

## Retrospective Cohort Study

**Comparative assessment of clinical profile and outcomes after primary percutaneous coronary intervention in young patients with single vs multivessel disease**

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**Institutional review board**

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Informed consent was obtained from all the patients.

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None to declare.

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**Abstract****BACKGROUND**

Even though percutaneous coronary intervention (PCI) improved the survival of patients with acute myocardial infarction, still multivessel coronary artery disease remains an important factor burdening prognosis and it is being associated with a worse prognosis compared to single-vessel disease (SVD).

**AIM**

To compare the clinical profile and outcomes after the primary PCI in young patients with SVD *vs* multivessel disease (MVD).

**METHODS**

The retrospective cohort of patients were divided into two groups: SVD and MVD group. The study population consisted of both male and female young ( $\leq 45$  years) patients presented with ST-elevation myocardial infarction (STEMI) at the National Institute of Cardiovascular Disease, Karachi, Pakistan and undergone primary PCI from 1<sup>st</sup> July 2017 to 31<sup>st</sup> March 2018. Pre and post-procedure management of the patients was as per the guidelines and institutional protocols.

**RESULTS**

A total of 571 patients with STEMI,  $\leq 45$  years were stratified into two groups by the number of vessels involved, 342 (59.9%) with SVD and 229 (40.1%) with MVD. The average age of these patients was  $39.04 \pm 4.86$  years. A lower prevalence of hypertension and diabetes was observed in SVD as compare to MVD group (25.1% *vs* 38%,  $P < 0.01$ ; 11.7% *vs* 27.5%,  $P < 0.001$ ) respectively.

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While, smoking was more prevalent among the SVD group as compare to MVD group (36.3% *vs* 28.4%,  $P = 0.05$ ). The high-C Lesion was observed in a significantly higher number of younger patients with MVD as compared to SVD group (48.8% *vs* 39.2%,  $P = 0.021$ ). Post-procedure thrombolysis in myocardial infarction flow grade was found to be not associated with the number of diseased vessels with a  $P$  value of 0.426 and thrombolysis in myocardial infarction flow grade III was observed in 98% *vs* 96.5% of the patients is SVD *vs* MVD group.

### CONCLUSION

The MVD comprised of around 40% of the young patients presented with STEMI. Also, this study shows that diabetes and hypertension have a certain role in the pathogenesis of multivessel diseases, therefore, preventive measures for diabetes and hypertension can be effective strategies in reducing the burden of premature STEMI.

**Key words:** Young; Multivessel disease; Primary percutaneous coronary intervention; ST-elevation myocardial infarction; Premature coronary artery diseases; Single-vessel disease

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**Core tip:** Premature coronary artery diseases are at rise. Multivessel disease (MVD) is associated with poor prognosis. MVD comprised of around 40.1% of the young patients with ST-elevation myocardial infarction. Prevalence of hypertension and diabetes was high in ST-elevation myocardial infarction patients with MVD. In-hospital outcomes of primary percutaneous coronary intervention were not different for patient with MVD.

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## INTRODUCTION

Coronary artery disease (CAD) have been surging day by day, in the third world countries<sup>[1]</sup>. The 45 years or below is one of the globally accepted cutoff value for premature CAD<sup>[2]</sup>, the cutoff value for young CAD in various studies varying from 35 to 55 years<sup>[3,4]</sup>. The field of cardiology has received great attention in the last decades with the young CAD with varying risk profiles and different prognosis and the length of severe coronary phase<sup>[5]</sup>. The ischemic coronary disease appears in young patients, generally below 40 to 45 years, when multiple coronary risk factors occur: Hyperlipidemia, diabetes mellitus, obesity, arterial hypertension, smoking and a family history of ischemic heart disease. Among the conventional risk factors of CAD, premature myocardial infarction (MI) was reported to be associated with smoking, family related history of coronary artery disease and dyslipidemia<sup>[5,6]</sup>.

The worst presentation of coronary artery disease is ST-elevation MI (STEMI)<sup>[7]</sup>, and primary percutaneous coronary intervention (PCI) is the guidelines recommended treatment for the patients with STEMI<sup>[8]</sup>. The primary purpose of revascularization is to open the infarct-related (culprit) artery in the setting of STEMI<sup>[9]</sup>. A significant atherosclerotic cardiovascular disease in more than one coronary artery is not an uncommon angiographic finding and in the setting of acute MI, significant atherosclerotic cardiovascular disease in multiple vessels is observed to be associated with increased complications and adverse clinical course<sup>[10-12]</sup>.

