Benefits of Introduction of Laparoscopic Appendectomy in a Community Hospital: a Shorter Hospital Stay and Reduced Wound Infection

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Abstract

AIM: To investigate the benefits of introduction of laparoscopic appendectomy (LA) in a community hospital.

PATIENTS AND METHODS: The subjects of the study were 56 patients who underwent appendectomy for acute appendicitis from June 2003 to January 2005 in Kokura Memorial Hospital. Before March 2004, all patients underwent open appendectomy (OA). We introduced LA in April 2004 and from that point onwards almost all the cases underwent LA, except for the initial few cases. Operating time, wound infection, postoperative fever, the time to the first flatus, time of use of postoperative analgesics, and the length of postoperative hospitalization were evaluated.

RESULTS: Of the 56 patients enrolled in the study, 35 underwent OA and 21 underwent LA. The operating time for LA was longer than that for OA (mean ± S.D.: 81 ± 37 vs. 58 ± 21 min, p<0.01). However, the rate of wound infection was lower (37% vs. 0%, p<0.01), and the hospitalization was shorter (9.0 ± 6.1 vs. 5.7 ± 3.4 days, p<0.05) for LA. There were no significant differences in other factors.

CONCLUSION: The introduction of LA into a community hospital can reduce wound infection and shorten hospitalization. Thus, we recommend use of LA in community hospitals.

Key words: laparoscopic appendectomy, acute appendicitis, operating time, wound infection, hospital stay

Introduction

Acute appendicitis is a common intraabdominal condition that requires emergency surgery. Open appendectomy (OA) was introduced by McBurney in 1894 and has remained as the standard treatment for more than a century. There have been few changes in OA over this period, since the original procedure was associated with low morbidity, a short hospital stay, and minimal postoperative discomfort. However, OA does have several concerns, including frequent wound infection that prolongs the

Fig. 1 The three trocar positions, with the surgeon and assistant on the patient’s left side and the video monitor on the right side.
postoperative hospital stay and causes discomfort for patients.

Laparoscopic surgery has recently become an important diagnostic and therapeutic tool as a minimally invasive method that has shown good results, especially for laparoscopic cholecystectomy (LAC). Laparoscopic appendectomy (LA) was first reported by Semm in 1983. Use of LA has gradually increased and many retrospective and prospective studies have shown that LA has clinical advantages over conventional OA, including fewer complications (including SSI), shorter hospital stay, less pain, and an earlier return to normal activity. However, LA is still not used as commonly as might be expected. For example, Nguyen reported that the percentage of appendectomies performed laparoscopically increased from 20% in 1999 to 43% in 2003, but the 43% rate is still relatively low compared to the use of LAC, particularly considering that LA was described prior to LAC. Therefore, the purpose of this study was to examine the possible benefits of LA within a year after introduction in a community hospital.

Patients and Methods

Patients
The subjects were patients who underwent appendectomy under a preoperative diagnosis of acute appendicitis from June 2003 to January 2005 in Kokura Memorial Hospital, where the authors formerly worked at. Before March 2004, all patients underwent OA. We introduced LA in April 2004 and from that time almost all cases underwent LA (the initial few cases received OA). Patients who underwent cecectomy or ileoceccectomy were excluded from the study. Two patients (one each in the OA and LA groups) were also excluded because they were also treated for acute heart failure and acute myelogenous leukemia.

Methods
Age, sex, preoperative WBC, and preoperative C-reactive protein (CRP) were compared as background data for the OA and LA groups. The number of surgeries performed by residents and the inflammatory grade of acute appendicitis judged by macroscopic findings were also compared. Perforated cases were included in the gangrenous group. The outcome was evaluated based on the operating time, wound infection, last day body temperature >37°C, the day of the first flatus after surgery, last day of prescription of analgesics after surgery, and postoperative hospital stay. All data are presented as the mean ± standard deviation (S.D.) and range. Statistical analyses were performed by unpaired Student t-test, chi-squared test or Mann-Whitney U test according to the data characteristics, using Stat View for Windows v.5.0 (SAS, Cary, NC). A probability value <0.05 was considered to indicate a significant difference.

Operative Procedure

Open appendectomy
Open appendectomy was performed conventionally under spine or general anesthesia. Three patients (14%) were converted from spine to general anesthesia during the operation. The appendix stump was inverted into the cecum with a purse string suture with 30 silk. The peritoneum and fascia were closed with a continuous absorbable suture.

