ORIGINAL ARTICLE
MULTIVESSEL DISEASE AS A PROGNOSTIC MARKER IN PATIENTS PRESENTING FOR PRIMARY PERCUTANEOUS CORONARY INTERVENTION

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Background: Multi-vessel disease is associated with higher mortality rates in ST-Elevation Myocardial Infarction (STEMI) patients, which may further alter clinical course and decision making. Hence, the purpose of this study is to determine prevalence, in hospital and early after discharge (up to 30 days) outcome of patients with multi-vessel disease as compared to single vessel disease presenting with acute STEMI undergoing Primary PCI. **Methods:** This study includes 282 consecutive selected patients, presented in emergency department with acute STEMI; undergo primary percutaneous coronary intervention (PCI) at Catheterization Laboratory of National Institute of Cardiovascular Diseases (NICVD), Karachi Pakistan during the study period of 17th December 2016 to 16th June 2017. Demographic characteristics, clinical history, post procedural complications, and short term adverse clinical events in patients with SVD and MVD were assessed and compared using z-test, t-test, and Fisher's Exact test. **Results:** Comparing the patients with single vessel disease, multi-vessel disease patients have worse post procedural outcomes, increased overall complications, length of hospital stay, higher referral for CABG, and in-hospital mortality. On follow up relatively higher, but not statistically significant, patient with MVD developed recurrence of symptoms and got re-admission. **Conclusion:** Multi-vessel disease in patients presenting for primary PCI is the direct indicative of significantly higher post procedure complications, mortality, morbidity, and prolonged hospitalization. Also, risk of recurrence of symptoms and re-admission remains high in patients with multi-vessel disease.
Keywords: Multi-vessel disease; Primary percutaneous coronary intervention, PCI; ST-Elevation Myocardial Infarction, STEMI

INTRODUCTION

Global burden of coronary artery disease (CAD) is increasing with every passing year, with varying intensity both developed and developing economies share this common health hazard.[1] ST-Elevation Myocardial Infarction (STEMI) is deadliest form of coronary artery disease.[2] Primary percutaneous coronary intervention (PCI) is the modality of choice among the practitioners for the treatment of patients with STEMI and supported by European Society of Cardiology (ESC)/acc guidelines.[3–4] The main goal of primary percutaneous coronary intervention (PCI) in the setting of ST elevation myocardial infarction (STEMI) is to re-perfuse the myocardium by opening the culprit (infarct-related) coronary.[5] However in addition to culprit vessel approximately fifty to eighty percent of the STEMI patients have significant atherosclerotic disease in other coronary arteries, which is a state highly associated with adverse clinical course.[6–9] Increase in cardiovascular risk in patients with multi-vessel CAD is explained by multiple factors that include impact of extensive atherosclerotic disease, impaired function of non-infarct zones, slow flow in critically narrowed non infarct related arteries, and presence of stunned and hibernating myocardium.[6,10,11] Multiple treatment strategies have been described, including multi-vessel percutaneous coronary intervention (PCI) at the time of the index procedure, staged PCI of non-culprit vessels guided by hemodynamic assessment, and a conservative approach with primary PCI of only the culprit lesion and subsequent medical therapy unless recurrent ischemia occurs.[12]

MATERIAL AND METHODS

This descriptive cross-sectional study is conducted at catheterization laboratory of National Institute of Cardiovascular Disease (NICVD) Karachi, Pakistan. In this study, we enrolled all consecutive patients presented with acute STEMI who were treated with primary PCI during the study period of 17th December 2016 to 16th June 2017. Data was collected after approval of institutional ethical review committee and informed consent was taken by principal investigator from all enrolled patients. Data was collected on predefined structural questionnaire. Demographic and clinical history of the patients was

taken regarding hypertension, diabetes, dyslipidaemia, smoking, family history of coronary artery disease (CAD) and chronic kidney disease (CKD). Presenting symptoms of the patient; chest pain, shortness of breath, state of shock, and survival of sudden cardiac arrest were recorded. Primary PCI was performed in all patients as per the institutional practice guidelines of the procedure. In-hospital outcome, length of stay (days) and post procedure complications were recorded. All the survived patients were followed-up for 1-month post procedure and short-term outcomes of the procedure were recorded.

SPSS-21 was used to analyse the data and patients were stratified into two groups based on number of vessel involved. Mean±SD was calculated for quantitative variables and frequency and percentages for categorical variables. z-test or t-test was applied to test the hypothesis of equality of proportions or mean. Two-sided p-value of <0.05 was taken as criteria for statistical significance.

RESULTS

This study includes 282 consecutive selected patients, presented in emergency department with acute STEMI.