Despite its prognostic importance, there is a paucity of data regarding the role of the number of vessels diseased in determining the outcome of management in young patients presenting with STEMI. Therefore, this study was conducted to carry out the comparative assessment of clinical profile and outcomes after the primary PCI in young patients with single-vessel disease (SVD) *vs* multivessel disease (MVD).

## MATERIALS AND METHODS

This retrospective study was conducted after the approval of the ethical review committee of the institution (ERC-29/2019). The study population consisted of both male and female young ( $\leq 45$  years) patients presented with STEMI at the National Institute of Cardiovascular Disease, Karachi, Pakistan and undergone primary PCI from 1<sup>st</sup> July 2017 to 31<sup>st</sup> March 2018. Data for the study were extracted from the institution database of prospectively collected National Cardiovascular Data Registry (NCDR™ CathPCI Registry®). Patients with a prior history of any cardiac-related surgery or intervention were excluded from the study. Informed consent was obtained from all the patients and all the diagnostic and primary PCI procedures were performed by the consultant cardiologists (with more than five years of experience) and only culprit artery was attempted with conventional stenting technique followed by post-dilation. Pre and post-procedure management of the patients was as per the guidelines and institutional protocols. Patient's baseline characteristics, demographic details, angiographic findings, and in-hospital outcome and complications were retrieved for this study. Patients with significant stenosis,  $\geq 50\%$ , in more than one vessels or left main artery were labelled as MVD.

The clinical profile consisted of demographic details [gender, age (years), and body mass index ( $\text{kg}/\text{m}^2$ )], angina status within past two weeks (Canadian Cardiovascular Society angina grade), and angiographic findings [number of diseased vessels, localization of culprit lesion, lesion complexity, pre and post-procedural thrombolysis in MI (TIMI) flow grade, presence of thrombus and bifurcating lesion]. The post-procedural outcomes included death, re-infarction, heart failure, cardiogenic shock, and needed dialysis.

### Statistical analysis

Statistical analysis of extracted data was performed using IBM SPSS Statistics for Windows (IBM Corp., Armonk, NY, United States), Version 21.0. Patients were categorized into two groups *i.e.*, patients with SVD and patients with MVD (two or three vessels). Summary statistics such as mean  $\pm$  SD for age (years) and body mass index ( $\text{kg}/\text{m}^2$ ) and frequency and percentage for all other study variables were computed for both of the groups. The comparative assessments of results between the SVD and MVD group were performed by applying appropriate *t*-test or Mann-Whitney *U* test for continuous variables and  $\chi^2$  test or Fisher exact test for the categorical response variables. Any *P* value  $\leq 0.05$  was considered statistically significant.

## RESULTS

A total of  $n = 571$  patients with ST-segment elevation myocardial, less than and equal to 45 years were stratified into two groups by the number of vessels involved, 342 (59.9%) with SVD and 229 (40.1%) with MVD. The average age of these patients was  $39.04 \pm 4.86$  years and a significant difference was observed in the average age of young patients in SVD group as compared to MVD group,  $38.24 \pm 5.18$  years *vs*  $40.24 \pm 4.06$  years ( $P < 0.001$ ). We observed a lower prevalence of hypertension and diabetes in SVD group as compare to MVD group (25.1% *vs* 38%,  $P < 0.01$ ) and (11.7% *vs* 27.5%,  $P < 0.001$ ) respectively. While, smoking was more prevalent among the SVD group as compare to MVD group (36.3% *vs* 28.4%,  $P = 0.05$ ). A positive family history of premature CAD and obesity were not significantly differed in both SVD and MVD groups. Similarly, gender and Canadian Cardiovascular Society angina grade within past two weeks were statistically insignificant in both SVD and MVD group. The baseline clinical and demographic characteristics stratified by the number of vessels involved are presented in [Table 1](#).

