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Assessment of the SYNTAX Score II in Patients with Non-ST Elevation Myocardial Infarction Who Have Coronavirus Disease-2019

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Abstract

Objectives: The objective of this research was to investigate the correlation between the SYNTAX score II (SS-II), a measure of the occurrence of coronary artery disease and mortality over a 4-year period, and factors that increase the susceptibility of individuals to atherosclerosis in coronavirus disease-2019 (COVID-19) patients diagnosed with non-ST-elevation myocardial infarction (NSTEMI).

Materials and Methods: We retrospectively examined 200 NSTEMI patients with COVID-19 who applied to Adıyaman Training and Research Hospital between 01.07.2021 and 01.11.2021. We recorded demographic data (age, gender), comorbid diseases, laboratory parameters (hemogram, biochemistry, serological test results), thorax computed tomography findings (COVID-19-compatible or not), angiography results, intervention needs, and mortality status. COVID-19 was confirmed by positive reverse transcription polymerase chain reaction. All patients had SS values and SS-II values calculated. Based on a median SS II value of 28.5, the patients were classified into the low and high SS-II groups.

Results: The high-SS-II group exhibited elevated total cholesterol, low-density lipoprotein, carotid intima-media thickness (CIMT), and left ventricular ejection fraction values ($p<0.001$). Logistic regression analysis revealed that CIMT (odds ratio: 3.124, 95% confidence interval: 1.744-5.628; $p<0.001$) was an independent predictor of SS-II.

Conclusion: In patients with NSTEMI and COVID-19, CIMT and SS-II might increase the risk of atherosclerosis. The combination of NSTEMI and COVID-19 increases mortality.

Keywords: Coronavirus disease-2019, non-ST elevation myocardial infarction, SYNTAX score II

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Introduction

Hubei Province's Wuhan province announced a new coronavirus epidemic in December 2019. This sickness spreads uncontrollably. Coronavirus disease-2019 (COVID-19) most often affects the respiratory system, whereas cardiac dysfunction often draws attention to the cardiovascular (CV) system[1]. In an extensive case series, older patients with CV died the most and were most affected by the pandemic[2]. A thorough COVID-19 case count of 72.314 was obtained from the Chinese Center for Disease Control and Prevention. Of 87% of 30-to 79-year-olds, 2.3% died. Mortality was 8% for patients aged 70-79 years and 14.8% for those aged 80+. Comorbidities increased diabetes CV mortality (10.5%)[1,3].

COVID-19 causes myocardial infarction (MI), myocarditis, heart failure (HF), arrhythmia, and venous thromboembolism. Risk-averse patients with CV infection with COVID-19 postpone hospital admission, which worsens outcomes[4,5]. On myocardial cells, severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) can cause cardiac dysfunction. On angiotensin-converting enzyme 2 receptors, the virus strongly activates the innate immune system, producing proinflammatory cytokines and inducing systemic inflammation. A "cytokine storm" causes widespread endothelium and procoagulant activity[6]. Local and systemic coagulation, platelet activation, and immunothrombosis increase with SARS-CoV-2 infection[7].

The severity of non-ST-elevated MI (NSTEMI) is dependent on clinical and laboratory findings[8]. Coronary atherosclerosis causes NSTEMI. Clinical decision-making depends on risk categorization. Early risk, clinical syndrome, and therapy for NSTEMI determine mortality[9]. Risk scoring is used by acute coronary syndrome (ACS) cardiologists to assess coronary artery disease (CAD) severity and complexity[9]. The lack of clinical factors in the SYNTAX score (SS) has been recognized as a notable constraint when used for patients with intricate CAD in terms of classification ability. Recently, researchers have created SS-II as a new solution to overcome this constraints[10]. Researchers have linked SS-II to both angiographic (anatomic SS) and clinical factors, including age, gender, left ventricular ejection fraction (LVEF), creatinine clearance, chronic obstructive pulmonary disease (COPD), and peripheral vascular disease[11]. The application of this method allows for a more precise and personalized prediction of mortality, resulting in a clinically valuable tool for making decisions at the patient's bedside and managing complex CAD[12].

