Original Article

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In Hospital Outcome Among Smoker and Nonsmoker Patients Presented with ST-Elevation Myocardial Infarction Undergoing Primary Percutaneous Coronary Intervention

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ABSTRACT

Objective: To determine the association between smoking and in-hospital outcomes in patients presented with ST-Elevation Myocardial Infarction undergoing primary percutaneous coronary intervention (PCI).

Methodology: This prospective cohort study was conducted at Department of Cardiology, National Institute of Cardiovascular Disease (NICVD), Karachi, from November 9, 2020 to May 8, 2021. All the patients (current smoker, ex-smoker and non-smoker) with age 18 years to 85 years, both gender, patients diagnosed with STEMI in accordance with operational definition and underwent primary PCI were included. Patients diagnosed with ST-Elevation Myocardial Infarction were divided into two groups, expose (smoker) and unexposed (nonsmoker). Before PPCI demographic detail were noted and body mass index was calculated after management of STEMI then PCI was performed. In hospital outcome i.e. heart failure, in-hospital mortality and transient ischemic attack were assessed within 30 days of hospital stay after PCI. All the collected data were entered into the proforma.

Results: Mean ±SD of age in exposed group was 56.5±11.8 and non-exposed group was 57.7±12.1 years. In group wise distribution of gender, 82 (70.7%) males and 34 (29.3%) females were enrolled in exposed group and 80 (68.9%) males and 36 (31.1%) females were included in non-exposed group. Risk of heart failure and transient ischemic attack were 1.4 and 5.0 times more likely in exposed as compared to unexposed with [Relative Risk 1.444 and 5.0 respectively. While risk of mortality was 0.2 times less likely in exposed as compared to unexposed with [Relative Risk 0.222] and P value was found to be as significant i.e. (P=0.030).

Conclusion: It is to be concluded that significant risk of heart failure and transient ischemic attack were noted in exposed as compared to unexposed and vice versa in case of mortality, but we cannot rule out residual confounders.

Keywords: ACS, In-Hospital mortality, Heart Failure, PPC, STEMI

Introduction

Cardiovascular disease (CVD) is responsible for around 30% of all mortality throughout the world, making it the leading cause of death.[1,2] The aging population has led to an increase in global CVD-related deaths, making it a serious health concern. Acute myocardial infarction (AMI) is a type of CVD that can result in a significant 30-day mortality rate, ranging from 3% to 14%.[1,3] Several studies have examined the risk factors, clinical symptoms, and outcomes during hospitalization of younger and older patients with acute ST-elevation myocardial infarction (STEMI).[4,5] In patients under the age of 40, risk factors such as being male, smoking,

having a family history of cardiovascular disease, diabetes mellitus (DM), hypertension, and dyslipidemia have been linked to STEMI.[4] Although it is widely recognized that smoking is a risk factor for coronary artery disease and is linked to higher rates of myocardial infarction and cardiovascular death.[6] However, there are studies indicating that in patients with ST-segment elevation myocardial infarction (STEMI), smokers may have lower mortality rates compared to non-smokers, particularly when treated with thrombolysis or without reperfusion therapy.[6,7]

According to a study, the impact of smoking on in-hospital mortality in patients with STEMI who underwent percutaneous coronary intervention (PCI).[8] The study found that, when compared with non-smokers, smokers seemed to have a significantly lower risk of in hospital death rate (2.2% vs 4.3%). The authors suggested that smoking may have a protective effect against myocardial infarction-related complications and that further research is needed to explore the underlying mechanisms.[8] Despite previous findings suggesting a potential protective effect of smoking in patients with STEMI, recent research has not consistently replicated these results in patients treated with percutaneous coronary intervention (PCI), which is currently the preferred treatment for STEMI.

