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Prognostic Factors for Extended Cecectomy in Complicated Appendicitis

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Abstract

Introduction: Some patients with complicated appendicitis and no periappendiceal abscess on preoperative computed tomography may need the extended cecectomy, including ileocecectomy and right hemicolectomy. In this study, we determined if there are predictive factors for extended cecectomy in these patients, to assist the preoperative decision-making.

Material and Methods: This retrospective study included 44 patients with complicated appendicitis who underwent surgical treatment beyond simple appendectomy, despite the absence of periappendiceal abscess on preoperative computed tomography of the abdomen. Patients were divided into two groups: those who underwent partial cecectomy (partial cecectomy group, n=23) and those who underwent ileocecectomy or right hemicolectomy (extended cecectomy group, n=21). Several clinical and laboratory variables including Alvarado score were compared between these two groups.

Results: The time from the onset of symptoms was shorter (p=0.015), Alvarado score higher (p=0.018), white blood cell count higher (p=0.046), and C-reactive protein level lower (p=0.011) in the partial cecectomy group compared to the extended cecectomy group. Twenty one patients in the partial cecectomy group and 17 patients in the extended cecectomy group had appendiceal perforation. The length of stay in hospital in the group of extended cecectomy was significantly longer than that in the group of partial cecectomy (p=0.015).

Conclusion: The present study suggests that low leukocyte counts, high C-reactive protein levels, low Alvarado scores, and long time from the onset of symptoms may be predictive factors for the extended cecectomy in patients with complicated appendicitis.

Keywords: Ileocecectomy; Hemicolectomy; Appendicitis; Alvarado score

Introduction

Acute abdomen is occasionally accompanied by a life-threatening condition requiring prompt diagnosis and emergency surgery. Among the causes such as appendicitis, ulcer perforation, bowel infarction, acute cholecystitis, etc. for emergency surgeries, acute appendicitis is the most common disease entity. Immediate appendectomy has been established as the standard treatment for appendicitis, and most patients with an acute appendicitis undergo a simple appendectomy [1]. However, the inflammation in acute appendicitis may sometimes be enclosed by the patient's own defense mechanisms, the formation of an inflammatory phlegmon, or a circumscribed abscess. Immediate surgical treatment for enclosed appendiceal inflammation is associated with a more than 3-fold increase in morbidity owing to distorted anatomy and difficulties in closing the appendiceal stump because of the inflamed tissues [2]. Such treatment may result in an unnecessary ileocecal resection or right-sided hemicolectomy for technical reasons or suspicion of malignancy [3]. The preoperative computed tomography (CT) of abdomen would show the presence of periappendiceal abscess, indicating a perforated appendicitis [4,5]. Thus, the patients with abscess on preoperative CT of abdomen should receive the primary nonsurgical treatment with antibiotics and abscess drainage as needed with or without an interval appendectomy [1,6].

In the absence of periappendiceal abscess on preoperative CT of abdomen, as in an uncomplicated appendicitis, appendectomy is considered to be preferable to the nonsurgical antibiotic treatment [1]. However, the absence of periappendiceal abscess on CT of abdomen does not rule out the presence of perforated appendicitis [4,5]. As such, preoperative radiologic diagnosis does not always correspond with intraoperative findings, and surgeons can be faced with advanced inflammation, obliteration of surgical landmarks, tissue friability, and flank intestinal gangrene, associated with a perforated appendicitis during the operation. Likewise, if a serious, complicated appendicitis with perforation is found during surgery in patients without periappendiceal abscess on the preoperative CT of abdomen, then a surgical treatment beyond a simple appendectomy should be done [3]. A partial cecectomy is technically feasible and can be safely performed, but an unexpected extended bowel resection, such as ileocecectomy or right hemicolectomy, can increase morbidity and mortality due to such factors as intestinal anastomosis formation and the spread of inflammation over wide areas owing to the manipulation of inflamed tissue [7]. This study aimed to determine possible predictive factors for extended bowel resection, including ileocecectomy and right hemicolectomy, in patients with a complicated appendicitis in whom the periappendiceal abscess was absent on preoperative CT abdominal imaging, in order to support preoperative decision-making in

emergency settings. To define predictive factors, we examined the differences in preoperative clinical and laboratory variables between the two groups of patients, those who underwent a partial cecectomy and those who underwent an extended cecectomy. We found that there were distinctive differences in several preoperative clinical and laboratory variables between the two groups.

Materials and Methods

We retrospectively reviewed data from 1,363 patients who presented in the emergency room with acute abdomen and underwent surgical intervention for a simple or complicated appendicitis at Inje University Haeundae Paik Hospital from March 2010 to July 2014. Institutional Review Board of Inje University Haeundae Paik Hospital approved this study and waived the need of the informed consent for this study and the consent for the protection of patient information. Diagnoses and decisions for surgery were made by the attending surgeon based on the patient's full medical history, physical examination, laboratory test results, and radiologic examination. We excluded 335 pediatric patients and 916 adult patients in whom simple laparoscopic appendectomy was performed. In addition, 27 patients were excluded for inadequate medical records or a formal reading of the CT of abdomen. Also, excluded were 41 patients who showed periappendiceal abscess formation on preoperative CT of the abdomen.

