

The diagnostic value of C-reactive protein, white blood cell count and neutrophil percentage in childhood appendicitis

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ABSTRACT

Objective: To analyze the value of C-reactive protein (CRP), total white blood cell count (WBC), and neutrophil percentage in the diagnosis of suspected cases of childhood appendicitis.

Methods: Prospective study of 216 patients admitted with a history of suspected acute appendicitis, between October 2001 through to May 2002, Al Fateh Teaching Hospital for Children, Benghazi, Libya. Blood samples for estimation of CRP, total WBC and neutrophil percentage were sent immediately to the laboratory. Sensitivity, specificity, positive predictive and negative predictive values were calculated, for each test and in combination.

Results: There were 139 male and 77 female patients, the age range was 3-13-years, 135 patients were operated.

Those who had appendicitis, we had 114 patients with positive CRP values of more than (8 microgram/ml), and 109 patients had total WBC count of more than (11,000/microL), and 111 patients with neutrophil percentage more of than 75%. One hundred and twelve patients out of 130 with appendicitis had the triple tests positive, and only 8 out of 86 patients without appendicitis had the triple tests positive. The sensitivity, specificity, positive and negative predictive values of the 3 tests in combination were 86%, 90.7%, 93% 81.2%.

Conclusion: Evaluation of the clinical symptoms and signs combined with the triple tests can improve the diagnostic accuracy and significantly reduce the incidence of perforation and the rate of negative laparotomy.

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Acute appendicitis is a common clinical problem in the pediatric age group, accurate and prompt diagnosis is essential and indispensable, it requires timely surgery, delay in the diagnosis and therapeutic decision making are continuing dilemmas leading to a high morbidity and mortality rate, specially when there are other associated medical diseases.^{1,2} A high negative appendectomy rate has been previously accepted to minimize the risks of complications, since the morbidity and mortality increase with perforation,² however, removal of a normal appendix may carry long term

risks which may require future surgery.³ Although appendectomy is currently a safe operation, several non invasive diagnostic tests and investigative maneuvers have been described to improve the diagnostic efficiency and reduce the incidence of unnecessary surgery. However, this can be achieved by good clinical evaluation and active in hospital observation combined by more standardized and an appropriately selected pre-operative laboratory tests or procedures.^{4,6} The aim of this study is to investigate the role of C-reactive protein (CRP) and its value in

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combination with the total white blood cells (WBC) count and neutrophil percentage in identifying a group of patients with suspected acute appendicitis in which surgery can be deferred, hoping to improve the diagnostic accuracy and reduces the incidence of perforation and negative laparotomy.

Methods. A prospective study of 216 consecutive patients, aged between 3-13-years, suspected of having acute appendicitis who attended the Pediatric Surgical Department, Al-Fateh Teaching Hospital for children were carried out, in the period during 1 October 2001 through to 1 June 2002. Careful history and physical signs were recorded and evaluated with an active in hospital observation, decisions were made to operate or to observe on clinical backgrounds. Blood tests for a total WBC count; neutrophil percentage and CRP were requested and immediately sent to the laboratory. For patients who are assigned for appendectomy the samples were taken while the patients were prepared to the theater. The estimation of the CRP was by the rapid method. The cut off value for positive tests was (8 ug/ml). The upper limit for normal WBC count and neutrophil percentage were (11,000/ microL), 75%. The histopathological results were graded as normal, simple inflamed, gangrenous and perforated appendix. Sensitivity, specificity, positive and negative predictive values were calculated and correlated for each of the above tests and in combination.

Results. The total number of patients studied is 216 patients: 139; 64.3% males and 77; 35.6% females. Male to female ratio is 1.8:1. The age ranged 3-13-years with a mean of 8.5-years. There were 135 patients had the operation carried out for them and 81 had no operation and discharged as non specific abdominal pain. One hundred and twenty-seven patients had CRP values more than 8 ug/ml), of these 90 cases out of 106 patients with simply inflamed appendicitis 13 patients had perforated appendicitis 3 patients out of 5 cases had normal appendix and 10 patients out of 81 cases without appendectomy. In cases with gangrenous appendix the values of CRP ranged 14.2-19.6ug /ml, and in cases of perforated appendix was 19.6-32.4ug/ml. One hundred and nine patients from the operated cases and 19 patients from the non operated cases had a total WBC count of more than 11,000/microL and 111 patients from the operated cases and 15 patients from the non operated cases had a neutrophil count more than 75%, with a total of 128, 126. One hundred and twelve patients out of 130 who had inflamed appendix found to have all the 3 tests positive, while out of 81 cases who were not subjected to operation and the 5 cases found to

have a normal appendix only 8 cases had positive triple tests. The average time between the appearance of symptoms and the operation was 18 hours. The sensitivity, specificity, positive and negative predictive values for CRP were 87.7%, 84.8%, 89.7%, 82%, WBC count 83.8%, 78%, 85%, 76% and the neutrophil percentage 85.3%, 82.5%, 88%, 78.8%. While the values for a positive triple tests were 86%, 90.7%, 93.3%, 81.2%, the later results indicate that the values for the triple tests are better than each of the above tests alone.