Laparoscopic appendectomy
Laparoscopic appendectomy was performed under general anesthesia with the patient in a supine position. Pneumatic compression stockings (SCD Response Compression System; Tyco Healthcare, Mansfield, MA, USA) and anti-embolism stockings (T.E.D. Surgical Stockings; Tyco Healthcare) were routinely used to prevent deep vessel thrombosis. The video monitor was positioned at the patient’s right side, with the surgeon and assistant on the left side. The bladder was catheterized in all cases.

The first trocar (10 mm, Endo Path; Ethicon, Summerville, NJ, USA) was inserted below the umbilicus utilizing an open technique and the peritoneal cavity was insufflated with carbon dioxide. The second trocar (5 mm, Endo Path; Ethicon) was inserted suprapublically along the midline under direct laparoscopic visualization through the first trocar. The third trocar (5 mm, Endo Path; Ethicon) was also inserted along the midline between the first and second trocars (Fig. 1). Then the patient was rotated head down and right side up, after irrigating the peritoneal cavity with warm physiological saline in cases with cloudy peritoneal fluid.

The laparoscope was inserted through the second trocar and the small bowel was removed using atraumatic grasping forceps for ileocecal visualization. The appendix was mobilized to identify the mesoappendix and the appendiceal base. In cases in
Laparoscopic appendectomy in a community hospital

Table 1  Background of patients

<table>
<thead>
<tr>
<th>Variable</th>
<th>OA</th>
<th>LA</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>35</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Age (y. o.)</td>
<td>39.0±21.6</td>
<td>43.5±21.4</td>
<td>N.S.'</td>
</tr>
<tr>
<td></td>
<td>(13–84)</td>
<td>(13–83)</td>
<td></td>
</tr>
<tr>
<td>Sex (M : F)</td>
<td>16 : 19</td>
<td>6 : 15</td>
<td>N.S.'</td>
</tr>
<tr>
<td></td>
<td>(46% : 54%)</td>
<td>(29% : 71%)</td>
<td></td>
</tr>
<tr>
<td>Preoperative WBC (/mm³)</td>
<td>12,800±4,600</td>
<td>11,900±4,000</td>
<td>N.S.'</td>
</tr>
<tr>
<td></td>
<td>(5,900–29,800)</td>
<td>(6,600–21,500)</td>
<td></td>
</tr>
<tr>
<td>Preoperative CRP (mg/dl)</td>
<td>8.4±9.1</td>
<td>6.0±4.8</td>
<td>N.S.'</td>
</tr>
<tr>
<td></td>
<td>(0.0–36.6)</td>
<td>(0.3–16.9)</td>
<td></td>
</tr>
<tr>
<td>Performed by residents</td>
<td>20/35 (57%)</td>
<td>15/21 (71%)</td>
<td>N.S.'</td>
</tr>
<tr>
<td></td>
<td>(37% : 37% : 26%)</td>
<td>(57% : 19% : 24%)</td>
<td></td>
</tr>
</tbody>
</table>

N.S.: no significant difference, 'Student t test 'chi-square test

Table 2  Outcomes of laparoscopic appendectomy and open appendectomy

<table>
<thead>
<tr>
<th>Variable</th>
<th>OA</th>
<th>LA</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating time (min.)</td>
<td>58±21</td>
<td>81±37</td>
<td>p&lt;0.01'</td>
</tr>
<tr>
<td></td>
<td>(30–120)</td>
<td>(35–185)</td>
<td></td>
</tr>
<tr>
<td>Wound infection</td>
<td>13/35</td>
<td>0/21</td>
<td>p&lt;0.01'</td>
</tr>
<tr>
<td></td>
<td>(37%)</td>
<td>(0%)</td>
<td></td>
</tr>
<tr>
<td>Body temperature &gt;37°C BT*</td>
<td>4.0±3.7</td>
<td>2.5±1.6</td>
<td>N. S.'</td>
</tr>
<tr>
<td></td>
<td>(0–19)</td>
<td>(0–6)</td>
<td></td>
</tr>
<tr>
<td>First flatus*</td>
<td>2.7±1.2</td>
<td>2.3±0.7</td>
<td>N. S.'</td>
</tr>
<tr>
<td></td>
<td>(1–6)</td>
<td>(1–4)</td>
<td></td>
</tr>
<tr>
<td>Use of analgesics*</td>
<td>2.0±1.9</td>
<td>1.7±1.6</td>
<td>N. S.'</td>
</tr>
<tr>
<td></td>
<td>(0–9)</td>
<td>(0–5)</td>
<td></td>
</tr>
<tr>
<td>Hospital stay*</td>
<td>9.0±6.1</td>
<td>5.7±3.4</td>
<td>p&lt;0.05'</td>
</tr>
<tr>
<td></td>
<td>(3–28)</td>
<td>(3–15)</td>
<td></td>
</tr>
</tbody>
</table>

