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FREQUENCY OF MULTI VESSEL DISEASE AND ASSOCIATED IN-HOSPITAL OUTCOMES IN PATIENTS PRESENTING WITH STEMI AND UNDERGOING PRIMARY PCI

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ABSTRACT

OBJECTIVES: To determine the frequency of multivessel disease in patients presenting with ST-segment evaluation myocardial infarction (STEMI) at NICVD Karachi.

1. To determine the frequency of in-hospital outcomes associated with multivessel disease in STEMI patients.

STUDY DESIGN AND SETTING: The descriptive case series study was conducted at the Cardiology Emergency Department and Cath Lab during the period of September 28, 2022, to March 25, 2023, at the National Institute of Cardiovascular Disease in Karachi, Pakistan.

MATERIALS AND METHODS: All patients who fulfilled the inclusion criteria and visited NICVD, Karachi, were included in the study. Informed consent was obtained after explaining the procedure, risks, and benefits of the study. All the patients underwent primary PCI and were observed for 48 hours post-PCI in the ward to assess the in-hospital outcomes of the associated multivessel disease. All the collected data was entered into the proforma attached at the end and used electronically for research purposes.

RESULTS: The mean ± SD of age was 55.36±8.40 years. In the distribution of gender, 107 (70.9%) were male while 44 (29.1%) were female. Multi-vessel disease was noted in 75 (49.7%) patients. In the distribution of in-hospital outcomes, contrast-induced nephropathy was noted in 10(13.3%) patients, pulmonary edema 3(4.0%), cardiogenic shock 2(2.7%), need for a ventilator 4(5.3%), heart block 3(4.0%) while mortality was documented in 7(9.3%) patients.

CONCLUSION: It is to be concluded that contrast-induced nephropathy was a common in-hospital outcome of multivessel disease in STEMI patients, followed by mortality and a need for a ventilator. Furthermore, our findings outline the need for future research to investigate those factors that could be considered to be at higher risk of adverse in-hospital outcomes.

KEYWORDS: Hospital Outcomes, Multi-Vessel Disease, Myocardial Infarction, STEMI

INTRODUCTION

Multivessel disease (MVD) is defined as significant stenosis (>70%) in two or more major coronary arteries of 2.5 mm diameter or more [1]. 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 artery. However, in as many as 50%–80% of patients with STEMI there is significant atherosclerotic disease in other coronary arteries in addition to the culprit vessel; a state which is associated with adverse outcomes [2, 3].

A large randomized clinical trial, culprit lesion-only PCI vs multi-Vessel PCI in cardiogenic shock (CULPRIT-SHOCK), found that multivessel PCI during the index procedure in cardiogenic shock and AMI led to a lower rate of survival at 30 days and at 1-year follow-up compared with culprit vessel–only PCI [4]. Coronary angiography showed MVD in 50% of the patients, of whom 61.81%

patients had two-vessel disease, and the remaining 38.18% had three-vessel disease [5]. The relative incidences of STEMI and NSTEMI are decreasing and increasing, respectively. Probably the most comprehensive European STEMI registry is found in Sweden, where the incidence rate of STEMI was 58 per 100000 per year in 2015 [6].

In a study the biggest complication seen among which includes contrast-induced nephropathy (12.41%), pulmonary edema (3.9%), cardiogenic shock (2.48%), needing a ventilator (3.9%), heart block (3.55%) and the in-hospital mortality rate was documented in 8.51% STEMI patients undergoing primary PCI with MVD [7].

Given the complexity level associated with MVD, the strategy of multi-vessel PCI over culprit lesion–only PCI may offer a certain benefit because plaque instability may involve other territories in the coronary vasculature along with infarct-related [8-10].

A recent analysis of a European registry, the Western Denmark Heart Registry, showed that multi-vessel PCI in the acute setting is associated with higher mortality than multi-vessel PCI performed in a staged fashion within 60 days after the index procedure [11]. In the same way, results came from a post hoc analysis of the HORIZONS- AMI trial, where multi-vessel PCI in the acute procedure was found to be significantly associated with higher 1-year mortality, cardiac mortality, and stent thrombosis than a staged multi-vessel PCI [12].

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. This study is designed to assess the multi-vessel disease and associated hospital outcomes to offer prompt treatment to patients with multi-vessel disease to reduce the burden and prognosis of the disease.

ORIGINAL STUDY

OBJECTIVES

1. To determine the frequency of multi-vessel disease in patients presenting with ST-segment evaluation myocardial infarction (STEMI) at NICVD Karachi.
2. To determine the frequency of in-hospital outcomes associated with multi-vessel disease in STEMI patients.