Some studies have reported lower rates of adverse outcomes among smokers compared to non-smokers with STEMI who undergo primary PCI, including in-hospital complications such as heart failure and stroke.[9,10] Overall, these studies have investigated the relationship between smoking and the distribution of coronary lesions, but the findings have been inconsistent and also suggest that smoking may have a protective effect in patients with STEMI, it is also important to note that smoking is a major risk factor for coronary artery disease and other cardiovascular diseases. Therefore, smoking cessation remains a crucial aspect of cardiovascular disease prevention and management. The impact of smoking on outcome in patients with STEMI treated with primary percutaneous coronary intervention (PCI) is less established. However, data from PCI studies on the smoker's paradox is limited and has mainly been derived from post-hoc analyses of selected patient groups within other trials. As such, the existence of the smoker's paradox in modern-day STEMI patients remains unclear and controversial. Therefore, the present study was designed to generate local data for a better understanding of the relationship.

Methodology

This prospective observational cohort study was done at the Department of Cardiology, National Institute of Cardiovascular Disease (NICVD), Karachi, from November 9, 2020 to May 8, 2021. Approval of ethical review committee of NICVD was taken prior to the data collection. Non-Probability, Consecutive Sampling technique was used. All the patients (current smokers, ex-smokers, and non-smokers) with age 18 years to 85 years, both genders, were diagnosed with STEMI in accordance with the operational definition and underwent primary PCI were included. All the patients with history of prior cardiac related surgery or intervention, individuals with comorbidities like renal impairment (>1.2mg/dl creatinine level), liver profile abnormalities (bilirubin >5mIU, AST >40IU, ALT>40IU,) and patients with valvular heart disease or neurological problem were excluded. Complete clinical examination and demographic details were obtained and body mass index (BMI) was calculated as per kg/m^2. After taking informed consent, the PCI was performed by consultant cardiologist as per Hospital protocols and assisted by the researcher himself. Patients were divided in two groups: smokers and ex-smokers were taken in group-I and non-smoker were taken in group-II. In- hospital outcome, i.e. heart failure, in-hospital mortality, and stroke, was assessed within 30 days of hospital stay after PCI. Confounders, risk factors and bias were controlled by strictly following the inclusion criteria. All data was recorded in a predesigned proforma and was kept secured and available to authorized person only. SPSS version was used for data analysis.

Results

In this study, a total of 232 patients, 116 in each group, to assess the association between smoking and in-hospital outcomes in patients presented with ST-elevation myocardial infarction undergoing primary percutaneous coronary intervention (PCI) and the results were analyzed. Mean age in exposed group was 56.5±11.8 years with and non-exposed group was 57.7±12.1 years. Mean BMI in exposed and non-exposed group was 26.4±6.5 kg/m^2 and 25.9±6.2 kg/m^2. In group wise distribution of gender, 82 (70.7%) males and 34 (29.3%) females were enrolled in exposed group and 80 (68.9%) males and 36 (31.1%) females were included in non-exposed group, respectively. Hypertension was in 55 (47.4%) patients in exposed group while 51 (43.9%) in non-exposed group, diabetes mellitus was in 44 (37.9%)

patients in the exposed group compared with 41 (35.3%) in non-exposed group. Positive family history of ischemic heart disease was in 19 (16.4%) patients in exposed group and 20 (17.2%) in non-exposed group. Heart failure was documented in 36 (31.1%) patients in exposed group while 25 (21.5%) in non-exposed group (p=0.101. Transient ischemic attack was found to be in 5 (4.3%) patients in exposed group while 1 (0.9%) in non-exposed group (p=0.106). In-hospital mortality was documented in 2 (1.7%) and 9 (7.8%) patients in the exposed and non-exposed group respectively (p=0.030). Table.1

Table I: In hospital outcomes in patients of STEMI (n=232)

In hospital outcomes		Study groups		p-value
		Exposed	**Non- exposed**	
Heart failure	Yes	36(31.0%)	25(21.6%)	0.101
	No	80(69.0%)	91(78.4%)	
Transient ischemic disease	Yes	5(4.3%)	1(0.9%)	0.106
	No	111 (95.7%)	115(99.1%)	
Mortality	Yes	2(1.7%)	9(7.8%)	
	No	114(98.3%)	107(92.2%)	0.030

Stratification of age groups, gender, BMI, hypertension, diabetic mellitus, family history of IHD were observed almost statistically insignificant with respect to in-hospital outcomes to assess the significant association between exposed and unexposed from. Table II to IV.

