

# Angiographic Perfusion Score to identify 30-Day Risk of Major Adverse Cardiac Events in Patients with ST Elevated Myocardial Infarction following Percutaneous Coronary Intervention

SM Ear-E-Mahbub<sup>1</sup>, Khaled Mohammad Iqbal<sup>2</sup>, MSI Tipu Chowdhury<sup>3</sup>, Leena Rafiq Choudhury<sup>4</sup>, Golam Sodrudin<sup>5</sup>, Md. Emdadul Haque<sup>6</sup>

<sup>1</sup>Assistant Professor, Department of Cardiology, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.

<sup>2</sup>Consultant, Department of Cardiology, Central Police Hospital, Dhaka, Bangladesh.

<sup>3</sup>Medical Officer, Department of Cardiology, Cox's Bazar Medical College and Hospital, Cox's Bazar, Bangladesh.

<sup>4</sup>General Practitioner, Segun Bagicha, Dhaka, Bangladesh.

<sup>5</sup>Medical Officer, 250 Bed Feni General Hospital, Feni, Bangladesh.

<sup>6</sup>Superintendent of Police, Human Resource Division, Central Police Hospital, Dhaka, Bangladesh.

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## ABSTRACT

**Background:** Prediction of major adverse cardiac events (MACE) following percutaneous coronary intervention (PCI) among patients with ST-segment elevated myocardial infarction (STEMI) is of great clinical importance to identify the patients in risk of adverse outcomes to guide the management. An angiographic perfusion score (APS) is a combination of thrombolysis in myocardial infarction flow grades (TFG) and myocardial perfusion grades (TMPG) before and after PCI, estimates the reperfusion better than those grades alone. **Objective:** This study was conducted to estimate the association of APS with the MACE among STEMI patients who undergone PCI. **Methods:** In this Cross-sectional observational study APS was calculated in 205 STEMI patients within 30 days of receiving PCI without thrombolytic pretreatment, who have been selected purposively in the Department of Cardiology, University Cardiac Center, Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka from July 2017 to June 2018. The score ranged from 0-12, where, reperfusion was defined as failed with the score of 0-3, partial: 4-9, and full: 10-12. Along with the ethical clearance from the correspondent authority, respondents were recruited who met the eligibility criteria for the study. **Results:** With 7.8% incidence of MACE following PCI, the APS among the MACE patient groups was recorded as partial among 5.6% of them and as failed in 2.2%. No MACE was recorded among the full perfusion group. These differences of adverse outcomes among the groups of perfusion status were statistically highly significant ( $p < 0.05$ ). **Conclusion:** An APS assesses the reperfusion status of both epicardial and myocardial perfusion and thus better predicts the risk of major adverse cardiac events following treatment.

**Keywords:** APS, MACE

## INTRODUCTION

Myocardial infarction (MI) is regarded as cardiomyocyte death caused by substantial and sustained ischaemia due to an imbalance of oxygen supply and demand. Among the coronary artery diseases, ST-segment elevation myocardial infarction (STEMI) is the acute manifestation of it and is associated with great morbidity and mortality. According to the Global Registry of Acute Coronary Events (GRACE), STEMI accounted for approximately 36% of the acute coronary syndromes

cases.<sup>[1]</sup> The major aspect of treatment of STEMI patients is initiating immediate reperfusion of the infarct related artery.<sup>[2-5]</sup> Primary percutaneous coronary intervention (PCI) has become the most preferred method of choice of reperfusion in patients with STEMI.<sup>[2]</sup>

Predicting Major Adverse Cardiac Events (MACE) following percutaneous coronary interventions (PCI) through identifying reperfusion status is of significant clinical importance to manage the patients in risk.<sup>[3]</sup> There are several methods of observing the reperfusion status in STEMI patients.<sup>[1,6-15]</sup> TFG (TIMI Flow Grade) and TMPG (TIMI Myocardial Perfusion Grade) are two among them. TFG is a grading system to assess epicardial coronary flow and TMPG is a grading system to assess myocardial perfusion. It has been seen that, myocardial reperfusion is not always achieved in

### Name & Address of Corresponding Author

Dr. Khaled Mohammad Iqbal,  
Consultant, Department of Cardiology,  
Central Police Hospital,  
Dhaka, Bangladesh.

