Available online at www.medicinescience.org

ORIGINAL ARTICLE

Medicine Science International Medical Journal

Medicine Science 2023;12(2):536-41

The prognostic value of the change in the level of inflammatory markers in stable coronary artery patients with stent implanted

Fatih Koca, Fatih Levent, Gokhan Ozmen, Barıs Sensoy, Mustafa Aldemir, Mehmet Demir, Erhan Tenekecioglu

Bursa Yuksek Ihtisas Training and Research Hospital, Department of Cardiology, Bursa, Türkiye

Received 09 March 2023; Accepted 23 May 2023
Available online 26.05.2023 with doi: 10.5455/medscience.2023.03.034

Abstract

Vascular inflammation has a pivotal role in the progression of atherosclerosis and major cardiovascular events (MACE). However, there is limited data concerning to role of changes in inflammatory markers in predicting MACE. In the current study, it was investigated whether the difference between high sensitive C-Reactive Protein (hs-CRP) and systemic immune-inflammatory index values (Δhs CRP and ΔSII) measured before and after the procedure and residual SYNTAX score (rSS) in stable coronary artery patients underwent percutaneous coronary intervention (PCI) could predict MACE. 203 patients (mean age: 62.11±9.20, 75% male) were included in the study. Before the first procedure and at the 1st month after the procedure(s), their blood was drawn. rSS was calculated. MACE was determined as cardiovascular mortality, target vessel revascularization non-fatal myocardial infarction, and ischemic stroke. MACE was observed in 20 patients (9.9%). Of these patients, 3 (1.5%) had cardiovascular mortality, 3 (1.5%) had a non-fatal myocardial infarction, 12 (5.9%) had target vessel revascularization due to unstable angina, and the remaining 2 (1.0%) had an ischemic stroke. The area under the curve (AUC) to predict MACE diagnosis was 0.548 for ΔSII and 0.647 for Δhs-CRP and 0.766 for rSS. In multiple regression analysis, only rSS > 4 was an independent predictor for MACE (HR=3.41, 95% CI: 1.39-8.35, p=0.007). The change in SII and hs-CRP after PCI was found to be insufficient to predict MACE, while rSS was the only independent predictor for MACE.

Keywords: Inflammation, high-sensitive CRP, systemic immune inflammation index, residual syntax score, stenting

Introduction

Vascular inflammation has a pivotal role in the development of atherosclerosis and major cardiovascular events [1-4]. C-reactive protein (CRP) is a non-specific marker of inflammation. It is mostly produced in liver and released from active leukocytes into the blood in reaction to infection, as well as from vascular smooth muscle cells due to atherosclerosis [5,6]. CRP facilitates the adhesion and migration of monocytes from the vessel wall [7]. With the help of high-tech techniques, values below 0.3 mg/dl can be detected since the 90's, called high sensitive CRP (hs-CRP). Studies have shown that hs CRP not only predicts cardiovascular events, but is also associated with atherosclerotic plaque load [8-10]. Although most previous studies used a single measure of hs-CRP as a marker of chronic inflammation, its blood concentration may vary over time. The evidence has shown that the amount of change in concentration is better than a single measurement to demonstrate chronic inflammation and cardiovascular events [11,12].

The systemic immune inflammatory index (SII) is acquired by multiplying the neutrophil/lymphocyte ratio with the platelet count. It indicates the status of systemic inflammation [13,14]. Similar to hs-CRP, previous studies have shown that SII also

CITATION
Koca F, Levent F, Ozmen G, et al. The prognostic value of the change in the level of ınflammatory markers ın stable coronary artery patients with stent ımplanted. Med Science. 2023;12(2):536-41.

Corresponding Author: Fatih Koca, Bursa Yüksek İhtisas Training and Research Hospital, Department of Cardiovascular Surgery, Bursa, Türkiye
Email: drfatihkoca@gmail.com

DOI: 10.5455/medscience.2023.03.034

predicts cardiovascular events and the severity of atherosclerotic heart disease [13-16]. The majority of studies with SII were done with a single index measurement. A previous study showed a decrease in SII with exercise may indicate that SII can vary according to physiological conditions [17]. The residual Synergy between Percutaneous Coronary Intervention with Taxus and Cardiac Surgery (SYNTAX) score (rSS) is obtained by evaluating the residual stenosis in coronary angiography after percutaneous coronary intervention (PCI). It shows the residual atherosclerotic plaque burden and has prognostic significance [18-20].

