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ORIGINAL ARTICLE

Residual Synergy between percutaneous Coronary Intervention With Taxus and Cardiac Surgery (SYNTAX) score to Predict in-hospital Clinical Outcomes among ST Elevation Myocardial Infarction Patients undergoing Primary Percutaneous Coronary Intervention

Imran Ali, Ihsan Ullah, Fazal Akbar, Abid Ullah, & Ali Raza
Peshawar Institute of Cardiology, Peshawar-Pakistan

Abstract

Background: The SYNergy between Percutaneous Coronary Intervention (PCI) with TAXUS and Cardiac Surgery (SYNTAX) score (SS) assesses the anatomical complexity of Coronary Artery Disease (CAD). Residual SS (rSS) quantifies the burden of residual CAD following PCI.

Methodology: It was a descriptive cross-sectional study conducted at the Peshawar Institute of Cardiology inpatient departments, from March 2023 to Aug 2023. Patients, who satisfied the criteria for type 1 Myocardial Infarction (MI), were included in the study by non-probability consecutive sampling technique. Baseline SS (bSS) and rSS were calculated using an online calculator (syntax.org/calculator) Patients were stratified as Complete Revascularization (CR) rSS =0, Reasonably Incomplete Revascularization (RICR) rSS >0 and ≤8, and Incomplete Revascularization (ICR) rSS >8. In-hospital clinical outcomes included all causes in-hospital mortality and Major Adverse Cardiac and Cerebrovascular Events (MACCE) were recorded. The analyses were conducted using the statistics and data analysis (STATA) version 14.2.

Results: A total of 426 patients were included in our study. The most common risk factor for CAD was hypertension. In the ICR group, 21.4% of patients had Significant Left Main Stem disease. The majority of the CR subjects had significant single-vessel CAD. In CR and RICR groups, the Left Anterior Descending artery while in ICR Right Coronary Artery was the common culprit vessel causing MI. All-cause in-hospital mortality was 4.2% and MACCE was 11.03%, and were common among the ICR subjects (9.8% and 10.7%, respectively), but had a comparable proportion in CR and RICR groups. Logistic regression revealed a significant association between rSS categories and mortality, (Odds ratio 2.42; 95% CI: 1.28 to 4.57).

Conclusion: The rSS is a useful tool in quantifying incomplete revascularization among STEMI patients undergoing primary PCI, and ICR appears to confer a higher in-hospital mortality and MACCE.

Introduction

"The management of patients with ST-segment elevation myocardial infarction (STEMI) undergoing primary percutaneous coronary intervention (PCI) remains a critical focus in cardiology, as the risk of adverse clinical outcomes is significant despite advancements in revascularization techniques. The SYNergy between PCI with TAXUS™ and Cardiac Surgery (SYNTAX) study was organized for patients with significant left main and/or three-vessel Coronary Artery Disease (CAD). The SYNTAX score (SS), was originally developed for this study to assess the anatomical complexity of CAD[1]. It has been a crucial tool in guiding treatment strategies[2]. Genereux et al described the residual SYNTAX score (rSS), which quantifies the burden of residual coronary stenosis post-PCI[3]. The rSS provides a valuable measure of incomplete revascularization and has emerged as an important prognostic tool for predicting both short- and long-term clinical outcomes in various patient populations[4,5].

Studies have underscored the prognostic value of rSS in assessing the likelihood of adverse in-hospital outcomes among STEMI patients undergoing primary PCI. High rSS scores have been associated with an increased risk of major adverse cardiac events and cerebrovascular events (MACCE), including mortality, myocardial infarction, and the need for repeat revascularization[6,7]. The ability of rSS to predict these outcomes highlights its potential utility in clinical decision-making, particularly in identifying patients who may benefit from more aggressive or alternative therapeutic strategies.

Moreover, the integration of rSS with other clinical factors, such as left ventricular function, renal impairment, and comorbid conditions like diabetes or obstructive sleep apnea, enhances its predictive accuracy[2,8]. This combined approach allows for a more nuanced risk stratification, providing a comprehensive assessment of a patient's post-PCI prognosis.

This study aims to explore the significance of the rSS score in predicting in-hospital clinical outcomes, in terms of all-cause mortality, recurrent Myocardial Infarction (MI), repeated revascularization, and MACCE, among STEMI patients undergoing primary PCI. By evaluating the relationship between rSS and immediate post-procedural complications, this research seeks to contribute to the growing body of evidence supporting the use of rSS as a critical metric in the management of STEMI patients.

