

Original Research Article

C-reactive protein as a diagnostic tool in acute appendicitis

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ABSTRACT

Background: Appendicitis is inflammation of the appendix. Symptoms commonly include right lower abdominal pain, nausea, vomiting, and decreased appetite. However, approximately 40% of people do not have these typical symptoms. Severe complications of a ruptured appendix include widespread, painful inflammation of the inner lining of the abdominal wall and sepsis. The main objective is to compare C-reactive levels in diagnosis of acute appendicitis.

Methods: In this study patients coming to General Surgery Department of ESIC Medical college, Rajajinagar, Bengaluru, from January 2017 to December 2017, who are diagnosed clinically as to have acute appendicitis form the source of study.

Results: In the present study, maximum number of cases belongs to 21-30 year age group (22 cases) and male female ratio is 1.07:1. Most common site of pain being right iliac fossa (52 cases), vomiting as presenting complaint was seen in 51 cases, fever as a presenting complaint was present in 31 cases, Mc-Burneys point tenderness noted in 49 cases, rebound tenderness noted in 46 cases. In present series 53 patients had elevated serum CRP level (>2.5 mg/dl) which is 89% of total study group. In these patients only one patient had high serum CRP level in spite of normal appendix.

Conclusions: An elevated serum CRP level supports the surgeon's diagnosis and hence avoids chances of error in diagnosis, due to atypical presentations. Similarly a normal preoperative serum CRP level in patients with suspected acute appendicitis is most likely to be associated with a normal appendix on histo-pathological examination.

Keywords: C-reactive protein, Acute appendicitis, Abdominal pain

INTRODUCTION

Appendicitis is inflammation of the appendix.¹ Symptoms commonly include right lower abdominal pain, nausea, vomiting, and decreased appetite. However, approximately 40% of people do not have these typical symptoms. Severe complications of a ruptured appendix include widespread, painful inflammation of the inner lining of the abdominal wall and sepsis.²

Appendicitis is caused by a blockage of the hollow portion of the appendix. This is most commonly due to a calcified "stone" made of feces. Inflamed lymphoid

tissue from a viral infection, parasites, gallstone, or tumors may also cause the blockage. This blockage leads to increased pressures in the appendix, decreased blood flow to the tissues of the appendix, and bacterial growth inside the appendix causing inflammation. The combination of inflammation, reduced blood flow to the appendix and distention of the appendix causes tissue injury and tissue death. If this process is left untreated, the appendix may burst, releasing bacteria into the abdominal cavity, leading to increased complications.

The diagnosis of appendicitis is largely based on the person's signs and symptoms. In cases where the

diagnosis is unclear, close observation, medical imaging, and laboratory tests can be helpful. The two most common imaging tests used are an ultrasound and computed tomography (CT scan). CT scan has been shown to be more accurate than ultrasound in detecting acute appendicitis. However, ultrasound may be preferred as the first imaging test in children and pregnant women because of the risks associated with radiation exposure from CT scans.³

The standard treatment for acute appendicitis is surgical removal of the appendix. This may be done by an open incision in the abdomen (laparotomy) or through a few smaller incisions with the help of cameras (laparoscopy). Surgery decreases the risk of side effects or death associated with rupture of the appendix. Antibiotics may be equally effective in certain cases of non-ruptured appendicitis. It is one of the most common and significant causes of severe abdominal pain that comes on quickly. In 2015 about 11.6 million cases of appendicitis occurred which resulted in about 50,100 deaths. In the United States, appendicitis is the most common cause of sudden abdominal pain requiring surgery. Each year in the United States, more than 300,000 people with appendicitis have their appendix surgically removed. Reginald Fitz is credited with being the first person to describe the condition in 1886.

Few studies have addressed the predictive value of C-reactive protein at different cutoff values in appendicitis. We have determined the cutoff values for C-reactive protein levels at different periods during clinical evolution of appendicitis and established their use to support the diagnosis of appendicitis.