To our knowledge, no study has examined the SS-II score for predicting lesion complexity in NSTEMI patients who survived COVID-19 without sequelae. Therefore, we believe our study will add to the literature. Therefore, we thought it appropriate to conduct a study on SS-II analysis in such patients.

Materials and Methods

Study Design

We retrospectively examined 200 NSTEMI patients with COVID-19 who applied to Adıyaman Training and Research Hospital between 01.07.2021 and 01.11.2021. The local ethics committees approved this Declaration of Helsinki-compliant study. Ethics committee approval was obtained from the Ethics Committee of Adıyaman University Non-Invasive Clinical Research (approval no.: 2021/04-15, date: 20.04.2021). All patients gave informed consent. We selected 213 patients with NSTEMI who underwent coronary angiography (CA) for the study. After determining the exclusion criteria, we admitted 200 consecutive eligible patients to our coronary care unit. At least 48 hours of cardiac troponin levels exceeding the 99th percentile upper reference limit and new or worsening chest discomfort at rest or with moderate effort defined NSTEMI. Abnormal chest discomfort occurred for more than 20 minutes, new-onset angina occurred, and its frequency, duration, and severity were increased. Heart troponin was detected at 0.04 ng/mL on the Alere Triage MeterPro [(Alere Inc., San Diego, California, United States of America (USA)]. The SS, which uses natural coronary arteries, has been found to exclude the recent coronary

artery bypass graft patients[13]. None had cardiogenic shock. Intrastent restenosis is also classified as de novo lesions. We recorded demographic data (age, gender), comorbid diseases, laboratory parameters (hemogram, biochemistry, serological test results), thorax computed tomography findings (COVID-19-compatible or not), angiography results, intervention needs, and mortality status. COVID-19 was confirmed by positive reverse transcription polymerase chain reaction (RT-PCR).

Study Protocol

Use of antihypertensive medication or arterial blood pressure >140/90 more than once defines hypertension (HT). Diabetes mellitus (DM) as ≥126 mg/dL fasting blood glucose or current antidiabetic medication use. Hyperlipidemia was diagnosed in patients with total cholesterol >200 mg/dL, triglycerides >150 mg/dL, and dyslipidemia or antilipidemic therapy. Active smoking was defined as 1 pack per year until 1 month before trial participation. Sudden cardiac death in male or female first-degree relatives under 55 or 65 was considered chronic HF. In the apical 4-chamber view, M-mode echocardiography measured the LVEF. Body mass index was calculated as weight in kg divided by height in meters squared.

In numerous angulated views, the Judkins method was used for femoral selective CA at 30 frames/s (Allura Xper FD10; Philips Healthcare, Best, The Netherlands). Separately, two invasive cardiologists evaluated coronary angiograms under clinical blinding. At least 50% luminal diameter stenosis in one major coronary artery is considered a significant vascular disease. For coronary lesions with a diameter stenosis ≥50% in arteries ≥1.5 mm, scores were required. In interventional cardiology, SS was determined using tertiles (<32, >32). We defined SS-II [percutaneous coronary intervention (PCI) and bypass] based on patient clinical characteristics[6]. Based on a median SS-II value of 28.5, the patients were classified into the low and high SS-II groups.

Statistical Analysis

Statistic calculations were performed using IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp., Armonk, New York, USA). Categorical variables were calculated using numbers and ratios. Mean ± standard deviation was used for regularly distributed data, whereas median (interquartile range) was used for non-normally distributed data. The Kolmogorov-Smirnov test confirmed data normality. Student's t-test and Mann-Whitney U test were used to compare the two groups. Categorical variables were tested using the chi-square. The multivariate logistic regression analysis included possible risk factors identified by the univariate logistic regression analysis ($p<0.25$). Finally, forward logistic regression identified the most dissimilar factors between the groups. $P<0.05$ qualifies as statistically significant.

