

PREVALENCE OF ACUTE STENT THROMBOSIS AFTER PRIMARY PCI IN STEMI PATIENTS

Running Head: Interventional Cardiology, Angiographic representation in PCI, Stent

ABSTRACT

Background

In-hospital mortality data of patients who have been experiencing ST (stent thrombosis) shows 7.9% statistics for acute stent thrombosis (AST) within 24 hours of PCI, Sub-Acute Stent Thrombosis (SAST) occurs during 30 days of Percutaneous Coronary Intervention (PCI), Late Stent Thrombosis (LST) found 3.8% within the first year after PCI, and Very Late Stent Thrombosis found 3.6% in 1 year after PCI. From our study, we found out the frequency of Acute Stent Thrombosis (AST) in ST-elevation myocardial infarction (STEMI) Patients after Primary Percutaneous Coronary Interventions (PPCI).

Method

This descriptive-analytic case series was conducted in 06 months data collection time in the NICVD Karachi Pakistan. All the study sample were computed and analyzed by using SPSS (20.0 Version). Mean \pm standard deviation was calculated for age, duration of surgery, weight, height, and BMI. Chi-square test by using $P \leq 0.05$ as significant on 95% Confidence Interval were used for other variables.

Result

Out of 142 patients of 55.56 years of mean age was evaluated with standard deviation ± 12.24 and BMI mean was 27.56 ± 6.28 . The mean \pm SD duration of surgery was 33.48 ± 9.26 .

Conclusion

It is to be concluded that the frequency of **AST** after primary PCI was found to be significant. Patients presenting with STEMI were at high risk of **AST** whether they were hemodynamically unstable or they had ACS stenting of multivessel coronary diseases.

Key Words

Percutaneous Coronary Thrombosis, ST-elevation myocardial infarction, Acute stent thrombosis, hypertension, Drug Eluting stents, Bare metal stents.

INTRODUCTION

Myocardial infarction is a coronary artery sickness in which heart muscles become deprived of oxygen due to blood supply shortage. According to World Health organization (WHO), ischemic coronary illness is the main cause of almost 12.2% mortality [1]. Acute stent thrombosis (AST) is an uncommon nevertheless very disastrous obstacle of percutaneous coronary intervention (PCI) events, which might happen even with new procedural methods and dual- antiplatelet therapy [2].

The elevation of ST segment in electrocardiogram demonstrate the cardiac myocytes damage, cellular polarization and formation of an injury current. The primary treatment of ST-elevation myocardial infarction STEMI is to achieve a sustained coronary reinfraction, reduce necrosis of myocytes and prevention of reinfarction. Once acute infarction occurs, the secondary prevention of cardiac risk factors should be strictly considered [3]. While managing STEMI strategies are usually considered and evaluated are Thrombolytic drug therapy, Percutaneous coronary interventions (PCI).

In 1977 the first balloon percutaneous intervention (PCI) introduced later in 1986 was an era of stent implantation turned the picture in PCI. The purpose of these stents is to reduce thrombosis and restenosis with other complications [4]. In-hospital mortality data of patients who have been experiencing ST (stent thrombosis) shows 7.9% statistics for acute stent thrombosis (AST) within 24 hours of PCI, Sub-Acute Stent Thrombosis (SAST) occurs during 30 days of Percutaneous Coronary Intervention (PCI), Late Stent Thrombosis (LST) found 3.8% within the first year after PCI, and Very Late Stent Thrombosis found 3.6% in 1 year after PCI. [5].

Review of previous studies demonstrate that the incidence of ST is very less, almost 1%, in routine coronary interventions (PCI), however, a greater incidence in case of acute myocardial infarction [6]. Several studies have been carried out to determine the potential predictors or agents involved in pathophysiology of early stent thrombosis, however, the exact mechanism is still not clear. The causative factors can be categorized into several categories i.e., device or stent design, material length, stent interaction with adjunctive treatment. Others are the patient associated factors such as acute coronary syndrome, angina, characteristics of plaque present in the left anterior coronary artery, diabetes, local platelet activity, Age, renal failure and dual antiplatelet therapy. The other category includes procedural factors i.e., positioning mistake of stent, stent under expansion, residual dissection, wrong sized stents, vessel injury and antithrombotic suboptimal therapy [7].

