

## ORIGINAL ARTICLE

# Residual Syntax Score as a Predictor of 30-Day Mortality after Primary Percutaneous Coronary Intervention for Acute ST-Elevation Myocardial Infarction

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**Objective:** To evaluate residual SYNTAX score as a predictor of 30-day mortality after primary percutaneous coronary intervention (P-PCI) in ST-elevation myocardial infarction (STEMI) patients.

**Methodology:** It was a quasi-experimental study conducted in the Emergency department of Rawalpindi Institute of Cardiology from September 2019 to September 2020. After the study approval from the ethics committee and informed consent, 200 patients presenting with acute STEMI were included by convenient sampling. Primary PCI was done in all patients by the consultant cardiologists, and then the residual SYNTAX score (rSS) was calculated for each patient. Patients were allocated the case or control group based on rSS: patients with complete revascularization were included in controls and those with incomplete revascularization were labeled as cases. All patients were followed after primary PCI for 30-day mortality. The analysis of data was carried out by the Statistical Package for Social Sciences (SPSS) version 25.

**Results:** The 30-day mortality occurred in 11(5.5%) patients. Mortality occurred in 9(4.5%) patients in the case group and 2(1%) patients in the control group with a significant p-value of 0.03. There was a significant association between diabetes mellitus & 30-day mortality (0.032) and a family history of ischemic heart disease & 30-day mortality (0.026). This shows that rSS can be used as a reliable predictor of 30-day mortality after P-PCI in STEMI patients. The patients with high rSS score and risk factors of diabetes mellitus and history of ischemic heart disease are at higher risk of 30-day mortality.

**Conclusion:** The residual Syntax score is a simple, reliable and significant marker of 30-day mortality after P-PCI in STEMI patients. It provides an accurate assessment of the extent of revascularization needed to prevent coronary artery disease and enhance the prognosis following P-PCI. It may also serve as a guide for additional PCI decisions.

**Keywords:** Residual Syntax score; rSS; Primary percutaneous coronary intervention; Acute ST-elevation myocardial infarction; STEMI; P-PCI

**INTRODUCTION**

ST-elevation myocardial infarction (STEMI) causes significant mortality and morbidity on a global scale. Despite the advancements in diagnostic and treatment modalities, STEMI is a common public health issue, particularly in developing nations.<sup>1</sup> ST-elevation myocardial infarction is characterized by persistent elevation of ST segment on electrocardiogram (ECG) and increase in troponin and CK-MB.<sup>2</sup> The pathogenesis of the disease involves blockage of the coronary artery due to the rupture of atherosclerotic plaque.<sup>3</sup> Dyslipidemia, diabetes mellitus (DM), tobacco use, hypertension (HTN), and a family history of ischemic heart disease (IHD) are the predisposing factors.<sup>4,5</sup>

The treatment of choice is primary percutaneous coronary intervention (P-PCI) but cardiogenic shock, arrhythmias, and cardiac arrest are the poor prognostic factors associated with high mortality in these patients. Literature has reported that the one-year mortality rate ranges from 11% to 69% after PCI.<sup>6</sup> Multivessel disease (MVD) is frequently detected in patients undergoing P-PCI. Compared to single vessel disease (SVD), MVD is associated with major adverse cardiovascular events (MACE), reinfarction & 30-day mortality.<sup>7</sup>

Various factors have a predictive role in determining the risk of mortality in patients of STEMI, such as increased age, Killip class, treatment modality, time to treatment initiation, diabetes mellitus, renal failure, history of previous myocardial infarction, SVD versus MVD, and ejection fraction of left ventricle (LVEF).<sup>8</sup> Following PCI, incomplete revascularization is linked to a higher risk of mortality. The COMPLETE trial's findings indicated positive outcomes for total revascularization in STEMI patients. According to the most recent recommendations, all therapeutic modalities should be used to achieve full revascularization in STEMI patients.<sup>9</sup>