Methodology

It was a descriptive cross-sectional study conducted at inpatient departments of Peshawar Institute of Cardiology (PIC), Peshawar from March 2023 to Aug 2023. Ethical approval was taken from the Institutional Review Board (IRB), PIC. Patients of any age and both genders who present within 12 hours of the onset of chest pain or within 12 to 24 hours of the onset of chest pain having ongoing symptoms who satisfied the criteria for type 1 MI, as stated in the 4th Universal Definition of Myocardial Infarction[9], were included in the study by non-probability consecutive sampling technique.

Patients with a previous history of Coronary Artery Bypass Graft (CABG) surgery, cardiogenic shock, re-canalized vessel, post-thrombolysis, and STEMI patients for whom medical management or deferred PCI was planned, were excluded from the study. Informed written consent was taken from patients or patients' families. Risk factors assessment for CAD (Diabetes mellitus, hypertension, cigarette smoking, and family history of CAD) was done through detailed medical history and clinically relevant laboratory investigations.

Baseline SYNTAX Score 1 (bSS) was calculated using an online calculator (syntax.org/calculator) of each coronary lesion with diameter stenosis of at least 50%, in vessels of at least 1.5 mm. Occluded infarct-related arteries were scored as occlusions of less than 3 months in duration All angiographies were seen by 2 interventional cardiologists and SS were calculated by consensus. The rSS was calculated after PCI using the same online SYNTAX calculator.

Patients were stratified as Complete Revascularization (CR) if rSS =0, Reasonably Incomplete Revascularization (RICR) if rSS >0 and ≤8, and Incomplete Revascularization (ICR) if rSS >8.

In-hospital clinical outcomes included all causes of in-hospital mortality, recurrent MI, stent thrombosis, repeated revascularization, and MACCE, according to the Academic Research Consortium-2 consensus document[10].

Data obtained were converted into variables. Binary variables were expressed as proportions and continuous data was reported as means±Standard Deviations. One-way ANOVA and Chi-square tests were used to compare the groups. A logistic regression analysis was conducted to establish a relationship between the rSS score and mortality. The analyses were conducted using the statistics and data analysis (STATA) version 14.2.

Results

A total of 426 patients were included in our study. The mean age had a rising trend from CR to RICR and ICR (55.6, 58.8, and 61.5 years, respectively). Male subjects were 320 (75.1%) while females were 106 (24.9%). The most common risk factor for CAD reported in our study was hypertension (55.9%), followed by diabetes mellitus (33.8%) and smoking (14.3%). Similar to age, a rising trend in the frequency of diabetes mellitus was recorded from CR to RICR and ICR (Table 1).

Significant Left Main Stem (LMS) disease was present in a significantly higher proportion (21.4%) in the ICR group. The majority of the CR subjects had significant single-vessel CAD (88.5%). And majority of the RICR and ICR subjects had significant two-vessel (60.0%) and three-vessel (53.6%) CAD, respectively (Table 1).

The Left Anterior Descending Artery (LAD) was the most common culprit vessel causing MI in the CR and RICR groups (55.7% and 57.1%, respectively) and its second common culprit vessel in the ICR group (39.3%). Right Coronary Artery was the most common culprit vessel in the ICR group (52.7%) and it was second most common in the other two groups (31.0% and 32.9%) (Table 1).

Trans-radial access was the predominant route for cardiac catheterization. Femoral access was used in a total of 6.8% of patients. Family history of premature CAD and previous history of MI and/or PCI were equally poised among the three groups and were statistically not significant (Table 1).

Table 1: Baseline and Clinical Characteristics

	Complete Revascularization n=174	Reasonably Incomplete Revascularization n=140	Incomplete Revascularization n=112	Total n=426	*P* value
Age	55.6±12.0	58.8±10.3	61.5±9.5	58.2±11.1	0.03
Male	141 (81%)	104 (72.3%)	75 (67%)	320 (75.1%)	0.02
Diabetes Mellitus	44 (25.3%)	50 (35.7%)	50 (44.6%)	144 (33.8%)	0.003
Hypertension	83 (47.7%)	88 (62.9%)	67 (59.8%)	238 (55.9%)	0.017
Smoking	20 (11.5%)	23 (16.4%)	18 (16.1%)	61 (14.3%)	0.049
Family History	5 (7.8%)	6 (10.7%)	4 (8.0%)	15 (8.8%)	0.830
Prior MI/ Prior PCI	20 (11.5%)	21 (15.0%)	14 (12.5%)	55 (12.9%)	0.647
Femoral Access	11 (6.3%)	10 (7.1%)	8 (7.1%)	29 (6.8%)	0.947