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patients with a good TIMI (Thrombolysis in Myocardial Infarction) flow of epicardial coronary artery. On the other hand, TIMI myocardial perfusion grade (TMPG) assesses myocardial perfusion at capillary level.<sup>[16,17]</sup> Thus TMPG adds additional prognostic information to the conventional epicardial TFG to predict any adverse outcome.<sup>[18]</sup> Incorporation of these two variables into a combined index of epicardial and myocardial microvascular blood flow has been regarded as the Angiographic Perfusion Score (APS) which is measured before and after PCI.<sup>[19]</sup> The APS is the sum of the TFG (0-3) added to the TMPG (0-3) before and after PCI, therefore, a total grade of 0 to 12 is possible. In this grading method, failed perfusion was defined as an APS of 0-3, partial perfusion as an APS of 4-9, and full perfusion as an APS of 10-12.<sup>[20]</sup> The APS is a more convenient method to inspect the angiographic metric of reperfusion status which also doesn't require complicated methods, thus expands its acceptability.<sup>[18]</sup>

This study aims to evaluate the use of the angiographic perfusion score to estimate patients in risk of developing major adverse cardiac events following percutaneous coronary intervention in patients with ST-elevated myocardial infarction within 30 days of the reperfusion.

### MATERIALS AND METHODS

In this Cross-sectional observational study Angiographic Perfusion Score (APS) was calculated in 205 ST Elevated Myocardial Infarction (STEMI) patients who have undergone Percutaneous Coronary Intervention (PCI) without thrombolytic pretreatment, have been selected purposively in the Department of Cardiology, University Cardiac Center, Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka from July 2017 to June 2018. Maximum score of APS being 12 where, reperfusion was defined as failed: 0-3, partial: 4-9, and full APS: 10-12. Thirty day MACE was observed in these patients. Major adverse cardiac events (MACE) were defined as a composite of death, reinfarction or ischemic-driven target vessel revascularization. Reinfarction was defined as elevation of CK- MB enzyme levels three times above its upper limit of normal associated with ischemic symptoms. After taking the permission from the ethical committee of the correspondent authority respondents were recruited after taking written consent from them. STEMI patients undergoing Primary PCI, presenting after 12 hours with cardiogenic shock and who had ongoing symptom presenting within 72 hours were recruited. STEMI patients presented after 72 hours and who received thrombolytic treatment were excluded from the study. Patients were interviewed with a

structured questionnaire and the medical records were checked for the collection of data. Data were analyzed with SPSS 20.0 software.

### RESULTS

With the age range of 35 to 60 years, this study recorded the mean age of the respondents were 52.83years with the SD of  $\pm 10.147$  years where highest incidence (34.1%) was recorded in the age group of 51-60 years. Male predominance have been observed in this study where male STEMI patients were 88.8% and female patients were only 11.2%.

Distribution of APS score and MACE among the patients and their association: Angiographic perfusion score showed that full perfusion was achieved in 32.7% patients, partial perfusion in 62.9% patients and failure of reperfusion was recorded in 4.4% patients. This study recorded, 16 (7.8%) cases of MACE among the 205 STEMI cases within 30 days following a PCI without thrombolytic treatment. [Table 1].

**Table 1: Frequency distribution of APS score and MACE (n=205)**

		Frequency	Percentage
APS	Full	67	32.7
	Partial	129	62.9
	Failed	9	4.4
MACE	Yes	16	7.8
	No	189	92.2

Patients with complete reperfusion have not been observed to undergo any MACE in the following 30 days after PCI. Among the partial perfusion group of patients there were 12 cases of MACE and among the failed perfusion group, 4 cases of MACE had been observed. The Chi square test between APS score groups and MACE showed that, these difference among the groups were statistically highly significant ( $p < 0.05$ ) [Table 2].

**Table 2: Association between APS score and MACE**

	APS score			P value
	Full (n=67)	Partial (n=129)	Failed (n=9)	
MACE	0 (0%)	12(9.3%)	4(44.4%)	0.001
No	67(100%)	117(90.7%)	5(55.5%)	

Item by item MACE distribution in perfusion status of patients disclosed that, in patients with partial reperfusion, MACE were 12(9.3%), among them 1 (0.8%) death, 2 (1.5%) QMI (Q-wave Myocardial Infarction), 5 (3.9%) non QMI & 4 (3.1%) TVR (Target Vessel Revascularization) respectively had been recorded. And, among 4(44.4%) patient with failed perfusion death was 2 (22.2%), non QMI was 1 (11.11%) and QMI was 1 (11.11%). Fatal outcome found to be significantly associated with the APS score ( $P < 0.05$ ) [Table 3].

