

## Previous Abdominal Surgery Has No Negative Effect on Laparoscopic Appendectomy for Acute Appendicitis

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### ABSTRACT

**Background :** Laparoscopic appendectomy is effective for acute appendicitis. Previous abdominal operations cause intraperitoneal adhesions and may lead to complications following abdominal laparoscopic operations. In the present study, we assessed the effect of previous abdominal surgery on laparoscopic appendectomy for acute appendicitis.

**Methods :** We retrospectively analyzed 170 patients who had undergone laparoscopic appendectomy for acute appendicitis at Shin-yurigaoka General Hospital from January 2013 through December 2016.

**Results :** Sixteen patients had previously undergone abdominal surgery by means of laparotomy or laparoscopy. Univariate analysis showed that patients who had previously undergone abdominal surgery were significantly older ( $p < 0.001$ ) and were more often women ( $p = 0.002$ ). The incidence of postoperative complications was similar among patients who had or had not previously undergone abdominal surgery. Multivariate analysis showed that independent risk factors for complications after laparoscopic appendectomy were perforated appendicitis ( $p = 0.003$ ), a stercolith of the appendix ( $p = 0.031$ ), and an elevated preoperative white blood cell count ( $p = 0.047$ ) but not a previous abdominal surgery.

**Conclusion :** The present findings suggest that for patients undergoing laparoscopic appendectomy for acute appendicitis, previous abdominal operation does not have negative effects on the incidence of postoperative complications or on the rate of conversion to laparotomy.

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**Key words :** previous surgery, appendicitis, laparoscopic appendectomy

### INTRODUCTION

Laparoscopic appendectomy is a common, safe, and effective procedure for treating acute appendicitis in most conditions, including the severity of inflammation<sup>1,2</sup>. A previously performed abdominal surgical procedure has been

considered a contraindication for laparoscopic surgery<sup>3</sup>. In particular, a previous abdominal operation performed with laparotomy increases the risks of complications and hospitalization after a subsequent laparoscopic surgery<sup>4</sup>. However, several recent studies have suggested that a previous abdominal surgical procedure is not a contraindication for

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laparoscopic surgery, including cholecystectomy<sup>5,6</sup>, gastrectomy<sup>7</sup>, colectomy<sup>8-10</sup>, hysterectomy<sup>11</sup>, radical cystectomy<sup>12</sup>, nephrectomy<sup>13</sup>, and bariatric surgery<sup>14</sup>. With regard to laparoscopic appendectomy for acute appendicitis, few studies have reported negative effects of a previous abdominal operation<sup>15,16</sup>. Therefore, the aim of the present study was to examine the effects of a previous abdominal surgical procedure on intraoperative outcomes, the rate of conversion to laparotomy, and postoperative complications in patients undergoing laparoscopic appendectomy for acute appendicitis.

## PATIENTS and METHODS

We reviewed 170 patients who had undergone laparoscopic appendectomy for acute appendicitis at the Department of Surgery, Shin-yurigaoka General Hospital, Kanagawa, Japan, from January 2013 through December 2016. Of these patients, 16 had previously undergone abdominal surgery by means of laparotomy or laparoscopy. Hematologic and chemical variables were routinely measured preoperatively for each patient.

We investigated via univariate analysis the relation between clinicopathologic variables and previous abdominal surgical procedures. The following 13 factors were analyzed: age, sex, preoperative white blood cell counts (WBC), preoperative serum C-reactive protein, time from onset to surgery, preoperative computed tomography (CT) findings, perforated appendicitis, duration of operation, drain replacement during operation, conversion to laparotomy, time to flatus after operation, postoperative hospital stay, and incidence of postoperative complications.

Next, we investigated via multivariate analysis the relation between clinicopathologic variables, including previous abdominal surgery, and the incidence of postoperative complications. The following 9 factors were analyzed: age, sex, previous abdominal operation, preoperative WBC, preoperative serum C-reactive protein, preoperative CT findings of stercolith of appendix, ascites, abscess, and perforated appendicitis during operation.