In the present study, the relationship between residual atherosclerotic plaque burden evaluated by rSS and the change of inflammatory markers (ΔSII, Δhs CRP), and the role of ΔSII and Δhs CRP in predicting major cardiovascular events in stable coronary artery patients (CAD) undergoing PCI were investigated.

Material and Methods

The study is a high-volume, single-center, prospective study in design. Ethics committee approval was obtained for the study. Patients who underwent PCI from September 2021 to December 2021 were included into the study. Patient inclusion criteria were as follows: (I) over 18 years of age; (II) grade 1-3 angina based on the Canadian Cardiovascular Society angina classification and showed an area of >10% ischemia on myocardial perfusion scintigraphy (exercise or pharmacologically stressed) or had significant ST changes on the treadmill exercise test. Exclusion criteria were; (I) class 4 angina according to the CCS classification or conforming to the description of myocardial infarction based on the 4th universal myocardial infarction guideline, [21] (II) diagnosis of malignancy, autoimmune disease, acute inflammatory disease, severe liver disease (III) those with an estimated glomerular filtration rate of 15-29 ml/min (IV) triglyceride level over 400 mg/dl (V), those taking steroids or immunosuppressive agents (VI), pregnant women, and those with a previous history of revascularization (VII) were eliminated from the study. 375 patients who were newly diagnosed with stable coronary artery disease and scheduled for stenting were screened for the study. Of these patients, 95 were excluded from the study because they refused to participate in the study and 53 met the exclusion criteria. The remaining 227 patients were included in the study after written informed consent was received.

Two dimensional transthoracic echocardiography were done all patients with An Epiq 7c Ultrasound System (Philips Medical System, Andover, MA, USA) using a 1-5 MHz probe within two weeks before the planned coronary angiography procedure. On the day of the coronary angiography procedure, fasting blood test was taken before the procedure (basal blood test). When PCI was planned, all patients were given 300 mg of clopidogrel and 300 mg of acetylsalicylic acid per orally within 2 hours before the procedure. The visual evaluation of the lesions, the decision and time of PCI, the type and technique of stent used, pre-dilatation/post dilatation etc. were left to two experienced operators. All planned percutaneous coronary angioplasty procedures were completed within 14 days after coronary angiography. As stent implantation could not be performed in 12 of the 227 included patients, these patients were eliminated from the study.

The remaining 215 patients were called for outpatient follow-up 1 month after the stent procedure(s), and 12 patients were eliminated from the study because they met one of the exclusion criteria (except the first criterion) in the follow-up examination. Finally, the remaining 203 patients were included in the statistical evaluation (Figure 1). Clinical and laboratory evaluation was performed in the outpatient clinic. ΔSII and Δhs-CRP were obtained by subtracting the SII and hs-CRP values in basal blood samples from the SII and hs-CRP values in the 1st month blood samples, respectively.

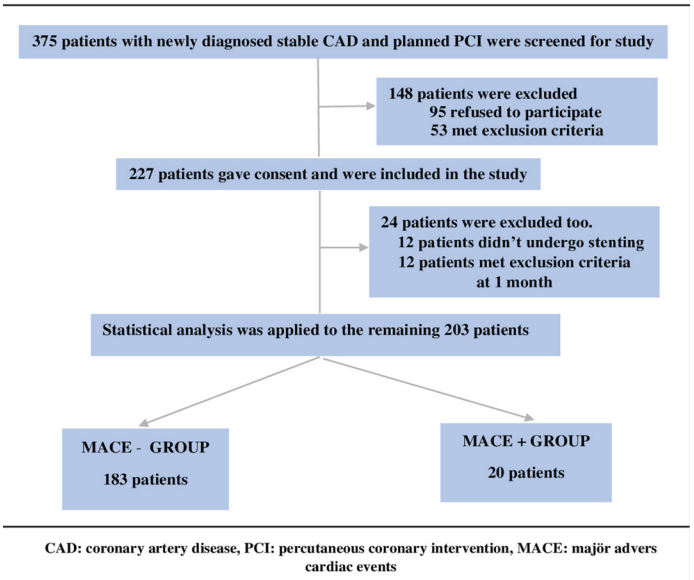

Figure 1. Study flowchart

Baseline syntax scores were acquired via the online calculator (www.syntaxscore.com, version 2.1) by two experienced invasive cardiologists blinded to the patients' clinical features. Then the same scoring was repeated for the remaining stenosis following all planned stenting procedures were done, and rSS was obtained.

