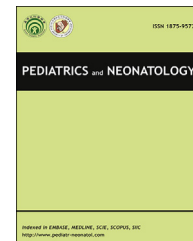


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## ORIGINAL ARTICLE

# Risk Factors for Prolonged Hospitalization in Pediatric Appendicitis Patients with Medical Treatment

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**Key Words**appendicitis;  
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risk factors

**Background:** With effective antibiotics against enteric flora and computed tomography-guided drainage for abscesses, the initial use of nonoperative therapy for children with appendicitis has increased both in recent reports and at our hospital. However, it has been reported that these patients have a relatively longer hospital stay and that their treatment is more expensive than those who undergo aggressive surgical intervention.

**Methods:** This was a retrospective cohort study based in a single medical center. A systemic chart review was conducted to identify risk factors for prolonged hospitalization in pediatric appendicitis patients not initially undergoing surgical treatment. Patient demographics, clinical symptoms, duration of symptoms, laboratory findings, imaging findings, complications, and length of hospital stay were analyzed. Logistic regression analysis was used to identify significant predictors of prolonged hospitalization ( $\geq 15$  days) and readmission.

**Results:** One hundred and twenty-five patients were recruited in this study, of whom 53 (42.4%) had prolonged hospitalization. The values of serum C-reactive protein (CRP) were significantly higher in patients with prolonged hospitalization compared with those without prolonged hospitalization ( $203 \pm 108.6$  mg/L vs.  $140 \pm 93.0$  mg/L,  $p = 0.001$ ). Risk factors of prolonged hospitalization were serum CRP  $>150$  mg/L (35/53 vs. 28/72,  $p = 0.001$ ), abscess formation (38/53 vs. 35/72,  $p = 0.008$ ), and multiple abscesses (10/53 vs. 1/72,  $p = 0.001$ ). Under multivariate analysis, CRP  $>150$  mg/L (odds ratio = 1.004,  $p = 0.0334$ ) and multiple abscesses (odds ratio = 8.788,  $p = 0.044$ ) were two independent predictors for prolonged hospitalization.

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**Conclusion:** Marked elevation of serum CRP (>150 mg/L) and multiple abscesses are two independent risk factors for prolonged hospitalization in children with appendicitis who are initially treated nonoperatively.

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## 1. Introduction

Appendicitis is one of the most common causes of acute abdomen in children.<sup>1–3</sup> Patients who are diagnosed early and undergo an appendectomy before perforation have a good outcome.<sup>4,5</sup> However, it is difficult to diagnose in young children because its clinical manifestations may be atypical and many patients have perforated appendicitis when diagnosed.<sup>6–8</sup> Appendiceal perforation occurs frequently in younger children with a longer duration of clinical symptoms. The rates of perforation vary by age, but are reportedly between 20% and 76%.<sup>6–11</sup>

In children with atypical presentations, ultrasonography (US) is recommended as a first-line imaging tool by the American College of Radiology.<sup>12</sup> Increased use of US alone or US with computed tomography (CT) for children's appendicitis is associated with lower negative appendectomy and misdiagnosis rates.<sup>13</sup>

Patients with perforated appendicitis or an uncertain diagnosis may initially be treated nonoperatively. Appropriate and effective antibiotic therapy against enteric flora and CT-guided drainage of abscesses increased the success rate of nonoperative treatment.<sup>14,15</sup> Most pediatric surgeons use the absence of fever, resolution of abdominal pain, normalization of white blood cell (WBC) count, and tolerance of a regular diet as indicators for discontinuation of postoperative intravenous antibiotics.<sup>14,16</sup> However, there is limited evidence as to the optimum duration of antibiotic therapy for children's appendicitis when they are not initially treated using surgery. Some patients have a poor response to antibiotic treatment, along with persistent symptoms, prolonged hospitalization, recurrent admission, and large abscesses that require image-guided drainage.

In this study, we identified the risk factors for prolonged hospitalization of children with appendicitis who were initially treated nonoperatively.

## 2. Methods

A 5-year retrospective chart review of pediatric patients with appendicitis was conducted. Consecutive patients who were aged <18 years and underwent regular follow-up visits for appendicitis at our hospital between January 1, 2009 and December 31, 2013 were enrolled into this study. Only those who received antibiotic treatment without initial surgical intervention were included. Children with underlying organic disease or who were receiving antibiotic treatment before admission to our hospital were excluded.

The diagnosis of appendicitis was based on clinical symptoms with positive diagnostic imaging (an abdominal

US and/or CT scan). After the diagnosis of appendicitis was made, broad-spectrum intravenous antibiotic treatment was administered. At our hospital, the routine first-line intravenous antibiotics for acute appendicitis were ampicillin or a first-generation cephalosporin, plus gentamicin and metronidazole. Second-line parenteral antibiotic regimens contained a third-generation cephalosporin. Imipenem or piperacillin–tazobactam was used for advanced conditions. After discharge, amoxicillin–clavulanate was the routinely prescribed oral antibiotic.

The pediatrician routinely consulted the pediatric surgeon regarding the possibility of surgical intervention in patients with clinical presentations and imaging findings consistent with appendicitis. Following our government's case payment regulation for pediatric patients receiving operation for acute appendicitis, the pediatric surgeon routinely performed the operation in cases of nonperforated, early-perforated (duration of clinical symptoms < 2–3 days), or advanced appendicitis with clinically ill-appearing or critical complications (intractable abdominal pain, unstable vital signs, and bowel obstruction). Antibiotics were administered orally (augmentin or cafepime) once the fever and abdominal pain had resolved, the WBC count was normal, and a regular diet could be tolerated. Upgraded antibiotics and/or CT-guided drainage for abscesses was used if the patient had persistent fever, abdominal pain, nausea, or vomiting. The indications for discharge of the patients included well-tolerated solid foods, normal bowel habits, absence of fever and dehydration, and resolution of abdominal pain, ileus, and leukocytosis. After discharge from the hospital, oral antibiotics were still administered until the resolution of intestinal ileus and intra-abdominal abscess. The pediatric surgeon performed the interval laparoscopic appendectomy in those patients who had complete resolution of clinical symptoms, and negative features for local ileus and residual abscess on abdominal US.

To identify the risk factors for prolonged hospitalization in pediatric appendicitis patients initially undergoing nonoperative treatment, the cutoff value of 15 days for the length of hospital stay (LOS) used for analysis was based on a mean LOS of 15.4 days in the enrolled patients. The enrolled patients were divided into two groups for analysis. Patients in Group 1 had a LOS of <15 days (no prolonged hospitalization), while those in Group 2 had a LOS of ≥15 days (prolonged hospitalization). The demographics and clinical characteristics evaluated included age, sex, clinical symptoms, duration of fever, use of parenteral nutrition, complications, adverse events, and LOS. The blood tests for hemogram [hemoglobin, WBC count and its percentage of immature neutrophil count

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