
Original Article

The Efficacy and Safety of Intra-Abdominal Drainage After Emergency Laparoscopic Appendectomy for Complicated Appendicitis

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Objectives: Laparoscopic appendectomy (LA) has been increasingly used for the management of complicated appendicitis in both children and adults. However, it remains controversial that placement of intra-abdominal drains is justified.

Methods: A retrospective cohort study presented data on LA performed in 28 patients without a prophylactic intra-abdominal drain (no drain group) was compared with 21 historical control LAs performed with a drain left (drain group). Only those patients suffering complicated appendicitis were included in this study. Efficacy of drain was based on rates of complications and other surgical parameters.

Results: The two groups were well matched with respect to the demographics, co-morbidities and surgical findings. The no drain group had significantly shorter time under anesthesia, faster resumption of oral intake of food, a shorter duration of intravenous antibiotic use, and a shorter hospitalization than the group with drains.

Conclusions: Routine use of drains after LA for complicated appendicitis appears to be unnecessary and even harmful, but this should be confirmed by further studies.

Key words: appendicitis, complication, laparoscopy

Introduction

Since the first description in 1983,¹ laparoscopic appendectomy (LA) has been

increasingly used in the treatment of patients with acute appendicitis.^{2,3} Moreover, there is increasing evidence that LA provides diagnostic and therapeutic advantages when compared to conventional surgery.⁴⁻⁹ However, a higher

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Received: December 11, 2014

Accepted: July 8, 2015

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incidence of postoperative intra-abdominal abscesses (Fig. 1) has been reported after LA in complicated appendicitis, i.e., perforated appendicitis, generalized peritonitis, and/or appendiceal abscess.¹⁰

Laparoscopy has been performed in patients with appendicitis for several years in our institution. Until 2005, most surgeons in our institution have placed a closed suction intra-abdominal drain on a routine basis after performing LA for complicated appendicitis (Fig. 2). Nevertheless, more and more evidence began to emerge questioning prophylactic drainage, including after open appendectomy in complicated appendicitis.¹¹ We therefore began to amend our policy about prophylactic drainage since 2005. From that point on, we no longer routinely placed the prophylactic drain-



Fig. 1 Representative case for intra abdominal abscess in a complicated appendicitis.

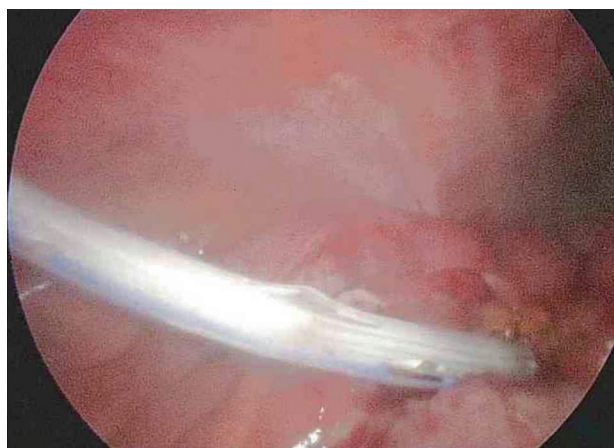


Fig. 2 Representative case for placement of a drain during laparoscopic appendectomy.

age after laparoscopy for patients with complicated appendicitis. To assess the results of this new policy, we performed this retrospective study to evaluate the safety and efficacy of prophylactic drainage after LA in patients with complicated appendicitis.

Patients and Methods

Study period, design, and definition

Between July 2005 and June 2007, all clinical records of patients undergoing LA for the clinical diagnosis of acute appendicitis were retrieved from the database of hospital. For this study, surgical records for these patients were comprehensively reviewed to identify those patients with complicated appendicitis for analysis. Complicated appendicitis was defined as operative findings of gangrenous or perforated appendix with or without abscess formation.¹²

Preoperative diagnosis, operation technique and postoperative treatment

Diagnosis of acute appendicitis was, for the most part, a clinical one, and was based on a patient's history, physical findings, and/or laboratory data. Imaging studies (e.g., computed tomography and abdominal ultrasonography) were obtained for those patients with equivocal symptoms and signs of appendicitis. Therefore, the attending surgeon cannot definitively predict the status of the appendix before the operation. We only included those patients undergoing LA, and therefore excluded all those patients who did not undergo surgery for any reasons.