Ultimately, based on preoperative CT of the abdomen which showed a complicated appendicitis without periappendiceal abscess, 44 patients underwent either partial cecectomy or extended cecectomy, such as ileocecectomy or right hemicolectomy. A partial cecectomy was performed for inflammatory involvement of the base of the appendix and the surrounding cecum. The resected portion of the cecum did not include the ileocecal valve. The surgical technique for partial cecectomy used a linear stapling device. In ileocecectomy, the entire cecum was resected with varying lengths of ileum and ascending colon, depending on gross inflammatory involvement. Intestinal anastomoses were performed with a stapling device. Right hemicolectomy was performed in case of suspected malignancy by gross observation during operation. All of 44 patients were performed by laparoscopy.

We divided the patients into two groups, those who underwent a partial cecectomy (partial cecectomy group) and those who underwent an ileocecetomy or right hemicolectomy (extended cecectomy group), based on whether the resection range extended beyond the cecum. These two groups were compared for age, gender, Alvarado scoring system elements, and C-reactive protein (CRP) level. The Alvarado scoring system is based on three symptoms (pain migration, nausea/vomiting, and anorexia), three signs (tenderness in the right lower quadrant, rebound tenderness, and fever), and two laboratory findings (leukocytosis and an increase in immature neutrophils [>75%]) [8]. The outcome variables we evaluated for the difference between these two groups included the length of stay and perioperative complications.

Statistical analysis was conducted using the Statistical Package for the Social Sciences version 18.0 for Windows (SPSS, Chicago, IL, USA). Categorical variables were analyzed using the Chi-square test, whereas continuous variables were analyzed by the Student's t-test. P values <0.05 were considered statistically significant.

Results

Data from a total of 44 patients were evaluated by operative findings or pathologic findings. The partial cecectomy group included 23 patients; 18 patients had a perforated appendicitis with abscess (or microabscess), 3 patients had a perforated appendicitis without abscess, and 2 patients had an advanced appendicitis without perforation. The extended cecectomy group included 21 patients; 17 patients had a perforated appendicitis with abscess (or microabscess) and 4 patients had an advanced appendicitis without perforation. These 4 patients underwent right hemicolectomy and the pathological findings were a periappendiceal edema with acute suppurative inflammation, ulceration with hemorrhagic necrosis in cecum, subacute inflammation with necrosis in cecum, and acute subserositis in cecum, respectively.

There were no differences in demographic characteristics, including gender, age, fever, and increased immature neutrophils between the partial cecectomy and extended cecectomy groups. Time from the onset of symptoms was longer in the extended cecectomy group than in the partial cecectomy group (3.6 ± 2.8 vs. 1.9 ± 0.9 days, p=0.015). White blood cell counts (13.3 ± 4.5 vs. 10.9 ± 3.0 $10^3/mm^3$, p=0.046) and Alvarado scores (6.7 ± 1.6 vs. 5.5 ± 1.6, p=0.018) were higher in the partial cecectomy group than in the extended cecectomy group. C-reactive protein (CRP) levels were lower in the partial cecectomy group than in the extended cecectomy group (3.9 ± 4.5 vs. 8.4 ± 5.6 mg/dL, p=0.011) (Table 1).

	Partial Cecectomy (n=23)	Extended Cecectomy (n=21)	p-value
Male	15	9	0.978†
Female	8	12	
Age (yrs)	46.6 ± 17.0	50.1 ± 17.1	0.490‡
Time from the onset of symptom (days)	1.9 ± 0.9	3.6 ± 2.8	0.015‡
Fever (≥37.3°C)	11	9	0.741†
Bilirubin, Total (mg/dL)	0.98 ± 0.24	0.88 ± 0.21	0.290‡
Left-shifted neutrophils (>75%)	15	9	0.236†
Leukocyte ($10^3/mm^3$)	13.3 ± 4.5	10.9 ± 3.0	0.046‡
Alvarado score	6.7 ± 1.6	5.5 ± 1.6	0.018‡
C-reactive protein (mg/dL)	3.9 ± 4.5	8.4 ± 5.6	0.011‡
Length of stay (days)	8.7 ± 2.7	11.2 ± 3.9	0.015‡
Complication	6 (26.1%)	7 (33.3%)	0.599†

Table 1: Comparison of clinical and laboratory values between the partial cecectomy group and the extended cecectomy group.

† by Chi-square test ‡ by t-test

Length of stay in hospital was significantly shorter for patients who underwent partial cecectomy than for patients who underwent extended cecectomy (8.7 ± 2.7 vs. 11.2 ± 3.9 days, p=0.015) (Table 1). There was a tendency toward a higher rate of complication in the extended cecectomy group than in the partial cecectomy group, (33.3

vs. 26.1%). Complications included six wound issues and one pleural effusion in the extended cecectomy group, and three wound issues, two ileuses, and one pleural effusion in the partial cecectomy group.

