is required. However, the following issues should be considered when performing LA during pregnancy: the necessity of general anaesthesia, the possibility of incidental injury of the gravid uterus with a Veress needle or a trocar, the potential effects of increased intra-abdominal pressure on the uteroplacental circulation, concerns related to the use of CO₂, and the technical difficulty in the third trimester. These issues and

the methods used to overcome them are discussed in detail in our preceding report.⁵

In an animal study, it was reported in ewes that increased intra-abdominal pressure can reduce uterine blood flow to 40%. Despite these intraoperative changes, severe short-term acidosis did not develop into long-term deleterious effects in healthy lambs.^{10, 11} Commonly used anaesthetic agents are not known to be teratogenic and it is known that different anaesthetic methods such as regional or general anaesthesia have little influence on obstetric outcomes.⁸ Moreover, there were no long-term adverse effects on the fetus in patients who underwent LA or laparoscopic cholecystectomy during pregnancy.¹²⁻¹⁴

For laparoscopic surgery during pregnancy, the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) recommends the open Hasson method to reduce the risk of damage to the gravid uterus.² However, in this study a pneumoperitoneum was safely developed with direct trocar insertion into the LUQ.⁵ This direct trocar insertion can be effective and safe because the distance between the LUQ and the fundus of the gravid uterus is longer than the distance between the umbilicus and the fundus. Therefore, uterine injury was readily avoided by inserting the first trocar perpendicularly to the abdominal wall using direct trocar insertion technique.

According to a previous study, the rates of appendectomy-associated fetal loss during pregnancy were 7% for LA and 3% for OA (odds ratio = 2.31).⁷ However, because this study was conducted only on patients with complications that occurred during the hospital stay after appendectomy, there was a selection bias and its persuasive power is weak.⁹ In the present study, no spontaneous abortion or intrauterine fetal death occurred except for those cases in which termination of the pregnancy was performed based on the patient's own decision. Fetal loss has not been reported in other studies of LA during pregnancy.^{3-5, 14}

Preterm deliveries occurred in 3 of 39 patients (7.7%) in the current study. In this study period, there were 412 patients (10.9%) with preterm deliveries out of 3756 total deliveries in our hospital. Compared with the general rate of preterm birth, which is 7.7% to 12.3%, appendectomy during pregnancy did not significantly increase preterm delivery.^{15, 16} Although both OAs and LAs in this study were performed by senior surgeons, the operating time for the LA group was significantly shorter than that for the OA group. However, LA cannot be performed with a gravid uterus large enough to occupy the entire abdominal cavity, such as in a multifetal pregnancy or during the third trimester.

Conclusion

In conclusion, LA performed by an expert gynaecologist

can be a safe and effective method for treating acute appendicitis during the first and second trimesters of pregnancy.

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