ESR and CRP Levels Can be Effective in Identifying and Predicting Infectious Complications after Spine Surgery

Mirbahador Athari[1], Said Safaei[2], Khalil komlakh[3*]

[1]Shahid Beheshti University of Medical Sciences, Imam Hossain Medical Center, Department of Spine Surgery, Shahid Madani Street, Tehran, Iran.

[2]Department of Spine Surgery, Milad General Hospital, Tehran, Iran.

[3*]Department of Neurosurgery, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran. E-mail: Khalilkomlakh@sbmu.ac.ir

Abstract

Introduction: Inflammatory factors play an effective role in complications after surgery. C-Reactive Protein and Erythrocyte Sedimentation Rate are two important indicators related to inflammation presence in body. Present study was conducted with the aim of investigating predictive power of ESR and CRP in identifying inflammation after spine surgery.

Materials and methods: This cross-sectional descriptive study was conducted on 80 patients undergoing spine surgery. Patients were divided into two groups with complications and without complications. They were examined in terms of ESR and CRP biochemical indicators during 50 postoperative days on 6 occasions. The relationship of these factors with complications occurrence after surgery was evaluated with the help of SPSS statistical software.

Findings: Out of 80 patients, 13 had infectious complications. The average CRP for people who had complications was equal to 52.6 and for patients without complications was 31.9. With the passage of time, CRP increased in group with complications of infection from the fourteenth postoperative day, while in group without complications, the level of CRP decreased. These changes were statistically significant ($P<0.05$). The average ESR for patients with complications was 31.4 and for patients without complications was 37.5. The ESR level of patients with complications was higher than that of patients without complications, but it was not significant ($P>0.05$).

Conclusion: Checking CRP level can be effective in predicting Infectious Complication after spine surgery. Studies with a longer follow-up period can be effective in providing more accurate results.

Keywords: Predictive Power, Diagnosis, ESR, CRP, Spine Surgery, Complications.

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Introduction

One of the problems of patients undergoing surgery is postoperative complications and the possibility of infection and prolonged recovery period, which can be dangerous in many cases [1]. C-Reactive Protein and Erythrocyte Sedimentation Rate are two important indicators of inflammation in body, and these factors have reported signs of infection after surgery [2, 3].

CRP is a protein produced by liver in response to inflammation and tissue damage. During inflammation, macrophages release certain factors into blood that lead to CRP production. CRP levels increase dramatically in chronic infections [3, 4].

Acute inflammation or infection in blood, in addition to affecting CRP levels, increases the sedimentation rate of red blood cells and, as a result, increases ESR. CRP has been shown to be more reliable than ESR for monitoring infection treatment effectiveness. But ESR can also predict the presence of infection, and in any case, it is important to know more about this issue [5, 6]. The level of CRP is stable for a person and has a specific normal range. Therefore, its measurement is effective in diagnosing drugs effect and most pathologies [7, 8]. ESR level changes after surgery and the role of this variable in spinal inflammation have also been reported in many studies [9, 10].

Contradictory findings have been made regarding the level of CRP and ESR in spine surgery [10-12]. Some studies have described these indicators as less effective and some as more effective, and the exact level of CRP has not been determined as an indicator of infection in spine surgery [13, 14]. Our hypothesis is that the normal kinematics of ESR/CRP in spine surgery and comparing their usefulness predicts infection in postoperative spine surgery. According to mentioned cases, our study was conducted with the aim of investigating the predictive power of ESR and CRP in identifying inflammation after spine surgery.

Materials and Methods

Study design

This cross-sectional descriptive study was conducted on 80 patients undergoing spine surgery during 2021. Eligible patients were examined according to inclusion criteria in terms of demographic factors and blood factors. Ethical matters related to patients, including consent to participate in study, confidentiality of patients' secrets, explanation of study method and its safety were explained to patients before study

start.

Exclusion and inclusion criteria

All people with consecutive spinal surgeries, aged 15 to 70 years, were included in study with personal consent. Exclusion criteria included pre-op infection, suffering from liver diseases, malignancy, inflammatory diseases and cardiovascular attacks (heart attack and deep vein thrombosis) and people who had revision surgery were excluded from study.

