

## ACUTE APPENDICITIS IN INFANTS AND TODDLERS: RARE BUT CHALLENGING

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### Abstract

The diagnosis of appendicitis in infancy is very difficult to make and is thus usually delayed causing complications such as perforation and abscess formation as well as prolonged hospital stays. Though appendicitis in infants and toddlers is a rare happening, it should nevertheless be overseen in children presenting with colicky pain, vomiting (and/or diarrhea), and fever. Delayed diagnosis is common, particularly in young children, with perforation correlating strongly with delayed diagnosis. WBC and CRP have been demonstrated to be well correlated to the diagnosis of appendicitis in infants and toddlers. Rate of appendiceal perforation is extremely high in infants. Hospitals should develop clinical and imaging protocols that they can use effectively. In countries with limited resources, these protocols should be adapted to the cost effectiveness of the diagnosis and duration of hospital stay. Reducing the morbidity depends largely on increasing the rate of surgical diagnosis at the first presentation to a medical clinic.

**Key words:** appendicitis, infants, toddlers, management

### Introduction

Acute appendicitis is the most common cause of abdominal pain requiring surgery in children. But it is an uncommon entity in young children and rare in infants. The diagnosis of appendicitis in infancy is very difficult to make and is thus usually delayed. This delay is often associated with complications such as perforation and abscess formation as well as prolonged hospital stays. Younger children can be particularly difficult to diagnose because the presentation may be nonspecific, and the child is often apprehensive and uncomfortable, making the evaluation challenging. This study and review of the literature is intended to call attention to the general practitioner that while appendicitis occurs rarely in infants and toddlers, it should be considered as part of the differential diagnosis in the evaluation of an infant or toddler with vomiting, diarrhea, or a simple colicky pain.

### Methods

The study was conducted in compliance with the guidelines and after approval of the local ethics board. Records of 19 children less than 4 years of age operated for acute appendicitis at the Pediatric Surgery Clinic of

Timisoara from January 2005 till December 2008 were reviewed. History, clinical examination and CBC were used as the primary diagnostic tools. Information reviewed included demographic data, laboratory data, imaging studies, operative reports and physicians' notes. Descriptive analysis of the pertinent data was performed. Correlation between clinical signs, laboratory analysis and the likelihood of developing appendicitis was performed using basic statistical tools.

### Results

19 children less than 4 years old ( mean 33.5 months) comprised the study lot, with a male preponderance of 73% (14/19) while female children accounting for only 27% of the operated cases. The most common presenting symptoms were abdominal pain (16), vomiting (15) and fever (14). Diarrhea and anorexia were noticed in 3 cases each. The average duration of symptoms was 2.4 days, with 3 or more days in 7 children. 14 children were seen by a physician before the correct diagnosis was made; 6 were initially treated for an upper respiratory tract infection or otitis media. Leukocytosis was seen in 17 of the patients with an average WBC count of 17423/mm<sup>3</sup>. ESR was reported high in 47% of the patients while C-reactive protein was positive in 77% of them. 9 patients were subjected to plain abdominal radiography revealing in all of them air-fluid level. Intraoperative findings revealed perforation with peritonitis (19) and intestinal occlusion (7). Culture of the peritoneal fluid was positive for E-coli (6) and Klebsiella (1). Postoperative antibiotics were administered to 17 children for an average of 7 days. The average hospital stay was 10 days including an average of 3 days ICU stay.

### Discussions

Appendicitis is the most common indication for emergent abdominal surgery in childhood and has been diagnosed in 1 to 8 percent of children evaluated in urgent care settings for abdominal pain [1,2]. The incidence increases from an annual rate of one to two per 10,000 children between birth and four years of age to 19 to 28 per 10,000 children younger than 14 years [3,4]. During the neonatal, infant and toddler period of life the diagnoses of acute appendicitis can be quite challenging due to the lack of specific signs and symptoms. Delayed diagnosis leads to

higher incidence of perforation and subsequently high morbidity and mortality rates.

*History and physical examination* of a child should consider the following age specific characteristics and should raise the suspicion of an acute appendicitis.

Neonates (birth to 30 days) - Abdominal distention and vomiting are frequently noted. Irritability and lethargy have been reported. A palpable abdominal mass and abdominal wall cellulitis have been noted. Hypothermia, hypotension, and respiratory distress may also occur.

Infants (less than two years) - Vomiting, pain, and fever are present in most patients. Diarrhea is not uncommon [5]. Irritability, grunting respirations, and right hip complaints have also been described.

Preschool (two to five years) - Vomiting and abdominal pain are present in most patients in this age group. Vomiting is often the first symptom noted and frequently precedes pain [6]. Fever and right lower quadrant tenderness are reported frequently in this age group. Anorexia occurs frequently. Most children have symptoms for at least two days prior to diagnosis [7].

Abdominal pain, vomiting and fever were observed to be the most significant classical triad in our study lot. Ninety-five percent (18/19) of patients with appendicitis had at least two of these three signs and symptoms. Presence of diarrhea can be misleading and is usually diagnosed as gastroenteritis.