Out of 282 patients 69.86% (197) were male, mean age 54.77±11.18 years and 62.06% (175) patients were more than 50 years of age. Diabetes mellitus was present in 32.98% (93) patients, hypertension in 58.51% (165), smoking in 30.50% (86), and dyslipidaemia in 26.60% (75) patients and chronic kidney disease in 3.55% (10). Patients were stratified into two groups based on number of vessel involved, 35.11% (99) patients had single vessel disease (SVD), while 64.89% (183) were diagnosed with multi vessel disease (MVD). Patients with MVD were much older with significantly higher mean age, p-value of <0.001. Diabetes and hypertension being major risk factors contribute significantly to multi-vessel disease. Patients on presentation to emergency department were in higher killip class and sick, angiographically type C lesion was found in significantly higher number of patients with multi-vessel disease. Because of complexity of disease amount of contrast used was significantly higher and on the other hand, post procedural TIMI flow was comparatively lower in MVD patients. All baseline and procedural characteristics of the patients are summarized in table-1.

Table-1: Baseline& procedural characteristics of the patients by overall and by number of vessel involve

Figures: n [column %] or Mean±SD		Total	Number of Vessel Involve		**p-value
		(n = 282)	Single Vessel (n=99)	Multi Vessel (n=183)	
Gender	Male	197 [69.86%]	73 [73.74%]	124 [67.76%]	0.296
	Female	85 [30.14%]	26 [26.26%]	59 [32.24%]	0.296
Age (years)	Mean±SD	54.77±11.18	50.67±11.14	56.99 ± 10.58	<0.001*
Co morbid	Diabetes Mellitus	93 [32.98%]	21 [21.21%]	72 [39.34%]	0.001*
	Hypertension	165 [58.51%]	48 [48.48%]	117 [63.93%]	0.011*
	Smoking	86 [30.5%]	29 [29.29%]	57 [31.15%]	0.746
	Dyslipidaemia	75 [26.6%]	24 [24.24%]	51 [27.87%]	0.51
	Family History of CHD	18 [6.38%]	7 [7.07%]	11 [6.01%]	0.728
	Chronic Kidney Disease	10 [3.55%]	3 [3.03%]	7 [3.83%]	0.73
Presenting Symptoms	Chest Pain	235 [83.33%]	91 [91.92%]	144 [78.69%]	0.004*
	Chest Pain with SOB	21 [7.45%]	2 [2.02%]	19 [10.38%]	0.01*
	Survival of sudden cardiac arrest	6 [2.13%]	2 [2.02%]	4 [2.19%]	0.926
	State of shock	20 [7.09%]	4 [4.04%]	16 [8.74%]	0.141
Lesion type	A	14 [4.96%]	7 [7.07%]	7 [3.83%]	0.231
	B	84 [29.79%]	38 [38.38%]	46 [25.14%]	0.02*
	C	184 [65.25%]	54 [54.55%]	130 [71.04%]	0.005*
Amount of contrast used (ml) [Mean ± SD]		164.66±31.92	150.25±33.2	172.46±28.39	<0.001*
Post Procedure TIMI Flow	No flow	4 [1.42%]	1 [1.01%]	3 [1.64%]	0.669
	I	3 [1.06%]	1 [1.01%]	2 [1.09%]	0.948
	II	18 [6.38%]	4 [4.04%]	14 [7.65%]	0.236
	III	257 [91.13%]	93 [93.94%]	164 [89.62%]	0.222
MBG Grade	0	4 [1.42%]	1 [1.01%]	3 [1.64%]	0.669
	1	5 [1.77%]	1 [1.01%]	4 [2.19%]	0.475
	2	19 [6.74%]	3 [3.03%]	16 [8.74%]	0.067
	3	254 [90.07%]	94 [94.95%]	160 [87.43%]	0.043*
*Statistically significant at 5% level of significance. **p-values are based on z-test for proportions and t-test for mean					

Comparing the patients with single vessel disease, multi-vessel disease patients have worse post procedural outcomes, increased overall complications, length of hospital stays, higher referral for CABG, and in-hospital mortality. On

follow up relatively higher, but not statistically significant, patient with MVD developed recurrence of symptoms and got re-admission. Post procedure complication, in-hospital outcome and outcome at one-month follow-up are presented in table-2.