Results

The study included 200 patients with NSTEMI (mean age: 62.3±12.5 years, 65% male). Table 1 shows baseline demographic and clinical data according to SS-II for the research population. Smoking, HT, DM, COPD, peripheral arterial disease, previous PCI, stroke, and family history were significantly more frequent in the high SS-II group ($p<0.001$). The low SS group had a higher proportion of men, whereas the high SS-II group had a higher average age ($p<0.001$). The high SS-II group exhibited elevated total cholesterol, low-density lipoprotein (LDL), carotid intima-media thickness (CIMT), and LVEF values ($p< 0.001$). The groups exhibited similar values for high-density lipoprotein (HDL) and triglyceride (TG) levels and medication rates ($p>0.05$).

Table 2 lists the parameters of the univariate linear regression analysis and the statistical evaluations. CIMT, HDL, LDL, and HT were independently associated with SS-II. Furthermore, logistic regression analysis revealed that CIMT (odds ratio: 3.124, 95% confidence interval: 1.744-5.628; $p<0.001$) was an independent predictor of SS-II.

Table 1. Characteristics of the study population

	Low SS-II (n=100)	High SS-II (n=100)	p-value
Age, years	59.1±0.8	65.1±0.3	**<0.001**
Gender, male, n, (%)	70 (70)	60 (60)	**<0.001**
Previous PCI history, (%)	42 (42)	49 (49)	**<0.001**
Family history, %	10 (10)	19 (19)	**<0.001**
BMI, kg/m²	27.4±0.6	28.1±1.1	0.356
DM (%)	22 (22)	28 (28)	**<0.001**
HT (%)	46 (46)	51 (51)	**0.008**
PAD (%)	25 (25)	42 (42)	**<0.001**
COPD (%)	43 (43)	50 (50)	**<0.001**
Smoking (%)	40 (40)	47 (47)	**<0.001**
Glucose (mg/dL)	115.5±54.3	128.5±58.4	0.072
GFR (mL per min/1.73 m²)	61.1±1.5	74.1±1.8	0.096
TC, mg/dL	162 (42-200)	186 (57-236)	**<0.001**
HDL, mg/dL	42 (12-48)	38 (10-44)	0.092
LDL, mg/dL	101 (34-122)	127 (42-156)	**<0.001**
TG, mg/dL	125.35 (69.9-116)	133.8 (80.25-156)	0.652
CIMT	0.73±0.26	0.97±0.3	**<0.001**
LVEF (%)	51.1 0.7	46.3±0.8	**<0.001**
Medications			
ACEI (%)	25	25.8	0.522
BB (%)	6.5	7.1	0.456
CCB (%)	8.7	9.4	0.324
ASA (%)	17.4	16.8	0.371
Statin (%)	16.2	17.6	0.666

p-value<0.05
PCI: Percutaneous coronary intervention, SS-II: SYNTAX score II, BMI: Body mass index, DM: Diabetes mellitus, HT: Hypertension, PAD: Peripheral arterial disease, COPD: Chronic obstructive pulmonary disease, GFR: Glomerular filtration rate, TC: Total cholesterol, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, TG: Triglyceride, CIMT: Carotid intima-media thickness, LVEF: Left ventricular ejection fraction, ACEI: Angiotensin-converting enzyme inhibitor, BB: Beta blocker, CCB: Calcium channel blocker, ASA: Acetyl salicylic acid

Table 2. Factors associated with SS-II

Linear regression analysis				**Logistic regression analysis**		
	Coefficients	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
CIMT	5.202	3.16-10.2	**<0.001**	3.124	1.744-5.628	<0.001
HDL	0.128	-0.025-0.622	**0.042**			
LDL	0.902	0.542-1.256	**0.029**			
HT	0.524	0.324-2.960	0.056			

Variables with p<0.25 in univariate regression were included into multivariate regression
SS-II: SYNTAX score II, CI: Confidence interval, OR: Odds ratio, CIMT: Carotid intima-media thickness, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, HT: Hypertension

Discussion

This study examined the correlation between SS-II and CIMT in patients with NSTEMI and COVID-19. The primary conclusions of this investigation were as follows: (i) There was a strong correlation between SS-II and CIMT, and (ii) CIMT is a reliable indicator of SS-II.

