HAYDARPAŞA NUMUNE MEDICAL JOURNAL

DOI: 10.14744/hnhj.2023.23245
Haydarpasa Numune Med J 2023;63(4):384–388

ORIGINAL ARTICLE

Effect of the Number of Lesions to Which Stenting and Coronary Balloon Angioplasty were Applied on Hs-CRP

Aysun Erdem Yaman[1], Nurgül Keser[2]

[1]Department of Cardiology, Dr Siyami Ersek Thoracic and Cardiovascular Surgery Training and Research Hospital, Istanbul, Türkiye
[2]Department of Cardiology, Sultan Abdulhamid Han Training and Research Hospital, Istanbul, Türkiye

Abstract

Introduction: This study aims to assess the high-sensitivity C-reactive protein (hs-CRP) levels in patients with stable coronary artery disease (CAD) after coronary stenting and evaluate the effect of different stent numbers (1, 2, and ≥3 stents) on hs-CRP levels.

Methods: Our study included 87 patients diagnosed with stable CAD who underwent coronary angiography and had >70% stenosis in the coronary arteries and underwent percutaneous coronary intervention (PCI). The study group was divided into three based on the number of treated lesions. Patients treated for only one lesion were grouped as Group-1, those treated for 2 lesions were Group-2, and those treated for 3 or more lesions were Group-3. The change in hs-CRP was defined as the difference between pre- and post-PCI hs-CRP levels.

Results: A total of 87 patients were included in the study (mean age 59±10 years and 81.6% were male). For the first group, the pre-PCI hs-CRP was 1.13 mg/dL ± 1.94 mg/dL, and the post-PCI hs-CRP was 1.68 mg/dL ±1.70 mg/dL ($p<0.05$). For the second group, the pre-PCI hs-CRP was 0.60 mg/dL ±0.80 mg/dL and the post-PCI hs-CRP was 1.49 mg/dL ±2.24 mg/dL ($p<0.05$). For the third group, the pre-PCI hs-CRP was 1.08 mg/dL ±1.31 mg/dL and the post-PCI hs-CRP was 2.35 mg/dL ±2.57 mg/dL ($p<0.05$). However, the differences between pre- and post-PCI hs-CRP levels among the groups were estimated as 0.55 mg/dL ±1.81 mg/dL, 0.82 mg/dL ±0.82 mg/dL, and 1.27 mg/dL ±1.86 mg/dL, but these differences were not statistically significant ($p>0.05$).

Discussion and Conclusion: In this study, we demonstrated that there was a significant increase in post-procedure hs-CRP levels. However, this was not related to the number of implanted stents.

Keywords: Coronary artery disease; coronary stenting; high-sensitivity c-reactive protein; inflammation.

Coronary artery disease (CAD) is considered one of the most fatal diseases of the cardiovascular system, posing a serious threat in the global health arena. In the treatment of stable CAD patients, revascularization of coronary arteries using stenting is widely applied. This invasive procedure is of critical importance for alleviating symptoms, improving the quality of life, and preventing acute coronary events[1-3]. However, the traumatic effect on the vessel's inner surface during the coronary stenting process triggers a systemic inflammatory response[4,5]. As a biomarker of this response, hs-CRP levels are frequently used. Hs-CRP is regarded as an indicator of systemic inflammation, and elevated levels in patients with CAD have been associated with a relationship between the progression of atheroscle-

Correspondence: Aysun Erdem Yaman, M.D. Department of Cardiology, Dr Siyami Ersek Thoracic and Cardiovascular Surgery Training and Research Hospital, Istanbul, Türkiye
Phone: +90 533 325 27 33 **E-mail:** erdemaysun@yahoo.com
Submitted Date: 02.07.2023 **Revised Date:** 20.08.2023 **Accepted Date:** 18.09.2023
Haydarpaşa Numune Medical Journal

rosis and adverse clinical outcomes[6,7]. In many studies, an increase in hs-CRP levels has been shown after coronary stent implantation[8-10]. However, there is insufficient evidence regarding the relationship between the number of implanted stents and the increase in hs-CRP levels.

In this context, this study aims to examine the hs-CRP levels of stable CAD patients after the coronary stenting procedure and to assess the effect of different coronary stenting numbers (1, 2, and ≥3 stents) on hs-CRP levels.

Materials and Methods

Our study included 87 patients diagnosed with stable coronary artery disease who underwent coronary angiography and had >70% stenosis in their coronary arteries and underwent percutaneous coronary intervention (PCI). Patients with a history of unstable angina/MI within 3 months before PCI, significant accompanying valve disease, presence of myocarditis, cardiomyopathy, hepatic, renal and thyroid diseases, acute inflammatory disease in the past 6 months, and morbid obesity were excluded from the study. The study was approved by the institutional ethical committee.