The primary endpoint in the patient follow-up was determined as major adverse cardiovascular events (MACE) consisting of cardiovascular mortality, non-fatal myocardial infarction, target vessel revascularization, and ischemic stroke. Patients without MACE were followed up to 12 months.

Statistical Analysis

All analyzes were done with MedCalc 20.0.4 (MedCalc Software Ltd, Ostend, Belgium). According to the Kolmogorov Smirnov test, continuous variables with normal distribution were showed as mean ± standard deviation, continuous variables without normal distribution were showed as median (25th-75th), and categorical variables were expressed as percent (%). After

DOI: 10.5455/medscience.2023.03.034

descriptive statistics were conducted, the two groups (MACE negative and positive) were compared with the Independent Samples t-Test (for normally-distributed continuous variables), the Mann Whitney U test (for non-normally distributed continuous variables), and the Chi squre test or Fischer exact test (whichever was appropriate for categorical variables). The power of the biomarkers, evaluated in predicting MACE (rSS, ΔSII, Δhs CRP), was detected and compared using Receiver operating characteristic (ROC) curve analysis and Hanley McNeil test. The correlation between ΔSII, Δhs-CRP and rSS were assessed using Pearson correlation or Spearman's correlation tests. Finally, univariate and multivariate Cox regression analyzes were done to determine independent predictors of 12-month MACE, respectively. Variables with significant p-values in univariate analysis were used in multivariate analysis. In all statistical tests, tests with a p-value below 0.05 were considered significant.

Results

Of the 203 patients included in the study (mean age: 62.11± 9.20, 75.9% male), MACE was observed in a total of 20 (9.9%) patients. Cardiovascular mortality was observed in 3 cases (1.5%), non-fatal myocardial infarction in 3 (1.5%), target vessel revascularization due to unstable angina in 12 (5.9%) and ischemic stroke in the remaining 2 (1.0%) patients. Antiplatelet treatment was interrupted in 4 patients due to major operation and in 2 patients due to severe bleeding. In 2 patients, statin treatment was discontinued due to side effects. Any MACE was not observed in those 8 patients. In the remaining 195 patients, adherence to cardiac treatment including antiplatelet therapy was complete. Demographic, clinical, imaging and laboratory features of the MACE negative and positive groups are shown in Table 1 and Table 2.

Table 1. Demographic, clinical characteristics and medications of the MACE negative (-) and positive (+) groups

Parameters	MACE (-) group n= 183	MACE (+) group n=20	p value
Male, N(%)	138(75)	16(80)	0.649
Age years, mean±SD	62.05±9.18	62.60±9.65	0.802
BMI kg/m², mean±SD	30.15±4.87	30.93±5.19	0.501
Diabetes, N (%)	65(36)	8(40)	0.841
Hypertension, N (%)	170(93)	17(85)	0.199
Active smoking, N (%)	51(28)	7(35)	0.696
COPD, N (%)	4(2)	1(5)	0.408
ACE inh/ARB, N (%)	100(55)	13(65)	0.376
Beta blocker, N (%)	167(91)	20(100)	0.376
CCB, N (%)	53(29)	3(15)	0.185
Statin, N (%)	174(95)	19(95)	1

Abbreviations: ACE inh:Angiotensin converting enzyme inhibitors, ARB:Angiotensin receptor blocker, BMI: Body mass index, CCB: Calcium channel blockers,COPD: Chronic obstructive pulmonary disease.