The angiographic and pre-procedural characteristics stratified by the number of vessels involved are presented in [Table 2](#). Culprit left anterior descending artery occurred in a significantly higher number of patients in single vessel as compare to multivessel groups (71.9% *vs* 50.2%), while, culprit right coronary artery (RCA) and circumflex artery (LCX) were more frequent in patients with MVD as compared to SVD, (34.5% *vs* 21.3%) and (12.7% *vs* 5.3%) respectively. The high-C Lesion was observed in a significantly higher number of younger patients with MVD as compared to SVD group (48.8% *vs* 39.2%,  $P = 0.021$ ).

Post-procedure outcomes stratified by the number of vessels involved are presented in [Table 3](#). Post-procedure TIMI flow grade was found to be not associated with the number of diseased vessels with a *P* value of 0.426 and TIMI flow grade III was observed in 98% *vs* 96.5% of the patients is SVD *vs* MVD group. In-hospital mortality rate was 1.7% *vs* 0.9%,  $P = 0.335$ , for MVD and SVD group respectively.

**Table 1** Baseline clinical and demographic characteristics stratified by number of vessels involved, *n* (%)

Characteristics	Total	Involved vessels		P value
		Single vessel	Multivessel	
<b>Total</b>	571	342 (59.9)	229 (40.1)	-
<b>Clinical characteristics</b>				
Age (mean ± SD, yr)	39.04 ± 4.86	38.24 ± 5.18	40.24 ± 4.06	< 0.001
Body mass index (mean ± SD, kg/m <sup>2</sup> )	26.24 ± 4.01	26.25 ± 4.07	26.22 ± 3.94	0.929
Male gender	501 (87.7)	303 (88.6)	198 (86.5)	0.446
Hypertension	173 (30.3)	86 (25.1)	87 (38)	0.001
Diabetes	103 (18)	40 (11.7)	63 (27.5)	< 0.001
Positive family history	41 (7.2)	27 (7.9)	14 (6.1)	0.419
Smoking	189 (33.1)	124 (36.3)	65 (28.4)	0.050
Obesity	89 (15.6)	55 (16.1)	34 (14.8)	0.690
<b>CCS angina grade (within past two weeks)</b>				
No symptoms, no angina	272 (47.6)	158 (46.2)	114 (49.8)	0.367
CCS I	33 (5.8)	22 (6.4)	11 (4.8)	
CCS II	66 (11.6)	35 (10.2)	31 (13.5)	
CCS III	105 (18.4)	70 (20.5)	35 (15.3)	
CCS IV	95 (16.6)	57 (16.7)	38 (16.6)	

CCS: Canadian Cardiovascular Society.

Similarly, post-procedure in-hospital rate of cardiogenic shock, heart failure, and dialysis were observed higher MVD group as compared to SVD group, but not statistically significant.

## DISCUSSION

To the best of our knowledge, this study is first of its kind in Pakistani young population. Aim of this study was to assess the differences in clinical profile and outcomes after primary PCI in young patients with SVD *vs* MVD. Main findings of our study are, 40.1% (229) young patients presented with STEMI had MVD. The MVD in young patients was found to be associated with age (years), hypertension, and diabetes mellitus, whereas, SVD were found to be associated with smoking. Young patients with MVD were more likely to have the angiographic finding of culprit RCA and LCX as against left anterior descending artery for the young patients with SVD and more likely to have high/C lesions. Post-procedure in-hospital outcomes among young patients were not significantly different between SVD and MVD patients, however, mortality and other complications, such as cardiogenic shock, heart failure, or dialysis, were relatively more frequent among patients with MVD.

In our study the prevalence of MVD was 40.1% among the young ( $\leq 45$  years) patients presenting with STEMI, similarly, a recently published local study by Batra *et al*<sup>[13]</sup> reported MVD in 38% of young ( $\leq 40$  years) patients diagnosed with STEMI. Noor *et al*<sup>[14]</sup> reported MVD in 36.6% among the patients under 35 years of age presented with acute coronary syndrome (ACS) and another study by Anjum *et al*<sup>[15]</sup> reported 28% of young ( $\leq 35$  years) patients with MVD among patients presented with ACS. In our population, MVD reported increasing with age and severity of presentation. Studies from the various parts of the world reported MVD ranging from 16% to 55.6% of the young patients with ACS depending on the cutoff value of age for the classification of young<sup>[16-21]</sup>.