OPERATIONAL DEFINITION

PRIMARY PCI

It was defined as a patient with STEMI presented in the emergency department taking for angioplasty within 12 hours.

ST SEGMENT ELEVATION MYOCARDIAL INFARCTION (STEMI)

Patients with chest pain > 20 minutes on vas scale > 6 consistent with acute MI with new ST elevation at the J point in at least 2 contiguous leads of ≥2 mm (0.2 mV) in men or ≥1.5 mm (0.15 mV) in women in leads V2–V3 and/or of ≥1 mm (0.1 mV) in other contiguous chest leads or the limb leads.

MULTI-VESSEL DISEASE

It was defined as 70% or greater stenosis in at least one major epicardial vessel (LAD, RCA, or LCX) along with 50% or greater stenosis in at least one other major vessel (LAD, RCA, or LCX).

ASSOCIATED IN HOSPITAL OUTCOMES WITH MULTI-VESSEL DISEASE

CARDIOGENIC SHOCK

The identification of cardiogenic shock was determined by specific hemodynamic standards, including a continuous drop in blood pressure (systolic pressure <90 mm Hg for at least half an hour) and a decrease in cardiac output (less than 2.2 L/min/m2) along with a high pulmonary capillary pressure (above 15 mmHg) as measured by echocardiography to evaluate heart function.

CONTRAST-INDUCED NEPHROPATHY (CIN)
It was described as follows: after 72 hours following PCI, a rise in blood serum creatinine of ≥ 0.5 mg/dl or an increase in estimated glomerular filtration rate (eGFR) of >25% over baseline.

PULMONARY EDEMA
It was defined as an abnormal accumulation of fluid in the extravascular compartments of the lung assessed on x-ray.

HEART BLOCK
It was defined as the presence of complete dissociation of atrial and ventricular activity rates with atrial rate greater than the ventricular rate detected on ECG.

MORTALITY
It was defined as a patient who died during a hospital stay within 02 days post-PCI.

DIABETES MELLITUS
Plasma glucose levels during fasting must be at least ≥6.5 mmol/I (126 mg/dl), or more than 10 mmol/I (180 mg/dl) two hours after a meal, or longer than six months if taking anti-diabetic medication.

HYPERTENSION
The individual has a blood pressure reading of 130 mmHg or higher for systolic blood pressure and 90 mmHg or higher for diastolic blood pressure at two different times, four hours apart, or while taking medication for hypertension for a duration of at least six months.

MATERIAL & METHODS

STUDY DESIGN
Descriptive Case Series Study.

STUDY SETTING AND DURATION
The Cardiology Emergency Department and Cath Lab at National Institute of Cardiovascular Disease Karachi during the period of ***September 28, 2022***to ***March 25, 2023***.

SAMPLE SIZE
By applying a sample size calculator with a frequency of multivessel disease (50%) among patients with STEMI who are receiving primary PCI, and setting a confidence level (C.I) at 95%, and a margin of error (d) of 8%, the calculated sample size was found to be n=151.

SAMPLING TECHNIQUE
Consecutive Sampling (Non-Probability,)

SAMPLE SELECTION
INCLUSION CRITERIA
- Patients between 30 to 70 years of age.
- Either gender.
- Patients presented with STEMI in accordance with the operational definition.
- Patients underwent primary PCI.
- Patients came in for treatment within a 12-hour period after experiencing symptoms.

EXCLUSION CRITERIA

- Patients initial blood creatinine level was above 1.3 mg/dl before the procedure.
- Patients had severe liver conditions confirmed through ultrasound.
- Patients had a past record of undergoing coronary artery bypass grafting or PCI.
- Patients were currently receiving medication for infarct-related arteries.

DATA COLLECTION

Every patient who came to NICVD Karachi and met the inclusion criteria was requested to voluntarily agree to participate in the study. The necessary patient details (including name, age, gender, and address) were collected. Subsequently, the patients received primary PCI treatment by the researcher, who was overseen by a senior registrar or consultant cardiology professional with over 5 years of experience. The outcome variable i.e. multivessel disease was noted per operational definition. All the patients were observed for 48 hours post PCI in the ward to assess in-hospital outcomes of associated multi-vessel disease i.e. contrast-induced nephropathy, pulmonary edema, cardiogenic shock, need a ventilator, heart block, and in-hospital mortality. All the collected information was noted and recorded in the proforma attached. *Confounding factors, explanatory variables, and bias were managed by adhering strictly to the inclusion criteria.*

RESULTS

In this research, a total of 151 patients were involved to evaluate the condition of multi-vessel disease and its outcomes in hospital settings among individuals who came in for evaluation of ST-segment elevation myocardial infarction (STEMI) at the National Institute of Cardiovascular Diseases (NICVD) in Karachi, and the findings were examined.