Under general anesthesia, LA procedures were performed by the attending surgeons or surgical residents (with at least 3 years of surgical training). We adopted a 3-trocar technique using two 3-mm and one 10-mm trocars as working and video ports. After the establishment of pneumoperitoneum, monopolar electrocautery dissectors were used for

tissue dissection. The appendiceal vessels were clipped with metallic clips and the vessels were divided subsequently. The appendix stump was secured with a pre-tied suture loop and/or metallic clips. The specimen was put into a finger tailored from a surgical glove and removed through the 10-mm port.

The peritoneal cavity was cleaned either by tailored small gauzes if feasible or by normal saline irrigation if contamination was severe. A Jackson-Pratt drain was routinely put into the Douglas pouch before July 2006, while we abandoned this policy from the time point on.

All of the patients received intravenous antibiotics and fluid supplement postoperatively. The antibiotics used postoperatively were effectively against both gram-negative bacteria and anaerobes, such as cefmetazole, ceftriazone and/or metronidazole. Oral intake was started as soon as the patient exhibited no signs of ileus or intra-abdominal infection. Wound condition was evaluated daily during hospitalization, and at follow-up, in the outpatient department. Infection was defined as turbid, purulent discharge from the wound. Culture of the discharge was not routinely performed. All patients with wound seroma or infection were managed by changing of the dressing.

The patient underwent abdominal ultrasonography or computed tomography if an intra-abdominal abscess was suggested by any clinical features, such as prolonged fever, ileus, or abdominal tenderness. All patients were discharged when the following conditions were met: 1) oral intake was satisfactory; 2) there were no signs of infection; 3) the drain, if any, was removed.

Data collection and statistical analysis

Data were retrieved from each patient's medical records, including demographic information, clinical presentations, surgical information, histopathological results, and hospital

course. All of the clinical data were compared between the two groups, those with intra-abdominal drains and those without. Continuous data are presented as means $\pm$ SD. The Mann's-Whitney *U* test, Pearson's Chi-Square test, and Fischer's exact test were used where applicable. Significance was set at $p < 0.05$.

Results

Between July 2005 and June 2007, 49 patients underwent LA for acute appendicitis at the hospital, including 22 women and 27 men. Twenty-one patients comprised the drain group, who were operated before July 2006 and consequently had a prophylactic drain placed during operation. On the other hand, 28 patients operated after July 2006 did not have a drain left, belonging to the no drain group.

Patient demographics and preoperative evaluation

The total 49 patients had a mean age of 33.0 ± 22.0 years, ranging from 5 to 81 years. Patient preoperative white blood cell counts were $14647 \pm 4683/\mu\text{l}$, and patient symptoms lasted for 2.43 ± 1.67 days before surgical intervention (range: 1-9 days).

The two groups were closely matched for demographics and baseline characteristics, including comorbidities, duration of illness before intervention and white blood cell count (Table 1).

Operative outcomes between the two groups are summarized in Table 2. In this study, there was no conversion from LA to OA procedure. Further, no iatrogenic trauma to major organs or structures (e.g., bowels, ureters, or vessels) occurred. The overall operation time was 87.6 ± 30.5 min, while the overall anesthesia duration was 108.9 ± 33.5 min. The operation time was significantly shorter in patients undergoing LA without drains than those with prophylactic drains. (79.9 ± 25.7 vs. 97.9 ± 33.6 min respectively, Table 2) The anes-

Table 1. Baseline characteristics of the patients according to study group

Variable	Drain group (n = 21)	No drain group (n = 28)	p-value
Gender, No. (%)			
Female	9(42.9%)	13(46.4%)	0.804
Male	12(57.1%)	15(53.6%)	
Age (years)	39.7 ± 22.2	27.9 ± 20.9	0.059
WBC ^a on admission (× 10 ³ /μl)	14.1 ± 4.0	15.2 ± 5.2	0.599
Illness days before LA	2.57 ± 1.80	2.32 ± 1.59	0.585
Preoperative fever, No. (%)	3(14.3%)	8(28.6%)	0.311
Comorbidity			
Diabetes, No. (%)	0(0%)	2(7.1%)	0.5
Hypertension, No. (%)	3(14.3%)	4(14.3)	1.0
COPD ^b , No. (%)	1(4.8%)	0(0%)	0.429
Heart failure, No. (%)	0(0%)	1(3.6%)	1.0

^a White blood cell^b Chronic obstructive pulmonary disease

thetia duration was also shorter in the no drain group than in the drain group. (99.1 ± 27.2 vs. 121.9 ± 33.9 min, Table 2) The operative findings were approximately comparable between the two groups (Table 2).