Discussion

ST-segment elevation myocardial infarction (STEMI) is a critical heart condition that necessitates rapid reperfusion therapy. It is worth noting that the majority of research on the smoker's paradox was conducted during the thrombolysis era, and It is still debatable as to whether or not smoking has an effect on the length of stay in the hospital for patients who have undergone percutaneous intervention (PCI).[11] The present study has been conducted to generate local data for a better understanding of the relationship. In this study, an elevated risk of heart failure and transient ischemic attack was observed in those who were exposed when compared to those who were not exposed, while mortality rate was higher among smokers compared to non-smokers. These finding were supported by De Luca G et al[12] as they observed that the active smoking was found to be significantly linked with improved epicardial recanalization and lower rates of in-hospital and 30-day mortality compared to those with a history of previous or non-smoking. In the study by Wu HP et al[13] observed that the phenomenon known as the "smoker's paradox" also applies to the long-term results of patients with stable coronary artery disease (CAD) who undergo percutaneous coronary intervention (PCI), and this can be attributed, in part, to differences in their baseline characteristics. Nevertheless, smoking was found to be a strong predictor of all-cause mortality and repeat PCI procedures in these patients.[13]

Although the Kızıltunç E et al[14] conducted the study to evaluate the relationship between smoking and death rate

Table II: Heart failure in accordance to age, gender, BMI, hypertension, diabetes and family history (n=232)

Variables		Study groups	HEART FAILURE		Relative risk	p-value
			Yes	**No**		
Age groups	18 – 50	Exposed	11(34.4%)	21(65.6%)	1.188	0.626
		Non-Exposed	11(28.9%)	27(71.1%)		
	>50	Exposed	25(29.8%)	59(70.2%)	1.658	0.079
		Non-Exposed	14(17.9%)	64(82.1%)		
Gender	Males	Exposed	26(31.7%)	56(68.3%)	1.631	0.083
		Non-Exposed	14(19.4%)	58(80.6%)		
	Females	Exposed	10(29.4%)	24(70.6%)	1.176	0.663
		Non-Exposed	11(25.0%)	33(75.0%)		
BMI kg/m^2	18 – 24 Kg/m^2	Exposed	24(38.1%)	39(61.9%)	1.026	0.926
		Non-Exposed	13(37.1%)	22(62.9%)		
	>24 kg/m^2	Exposed	12(22.6%)	41(77.4%)	1.528	0.248
		Non-Exposed	12(14.8%)	69(85.2%)		
Hypertension	Yes	Exposed	20 (36.4%)	35(63.6%)	1.855	0.056
		Non-Exposed	10(19.6%)	41(80.1%)		
	No	Exposed	16(26.2%)	45 (73.8%)	1.137	0.681
		Non-Exposed	15(23.1%)	50 (76.9%)		
Diabetes	Yes	Exposed	18 (40.9%)	26(59.1%)	1.864	0.061
		Non-Exposed	9(22.0%)	32(78.0%)		
	No	Exposed	18(25.0%)	54 (75.0%)	1.172	0.598
		Non-Exposed	16(21.3%)	59(78.7%)		
Family history	Yes	Exposed	5 (26.3%)	14(73.7%)	0.752	0.406
		Non-Exposed	7(35.0%)	13(65.0%)		
	No	Exposed	31(32.0%)	66(68.0%)	1.704	0.026
		Non-Exposed	18(18.8%)	78(81.2%)		

in the extended period following STEMI, they observed that the risk of all-cause mortality following ST elevation myocardial infarction (STEMI) increases gradually with smoking. On the other hand, Alaarag A et al[15] Individuals who smoke tend to be younger and have fewer accompanying health conditions compared to non-smokers. Among patients who received treatment through primary percutaneous coronary intervention (PCI) and a

Table III: Heart failure in accordance to age, gender, BMI, hypertension, diabetes and family history (n=232)