Mean age was 55.36±8.40 years (CI 54.01-56.71), height was 168.23±8.39 cm (CI 166.88-169.57), weight was 76.89±11.28 kg (CI 75.08-78.71), and BMI was 27.28±4.43 kg/m2 (CI 26.57-28.00) as displayed in TABLE 1.

TABLE 1 DESCRIPTIVE STATISTICS OF DIFFERENT VARIABLES

Variable	Mean	Std. Error	Standard deviaion	95% Confidence Interval for Mean		Range	Interquartile Range
				L. border	U. Border		
Age	55.36	0.684	8.408	54.01	56.71	40	9
Height	168.23	0.683	8.395	166.88	169.57	27	15
Weight	76.89	0.918	11.283	75.08	78.71	44	144
BMI	27.288	0.3605	4.4305	26.575	28.0006	20	6.99

The study found different frequency distribution that 107 (70.9%) male patients had hypertension (64.9%), 73 (51.7%) had diabetes mellitus, and 75 (49.7%) had multi-vessel disease as shown in TABLE 2.

TABLE 2 FREQUENCY DISTRIBUTION OF DIFFERENT VARIABLES

Age (years)	**18-40**	**64**	**40.3%**
	41-60	76	47.80%
	61-70	19	11.9%
Gender	**MALE**	107	70.9%
	FEMALE	44	29.1%

Hypertension	**Yes**	98	64.9%
	No	53	35.1%
Diabetes Mellitus	**Yes**	73	51.7%
	No	78	38.3%
Multivessel disease	**Yes**	75	49.7%
	No	76	50.3%

In the distribution of in-hospital outcomes contrast-induced nephropathy was noted in 10 (13.3%) patients, pulmonary edema 3 (4.0%), cardiogenic shock 2 (2.7%), need for ventilator 4 (5.3%), heart block 3 (4.0%) while mortality was documented in 7 (9.3%) were patients. as shown in **TABLE 3**

TABLE 3 FREQUENCY OF ASSOCIATED IN-HOSPITAL OUTCOMES n=75

ASSOCIATED IN-HOSPITAL OUTCOMES	FREQUENCY (%)	
	YES	**NO**
Contrast Induced Nephropathy	10 (13.3%)	**65 (86.7%)**
Pulmonary Edema	3 (4.0%)	**72 (96.0%)**
Cardiogenic Shock	2 (2.7%)	**73 (97.3%)**
Need Ventilator	4 (5.3%)	**71 (94.7%)**
Heart Block	3 (4.0%)	**72 (96.0%)**
Mortality	7 (9.3%)	**68 (90.7%)**

Stratification of age group, gender, hypertension, diabetes mellitus, and body mass index was done with respect to multi-vessel disease, and its associated in-hospital outcomes (contrast-induced nephropathy, pulmonary edema, cardiogenic shock, need ventilator, heart block, and mortality) patients as shown from **TABLE 4,5**

TABLE 4 STRATIFICATION OF DIFFERENT VARIABLES WITH MULTI VESSEL DISEASE n=151

VARIABLES		MULTIVESSEL **DISEASE**		**P-VALUE**
		Yes	**No**	
Age	30 – 55	31(20.5%)	28(18.5%)	**0.572**
	>55	44(29.1%)	48(31.8%)	
Gender	Male	51(33.8%)	56(37.1%)	**0.442**
	Female	24(15.9%)	20(13.2%)	
Hypertention	Hypertensive	49(32.5%)	49(32.5%)	**0.912**
	NonHyperten:	26(17.2%)	27(17.9%)	
Diabetic	Diabetic	36(23.8%)	37(24.5%)	**0.933**
	Non-Diabetic	39(25.8%)	39(25.8%)	
BMI	19 – 27	40(26.5%)	41(27.2%)	
	>27	35(23.2%)	35(23.2%)	**0.940**