LMS Disease	4 (2.3%)	4 (2.9%)	24 (21.4%)	32 (7.5%)	<0.001
SVCAD	154 (88.5%)	27 (19.3%)	15 (13.4%)	196 (46.0%)	<0.001
DVCAD	20 (11.5%)	84 (60.0%)	37 (33.0%)	141 (33.1%)	<0.001
TVCAD	0 (0%)	29 (20.7%)	60 (53.6%)	89 (20.9%)	
Culprit Vessel					
LAD	97 (55.7%)	80 (57.1%)	44 (39.3%)	221 (51.9%)	0.007
LCx	23 (13.2%)	14 (10.0%)	9 (8.0%)	46 (10.8%)	0.360
RCA	54 (31.0%)	46 (32.9%)	59 (52.7%)	159 (37.3%)	0.0004

*MI: Myocardial Infarction, PCI: Percutaneous Coronary Intervention, LMS: Left Main Stem, SVCAD: Single Vessel Coronary Disease, DVCAD: Double Vessel Coronary Disease, TVCAD: Three Vessel Coronary Disease, LAD: Left Anterior Descending artery, LCx: Left Circumflex artery, RCA: Right Coronary Artery

A fall in the mean SS score from the baseline, in all three groups, has been shown in Table 2 and Figure 1.

Table 2: Baseline and Residual SYNTAX scores

	Complete Revascularization n=174	Reasonably Incomplete Revascularization n=140	Incomplete Revascularization n=112
Baseline SYNTAX Score	12.9±17.1	17.0±7.0	23.5±7.1
Residual SYNTAX Score	0	4.6±1.9	15.5±5.6
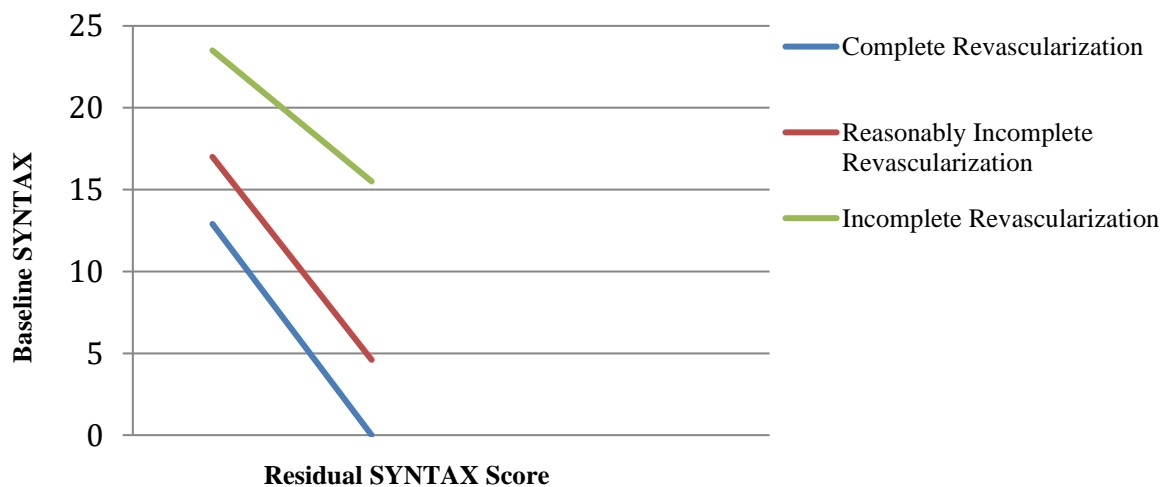
**Figure 1 Change in SYNTAX score after Primary Percutaneous Intervention**

In the current study, overall in-hospital all-cause mortality was 4.2% and MACCE was 11.03%. Among the three groups, ICR subjects had higher in-hospital mortality and heart failure rates (9.8% and 10.7%, respectively). While a comparable proportion of in-hospital death and heart failure was recorded in CR and RICR groups. Target vessel failure and repeated PCI rate were relatively higher in RICR groups, but it was not statistically significant. (Table 3, Figure 2)

A comparable rate of uneventful recovery was recorded for CR and RICR groups (90.2% and 87.8%, respectively) and was relatively low in ICR subjects (70.5%). (Table 3)