The analysis of C-reactive protein levels demonstrated a high sensitivity to differentiate patients with and without appendicitis. C-reactive protein levels can be used to support the clinical diagnosis of appendicitis, and depending on time from onset of symptoms to diagnosis, they also can be used to differentiate patients with and without appendicitis.

The classic clinical picture of appendicitis has been widely known for more than 110 years, and described mainly in adults. Some atypical symptoms that could lead to errors in the diagnosis of appendicitis have also been described in young adults and children.⁴

The problem with an erroneous diagnosis of appendicitis is that the removal of a normal appendix or, on the contrary, the delay in treatment of appendicitis associated to its major complications, such as phlegmon, abscess or peritonitis, has ethical, economical and legal implications.⁵

To avoid these problems and to improve the early and accurate diagnosis of appendicitis, technological approaches to diagnose appendicitis have been

developed, including ultrasound, computed tomographic scan with intravenous contrast or immunological markers, magnetic resonance imaging, radiological contrasted techniques, and many different laboratory tests including C-reactive protein (CRP).

The role of CRP levels in patients with appendicitis has been extensively studied in adults. Some studies have addressed the predictive value of CRP at different cutoff levels in adults determined by ROC curve analysis and have found that CRP levels were useful for the diagnosis of appendicitis during the first 3 days after the onset of symptoms.

The main objective is to compare C-reactive levels in diagnosis of acute appendicitis.

METHODS

In this study patients coming to General Surgery Department of ESIC Medical college, Rajajinagar, Bengaluru, from January 2017 to December 2017, who are diagnosed clinically as to have acute appendicitis form the source of study.

Inclusion criteria

All the patients who will be admitted to ESIC Medical College, Rajajinagar, Bengaluru, during the study period with diagnosis of acute appendicitis and posted for surgery are included in the study.

Exclusion criteria

Patients with past history of jaundice, signs and symptoms of liver disease, chronic alcoholism are excluded as CRP is exclusively produced in liver. Females taking oral contraceptive pill or pregnant are excluded as CRP is elevated in these individuals.

Data analysis

Preoperative blood test results for the corresponding patients from the histological database were obtained using our hospital computer system. The median CRP levels for each of the NA, AA and PA groups were obtained using excel[®] (Microsoft, Redmond, WA, US). All statistical analysis was performed using stata[®] v11 (StataCorp, College Station, TX, US) and prism[®] 5 (GraphPad Software, La Jolla, CA, US). Results were compared using the Mann–Whitney U test. A p-value of <0.05 was considered statistically significant.

The diagnostic value of CRP was predicted with sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) for the above groups either for each individual test or when combined. Sensitivity, specificity, PPVs and NPVs varied when different cut-off values were examined (sensitivity

analysis). The cut-off value finally chosen to compare sensitivity, specificity, PPV and NPV for each variable when looked at individually corresponded to the highest combined value for sensitivity and specificity, which resulted in a value either higher than normal or within the upper range of normal for each of the corresponding markers.

RESULTS

In the present study maximum number of cases belongs to 21-30 year age group (22 cases) and male female ratio is 1.07:1.

Table 1: Age and sex wise distribution of cases (n=58).

Age group	Male	Female	Total
11-20	08	07	15
21-30	12	10	22
31-40	06	05	11
41-50	04	06	10
Total	30	28	58

Table 2: Distribution of cases based on sign and symptoms.

Sign and symptoms	Number of cases
Abdominal pain	
Right iliac fossa	52
Umbilical	06
Vomiting	51
Fever	31
Diarrhoea	26
McBurney tenderness	49
Rebound tenderness	46
Shifting tenderness	21

Table 3: Correlation between C-reactive protein level and appendicitis.

CRP level	CRP test			
	True Positive	True Negative	False Positive	False Negative
Elevated	52	-	1	-
Normal	-	6	-	1

The most common site of pain being right iliac fossa (52 cases), vomiting as presenting complaint was seen in 51 cases, fever as a presenting complaint was present in 31 cases, Mc-Burneys point tenderness noted in 49 cases, rebound tenderness noted in 46 cases.