TABLE 5 STRATIFICATION OF DIFFERENT VARIABLES WITH ASSOCIATED IN-HOSPITAL OUTCOMES n=75

Associated In-Hospital Outcomes		Age Group		Gender		Hypertension		Diabetes Mellitis		BMI	
		30-55	>55	MALE	FEMALE	HTN	NON-HTN	DM	NON-DM	19–27	>27
Contrast Induced Nephropathy	Y	6 (8.0%)	4 (5.3%)	6 (8.0%)	4 (5.3%)	7 (9.3%)	3 (4.0%)	4 (5.3%)	6 (8.0%)	2 (2.7%)	8 (10.7%)
	N	25 (33.3%)	40 (53.3%)	45 (60.0%)	20 (26.7%)	42 (56.0%)	23 (30.7%)	32 (42.7%)	33 (44.0%)	38 (50.7%)	27 (36.0%)
	P*	0.173		0.402		0.521		0.421		0.026	
Pul: Edema	Y	2 (2.7%)	1 (1.3%)	2 (2.7%)	1 (1.3%)	3 (4.0%)	0 (0.0%)	2 (2.7%)	1 (1.3%)	2 (2.7%)	1 (1.3%)
	N	29 (38.7%)	43 (57.3%)	49 (65.3%)	23 (30.7%)	46 (61.3%)	26 (34.7%)	34 (45.3%)	38 (50.7%)	38 (50.7%)	34 (45.3%)
	P*	0.370		0.692		0.273		0.470		0.551	
Cardiogenic shock	Y	0 (0.0%)	2 (2.7%)	1 (1.3%)	1 (1.3%)	1 (1.3%)	1 (1.3%)	1 (1.3%)	1 (1.3%)	1 (1.3%)	1 (1.3%)
	N	31 (41.3%)	42 (56.0%)	50 (66.7%)	23 (30.7%)	48 (64.0%)	25 (33.3%)	35 (46.7%)	38 (50.7%)	39 (52.0%)	34 (45.3%)
	P*	0.341		0.541		0.576		0.733		0.719	
Need ventilator	Y	2 (2.7%)	2 (2.7%)	3 (4.0%)	1 (1.3%)	1 (1.3%)	3 (4.0%)	2 (2.7%)	2 (2.7%)	3 (4.0%)	1 (1.3%)
	N	29 (38.7%)	42 (56.0%)	48 (64.0%)	23 (30.7%)	48 (64.0%)	23 (30.7%)	34 (45.3%)	37 (49.3%)	37 (49.3%)	34 (45.3%)
	P*	0.551		0.617		0.117		0.662		0.360	
Heart block	Y	1 (1.3%)	2 (2.7%)	2 (2.7%)	1 (1.3%)	2 (2.7%)	1 (1.3%)	1 (1.3%)	2 (2.7%)	3 (4.0%)	0 (0.0%)
	N	30 (40.0%)	42 (56.0%)	49 (65.3%)	23 (30.7%)	47 (62.7%)	25 (33.3%)	35 (46.7%)	37 (49.3%)	37 (49.3%)	35 (46.7%)
	P*	0.6630		0.692		0.726		0.530		0.146	
Mortility	Y	2 (2.7%)	5 (6.7%)	5 (6.7%)	2 (2.7%)	5 (6.7%)	2 (2.7%)	5 (6.7%)	2 (2.7%)	2 (2.7%)	5 (6.7%)
	N	29 (38.7%)	39 (52.0%)	46 (61.3%)	22 (29.3%)	44 (58.7%)	24 (32.0%)	31 (41.3%)	37 (49.3%)	38 (50.7%)	30 (40.0%)
	P*	0,384		0.603		0.539		0.183		0.146	

P^* =P value Y = Yes N = No

DISCUSSION

Worldwide, heart and blood vessel diseases (CVDs) are responsible for the most fatalities and greatly diminish overall well-being annually [13]. In the year 2017, CVDs were the cause of 17.8 million deaths and 35.6 million years of life lost due to disabilities [14,15]. A significant portion, about 80%,