Two patients had infections in the umbilical port wound, one in each group respectively. Both the two patients recovered well after regular changing the dressing in the outpatient clinics and did not require surgical debridement. No intraabdominal abscess or appendiceal stump leakage took place in this study (Table 3).

There were no significant differences in the duration of postoperative fever (Table 3). The patients began oral feeding 2.48 ± 2.20 days after the operation (range: 1-12 days). The use of intravenous antibiotics lasted 3.52 ± 2.04 days after the operation (range: 1-14 days), with the length of hospital stay being 5.69 ± 2.70 days (range: 2-15 days). The duration of postoperative fasting, antibiotic use and hospitalization were all considerably

Table 2. Surgical variables according to study group

Variable	Drain group (n = 21)	No drain group (n = 28)	p-value
Operation time (min)	97.9 ± 33.6	79.9 ± 25.7	0.021*
Anesthesia time (min)	121.9 ± 33.9	99.1 ± 27.2	0.02*
Operative findings (%)			
Gangrene of the appendix	5(23.8%)	7(25%)	0.932
Purulent ascites in pelvis	18(85.7%)	20(71.4%)	0.236
Periappendiceal abscess	6(28.6%)	8(28.6%)	1.0
Pseudotumor formation	3(14.3%)	3(10.7%)	0.706

Table 3. Postoperative course and complications

Variable	Drain group (n = 21)	No drain group (n = 28)	p-value
Complications (%)			
Wound infection ^a	1(4.7%)	1(3.5%)	0.835
Intraabdominal abscess	0	0	-
Stump leakage	0	0	-
Early postoperative mortality (< 30 days)	0	0	-
Postoperative duration of (days)			
Fever	0.76 ± 1.0	0.59 ± 1.1	0.313
Fasting	3.67 ± 2.83	1.59 ± 0.70	0.001*
Intravenous antibiotic use	4.71 ± 2.35	2.60 ± 1.12	0.001*
Drain insertion	5.43 ± 2.11	-	
Hospitalization	5.90 ± 3.45	4.74 ± 1.38	0.003*

^a Wound infection was defined as turbid, foul and purulent discharge from the wound requiring drainage.

shorter in the no drain group than in the drain group ($p < 0.05$, Table 3).

Discussion

The paucity of literature concerning the role of prophylactic intra-abdominal drain-

age after LA for complicated appendicitis fueled our interest in performing this comparative study. The purported purpose of prophylactic intra-abdominal drainage is to drain possible fluid collections and to control potential appendiceal stump leaks. Some surgeons prefer the routine use of prophylactic drain after LA for complicated appendicitis,¹³ while others do not.⁹ In this study, we demonstrated that the elimination of intra-abdominal drainage after LA did not increase the incidence of complications (e.g., wound infection or intra-abdominal abscess). Moreover, patients without a drain were likely to have a faster resumption of oral intake, a shorter period of antibiotic use, and a shorter period of hospitalization, compared with those with a drain. Thus, prophylactic intra-abdominal drainage in this series appeared to have minimal benefits, and therefore may not be advisable after LA for complicated appendicitis.

Several randomized controlled studies have investigated the benefits of operative intra-abdominal drainage after OA for acute complicated appendicitis.¹⁴⁻¹⁷ These reports did not support the use of prophylactic drain after open appendectomy. Meta-analysis¹¹ revealed that the odds ratio (OR) for fecal fistulas favors the no-drainage group, whereas the OR for the end point intra-abdominal infection and wound infection does not favor either group. One possible reason for the ineffectiveness of drain placement after OA is the inappropriate location of the drain, mainly due to limitations in the visual field through the small wound. This shortcoming may result in poor function of the drain and/or misplacement of the drain into the middle of bowel loops, which may even cause the development of fecal fistula.¹¹

On the other hand, LA provides better visualization which aids in the precise placement of the drain in the dependent area, namely the pelvic cavity. There is also concern related to a higher technical demand, longer operative time, and a reported higher incidence

of intra-abdominal collections for LA in the management of complicated appendicitis.^{6,18-22} Hence, we thought the value of prophylactic drain merited reappraisal in LA.

