

RESEARCH ARTICLE

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# Post-operative C-reactive protein and white blood cells changes pattern following spinal deformity surgery and its clinical correlation

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## Abstract

**Objective** Following the changing pattern of post-operative CRP and WBC counts and compare them to the patient's clinical condition to find which one is better for early detection of early infection.

**Methods** A total of 50 patients who underwent spinal deformity correction surgery without clinical signs of infection such as fever, wound redness, or discharge were enrolled in this prospective study. The C-reactive protein (CRP) and white blood cell (WBC) counts were measured the 2nd and 7th post-operative days. We try to detect the type of correlation between both CRP and WBCs level and clinical condition of patient regarding wound local condition.

**Results** All cases showed high CRP by the 2nd day post-operative which decreased significantly but not reaching normal levels even by the 7th day. All cases showed elevated WBCs count by the 2nd day which decreased to normal levels by the 3rd day in 86% of patients, and by the 7th day, 94% of cases showed normal levels. In addition, WBCs in the 2nd day post-operative significantly positive correlated with fusion level and operative time. There was no significant correlation between WBCs and blood transfusion or age. No significant correlation between CRP and number of fusion levels, blood transfusion nor operative time.

**Conclusion** WBCs count returned earlier to normal levels than CRP in our cases, so monitoring early changes in the 1st week in WBCs count pattern is more indicative of an ongoing infectious process.

## Study design

Prospective study.

## Introduction

Post-operative infection is a fearful complication that faces any spine deformity surgeon. The incidence of surgical site infection (SSI) following spinal surgery differs significantly according to the type of surgery, duration, and its complexity. Multiple factors may pose increased risk of developing SSI including diabetes, revision

surgery, high body mass index, and associated syndromes as neurofibromatosis [1].

Patients with post-operative infections usually develop specific symptoms such as swelling, skin inflammation, exaggerated pain, and occasionally fever. Additionally, any inflammatory process is associated with a surge in the production of the acute-phase reactants, namely, C-reactive protein (CRP) increasing its serum levels [2]. The CRP was first described by Tillet and Francis in pneumonia [3] and with time and continuous research has been established as a reliable parameter in detecting and monitoring different types of infections [4].

White blood cells (WBC) count is not consistently elevated in infection, especially in chronic cases. Thus, it poses little importance in following up infection. On the other hand, it is often elevated in acute infections [5].

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Medical imaging does not attain a high positive predictive value in the evaluation of post-operative infection. Consequently, laboratory investigations are more valuable, especially, CRP and WBC, as they have been studied extensively [1].

The purpose of this study is to determine the normal changing pattern of CRP and WBC in the post-operative period in spinal deformity corrective surgery in the absence of infection to serve as a benchmark in detecting early post-operative SSI. Additionally, evaluating the effect of different variables such as blood transfusion, length of surgery, and fusion levels on the pattern of change in the CRP and WBC to help differentiate between normal pattern and SSI.

**Patients and methods**

This is a prospective study done at a single spine center. The first 50 patients who were indicated for spinal deformity surgery and fit our inclusion criteria were included in the study after obtaining informed consent.

The inclusion criteria were patients who had a spinal deformity (adolescent idiopathic scoliosis, neuromuscular scoliosis, congenital scoliosis, and Sherman kyphosis) needing surgical correction and otherwise health individuals.

The exclusion criteria were presence of an autoimmune disease, chronic infection, cancer, use of immunosuppressive drugs, chronic illnesses, or history of surgery in the past 3 months.

Our aim was to illustrate the normal pattern of WBC and CRP changes in the 2nd and 7th post-operative days and to detect their relations with blood transfusion, age, fusion levels, and operative time.

All patients were administered—as per hospital protocol—Cefepime (after a sensitivity test) half an hour before surgical incision which was repeated every 4-h intra-operative in lengthy procedures followed by two consecutive doses every 12 h post-operatively.

