The influence of delay on perforation in childhood appendicitis

A retrospective analysis of 58 cases

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ABSTRACT

Objective: Appendicitis is the most common non-traumatic surgical abdominal disorder in children aged 2-years or older. It is generally believed that delay in diagnosis and surgery of acute appendicitis is associated with a more advanced stage of disease and a higher morbidity. The aim of this retrospective study was to document the clinical features of acute appendicitis (AA), and to describe the factors associated with appendiceal perforation (AP) among children.

Methods: This study included 58 patients who underwent emergency appendectomy during the period January 1998 through to December 2002, Süleyman Demirel University Hospital, Isparta, Turkey. They were proven to have AA by operative findings and pathology reports, and were further included in this study.

Results: The preadmission delay which is mostly due to parents and post admission delay which is due to physicians other than pediatric surgeons were found as highly associative factors for AP. Perforation is unlikely in AA patients in the first 48-hours of the abdominal pain.

Conclusion: Associated symptoms of the abdominal pain may cause delay to diagnosis. The children who have abdominal pain and associated symptoms should be consulted with a pediatric surgeon.

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Acute appendicitis (AA) is the most common abdominal emergency in children requiring immediate surgical intervention.[1] Particularly in the very young the history and physical examination may be difficult, which often causes "diagnostic delay" before appendicitis is eventually diagnosed.[2,3] The rate of perforation is related to a delay in diagnosis or treatment, or both. Recent studies suggest that the rate of perforation is due to a delay in patient presentation, rather than to a delay in treatment.[4] The preadmission delay (parental delay) on the part of the patient and the post admission delay (professional delay) on the part of the surgeon are responsible for the combined delay in diagnosis and surgery.[5] Delayed diagnosis may result in perforation of the inflammed appendix, peritonitis, or appendiceal abscess formation. Several previous studies indicated that the perforation rate for children ranges from 35-90%.[6,7] Although mortality rates have been significantly reduced by improvements in fluid resuscitation, anesthesia, and antibiotics, late recognition leads to increased postoperative morbidity and prolonged hospital stays.[8] Despite the advances of the medical sciences, missing cases of appendicitis in children remains a common problem. We performed a retrospective study to establish the incidence of diagnostic delay in children admitted to our hospital in which ultimately the diagnosis of AA was made.

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Methods. We performed a retrospective chart review of pediatric patients admitted to the Department of Pediatric Surgery from the Pediatric Emergency Room with a clinical diagnosis of AA, and who had confirmation of appendicitis by surgically and pathologically. Patients underwent emergency appendectomy from January 1998 through to December 2002. All patients were operated on by the same surgical team. A total of 64 patients, 16-years of age or less, were enrolled in this study. Patients reviewed included emergency department and inpatient medical records, operative notes, and pathology reports. Chart review and data entry were performed by one author only, who was aware of study hypotheses, using a standardized form designed for the purpose. Information in the following categories was recorded when available: 1. Demographic data such as age and gender; 2. Historical findings consisting of first medical advice, drugs used prior to diagnosis (analgesic or antibiotic), fever, anorexia, vomiting, and diarrhea; 3. Physical examination findings, including abdominal guarding (voluntary or involuntary tensing of abdominal musculature in response to palpating), mass, and rebound tenderness (a sharp, localized increase in abdominal pain when the pressure of palpation is released); 4. Laboratory findings such as leukocyte count and urinalysis; radiologic findings consisting of plain abdominal radiography in erect position and ultrasonography (USG); 5. Chronologic data such as parental and professional delays; 6. Inpatient data, including migration of pain, anorexia, nause, tenderness, rebound tenderness, elevated temperature, leukocytosis, shifted white blood cell count (MANTRELS) and modified Lindberg's scores, operative findings such as anatomical location of appendix (preileal, retrocecal, or pelvic), appendiceal pathology (inflamed or perforated), and the presence or absence of intraabdominal abscess. Historical data findings were dependent on parental reports; fever was measured in all cases (above 38°C), and the exact number of episodes of vomiting or diarrhea was not recorded. When any one item of information was not available, that patient was excluded from the analysis of that type, missing values were not interpreted as negative findings. We divided total delay into 2 components: parental delay and professional delay. We were particularly interested in the relative effects that parental and professional delay had upon perforation. Total delay was the time between the onset of abdominal pain and the start of surgery. Parental delay was the interval between onset of abdominal pain and the parent's first contact with a health professional. We divided also professional delay into 2 components: Due to pediatric surgeon and non-pediatric surgeon (general practitioner or pediatrician). Professional delay was defined as the interval between this contact and the start of surgery.

All numeric data were expressed as mean ± SD. Clinical features and operative findings of patients with perforated (PA) and non-perforated appendicitis (NPA) were compared using student-t test. A correlation analysis was also carried out using Spearman test between AP and the other parameters.