Table 2. Imaging and laboratory findings of the of the MACE negative (-) and positive (+) groups

Parameters	MACE (-) group n= 183	MACE (+) group n=20	p value
LVEF on admission % mean±SD	59.48±5.74	58.08±5.62	0.300
Hemoglobin g/dl; mean±SD	13.92±1.81	13.47±2.02	0.295
White blood cell, ×10³/µL , mean±SD	8.05±1.63	8.42±1.51	0.339
Neutrophils, ×10³/µL, mean ±SD	4.98±1.39	5.41±1.54	0.196
Lymphocytes, ×10³/µL, mean±SD	2.29±0.70	2.22±0.72	0.693
Platelet, ×10³/µL, mean±SD	249.30±58.24	260.70±73.12	0.420
TSH mIU/L, median (25th-75th)	1.39(0.85-2.30)	1.23(0.83-1.56)	0.25
CrCl* mL/min, median (25th-75th)	85.34(70.37-97.19)	81.26(67.17-93.27)	0.363
LDL mg/dl mean±SD	114.56±40.29	103.86±42.87	0.263
Triglyceride mg/dL mean±SD	185.03±112.20	171.75±107.40	0.614
Total cholesterol mg/dL, mean±SD	193.60±45.82	178.65±49.09	0.170
Baseline hs-CRP, mg/L, median (25 th –75 th)	3.20(2.30-4.60)	4.80(3.67-6.70)	**0.008**
Baseline SII, median (25th-75th)	536(392.61-712.38)	657.41(381.43-1155.56)	0.197
Δhs CRP, mg/L median (25 th–75 th)	-0.40(-1.40-0.35)	0.25(-0.37-1.07)	**0.011**
ΔSII, median (25th-75th)	-10.28±386.48	115.15±476.38	0.482
Syntax score, median (25th-75th)	8(6-11)	14.75(10.10-19.75)	**<0.001**
Rss, median (25th-75th)	2(0-5)	7.5(2.25-10.75)	**<0.001**

Abbreviations: CrCI: Creatinine Clearance, hs-CRP: High sensitive, C reaktif protein, LDL: Low-density lipoprotein LVEF: Left ventricular ejection fraction, rSS: Residual SYNTAX score, SII: Systemic immune-inflammation index, TSH: Thyroid-stimulating hormone

DOI: 10.5455/medscience.2023.03.034

The correlation between rSS, ΔSII and Δhs CRP was evaluated; while there was no significant correlation between rSS and both Δhs CRP and ΔSII, (rSS vs Δhs CRP; r=-0.008 p=0.905, rSS vs ΔSII: r=0.105, p=0.136). A modest correlation was found among Δhs CRP and ΔSII (r=0.660, p<0.001).

In the evaluation of the power in predicting MACE of all three parameters with ROC curve analysis, the area under the curve (AUC) for rSS was 0.766 (CI:0.701-0.822), AUC for Δhs-CRP was 0.674 (CI:0.604-0.738), and AUC for ΔSII was 0.548 (0.477-0.618). In the statistical comparison of the curves; while both rSS and Δhs-CRP were superior to ΔSII (p=0.002 in both comparisons), no statistically significant difference was found between rSS and Δhs CRP (p=0.24) (Figure 2).

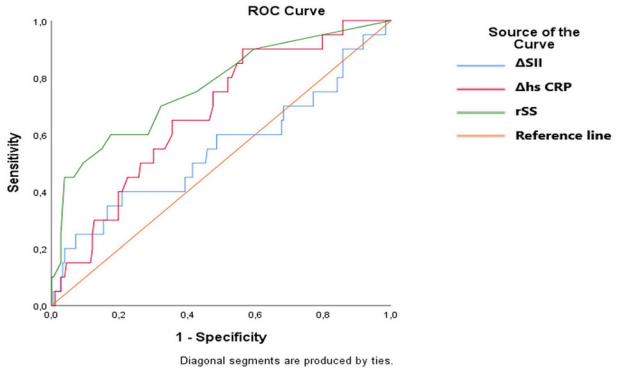

Figure 2. ROC curve analysis indicating the power of Δ systemic immune-inflammation index (SII) values, Δ high sensitivity C-reactive protein levels (hs-CRP) and Residual SYNTAX score (rSS) in predicting major adverse cardiovascular event (MACE) following stent implantation

Table 3. Cox regression analysis for identifying predictors of MACE following stent implantation