Table 3 In-hospital Clinical outcomes following Primary Percutaneous Intervention

|	Complete Revascularization n=174	Reasonably Incomplete Revascularization n=140	Incomplete Revascularization n=112	Total n=426	*P* value
Death	4 (2.3%)	3 (2.1%)	11 (9.8%)	18 (4.2%)	0.002
Arrhythmias	3 (1.7%)	2 (1.4%)	3 (2.6%)	8 (1.8%)	0.750
Pulmonary Edema/Heart Failure	5 (2.8%)	3 (2.1%)	12 (10.7%)	20 (4.6%)	0.002
Target Vessel failure/ Repeat Revascularization	3 (1.7%)	8 (5.7%)	4 (3.6%)	15 (3.5%)	0.162
Non Fatal Stroke	2 (1.1%)	0 (0%)	0 (0%)	2 (0.4%)	
Non Fatal MI	0 (0%)	1 (0.7%)	1 (0.9%)	2 (0.4%)	
Contrast Induced Nephropathy	0	0	2	2 (0.4%)	
No MACCE	157 (90.2%)	123 (87.8%)	79 (70.5%)	359 (84.2%)	<0.001

*MI: Myocardial Infarction, MACCE: Major Adverse Cardiac and Cerebrovascular Events
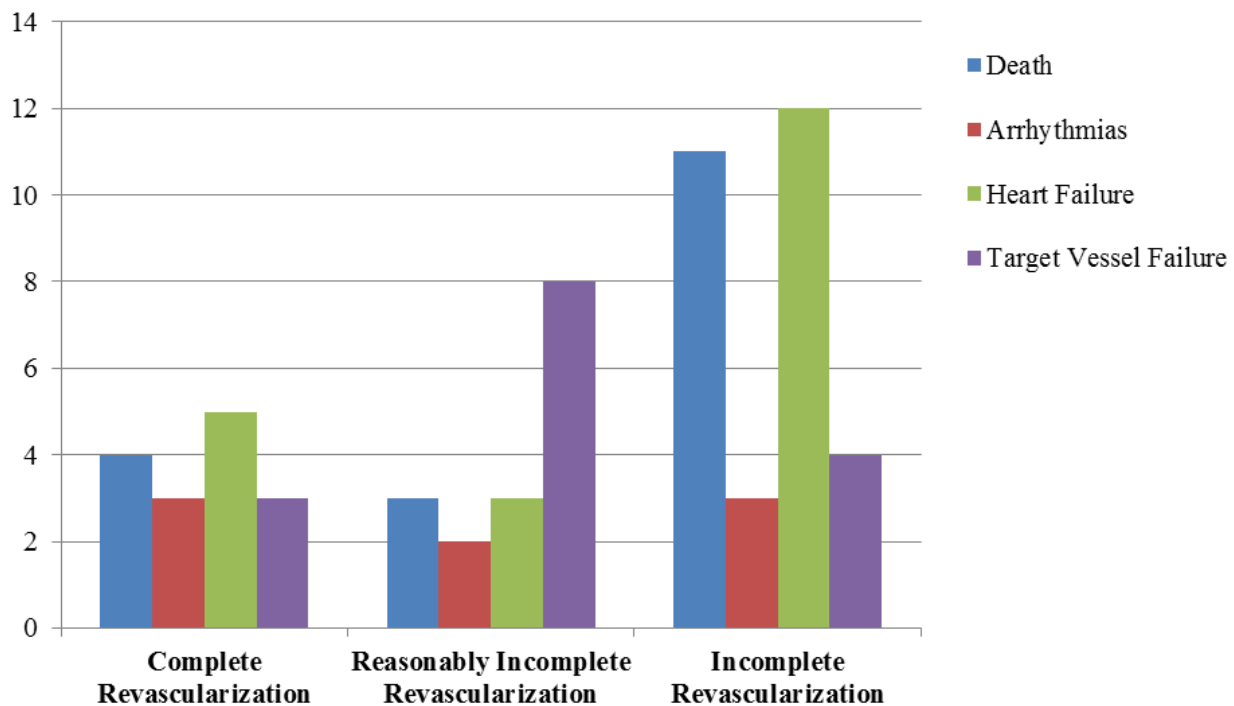
Figure 2 In-hospital Mortality and Major Adverse Cardiac Events following Primary Percutaneous Coronary Intervention

