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Journal of Clinical Cardiology and Cardiovascular Interventions
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Research Article

Prognostic value of SYNTAX scores for Predicting Major Cardiac Adverse events in Patients with acute Myocardial Infarction who Underwent Primary Percutaneous Coronary Intervention

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Received Date: December 12, 2022; **Accepted Date:** March 27, 2023; **Published Date:** April 03, 2023

Citation: Tran Duc Hung, Nguyen Quang Toan, Do Van Chien (2023), Prognostic value of SYNTAX scores for Predicting Major Cardiac Adverse events in Patients with acute Myocardial Infarction who Underwent Primary Percutaneous Coronary Intervention, *J. Clinical Cardiology and Cardiovascular Interventions*, 6(3); DOI:10.31579/2641-0419/299

Abstract

Background: SYNTAX (SS) and clinical SYNTAX (CSS) scores are widely used in clinical practice to predict major adverse cardiac events (MACE) after elective and primary percutaneous intervention (PCI). We sought to investigate prognostic values for SS and CSS with more accurate predictive ability for MACE.

Methods: All patients of two referral hospitals who were diagnosed with ACS were recruited for the study. SS and CSS were calculated by researchers blinded to the operators using the designed web-based software and clinical factors. SS was classified into three categories: low SS1:0 – 11.75, moderate SS2:11.75 – 23.25, and high SS3: ≥ 23.25. CSS was classified as follows: low CSS1:0-22.95, moderate CSS2:22.95-35.95, and high CSS3: ≥ 35.95. All patients were advised to visit our clinic at 1, 6, and 12 months. Clinical examination results and MACE were recorded in the hospital clinical system database.

Results: We recorded the clinical data of 296 patients. After 12 months of follow-up, MACE occurred in 16.8% of SS3, 9.3% of SS2, and 8.2% of SS1 cases. MACE accounted for 14.0% of CSS3, 11.3% of CSS2, and 8.1% of CSS1 cases. Conclusions: The classification of SS (low SS1:0 – 11.75, moderate SS2:11.75 – 23.25, high SS3: ≥ 23.25) and CCS (low CSS1:0-22.95, moderate CSS2:22.95-35.95, high CSS3: ≥ 35.95) had important roles in the risk assessment of patients with ACS who underwent primary PCI.

Keywords: syntax score; clinical syntax score; mace; percutaneous coronary intervention

Introduction

Acute myocardial infarction (AMI) is the leading cause of death worldwide. Several studies have shown that primary percutaneous coronary intervention (PCI) is effective in reducing mortality [1]. Predicting major cardiac adverse events after PCI is challenging. In clinical practice, there are several clinical models and scoring systems that attempt to predict patient outcomes, such as hemodynamics, severity of coronary lesions, electrocardiographic features, age, cardiac enzyme, Leamen score, Zwolle index, Mayo, CARDILLAC, ACEF, and Gensini [2-7]. However, these models and scores have many limitations that make them less practical. The SYNTAX score (SS) was designed in 2005 and was inherited and developed from previous scores [18]. However, the SS was independent of patients' clinical parameters. The clinical SYNTAX score (CSS) simulates the SS when adding clinical features (age, left ventricular ejection fraction, serum creatinine clearance) to improve the limitations of the SS. Previous studies have shown that including the clinical characteristics of the patient can improve the prognostic value of the SS. The CSS together with the SS can predict major cardiovascular events after PCI in the short and long terms [8,9]. However, clinical data show that the prognostic value of the anatomical and CSS to predict major cardiac events in patients with acute coronary syndrome (ACS) who underwent primary PCI is still controversial. Therefore, the main objective of our study was to define the role of CSS and SS to predict major adverse cardiac events (MACE) in a cohort of patients with acute myocardial infarction who underwent PCI at 12 months follow-up.

Materials and Methods

Study populations

During the period from May 2015 to February 2020, we were able to follow 296 patients for 12 months. All the patients underwent primary PCI at two referral hospitals in Hanoi, Vietnam. Patients must have fulfilled all the criteria for ST-elevation myocardial infarction (STEMI) according to the

2012 European Society of Cardiology guidelines [10] and agreed to participate in the study. Data were collected from a hospital database containing information on patient demographics, electrocardiographic and echocardiographic characteristics, and laboratory test results. Primary PCI was performed by interventionalists on duty, and all data were obtained by the researchers at the end of the procedure, and patients were prospectively followed up for 12 months. All patients were advised to visit our clinic at 1, 6, and 12 months. We recorded all cardiovascular events, such as all-cause mortality, cardiovascular mortality, myocardial infarction, stroke, and re-intervention, and a composite of all the above-mentioned events was considered a MACE.