The *laboratory findings* are non-specific, thus demanding the diagnosis of acute appendicitis to be an operative one during the infancy period. Elevations in the peripheral white blood cell count (WBC) and C-reactive protein (CRP) levels have been noted in children with appendicitis. The urinalysis is abnormal in some cases. However, these findings are variable and nonspecific. Consistent to the findings in literature, we observed high WBC count the percentage of neutrophils elevated in 90% of children in our study lot. This finding, however, is nonspecific [8]. In an observational report describing children with nontraumatic abdominal pain who were evaluated in an emergency department, for those who had either increased WBC or elevated neutrophil count, the sensitivity and specificity for appendicitis were 79 and 80 percent respectively [9]. Infectious disorders that may cause abdominal pain with an increased WBC include gastroenteritis, streptococcal pharyngitis, pneumonia, and pelvic inflammatory disease [10,11]. Elevation of CRP has been reported in children with appendicitis, but sensitivities and specificities range widely [10]. The test appears to be less sensitive in patients who have had symptoms for less than 12 hours [12]. Limited studies suggest that CRP may be more sensitive than WBC in identifying both a gangrenous appendix and appendiceal perforation [12,13]. We noticed elevated ESR in 47% and CRP in 36% of the children. Increased CRP was highly suggestive of appendiceal perforation.

*Imaging techniques* like plain abdominal radiographs showing the presence of caecum and small intestine dilations in the right lower quadrant (sentinel loop sign) in association with air-fluid level which increase in time are indicative for appendicitis. Free abdominal air is a negative prognostic sign indicating intestinal perforation. Ultrasonography (US) is available in most institutions, is relatively inexpensive, and is safe. US improves diagnostic accuracy in children with suspected appendicitis [14]. Sensitivities have been more variable, ranging from 74 to 100 percent [14,17]. Specificities from 88 to 99 percent have been reported. The diagnosis of appendicitis cannot be reliably excluded unless a normal appendix is seen. Reported visualization rates vary from 22 percent to 98 percent [15,16]. Factors that affect this variability include the experience and technique of the sonographer. Increased utilization of Computed Tomography (CT) and improved accuracy of imaging for acute appendicitis have not contributed substantially to lower rates of negative appendectomy since the mid 1990s, and the perforation rate remains as high as 33 percent [18]. This has raised concerns regarding increased exposure to ionizing radiation, health care costs, and delay in surgical treatment [19]. Limited evidence suggests that protocols emphasizing early surgical evaluation, selective imaging that emphasizes ultrasonography, and careful serial examination (for patients with equivocal radiographic and/or clinical findings) lower rates for negative appendectomy and perforation [20]

*Avoiding complications:* Most children with acute appendicitis have had a period of poor oral intake with increased fluid losses related to fever and vomiting prior to diagnosis. Evaluation of their fluid and electrolyte status is therefore important preparation for surgery. Intravenous hydration and analgesia should be provided. Electrolyte abnormalities should be corrected. Pain control is an important component of preoperative care of children with acute appendicitis, both before and after the diagnosis is made. Antibiotic prophylaxis is routinely used for patients with early appendicitis to reduce the incidence of wound infection and intraabdominal abscess formation. The effectiveness of this practice is supported by a systematic review that noted a significant reduction in wound infections and intraabdominal abscesses among adults and children undergoing appendectomy who received antibiotic prophylaxis [21]. Piperacillin/Tazobactam was the antibiotic of choice in 64% of the children (11/17), while culture sensitive antibiotics were introduced following positive results and included Ceftriaxone, Metronidazole, Ertapenam (all with or without the primary antibiotic). Evidence regarding the optimum duration of antibiotic therapy is limited. Many pediatric surgeons use normalization of white blood cells (WBC) and absence of fever as indications to discontinue intravenous antibiotics [22]. It is common practice among pediatric surgeons, however, to treat for up to seven days or longer, consistent with our findings [22]. We continue intravenous antibiotics in children with advanced appendicitis until they are afebrile, tolerating a regular diet, and have a normal WBC.

### Conclusions

Though appendicitis in infants and toddlers is a rare happening, it should nevertheless be overseen in children presenting with colicky pain, vomiting, (+/- diarrhea) and fever. Delayed diagnosis is common, particularly in young children, with perforation correlating strongly with delayed diagnosis. A reliable abdominal examination is the key to demonstrating the physical findings associated with appendicitis and requires that the child be quiet and cooperative. Localized right lower quadrant pain develops more reliably in preschool age children and older. Early diagnosis of appendicitis in infants and children can prevent perforation, abscess formation, and postoperative complications, and can decrease cost by shortening hospitalizations. WBC and CRP have been demonstrated to be well correlated to the diagnosis of appendicitis in infants and toddlers. All children presenting with acute localized abdominal pain, vomiting and fever should be referred for surgical consultation. In children with a typical clinical presentation for acute appendicitis, clinicians should consult a surgeon with experience caring for children prior to obtaining imaging studies. Close observation and follow up without imaging is recommended in children who are unlikely to have appendicitis based upon the clinical examination and laboratory studies (absolute neutrophil

count less than 6750/mm<sup>3</sup>; absence of nausea or vomiting; absence of maximal tenderness in the right lower quadrant). When an apparently normal appendix is found, it should be removed. A careful search for other causes of abdominal pain should be performed. Careful preoperative preparation is necessary to ensure the best outcome for patients with perforating or gangrenous appendicitis. Preoperative management includes replacement and maintenance fluid therapy and preoperative antibiotics. The choice of imaging study in any given clinical situation should consider patient characteristics and institutional resources, such as the availability of US and CT and the expertise of the staff. CT has led to modest improvements in reducing the rate of negative surgery. CT is costly and carries a risk due to radiation exposure. Hospitals should develop clinical and imaging protocols that they can use effectively. In countries with limited resources, these protocols should be adapted to the cost effectiveness of the diagnosis and duration of hospital stay. Reducing the morbidity depends largely on increasing the rate of surgical diagnosis at the first presentation to a medical clinic. The prognosis is reserved and severe in infants and toddlers with acute appendicitis as compared to older children and therefore warrants rapid diagnosis and treatment.

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