The COVID-19 pandemic has severely impacted healthcare services, limiting patient access, halting elective procedures, and causing patients to hesitate to visit hospitals due to infection transmission, particularly in NSTEMI[14,15]. Chronic illnesses COVID-19 increase risk and mortality. Ischemic heart disease, HT, HF, and atrial fibrillation are more common in COVID-19 deaths[16].

COVID-19 patients with elevated cardiac troponin levels, echocardiographic abnormalities, and electrocardiograms have reported acute myocarditis. Cardiac histopathological findings in deceased patients include inflammatory and prothrombotic features, damage from previous conditions, and myocardial hypertrophy. A significant proportion of patients with COVID-19 have increased high-sensitivity cardiac troponin (hs-cTn) levels, with over 50% of those who died having hs-cTnI levels above 28 mg/mL. We recommend searching for other clinical features because troponin elevation alone does not diagnose ACS. CA is recommended for patients with inflammatory marker values. Patients whose CT scan results were not compatible with COVID-19 and whose RT-PCR test was negative also required more intervention. Laboratory tests, RT-PCR test results, and thorax CT findings do not have a statistically significant effect on the requirement for CA[17-19].

A study by Majeed et al.[20] found that patients with NSTEMI and COVID-19 had a higher inpatient mortality rate, longer length of stay, and fewer invasive cardiac procedures. Despite lower underlying cardiac and pulmonary comorbidities, these patients have a five-fold mortality risk. COVID-19 can lead to various clinical symptoms, including MI, myocarditis, HF, arrhythmias, and venous thromboembolism. Cardiac damage in COVID-19 infections is attributed to mechanisms such as inflammation, cytokine storms, increased coagulation functions, and an imbalance between oxygen supply and demand[21].

The SS angiographic scoring instrument ranks coronary lesions by complexity. Patients with stable CAD, multivessel disease, or complicated coronary lesions were tested first. The SS-II grading system, which combines anatomical SS and clinical factors, may better predict clinical events[22]. Song et al.[23] found SS-II better than SS for predicting 2-year death in patients with complicated CAD, and Salvatore et al.[24] showed it may predict unfavorable clinical outcomes in patients with severe CAD. Combined anatomical and clinical characteristics favored anatomical SYNTAX. Through cardiac bypass or PCI risk rating, SS-II was found to predict 4-year mortality. Age, creatinine, and ejection fraction enhanced SYNTAX adverse event prediction. Lower LVEF, creatinine clearance, anatomical SS, younger age, and female sex were favorable markers for coronary bypass in the SYNTAX research[25-27]. CIMT, an atherosclerosis measure, was significantly correlated with SS-II in our research.

Hayiroglu et al.[28] observed that SS-II was associated with in-hospital mortality and major adverse cardiovascular events (MACE). To predict target lesion revascularization, stent thrombosis, or recurrent MI, SS-II is a poor predictor. We did not assess individuals with long-term MACE who tested positive for COVID-19 in cases of NSTEMI.

Study Limitations

The SS-II score in patients with COVID-19 and NSTEMI has several drawbacks. Hypercoagulability due to COVID-19 increases thrombosis risk. This may make CAD severity assessment and revascularization decisions more difficult, underestimating CAD's complexity. Inflammation due to COVID-19 can worsen CV problems. This heightened inflammatory state can alter the presentation and prognosis of patients with NSTEMI, whereas the SYNTAX II score does not. In patients with severe COVID-19, hemodynamic instability