Batra *et al*<sup>[13]</sup> reported that MVD was a predictor of increased morbidity and mortality in patients undergoing primary PCI for STEMI. Although, MVD is observed to be less frequent in cases of premature CAD patients<sup>[13]</sup>, however, it is important to understand its association with risk factors in order to control the burden of disease in productive years of life. In our study MVD in young was found to be associated with relatively older age, 40.24 ± 4.06 years *vs* 38.24 ± 5.18 years ( $P < 0.001$ ). However, this wasn't the case in various other parts of the world<sup>[18,19]</sup>. It was reported that diabetes mellitus and hypertension were less commonly observed risk factors among young

**Table 2** Angiographic and pre-procedural characteristics stratified by number of vessels involved, *n* (%)

Characteristics	Total	Involved vessels		P value
		Single vessel	Multivessel	
<b>Total</b>	571	342 (59.9)	229 (40.1)	-
<b>Culprit vessel</b>				
Left anterior descending artery	361 (63.2)	246 (71.9)	115 (50.2)	< 0.001
Right coronary artery	152 (26.6)	73 (21.3)	79 (34.5)	
Circumflex artery	47 (8.2)	18 (5.3)	29 (12.7)	
Posterior descending artery	6 (1.1)	3 (0.9)	3 (1.3)	
Left main	5 (0.9)	2 (0.6)	3 (1.3)	
<b>Pre-procedure TIMI flow grade</b>				
TIMI - 0	321 (56.2)	185 (54.1)	136 (59.4)	0.066
TIMI - 1	58 (10.2)	38 (11.1)	20 (8.7)	
TIMI - 2	111 (19.4)	61 (17.8)	50 (21.8)	
TIMI - 3	81 (14.2)	58 (17)	23 (10)	
<b>Lesion complexity</b>				
Non-high/non-C lesion	325 (56.9)	208 (60.8)	117 (51.1)	0.021
High/C lesion	246 (43.1)	134 (39.2)	112 (48.9)	
<b>Thrombus presence</b>				
No	102 (17.9)	58 (17)	44 (19.2)	0.491
Yes	469 (82.1)	284 (83)	185 (80.8)	
<b>Bifurcation lesion</b>				
No	427 (74.8)	254 (74.3)	173 (75.5)	0.731
Yes	144 (25.2)	88 (25.7)	56 (24.5)	

TIMI: Thrombolysis in myocardial infarction.

patients<sup>[13]</sup>, but both have significant associations with MVD<sup>[11]</sup>. Similar to these past findings, in our study, we observed that MVD in young STEMI patients was significantly associated with hypertension, and diabetes mellitus with 27.5% vs 11.7%,  $P < 0.001$  and 38% vs 25.1%,  $P < 0.01$  respectively.

In our study angiographic findings of culprit RCA (34.5% vs 21.3%) and LCX (12.7% vs 5.3%) were more common in young patients with MVD as compared to SVD and these were the similar observations made for young as well as entire STEMI patients in the past studies<sup>[11,18,19]</sup>. Similarly, MVD among young is found to be associated with poor pre-procedural TIMI flow grade and complex (high C) lesions.

The presence of MVD is a prognostic indicator for the patients undergoing primary PCI<sup>[11]</sup>, whoever, despite multiple investigations the mechanism behind its prognostic value is unexplained. MVD was reported to be associated with the increased use of contrast volume ( $172.46 \pm 28.39$  mL vs  $150.25 \pm 33.2$  mL,  $P < 0.001$ )<sup>[11]</sup>, which increases the risk of post-procedural morbidities including contrast-induced acute kidney injury. Continuing the observations made by Anello *et al*<sup>[18]</sup>, in our study post-procedural in-hospital outcomes of primary PCI for STEMI were not significantly different for young patients with MVD as compared to SVD. However, MVD patients tends to have relatively higher rate of in-hospital mortality (1.7% vs 0.9%,  $P = 0.355$ ), cardiogenic shock (0.9% vs 0.0%,  $P = 0.083$ ), heart failure (0.9% vs 0.0%,  $P = 0.083$ ), and dialysis (0.4% vs 0.0%,  $P = 0.221$ ).