The postoperative course of our patients was compatible with other reports from Asia.^{9,13} In our study, we found that the placement of the prophylactic drain did not affect the risk of postoperative morbidity or mortality. Thus, prophylactic drainage after LA was neither beneficial nor detrimental. Both groups suffered a similar duration of postoperative fever but the drain group had a longer period of postoperative fasting, intravenous antibiotic use, and hospitalization. Similar findings have been reported after OA for complicated appendicitis.²³ This similarity may be due to the surgeon's concern about the potential contamination through the drain site and, therefore, the drain group might be treated more cautiously.

The feasibility and safety of laparoscopy in the management of complicated appendicitis have been addressed in the literature.⁹ In this series, we successfully managed all patients with complicated appendicitis by laparoscopy. No conversion from LA to OA was encountered. The average operation time was comparable to other reports of LA in managing complicated appendicitis.^{9,13} Our data showed that the operation and anesthesia time were approximately 20 minutes longer in the drain group than in the no drain group. We believe that extra time is required for the placement of the drain. Moreover, since we usually inserted the drain through one of the working ports, further manipulation (if necessary) may be hindered after drain placement.

Complicated appendicitis usually carries a high risk of developing postoperative complications such as wound infection, intra-abdominal abscess formation, and bowel obstruction. In comparison to other series,^{9,13} our patients had similar wound infection rate as high as 4.1%. Nevertheless, no intra-abdominal fluid collection occurred in our patients, which

is one of the most troublesome complications. In a randomized controlled study comparing peritoneal lavage and drainage for perforated appendicitis in children, two of the drainage group patients developed an intra-abdominal abscess in Douglas' pouch postoperatively, despite peritoneal drainage with a silicon tube placed therein. No abscess was noted in the lavage group.²⁴ In our opinion, minimization of the contaminated ascites during operation was essential to prevent this complication. With the help of laparoscopy, the surgeon can clearly inspect all the potential sites of ascites accumulation (i.e., pelvic floor and bilateral subphrenic spaces). The surgeons should remove all the fluid accumulation under direct visual inspection by suction and/or irrigation.

The drain used in the drain group was a type of closed suction drain. There were some case reports that documented bowel perforation caused by closed suction drains.²⁵⁻²⁷ Clearly, the suction pressure generated by such closed systems can be at a level to cause injury to adjacent visceral tissues.²⁸ Although this was not reported in our series, it is important to prevent such complications by lowering suction force and avoiding placement of the drain directly next to the small bowel.

A few limitations about the present study should be addressed. First, our study was based on a relatively small sample from a single medical center, so it is unclear whether the results are generalizable to other medical settings. Second, despite the two groups were well similar in aspects of most preoperative risk factors, co-morbidities and the operative findings, we cannot fully exclude certain study and selection bias. Although the present study demonstrated that the no drain group had a shorter operative time, shorter anesthesia duration, a reduced need for fasting, decreased use of intravenous antibiotics, and a shorter hospital stay, the intrinsic deficit of the retrospective study must be taken into account and the results of subgroup analyses have

to be interpreted with caution. For example, the improvement of the laparoscopic equipment may have some impact on our results. Last but not least, the grouping of our patients, i.e. the placement of drain, was mainly based on the surgeon's preference, instead of randomization. Many factors could influence the surgeon's decision, such as the surgeon's experiences, the severity of peritoneal contamination, the patient's general condition. Therefore, our results should be verified by further studies.

In summary, prophylactic drainage after LA for complicated appendicitis may not be necessary, nor beneficial. The mean hospital stay, the durations of intravenous antibiotic use, and the need for fasting after operation were significantly less in the no drain group than in the drain group. There was no increased risk of wound infection or intra-abdominal abscess without intra-abdominal drainage. The risks and benefits of intra-abdominal drainage after LA for complicated appendicitis may be better answered within the context of a randomized trial.

Acknowledgements

This work was partly supported by the institutional grants from National Taiwan University Hospital (97-N-1006) and its Yun-Lin Branch (96-N-017).

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