Data collection

After ethical issues approval by hospital officials, available patients who underwent spine surgery were included in study after signing the consent form, and their number was 83 according to exclusion and inclusion criteria during one year. Patients sampling was done on days before, 1, 7, 14, 30 and 50 after operation; whereby 5 cc of venous blood was sent to laboratory after 8 hours of fasting to determine the level of CRP and ESR. All patients were told that this procedure has no consequences and does not impose any costs on the patient.

Venous blood samples were collected in test tubes containing clot activator, immediately stored on ice, and—one hour after collection—centrifuged at 3800 rpm for 8 minutes. Plasma were separated and stored at −70°C through the hour to be analyzed. ESR = < 20 mmhg /h, CRP = negative < 6.2 mg / L, CRP + = 6 – 12 mg / L, CRP ++ = 16 – 18 mg / L, CRP +++ = > 20 mg / L as Normal sizes were considered.

Biochemical parameters effective in inflammation were investigated with the help of Bio-Rad kit. Also, CRP and ESR *parameters* were measured using a kit from Bio-Rad (Bio-Rad Laboratories, Munich, Germany) essentially as described by the manufacturer. Cases of pollution and unusual cases were also reported in the previously prepared checklist. Eventually, Demographic data of patients and laboratory results were recorded in a pre-designed information form and finally entered for statistical analysis.

Statistical analysis

Data were analyzed using descriptive statistics (mean), independent t-test and chi-square. *SPSS V.25* was used applied for statistical analysis. Statistical significance was assessed at the 5% level.

RESULTS

3 people were excluded from study due to their unwillingness to do study at the beginning of research. 80 patients were examined in two groups with 67 complications and 13 in group without infectious complications. The average age of examined patients was 38.72±6.44. 53 were men and 27 were women. 11 people used alcohol and 8 people used drugs. The demographic and general information of patients after surgery can be seen in Table 1. There was no significant difference between two groups.

Table 1. Demographic and General data

Parameters		Patients with complications (n=13) (Mean ± SD)	patients without complications (n=67) (Mean ± SD)	p-value
Age (year)		37.13 ±5.6	38.86 ±6.4	0.57
Weight(kg)		77.20 ± 11.9	73.04 ±14.2	0.23
Body mass index		26.12 ± 3.8	26.93 ± 3.4	0.34
surgery time(h)		7.49 ± 1.4	7.34 ± 1.6	0.29
blood loss(cc)		1157.9± 38.7	1189.5± 46.3	0.43
Systolic blood pressure (mmHg)		125.66 ± 16.4	122.66 ± 22.8	0.15
Diastolic blood pressure (mmHg)		83.33 ± 2.8	79.66 ± 3.1	0.18
		%	%	
Gender	**Males**	51.3	56.1	0.09
	Females	48.7	43.9	
Surgical Procedure	**lumbar**	47.0	43.3	
	cervical	32.0	34.0	0.26
	thoracic	21.0	23.7	
alcohol consumption	**yes**	15.8	20.1	0.11
	no	84.2	79.9	
drug use	**yes**	9.6	8.4	0.25
	no	90.4	91.6	

Biochemical factors effective in inflammation such as platelets, antioxidant capacity, and liver enzymes effective in inflammation were investigated in patients. According to Table 2, findings show that during follow-up period, levels of some biochemical factors were not significantly different in two investigated groups (P>0.05). Of course, TAC, which is one of the indicators that determines the presence of oxidants in the body, was reduced on 14th and 30th days in group with complications, but it was not statistically significantly different from group without complications.