In present series 53 patients had elevated serum CRP level (>2.5 mg/dl) which is 89% of total study group. In these patients only one patient had high serum CRP level in spite of normal appendix.

DISCUSSION

In the present study, maximum number of cases belongs to 21-30 year age group (22 cases) and male female ratio is 1.07:1. CRP levels were higher in patients with appendicitis compared with patients without appendicitis; CRP levels were significantly higher in patients diagnosed between 13 and 24 hours from the onset of symptoms compared with patients with symptoms for less than 12 hours. CRP reaches its peak approximately at 40 hours; consequently, the higher value encountered at 24 hours represents the rising of the CRP concentration. CRP levels increase with complications of appendicitis.⁶ It has been reported that a CRP value higher than 100 mg/L was strongly related to appendiceal necrosis, and a CRP value higher than 170 mg/L was a strong predictor for the presence of infection.⁷

In our study, the most common site of pain being right iliac fossa (52 cases), vomiting as presenting complaint was seen in 51 cases, fever as a presenting complaint was present in 31 cases, Mc-Burneys point tenderness noted in 49 cases, rebound tenderness noted in 46 cases. According to a study by Ghimire et al, a cross sectional study was done with consecutive patients diagnosed with acute appendicitis that underwent appendectomy over six month's period. Pre-operative findings and histopathology report were compared and analyzed with the level of C-reactive protein. A total of 54 patients were enrolled in this study. 94.40% were proved as acute appendicitis in histopathology. The level of C-reactive protein was significantly raised among highly inflamed appendix. C-reactive protein showed 84.31% sensitivity, 66.66% specificity, 97.72% positive predictive value and 20% negative predictive value in diagnosing acute appendicitis. So author concluded that, raised level of C-reactive protein is an aid for diagnosing acute appendicitis.⁸

In present series, 53 patients had elevated serum CRP level (>2.5 mg/dl) which is 89% of total study group. In these patients only one patient had high serum CRP level in spite of normal appendix. A study was done to assess the utility of these markers in patients presenting with acute lower abdominal pain. WCC and CRP were measured prospectively in 98 patients presenting with lower abdominal pain, and the results were correlated with each patient's outcome. No patients with WCC and CRP both in the normal range had acute appendicitis. Raised WCC and CRP were poor positive predictors of appendicitis, both alone and in combination, and correlated poorly with the development of complications. This result may have important clinical and economic implications. We suggest that patients experiencing lower abdominal pain, with normal WCC and CRP values, are unlikely to have acute appendicitis and can be safely sent home.⁹

In a prospective, double blind study, blood for the measurement of serum C-reactive protein was collected

pre-operatively from 192 children before going to the operating theatre for appendectomy. The histopathology was grouped into positive (acute appendicitis) and negative (normal appendix) and this was correlated with CRP values. CRP was normal in 14 out of 33 negative explorations (normal appendix on histopathology). The specificity and sensitivity of serum CRP was 42% and 91% respectively. The predictive value of a positive (raised CRP) and negative (normal CRP) test is 88% and 48% respectively. They concluded that neither raised nor normal CRP value is helpful in the diagnosis of acute appendicitis. CRP is not a good tool for helping the surgeon makes the diagnosis of appendicitis and it should not be measured in suspected appendicitis.¹⁰

CONCLUSION

An elevated serum CRP level supports the surgeon's diagnosis and hence avoids chances of error in diagnosis, due to atypical presentations. Similarly a normal preoperative serum CRP level in patients with suspected acute appendicitis is most likely to be associated with a normal appendix on histo-pathological examination. Therefore normal serum CRP level after 12 hours of onset of symptoms should be used as a basis for the decision to defer surgery to reduce the rate of negative appendectomies, and also to reduce burden on patient as well as on health system.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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