Variables		Study groups	Transient ischemic disease		Relative risk	p-value
			Yes	No		
Age groups	18 – 50	Exposed	2(6.2%)	30(93.8%)		
		Non-Exposed	1(2.6%)	37(97.4%)	2.375	0.435
	>50	Exposed	3(3.6%)	81(96.4%)		
		Non-Exposed	0(0.0%)	78(100.0%)	N/A	0.137
Gender	Males	Exposed	3(3.7%)	79(96.3%)		
		Non-Exposed	1(1.4%)	71(98.6%)	2.696	0.361
	Females	Exposed	2(5.9%)	32(94.1%)		
		Non-Exposed	0(0.0%)	44(100.0%)	N/A	0.187
BMI kg/m^2	18 – 24 Kg/m^2	Exposed	2(3.2%)	61(96.8%)		
		Non-Exposed	0(0.0%)	35(100.0%)	N/A	0.411
	>24 kg/m^2	Exposed	3(5.7%)	50(94.3%)		
		Non-Exposed	1(1.2%)	80(98.8%)	4.585	0.171
Hypertension	Yes	Exposed	3(5.5%)	52(94.5%)		
		Non-Exposed	1(2.0%)	50(98.0%)	2.782	0.338
	No	Exposed	2(3.3%)	59(96.7%)		
		Non-Exposed	0(0.0%)	65(100.0%)	N/A	0.232
Diabetes	Yes	Exposed	1(2.3%)	43(97.7%)		
		Non-Exposed	0(0.0%)	41(100.0%)	N/A	0.518
	No	Exposed	4(5.6%)	68(94.4%)		
		Non-Exposed	1(1.3%)	74(98.7%)	4.167	0.171
Family history	Yes	Exposed	1(5.3%)	18(94.7%)		
		Non-Exposed	0(0.0%)	20(100.0%)	N/A	0.487
	No	Exposed	4(4.1%)	93(95.9%)		
		Non-Exposed	1(1.0%)	95(99.0%)	3.959	0.187

Table IV: Heart failure in accordance to age, gender, BMI, hypertension, diabetes and family history (n=232)

Variables		Study groups	Mortality		Relative risk	p-value
			Yes	No		
Age groups	18 – 50	Exposed	1(3.1%)	31(96.9%)		
		Non-Exposed	3(7.9%)	35(92.1%)	0.396	0.375
	>50	Exposed	1(1.2%)	83(98.8%)		
		Non-Exposed	6(7.7%)	72(92.3%)	0.155	0.048
Gender	Males	Exposed	1(1.2%)	81(98.8%)		
		Non-Exposed	3(4.2%)	69(95.8%)	0.293	0.263
	Females	Exposed	1(2.9%)	33(97.1%)		
		Non-Exposed	6(13.6%)	38(86.4%)	0.216	0.105
BMI kg/m^2	18 – 24 Kg/m^2	Exposed	1(1.6%)	62(98.4%)		
		Non-Exposed	4(11.4%)	31(88.6%)	0.139	0.053
	>24 kg/m^2	Exposed	1(1.9%)	52(98.1%)		
		Non-Exposed	5(6.2%)	76(93.8%)	0.306	0.234
Hypertension	Yes	Exposed	0(0.0%)	55(100.0%)		
		Non-Exposed	5(9.8%)	46(90.2%)	N/A	0.023
	No	Exposed	2(3.3%)	59(96.7%)		
		Non-Exposed	4(6.2%)	61(93.8%)	0.533	0.371
Diabetes	Yes	Exposed	0(0.0%)	44(100.0%)		
		Non-Exposed	3(7.3%)	38(92.7%)	N/A	0.108
	No	Exposed	2(2.8%)	70(97.2%)		
		Non-Exposed	6(8.0%)	69(92.0%)	0.347	0.151
Family history	Yes	Exposed	0(0.0%)	19(100.0%)		
		Non-Exposed	2(10.0%)	18(90.0%)	N/A	0.256
	No	Exposed	2(2.1%)	95(97.9%)		
		Non-Exposed	7(7.3%)	89(82.7%)	0.283	0.082

pharmaco-invasive strategy, no significant difference in angiographic data and outcomes was found between smokers and non-smokers in all four groups, except for smokers who were treated with pharmaco-invasive strategy, who showed a lower occurrence of TIMI flow III during diagnostic angiography before PCI.[15]