The utilization of intravascular imaging has uncovered extra reasons for ST. Under the expansion and malaposition give off an impression of being driving reasons for AST and SAST. Besides, neoatherosclerosis has been demonstrated as a significant supporter of late ST (VLST) [8]. There are very limitations of Angiography in identifying stent thrombosis, which can be minimized by using optical coherence tomography (OCT).

Optical coherence tomography (OCT), because of its high (10 mm axial and 20 mm lateral) resolution is considered as the most effective in vivo technique to detect residual thrombus, plaque prolapse, strut malapposition and dissections. OCT is also being used to evaluate vascular healing and the process of stent thrombosis after PCI [9]. Souteyrand and his colleagues in 2016, used OCT to determine ST characteristics and mechanisms. Their results revealed 97% authenticity of OCT [5,6]. Their study shows Bare metal stent (BMS) and Drug-eluting stent (DES) with no significant role in the allotment of ST types [10]

For the prevention of stent thrombosis (ST), Dual antiplatelet therapy (DAPT) is considered as a standard therapy after PCI. DAPT, however, can cause bleeding complications in some patients [11]. The patients who not eligible for long DAPT therapy and high bleeding risk, Drug Eluting Stents (DESs) was also not advised for them. However, European guidelines⁴ has declared DESs as standard therapy for coronary stenosis even in the unsustained DAPT cases [9].

The development of ST in STEMI patients can increase morbidity and hospital stay. This study will prove beneficial in identification of patients group having high ST risk. It will also highlights the importance of early detection and efficient management plan to prevent cardiac damage, morbidity and hospital stay of patients. There is very less data available on the incidence rate of early ST after primary PCI in Pakistani population. Therefore, this study aims to identify the frequency of of early (acute) stent thrombosis after primary PCI in STEMI patients along with the identification of potential predictors.

METHOD

This descriptive-analytic case series was conducted in 06 months data collection time during 2021, in the National Institute of Cardiovascular Diseases Karachi Pakistan. By using W.H.O sample size calculator using the frequency of Acute Stent Thrombosis after PCI in STEMI patients (62%)¹⁰, (d)=8% was considered as margin of error, 95% confidence interval was taken into account then the estimated sample size was n=142. The individual data of patients presenting with ST-segment elevation myocardial infarction (STEMI) and if they had 30 minutes or longer than 30 minutes chest pain which was later on confirmed on ECG changes of ST-elevation greater than 2mm in minimum two precordial leads or greater than 1mm in limb, recommended to admission to the hospital were included in the study after their written consent.

Furthermore, all patients who were under the age of 25-75 years of either gender admitted for primary percutaneous coronary intervention (PPCI) were prospectively recorded through nonprobability consecutive sampling. This study excluded all those patients who have a Prior history of STEMI, Prior history of cardiac surgery and PCI, heart failure, and was not willing to be a part of this study i.e., not gave their consent.

All those patients with STEMI following the inclusion criteria admitted in NICVD Karachi, undergoing primary PCI by the researcher himself under the supervision of senior registrar or consultant cardiology having > 5 years of experience and stent either drug-eluting stents (coated with medication) or bare-metal stent was being placed. These patients were observed for 24 hours for early (acute) stent thrombosis. Patients indicating acute ischemia in the distribution of the target vessel (in which stent was placed), developed sudden onset of typical chest pain, were subjected to angiography for relook. In case of complete occlusion within the stented segment with an evidence of thrombus, the patient was being labeled as having acute stent thrombosis.

The patients included in the study were prescribed standard recommended medications i.e., aspirin (300mg), clopidogrel (600mg), weight based dose adjusted unfractionated heparin (70-100 U/kg) followed by tirofiban. The patients were also kept on Dual antiplatelet Therapy (DAPT) i.e., for one month (1 aspirin 300mg/day and 2 clopidogrel 600mg/day) after which one year medication (1 aspirin 75mg indefinitely and 1 clopidogrel 75mg/day).