The data were collected through history taking, clinical examination, and laboratory investigation. The data were entered into Microsoft Excel software then imported into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. The following tests were used to test differences for significance. Differences between quantitative paired by paired t, correlation by Pearson’s correlation or Spearman’s. *P* value was set at <0.05 for significant results and <0.001 for high significant result.

**Results**

Fifty patients were included in our study. The mean age of our study group was 16 years (range 5–36), sex distribution was 33 females and 17 males. All patients did

not have any clinical, radiological nor laboratory signs of infection up to 1-year follow-up.

The distribution of diagnosis is outlined in Table 1. The mean operative time was 4 h 45 min (range 3–10). The mean number of fusion levels was 13 (range 7–16). As for blood transfusion, 26 cases received intra-operative blood transfusion, and 23 cases received post-operative blood transfusion.

**Overall changes in WBCs count and CRP levels**

WBCs count and CRP levels were measured according to this routine: WBCs at the 1st, 2nd, 3rd, and 7th day post-operative while CRP levels at the 2nd, and 7th day post-operative.

Our findings demonstrated that by the 3rd day post-operative, 86% of cases showed normal WBCs count while by the 7th day post-operative, 94% of cases showed normal WBCs count. All cases showed high CRP by the 2nd day which decreased significantly but not reaching normal levels even by the 7th day post-operative.

**Changes in WBCs and CRP levels in relation to different variables**

WBCs in the 2nd post-operative day showed significant positive correlation with the number of fusion levels. Additionally, there was a positive correlation between the operative time and WBCs in the 7th post-operative day. There was no significant correlation between WBCs, blood transfusion, and age of the patients. No correlation was detected between CRP, number of fusion levels, blood transfusion, or operative time.

**Discussion**

Post-operative infection is a feared complication especially in spine deformity surgery; hence, early detection is of paramount importance. Post-operative infections could manifest itself with different symptoms including

**Table 1** Diagnosis distribution

Diagnosis	
Adult scoliosis	4
Adolescent idiopathic scoliosis	18
Congenital scoliosis	7
Idiopathic early-onset scoliosis	7
Marfan syndrome	2
Neurofibromatosis	3
Neuromuscular scoliosis	2
Syndromic early-onset scoliosis	1
Sherman kyphosis	6
Total	50



evaluating the treatment modality rather than diagnosing the infection itself.

Additionally, several studies have documented the sensitivity of serial CRP levels in monitoring SSI following fracture fixation [4, 15, 16] as well as in lumbar spine surgery [17] but none of them have correlated the CRP and WBCs count in patients without infections.

Apart from the different limitations of any retrospective study, the main limitations were the small sample group, heterogenous patients underlying pathology, and wide age range. However, we believe that it serves as an additional piece of information that could help the early detection of a catastrophic complication as SSI in spinal deformity surgery.

## Conclusion

In spinal deformity surgery, WBCs count return to normal levels earlier than CRP. So, monitoring changes in WBCs pattern is more reliable than CRP in the early post-operative period as an indicator for possible infectious process.

## Abbreviations

SSI	Surgical site infection
CRP	C-reactive protein
WBC	White blood cells
POD	Post-operative day

## Author contributions

Both authors collected the data, collaborated to write the manuscript, the senior author is submitting the manuscript.

## Funding

Open access funding provided by The Science, Technology & Innovation Funding Authority (STDF) in cooperation with The Egyptian Knowledge Bank (EKB). This study did not receive any funding.

## Availability of data and materials

All data used in this manuscript are available with the corresponding author and can be presented upon request.

## Declarations

### Ethical approval and consent to participate

This study has gained the approval of the Ethical committee and the Institutional Review Board (IRB) of the faculty of medicine in Zagazig University no. #10109/13-11-2022.

### Competing interests

The authors declare no competing interests.

Received: 30 July 2023 Accepted: 14 October 2023

Published online: 24 October 2023

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Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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