Table 2. Plasma concentrations of biochemical variables

Variables	Day operation	Patients with complications (Mean ± SD)	patients without complications (Mean ± SD)	p-value
Platelet (µg /ml)	**Before**	164.3 ± 49.5	168.6 ±41.6	0.14
	1	192.8 ± 39.7	184.7 ±79.8	0.13
	7	191.6 ±72.4	183.9 ±79.9	0.28
	14	193.1 ±43.2	187.3 ±46.2	0.24
	30	195.8 ±48.7	183.8 ±81.8	0.62
	50	193.3 ±41.2	183.9 ±74.1	0.18
	all	192.6 ±58.7	184.1 ±72.4	0.12
TAC (µm/L)	**Before**	439.5±67.2	433.6±60.8	0.35
	1	404.3±43.9	401.2±69.5	0.22
	7	403.4±67.8.	402.3±71.6	0.37
	14	398.9±71.5	411.3±70.4	0.09
	30	401.5±73.7	413.3±58.9	0.07
	50	411.8±64.6	419.8±63.5	0.08
	all	409.5±62.5	419.8±67.9	0.06
AST (IU/L)	**Before**	20.5±4.2	19.8± 4.9	0.21
	1	23.9±4.7	22.8± 5.2	0.14
	7	23.3±4.8	21.9± 5.2	0.29
	14	23.5±4.1	21.5± 4.8	0.32
	30	23.6±3.2	22.2± 4.6	0.54
	50	22.7±3.5	21.8± 5.1	0.18
	all	22.9±3.9	22.4± 5.2	0.25
ALT (IU/L)	**Before**	12.2±4.7	11.9±3.8	0.42
	1	14.3±5.0	13.5±3.9	0.12
	7	14.6±4.7	12.9±3.5	0.11
	14	13.8±4.8	12.9±3.7	0.39
	30	14.1±5.2	13.2±3.4	0.20
	50	13.9±5.4	13.4±3.1	0.63
	all	14.3±5.1	13.2±3.5	0.14

TAC =Total antioxidant capacity. ALT = alanine aminotransferase. AST = aspartate aminotransferase

Examining the relationship between ESR level and Infectious Complications in examined patients showed that the amount of ESR changes during 5 times did not have significant changes in two groups (Table 3). Although ESR level in patients with complications showed a numerical difference over time compared to patients without complications; due to being close to significant level of 5 percent, this difference was not significant ($P>0.05$).

CRP changes in the two investigated groups showed a significant difference. So that with the passage of time, CRP in the group with complications of infection increased from the 14th day onwards, and in the group without complications, on the contrary, the level of CRP decreased with the passage of time, and these changes were statistically significant in both groups ($P<0.05$).

In general, according to Table 3, Patients who had post op infection were found to have a significantly higher pre op CRP than patients who didn't have infection. No significant relationships were detected for ESR.

Table 3. Comparisons of serum ESR and CRP according to cognitive status

Variables	Day operation	Patients with complications (Mean ± SD)	patients without complications (Mean ± SD)	p-value
ESR (mm/hr)	**Before**	8.9±1.4	10.1± 2.2	0.37
	1	76.5±4.8	74.7± 5.1	0.29
	7	68.7±4.6	66.8±4.8	0.09
	14	59.4±4.8	51.6±4.6	0.06
	30	31.2±4.9	16.4±6.1	0.07
	50	18.9±3.7	11.2±4.9	0.07
	all	40.5±4.3	37.5±5.2	0.18
CRP (mg/L)	**Before**	3.2±1.0	3.4±1.3	0.21
	1	132.9±14.8	147.7± 15.2	0.23
	7	118.5±11.0	101.3±23.5	0.02
	14	107.8±12.9	62.4±13.8	0.01
	30	74. 3±14.1	21.7±12.9	0.005
	50	22.8±8.4	9.0±7.1	0.009
	all	52.6±14.8	30.9±8.3	0.01

CRP = C-reactive protein ESR :Erythrocyte Sedimentation Rate

DISCUSSION

The post-spinal surgery period has complex and diverse complications due to the time of surgery and presence of pain due to being close to spinal cord, and it is important to pay attention to the occurrence of infection in this type of surgery [11, 15].