Exclusion criteria were followed strictly to avoid confounding variables. All the study sampled data was entered and analyzed by using SPSS (20.0 version). Mean \pm standard was calculated for age, duration of surgery, weight, height, and BMI. Gender; hypertension, smoking status, diabetes mellitus, and outcome variable i.e., acute stent thrombosis (yes/no) were measured in

frequency and percentage. Effect modifiers were controlled through stratification of age, gender, hypertension, diabetes mellitus, BMI, height, weight smoking status, and duration of surgery to evaluate its effect on outcome followed by chi-square test. $P \leq 0.05$ was taken as significant.

RESULT

Out of 142 patients mean age of 55.56 year were evaluated with standard deviation ± 12.24 and BMI mean was 27.56 ± 6.28 . The mean \pm SD duration of surgery was 33.48 ± 9.26 minutes. The mean height of study sample was $1.76 \pm$ with S.D 0.48 beside, mean weight was

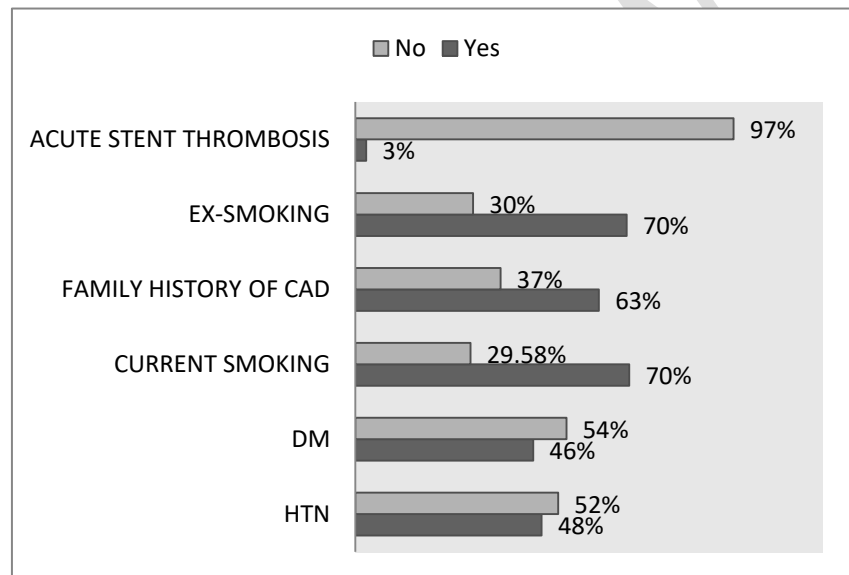


Figure 1: Acute Stent Thrombosis in relation of Ex-Smoker, Family History of Coronary Artery Disease, Current Smoking, Diabetes Mellitus, and Hypertension.

$58.25 \pm$ with S.D 8.48. Among 142 study sample, 103 (72.53%) were male and 39 (27.4%) were female. Common predictors were 68 (47.88%) hypertensive, 65 (45.77%) were diabetic, 89 (62.6%) patients with a family history of CAD. On the other hand, smoking status was also measured with the value of 100 (70.42%) presented as current smokers and 42 (29.58%) were currently non-smokers while 99 (69.7%) patients revealed a history of ex-smoking. The frequency of Acute stent thrombosis was found to be 4 (2.82%). The stratification of age group 25—55 and > 55 years early sub-acute stent thrombosis was found to be 0% and 2.8% respectively which shows a highly significant association between age and Acute stent thrombosis i.e. ($P=0.047$). Acute stent thrombosis was found 2.1% in males and 0.7% in the

female which shows the non-significant difference between gender and Acute stent thrombosis. In stratification for the duration of surgery (30-45) minutes 0.7% had Acute stent thrombosis and in >45 minutes 2.1% had Acute stent thrombosis and found a highly significant association between them i.e. (P=0.04).

