Is Single Administration of Prophylactic Antibiotics Enough after Laparoscopic Appendectomy for Uncomplicated Appendicitis?

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Purpose: Research comparing the effectiveness of different doses of antibiotics prior to surgery for preventing infection is sparse. This study examines whether a single dose of preoperative antibiotics suffices to treat uncomplicated appendicitis via laparoscopic appendectomy.

Methods: This study retrospectively reviewed the medical records of 149 patients who underwent laparoscopic appendectomy from July 2013 to December 2014 in a single institution. The participants were divided into two groups; group A (n=99) was given a single dose of prophylactic antibiotics before surgery, and group B (n=50) was given both preoperative and postoperative antibiotics. Clinical factors and surgical outcomes were compared between two groups.

Results: The mean length of hospital stay for group A (2.5 days) was shorter than for group B (3.2 days) ($p<0.001$). Average operation time was 58.7 minutes for group A, longer than for group B (52.2 minutes, p=0.027). There was no difference in pathologic results and postoperative complications, such as surgical site infection (SSI) between the two groups. In groups A and B, 4.0% of patients had superficial SSIs. One patient (2.0%) in group B had deep/organ SSI.

Conclusion: A single dose of prophylactic antibiotics administration to patients undergoing laparoscopic appendectomy is acceptable as a treatment in uncomplicated appendicitis. **(J Acute Care Surg 2015;5:59-63)**

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Introduction

Acute appendicitis is one of the most common abdominal diseases requiring surgical interventions, with lifetime risk of 6% to 20% [1,2]. If patients do not get appropriate treatment as soon as possible after the diagnosis of acute appendicitis, they could develop perforated appendicitis, which may lead to abscess or peritonitis. Even worse, it can progress to bacteremia or septicemia.

A lot of studies have been conducted for the purpose of reducing the rate of surgical site infection (SSI), one of the main factors affecting patient outcomes. In general, antibiotics

are administered to patients after surgery to reduce the risks of bacteremia and septicemia as well as SSI in the case of complicated appendicitis [3].

Many studies have demonstrated an association between the duration of surgery and SSI in open appendectomy, and to that respect administration of antibiotics before surgery may reduce the chance of infection after surgery [4-6]. However, there are a few studies that analyze the correlation between single dose administration of antibiotics prior to surgery and the infection rate of patients, and it is still controversial whether the administration of postoperative antibiotics helps reduce the infection rate and improve the prognosis. Therefore, we believe that it would be helpful to analyze the efficacy of administering postoperative antibiotics.

Thus, this study is conducted to determine whether administering a single dose of preoperative antibiotics, without postoperative antibiotics would be sufficient for patients undergoing laparoscopic appendectomy to treat uncomplicated appendicitis.

Methods

This study was based on a retrospective review of the medical records of 149 patients who underwent laparoscopic appendectomy from July 2013 to December 2014. The study was approved by the Severance Institutional Review Board (IRB No. 4-2014-0068).

Patients considered for inclusion in this study had all undergone laparoscopic appendectomy, and they were at the age of 18 or above. The total number of patients during the study period was 342 patients. Laparoscopic appendectomy was performed with a three-port technique, placing one 10-mm port in the subumbilicus, and two 5-mm ports in the left lower quadrant and the suprapubic site. The mesoappendix was identified and resected using clips and electrocautery. The appendix was divided with Endoloops (Ethicon, Cincinnati, OH, USA), and removed via the umbilical trocar site with an endo-bag (Lap-Bag; Sejong Medical, Paju, Korea). The 10-mm port sites were closed with 2-0 Vicryl suture (Ethicon, Somerville, NL, USA). All operations were performed by surgeons with sufficient experience in laparoscopic surgery. We defined uncomplicated appendicitis as acute appendicitis when the computed tomography scan images did not show evidence of perforation and it was described on the operation records that there was no perforation of appendix in operative findings. Patients with periappendiceal abscess or perforated appendicitis and those with drain insertion were all excluded from this study. Finally a total of 149 patients were enrolled in our study.

Patients were divided into two groups. Group A with 99 patients was given only a single dose of prophylactic antibiotic before surgery, and 50 patients in group B were given both preoperative and postoperative antibiotics. Intravenous antibiotics were administered postoperatively until discharge to patients in the group B. Then, we compared age, gender, body mass index (BMI), American Society of Anesthesiologists (ASA) score, white blood cell (WBC) count, C-reactive protein (CRP) level, hospital length of stays, operation time, and SSI in both groups. Wound infection was defined based on the Centers for Disease Control and Prevention criteria for SSI [7].