*Days after the operation; N. S.: no significant difference; 'Student t test 'chi-square test. 'Mann-Whitney U test
which the appendix was gangrenous (or perforated) and friable, and disintegrated under normal traction, all procedures were performed without direct grasping of the appendix itself when possible. The mesoappendix was thermocoagulated with a vessel sealing system (Liga Sure Atlas; Valleylab, Boulder, CO, USA) and the appendix was transected using a stapling device (Endo Cutter; Ethicon) at the appendiceal base. The stump was not buried. The resected appendix was removed from the peritoneal cavity through the first 10 mm port when the appendix could be completely placed inside the trocar. In cases in which the resected appendix was larger than the 10 mm trocar, the appendix was placed in a plastic specimen bag (Endo Pouch, Ethicon) before removal.

Except for two early cases, a drainage tube was not required because LA allowed sufficient irrigation of the peritoneal cavity. The fascia of the first port site was closed with absorbable suture (1 Vicryl; Ethicon) and skin incisions were closed by an interrupted buried absorbable suture (5-0 Vicryl; Ethicon).

All patients in the OA and LA groups were given antibiotics preoperatively, and these drugs were continued postoperatively as indicated.

Results
Background of the patients
A total of 56 patients were enrolled in the study, of whom 35 underwent OA and 21 underwent LA. There were no cases that required conversion from LA to OA. The background of the patients is summarized in Table 1. The patients who underwent LA were older (43.5 ± 21.4 vs. 39.0 ± 21.6 years old) and more likely to be female (71% vs. 54%), but these differences were not significant. There were also no significant differences between the two groups in terms of preoperative WBC and preoperative CRP. Based on the inflammatory grade of appendicitis, phlegmonous and gangrenous cases in open surgery were more than those in LA, but again this difference was not significant.

We did not hesitate to perform LA for patients with a surgical scar in the lower abdominal midline, and 2 patients with operative histories for the lower abdomen, such as hysteromyoma or colon cancer, underwent LA. No intraoperative complications such as port site bleeding or injury to abdominal organs occurred in these cases.

The majority of OA (20/35, 57%) and LA (15/21, 71%) procedures were performed by general surgery residents in postgraduate years 2-5, supervised by the attending surgeon. These percentages did not differ significantly (Mann-Whitney U test). We consider LA as the first step of the laparoscopic training program, similarly to LAC, so only the first 6 LA procedures were performed by the attending surgeon, and then LA cases were routinely assigned to three residents. Two of these residents were relatively experienced in laparoscopic surgery, especially in LAC, but the other resident had little experience in LAC or LA.

In addition to acute appendicitis, one phlegmonous case in the OA group had diverticulitis in the ascending colon, and a gangrenous case in the LA group had diverticulitis in the cecum. In both cases, the appendixes were resected and diverticulitis was cured by postoperative fasting and antibiotics.

Outcomes
The outcomes in the OA and LA groups are summarized in Table 2. The operating time for LA (81 ± 37 min) was significantly longer than that for OA (58 ± 21 min). Four cases of LA required an operating time of >120 min. In two of these cases, the appendix was long, positioned retroceally, and severely adhered to the retroperitoneum. In another case, the appendix was gangrenous and perforated with a stone, which resulted in panperitonitis. The fourth case was the first experience of LA for the surgeon.

There was no case with wound infection in the LA group, but 13 patients (37%) who underwent OA developed wound infection (p<0.01). These cases included 2, 3 and 8 cases in the catarhal, phlegmonous and gangrenous subgroups, respectively, with rates of 15%, 23% and 89% in the respective subgroups. Of these 13 cases, wound infection was first observed during hospitalization in 8 cases and after hospital discharge in 5 cases.

There were 2 cases (1 in each group) with postoperative intraabdominal abscess. Both cases were cured with antibiotics given intravenously, without the need for percutaneous drainage. There were no intraoperative complications such as injury of intraabdominal organs, bleeding from the appendicular artery, or other major postoperative complications such as pneumonia, urinary infection, hemoperitoneum, and small bowel occlusion. No
complications due to pneumoperitoneum occurred, such as deep vessel thrombosis or pulmonary embolism. Long term complications such as incisional hernia or appendiceal stump abscess were not examined. There were no deaths during the postoperative course in either group.

