



RESEARCH ARTICLE

COMPARISON OF C- REACTIVE PROTEIN, ERYTHROCYTE SEDIMENTATION RATE, AND
LEUKOCYTE COUNT AS INFLAMMATORY MARKERS

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ARTICLE INFO

Article History:

Received 15th April, 2014
Received in revised form
06th May, 2014
Accepted 10th June, 2014
Published online 20th July, 2014

Key words:

C-reactive protein;
Erythrocyte sedimentation rate;
Leukocyte count;
Inflammation.

ABSTRACT

Background: Erythrocyte sedimentation rate, C-reactive protein, and leukocyte count are commonly used inflammatory markers. It is debatable whether each of these tests can be used individually or always these tests should be used in together.

Objective: This study aimed to compare C-reactive protein, erythrocyte sedimentation rate and leukocyte count as inflammatory markers.

Materials and Methods: This is an analytical comparative study; included 50 patients with different inflammatory disorders. Three blood samples were collected from each patient. Erythrocyte sedimentation rate was measured by Erythrocyte sedimentation rate fast detector, C-reactive protein was measured by immunofluorescent assay, and total and differential leukocyte counts were performed by automated haematology analyzer.

Results: All patients were found to have high C-reactive protein and high erythrocyte sedimentation rate; while 19(38%) were had leukocytosis, 25(50%) had normal leukocyte count, and 6(12%) had low leukocyte count. The correlation analysis showed a significant positive correlation between the C-reactive protein and each of total leukocyte count, absolute neutrophil count, absolute monocyte count, and absolute eosinophil count.

Conclusion: As inflammatory markers, C-reactive protein and erythrocyte sedimentation rate can be used as interchangeably, while leukocyte count, when used, should be accompanied with either C-reactive protein or erythrocyte sedimentation rate.

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INTRODUCTION

Inflammation is part of a complex biological response of vascular tissues to harmful stimuli, such as pathogens, damaged cells, or irritants (Ferrero-Miliani *et al.*, 2007). C-reactive protein (CRP) is known as acute phase protein, which reflects a measure of the acute-phase response. The term “acute phase” refers to local and systemic events that accompany inflammation. The clinical use of acute phase proteins is as an aid to diagnosis. Because the acute phase response is relatively non-specific, the value of measuring acute-phase protein concentrations is to assess the extent of inflammation reflecting momentary disease activity (Leeuwen, 1994). Erythrocyte sedimentation rate (ESR) is an indirect measure of the acute phase reaction. Its value lies in the fact that it is a simple and inexpensive laboratory test for assessing inflammation. It has even been used for the prognosis of non-inflammatory conditions, such as prostate cancer, coronary artery disease, and stroke (Ng, 1998). White blood cell (WBC) count measures the total amount of WBCs in a specified amount of

blood, while a differential count measures specific WBCs as a percentage of the total WBC count, and allows for more specific diagnosis. The absolute count is the product of a mathematical calculation done in the laboratory, and is done as a further diagnostic tool. Total and differential WBC counts are always done as part of a complete blood count (CBC), which gives the doctor a lot of information concerning general health, and is used to help diagnose illness, and to monitor how well you are responding to treatment. Furthermore, it is used as an inflammatory marker (Pagana and Pagana, 2009; Jafari, *et al.*, 2012). Recent studies tend to favor CRP over ESR, mainly because of the fact that, ESR is affected by a multitude of factors (Ng, 1998; Jafari, *et al.*, 2012). In this context, we conducted this study to compare CRP, ESR, and total and differential leukocyte counts as inflammatory markers to verify if each of these tests can be used individually or they should be used together.

MATERIALS AND METHODS

This study is an analytical comparative study, conducted in the period from June to October 2013 at Asia hospital and Military hospital, Omdurman, Sudan. A total of 50 patients with inflammatory disorders were enrolled in this study. After

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informed consent, three blood samples were collected from each patient, one in ethylene diamine tetra acetic acid (EDTA) for total and differential leukocyte counts, one in trisodium citrate for ESR, and one in plain container for measurement of CRP. ESR was measured by ESR fast detector, CRP was measured by immunofluorescent assay using i-Chroma kit and reader (SYCOMed, GERMANY), and total and differential leukocyte counts were measured by automated haematology analyzer (SYSMEX Xt-2000i, JAPAN). Data of this study was analyzed by statistical package for social sciences (SPSS), version 20. Quantitative variables were expressed as mean \pm SD, and correlation between quantitative variables was tested by Pearson correlation.