Cefbuperazone, Cefotetan, Cefotiam, Cefoxitin, Cefminox, and all the second generation Cephalosporin were administered to the patients before surgery, and Cefbuperazone, Cefotetan, Cefotiam, Cefminox, Piperacillin/Tazobactam, and Isepamicin (aminoglycosides) were administered to the patients after surgery. All antibiotics used in this study are described in Table 1.

Table 1. Antibiotics used in the pre- or postoperative periods

Antibiotics	Number
Preoperative	149
Cefbuperazone	114
Cefotetan	27
Cefotiam	5
Cefoxitin	1
Cefminox	1
Piperacillin/tazobactam	1
Postoperative	50
Cefbuperazone	29
Cefotetan	13
Cefotiam	4
Cefminox	1
Piperacillin/tazobactam	1
Cefbuperazone+isepamicin	1
Cefbuperazone+piperacillin/tazobactam	1

All cephalosporins are the 2nd generations.

Statistical analyses were performed using IBM SPSS Statistics ver. 20.0 (IBM Co., Armonk, NY, USA). Categorical variables were presented as frequencies and percentages, continuous variables as the mean±standard deviation or medians and inter-quartile ranges. The analyses were conducted using a chi-square test or Fisher's exact test for categorical variables and Student's t-test or Mann-Whitney U test for continuous variables.

Results

Characteristics of the subjects

There were 67 males and 82 females, and the average age was 37.5±14.1. BMI was 22.7±3.2, and ASA scores were mainly 1 (64.4%) or 2 (31.5%). WBC counts were 12,519.3±4,217.5 in group A and 11,577.6±4,330.7 in group B (p=0.204). CRP level had no significant difference between the two groups (9.6 mg/L vs. 17.8 mg/L, p=0.388). The average operation time for group A was 58.7±16.5 minutes, which was longer than that of group B (52.2±17.2 minutes, p=0.027). Pathologic results had no significant difference between the two groups (p=0.425; Table 2).

Table 3. Comparison of two groups: group A vs. group B

	Group A (n=99)	Group B (n=50)	p-value
Hospital LOS (d)	2.5±0.7	3.2±1.0	<0.001
Hospital LOS (h)	31.2±17.6	46.8±23.0	<0.001
Postoperative complications	4 (4.0)	3 (6.0)	0.455
Superficial incisional SSI	4 (4.0)	2 (4.0)	
Deep incisional SSI	0 (0)	0 (0)	
Deep/organ SSI	0 (0)	1 (2.0)	

Values are presented as mean±standard deviation or number (%). Group A: preoperative antibiotics single use group, Group B: non-single use group, LOS: length of stay, SSI: surgical site infection.

Table 2. Characteristics of the 149 patients who underwent laparoscopic assisted appendectomy for acute appendicitis

Characteristic	Total (n=149)	Group A (n=99)	Group B (n=50)	p-value
Age (y)	37.5±14.1	35.9±13.5	40.7±15.0	0.054
Gender (male:female)	67 (45.0):82 (55.0)	45 (45.5):54 (54.5)	22 (44.0):28 (56.0)	1.000
Body mass index (kg/m^2)	22.7±3.2	22.7±3.3	22.9±3.1	0.616
American Society of Anesthesiologists score				0.904
1	96 (64.4)	65 (65.7)	31 (62.0)	
2	47 (31.5)	31 (31.3)	16 (32.0)	
3	4 (2.7)	2 (2.0)	2 (4.0)	
4	2 (1.3)	1 (1.0)	1 (2.0)	
Preoperative values				
White blood cell count (per μl)	12,203.3±4,264.5	12,519.3±4,217.5	11,577.6±4,330.7	0.204
C-reactive protein (mg/L)	11.4 (3.6～29.9)	9.6 (3.3～29.6)	17.8 (4.9～31.0)	0.388[a]
Timing of preoperative antibiotics administration (min)	55.0 (39.0～120.5)	53.0 (34.0～124.0)	63.0 (44.8～115.5)	0.269[a]
Length of postoperative antibiotics use (d)			1.6±1.0	
Operative time (min)	56.53±17.0	58.7±16.5	52.2±17.2	0.027
Pathologic findings				0.425
Suppurative type	131 (87.9)	89 (89.9)	42 (84.0)	
Gangrenous type	18 (12.1)	10 (10.1)	8 (16.0)	
Pre-morbid conditions				
Hypertension	12 (8.1)	9 (9.1)	3 (6.0)	0.751[b]
Diabetes mellitus	6 (4.0)	2 (2.0)	4 (8.0)	0.098[b]
Ischemic heart disease	8 (5.4)	4 (4.0)	4 (8.0)	0.443[b]
History of cerebrovascular accident	5 (3.4)	3 (3.0)	2 (4.0)	1.000[b]

Values are presented as mean±standard deviation, number (%), or median (interquartile range).
Group A: preoperative antibiotics single use group, Group B: non-single use group.
[a]Mann-Whitney U test, [b]Fisher's exact test.

