

## Original Research Article

# The study of serum c-reactive protein and its diagnostic importance in reducing the rate of negative appendectomy

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## ABSTRACT

**Background:** Introduction-Acute appendicitis is the most common abdominal surgical emergency and appendectomy is one of the most frequently performed abdominal operation but the diagnosis of acute appendicitis remains an enigmatic challenge, plagued by high rate of negative exploration. The objective of this study was to assess the accuracy of CRP over TLC in the diagnosis of acute appendicitis.

**Methods:** Total 200 patients who had been diagnosed as a case of acute appendicitis based on WBC count and clinical diagnosis and were planned for appendectomy were selected for purposive sampling. Serum CRP was estimated in these patients before operation but was not considered in decision making process of appendectomy. All 200 removed appendixes were sent for histopathological examination.

**Results:** Result-Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of serum CRP were much greater than WBC count. Mean and standard deviation of serum CRP was  $41.92 \pm 26.28$  with  $p < 0.0001$  which is highly significant.

**Conclusions:** Conclusion-CRP should be added along with clinical diagnosis and other laboratory test in diagnosis of acute appendicitis to reduce the rate of negative appendectomy.

**Keywords:** Acute appendicitis, Appendectomy, C-reactive protein

## INTRODUCTION

Acute appendicitis is the most common cause of acute surgical abdomen.<sup>1</sup> Approximately 7% of the population will have appendicitis in their life time with peak incidence occurring between the age of 10-30 years.<sup>2</sup> In 70% of cases the clinical presentation is typical and there is no difficulty in diagnosis. The remaining 30% have atypical clinical presentation and present a diagnostic dilemma for the surgeons specially in extremes of age, in

women of reproductive age and with abnormal position of appendix and thus have an uncertain preoperative diagnosis leading to unnecessary laparotomy and appendectomy.<sup>3</sup>

Diagnosis is based on medical history (symptoms) and physical examination which is supported by an elevated WBC count and imaging study if needed.<sup>4,5</sup> Although 70% patients of acute appendicitis have elevated WBC count, there are many other abdominal and pelvic

conditions that can cause WBC count to be elevated.<sup>6</sup> Because of lower sensitivity and specificity on its own, WBC count is not considered a good marker of appendicitis.<sup>7</sup> Ultrasonography (USG) and Doppler sonography are useful to detect appendicitis especially in children. In some cases (approximately 5%) USG doesn't reveal any abnormalities despite presence of appendicitis. This false negative finding is especially true of early appendicitis before appendix has been significantly distended a retrocaecal appendix which is most common position, large amount of fat and bowel gas which makes visualization of appendix technically difficult.<sup>8</sup> Some mimicking conditions like inflammation of lymph node near appendix or pain originating from other pelvic organ like ovaries or fallopian tube make diagnosis difficult.

Computed tomography (CT) is also used to diagnose appendicitis but because of its limited availability in rural areas of India, high cost, risk of radiation especially in children and pregnant women has limited its use in diagnosis of appendicitis. In the journal of "The American Medical Association" published in 2001, a large population based study was done which revealed the fact that accuracy of diagnosing acute appendicitis has not improved with the use of advanced imaging techniques over the last 15 years.<sup>9</sup>

The aim of this study was to assess the accuracy of CRP over TLC in the diagnosis of acute appendicitis.

**METHODS**

The present study was conducted in department of Biochemistry, Patna Medical Collage, Patna, Bihar, India from January 2011 to October 2012. This study comprises a total of 200 patients who were planned for appendectomy based on clinical examination and WBC count. Serum CRP was performed before operation but was not taken into account for decision of appendectomy. WBC count which was done in all patients was noted. After appendectomy, the removed appendix was sent for histopathological examination.

Estimation of serum CRP was done by quantitative turbidimetric assay method. Latex particle coated with specific human anti-CRP are agglutinated when mixed with sample containing CRP. The agglutination causes an absorbance change, depending upon the CRP content of patient sample that can be quantified by comparison from a calibrator of known CRP concentration.<sup>10</sup>

Written informed consent was taken from all the subjects before undergoing any intervention.