SYNTAX score (SS) and clinical SYNTAX score (CSS) calculations

The SS was calculated offline by the researchers based on coronary images after primary PCI. We used SS calculator application version 2.11 (www.SYNTAXscore.com) and the CSS was obtained after calculation of the anatomical SS (CSS formula: anatomical SS X (Age/Left ventricular ejection fraction) + 1(for each reduction of 10 ml/minute of creatinine clearance, maximum 6 points). All scores were documented using electronic database systems. To ensure reproducibility, we randomly asked another cardiologist who was blinded to the patient demographics and details to check 15 patients (5%) for the variability of measurement.

We relied on a cohort of patients with major cardiovascular events that occurred during the 12-month period following coronary intervention. The SS and CSS of these patients were obtained using the receiver operating characteristic curve analysis algorithm, and we relied on the Youden index (J = Youden index) with the highest and lowest values to determine the landmarks for the SS and CSS groups. The J-index was highest at the SS of 23.25 and lowest at 11.75; for CSS, the J-index was highest at 35.95 and lowest at 22.95. These were the benchmarks used to subgroup high and low CSS and SS in the study. Our cutoff values were classified as high (SS1:23.25, CSS1:35.95) and low (SS3:11.75; CSS3:22.95), and the values between them were considered moderate risk (SS2:11.75-23.25; CSS2:22.95-35.94).

All patients were treated with antiplatelet therapy according to the 2012 European Society of Cardiology guidelines on STEMI and well-controlled for comorbidities.

Statistical analysis

SPSS software (version 21.0, USA) was used for statistical analysis. Quantitative variables are expressed as mean, median (maximum, minimum), and standard deviation (SD). Qualitative variables were expressed as percentages. To test the statistical difference, we used Chi-squared test (χ^2) and Student's t-test (T-test). To assess the relationship between independent variables, such as risk factors, scales, or other prognostic indicators, and mortality or major events in patients with myocardial infarction, we used an analytical algorithm. When analyzing multiple factors with prognostic value for the risk of death and cardiovascular events to determine which factors have prognostic value, we used a multivariable logistic regression analysis algorithm.

Results and Discussion

Baseline clinical and angiographic characteristics

Overall, we included 296 patients (mean age, 65.5±10.9 years) in our study. Data from the patients were obtained from the hospital electronic database. Most patients were male (77.7%). There were 61 patients with low SS (mean age, 64.3±17.6 years), 140 patients with moderate SS (mean age, 58.7±15.9 years), and 95 patients with high SS (mean age, 61.5±19.6). The average SS was 19.5±9.4. Among the risk factors, SS1, SS2, and SS3 differed in terms of hypertension and previous PCI. In terms of angiographic characteristics, we found that there were significant differences in complex lesions, such as multi-vessel disease or left main or CTO, among the three groups. However, we could not find any differences among SS1, SS2, and SS3 in the left circumflex and right coronary arteries. Patients with moderate and high SS had more drug-eluting stents (97.0% and 97.2%, respectively) (Table 1).

Table 2 shows the clinical and angiographic characteristics of the patients based on the CSS. There were 115 patients with low CSS (mean age, 59.3 ±19.3 years), 74 patients with moderate CSS (mean age, 61.7 ± 14.3 years), and 107 patients with high SS (mean age, 67.1 ± 16.6 years). The average CSS was 30.2±18.8. Among the risk factors, the only difference among SS1, SS2, and SS3 was in terms of hypertension. Regarding angiographic characteristics, we found that there were significant differences in complex lesions, such as multi-vessel disease or left main or CTO, among the groups. However, we could not find any differences among CSS1, CSS2, and CSS3 in the left anterior descending, circumflex, and right coronary arteries. Patients with low and moderate CSS had more thrombus suction (3.0% and 1.9%, respectively).

Patients with SS3 had the highest all-cause mortality, cardiovascular death, and MACE (22.1%, 15.8%, and 16.8%, respectively), followed by patients with moderate SS (15.0%, 12.9%, and 9.3%, respectively). Patients with SS1 had the lowest all-cause mortality, cardiovascular death, and MACE (8.2%, 6.2%, and 8.2%, respectively). Based on CSS, patients with SS3 had the highest all-cause mortality, cardiovascular death, and MACE (26.2%, 18.7%, and 14.0%, respectively), followed by patients with moderate SS (14.9%, 16.2%, and 11.3%, respectively). Patients with SS1 had the lowest all-cause mortality, cardiovascular death, and MACE (7.0%, 4.3%, and 8.1%, respectively) (Table 3).

After 12 months, the group with a high SS of SS3 had the lowest survival rate of 77.9%, and the group with an average SS of SS2 and low SS1 had a statistically significant difference. Thus, the higher the SS, the higher the mortality rate after 12 months of intervention (Figure 1). With the data table and Kaplan-Meier analysis, the probability of survival after 12 months in the group with high CSS3 was the lowest at 73.8%, followed by the group with average CSS2, and low CSS1 score with p(log) -rank) <0.001 was statistically significant (Figure 2).