According to American Heart Association (AHA) guidelines, Thrombolysis in Myocardial Infarction (TIMI) is the recommended score for the prognosis of patients with STEMI. The Global Registry of Acute Coronary Events (GRACE) score, however, has also been shown to be beneficial in the risk stratification of patients with STEMI, according to published research. The TIMI and GRACE scores are based on parameters related to the patient's history, laboratory findings, and ECG changes. The parameter of angiographic findings before and after undergoing PCI is not included in these scores. The "SYnergy between percutaneous coronary intervention with TAXus and cardiac surgery" (SYNTAX) score is preferred in STEMI patients. It is used worldwide by cardiologists to determine the severity of coronary artery disease. It also helps them in decision-making regarding the treatment of choice: PCI or coronary artery bypass surgery.<sup>10</sup> The incomplete revascularization after PCI can be evaluated with a residual SYNTAX score (rSS).<sup>11</sup> In STEMI patients, rSS also serves as a predictor of adverse outcomes.<sup>12</sup> The chances of mortality and MACE increase with increasing SYNTAX score. Patients who have higher pre- or post-PCI scores, showed poor short- and long-term outcomes.<sup>13</sup>

A variety of scoring systems have been used widely to evaluate the prognosis of patients with STEMI, but these scores only assess the parameters related to the patient's history, laboratory findings, and ECG changes. The SYNTAX score also evaluates the angiographic findings of patients before and after undergoing PCI. The rSS predicts adverse outcomes in STEMI patients by also assessing the revascularization in these patients. This study was planned to determine the role of rSS as a predictor of 30-day mortality after P-PCI in STEMI patients.

**METHODOLOGY**

It was a quasi-experimental study conducted in the Emergency department of Rawalpindi Institute of Cardiology from September 2019 to September 2020. After the study approval from the ethics committee, 200 patients presenting with acute STEMI were

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included by nonprobability convenient sampling technique. The sample size of 200 was estimated using the mortality frequency of 8.25%, 95% confidence interval, and an absolute precision of 4%.<sup>14</sup>

Informed consent was taken from the patients. Diagnosis of STEMI was made using ECG and serum biomarkers of acute MI. ST-segment elevation of  $\geq 1$  mm on ECG along with an increase in cardiac troponin T (Trop-T) levels  $>0.4$  ng/ml was labeled as STEMI. The patients who presented within 06 hours duration of symptoms and planned for P-PCI, with or without residual SYNTAX score were enrolled. Patients who underwent P-PCI after failed thrombolysis or urgent CABG after PPCI were excluded.

Data including the patient's age, gender, history of DM, HTN, smoking, and family history of IHD was collected on a proforma sheet. Primary PCI was done in all patients by consultant cardiologists. After primary PCI, the rSS was determined for each patient. Patients were allocated the case or control group based on rSS: those with complete revascularization (CR) were included in controls and with incomplete revascularization (IR) were labeled as cases. All patients were followed till 30 days after primary PCI and 30-day mortality was noted.

**Residual SYNTAX Score (rSS):** In coronary vessels more than 1.5 mm in size having  $>50\%$  stenosis, rSS was applied. The total rSS score was calculated by estimating each lesion using software (SYNTAX score calculator v2.02, www.syntaxscore.com). The rSS=5 showed unsuccessful PCI (TIMI 0 flow after the procedure), rSS=0 showed complete revascularization and rSS  $\geq 1$  indicated incomplete revascularization.

**Data Analysis:** The analysis of data was carried out by the Statistical Package for Social Sciences (SPSS) version 25. For numeric variables, like age, mean and standard deviation were calculated, whereas, for categorical variables such as gender, DM, HTN, family history of IHD, smoking, and 30-day mortality, frequency and percentage were calculated. The comparison of demographic variables of cases & controls and the association of these variables with 30-day mortality was determined by applying Chi-square test. The significant p-value was  $<0.05$ .

**RESULTS**

The patients had a mean age of  $50.10 \pm 10.74$  years with a mean age of  $49.56 \pm 10.24$  years in cases and  $50.64 \pm 11.25$  years in controls. The difference in age was insignificant between the two groups (p-value=0.479). Most of the patients (37%) were in the age group 36-45 years followed by 46-55 years (31%).