**Table 3: Association between APS score and MACE item-by-item (Outcome within 30 days) (n=16)**

MACE		APS				P value
		Full	Partial	Failed	Total	
Death	Yes	0(0.0%)	1(0.8%)	2(22.2%)	3(1.5%)	0.01
	No	67(100%)	128(99.2%)	7(77.8%)	202(98.5%)	
QMI	Yes	0	2(1.5%)	1(11.1%)	3(1.5%)	0.55
	No	67(100%)	127(98.4%)	9(100%)	202(98.5%)	
Non QMI	Yes	0(0.0%)	5(3.9%)	1(11.11%)	6(2.9%)	0.55
	No	67(100%)	124(96.1%)	8(88.89%)	198(97.1%)	
TVR	Yes	0(0.0%)	4(3.1%)	0(0.0%)	4(1.9%)	0.30
	No	67(100%)	125(96.9%)	9(100%)	201(98.1%)	
Composite (n=16)		0(0.0%)	12(13.9%)	4(44.4%)	22(10.7%)	
Total		67	129	9	205	

## DISCUSSION

Percutaneous coronary intervention (PCI) is the most preferred choice of treatment in patients with ST segment elevated myocardial infarction. The reperfusion status evaluated only with TMPG is practiced for predicting the outcomes after PCI. But, reperfusion of the infarct-related artery may not be enough to risk out the occurrence of major adverse outcome following the intervention. But also both the epicardial perfusion along with myocardial perfusion needed to be assessed to ensure the reperfusion status. Additionally, determining the perfusion status after PCI without taking into consideration the status of perfusion prior to the procedure may not be totally predictive of the outcomes.

In this regard, angiographic perfusion score integrates both epicardial and micro vascular perfusion levels before and after PCI which was first investigated by Gibson et al 2004, among patients presenting with acute coronary syndromes who underwent PCI.<sup>[18]</sup> In their study, lower APS was associated with larger infarct sizes and mortality rate by 30 days. Another study, done by Narain et al 2013, found statistically significant correlation between APS and MACE, following percutaneous interventions in acute coronary syndromes. They found, the incidence of MACE was significantly higher as predicted by failed APS (22.4%).<sup>[21]</sup> Similarly, according to a study findings, patients with a poorer APS were associated with a higher frequency of mortality by 30 days (P<0.010). And, patients with a poorer APS were associated with an increased rate of death or MI by 30 days (P<0.039).<sup>[22]</sup>

Substantial with these study findings, this study also observed statistically highly significant association between APS score groups and MACE among the patients underwent PCI following STEMI (P<0.05) It was observed that MACE in the patients who had full perfusion was 0.0% whereas, 9.3% in partial perfusion group and 44.4% in failed perfusion group. This study observed that 15.6% & 13.2% of the patients had Post PCI Angina & minor bleeding respectively at 30 days. While 8.8% had vascular access site complication, 2.9% had non QMI,

2.4% had fatal arrhythmia, 1.9% had TVR, death was 1.5% and 1.5% of the patients had QMI.

The MACE distribution among the patients revealed that out of the 16 with routine procedures, patient with Partial reperfusion were 12 (9.3%) among them 1(0.8%) death, 2(1.5%) QMI, 5(3.9%) non QMI, 4(3.1%) & TVR respectively. Patient with failed perfusion, there were MACE in 4 patients (44.4%) among them death was 2(22.2%), non QMI was 1(11.11%), QMI 1(11.11%) respectively. There were no differences in the baseline characteristics of those who had full, partial or failed perfusion.

## CONCLUSION

Both epicardial and microvascular perfusion must be restored to normal to optimize outcomes of the PCI among the STEMI patients. TMPG was widely accepted method of predicting the reperfusion status as well as the outcomes comes with the limitation of calculating the perfusion status at one point of time, whereas, APS combines TMPG with TFG and also calculates the perfusion status both before and after PCI thus is capable of observing the minor differences resulting from operator related interpretation of the angiographic parameters. Therefore, angiographic perfusion score is a better discriminator of 30 day major adverse cardiac events in patients with ST elevated myocardial infarction following percutaneous coronary intervention.

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