Results. During the study period, 64 patients underwent laparotomy for suspected AA. Among them, 6 (9.3%) children were found to have normal appendix. The remaining 58 patients were proven to have AA by operative findings and pathology reports, and hence were entered into this study. **Table 1** shows the patients characteristics, clinical and laboratory findings, and preoperative course of patients at the 2 stages of disease. There were 32 (55.2%) boys and 26 (44.8%) girls, and the mean age for NPA was 10.0 ± 3.5 years (with a range of 2 to 16 years) and for PA 6.0 ± 3.8 years (with range of 1-16). The difference was found to be statistically significant (p<0.05). Thirty-eight (65.5%) patients were in the NPA group and 20 patients (34.5%) were in the PA group. Parental delay was 29.1 ± 24.2 hours (with a range of 4-96 hours) in the NPA group and in 75.6 ± 42.8 hours (with a range of 24 -168 hours) in the PA group. The parental delay for PA patients was significantly longer than for NPA patients (p<0.05). Professional delay in hours which is due to pediatric surgeon for NPA was 3.9 ± 3.49 hours (with a range of 2-24 hours) and for PA 6.65 ± 2.9 (with a range for 3- 12 hours). Professional delay in hours which was due to non-pediatric surgeon was 31.0 ± 15.5 hours (with a range for 20-42 hours) in NPA group and 86.8 ± 44.1 hours (with a range for 21-156 hours) in PA group. There was a statistically significant difference between the groups with respect to professional delay (p<0.05). Patients with low socio-economic level were higher in PA group than in NPA group. There was a statistically significant difference between PA and NPA patients with respect to socio-economic level (p<0.05). Duration of pain in the NPA and PA groups were 34.7 ± 28.2 hours (with a range of 6-120 hours) and 130.0 ± 59.2 hours (with a range of 48-240 hours). The duration of pain in the NPA group was significantly shorter than in the PA group (p<0.05). The leukocyte count in the NPA and PA groups was 13600 ± 4486 (with a range of 5600-22400/mm^3) and 17190 ± 6176 (with a range of 5400 to 27500 /mm^3). The difference was significant (p<0.05). Modified Lindberg's score was 4.3 ± 19.8 (with a range of –38 to 43) in the NPA group and 16.5 ± 12.3 (with a range of –12-41) in the PA group. Migration of pain, anorexia, nause, tenderness, rebound tenderness, elevated temperature, leukocytosis, shifted white blood cell count score was 6.8 ± 1.5 (with a range of 3 to 10) in the NPA group and 9.0 ± 0.9 (with a range of 7-10) in the PA group. There were significant differences for both modified Lindberg's and MANTRELS score between the NPA and the PA patients (p<0.05). The history of drug usage before admission was met in 9 (23.7%) patients in the NPA group, and in 11 (55%) patients in the PA group. The difference was significant (p<0.05). First, medical advice was given from practitioner to 2 (5.3%) patients, from pediatrician to one (2.6%) patient, and from pediatric surgeon to 35 (92.1%) patients in the NPA group. First, medical advice was given from practitioner to 11 (55%) patient, from pediatrician to 9 (45%) patients in the PA group. The number of first medical advice in the PA group was significantly different than in the NPA group (p<0.05). Initial diagnosis made by a specialist other than pediatric surgeon were as upper respiratory infection in one (2.6%) patient, urinary infection in one (2.6%) patient, and AP in 36 (94.7%) patients in the NPA group. Initial diagnosis made by specialist other than pediatric surgeon were urinary as infection in 6 (30%) patients, gastroenteritis in 3 (15%) patients, acute abdomen in one (5%) patient, and upper respiratory infection in 10 (50%) patients in the PA group. The number of unrelated diagnosis in the PA group was significantly different than in the NPA group (p<0.05). Abdominal pain was present in all of the patient. There was diarrhea in one (2.6%) patient in the NPA group, and in 3 (15%) patients in the PA group. Patients had more associated diarrhea in the PA group than in the NPA group (p<0.05). Abdominal USG was positive in 16 (42.1%) patients in the NPA group and in 13 (65%) patients in the PA group. The difference was not statistically significant (p>0.05). The mean hospital stay 12.8 ± 6.3 days in the PA group and 7.47 ± 4.1 days in the NPA group. The difference was statistically significant (p<0.05).

Table 1 - The characteristics, clinical and laboratory findings, preoperative and postoperative course of patients at the 2 stages of disease.

Characteristics	NPA	PA	*P* value
Gender			
Male	20	12	
Female	18	8	
Mean age (years)	10 ± 3.5	6 ± 3.8	*
Patients with low socioeconomic level (n)	9	17	*
Preoperative course	29.1 ± 24.2	75.6 ± 42.8	*
Parental delay (hours)			
Professional delay (hours)			
Due to pediatric surgeon	3.9 ± 3.4	6.6 ± 2.9	
Due to non pediatric surgeon	31 ± 15.5	86.8 ± 44.1	*
Duration of pain (hours)	34.7 ± 28.2	130 ± 59.2	*
Drug usage before admission (%)	23.7	55	*
Vomiting (%)	55.3	90	*
Diarrhea (%)	2.6	15	
Constipation (%)	2.6	10	
Clinical and laboratory findings			
Leukocytosis (/mm3)	13600 ± 4486.9	17190 ± 6176.2	*
Pathological abdominal USG (%)	42.1	65	
Pathological pain abdominal radiography (%)	10.5	75	*
Positive urinanalysis (%)	23.7	30	
Modified Lindberg's score	4.34 ± 19.8	16.52 ± 12.38	*
Mantrels score	6.82 ± 1.54	9.0 ± 0.95	*
Operative findings			
Pathology (n)	38	20	
Mean hospital stay (days)	7.47 ± 4.1	12.8 ± 6.3	*