The research protocol was conducted in accordance with the Helsinki declaration. 5 ml of venous blood was taken and allowed to clot at room temperature. The clot was retracted and serum was separated by centrifugation at 2000 rpm for 10 minutes.

Elevated serum CRP in human serum is defined as values more than 10mg/L.<sup>11</sup> Cut off value for leukocyte was 12,000/L.<sup>12</sup>

Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of CRP and WBC count were estimated.

Sensitivity=  $TP/TP+FN \times 100$ , TP= True positive

Specificity=  $TN/FP+TN \times 100$ , TN= True negative

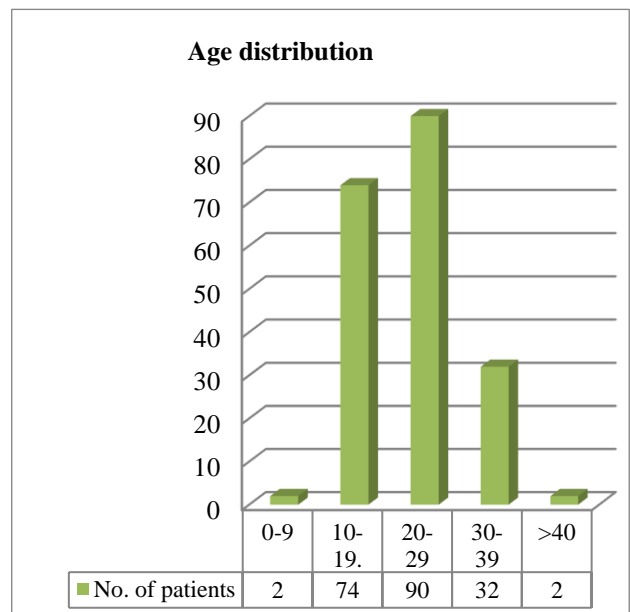
Positive predictive value (PPV)=  $TP/TP+FP \times 100$ , FP=False positive

Negative predictive value (NPV) =  $TN/TN+FN \times 100$ , FN=False negative

Accuracy =  $TP+TN/TP+TN+FP+FN \times 100$ .

**RESULTS**

Out of 200 patients 170 were diagnosed with inflamed appendix on histopathological examination. 30 had normal appendix. Out of 200 patients, 110 were females and 90 were males. Pregnant females were excluding from this study. Maximum number of patients were in age group 20-29 years followed by 10-19 years as shown in Figure 1.



**Figure 1: Distribution of cases in different age groups.**

CRP was positive in 168 patients out of which 160 had histologically inflamed appendix (true positive) while 8 had normal appendix (false positive). CRP was negative in 32 patients out of whom 10 had histologically inflamed appendix (false negative) and 22 had normal appendix (true negative) as shown in Table 1.

**Table 1: Histopathological correlation with serum CRP.**

	Histopathology of removed appendix		Total
	Inflamed appendix	Normal appendix	
CRP positive (raised)	160 (true positive, TN)	8 (false positive, FP)	168
CRP negative (Normal)	10 (false negative, FN)	22 (true negative, TN)	32
Total	170	30	200

WBC count was raised in 162 patients. Out of these 150 had inflamed appendix (true positive) and 12 had normal appendix (false positive).

WBC count was normal in 38 patients out of whom 20 had inflamed appendix (false negative) and 18 had normal appendix (true negative) as shown in Table 2.

**Table 2: Histopathological correlation with WBC count.**

	Histopathology of removed appendix		Total
	Inflamed appendix	Normal appendix	
Raised WBC count	150 (true positive, TP)	12 (false positive, FP)	162
Normal WBC count	20 (false negative, FN)	18 (true negative, TN)	38
Total	170	30	200

WBC count was raised in 162 patients. Out of these 150 had inflamed appendix (true positive) and 12 had normal appendix (false positive).