Table 1: Demographic Variables of Cases and Controls

Variables	Cases	Control	Total	p-value
<b>Age Groups (Years)</b>				
26-35	3(1.5%)	6(3%)	9(4.5%)	0.329
36-45	38(19%)	36(18%)	74(37%)	
46-55	33(16.5%)	29(14.5%)	62(31%)	
56-65	21(10.5%)	17(8.5%)	38(19%)	
66-75	5(2.5%)	12(6%)	17(8.5%)	
<b>Gender</b>				
Male	72(36%)	64(32%)	136(68%)	0.225
Female	28(14%)	36(18%)	64(32%)	
<b>Diabetes mellitus</b>				
Present	42(21%)	46(23%)	88(44%)	0.569
Absent	58(29%)	54(27%)	112(56%)	
<b>Hypertension</b>				
Present	68(34%)	65(32.5%)	133(66.5%)	0.653
Absent	32(16%)	35(17.5%)	67(33.5%)	
<b>Family history of IHD</b>				
Present	31(15.5%)	36(18%)	67(33.5%)	0.454
Absent	69(34.5%)	64(32%)	133(66.5%)	
<b>Smoking</b>				
Yes	52(26%)	37(18.5%)	89(44.5%)	0.033*
No	48(24%)	63(31.5%)	111(55.5%)	

\* Significant p-value  $< 0.05$

The majority of the patients were males (68%) as compared to females (32%). There were 72(36%) males & 28(14%) females in the case group and 64(32%) males & 36(18%) females in the control group with an insignificant p-value of 0.225. Out of a total of 88(44%) patients with DM, it was found in 42(21%) cases and 46(23%) controls with an insignificant p-value of 0.569. Hypertension was found in 133(66.5%) patients, 68(34%) of the cases and 65(32.5%) of the controls with an insignificant p-value of 0.653. The family history of IHD was positive in 67(33.5%) patients and it was negative in 133(66.5%) patients. Positive family history in case and control groups was found in 31(15.5%) and 36(18%) of patients, respectively with a p-value of 0.454. Out of 200 patients, 89(44.5%) were smokers. There were 52(26%) smokers in the case group and 37(18.5%) smokers in the control group with a significant p-value of 0.033. These results are given in table 1.

The 30-day mortality occurred in 11(5.5%) patients. Mortality occurred in 9(4.5%) and 2(1%) of patients in the case and control groups, respectively with a significant p-value of 0.03 (Figure 1).

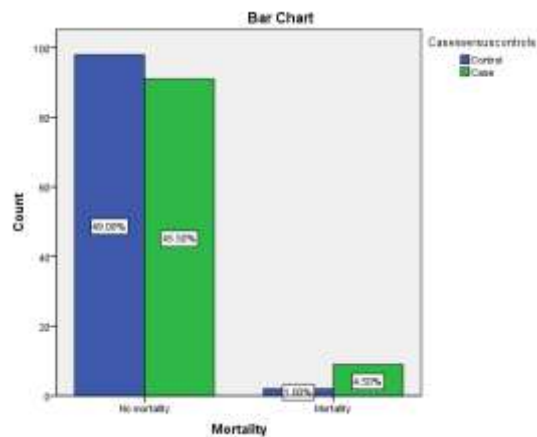


Figure 1: 30-day Mortality in Cases versus Controls (p-value = 0.030\*) (\* Significant p-value  $< 0.05$ )

There was no significant association of age with 30-day mortality (p-value=0.688). Similarly, no association was found between gender, HTN, and smoking with 30-day mortality. There was a significant association between DM & 30-day mortality (0.032) and the family history of IHD & 30-day mortality (0.026) (Table 2).

Table 2: Association of Demographic Variables of Cases and Controls with 30-day Mortality

Variables	Cases	Controls	Total	p-value
<b>Age groups (Years)</b>				
26-35	0(0%)	0(0%)	0(0%)	0.688
36-45	2(18.2%)	0(0%)	2(18.2%)	
46-55	3(27.3%)	1(9.1%)	4(36.4%)	
56-65	2(18.2%)	1(9.1%)	3(27.3%)	
66-75	2(18.2%)	0(0%)	2(18.2%)	
<b>Gender</b>				
Male	6(54.5%)	2(18.2%)	8(72.7%)	0.730
Female	3(27.3%)	0(0%)	3(27.3%)	
DM	4(36.4%)	0(0%)	4(36.4s%)	0.032*
HTN	6(54.5%)	2(18.2%)	8(72.7%)	0.338
Family history of IHD	4(36.4%)	0(0%)	4(36.4%)	0.026*
Smoking	6(54.5%)	1(9.1%)	7(63.6%)	0.127