The study group was divided into three based on the number of lesions treated. Patients treated for only one lesion were named Group-1, those treated for 2 lesions were Group-2, and those treated for 3 or more lesions were Group-3. Blood samples for hs-CRP were taken from these patients 30 min before the procedure and 24 h after. Patients with a blood pressure of >140/90 mmHg in at least 2 measurements or those taking antihypertensives were defined as having hypertension. Patients with a fasting blood glucose >126 mg/dL or HbA1c >6.5 or those taking oral antidiabetics were defined as having diabetes mellitus. Plasma hs-CRP measurements were made in the dimension RXL (Dade-Behring, Belgium) autoanalyzer using an hs-CRP kit. The change in hs-CRP was defined as the difference between pre- and post-PCI hs-CRP levels.

Statistics

Continuous variables are shown as median (interquartile range), and categorical variables are presented as number and %. Due to the small number of patients included in the groups (≤30), the Kruskal–Wallis test was used for comparison of continuous variables. The Chi-square test was used for the comparison of categorical variables. A $p<0.05$ was considered the limit of statistical significance. All statistical analyses were conducted using (SPSS Inc., Chicago, Ill., USA) version 18.0.

Results

A total of 87 patients were included in the study (with an average age of 59±10 years and 81.6% were male). Patients were divided into three distinct groups based on the number of balloon pre-dilatations and stent implantations performed. The first group (single intervention) consisted of 30 patients, while the second group (two interventions) had 29 patients, and the third group (three interventions) had 28 patients. The baseline clinical and biochemical characteristics of these groups are summarized in Table 1.

Table 1. Baseline characteristics according to groups

	Group-1 (n=30)	Group-2 (n=29)	Group-3 (n=28)	p
Age (years) mean±standard deviation	59±12	58±11	59±11	0.781
Sex, male, n (%)	26 (87)	25 (86)	19 (68)	0.136
Diabetes, n (%)	4 (13)	9 (31)	9 (32)	0.176
Hypertension, n (%)	14 (47)	16 (55)	13 (46)	0.750
Smoking, n (%)	4 (13)	6 (21)	10 (36)	0.121
Glucose, mg/dL	67–421 (101)	78–391 (102)	70–294 (107)	0.104
HbA1c, %	3.7–8.1 (5.2)	5.1–9.6 (5.7)	4.9–10.9 (5.9)	0.136
Creatinine, mg/dL	0.7–1.2 (0.9)	0.6–1.4 (0.9)	0.3–1.3 (0.8)	0.638
Uric acid, mg/dL	4.1–8.2 (5.5)	3.9–12.5 (5.2)	3.3–7.3 (5.5)	0.616
Leukocyte, $10^3/mm^3$	4.1–13.1 (8.1)	3.6–15.4 (8.7)	5–10.4 (6.9)	0.061
Neutrophil, $10^3/mm^3$	1.6–8.9 (5.2)	3.6–12.5 (5,7)	2.1–6.6 (3.8)	0.082
Hemoglobin, g/dL	11–15.3 (13)	7.9–16.1 (14.2)	11.3–15 (14.2)	0.112
Platelet count, $10^3/mm^3$	131–435 (225)	118–371 (215)	154–359 (220)	0.215
LDL Cholesterol, mg/dL	51–255 (108)	42–178 (119)	58–226 (129)	0.042

*LDL: Low-density lipoprotein.

Table 2. hs-CRP measurements before and after PCI and change in hs-CRP

	Group-1 (n=30)	Group-2 (n=29)	Group-3 (n=28)	p
hs-CRP (before PCI) mg/dL	1.13±1.94	0.60±0.80	1.49±2.24	0.007
hs-CRP (after PCI)	1.68±1.70	1.49±2.24	2.35±2.57	<0.001
Change in hs-CRP (after-before PCI)	0.55±1.81	0.82±0.82	1.27±1.86	0.068

*hs-CRP: High sensitivity C-reactive protein; PCI: Percutaneous coronary intervention.

