

The Role of C-Reactive Protein, Granulocyte Colony Stimulating Factor and Total Antioxidant Capacity in Diagnosis of Acute Appendicitis

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Abstract

Background and Aim: Despite the fact that acute appendicitis is the most common surgical emergency all around the world, its diagnosis is still based on clinical evaluation and accuracy of the diagnosis depending on experience. The aim of this study is to evaluate the role of inflammatory markers in diagnosis of acute appendicitis. **Material and Method:** The study includes 77 cases with histopathologically proven acute appendicitis and 17 control cases. Blood samples were obtained from all cases and C-reactive protein (CRP), Granulocyte Colony Stimulating Factor (G-CSF) and Total Antioxidant Capacity (TAC) were measured. **Findings:** In cases with acute appendicitis, CRP and G-CSF levels were found to be related to acute appendicitis; however, TAC was not affected by the disease process. Moreover, CRP and G-CSF levels were correlated with the disease severity. **Conclusion:** Both CRP and G-CSF can be used in diagnosis of acute appendicitis. Furthermore, increased CRP level can be a marker to show advanced cases. However, G-CSF is not an effective marker to show disease severity.

Keywords

Acute Appendicitis, C-Reactive Protein, Granulocyte Colony Stimulating Factor, Total Anti-Oxidant Capacity

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1. Introduction

Despite the fact that acute appendicitis (AA) is the most common surgical emergency all around the world, its diagnosis is still based on clinical evaluation and accuracy of the diagnosis depending on experience [1]-[4].

In AA, with the initiation of symptoms, serum inflammatory markers begin to appear in blood stream within hours [5].

C-reactive protein (CRP) as a nonspecific indicator of inflammation is shown to be an indicator of acute appendicitis and reported to be a reliable indicator of severity of AA [6] [7]. Besides mobilizing neutrophils from bone marrow, Granulocyte colony stimulating factor (G-CSF) is known to have inflammatory effects.

Increased G-CSF levels are shown in inflammatory disorders [8]. There is little data about the use of G-CSF in diagnosis of AA [9]. In a study, it is found to be useful in staging of AA [10].

The role of free oxygen radicals in inflammatory status is well known. Plasma total antioxidant status (TAS) is an indicator of anti-oxidant defense status and a well-established marker of oxidative stress [11].

The aim of this study is to evaluate the role of inflammatory markers (CRP, G-CSF and TAS) in diagnosis of AA.

2. Material and Method

After approval from University Ethical Committee, the study was conducted in between January 2013 and January 2014. In this period serum samples of the patients with diagnosis of acute appendicitis were collected. For the control group, blood samples were taken from healthy volunteers who did not have any inflammatory disorder. An informed consent was obtained from all the cases. All serum samples were stored at -80 Celsius.

After the operation all specimens were histopathologically examined and only the cases with histopathologically proved diagnosis of acute appendicitis were included in the study group.

From the blood samples CRP, G-CSF and AC were measured.

Statistical Analysis

Statistical analysis was performed by IBM SPSS Statistics version 20. Data were presented as mean \pm standard deviation. Chi square and Student T tests were used and statistical significance was accepted as 0.05.

3. Results

There were 94 patients included in the study. The mean age of the patients was 30.6 ± 12.9 . There were 77 cases in study group (60 cases with simple appendicitis and 11 cases with perforated appendicitis) and 17 cases in control group.

Mean CRP level was significantly higher in appendicitis group (0.53 for controls and 36.12 in study group) ($p < 0.001$). Moreover, mean CRP level was significantly higher in perforated cases compared to simple appendicitis (57.68 vs. 33, respectively) ($p < 0.001$). According to the ROC curve the optimal CRP value for discrimination of perforated appendicitis from uncomplicated appendicitis was found to be 15.3 with a sensitivity of 63.6% and specificity of 43.4% (AUC: 0.572, $p < 0.001$).

Mean G-CSF levels were also higher in appendicitis group than controls (1.11 vs. 0.26, respectively) ($p < 0.05$). According to the ROC curve the optimal G-CSF value for acute appendicitis was found to be 0.4 with a sensitivity of 71.4% and specificity of 76.5% (AUC: 0.837, $p < 0.001$).