(*=p<0.05), NPA - non-perforated appendicitis
PA - perforated appendicitis, USG - ultrasonography

Discussion. Acute appendicitis remains one of the most common surgical procedures in children.[9] It has been well documented that diagnostic delay leads to perforation and increased morbidity and mortality.[8] The diagnosis of AP is based only on clinical and sometimes laboratory data. The application of the current clinical scoring system for the diagnosis of AP in children could be of help. Several studies have evaluated computerized scoring systems for increasing diagnostic accuracy in children with suspected appendicitis.[10,11] Although, a study by Bond et al[12] found the use of the Mantrels Score in children under 16 to be inaccurate, in our study, both of MANTRELS and modified Lindberg's scoring systems were found very sensitive.

According to an other study, although a white blood cell count is frequently ordered in children with suspected appendicitis, it is nonspecific and insensitive for this disorder.[10] Nonspecific signs and symptoms together with the rarity of this disorder in infancy account for overall misdiagnosis rates of 70-100% those 2 years or younger despite the multiple diagnostic modalities now available to clinicians.[2,13-15]

One study found that children with misdiagnosis more frequently complained of vomiting preceding pain (29% versus 8%), dysuria (20% versus 4%), constipation (17% versus 5%), diarrhea (37% versus 10%), and respiratory signs and symptoms (27% versus 2%) compared with children with correct diagnoses.[13] In our study, diarrhea was seen 15% PA patients. Dysuria was seen 10% PA patient. Children with misdiagnoses more frequently exhibited perforation and abscess formation. As complains such as diarrhea, dysuria, and respiratory symptoms delay the diagnosis and lead to perforation, especially when the child is first seen by a nonpediatric surgeon physician. Before a diagnosis of appendicitis is made, 28% of children have been previously evaluated by a physician for their symptoms. In our patient, drug usage before admission was 55% PA patients. In all these patients medication was started by general practitioner or pediatricians. In our study, who had previously evaluated by a physician rate 45% in PA patient, 7.9% in NPA patient. This data shows that pediatric surgeons diagnose the AP more accurately than the pediatricians or general practitioners. So, every abdominal pain in children should be consulted to the pediatric surgeons to exclude the surgery. Plain abdominal radiographs have been recommended as potentially useful for evaluating children with suspected appendicitis.[16,17] In our study, plain abdominal radiography was not sensitive for NPA, but for PA patients its sensitivity rate noted 75%. Ultrasonography has been studied extensively in the evaluation of children with suspected AP. Although the 2 largest studies found USG to be 90-92% sensitive and 97-98% specific for appendicitis,[18,19] other studies have noted sensitives and specificities as low as 80-86%.[20,21] Our study showed that sensitives of USG was 42.1% in NPA, and 65% in PA patients. Sensitivity of USG was very low in our study. It is due to radiologists experience in our hospital.

The approach to AP is influenced by the desire to reduce the misdiagnosis rate in order to avoid unnecessary surgery on the one hand and by the attempt to operate at an early stage of the disease in order to reduce the associated morbidity on the other hand. Patients may not be able to provide a good history of their symptoms, and the etiology of abdominal pain is often unclear. In uncertain cases, delay of surgery and close follow up in hospitals are common practice in order to reach a more precise diagnosis. Children may therefore require longer periods of observation prior to identification of specific disease processes.[22,23] This approach may affect the stage of disease and cause a higher complication rate. Our negative appendectomy rate was 9.3% but our study showed that professional delay which is due to non pediatric surgeon as a highly associated factor for PA. Drug usage before admission was 55% for PA patients due to initial misdiagnosis. The second associative factor for perforation was parental delay. Our study showed that associated symptoms caused especially parental delay. Parental delay was due to low socioeconomic level in our area. The number of patients with low socio-economic level was significantly higher in PA group. Those patients whose hospital costs paid by the governmental health programme were classified as patients with low socio-economic level. Parents with low socioeconomic level were unaware of their childrens' health status, as parental delay was very significant in this group. Perforation is unlikely in AP patients in the first 48-hours of the abdominal pain. However, the risk of perforation increases as the duration of pain is more than 48- hours.

In our cases, PA were found highly associated with professional delay which is due to non pediatric surgeon and parental delay which due to low socioeconomic and sociocultural levels in our area. Whatever the reason is, advanced appendicitis was associated with delayed oral consumption, prolonged hospital stay, infectious and noninfectious complications. There is still much to be learnt from this imperfect clinical diagnosis of appendicitis that is not necessarily technology dependent. Acute appendicitis must be included in the differential diagnosis of any young child who develops abdominal pain and associated symptoms. They should be consulted with a pediatric surgeon.

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