Effectiveness of Interval Appendectomy After Conservative Treatment of Pediatric Ruptured Appendicitis with Abscess

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Abstract The management of patients with acute perforated appendicitis with abscess is controversial. The aim of the present study was to assess the outcomes of treatment in patients with this condition. We retrospectively analyzed 31 patients (16 men and 15 women with a mean age of 8.4 years) with appendicitis presenting with abscess. Patients were divided into two groups (emergency operation group and interval operation group), and clinical characteristics and outcomes of treatment were investigated. On presentation, no differences in gender, age, body weight, duration of symptoms, temperature, white blood cell count, C-reactive protein level, or maximum size of the abscess in the axial view were detected between the two groups. Fifteen patients (48.4 %) underwent emergency surgery. The remaining 16 patients (51.6 %) were initially treated conservatively with antibiotics. All 16 patients underwent planned operations after receiving conservative treatment, and two (12.5 %) of these patients underwent appendectomy before the planned operation day because of recurrent appendicitis without abscess. There were no differences in the length of hospital stay. In the emergency operation group, six (40 %) patients presented with wound infection and four (26.7 %) developed a postoperative intra-abdominal abscess. No

infective complications were reported in the interval operation group. Interval appendectomy after conservative treatment of pediatric ruptured appendicitis with abscess significantly reduced postoperative infection rates.

Keywords Appendicitis · Abscess · Interval appendectomy · Child

Introduction

Appendicitis is the most common gastrointestinal condition requiring urgent surgical treatment in children. Perforated appendicitis with abscess at presentation occurs in approximately 30 to 60 % of children [1, 2]. The management of this condition, however, is controversial.

Emergency operation for perforated appendicitis with abscess is associated with an increased risk of complications, particularly wound infection [3]. Therefore, in patients suspected of having appendicitis with abscess, instead of the traditional emergency operation, the current trend favors conservative management consisting of ultrasound-guided percutaneous drainage and antibiotic treatment followed by interval appendectomy. Consequently, there is great variation in the initial antibiotic treatment and the timing of interval appendectomy, with very few clinical practice guidelines [4, 5]. In the present study, we compared the outcomes of children who did and those who did not undergo emergency operation to determine the effectiveness of interval appendectomy after conservative treatment of pediatric perforated appendicitis with abscess.

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Patients and Methods

Population

Informed consent was obtained from all patients. Between January 1996 and May 2006, 31 patients aged 4 to 13 years were enrolled in a retrospective observational pediatric perforated appendicitis with abscess study in the Department of Pediatric Surgery of Nihon University Hospital, Tokyo, Japan. Patients who underwent emergency operation between January 1996 and March 2001 were included in the emergency operation group (group 1). Patients treated with conservative management without ultrasound-guided percutaneous drainage between April 2001 and May 2006 were included in the interval operation group (group 2). The diagnosis of perforated appendicitis with abscess was made on the basis of ultrasonography (US) or computed tomography (CT) scan findings showing a well circumscribed abscess. In group 1, emergency operation was performed by using open or laparoscopic appendectomy, and the stump was ligated. At the emergency operation, intraoperative irrigation was performed with 5 L of warm saline in all cases, and no drains were used. Intraoperative abdominal cavity and abscess culture were taken to select the postoperative antibiotics. All patients received intravenous broad-spectrum antibiotics (cefmetazole and amikacin or imipenem/cilastatin and amikacin) until the normalization of C-reactive protein (CRP) during hospitalization. Group 2 patients received intravenous broad-spectrum antibiotics until the normalization of CRP consisting of cefmetazole and amikacin or imipenem/cilastatin and amikacin for a mean period of 20.2 ± 6.5 days and interval appendectomy 4 to 23 weeks (mean 12.7 ± 5.3) after the detection of negative CRP values. Intravenous analgesia (meperidine or ketorolac for those over 5 years old and acetaminophen suppository for children younger than 5 years old) was administered when patients voiced complaints of severe abdominal pain. Interval appendectomy was also performed by using open or laparoscopic approaches. An acetaminophen suppository or intravenous meperidine was prescribed for analgesia when patients voiced complaints of severe abdominal pain. Data collected included demographics, duration of symptoms, white blood cell (WBC) counts, CRP, antibiotics administered, length of stay, US and CT scan findings, and postsurgical complications.