\* Significant p-value  $< 0.05$

**DISCUSSION**

Residual SYNTAX score predicts residual coronary atherosclerotic plaque burden and clinical outcomes after P-PCI. Several studies have reported adverse short and long-term outcomes associated with incomplete revascularization.<sup>15,16</sup> The evidence from a meta-

analysis conducted in this aspect has shown that the risk of adverse outcomes can be reduced by achieving complete revascularization in STEMI patients particularly in those with MVD.<sup>17</sup>

In our study, patients had a mean age of 50.10±10.74 years with a mean age of 49.56±10.24 years in cases and 50.64±11.25 years in controls. The majority of the patients were males (68%), 36% in the case group and 32% in the control group with an insignificant p-value of 0.225. In contrast, in a study, patients had a mean age of 61.9 ± 12.8 years. The mean age of the patients was 57.9 ± 12.4, 60.8 ± 12.3 and 65.3 ± 12.7 years in the groups with rSS = 0, rSS < 7, and rSS > 7, respectively. Out of 538 patients, 422 (78.4%) were males with 100 (76.3%) in rSS = 0 group, 149 (79.3%) in rSS < 7 group and 173 (79%) in rSS > 7 group.<sup>18</sup> In a study by Bortnick et al., the mean age of the patients was 62 years with 70.9% men.<sup>13</sup> In another study, cases had a mean age of 62.18±12.05 and controls had a mean age of 53.96±11.4 and the majority of them (78.4%) were males.<sup>19</sup>

Our results showed that 44% of patients were diabetic, 66.5% of patients were hypertensive and 44.5% of patients were smokers. The majority of the patients in the case group were hypertensive and smokers. Similarly 47.4% of patients were diabetic, 61.3% were hypertensive and 40.3% of patients were smokers, with most of the patients in the higher rSS group in a study by Altekin et al.<sup>18</sup> In another study, diabetes mellitus was present in 35.8% of patients and hypertension in 67.9% of patients.<sup>13</sup>

In our study, 30-day mortality occurred in 11 (5.5%) patients, 9 (4.5%) patients in the case and 2 (1%) patients in control groups respectively with a significant p-value of 0.03. According to a study by Altekin et al., in-hospital mortality and MACE were high in patients with a higher rSS score. Out of a total of 47 (8.7%) cardiac deaths, 1 (0.8%) patient died in the rSS = 0 group, 2 (1.1%) patients died in the rSS < 7 group and 44 (20.1%) deaths occurred in the rSS ≥ 7 group with a significant p-value < 0.001.<sup>18</sup> Barthelemy et al. reported that rSS is associated with 30-day mortality in STEMI patients (odds ratio: 1.49; CI: 1.11 to 2.01).<sup>12</sup> In contrast, another study reported that rSS is not a predictor of 30-day mortality and MACE. But it has association with readmission and long term mortality.<sup>13</sup> In another study, 30-day mortality occurred in 8 (6.2%) cases and 1 (1.3%) control with a significant p-value of < 0.01.<sup>19</sup> A study conducted by Salari et al. reported that rSS is associated with higher mortality within 30 days after P-PCI; the mortality rate was 0.25% in patients with no rSS versus 8% in patients with rSS.<sup>14</sup> A study by Braga et al. showed that 30-day mortality was significantly lower in patients with revascularization. The mortality was reported in 1.5% of patients with complete revascularization, 1.7% of patients with incomplete revascularization and 9% of patients with high rSS score.<sup>20</sup>

## CONCLUSION

The residual Syntax score is a simple, reliable and significant marker of 30-day mortality after P-PCI in STEMI patients. It provides an accurate assessment of the extent of revascularization needed to prevent coronary artery disease and enhance the prognosis following P-PCI. It may also serve as a guide for additional PCI decisions.

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