Univariate Analysis			
Variables	**HR**	**95 % CI**	**p value**
Age	1.00	0.96-1.06	0.807
Male	0.77	0.26-2.31	0.641
BMI	1.03	0.95-1.12	0.496
Active smoking	0.84	0.34-2.05	0.702
Hypertension	2.23	0.65-7.61	0.201
Diabetes	1.48	0.61-3.57	0.387
ACE inh/ARB	0.92	0.37-2.31	0.860
Statin	1.05	0.14-7.85	0.962
LVEF	0.96	0.90-1.03	0.294
Hemoglobin	0.89	0.71-1.12	0.307
CrCl	0.99	0.97-1.01	0.323
LDL	0.99	0.98-1.01	0.245
Δhs CRP > 0.1	2.50	1.02-6.13	0.044
rSS > 4	3.48	1.42-8.52	0.006
Multivariate Analysis			
Variables	**HR**	**95%CI**	**p value**
rSS > 4	3.41	1.39-8.35	0.007
Δhs CRP > 0.1	2.43	0.99-5.95	0.051

Abbreviations: ACE inh: Angiotensin converting enzyme inhibitors, ARB:Angiotensin receptor blocker, BMI: Body mass index, CrCI: Creatinine Clearance ,hs-CRP: High sensitive C reaktif protein, LDL: Low-density lipoprotein LVEF: Left ventricular ejection fraction MACE: Major adverse cardiovascular events, rSS: Residual SYNTAX score, SII: Systemic immune-inflammation index TSH: Thyroid-stimulating hormone

Discussion

The predictive values of changes in hs-CRP and SII (Δhs-CRP and ΔSII, respectively) and rSS for MACE were evaluated in patients who underwent PCI in the present study. The change in inflammation after PCI with the difference of hs-CRP and SII was evaluated and the predictive power of ΔSII for MACE was very poor. In regression analysis, Δhs-CRP was not an independent predictor for 1-year MACE, while rSS was the only independent predictor for 1-year MACE.

In the sub study group of the COURAGE (Clinical Outcomes Utilizing Revascularization and Aggressive Drug Evaluation) study, the extent and severity of obstructive coronary artery disease was discovered to predict death, myocardial infarction, and acute coronary syndrome rather than the degree of myocardial ischemia [22]. On the basis of ischemia and inflammation relationship, association between hs-CRP and cardiovascular events in CAD had disappeared after adjusting for comorbidities, suggesting inflammation to be an indicator of comorbidities rather than cardiovascular events in CAD [23]. The rSS shows the coronary atherosclerotic load after PCI and elevated NLR was discovered to be associated higher rSS in patients with STEMI [24]. Different from this study, our study addressed the variability of inflammation markers over time.

Correlation of rSS with Δhs CRP and ΔSII was evaluated, but no significant correlation was found to show whether residual coronary artery disease is associated with ongoing inflammation. This was not surprising because non-coronary arteries also have a burden of atherosclerotic plaque, and there may be confounding factors such as hypertension, diabetes mellitus, smoking and obesity that have been revealed to stimulate hs-CRP secretion [25]. In the study of Chehrevar et al including 582 patients with chronic coronary syndrome similar to our study, 1-year MACE was found to be approximately 7% after PCI [26]. In the study of Farshidi et al, 1-year MACE was 14.5% [27]. The fact that all patients who underwent PCI including those with acute coronary syndrome were included in the study of Farshidi et al may explain why higher rate of MACE was found in this study compared to the present study.

Although it has been proven that hs-CRP varies even during the day in stable coronary artery patients, [28] the majority of studies in the literature have preferred basal hs-CRP values instead of the change in hs-CRP. Therefore, in our study, the hs-CRP difference before and after PCI was assessed, but the difference was found insufficient for predicting 1-year MACE after PCI. As no important relation was detected among basal serum hs-CRP levels and CAD severity or the extent of disease in patients with coronary syndromes [29], morphology and vulnerability of coronary lesions in our study population could be partially responsible for our findings.

Some prior reports failed to detect an important difference in mortality and unfavorable ischemic events according to the extent of coronary revascularization [30,31]. In contrast,

DOI: 10.5455/medscience.2023.03.034

Généreux et al. showed the predictor value of rSS for ischemic events after PCI and Malkin et al. found rSS to be an independent indicator of mortality following PCI [18,32]. The finding of rSS as an independent predictor for MACE in our study also supports the results of these preceding studies. The significant difference in MACE according to the extent of revascularization might be related to the more precise categorization of incomplete revascularization and the reflection of differences in patient populations to study findings.