Our findings show that CRP in patients suffering from inflammatory complications was reduced on the first day and later; But these changes were less compared to the group of patients without complications. In fact, CRP showed a significant increase over time in patients with complications. So that on fourteenth day to fiftieth day, a significant difference was observed between two investigated groups. In a similar study on spine surgery patients, it was found that CRP levels peaked on the third postoperative day and then gradually decreased in cervical and lumbar spine surgery patients [11]. In a similar study, Kunakornsawat et al. reported that mean CRP levels peaked on postoperative day 3 in all groups and rapidly decreased on postoperative day 7. On the 14th and 28th postoperative days, a decrease to normal CRP levels was observed in 16% and 80% of all patients, respectively. The pattern of CRP reduction was similar among groups. ESR values increased and reached a peak between the third and seventh postoperative days. ESR values decreased gradually. At 42 days after surgery, ESR levels remained higher than normal values in all groups [12].

In our study, the findings of measuring the ESR level in time periods after surgery showed that ESR in patients with complications after surgery is higher than in patients without complications. But this difference was not statistically significant. In a study similar to the present research, post-operative CRP and ESR were studied in non-infectious spinal surgery patients. This study showed that the CRP level reached its peak on the third day after surgery in spinal decompression patients, while the CRP level reached its peak on the fifth day after surgery in patients with instrumentation [16]. In the past, findings have shown that CRP and ESR are activated in the response of the immune system regarding damage and the presence of pathogens and increase in the plasma level. After surgery, inflammatory processes such as infection, tissue damage, trauma, or immunological reactions increase due to the aggressiveness and affecting the surrounding tissues. In this case, after a sudden increase in CRP and ESR values, the levels of these factors in plasma gradually decrease. As a result, the lack of change in size can indicate infection [16, 17]. Studies similar to this finding, which was also seen in our study, proved that in the early days after surgery, CRP and ESR levels increase and after a peak, their levels decrease [10]. But our finding proves that in patients with infectious complications, the gradual reduction of CRP and ESR is done in a slower way, and in patients with infectious complications, the level of CRP and ESR has a considerable increase compared to people without complications.

The role of CRP in identifying postoperative infection has also been observed in other types of surgery. Recently, similar findings have shown that C-reactive protein was at a high level in many women who underwent cesarean surgery and had surgical site infection. Also, CRP on days 1, 3, and 6 of these changes were significant in the healthy and surgical groups [18].

In relation to CRP level, another thing that has been mentioned as an influencing factor in various studies is the severity of injury in surgery. In minimally invasive surgeries with less intervention, less tissue destruction occurs and the inflammation caused by surgery is less, and the CRP level decreases in a shorter period after surgery [19-21]. The action of CRP decreased to a normal level of less than 6 mg/liter [16]. In the present study, in the group without infectious complications, the level of CRP showed a significant

decrease on the 30th day and was close to the normal level, but in patients with complications, on the 30th day after surgery, CRP was still at a high level.

There are some biochemical factors such as platelet levels, total antioxidant capacity, alanine aminotransferase and aspartate aminotransferase whose role in chronic inflammation has been proven in the past [22-25]; But in our study, no significant relationship was observed regarding these variables.

In the present study, it was also found that among the biochemical factors effective in infection, TAC was reduced on the 14th and 30th day in the group of patients with complications, although no statistically significant difference was observed. For sure, factors related to antioxidant levels can be investigated as a parameter affecting infections related to spine surgery in the future, and paying attention to these factors is also important in predicting complications.

Overall, our findings show that CRP was associated with postoperative infectious complications. ESR increased in patients with complications, despite the lack of significance. But this finding showed that with the increase of esr, the complications of infection after surgery increase in patients.

One of the limitations of present study was non-cooperation of some patients. Three people were excluded from study. For the convenience of the patients, follow-up blood sampling was done by the researcher for 12 of patients at the place requested by the them. One of the strengths of current research was the sample size that was collected over 12 months.

Conclusion

The level of CRP in patients with complications had significant changes and this finding shows that the level of CRP can be effective in predicting infectious complications after spine surgery. Of course, attention to ESR can also be considered as an effective variable in inflammation. Cross-sectional and prospective studies with a longer follow-up period and a larger sample size can be effective in providing more accurate results.

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