

# Diagnostic Accuracy of Raised Serum C-Reactive Protein Levels in Diagnosis of Acute Appendicitis

FALAK SHER<sup>1</sup>, WASIM HAYAT KHAN<sup>2</sup>, USMAN ISMAT BUTT<sup>3</sup>, SYED MUHAMMAD BILAL<sup>4</sup>, MUHAMMAD UMAR<sup>5</sup>, SAID OMER<sup>6</sup>

<sup>1</sup>SR Surgery, LGH

<sup>2</sup>Associate Professor of Surgery, SIMS

<sup>3,5</sup>SR Surgery, SIMS

<sup>4</sup>Assistant Professor of Surgery, SIMS

<sup>6</sup>Consultant Surgeon, National Hospital & Medical Center, Lahore

Correspondence to Dr. Falak Sher, Email: dr\_falak\_mahl@yahoo.com Cell0333-7795278

## ABSTRACT

**Background:** Among the conditions which present in the surgical emergency, acute appendicitis is a common one. Diagnosis is on the basis of a combination of careful history, physical examination, laboratory and imaging investigation. C-Reactive Protein is a non-specific inflammatory marker. It may be used as an aid in the workup of acute abdomen.

**Aim:** To evaluate the diagnostic accuracy of raised serum C-reactive protein levels in diagnosis of acute appendicitis using histopathology as gold standard.

**Methodology:** We carried out this study at Department of Surgery, Lahore General Hospital, Lahore from 1<sup>st</sup> June, 2013 to 30<sup>th</sup> November, 2013. It was cross-sectional by design. A total of 135 cases undergoing appendectomy were included in the study. Co-relation of preoperative CRP levels and postop histopathological reports were done.

**Results:** 42.22% patients (n=57) were between 20-40 years while 78(57.78%) were between 41-60 years of age, 63(46.67%) were male and 72(53.33%) were females. The diagnostic accuracy of raised serum C-reactive protein levels in diagnosis of acute appendicitis using histopathology as gold standard was recorded, which showed 104(77.04%) were true positive, 5(3.70%) were false positive, 8(5.93%) were true negative and 18(13.33%) were false negative. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy rate was computed as 92.86%, 78.26%, 94.39%, 69.23% and 90.37% respectively.

**Conclusion:** We concluded that diagnostic accuracy of raised C-reactive protein for the diagnosis of appendicitis is higher. It may be used as an aid while making diagnosis of acute appendicitis.

**Keywords:** Diagnostic accuracy, raised serum C-reactive protein levels, acute appendicitis

---

## INTRODUCTION

Acute appendicitis is a commonly seen condition in the emergency. It constitutes one of the most common cause of acute abdomen especially in young adults<sup>1</sup>. The prevalence of acute appendicitis is approximately 1 in 7<sup>2</sup> Clinical findings and basic workup followed by evaluation by surgeon is usually done before appendectomy in the emergency department. However at times histopathology reports shows normal appendix which constitutes negative appendectomy<sup>2</sup>. Timely recognition and treatment of the condition is necessary since delay may result in perforation and increased patient morbidity<sup>3-4</sup>.

Despite the widespread use of various diagnostic tests and numerous scoring systems the diagnosis of acute appendicitis still remains challenging. Since its discovery in 1930 by Tillett and Francis, C-reactive protein has been noted to be present in the serum of patients with acute inflammation. It is synthesized by the liver. Its levels begin to increase after 8 hours of injury and remain increased as long as the inflammatory process persists.<sup>5</sup> It has been suggested that measurement of CRP in cases of appendicitis may improve diagnostic accuracy<sup>5-6</sup>.

But unfortunately, regarding its diagnostic accuracy, literature shows significant variation. The rationale of the study is to determine the diagnostic accuracy of raised C-

reactive protein for the diagnosis of appendicitis using histopathology as gold standard.