	EARLY SUBACUTE STENT THROMBOSIS		P-Value
	YES	NO	
AGE GROUP IN YEARS			0.047
25-55	0(0.0%)	75(52.8%)	
>55	4(2.8%)	63(44.4%)	
GENDER			1.00
Male	3(2.1%)	100(70.4%)	
Female	1(0.7%)	38(26.8%)	
DURATION (In Minutes)			0.046
30---45	1(0.7%)	106(74.7%)	
>45	3(2.1%)	32(22.5%)	
WEIGHT (In kg)			0.03
45---60	1(0.7%)	111(78.2%)	
>60	3(2.1%)	27(19.0%)	
HEIGHT (In m)			0.527
1.5---1.8	3(2.1%)	115(81%)	
>1.8	1(0.7%)	23(16.2%)	
BODY MASS INDEX (In kg/m2)			0.291
18.5---27	2(1.4%)	102(71.8%)	
>27	2(1.4%)	36(25.4%)	
HYPERTENSION			0.05
Yes	4(2.8%)	64(45.1%)	
No	0(0%)	74(52.1%)	
DIABETES MELLITUS			0.04
Yes	4(2.8%)	61(43.0%)	
No	0(0%)	77(54.2%)	
SMOKING STATUS			0.007
Yes	0(0%)	100(70.4%)	
No	4(2.8%)	42(26.8%)	
ANTITHROMBOTIC THERAPY			<0.00001
Yes	5(3.52%)	70(49.2%)	
No	63(44.3%)	4 (28.1%)	
TYPES OF STENTS			0.653
Drug-Eluting Stent	3(2.11%)	60(42.2%)	
Bare-Metal Stent	2(1.40%)	77(54.2%)	

Table 1: Stratification of age, gender, hypertension, diabetes mellitus, BMI, height, weight smoking status, antithrombotic therapy, types of the stent, and duration of surgery to seeing its

In stratification of BMI 18.5—27 and > 27 kg/m², Acute stent thrombosis was found to be 1.4% each which shows no significant association between BMI and acute stent thrombosis i.e. (P=0.291). Acute stent thrombosis was found at 2.8% in hypertensive and 0% in non-hypertensive patients which shows a significant association between hypertension and acute stent thrombosis i.e. (P=0.05). Acute stent thrombosis was found to be 2.8% in diabetes patients which shows a significant association and acute stent thrombosis i.e. (P=0.04). In Smoker acute stent thrombosis was found 0% and 2.8% in a non-smoker which shows a highly significant association between smoking and acute stent thrombosis i.e. (P=0.007). Acute stent thrombosis was found 3.52% in antithrombotic therapy and 44.3% in non- antithrombotic therapy during PCI which shows a highly significant association between non-antithrombotic therapy and acute stent thrombosis i.e. (P=<0.00001). Acute stent thrombosis was found 2.11% in drug eluting stent and 1.40% in a bare-metal stent which shows a non-significant difference between types of the stent and acute stent thrombosis

DISCUSSION

The occurrence of cardiovascular disease depends on several different factors such as framework of medical services, financial status, emotional and psychological pressure and many more. It has been computed that yearly around five million percutaneous coronary interventions (PCIs) are performed. Hence, stent-related intricacies, regardless of whether they happen at a genuinely low rate, are a significant worry for public well being. Among these difficulties, ST, with 5–45% mortality and a 15–20% repeat rate at 5 years, is the most significant one [12].

Ahmad et al., 2017 conducted an observational study on a group of 43 STEMI cases at PIMS Islamabad. The average age of the patients was 55.91 ± 9.51 years and the mean TIMI score was 2.56 ± 0.50 who got high rate of essential PCI almost 100% [13]. In the present study, the mean age of patients also reside in 55.56 ± 12.24 years age. It indicates that the risk of STEMI and stent thrombosis after primary PCI are more in the people of age 55 or greater than that. In another study, Singth et al 2018 reported only 1% ST cases of 2303 cases of STEMI having PCI [14]. Khoury in 2017 reported a retrospective study data of about 2071 cases with 1.5% left ventricular thrombus cases majority of them were having STEMI [15].