Table-2: Post procedure outcome by overall and by number of vessel involve

Figures: n [column %] or Mean ± SD		Total (n = 282)	Number of Vessel Involve		**p-value
			Single Vessel (n=99)	Multi Vessel (n=183)	
Length of Stay (days) [Mean ± SD]		3.09 ± 1.41	2.58 ± 0.82	3.36 ± 1.58	<0.001*
Complications	No Complications	197 [69.86%]	79 [79.8%]	118 [64.48%]	0.007*
	Dissection	6 [2.13%]	2 [2.02%]	4 [2.19%]	0.926
	Slow/No flow	14 [4.96%]	6 [6.06%]	8 [4.37%]	0.533
	Shock	7 [2.48%]	1 [1.01%]	6 [3.28%]	0.242
	Pulmonary Edema	11 [3.9%]	2 [2.02%]	9 [4.92%]	0.23
	Needs IABP	3 [1.06%]	0 [0%]	3 [1.64%]	0.2
	Need Ventilator	11 [3.9%]	1 [1.01%]	10 [5.46%]	0.065
	Heart Block	10 [3.55%]	3 [3.03%]	7 [3.83%]	0.73
	Contrast Induced Nephropathy	35 [12.41%]	9 [9.09%]	26 [14.21%]	0.213
Procedure	CABG	14 [4.96%]	0 [0%]	14 [7.65%]	0.004*
	IRA PCI done only	252 [89.36%]	92 [92.93%]	160 [87.43%]	0.152
	IRA+NON-IRAas index case	5 [1.77%]	0 [0%]	5 [2.73%]	0.097
	IRA+NON-IRA at index hospitalization	5 [1.77%]	1 [1.01%]	4 [2.19%]	0.475
	Staged PCI with recurrent ischemia	1 [0.35%]	0 [0%]	1 [0.55%]	0.461
	Left on medical treatment	12 [4.26%]	6 [6.06%]	6 [3.28%]	0.269
In-hospital Outcome	Expired	24 [8.51%]	3 [3.03%]	21 [11.48%]	0.015*
	Discharge to Home	258 [91.49%]	96 [96.97%]	162 [88.52%]	0.015*
+1 Month Follow-up	Recurrence of symptoms	66 [25.58%]	23 [23.96%]	43 [26.54%]	0.405
	Re - admission	12 [4.65%]	2 [2.08%]	10 [6.17%]	0.097

*Statistically significant at 5% level of significance. **p-values are based on z-test for proportions and t-test for mean. +Follow-up after 1 month was made for 258 survived patients (96 with SVD and 162 with MVD)

Amount of contrast used, 172.46±28.39 ml vs. 150.25±33.2 ml with p-value <0.001, and length of hospital stay, 3.36±1.58 days vs. 2.58±0.82 days with p-value <0.0001, were significantly higher for patients with MVD. Significantly higher in-hospital mortality, 11.48% vs. 3.03% with p-value=0.015, and post procedure complications, 35.52% vs. 20.2% with p-value=0.007, were observed in patients with multivessel. Comparison of post procedure outcome in patients with MVD and SVD are presented in figure-1.
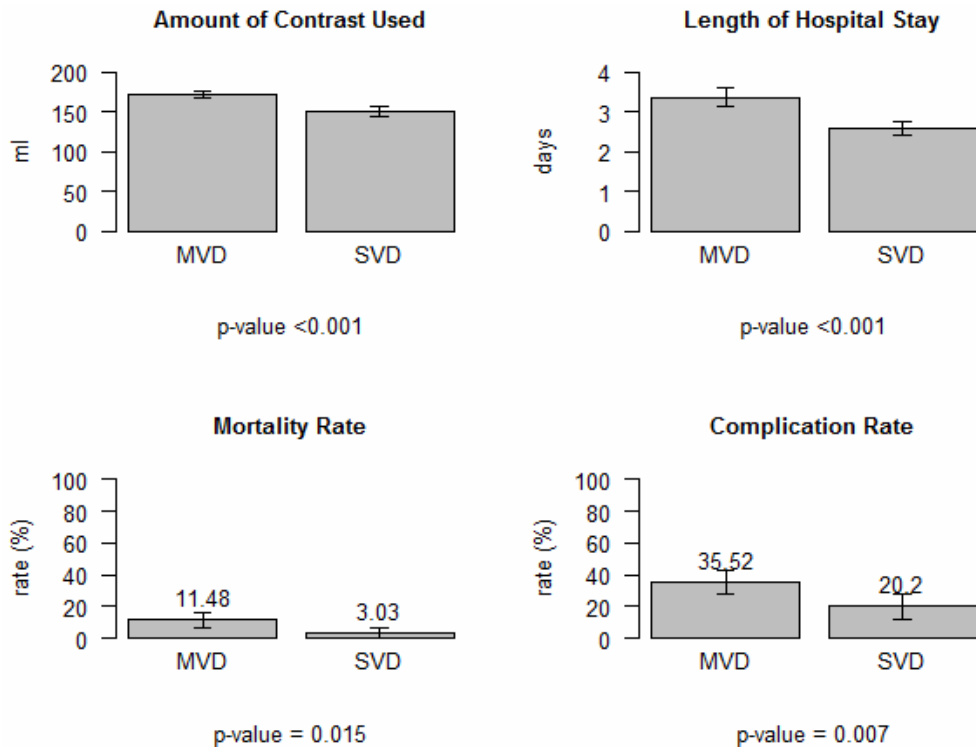