## MATERIAL & METHODS

A cross sectional study from 01-06-2013 to 30-11-2013 at department of Surgery, Lahore General Hospital, Lahore. 135 cases were included in the study. We included patients between ages of 20-60 of either gender who presented with suspected diagnosis of acute appendicitis. All patients fulfilling the inclusion/exclusion criteria were enrolled from the Emergency Patient Department of Surgical Unit-I, Lahore General Hospital, Lahore. Consent was obtained from the patients after full disclosure. Detailed history with clinical examination was done. A 5cc blood in a disposable syringe was taken from the patients with the help of paramedical staff and sent to the hospital laboratory for Serum C-reactive protein levels. Patients judged as having acute appendicitis by consultant surgeon were operated for appendectomy. Specimens of the subjects after appendectomy were sent to hospital laboratory, for the final diagnosis i.e. histopathology for confirming the diagnosis, presence and absence of appendicitis was recorded and then correlated with the Serum C-reactive protein reports. All this information was recorded on a pre-designed proforma (attached). The raised C-Reactive protein(CRP) levels were considered, positive if the values was > 6mg/L.

Analysis of data was done by SPSS software (version 16.0). Mean and S.D was calculated for quantitative data

Received on 13-04-2019

Accepted on 17-07-2019

while frequency and percentage were calculated for qualitative data. The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of raised serum C-reactive protein levels taking histopathology as gold standard was calculated.

## RESULTS

There were 135 cases included in our study. Majority of patients, 78(57.78%) were aged between 41-60 years while

SD was 39.84±8.20 years. Prevalence was more in females 72(53.33%) as compared to males 63(46.67%) (n=63). Histopathology examination showed positive correlation in 112(82.96%) cases.

By using histopathology as gold standard sensitivity, specificity, positive predictive value, negative predictive value and accuracy rate was calculated as 92.86%, 78.26%, 94.39%, 69.23% and 90.37% respectively. (Table 1)

Table 1: Diagnostic accuracy of raised serum c-reactive protein levels in diagnosis of acute appendicitis using histopathology as gold standard (n=135)

Serum C-reactive protein	Histopathology for Acute Appendicitis		Total
	Appendicitis Present	Appendicitis absent	
Appendicitis Present	True positive(a) 104(77.04%)	False positive(b) 5(3.70%)	a + b 109(80.74%)
Appendicitis Absent	True negative(c) 8(5.93%)	False negative(d) 18(13.33%)	c + d 26(19.26%)
<b>Total</b>	a + c 112(82.96%)	b + d 23(17.04%)	135(100%)

Sensitivity = 92.86%,  
Negative predictive value = 69.23%,

Specificity = 78.26%,  
Accuracy rate = 90.37%

Positive predictive value =94.39%

## DISCUSSION

Acute appendicitis is a commonly seen condition. Detailed history, physical examination, laboratory and imaging investigations are the basis of making accurate diagnosis of acute appendicitis. CRP is a non-specific inflammatory marker<sup>7-9</sup>. In 1967 Russian surgeons first evaluated the use of CRP in diagnosing acute appendicitis. A number of investigators have evaluated raised serum CRP in facilitating diagnosis of acute appendicitis but the results have varied.<sup>7,8,10</sup>

In this study, 42.22% patients (n=57) were between 20-40 years while 78(57.78%) were aged 41-60 years, mean±sd was calculated as 39.84±8.20 years, 63(46.67%) were male and 72(53.33%) were females. Using histopathology as gold standard 112(82.96%) were determined to be acute appendicitis while 23(17.04%) had no findings of acute appendicitis. The Diagnostic accuracy of raised serum C-reactive protein levels in diagnosis of acute appendicitis was recorded which shows 104(77.04%) were true positive, 5(3.70%) were false positive, 8(5.93%) were true negative and 18(13.33%) were false negative. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy rate was computed as 92.86%, 78.26%, 94.39%, 69.23% and 90.37% respectively.

In another study<sup>11</sup> these values were 93.42%, 79.17%, 93.42%, 79.17% and 59%, the only difference with our results was increased diagnostic accuracy. These are similar to our results.

Our results are contrary with another study<sup>12</sup> showing these findings as 75%, 72%, 90%, 46% and 75.5% respectively.

Although Shakhatareh<sup>13</sup> considered CRP measurement to be helpful in making diagnosis of acute appendicitis, however it cannot be used to replace the clinical judgement of a surgeon. WBC and neutrophil count were found to be better diagnostic aids in a prospective study of 420 patients with suspected diagnosis of acute

appendicitis<sup>14</sup>. A normal CRP in paediatric population was not found to rule out acute appendicitis<sup>15</sup>. Shefki Xharra<sup>16</sup> noted that with regards to age and gender, there was no significant difference regarding CRP values.