Clinical outcomes

The length of hospital stay (LOS) for group A was 2.5±0.7 days, which was shorter than LOS (3.2±1.0 days) for group B ($p<0.001$).

Four patients in group A (4.0%) and 2 in group B (4.0%) had superficial SSI; 1 in group B (2.0%) had only deep/organ SSI, and there were no significant differences in SSI between the two groups (p=0.455; Table 3).

Discussion

Laparoscopic appendectomy is a widely performed technique due to many advantages, including smaller surgical wound and faster recovery than open appendectomy [8-14]. Since patients receiving this surgery have shorter hospital stays and faster return to work, SSI, such as wound infection, can substantially affect the outcome of patients. Thus, many studies have been conducted to reduce the risk of SSI [11,15]. Although it has been shown that administration of prophylactic antibiotics lowers the risk of SSI, debates are underway on whether postoperative antibiotics have any efficacy and for how long they should be administered. Moreover, there is only a few data on this issue.

Le et al.[1] compared 321 patients who were administered antibiotics after surgery and 186 patients who were not, and reported that the administration of antibiotics after surgery did not significantly reduce SSI in patients with non-perforated acute appendicitis. Another study compared 334 patients who were administered antibiotics after surgery and 394 patients who were not, and reported that the administration of antibiotics after surgery did not significantly reduce SSI and other infectious complications in patients with non-perforated acute appendicitis [3].

Another study recruited 188 patients with uncomplicated appendicitis and 78 patients with complicated appendicitis, and then divided them into three groups: the first group of patients were not administered antibiotics after surgery at all; the second group of patients were administered antibiotics after surgery for less than five days; the last group of patients were administered antibiotics after surgery for more than five days. It compared the three groups and described that the duration of antibiotics administered did not affect the SSI rates in patients with complicated appendicitis, as well as in patients with uncomplicated appendicitis, and concluded that administering antibiotics for a long period of time had no clinical benefit [16].

Our study has yielded similar results. Patients in both groups, group A and group B, did not show any significant differences in developing complication, such as SSI. Patients in group A had rather shorter hospital stays.

Therefore, the use of postoperative antibiotics in uncomplicated appendicitis did not show any clinical benefit in our study. Furthermore, longer hospital stays and more expensive medical costs incurred by these procedures may not be necessary. These results are not much different from other studies; however, the studies we mentioned above enrolled patients who underwent open appendectomy and patients who underwent laparoscopic appendectomy, and did not compared the two groups separately. This study enrolled only patients who underwent laparoscopic appendectomy, which may be meaningful in that we can analyze how the administration of antibiotics affect the outcome of patients undergoing laparoscopic appendectomy, regardless of other variables made by the surgery type.

We then need to consider how many times prophylactic antibiotics should be administered before surgery. Although it has been reported that antibiotics administration before and after surgery does not make a significant difference in many studies, only a few studies have discussed the proper frequency of antibiotics administration. A few studies reported that administering a single dose of prophylactic antibiotics to patients undergoing open appendectomy did not make significant differences in the outcome for patients [17,18].

However, there is almost no data on the efficacy of administering a single dose of prophylactic antibiotics to patients undergoing laparoscopic appendectomy, and it is hard to find studies that enrolled only patients undergoing laparoscopic appendectomy. Therefore, this study adds knowledge to the existing literature on this matter since it only included patients undergoing laparoscopic appendectomy.

This study made a comparison between two groups-one group with a single dose administration of antibiotic before lapar-

oscopic appendectomy and another group with antibiotic administration after the surgery-and did not show any significant differences in the SSI rates between the two groups. Moreover, a single dose of antibiotic before the surgery is acceptable, considering the costs and the risks of antibiotic-related complications.

Our study has some limitations. First, study population was relatively small. Second, selection bias may exist due to the retrospective nature. Therefore, our results need to be interpreted carefully. Third, skin apposition was mostly done with subcuticular sutures using 4-0 undyed Vicryl suture or a skin stapler (3M, St. Paul, MN, USA). However, we could not analyze a difference of SSI according to suture technique due to the lack of a medical record.

In conclusion, a single administration of preoperative antibiotics in patients undergoing laparoscopic appendectomy may be accepted in the case of uncomplicated appendicitis.

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