In terms of TAC there was no significant difference between any groups. Mean CRP, G-CSF and TAS levels were presented in **Table 1** and **Table 2**.

4. Discussion

Although AA is the most common emergency surgical condition the accuracy of clinical diagnosis is still between 71% - 97% [4]. This report reveals that serum CRP and G-CSF levels are increased in AA and this increase is more relevant in perforated cases. However, serum TAS has no difference between AA and control patients.

The increase in CRP levels in AA cases has shown in several studies. Xharra *et al.*, in a prospective study, reported increased CRP levels in AA [12]. Moreover, they reported a positive correlation between CRP levels

Table 1. CRP, G-CSF and TAS levels compared to control group.

	Group	N	Mean	Std. Deviation	<i>p</i> *
CRP level	Control	17	0.5394	0.33756	
	Appendicitis**	77	36.1212	41.42172	<0.001***
	Perforated appendicitis	11	57.6836	60.92200	<0.001***
G-CSF level	Control	17	0.2653	0.24295	
	Appendicitis**	77	1.1158	1.74546	<0.05***
	Perforated appendicitis	11	1.3218	0.96389	<0.001***
Total antioxidant status	Control	17	0.2194	0.03172	
	Appendicitis**	77	0.2387	0.04293	0.05***
	Perforated appendicitis	11	0.2327	0.03717	>0.05***

*Student T test; ** Appendicitis indicates all cases with simple and perforated cases; *** Values are compared to control group. CRP: C-reactive protein, G-CSF: Granulocyte colony stimulating factor, TAS: total antioxidant capacity.

Table 2. Comparison of CRP, G-CSF and TAS levels in Simple appendicitis and perforated cases.

	Group	N	Mean	Std. Deviation	<i>P</i> *
CRP level	Simple Appendicitis	60	33.0035	37.82235	
	Perforated appendicitis	11	57.6836	60.92200	<0.05
G-CSF level	Simple Appendicitis	60	1.0777	1.93318	
	Perforated appendicitis	11	1.3218	0.96389	>0.05
Total antioxidant status	Simple Appendicitis	60	0.2375	0.04359	
	Perforated appendicitis	11	0.2327	0.03717	>0.05

*Student T test. CRP: C-reactive protein, G-CSF: Granulocyte colony stimulating factor, TAS: Total antioxidant capacity.

and AA severity. Furthermore, Erkasap *et al.* reported sensitivity and specificity of CRP as 96% and 78%, respectively and positive predictive value as 100% [13]. However, according to Shakhathreh *et al.* CRP is not superior to white blood cell count in diagnosis of AA [14]. In our study CRP levels are found to be elevated in AA, moreover, it correlates with severity of the disease.

Granulocyte colony stimulating factor is produced in inflammatory site and transported to bone marrow to stimulate granulocyte synthesis [15]. There are little and controversial data about the use of G-CSF in AA diagnosis. Dalal *et al.* reported that there is not any significant increase in levels of G-CSF in AA [9]. In contrast, Allister *et al.* found that when compared to normal population, in AA G-CSF levels increase significantly [10]. Moreover, they concluded that, G-CSF can be useful adjunctive test in diagnosis and staging of AA. Similarly in our study G-CSF levels are found to increase in AA. However, there is no significant difference in perforated cases, compared to simple AA.

Total anti-oxidant status is a well known marker of oxidative stress. There are several clinical and experimental studies showing the role of reactive oxygen species in acute inflammation [16]-[18]. Furthermore, these studies reported that the activity of those reactive oxygen species is correlated with the severity of AA. However, in a prospective study, Özdoğan *et al.* concluded that, TAS is decreased advanced AA cases; however, it cannot be used in diagnosis of acute appendicitis. In our study, there is no significant correlation between AA and TAS. TAS level was similar in both AA and control groups.

5. Conclusion

Both CRP and G-CSF can be used in diagnosis of acute appendicitis. Furthermore, increased CRP level can be a marker to show advanced cases. However, G-CSF is not an effective marker to show disease severity. TAC is useless both in diagnosis and estimating the progression of acute appendicitis.

Conflict of Interest

Author BS, Author AO, Author SA, Author NA and Author RD declare that they have no conflict of interest.

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