RESULTS

This study conducted to compare CRP, ESR, and total and differential leukocyte counts as inflammatory markers. It included 50 patients with different inflammatory disorders. All patients were found to have high CRP and also high ESR; while 19(38%) were had leucocytosis, 25(50%) had normal leukocyte count, and 6(12%) had low leukocyte count. The result of the absolute leukocyte counts showed that, 18(36%) of the patients had neutrophilia, 7(14%) had lymphocytosis, 2(4%) had monocytosis and 1(2%) had eosinophilia (Table 1). The correlation analysis showed that, there was a significant positive correlation between the CRP and each of T.WBCs count, absolute neutrophil count, absolute monocyte count, and absolute eosinophil count. No statistically significant correlation was found between CRP and each of absolute lymphocyte count, absolute basophil count and ESR (Table 2).

Table 1. Results of inflammatory markers

Parameter	Minimum	Maximum	Mean	SD
C-reactive protein (mg/l)	11	293	49.05	63.7
Erythrocyte Sedimentation Rate (mm/hr)	24.00	135.00	72.7	31.05
Total White Blood Cell (X 10 ³ /μl)	3.30	25.3	9.41	5.14
Neutrophil (X 10 ³ /μl)	1.70	24.2	6.7	4.95
Lymphocyte (X 10 ³ /μl)	0.50	4.6	2.03	0.91
Monocyte (X 10 ³ /μl)	0.00	2.5	0.39	0.42
Eosinophil (X 10 ³ /μl)	0.00	0.60	0.15	0.13
Basophil (X 10 ³ /μl)	0.00	0.10	0.0020	0.014

Table 2. Correlation between C-reactive protein and other inflammatory markers

Parameter	No.	Pearson Correlation	P.value
ESR (mm/hr)	50	0.238	0.097
T. WBCs count (X 10 ³ /μl)	50	0.301	0.034
Absolute Neutrophil count (X 10 ³ /μl)	50	0.309	0.029
Absolute Lymphocyte count (X 10 ³ /μl)	50	-0.228	0.111
Absolute Monocyte count (X 10 ³ /μl)	50	0.443	0.001
Absolute Eosinophil count (X 10 ³ /μl)	50	0.415	0.003
Absolute Basophil count (X 10 ³ /μl)	50	0.120	0.407

DISCUSSION

CRP, ESR, and leukocyte count are common laboratory measurements as inflammatory markers (Leeuwen, 1994; Ng 1998; Madjid *et al.*, 2004). This study aimed to verify whether each of these inflammatory markers can be used individually or

always should be used together. The results of both CRP and ESR were identical; that, all patients with high CRP were also had high ESR. On the other hand, 19(38%) of patients were found to have leucocytosis, 25(50%) had normal leukocyte count, and 6(12%) had leucopenia. The results of absolute leukocyte counts showed that, 18(36%) of the patients had neutrophilia, 7(14%) had lymphocytosis, 2(4%) had monocytosis and 1(2%) had eosinophilia. These findings revealed that, ESR but not leukocyte count has the same sensitivity as CRP which is considered as a powerful marker and superior test in the diagnostic evaluation for some inflammatory conditions (Bircan, 2006; Reitzenstein, 2010). This finding is supported by that reported by Costenbader *et al.*, that CRP and ESR are used for the diagnosis and monitoring of a variety of conditions, in particular rheumatic diseases and infections, and often they are viewed as interchangeable (Costenbader, 2007). Our finding is inconsistent with that of Jafari *et al.*, who compared these markers in infected and non-infected diabetic foot and concluded that, ESR was introduced as the best independent predicting marker for distinguishing infection because of its higher sensitivity and specificity (Jafari *et al.*, 2012), inconsistency may be because of the difference in study population as they only focused on diabetic foot infections. The correlation analysis showed that, there was statistical significant positive correlation between CRP and each of T/WBC, absolute Neutrophil count, absolute Monocyte count and absolute Eosinophil count. This finding with the finding that not always increased leukocyte count is accompanied with increased CRP suggesting that, leukocyte count should not be used individually but in combination with either ESR or CRP. This is consistent with the study done by Xharra *et al.*, who reported that, the combination of the CRP, the WBC and the Neutrophil percentage has greater diagnostic accuracy (Xharra *et al.*, 2012).

Conclusion

In conclusion, as inflammatory markers, CRP and ESR -but not leukocyte counts- have the same sensitivity.

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