Discussion. The diagnosis of acute appendicitis is primarily a clinical matter, the diagnostic accuracy of which is a bit low in the pediatric age group.⁸ Pre-operative measurement of CRP to improve the accuracy of diagnosis of acute appendicitis had been advocated by many authors. However, the positive effect of pre-operative CRP estimation in pediatric age group remains a subject for continuing research. The role of CRP estimation in predicting acute appendicitis in childhood was found to be low; high levels were only found with complicated appendicitis.^{5,9} However, in our study positive levels were reported even in simply inflamed appendix. Significantly high levels of CRP were seen with gangrenous and perforated appendix as reported by Paltola et al.¹⁰ Therefore, high CRP value may indicate complicated appendix; consequently, we have to start pre-operative antibiotic and perform surgery as soon as possible. High levels of CRP can even predict post-operative complications in appendicitis.^{11,12} It has been shown that the predictive value CRP is higher in appendicitis than in other causes of acute abdomen.¹⁰ It is a better indicator of complicated appendix than WBC count.¹³ Our study clearly demonstrated that the sensitivity, specificity, positive and negative predictive values for CRP 87.7, 84.8, 89.7, 82 were superior to that for a single total WBC count 83.8, 78, 85, 76 and neutrophil percentage 85.3, 82.5, 88, 78.8. C-reactive protein can be regarded as a valuable test and can support the surgeon clinical diagnosis in suspected cases of appendicitis.¹⁴⁻¹⁷ However, a negative value of CRP can be expected in the presence of a pathological appendix if the sample is drawn within 12 hours of the beginning of symptoms.^{18,19} Furthermore, serum level of CRP decline in response to antibiotic therapy.²⁰ These factors may limit the predicting value of CRP. In our study, a single total WBC count does not significantly influence surgical decision making, and it is an unreliable predictor in suspected cases of appendicitis as reported by other authors.²¹⁻²⁴ The low sensitivity and specificity of single WBC count compared with the neutrophil percentage and CRP 83.8, 78, 85, 76, 85.3, 82.5, 88, 78.8, 87.7, 84.8,

89.7, 82 reflected its relative lower diagnostic accuracy. When there is an inflamed appendix whatever the cause, there is an increase in the neutrophil response at the expense of lymphocytes without general increase in the total WBC count. Later on, when invasion of bacteria set in, there will be a general increase in the total WBC count in addition to the pre-existing neutrophil response.²⁵ Therefore, the diagnostic accuracy of WBC count can be improved if the neutrophil percentage is taken in consideration.²⁶ The upper normal values of total WBC and neutrophil percentage in pediatric age group vary with age,^{25,27} and the results need to be adjusted accordingly which will affect adversely their specificity and sensitivity.²⁵ Furthermore, the leucocytes response usually declines in (0-5)-years old children with appendicitis on the other hand CRP response is well preserved in all age groups.²⁸ Despite these limitations a neutrophil percentage of more than (75%) and total WBC count of more than (11,000/microL) must be taken in consideration in the light of physical findings in suspected cases of appendicitis. From the above given findings and in light of our results, any of the above tests alone did not meet the criteria of a diagnostic test (a sensitivity more than 80% and a specificity more than 90%). In addition, each of these tests has its own limitations which will affect its diagnostic accuracy. We recommend the use of the triple test to enhance the diagnostic efficiency in suspected cases of appendicitis. The use CRP estimation in combination with other laboratory tests in the diagnosis of acute appendicitis had been investigated by many authors.^{13,28,29,30} Our results clearly show that the triple test can fulfill the criteria of a diagnostic test (a sensitivity: 86 and a specificity: 90.7). If the triple test are within normal values the diagnosis of acute appendicitis should be made with reservation, and we have to think of other causes of abdominal pain and surgery may be deferred.³⁰⁻³² Indeed, a negative results may be of greater help to the surgeon in his clinical decision than a positive one.

In conclusion, although the triple test are very easy to be carried , they are not widely used, the use of the above triple test combined with evaluation of the physical findings will improve significantly the diagnostic accuracy and reduces the incidence of perforation and negative laparotomy in suspected cases of acute appendicitis.

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