may occur. This may cause SS-II score errors because it can complicate angiographic interpretation and coronary architecture assessment. COVID-19 can damage, inflame, and cause stress in the heart. The SS-II does not include these conditions, prioritizing anatomy over function. Catheterization laboratories and specialized staff may be scarce during the COVID-19 pandemic. Rapid or accurate patient assessment could potentially impact the SS-II. SS-II predicts long-term results using anatomical and clinical characteristics. COVID-19 increases the risk of serious respiratory problems and longer hospital admissions, which can change the outcome. COVID-19's symptoms and severity of COVID-19 affect NSTEMI's clinical appearance. Due to this unpredictability, a standardized scoring system like SS-II may not adequately represent the clinical context of these patients.

Conclusion

The correlation between CIMT and SS-II in patients with COVID-19 diagnosed with NSTEMI might provide useful insights into their susceptibility to atherosclerosis. The correlation between NSTEMI and COVID-19 is a significant contributor to the increase in mortality rates.

Ethics

Ethics Committee Approval: Ethics committee approval was obtained from the Ethics Committee of Adıyaman University Non-Invasive Clinical Research (approval no.: 2021/04-15, date: 20.04 2021).

Informed Consent: Informed consent was obtained from all patients.

Authorship Contributions

Surgical and Medical Practices: Tanrıverdi O, Concept: Aşkın L, Design: Şengül Aşkın H, Data Collection and/or Processing: Tanrıverdi O, Analysis and/or Interpretation: Aşkın L, Literature Search: Aşkın L, Şengül Aşkın H, Writing: Tanrıverdi O.

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References

1. Bader F, Manla Y, Atallah B, Starling RC. Heart failure and COVID-19. Heart Fail Rev. 2021;26:1-10.
2. Salabei JK, Asnake ZT, Ismail ZH, et al. COVID-19 and the cardiovascular system: an update. Am J Med Sci. 2022;364:139-47.
3. Askin L, Tanrıverdi O, Askin HS. The Effect of Coronavirus Disease 2019 on Cardiovascular Diseases. Arq Bras Cardiol. 2020;114:817-22.
4. Xiang D, Xiang X, Zhang W, et al. Management and Outcomes of Patients With STEMI During the COVID-19 Pandemic in China. J Am Coll Cardiol. 2020;76:1318-24.
5. De Rosa S, Spaccarotella C, Basso C, et al. Reduction of hospitalizations for myocardial infarction in Italy in the COVID-19 era. Eur Heart J. 2020;41:2083-8.
6. Liao CT, Chang WT, Yu WL, Toh HS. Management of acute cardiovascular events in patients with COVID-19. Rev Cardiovasc Med. 2020;21:577-81.
7. Choi H, Lee JH, Park HK, et al. Impact of the COVID-19 Pandemic on Patient Delay and Clinical Outcomes for Patients With Acute Myocardial Infarction. J Korean Med Sci. 2022;37:e167.
8. Aktürk E, Aşkın L, Taşolar H, Türkmen S, Kaya H. Comparison of the Predictive Roles of Risk Scores of In-Hospital Major Adverse Cardiovascular Events in Patients with Non-ST Elevation Myocardial Infarction Undergoing Percutaneous Coronary Intervention. Med Princ Pract. 2018;27:459-65.
9. Kurtul S, Sarli B, Baktir AO, et al. Neutrophil to lymphocyte ratio predicts SYNTAX score in patients with non-ST segment elevation myocardial infarction. Int Heart J. 2015;56:18-21.
10. Granger CB, Goldberg RJ, Dabbous O, et al. Predictors of hospital mortality in the global registry of acute coronary events. Arch Intern Med. 2003;163:2345-53.
11. Farooq V, van Klaveren D, Steyerberg EW, et al. Anatomical and clinical characteristics to guide decision making between coronary artery bypass surgery and percutaneous coronary intervention for individual patients: development and validation of SYNTAX score II. Lancet. 2013;381:639-50.
12. Xu B, Généreux P, Yang Y, et al. Validation and comparison of the long-term prognostic capability of the SYNTAX score-II among 1,528 consecutive patients who underwent left main percutaneous coronary intervention. JACC Cardiovasc Interv. 2014;7:1128-37.
13. Farooq V, Girasis C, Magro M, et al. The CABG SYNTAX Score - an angiographic tool to grade the complexity of coronary disease following coronary artery bypass graft surgery: from the SYNTAX Left Main Angiographic (SYNTAX-LE MANS) substudy. EuroIntervention. 2013;8:1277-85.
14. De Luca G, Verdoia M, Cercek M, et al. Impact of COVID-19 Pandemic on Mechanical Reperfusion for Patients With STEMI. J Am Coll Cardiol. 2020;76:2321-30.