Statistical Analysis

For statistical analysis, all calculations were performed using SPSS software (Statistical Package for Social Science, Munich, Germany). Univariate analysis was performed with the Student's *t* test for continuous variables ($p < 0.05$ was considered significant). Categorical variables were compared using

the Fisher's exact test where appropriate ($p < 0.05$ was considered significant).

Results

During the study period, data for 31 patients with pediatric perforated appendicitis with abscess were collected. Of these, 15 received emergency operation (group 1) and 16 received antibiotic treatment (group 2) (Fig. 1). Fourteen of the 16 patients who received antibiotic treatment underwent interval appendectomy without recurrence of appendicitis. During this period, a total of 317 patients underwent appendectomy at our hospital, and our subjects accounted for approximately 9.8 % of all appendicitis patients. Patients in the emergency operation group showed similar characteristics to those in the interval operation group at the time of study enrollment (Table 1).

Comparison of Clinical Outcomes Between Group 1 and Group 2

Patients in group 1 underwent appendectomy at an average of 0.53 ± 2.8 days after diagnosis. An appendectomy was performed in all patients. The average time to appendectomy in group 2 was 129.6 ± 39.5 days after diagnosis. Patient outcomes are described in Table 2. Patients initially treated nonoperatively tolerated a regular diet much sooner than those who underwent initial appendectomy. There was no difference in the time to normalization of CRP, the total length of hospitalization, or the rate of recurrence of appendicitis.

Comparison of Postoperative Complications Between Group 1 and Group 2

The postoperative complications for the two groups are summarized in Table 3. The most common complications among patients who underwent emergency operation were intra-abdominal abscess and wound infection. Intra-abdominal abscess developed in five (33.3 %) patients and wound infection developed in six (40 %) patients in group 1. The difference in the rate of intra-abdominal abscess and wound infection between the groups was statistically significant.

Discussion

In the present study, we showed the effectiveness of interval appendectomy after conservative treatment of pediatric perforated appendicitis with abscess from the point of view of postoperative complication rates. In the present study, the patients who underwent emergency operation between

Fig. 1 Outcomes of patients with acute pediatric perforated appendicitis with abscess

January 1996 and March 2001 were included in the emergency operation group. During this period, the rate of incidence of postoperative complications was high. To reduce the rate of complications, a conservative management strategy without ultrasound-guided percutaneous drainage was adopted between April 2001 and May 2006.

Most children who present with acute appendicitis are definitively treated with urgent appendectomy. However, a small proportion of patients present with perforated appendicitis with associated abscess. There are three main treatment methods for the management of acute appendicitis with abscess: emergency appendectomy on presentation, initial conservative management followed by interval appendectomy, and a totally conservative approach without interval appendectomy. Although each treatment modality has advantages and disadvantages, with the advent of antibiotics and

supportive care, surgical intervention at any stage of appendicitis can be performed without major complications [6, 7].

Emergency surgery in such patients has been associated with an increased risk of postoperative complications, especially wound infection [3]. In our series, although appendectomy was successfully performed in all of 15 (100 %) patients, postoperative intra-abdominal abscess was detected in 5 (33.3 %), wound infection in 6 (40 %), and small bowel obstruction in 2 (13.3 %) patients. These postoperative complication rates were high.

Currently, most surgeons favor a conservative management strategy for acute appendicitis with abscess with or without interval appendectomy. The patients are usually treated with broad-spectrum antibiotics on presentation, and interval appendectomy is usually performed 4–8 weeks after resolution of the inflammatory mass. Nonetheless, several previous studies reported high success rates of 76 to 97 % and a low incidence of postoperative complications after conservative management of patients with appendicitis associated with

Table 1 Clinical characteristics of patients in the emergency operation and interval operation groups on admission ($n=31$)