Soomro et al 2021 also carried out a descriptive cross sectional study on a group of 163 patients to determine the ST frequency in STEMI patients having PCI. Of all the patients 71.7% were male while 28.23% were female with average age of patients to be 51.78 ± 13.09 years. During PCI, 53.37% patients were placed with DESs while the others get Bare metal stents. They reported 1.23% acute stent thrombosis cases among all the patients [1]. Tariq and his coworkers also attempted to identify the potential predictors of early stent thrombosis. Among 569 patients early

stent thrombosis was observed in 5.8% patients. They concluded hypertension and diabetes as the major caused of ST [10].

Triantafyllou *et al.*, (2021) reported a significant association between hypertension and acute stent thrombosis. ST was associated with significantly diabetes mellitus and acute stent thrombosis. Moreover, large coronary vessels showed no differences when treated by bare-metal stents BMS or drug-eluting stents DES. Even after adjustment for stent diameter and stent length, BMS implantation in large coronary vessels appeared equally effective as DES implantation. Patients with vessels >3.5 mm in diameter represented a low-risk population in whom BMSs confer a similarly low event rate as DESs. Their study resulted that in both group Stent thrombosis had not occur abundantly [16].

Our study supports the hypothesis that DESs do not have an edge over BMSs for larger vessels. It also stands that clinically or angiographically neointimal growth occurring in large vessels would given a similar degree of neointimal proliferation around a stent of any diameter. Concerning BMSs, a very rare observed case in new generation of BMS that in a ≥ 3.5 mm vessel would render a 2.5 mm diameter vessel even a late loss of 1 mm at long-term follow-up. This analysis would not require further intervention with no hemodynamic compensation as binary restenosis of $<50\%$ were observed on sufficient patency. The results of our study can be compared to David J Clark and colleagues who concluded that in the use of DES or BMS within 01 year or 30 days, large coronary arteries is associated with deployment of 3.5 mm diameter stents had low rate of mortality and major adverse cardiac events (MACE) [17].

Yan and his colleagues also compared the outcomes of DESs and BMS in 672 consecutive patients via PCI in native coronary vessels ≥ 3.5 mm. On 12 month mortality stats showed no

significant differences in MI (6.3 vs. 3.4%, $p=0.15$), MACE (9.4 vs. 9.4%, $p=0.90$), TVR (3.6 vs. 4.8%, $p=0.54$), stent thrombosis (0.9 vs. 1.0%, $p=0.88$), or in patients who received DES vs. BMS [18]. Similar results have been observed in our study i.e., no significant difference by using DESs and BMS.

Sahar et al conducted a study at a tertiary care university hospital in Karachi, Pakistan. Their data showed Diabetes mellites and hypertensive patients were observed on high risk of ST [19]. According to our study diabetes and hypertension are the risk factors for ST. Our results correlate with all national and international studies. The strength of our study was the use of consecutive sampling which compatibly suitable for inclusion and exclusion criteria, study design and sample selection.

LIMITATIONS

Our study's results co relate with several other studies, but there are certain limitations as well. The study was conducted on the sample size of 142 patients. Similar studies could also be conducted taking larger groups or some retrospective case analysis can also be done for more detailed outcomes. The study was truly based on the patients admitted at NICD Karachi, the outcome may slightly different in different socio-economical settings. This study deals on with acute stent thrombosis cases because patients were observed only for 24 hours. This does not include the outcomes after a month or a year of the PCI in patients

CONCLUSION

It is to be concluded that the frequency of AST after primary PCI was found to be significant. Patients presenting with STEMI were at high risk of AST whether they were hemodynamically unstable or they had ACS stenting of multivessel coronary diseases.

CONSENT

Informed consent was taken from the patients or from the attendee. Senior Cardiologist or patient's cardiologist consent was also taken when extracting the data from file.

AVAILABILITY OF DATA AND MATERIAL

Confidentiality of the data was maintained by keeping the identity of the patient hidden and data is restricted to the primary investigator only. The data and material will be represented on request.

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