15. De Luca G, Cercek M, Jensen LO, et al. Impact of COVID-19 pandemic and diabetes on mechanical reperfusion in patients with STEMI: insights from the ISACS STEMI COVID 19 Registry. Cardiovasc Diabetol. 2020;19:215.

16. Nai Fovino L, Cademartiri F, Tarantini G. Subclinical coronary artery disease in COVID-19 patients. Eur Heart J Cardiovasc Imaging. 2020;21:1055-6.

17. Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet. 2020;395:1054-62.

18. Zhang J, Wang Z, Wang X, Hu Z, Yang C, Lei P. Risk Factors for Mortality of COVID-19 Patient Based on Clinical Course: A Single Center Retrospective Case-Control Study. Front Immunol. 2021;12:581469.

19. Weiss P, Murdoch DR. Clinical course and mortality risk of severe COVID-19. Lancet. 2020;395:1014-5.

20. Majeed H, Gangu K, Sagheer S, et al. COVID-19 and NSTEMI Outcomes among Hospitalized Patients in the United States and Racial Disparities in Mortality: Insight from National Inpatient Sample Database. Vaccines (Basel). 2022;10:2024.

21. Aşkın L. Aşkın HŞ. Tanrıverdi O. COVID-19 ile İlişkili Miyokardit. MN Kardiyoloji. 2021;28:254-60.

22. Aşkın L, Aktürk E. Association between SYNTAX II score and electrocardiographic evidence of no-reflow in patients with ST-segment elevation myocardial infarction. Turk Kardiyol Dern Ars. 2018;46:455-63.

23. Song Y, Gao Z, Tang X, et al. Usefulness of the SYNTAX score II to validate 2-year outcomes in patients with complex coronary artery disease undergoing percutaneous coronary intervention: A large single-center study. Catheter Cardiovasc Interv. 2018;92:40-7.

24. Salvatore A, Boukhris M, Giubilato S, et al. Usefulness of SYNTAX score II in complex percutaneous coronary interventions in the setting of acute coronary syndrome. J Saudi Heart Assoc. 2016;28:63-72.

25. Yadav M, Palmerini T, Caixeta A, et al. Prediction of coronary risk by SYNTAX and derived scores: synergy between percutaneous coronary intervention with taxus and cardiac surgery. J Am Coll Cardiol. 2013;62:1219-30.

26. Chieffo A, Meliga E, Latib A, et al. Drug-eluting stent for left main coronary artery disease. The DELTA registry: a multicenter registry evaluating percutaneous coronary intervention versus coronary artery bypass grafting for left main treatment. JACC Cardiovasc Interv. 2012;5:718-27.

27. Girasis C, Garg S, Räber L, et al. SYNTAX score and Clinical SYNTAX score as predictors of very long-term clinical outcomes in patients undergoing percutaneous coronary interventions: a substudy of SIRolimus-eluting stent compared with pacliTAXel-eluting stent for coronary revascularization (SIRTAX) trial. Eur Heart J. 2011;32:3115-27.

28. Hayiroglu MI, Keskin M, Uzun AO, et al. Predictive value of SYNTAX score II for clinical outcomes in cardiogenic shock underwent primary percutaneous coronary intervention; a pilot study. Int J Cardiovasc Imaging. 2018;34:329-36.