Limitations

The study was single-centered and consisted of a limited number of study groups that hinders the generalizability of the results in larger populations. While evaluating Δhs-CRP, post PCI 1st month values were used in addition to baseline values, and values in later months were not utilized. Also we didn't determined the rate of unfavorable anatomy for PCI such as chronic total occlusion, complex bifurcations/trifurcations, lesions unsuitable for PCI, small vessel disease and diffuse vessel disease. However, rSS, which expresses the amount of disease eliminated by PCI, will be a surrogate marker for lesions that cannot be intervened. Therefore, we would like emphasize the importance of aggressive secondary prevention in patients without complete revascularization during PCI.

Conclusion

In our study, the alteration in the level of hs-CRP and SII failed to predict 1-year MACE at follow-up after PCI. However, the fact that rSS was an independent predictor for post PCI MACE indicates that this marker can be used for risk stratification in such patients. As an independent predictor for post PCI MACE, rSS can be a practical marker for risk classification.

Conflict of interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical approval
Bilecik Seyh Edebali University, Non-Invasive Clinical Research Ethics Committee,REC Number: E-10333602-050.01.04-83029 Date: 10.03.2022.

References

1. Zhang R, Brennan ML, Fu X, et al. Association between myeloperoxidase levels and risk of coronary artery disease. Jama. 2001;286:2136-42.

2. Horne BD, Anderson JL, John JM, et al. Which white blood cell subtypes predict increased cardiovascular risk? J Am Coll Cardiol. 2005;45:1638-43.

3. Tzoulaki I, Murray GD, Lee AJ, et al. Relative value of inflammatory, hemostatic, and rheological factors for incident myocardial infarction and stroke: the edinburgh artery study. Circulation. 2007;115:2119-27.

4. Kwaijtaal M, van Diest R, Bär FW, et al. Inflammatory markers predict late cardiac events in patients who are exhausted after percutaneous coronary intervention. Atherosclerosis. 2005;182:341-8.

5. Norata GD, Marchesi P, Pulakazhi Venu VK, et al. Deficiency of the long pentraxin PTX3 promotes vascular inflammation and atherosclerosis. Circulation. 2009;120:699-708.

6. Libby P. Inflammation in atherosclerosis. Nature. 2002;420:868-74.

7. Libby P, Nahrendorf M, Pittet MJ, Swirski FK. Diversity of denizens of the atherosclerotic plaque: not all monocytes are created equal. Circulation. 2008;117:3168-70.

8. Ridker PM, Hennekens CH, Buring JE, Rifai N. C-reactive protein and other markers of inflammation in the prediction of cardiovascular disease in women. N Engl J Med. 2000;342:836-43.

9. Ridker PM, Rifai N, Rose L, et al. Comparison of c-reactive protein and low-density lipoprotein cholesterol levels in the prediction of first cardiovascular events. N Engl J Med. 2002;347:1557-65.

10. Swastini DA, Wiryanthini IAD, Ariastuti NLP, Muliantara A. Atherosclerosis prediction with high sensitivity c-reactive protein (hs-crp) and related risk factor in patient with dyslipidemia. Maced J Med Sci. 2019;7:3887-90.

11. Parrinello CM, Lutsey PL, Ballantyne CM, et al. Six-year change in high-sensitivity c-reactive protein and risk of diabetes, cardiovascular disease, and mortality. Am Heart J. 2015;170:380-9.

12. Xu R, Jiang X, Fan Z, et al. The trajectory of high sensitivity c-reactive protein is associated with incident diabetes in chinese adults. Nutr Metab (Lond). 2020;17:49.

13. Yang YL, Wu CH, Hsu PF, et al. Systemic immune-inflammation index (SII) predicted clinical outcome in patients with coronary artery disease. Eur J Clin Invest. 2020;50:e13230.

14. Zhou L, Ma X, Wang W. Inflammation and coronary heart disease risk in patients with depression in china mainland: a cross-sectional study. Neuropsychiatr Dis Treat. 2020;16:81-6.