Parameters	Group 1 ($n=15$)	Group 2 ($n=16$)	<i>p</i> value
Gender, no. (male/female)	8/7	8/8	1.000
Age, mean $\pm$ SD (years)	8.7 $\pm$ 3.2	8.1 $\pm$ 2.5	0.560
Duration of symptoms, mean $\pm$ SD (days)	3.5 $\pm$ 2.1	4.5 $\pm$ 2.3	0.126
Admission WBC count, mean $\pm$ SD (1,000/mm ³)	18.5 $\pm$ 6.6	16.8 $\pm$ 2.4	0.341
CRP level, mean $\pm$ SD (mg/L)	11.6 $\pm$ 6.8	12.2 $\pm$ 6.8	0.794
Maximum size of abscess, mean $\pm$ SD (mm)	40.3 $\pm$ 11.2	44.1 $\pm$ 14.5	0.433

Group 1 emergency operation group, Group 2 interval operation group, WBC white blood cell, CRP C-reactive protein

Table 2 Comparison of clinical outcomes between the emergency operation and the interval operation groups ($n=31$)

Parameters	Group 1 ($n=15$)	Group 2 ($n=16$)	<i>p</i> value
Time of appendectomy after diagnosis, mean $\pm$ SD (days)	0.53 $\pm$ 2.8	129.6 $\pm$ 39.5	
Time to goal intake, mean $\pm$ SD (hours)	77.3 $\pm$ 22.8	40.8 $\pm$ 14.4	<0.001
Time to goal normalization of CRP, mean $\pm$ SD (days)	23.1 $\pm$ 6.6	20.2 $\pm$ 6.5	0.221
Total length of hospitalization, mean $\pm$ SD (days)	26.2 $\pm$ 7.6	28.6 $\pm$ 6.0	0.332
Recurrent appendicitis (%)	0	2 (12.5)	0.484

Group 1 emergency operation group, Group 2 interval operation group

Table 3 Comparison of postoperative complications between the emergency operation and the interval operation groups ($n=31$)

Parameters	Group 1 ($n=15$)	Group 2 ($n=16$)	<i>p</i> value
Small bowel obstruction (%)	2 (13.3)	0	0.226
Intra-abdominal abscess (%)	5 (33.3)	0	0.018
Wound infection (%)	6 (40)	0	0.007

Group 1 emergency operation group, Group 2 interval operation group

abscess [3, 8–11]. In our series, the success rate of 87.5 % without postoperative complications is consistent with those of previously published reports and appendicitis recurrence occurred in two patients before interval appendectomy. These two patients showed recurrent appendicitis at 20 and 169 days after the normalization of CRP. Interval appendectomy is usually performed in 4–8 weeks after resolution of the inflammatory mass. During conservative treatment, persistent presence of an appendicolith and the patency of the appendicular lumen after resolution of the mass is a risk factor for recurrent appendicitis [12, 13]. Both of our two patients with recurrent appendicitis had an appendicolith and the patency of the appendicular lumen after resolution of the mass (data not shown), and the planning of interval appendectomy was too late in a patient with recurrent appendicitis at 169 days after the normalization of CRP.

In the present cohort study group, the interval operation group showed better results than the emergency operation group. The time to goal intake was significantly shorter in the emergency group, whereas no differences in the time to the normalization of CRP, the total length of hospitalization, or the recurrence rate were observed between the emergency operation group and the interval operation group. The high rate of postoperative complications in the emergency group and the short time to goal intake indicated that the interval operation strategy was useful for the treatment of pediatric perforated appendicitis with abscess.

In summary, we showed that interval appendectomy after conservative treatment of pediatric ruptured appendicitis with abscess significantly reduced postoperative infection rates. Therefore, interval appendectomy may be considered a superior strategy to emergency appendectomy for the management of pediatric perforated appendicitis with abscess. However,

the present study had some limitations. First, the emergency operation group had slightly higher infection rates than those published previously. A second limitation of our study is that it was a retrospective review. We plan to perform a prospective study at our institution to further examine the outcomes of interval appendectomy in pediatric perforated appendicitis with abscess and establish an effective treatment strategy.

Conflict of Interest The authors declare that they have no conflict of interest.

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