Discussion

The main finding of our study was that we were able to establish new prognostic cutoff values for the classification of SS and CSS: SS: Low SS1: 0 – 11.75; moderate SS2: 11.75 – 23.25; high SS3: ≥ 23.25. CSS: low CSS1:0-22.95, moderate CSS2:22.95-35.95, high CSS3: ≥ 35.95. After 1 year of follow-up, MACE occurred in 16.8% of SS3 cases, 9.3% of SS2 cases, and 8.2% of SS1 cases. MACE accounted for 14.0% of CSS3, 11.3% of CSS2 and 8.1% of CSS1 cases. The SS and CSS have been tested in many trials, which showed that these scores are valuable in risk classification after both primary and elective PCI [11,12]. However, there is still debate on which v prognostic values are the best to classify risk based on SS and CSS, and we tried to answer this question with our cohort of patients. We followed the protocol to identify the CSS by calculating the anatomical SS, and by adding age, LVEF, and eGFR to SS, we determined CSS. Based on our findings (MACE) and Youden index, we were able to identify cutoff values that helped to divide the SS and CSS into three tertiles: low, moderate, and high.

Karabag et al. [13] studied 1912 STEMI patients and defined CSS as low (≤24.6), moderate (26.4-34.4), and high (≥34.4) and found that in-hospital and long-term mortality rates from all causes (0 vs. 0.5 vs. 10.6% and 1.8 vs. 3.2 vs. 18.1%, respectively; p≤0.001) were significantly increased with higher SS, and high SS was found to be an independent predictor of in-hospital and long-term mortality (HR:1.076; 95% CI:1.060–1.092, p<0.0001). When using our values for clarification, we found that SS and CSS had more accurate prognostic values after 12 months of follow-up (RR:2.99; 95%CI:1.11-7.84 for SS and RR:4.23; 95%CI:1.94-9.36 for CSS). This can be explained by the fact that their cohort of patients was younger

(57±12 years) than our cohort. Garg et al. [8] retrospectively calculated the SS and divided the patients into three groups: low SS < 9, moderate SS:9-15, and high SS > 15. Their cut-off points showed that the primary event occurred earlier, and with our lower SS; a larger number of patients was studied [14]. At the 1-year follow-up, all clinical outcomes, including mortality; mortality/reinfarction; MACE (a composite of all-cause death, reinfarction, and target vessel revascularization); and definite, definite/probable, and any stent thrombosis, were significantly higher in patients in the highest SS tertile. The SS was identified as an independent predictor of mortality, MACE, and stent thrombosis at the 1-year follow-up. The authors also combined the SS and PAMI scores, which led to a net reclassification improvement of 15.7% and 4.6% for mortality and MACE, respectively.

When we followed up 12 months after the intervention, the mortality rate in the high CSS3 group was 26.2%, compared with 14.9% in the moderate CSS2, and 7% in the low CCS1 group. Through linear regression analysis, we found that CSS3 had a 4.23-times higher risk of death than the CSS1 group (RR = 4.23; 95% CI:1.94 - 9.36, p < 0.001), death in the CSS3 group was 1.96-times higher than that in the CSS2 group, and death in the CSS2 group was 2.19-times higher than that in the CSS1 group (RR = 2.19; 95% CI:0.88 - 5.44, p = 0.092). On the Kaplan-Meier curve, we found that the CSS3 group had the lowest survival probability of 85.1% (red line) compared with that of the CSS2 group (93.2%, yellow line) and low SS1 (96.5%; blue line). The difference was considered statistically significant at p (log-rank) < 0.001. Thus, the CSS was an independent predictor of mortality risk in patients with AMI after PCI at 12 months. Centinkal et at. [15] reported that CSS > 26 was an independent predictor of the composite of all-cause mortality, myocardial infarction, and stroke (HR = 3.58, 95% CI:1.68-7.60, p = 0.001). Many other studies have also demonstrated that the CSS is an independent predictor of the risk of all-cause mortality and cardiovascular death in patients with coronary artery disease, including those with AMI after percutaneous coronary intervention [16,17].

Study limitations

This study had limitations. First, the sample size of the study was small and taken from two tertiary hospitals and cannot be generalized to all patients with ACS. Second, we were unable to follow-up every month after discharge from the hospital due to limited financial support.

Conclusions

The new cutoff values of SS (low SS1:0 – 11.75; moderate SS2:11.75 – 23.25; high SS3: ≥ 23.25) and CCS (low CSS1:0-22.95, moderate CSS2:22.95-35.95, high CSS3: ≥ 35.95) have an important role in the risk assessment of patients with ACS who underwent primary PCI.

Data Availability

Contact correspondent author on special request.

Conflicts of Interest

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

Funding Statement

The research did not receive any funding.

Acknowledgments

None.

Ethics Committee Approval

Ethical committee approval was received from the Ethics Committee of Bach Mai and 103 Military Hospital (approval no:320; date:04.07.2015).

Informed Consent

Written informed consent was obtained from all participants who participated in this study.

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DOI:10.31579/2641-0419/299