This retrospective study was approved by the Ethics Committee of Shin-yurigaoka General Hospital (20171127-1), where the work was performed, and conforms to the provisions of the Declaration of Helsinki in 1995 (as revised in Brazil in 2013).

## *Surgical procedure*

Hasson's open technique was used to insert the first 12-mm trocar from the umbilicus for patients who had or had not previously undergone an abdominal operation. The suprapubic 5-mm trocar and the left lower quadrant abdominal 5-mm trocar were inserted under visual guidance with a 5-mm flexible laparoscope. If adhesions or inflammation was severe, another 5-mm trocar was inserted in the right lower quadrant of the abdomen. The mesoappendix was divided with laparoscopic coagulating shears, and the appendiceal stump was closed with a linear stapler.

## *Statistical analysis*

Univariate analysis of clinicopathologic variables was performed with the Mann-Whitney U test and Pearson's chi-square test. Multivariable analysis was performed to investigate the relationship between clinicopathologic variables and the incidence of postoperative complications via a logistic regression model and a backward-elimination stepwise approach. All *P*-values were considered statistically significant when the associated probability was less than 0.05. These analyses were performed with software program IBM SPSS Statistics version 20.0 (IBM Japan, Tokyo, Japan).

## RESULTS

### *Patients with previous abdominal operations*

For the abdominal operations that had previously been performed in 16 patients, laparotomy had been used in 11 patients, and laparoscopy had been used in 5 patients (Table 1).

### *Univariate analysis of characteristics and variables in patients who had or had not undergone abdominal surgery before laparoscopic appendectomy*

Patients who had previously undergone abdominal surgery were significantly older ( $p < 0.001$ ) and were more often women than were patients who had not ( $p = 0.002$ ; Table 2). Of the 16 patients who had previously undergone abdominal surgery, 1 had had an abdominal abscess as a postoperative complication. The incidence of postoperative complications was similar among patients who had and patients who had not previously undergone abdominal surgery.

Table 1. Patients with previous abdominal surgery

No.	Age (years)	Sex	Indication	Procedure
1	61	female	cesarean section	laparotomy
2	47	female	ovarian cysts	laparoscopy
3	37	female	cesarean section	laparotomy
4	51	female	myoma uteri	laparotomy
5	72	female	gastric cancer	laparoscopy
6	43	female	ovarian cysts	laparoscopy
7	64	female	cesarean section	laparotomy
8	52	female	myoma uteri	laparotomy
9	41	female	cesarean section	laparotomy
10	70	male	gastric perforation	laparoscopy
11	75	female	myoma uteri	laparotomy
12	79	female	myoma uteri	laparotomy
13	43	female	cesarean section	laparotomy
14	85	male	gastric cancer	laparotomy
15	77	female	myoma uteri	laparotomy
16	84	female	cholelithiasis	laparoscopy

Table 2. Univariate analysis of characteristics and variables in patients with or without previous abdominal surgery on laparoscopic appendectomy

Factor	Previous abdominal surgery		P-value
	Yes (n = 16)	No (n = 154)	
Age (years)	61.3 ± 16.5*	39.3 ± 18.7	<0.001
Sex (male : female)	2 : 14	83 : 71	0.002
Preoperative white blood cell count (10 <sup>3</sup> /μl)	12.4 ± 3.2	12.8 ± 3.9	0.651
Preoperative serum C-reactive protein (mg/dl)	7.0 ± 5.4	5.8 ± 6.7	0.404
Time to surgery from the onset (days)	1.6 ± 1.3	1.4 ± 1.0	0.580
Preoperative computed tomography findings			
Stercolith of the appendix (yes)	9 (56.3%)	77 (50.0%)	0.634
Ascites (yes)	4 (25.0%)	35 (22.7%)	0.837
Abscess (yes)	1 (6.3%)	13 (8.4%)	0.762
Perforated appendicitis (yes)	5 (31.3%)	38 (24.7%)	0.565
Duration of operation (min)	65.2 ± 27.5	53.0 ± 21.1	0.105
Drain replacement at surgery (yes)	7 (43.8%)	42 (27.3%)	0.166
Conversion to laparotomy (yes)	1 (6.3%)	6 (3.9%)	0.652
Time to farting after surgery (days)	1.6 ± 0.6	1.5 ± 0.9	0.473
Postoperative hospital stay (days)	4.9 ± 1.8	4.6 ± 2.9	0.557
Postoperative complication			
Reoperation	0	2 (1.3%)	0.647
Abdominal abscess	1 (6.3%)	4 (2.6%)	0.410
Surgical site infection	0	4 (2.6%)	0.514
Paralytic ileus	0	4 (2.6%)	0.514