The most recent evidence suggests that as against the culprit vessel only strategy, multivessel PCI or complete revascularization in STEMI patients with MVD was superior with reduced risk of re-infarction or cardiovascular mortality<sup>[22]</sup>. However, more targeted research efforts are required in young patients to ensure the early returning to work.

In conclusion, MVD comprised of around 40.1% of young patients ( $\leq 45$  years) presented with STEMI. It was found to be associated with age, hypertension, and diabetes mellitus. In-hospital outcomes of primary PCI in patients with MVD were not significantly different from the patients with SVD. Also, this study shows that diabetes mellitus and hypertension have a certain role in the pathogenesis of MVD in young patients, preventive measures for diabetes mellitus and hypertension can be

**Table 3 Post-procedure outcomes stratified by number of vessels involved, n (%)**

Characteristics	Total	Involved vessels		P value
		Single vessel	Multivessel	
<b>Total</b>	571	342 (59.9)	229 (40.1)	-
Contrast volume (mL)	135.65 ± 44.28	134.3 ± 42.97	137.66 ± 46.18	0.375
Fluro time (min)	13.2 ± 6.69	12.83 ± 6.53	13.75 ± 6.91	0.107
Number of stents deployed	1.09 ± 0.66	1.01 ± 0.44	1.21 ± 0.87	< 0.001
<b>Post-procedure TIMI flow grade</b>				
TIMI - 0	3 (0.5)	2 (0.6)	1 (0.4)	0.426
TIMI - 1	3 (0.5)	2 (0.6)	1 (0.4)	
TIMI - 2	9 (1.6)	3 (0.9)	6 (2.6)	
TIMI - 3	556 (97.4)	335 (98)	221 (96.5)	
<b>Post-procedure in-hospital outcomes</b>				
Composite adverse events	11 (1.9)	6 (1.8)	5 (2.2)	0.715
Re-infarction	3 (0.5)	3 (0.9)	0 (0)	0.155
Cardiogenic shock	2 (0.4)	0 (0)	2 (0.9)	0.083
Heart failure	2 (0.4)	0 (0)	2 (0.9)	0.083
Dialysis	1 (0.2)	0 (0)	1 (0.4)	0.221
Mortality	7 (1.2)	3 (0.9)	4 (1.7)	0.355

TIMI: Thrombolysis in myocardial infarction.

effective strategies in reducing the burden of premature CAD.

## ARTICLE HIGHLIGHTS

### Research background

Even though percutaneous coronary intervention (PCI) improved the survival of patients with acute myocardial infarction, the multivessel coronary artery disease remains an important factor burdening prognosis, and it is being associated with a worse prognosis compared to single-vessel disease (SVD).

### Research motivation

Despite its prognostic importance, there is a paucity of data regarding the role of the number of vessels diseased in determining the outcome of management in young patients presenting with ST-elevation myocardial infarction (STEMI).

### Research objectives

This study was conducted to carry out the comparative assessment of clinical profile and outcomes after the primary PCI in young patients with SVD *vs* multivessel disease (MVD).

### Research methods

Patients were divided into SVD and MVD group. The study population consisted of both male and female young ( $\leq 45$  years) patients presented with STEMI and undergone primary PCI from 1<sup>st</sup> July 2017 to 31<sup>st</sup> March 2018. Pre and post-procedure management of the patients was as per the guidelines and institutional protocols.

### Research results

A total of 571 patients with STEMI ( $\leq 45$  years) were stratified into two groups by the number of vessels involved. The average age of these patients was  $39.04 \pm 4.86$  years. A lower prevalence of hypertension and diabetes was observed in SVD as compare to MVD group. Smoking was more prevalent among the SVD group as compare to MVD group. The high-C Lesion was observed in a significantly higher number of younger patients with MVD as compared to SVD group. Post-procedure thrombolysis in myocardial infarction flow grade was found to be not associated with the number of diseased vessels and thrombolysis in myocardial infarction flow grade III was observed in 98% *vs* 96.5% of the patients (SVD *vs* MVD group).

### Research conclusions

The MVD comprised of around 40% of the young patients presented with STEMI. Also, this study shows that diabetes mellitus and hypertension have a certain role in the pathogenesis of MVD in young patients, preventive measures for diabetes mellitus and hypertension can be effective strategies in reducing the burden of premature coronary artery disease.

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