Discussion

Previous studies have shown that in patients with an acute complicated appendicitis, the absence of periappendiceal abscess on preoperative CT of the abdomen does not rule out a perforated appendicitis [4,5]. In the present study, we aimed to determine predictive factors for extended bowel resection in these patients, in order to assist preoperative decision-making. We examined the differences in preoperative clinical and laboratory variables between two groups of patients, those who underwent a partial cecectomy and those who underwent an extended cecectomy. Our study documented that patients in the extended cecectomy group had a longer length of time from the onset of symptoms until surgery, lower leukocyte counts, lower Alvarado scores, and higher CRP levels than patients in the partial cecectomy group, suggesting that these variables could be used as predictive factors for extended bowel resection in patients with complicated appendicitis, in whom periappendiceal abscess is absent on preoperative CT of the abdomen.

The length of symptoms before hospitalization correlates with of progress of acute appendicitis from simple to inflamed, and further to perforated [9]. As such, acute uncomplicated appendicitis changes to complicated appendicitis over time. An inflammation in complicated appendicitis may sometimes be enclosed by the adherent omentum and small bowel around the inflamed appendix to prevent the spread of inflammation through the abdominal cavity. However, a prolonged delay before surgery will allow the inflammation to spread further, resulting in appendiceal perforation [9,10]. Furthermore, the present study showed that patients with a longer delay before surgery required extended cecectomy, including ileocecectomy and right hemicolectomy, when compared with those with a shorter delay before surgery, regardless of whether patients had an appendiceal perforation or not. Thus, in complicated appendicitis, the time from the onset of symptoms can be used to predict not only the possibility of appendiceal perforation but also the requirement of extended cecectomy in patients undergoing the surgical treatment.

The combination of CRP level and leukocyte count increases diagnostic accuracy of appendicitis, and has a positive predictive value when both markers are elevated and a negative predictive value when both are normal [11,12]. Previous studies have suggested that an increased leukocyte count may be the earliest laboratory test to indicate appendiceal inflammation [13,14]. However, during prolonged inflammation, leukocyte count does not show a concomitant increase, in contrast to CRP level. Serum CRP levels are higher when inflammation and tissue destruction are more extensive. According to a previous study [13], repetitive tests showed a continuing rise in CRP values but a continuing decrease in leukocyte count in patients with acute appendicitis. In addition, it has been reported that a markedly elevated serum CRP level is a better indicator of perforation and abscess formation in patients with appendicitis [14]. In the present study, leukocyte count was lower and CRP value was higher in patients in the extended cecectomy group when compared with patients in the partial cecectomy group, despite the fact that majority of patients in both groups had appendiceal perforation. This finding strongly indicates that the inflammation in the extended cecectomy group was much more severe. As such, in complicated appendicitis, an increased CRP value and a decreased leukocyte count can be used to predict not only the possibility of appendiceal perforation but also the requirement of extended cecectomy in patients undergoing the surgical treatment.

In the present study, the Alvarado score was higher in the partial cecectomy group than in the extended cecectomy group. In 1986, Alfredo Alvarado introduced eight predictive factors that he found to be useful in making a diagnosis of acute appendicitis [8]. The Alvarado score enables risk stratification in patients with symptoms of suspected appendicitis, linking the probability to recommendations regarding discharge, observation or surgical intervention. Although the Alvarado score is well calibrated in men, however, it is inconsistent in children and it over predicts in women across all strata of risk, according to a recent systematic review [15]. In any event, many elements of the Alvarado score, such as leukocytosis and the increase in premature neutrophils mainly occur in the early phase of inflammation. Gastrointestinal symptoms, including pain migration, nausea or vomiting, and anorexia, develop relatively early. These reasons may explain why the partial cecectomy group had a shorter period of symptom duration along with a higher Alvarado score compared to the extended cecectomy group. In other words, in patients with complicated appendicitis, a low Alvarado score indicates an advanced inflammation including appendiceal perforation and abscess formation, requiring the extended cecectomy for the surgical intervention.

This study has several limitations. First, the data were retrospectively collected, so our study lacked randomization. Second, operations were performed by multiple surgeons, so the choosing of operative methods was not constant. However, the operations were performed by surgeons at least 3 years after they acquired professional qualifications; therefore, the lack of decisional consistency may have been minimal. Third, this review included a small number of patients, and the study was performed at one institution. To clarify these associations further, large-scale, multicenter studies are required.

Conclusion

The present study suggests that low leukocyte count, high CRP level, low Alvarado score, and a longer length of time from the onset of symptoms to surgery were predictive factors for the extended cecectomy, such as ileocecectomy or right hemicolectomy in patients with complicated appendicitis. In making the decision for an emergency appendectomy, surgeons should consider the predictive factors carefully in order to help prevent the extended bowel resection. The delayed surgery might be considered than immediate surgery in patients with low leukocyte count, high CRP level, low Alviardo score, and a longer length of time from the onset of symptoms.

Competing Interests

I disclose no possible conflicts of interest, sources of financial support, corporate involvement or patent holdings. I disclose no financial or personal relationships with other people or organizations that could inappropriately influence author's work.

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