Logistic Regression Analysis

Logistic regression revealed a significant association between rSS categories and mortality (χ^2 = 8.245, df = 1, p = 0.0041). The odds ratio for mortality was 2.42 (95% CI: 1.28 to 4.57), indicating more than twice the odds of mortality in higher rSS categories. The regression coefficient was 0.882 (SE = 0.325), confirming a significant increase in log odds of mortality with incomplete revascularization (Figure 3).
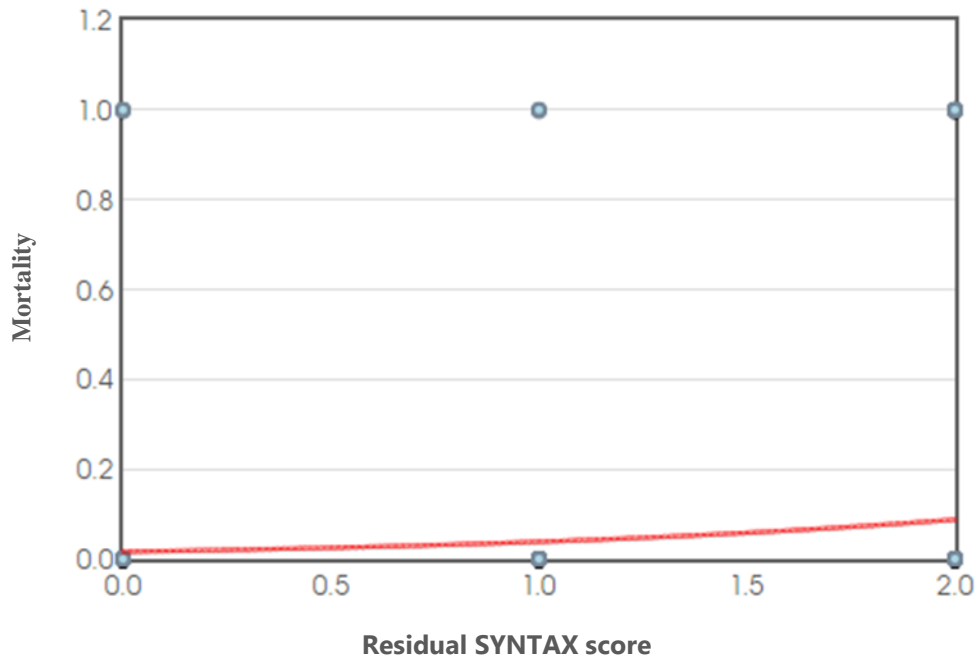
Figure 3: Logistic Regression curve

Discussion

The rSS is the marker of residual CAD burden and hence myocardial ischemia. Completeness of revascularization is therefore associated with favorable short and long-term clinical outcomes[11-13]. Recently reported clinical trials and meta-analyses have shown a reduction in the risk of adverse clinical outcomes among STEMI patients by achieving complete revascularization[14-17]. In the current study, a rising trend in MACCE was noted with increasing rSS i.e. CR 7.4%, RICR 10.0%, and ICR 17.8% (p-value 0.02).

In our study, the ICR arm tends to have a more aged population (61.5±9.5 years) and has more diabetes mellitus reported (44.6%) compared to the other two groups (p-value 0.03 and 0.003 respectively). Also, the ICR group has a higher proportion of significant LMS and TVCAD (21.4% and 53.6%), comparing the CR and ICR (p-value <0.001). Farooq V. et al, have reported similar trends in their ICR groups where not only the clinical comorbid but also a higher anatomical complexity of CAD was associated with higher rSS[18].

In the current study, overall all-cause in-hospital mortality was 4.2%. Satti KN et al. have reported 30 30-day mortality of 5.5%[19]. In our study population, a comparable mortality rate was noted for CR and RICR (2.3% and 2.1%, respectively), but a significantly high mortality of 9.8% was noted in ICR (p=0.002). Our findings are consistent with the study reported by Braga CG et al., who had reported 30-day mortality of 1.5%, 1.7%, and 9% for CR, RICR, and ICR, respectively[20].

Altekin et al. have reported an overall 8.7% in-hospital mortality, while their CR and RICR groups have lower mortalities i.e., 0.8% and 1.1%, respectively, and much higher mortality in the ICR arm of 20.1%, compared to our study[21]. Salaria A et

al. have reported 30-day mortality of 0.25% among patients with CR and 8% among others, following primary PCI[22].

The logistic regression analysis has established a relationship between rSS and mortality 2.42 (95% CI: 1.28 to 4.57), and suggested odds of mortality increase more than twice with an increase in the rSS category. Barthelemy O. et al. also reported an association of rSS with 30-day mortality (odds ratio:1.49; CI: 1.11 to 2.01)[23].

There were a few limitations of the current study: it was a single-center study, post-CABG and patients in cardiogenic shock were excluded, long-term clinical outcomes were not available, and operator visual assessment was involved in SS calculation without physiological evaluation.

Conclusion

The rSS is a useful tool in quantifying incomplete revascularization in patients undergoing primary PCI for STEMI. The ICR appears to confer a higher in-hospital mortality and MACCE, however, clinical outcomes outcomes for RICR and CR were comparable.

Acknowledgment

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