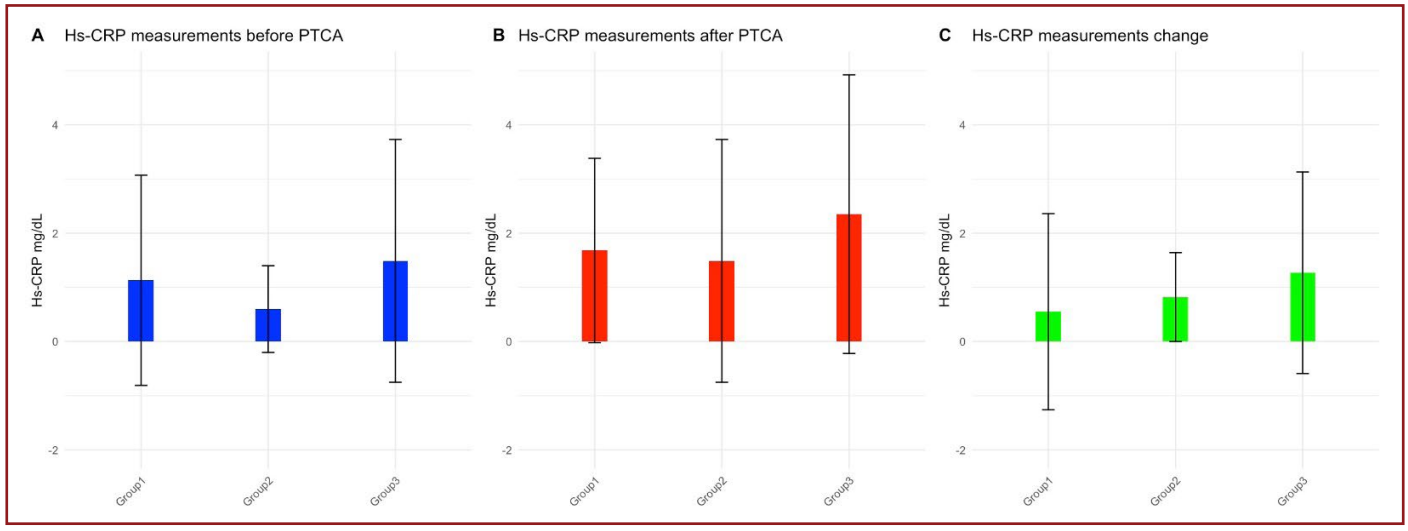

Figure 1. Distribution of hs-CRP level before PCI, after PCI, and change between before and after PCI.

The average hs-CRP levels of patients in the groups before and after percutaneous transluminal coronary angioplasty (PTCA) are as follows: For the first group, the values before the procedure were 1.13 mg/dL ±1.94 mg/dL and after the procedure were 1.68 mg/dL ±1.70 mg/dL ($p<0.05$). For the second group, the values were 0.60 mg/dL ±0.80 mg/dL before and 1.49 mg/dL ±2.24 mg/dL after ($p<0.05$). For the third group, the values were 1.08 mg/dL ±1.31 mg/dL before and 2.35 mg/dL ±2.57 mg/dL after ($p<0.05$). These results indicate a significant increase in hs-CRP levels post-PTCA across all groups. On the other hand, the differences in hs-CRP levels before and after angioplasty among the groups were calculated to be 0.55 mg/dL ±1.81 mg/dL, 0.82 mg/dL ±0.82 mg/dL, and 1.27 mg/dL ±1.86 mg/dL, respectively, and these differences were not statistically significant ($p>0.05$) (Table 2 and Fig. 1).

Discussion

In our study, we demonstrated that there was an increase in hs-CRP levels following coronary stenting, regardless of the number of stents implanted. However, we found no association between the number of implanted coronary stents and the increase in hs-CRP levels.

C-reactive protein (CRP) is considered a sensitive indicator of inflammatory events as it is an acute-phase protein. Numerous studies have shown a significant relationship between CRP levels and cardiovascular events in both primary and secondary prevention[11]. Furthermore, significant associations have been identified between baseline CRP levels before coronary intervention and both angiographic outcomes (like stent restenosis or stent thrombosis) and clinical outcomes in patients undergoing PCI, whether for stable CAD or acute coronary syndromes[7]. Coronary stent implantation is known to induce an inflammatory response, triggering a local inflammatory reaction[4,5,12]. Many studies reported an increase in CRP levels after stent implantation as compared to before the coronary intervention[8-10]. In fact, some research suggests that this increase persists for up to 120 h[10] and even up to a month[13]. In our study, we observed a notable elevation in hs-CRP levels 24 h after coronary stent implantation compared to their baseline. However, few studies have evaluated the relationship between the post-PCI elevation in CRP levels (compared to baseline)

and angiographic and clinical outcomes. Kang et al.[14] studied 42 patients with stable angina implanted with drug-eluting stent and measured hs-CRP before the PCI and 24 and 72 h after. An angiography and intravascular ultrasound examinations were conducted 9 months after PCI. They found no association between baseline hs-CRP levels and neointimal hyperplasia (NIH). However, a significant positive correlation was observed between hs-CRP levels taken 24 and 72 h post-PCI and NIH. Similarly, a study by Lee et al.[15] using optical coherence tomography also found similar results. Our study, however, lacked follow-up data.

The distinctive feature of our study compared to other research was to demonstrate the relationship between the increase in the number of implanted coronary stents and the elevation in hs-CRP levels. We hypothesized that each implanted stent would have an additive effect on the magnitude of the inflammatory reaction. Nevertheless, the changes in post-procedure and baseline hs-CRP in patients with one, two, or ≥three coronary stents were found to be similar. The reason for the similar hs-CRP levels might be due to the small sample size and measuring the inflammatory response solely using hs-CRP.