of this worldwide impact is felt by people living in low- and middle-income areas.[16]
Individuals from South Asian nations face the greatest risk of developing CVDs, leading to the highest mortality rates globally [17-19]. The rapid expansion of urban areas in this region has led to an increase in urban migration, which has in turn caused a rise in the prevalence of coronary artery disease (CAD). This situation underscores the need for in-depth research, analysis, and comprehension of the factors contributing to a high risk of disease, in order to devise effective prevention strategies.[17]
The elevated levels of CAD among people from South Asia are associated with a prolonged shift towards an epidemic pattern and a greater incidence of heart disease risk factors, including high blood pressure, obesity, inactive lifestyle, smoking, and type 2 diabetes. [15,20,21].
Various research studies, which include clinical trials and data from hospital records, have reported that nearly half of individuals experiencing a heart attack have more than one blocked artery. Having more than one blocked artery increases the risk of death and complications in these patients. [22-24].
The use of thrombolysis to treat heart attacks is a common practice, and the ability to restore blood flow through coronary arteries is measured using the TIMI flow assessment scale. Achieving TIMI flow grades II or III for the main artery after a heart bypass surgery indicates the success of the procedure. Achieving TIMI flow grade III post-surgery is associated with lower mortality and morbidity rates, lower levels of enzymes, and better overall results, including improved heart function in the left ventricle. [25].
In patients with STEMI (ST-segment elevation myocardial infarction), those with multi-vessel disease (MVD) experience higher rates of both short and long-term death and illness, no matter the reperfusion method used. This condition is also linked to a lower success rate in restoring blood flow.[26] Due to the complexity of MVD, performing multi-vessel PCI (percutaneous coronary intervention) on multiple vessels instead of just the blocked one might provide some advantages.[27]This is because the instability of the plaque could spread to other parts of the coronary arteries, including those affected by the heart attack. However, multi-vessel PCI also has its drawbacks, such as the risk of treating a non-affected artery could lead to complications during the procedure, more contrast dye is needed due to the longer procedure, and there's a higher chance of complications with the blood vessels.[28] Research indicates that the usual approach of treating non-affected arteries should continue to be the primary method for STEMI patients with MVD, as it has been shown to enhance both short-term and long-term survival rates [28,29].
Our study's results are consistent with those of several other research that are mentioned below. The mean age for participants in this research was 55.36±8.40 years. 56.3±11.4 years was the mean age determined by Majeed H. et al [5]. 54.77±11.18 was the mean age reported by Batra MK, et al [7].
In the present study, 44 (29.1%) and 107 (70.9%) of the participants were female. There were 20 (18.2%) females and 90 (81.8%) males, according to Majeed H. et al.'s research [5]. There were 197 (69.86%) females and 85 (30.14%) men [7].
In recent research, 98 (64.9%) patients had hypertension, compared to 74 (67.3%) instances by Majeed H, et al [5]. 165 people (58.51%) had hypertension, according to Batra MK, et al. [7].
Diabetes mellitus was identified in 73 (51.7%) of the individuals in our investigation. Diabetes was reported in 44 (40%) of the patients by Majeed H. et al. [5]. According to Batra MK, et al.'s study, 93 people (32.98%) had diabetes [7].
75 individuals, or 49.7%, had multivessel disease, according to the current study. A different investigation revealed that 55 individuals, or 50%, had multivessel disease [5]. 162 patients (57.44%) had the multi-vascular disease, according to Batra MK, et al [7].
In our analysis, related in-hospital outcomes included 10 (13.3%) contrast-induced nephropathy, 3 (4.0%) pulmonary edema, 2 (2.7%) cardiogenic shock, 4 (5.3%) ventilator-related complications, and 3 (4.0%) heart block, while 7 (9.3%) of the patients had a recorded death. The most common complications observed in the study were contrast-induced nephropathy (12.41%), heart block (3.55%), cardiogenic shock (2.48%), pulmonary edema (3.9%), and the need for a ventilator (3.9%).

Hospital mortality was recorded in 8.51% of STEMI patients receiving primary PCI for multivessel disease. 35 (12.41%) had contrast-induced nephropathy, 11 (3.9%) had pulmonary edema, 07 (2.48%) had a cardiogenic shock, 11 (3.9%) required a ventilator, 10 (3.55%) had heart block, and 24 (8.51%) were patients who died, according to the Batra MK, et al. research [7].

In our study, stratification of confounders/effect modifiers with respect to multi-vessel disease, the insignificant difference was noted in age group (P=0.572), gender (P=0.442), hypertension (P=0.912), diabetes mellitus (P=0.933) and body mass index (P=0.940).

In this study, stratification of confounders/effect modifiers with respect to associated in-hospital outcomes was also done.

A major drawback of our research was its small sample size, despite being carried out at the country's largest heart hospital, which reached nearly all segments of the population. Additionally, our research was confined to males, with over 82% of the participants being male, thus making it difficult to generalize the results to include gender-based differences in TIMI flow grade after primary PCI.

CONCLUSION:

In conclusion, the study found that contrast-induced nephropathy was a frequent adverse event in-hospital following complex aortic and coronary artery disease, with mortality and the requirement for mechanical ventilation following closely. Moreover, these results highlight the importance of future studies focusing on identifying risk factors associated with poorer in-hospital outcomes.

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