Consistently numerous previous studies conducted with thrombolysis have demonstrated that smoking is correlated with lower mortality rates in both short- and long-term follow-up periods.[12,16-18]

In this study, the mean body mass index in the exposed group and non-exposed group was 26.4±6.5 and 25.9±6.2 kg/m^2 respectively. The study of Mehta RH, et al[19] reported a body mass index of 27.6±4.8 kg/m2. In group wise distribution of gender, 82 (70.7%) males and 34 (29.3%) females were enrolled in exposed group and 80 (68.9%) males and 36 (31.1%) females were included in non-exposed group. The study of Toluey M, et al[20] reported that there were 277 (92.3%) males and 23 (7.7%) females were in exposed group, while 452 (63%) males and 265 (37%) females were in non-exposed group. Hypertension was noted in 55 (47.4%) patients in exposed group while 51 (43.9%) in non-exposed group. Toluey M, et al[20] further noted hypertension in 96 (32%) patients in exposed group and 396 (55.2%) in non-exposed group, diabetes mellitus was documented in 44 (37.9%) patients in exposed group while 41 (35.3%) in non-exposed group. There were 61 (20.3%) and 307 (42.8%) diabetic patients noted in exposed and non-exposed groups in the findings, study conducted by Toluey M, et al[20]. Positive family history of ischemic heart disease was found in 19 (16.4%) patients in exposed group while 20 (17.2%) in non-exposed group, respectively. Toluey M, et al[20] also reported to have family history in 12 (4%) cases in exposed group and 54 (7.5%) cases non- exposed group. Risk of heart failure and transient ischemic attack were 1.4 and 5.0 times more likely in exposed as compared to unexposed with [Relative Risk 1.440 and 5.0 respectively. While risk of mortality was 0.2 times less likely in exposed as compared to unexposed with [Relative Risk 0.222] and P value was found to be as significant i.e. (P=0.030). Toluey M, et al[20] reported heart failure in exposed group as 60 (20%) and non-exposed group as 243 (33.9%) whereas mortality was noted in 20 (6.7%) and 124 (17.3%) patients in exposed and non- exposed groups, respectively. Although the relationship between smoking

and cardiovascular disease has long been established, with smoking seems to be a significant risk factor for CAD and MI. However, recent studies have suggested that smokers with ST-segment elevation myocardial infarction (STEMI) may have lower mortality rates compared to non-smokers, particularly when treated with thrombolysis or without reperfusion therapy. One possible explanation for this observation is the potential antiplatelet effect of smoking, which may inhibit platelet aggregation and reduce the risk of thrombotic occlusion. Additionally, smoking has been associated with improved fibrinolysis response, which may contribute to better outcomes in patients with STEMI treated with thrombolysis. However, it is important to note that smoking remains a significant risk factor for cardiovascular disease and that the benefits observed in some studies may be outweighed by the detrimental effects of smoking on overall health. Moreover, the protective effect of smoking in STEMI patients may not extend to those who receive primary percutaneous coronary intervention (PCI), which is the preferred treatment for STEMI. It is also important to consider potential confounding factors in these studies, such as differences in patient characteristics and comorbidities between smokers and non-smokers. For example, smokers may be more likely to be younger and have fewer comorbidities, which could contribute to better outcomes independent of smoking status. However, the relationship between smoking and mortality in patients with ST-segment elevation myocardial infarction (STEMI) is a complex issue that requires further investigation.

Conclusion

It is to be concluded that significant risk of heart failure and transient ischemic attack were noted in exposed as compared to unexposed and vice versa in case of mortality, but we cannot rule out residual confounders. Further research is required to assess the statistical risk and correlation, using a larger and more diverse sample size, as well as incorporating additional parameters, across multiple research centers in Pakistan, to confirm the results of the current study.

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