Our study has several limitations. Primarily, the number of patients in all three groups is small. Although we observed an increase in hs-CRP levels with an increasing number of procedures, the non-significance of this finding may be attributed to the small patient count. There is a higher number of diabetic patients in the group that underwent revascularization for 2 or 3 vessels, although this was not statistically significant. As a result, this group may have experienced more inflammatory stress, potentially influencing the inflammatory response to endothelial damage. Moreover, our study only encompassed patients with stable angina, which might have impacted the severity of the inflammatory response.

Conclusion

In our study, we demonstrated that a significant increase in post-procedure hs-CRP levels in patients stented due to stable coronary artery disease. However, this increase was found to be unrelated to the number of implanted stents.

Peer-review: Externally peer-reviewed.

Authorship Contributions: Concept: A.E.Y, N. K.; Supervision: A.E.Y., N.K.; Data Collection or Processing: A.E.Y.; Analysis or Interpretation: A.E.Y. N.K.; Literature Search: A.E.Y., N.K.; Writing: A.E.Y.; Critical Review: A.E.Y., N.K.

Conflict of Interest: None declared.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Boden WE, Marzilli M, Crea F, Mancini GBJ, Weintraub WS, Taqueti VR, et al; Chronic Myocardial Ischemic Syndromes Task Force. Evolving management paradigm for stable ischemic heart disease patients: JACC review topic of the week. J Am Coll Cardiol 2023;81:505–14.
2. Kohsaka S, Ejiri K, Takagi H, Watanabe I, Gatate Y, Fukushima K, et al. Diagnostic and therapeutic strategies for stable coronary artery disease following the ISCHEMIA Trial. JACC Asia 2023;3:15–30.
3. Writing Committee Members; Virani SS, Newby LK, Arnold SV, Bittner V, Brewer LC, et al. 2023 AHA/ACC/ACCP/ASPC/NLA/PCNA guideline for the management of patients with chronic coronary disease: A report of the American Heart Association/American College of Cardiology Joint Committee on Clinical Practice Guidelines. J Am Coll Cardiol 2023;82:833–955.
4. Li JJ. Inflammatory response, drug-eluting stent and restenosis. Chin Med J (Engl) 2008;121:566–72.
5. Versaci F, Gaspardone A. Prevention of restenosis after stenting: The emerging role of inflammation. Coron Artery Dis 2004;15:307–11.
6. Yi M, Wu L, Ke X. Prognostic value of high-sensitivity C-reactive protein in In-stent restenosis: A meta-analysis of clinical Trials. J Cardiovasc Dev Dis 2022;9:247.
7. Montone RA, Niccoli G. Predictive value of C-reactive protein after drug-eluting stent implantation: An update view. Future Cardiol 2018;14:355–8.
8. Almagor M, Keren A, Banai S. Increased C-reactive protein level after coronary stent implantation in patients with stable coronary artery disease. Am Heart J 2003;145:248–53.
9. Saleh N, Svane B, Jensen J, Hansson LO, Nordin M, Tornvall P. Stent implantation, but not pathogen burden, is associated with plasma C-reactive protein and interleukin-6 levels after percutaneous coronary intervention in patients with stable angina pectoris. Am Heart J 2005;149:876–82.
10. Gottsauner-Wolf M, Zasmeta G, Hornykewycz S, Nikfardjam M, Stepan E, Wexberg P, et al. Plasma levels of C-reactive protein after coronary stent implantation. Eur Heart J 2000;21:1152–8.
11. Niccoli G, Montone RA, Ferrante G, Crea F. The evolving role of inflammatory biomarkers in risk assessment after stent implantation. J Am Coll Cardiol 2010;56:1783–93.
12. Aggarwal A, Blum A, Schneider DJ, Sobel BE, Dauerman HL. Soluble CD40 ligand is an early initiator of inflammation after coronary intervention. Coron Artery Dis 2004;15:471–5.
13. Mostowik M, Siniarski A, Gołębiowska-Wiatrak R, Nessler J, Gajos G. Prolonged CRP increase after percutaneous coronary

intervention is associated with high thrombin concentrations and low platelet' response to clopidogrel in patients with stable angina. Adv Clin Exp Med 2015;24:979–85.
14. Kang WC, Il Moon C, Lee K, Han SH, Suh SY, Moon J, et al. Comparison of inflammatory markers for the prediction of neointimal hyperplasia after drug-eluting stent implantation. Coron Artery Dis 2011;22:526–32.
15. Lee SY, Hong MK, Mintz GS, Shin DH, Kim JS, Kim BK, et al. Temporal course of neointimal hyperplasia following drug-eluting stent implantation: A serial follow-up optical coherence tomography analysis. Int J Cardiovasc Imaging 2014;30:1003–11.