Figure-1: Comparison of post procedure outcome in patients with MVD and SVD

DISCUSSION

Multi-vessel disease (MVD) in STEMI patients is associated with higher post procedure short and long-term mortality and morbidity, regardless of the type of performed reperfusion strategy, it is also associated with poor success rate of re-perfusion.[6,13,16,17] In this study multi-vessel coronary artery disease (MVD) is diagnosed in 64.89% (183) of STEMI patients. The presence of MVD in this study coincides with the reported occurrence of 46–66% in past studies.[2,12,14,15]

Several differences in the baseline characteristics, cardiac history and presentation were observed between the patients with SVD and MVD. Patients with MVD were much older with significantly higher mean years of age, p-value of <0.001. Diabetes and hypertension are significantly higher associated co-morbid with multi-vessel disease. In addition, higher proportion of lesion type C and lesser proportion in MBG grade 3 was observed among the patients with MVD. These differences in characteristics are the indicative of complexity and severity of disease and are consistent with the findings of past studies.[12,14,15,17]

Despite the extensive investigations in the subject matter, the apparent mechanism behind how multi-vessel coronary artery disease worsens the prognosis so seriously remains unanswered.[15]

Rate of post procedure complication, defined as any of dissection, slow or no flow, shock, pulmonary oedema, needed IABP or ventilator, developed heart block, remains significantly higher in patients with MVD as compared to SVD. Study conducted by de Waha S *et al* reported 9.6% vs. 4.8% MACE with p-value = 0.01 in patients with MVD and SVD respectively.[14] Lekston A *et al* reported significantly higher cumulative incidence of MACE during 12-month follow-up in patients with MVD (32.5% vs 14.5%, p<0.0001).[15] Cumulative incidence of post procedure complication in patients with MVD (35.52% vs. 20.02%, p-value=0.007) in our study is align with post studies.

Significantly higher mortality is found to be associated with MVD (11.48% vs. 3.03%, p-value = 0.015). Association of in-hospital mortality with MVD is supported by past studies; study conducted by Karamfiloff KK *et al* reported significant increase in mortality rate in MVD patients (15.6% vs. 6.5%, p-value ≤0.01).[2] Lekston A *et al* reported in-hospital mortality of 9.5% vs. 2.9% with p-value <0.001 in patients with MVD.[15]

Even poorer outcome of procedure, in terms of in-hospital mortality, in STEMI patients is observed in presence of co-morbidities. In-hospital mortality in patients with; diabetes mellitus is 13.9% vs. 0%, hypertension is 15.4% vs. 2.1%, and dyslipidemia is 15.7% vs. 4.2%.

Furthermore, past studies suggest patients with MVD have more impaired long-term recovery of left ventricular ejection fraction (LVEF). Recurrence of symptoms and re – admission to hospital, during the one month of follow-up time, was observed to be relatively higher in MVD patients.

Given the complexity level associated with MVD, strategy of multi-vessel PCI over culprit lesion–only PCI may offer a certain benefits[18,19], because plaque instability may involve other territories in the coronary vasculature along with infarct-related[20]. However, strategy of multi-vessel PCI does possess pertinent disadvantages such as intervention of a non-culprit lesion may result in unnecessary hemodynamic compromise during PCI, increased amount of contrast use due to extended duration, and complications related to vessel.[20] Studies suggest that the staged strategy for non-culprit lesions should remain the standard approach to primary PCI in STEMI patients with MVD, it improves short and long-term survival of the patients.[20,21]

Our study enrolled only 282 STEMI patients from a single centre. This could be a potential reason to limit the generalize-ability of our study findings.

CONCLUSION

Multi-vessel disease in patient is the direct indicative of significantly higher post procedure complications, mortality, morbidity, and prolonged hospitalization. Also, risk of recurrence of symptoms and re-admission remains high in patients with multi-vessel disease.

AUTHORS' CONTRIBUTION

MKB: literature search, study design, concept data interpretation and write-up. AIR: Study design, and proof reading. BAS: Literature search, data collection. NK: Study design, Write-up. MK: Data analysis, data interpretation. SNHR: Concentration and proof reading

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