\*mean ± SD

*Multivariate analysis of clinicopathologic variables in relation to postoperative complications after laparoscopic appendectomy*

Independent risk factors for postoperative complica-

tions after laparoscopic appendectomy were a perforated appendicitis at surgery (odds ratio = 7.022, 95% confidence interval [CI] = 1.923-25.644,  $p = 0.003$ ), preoperative CT

Table 3. Multivariate analysis of clinicopathologic variables in relation to postoperative complications after laparoscopic appendectomy

Factor	Hazard ratio (95% confidence interval)	P-value
Perforated appendicitis	7.022 (1.923-25.644)	0.003
Stercolith of the appendix	5.922 (1.177-29.787)	0.031
Preoperative white blood cell count ( $10^3/\mu\text{l}$ )	1.170 (1.002-1.367)	0.047

Variables analyzed : age, sex, previous abdominal surgery, ascites, abdominal abscess, preoperative C-reactive protein

findings of stercolith of the appendix (odds ratio = 5.922, 95% CI = 1.177-29.787,  $p = 0.031$ ), and elevated preoperative WBC (odds ratio = 1.170, 95% CI = 1.002-1.367,  $p = 0.047$ ) but not a previous abdominal operation (Table 3).

### DISCUSSION

Because of recent improvements in laparoscopic surgical techniques and instruments, a previous abdominal surgery procedure has become a relative contraindication for a subsequent laparoscopic surgery procedure. However, several concerns remain regarding operative results, such as the duration of an operation and the rate of conversion to laparotomy, especially for gastrointestinal surgery. Among other laparoscopic procedures, laparoscopic cholecystectomy is common and is, for patients who have previously undergone abdominal surgery, even in the upper abdomen, effective and safe. However, a previous upper abdominal operation is associated with a higher conversion rate to laparotomy, a longer duration of the operation, a higher incidence of surgical wound infection, and a longer postoperative hospital stay<sup>5,6</sup>. A previous abdominal operation has been suggested to not be a contraindication for laparoscopic-assisted gastrectomy if careful attention is given for all procedures, including port insertion and dissection of intra-abdominal adhesions<sup>7</sup>. Laparoscopic colectomy for patients with previous abdominal surgery has exhibited acceptable short- and long-term outcomes but has been associated with increases in the conversion rate, the incidence of postoperative ileus, and the incidence of surgical wound infection<sup>8-10</sup>. Laparoscopic liver resection has been suggested to be a safe procedure for patients who have previously undergone upper abdominal surgery but to be associated with a conversion to laparotomy<sup>17</sup>. Regarding laparoscopic appendectomy, earlier studies and the present study have concluded that previous abdominal operations have no negative effect on outcomes, including the duration of operation, the

conversion rate to laparotomy, and the incidence of postoperative complications<sup>15,16</sup>. Possible reasons for the lack of negative effects are that laparoscopic appendectomy is simpler and easier to perform than other laparoscopic procedures and requires only limited adhesiolysis.

A major concern regarding laparoscopic surgery is the risk of bowel or vessel injury when the first trocar is inserted if adhesion has been caused by a previous abdominal operation. However, for inserting the first trocar in such patients, Hasson's open technique is reportedly safe<sup>15</sup>. In the present study, Hasson's open technique was used to insert the first trocar regardless of whether the patient had previously undergone abdominal surgery. With Hasson's open technique, the first trocar was successfully inserted from the umbilicus in all patients and produced no intraoperative complications, such as bowel or vessel injury.

In conclusion, our findings suggest that a previous abdominal operation has no negative effects, such as an increased incidence of postoperative complications or conversion to laparotomy, when laparoscopic appendectomy is performed for acute appendicitis.

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