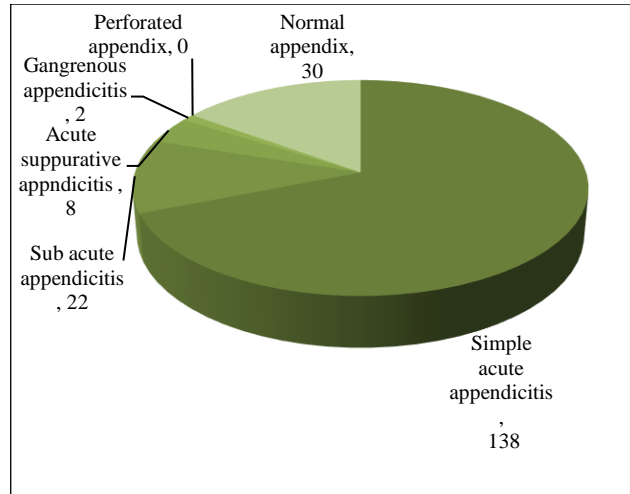
WBC count was normal in 38 patients out of whom 20 had inflamed appendix (false negative) and 18 had normal appendix (true negative) as shown in Table 2.

Mean and standard deviation of serum CRP (mg/L) was 41.92±26.28 with p= <0.0001 which is highly significant.

**Table 3: Diagnostic efficacy of serum CRP and WBC count.**

	CRP	WBC count
Sensitivity	94.1%	88.23%
Specificity	73.3%	60%
Positive predictive value	95.23%	92.59%
Negative predictive value	68.75%	47.36%
Diagnostic accuracy	91%	84%

Among the histologically inflamed appendix, maximum was of simple acute appendicitis followed by subacute appendicitis, acute suppurative appendicitis and gangrenous appendicitis as shown in Figure 2.



**Figure 2: Histological findings in present study.**

**DISCUSSION**

The incidence of appendicitis seems to have risen in some Asian and African countries because of changing lifestyle and western type of food habits.<sup>13</sup> Negative appendectomy rate in surgical literature varies from 15-30%.<sup>14</sup> This is a burden faced not only by the surgeon, but also the patients and the society as a whole, since negative appendectomy like any other operations result in socio economic impacts in the form of hospital expenses, lost working days and declined productivity. Despite extraordinary advances in modern radiographic imaging the diagnosis of appendicitis remains difficult and it is not infrequent after an appendectomy is performed, a normal appendix is found. The laboratory test such as WBC count have long been used to support clinical data in decision making process, but the considerable overlap with other inflammatory condition account for low specificity and positive predictive value of the test. Inflammatory marker like CRP can be measured easily in any primary health care setting.<sup>15</sup>

Shafi et al concluded that CRP had sensitivity, specificity and positive predictive value of 95.6%, 77.77% and 95.6% respectively which was almost similar to present study.<sup>16</sup> Similarly Iqbal J concluded that sensitivity, specificity of serum CRP was 92.8% and 76.5% respectively which matched with present study.<sup>17</sup> According to Khan et al the sensitivity and specificity of WBC count was 85% and 62.1% which is comparable with present study.<sup>18</sup> Ali S et al also showed that sensitivity and specificity of WBC count was 76.13% and 66.7% which is comparable with present study.<sup>19</sup>

In the present series, we also found that when both serum CRP and WBC count was normal the histology of removed appendix was normal. Deferring surgery in this group of patients would have reduced the negative exploration.

If serum CRP had been added to the clinical diagnosis and other laboratory investigation the rate of negative exploration would have reduced.

Limitation of present study was that we didn't explore the sensitivity, specificity of other investigations like USG and CT scan. Also, we couldn't find the cause of pain in patients who had negative exploration.

## CONCLUSION

If serum CRP test been added to the clinical diagnosis and other laboratory investigations then the diagnosis of acute appendicitis can be made with fair degree of accuracy and rate of negative appendectomy can be decreased. Hence CRP level should be included in the decision-making process of suspected cases of acute appendicitis to reduce the rate of negative appendectomy and thus serving the humanity.

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