15. Candemir M, Kiziltunç E, Nurkoç S, Şahinarslan A. Relationship between systemic immune-inflammation index (sii) and the severity of stable coronary artery disease. Angiology. 2021;72:575-81.

16. Esenboğa K, Kurtul A, Yamantürk YY, et al. Systemic immune-inflammation index predicts no-reflow phenomenon after primary percutaneous coronary intervention. Acta Cardiol. 2022;77:59-65.

17. Winker M, Stössel S, Neu MA, et al. Exercise reduces systemic immune inflammation index (sii) in childhood cancer patients. Support Care Cancer. 2022;30:2905-8.

18. Généreux P, Palmerini T, Caixeta A, et al. Quantification and impact of untreated coronary artery disease after percutaneous coronary intervention: the residual syntax (synergy between pci with taxus and cardiac surgery) score. J Am Coll Cardiol. 2012;59:2165-74.

19. Farooq V, Serruys PW, Bourantas CV, et al. Quantification of incomplete revascularization and its association with five-year mortality in the synergy between percutaneous coronary intervention with taxus and cardiac surgery (syntax) trial validation of the residual syntax score. Circulation. 2013;128:141-51.

20. Braga CG, Cid-Alvarez AB, Diéguez AR, et al. Prognostic impact of residual syntax score in patients with st-elevation myocardial infarction and multivessel disease: analysis of an 8-year all-comers registry. Int J Cardiol. 2017;243:21-6.

21. Thygesen K, Alpert JS, Jaffe AS, et al. Fourth universal definition of myocardial infarction (2018). Eur Heart J. 2019;40:237-69.

22. Mancini GBJ, Hartigan PM, Shaw LJ, et al. Predicting outcome in the courage trial (clinical outcomes utilizing revascularization and aggressive drug evaluation): coronary anatomy versus ischemia. JACC Cardiovasc Interv. 2014;7:195-201.

DOI: 10.5455/medscience.2023.03.034

23. Pokharel Y, Sharma PP, Qintar M, et al. High-sensitivity c-reactive protein levels and health status outcomes after myocardial infarction. Atherosclerosis. 2017;266:16-23.

24. Kahraman S, Agus HZ, Avci Y, et al. The neutrophil to lymphocyte ratio (nlr) is associated with residual syntax score in patients with st-segment elevation myocardial infarction. angiology. 2021;72:166-73.

25. Sabatine MS, Morrow DA, Jablonski KA, et al. Prognostic significance of the centers for disease control/american heart association high-sensitivity c-reactive protein cut points for cardiovascular and other outcomes in patients with stable coronary artery disease. Circulation. 2007;115:1528-36.

26. Chehrevar M, Vafa RG, Rahmani M, et al. Effects of high- or moderate-intensity rosuvastatin on 1-year major adverse cardiovascular events post-percutaneous coronary intervention. Intervent Cardiol. 2022;17:e20.

27. Farshidi H, Abdi A, Madani A, et al. Major adverse cardiovascular event (mace) after percutaneous coronary intervention in one-year follow-up study. Electron Physician. 2018;10:6383-9.

28. Koc M, Karaarslan O, Abali G, Batur MK. Variation in high-sensitivity c-reactive protein levels over 24 hours in patients with stable coronary artery disease. Tex Heart Inst J. 2010;37:42-8.

29. Niccoli G, Biasucci LM, Biscione C, et al. Independent prognostic value of c-reactive protein and coronary artery disease extent in patients affected by unstable angina. Atherosclerosis. 2008;196:779-85.

30. Leaman DM, Brower RW, Meester GT, et al. Coronary artery atherosclerosis: severity of the disease, severity of angina pectoris and compromised left ventricular function. Circulation. 1981;63:285-99.

31. Head SJ, Mack MJ, Holmes DR, Jr, et al. Incidence, predictors and outcomes of incomplete revascularization after percutaneous coronary intervention and coronary artery bypass grafting: a subgroup analysis of 3-year syntax data. Eur J Cardiothorac Surg. 2012;41:535-41.

32. Malkin CJ, George V, Ghobrial MS, et al. Residual syntax score after pci for triple vessel coronary artery disease: quantifying the adverse effect of incomplete revascularisation. EuroIntervention. 2013;8:1286-95.