Patients who underwent OA remained febrile (>37°C) for an average of 5.5 days longer than those who underwent LA, but this difference was not significant. The longest period of febrility (19 days) in the OA group was a case of an elderly patient (84 years old) with gangrenous appendicitis that resulted in peritonitis, paralytic ileus, and severe wound infection. The longest period of febrility (6 days) in the LA group occurred in the case of perforated appendicitis that resulted in postoperative intraabdominal abscess, as described above.

There was no significant difference in the time until the first flatus or in the period of use of analgesics between the groups. In the OA group, 21 patients were anesthetized spinally, of whom 3 were converted to general anesthesia. Of these 21 patients, 9 (43%) suffered from headache, and analgesics used for headache were excluded from the data.

Patients in the LA group were discharged about 30% earlier than those in the OA group. The longest hospital stays in the OA (28 days) and LA (15 days) groups were the cases with postoperative intraabdominal abscess described above. In the OA group, patients with wound infection were hospitalized for about 80% longer than those without wound infection (12.4 ± 6.3 vs. 7.0 ± 5.1 days, p<0.01).

Discussion
More than 20 years have passed since the first report of LA by Semm, and many subsequent reports have shown similar morbidity of LA with OA. In 2004, Ulrich showed that LA was associated with a significantly lower overall complication rate and similar mortality compared to OA. In addition to improvements of LA, these results might also be due to the progress of general anesthesia and techniques preventing DVT, such as use of pneumatic compression stockings. Generally, these findings indicate that LA is as safe as OA.

In some reports, LA was performed only by surgeons experienced in laparoscopic techniques such as LAC. However, LA is a simple laparoscopic procedure and is the most appropriate operation for resident surgeons to perform as the first step of a laparoscopic training program. In our hospital, we require no experience of any other laparoscopic operation, including LAC, before a resident performs LA; therefore, resident surgeons start laparoscopic training in LA as well as LAC. Ignacio reported results for LA performed by residents that were comparable to those for OA. Therefore, we suggest that LA (and LAC) should be assigned as the first step of a laparoscopic training course, followed by laparoscopic colectomy or gastrectomy.

In our study, the operating time for LA was significantly longer than that for OA. This result is consistent with previous reports and this disadvantage of LA is a concern. However, the results from our study and elsewhere probably reflect procedures performed early in the learning curve. The operating time of LA performed by resident surgeons can be shortened to a length (77.4 min) comparable to that for OA (66.9 min), and Alfredo also found similar operating time for LA and OA (51.1 vs. 51.5 min). Thus, the disadvantage of a longer operating time for LA is likely to be overcome as the procedure becomes more common.

The results of this study also confirmed the findings in previous reports that wound infection is significantly reduced in LA. This may be due to removal of the resected specimen through the trocar or a specimen bag, which eliminates contact with the skin in almost all cases. The skin incision is larger in OA, but retraction is necessary in OA, which results in contamination with the inflamed appendix and detriments of the incision.

We did not find a significant difference in postoperative discomfort between LA and OA in terms of fever, flatus and pain. Since the conventional method is already minimally invasive, it may be difficult to reduce postoperative discomfort. However, Miliewczyk et al. reported that LA resulted in significantly less postoperative pain based on the number of analgesic ampules used and on a visual analog scale. Richards et al. reached a similar conclusion in a questionnaire-based study, and several other reports support these findings. Two meta-analyses showed quicker recovery and return to normal activity after LA compared to OA, and this advantage is also supported by other studies. In our study, the postoperative hospital stay was significantly shorter for patients who underwent LA, as
also found in most previous studies\textsuperscript{6,9,10,14-16}. This benefit is likely to be due to the reduced frequency of wound infection, lower postoperative pain, and quicker recovery of normal activity after LA compared to OA.

Organization of the proper equipment and staff to perform LA, particularly during the late evening and at night, may be challenging for a community hospital. However, once anesthetists and other medical staff understand the benefits of LA, it is likely that these problems can be overcome. As already stated, LA allows informative intraperitoneal visualization, which produces a diagnostic advantage\textsuperscript{10}. Moreover, recent reports show that LA may also have technical advantages, especially in obese patients\textsuperscript{10} and in complicated cases\textsuperscript{10}. Further studies are needed to clarify the exact indications for use of LA for appendicitis.

In summary, previous studies have shown that LA is as safe as OA and has minimal postoperative complications. In this study, we showed that LA was associated with a lower incidence of wound infection and earlier hospital discharge, even within a year after introduction in our institution. Although there may be obstacles in terms of equipment and manpower, these findings indicate that introduction of LA into a community hospital is beneficial.

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References