On the basis of a retrospective study the sensitivity of CRP in diagnosis of acute appendicitis has been documented to be greater than 90%.<sup>17</sup> In patients having normal levels of CRP and white blood cell count, postponement of surgery led to a 8% reduction of the negative appendectomy.<sup>18</sup>

## CONCLUSION

We concluded that raised C-reactive protein levels are an accurate predictor for the diagnosis of appendicitis and these findings help us to suggest it as an alternative diagnostic technique for acute appendicitis.

## REFERENCES

1. Shah SWA, Khan CA, Malik SA. Modified Alvarado score; accuracy in diagnosis of acute appendicitis. Prof Med J 2010;17:546-50.
2. Kanumba ES, Mabula JB, Rambau P. Modified Alvarado Scoring System as a diagnostic tool for Acute Appendicitis at Bugando Medical Centre, Mwanza, Tanzania. BMC Surgery 2011;11:4.
3. Ohene-Yeboah M, Toqbe B. An audit of acute appendicitis and appendectomy in Kurnasi, Ghana. West Afr J Med 2007;25:138-43.
4. Parks NA, Schroepel TJ. Update on Imaging for Acute Appendicitis. Surg Clin North Am 2011;91:141-54.
5. Sengupta A, Bax G, Paterson-Brown S. White cell count and C-reactive protein measurement in patients with possible appendicitis. Ann R Coll Surg Engl. 2008;19:344.
6. Ahmad QA, Muneera MJ, Rasool MI. Predictive value of TLC and CRP in the diagnosis of acute appendicitis. Ann 2010;16:116-9.

7. Gurleyik E, Gurleyik G, Unalmişer S. Accuracy of serum C-reactive protein measurements in diagnosis of acute appendicitis compared with surgeon's clinical impression. *Dis Colon Rectum* 1995, 38(12):1270-4
8. Mohammed AA, Dagman NA, Aboud SM, Oshibi HO: The diagnostic value of C-reactive protein, white blood cell count and neutrophil percentage in childhood appendicitis. *Saudi Med J* 2004;25(9):1212-5.
9. Asfar S, Safar H, Khoursheed M, Dashti H, Al-bader A. Would measurement of C-reactive protein reduce the rate of negative exploration for acute appendicitis? *J R Coll Surg Edinb* 2000;45:21-4
10. Öztürk ZA, Köklü S, Erol MF, Yılmaz FM, Baar Ö, Yüksel O, Yılmaz G, Ksack Yüksel B: Serum adenosine deaminase levels in diagnosis of acute appendicitis. *Emerg Med J* 2008;25:583-5.
11. Kamal D, Akhtar A, Siraj A, Shukr I, Shah SHA. Accuracy of Total Leukocyte Count and C – Reactive Protein in the Diagnosis of Acute Appendicitis. *Journal of Rawalpindi Medical College (JRMC)*;2010;14(2):75-7.
12. Siddique K, Baruah P, Bhandari S, Mirza S, Harinath G. Diagnostic accuracy of white cell count and C-reactive protein for assessing the severity of paediatric appendicitis. *JRSM* 2011;2:1-6.
13. Shakhathreh HS. The accuracy of C-reactive protein in the diagnosis of acute appendicitis compared with that of clinical diagnosis. *Med Arh* 2000, 54(2):109-110.
14. Andersson RE, Hugander A, Ravn H, Offenbartl K, Ghazi SH. Repeated clinical and laboratory examinations in patients with an equivocal diagnosis of appendicitis. *World J Surg* 2000;24:479-85
15. Grönroos JM. Do normal leukocyte count and C-reactive protein value exclude acute in children? *Acta Paediatr* 2001;90(6):649-5
16. Xharra S, Gashi-Luci L, Xharra K, Veselaj F, Bicaj B, Sada F. Correlation of serum C-reactive protein, white blood count and neutrophil percentage with histopathology findings in acute appendicitis. *World Journal of Emergency Surgery* 2012;7:27.
17. Paajanen H, Mansikka A, Laato M, Kettunen J, Kostiaainen S. Are serum inflammatory markers age dependent in acute appendicitis? *J Am Coll Surg* 1997, 184:303-308.
18. Eriksson S, Granstrom L, Bark S. Laboratory tests in patients with suspected acute appendicitis. *Acta Chir Scand* 1989, 155:117-120.