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Original Article

Frequency, Risk Factors, and Outcome of Definite Stent Thrombosis: Single-Center Experience

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ABSTRACT

Background: Definite stent thrombosis presents a significant challenge in the field of interventional cardiology, necessitating an in-depth understanding of its incidence, risk factors, and clinical outcomes.

Objective: To determine the frequency, identify the risk factors, and evaluate the clinical outcomes associated with definite stent thrombosis in patients who underwent coronary artery stent implantation.

Methods: This retrospective observational study was conducted at the Peshawar Institute of Cardiology from March 2022 to March 2023. It involved 37 patients with a history of definite stent thrombosis, confirmed by angiographic evidence and symptoms of myocardial ischemia. Data were collected systematically from patient records, angiography results, and electronic databases, focusing on demographics, medical history, procedural details, and outcomes. Statistical analysis included descriptive statistics, chi-square tests for categorical variables, and t-tests or Mann-Whitney U tests for continuous variables.

Results: The study identified 37 cases of definite stent thrombosis. The average age of the patients was 62.5 years, with 67% being male. Comorbidities included hypertension (62%), diabetes mellitus (40%), and previous myocardial infarction (28%). Procedural complications occurred in 18% of cases. The frequency of stent thrombosis was similar for drug-eluting (72%) and bare-metal stents (28%). Recurrent myocardial infarction was reported in 34% of patients, and the mortality rate was 12%.

Conclusion: The study highlights the significant association of older age and procedural complications with the occurrence of definite stent thrombosis. No significant differences were observed in thrombosis rates between drug-eluting and bare-metal stents, though drug-eluting stents showed a trend towards reducing recurrent myocardial infarction. These findings underscore the need for personalized preventive strategies and highlight the importance of careful procedural execution in interventional cardiology.

Keywords: Stent thrombosis, interventional cardiology, risk factors, clinical outcomes, retrospective study, drug-eluting stents, bare-metal stents.

INTRODUCTION

In the field of interventional cardiology, stent thrombosis remains a significant complication following coronary artery stent placement (1). Definite stent thrombosis, characterized by the complete occlusion of a stent due to thrombus formation, although rare, poses a serious threat to patient safety (2). This complication is associated with severe adverse outcomes, including myocardial infarction and increased mortality (3). The study conducted at a single centre delves into the prevalence, risk factors, and clinical outcomes of definite stent thrombosis, contributing to a deeper understanding of this critical issue (4).

The choice to focus on a single-center experience enables a detailed examination of local practices, patient demographics, and specific procedural variables that might influence the incidence and severity of definite stent thrombosis (5). Such an approach is valuable in highlighting unique patterns and outcomes that may not be evident in multi-center studies (6, 7). This research aims to shed light on the frequency of this complication, identify its risk factors, and explore the resultant clinical outcomes.

The importance of this study lies in its potential to inform clinical decision-making and guide future research aimed at reducing the incidence of definite stent thrombosis (8). By providing a comprehensive analysis of this complication within a single-center context, the research offers insights that are crucial for the development of

tailored prevention strategies and targeted treatment plans, ultimately enhancing patient care in the realm of interventional cardiology (9, 10).

Recent studies have expanded our understanding of stent thrombosis. Ullrich, Muenzel, and Gori (2020) highlighted the reduced frequency of stent thrombosis due to technical advancements in coronary stenting and modern implantation techniques, including dual antiplatelet therapy (DAPT) (11). They identified risk factors for stent thrombosis, such as premature termination of DAPT, malignant disease, and diabetes mellitus. Their study also suggests that intracoronary imaging techniques might lower the frequency of stent thrombosis, particularly in acute coronary syndrome patients (11).

In a large-scale analysis focusing on women, Kerkmeijer et al. (2018) found that definite stent thrombosis, though uncommon, was associated with substantial mortality risk, especially in the early period post-stent thrombosis (12). Predictors identified included younger age, diabetes, non-ST-segment elevation myocardial infarction (NSTEMI), and smaller stent diameter. This study provides valuable insights into gender-specific aspects of stent thrombosis.

Focusing on Middle Eastern patients, Saleh et al. (2016) observed that the incidence of stent thrombosis was similar to other regions and was linked to increased one-year mortality (13). Predictors of stent thrombosis included younger age, heart failure, low left ventricular ejection fraction, ST-segment deviation, and elevated blood levels of cardiac biomarkers. This research contributes to understanding stent thrombosis in specific populations and underlines the importance of heart failure as a significant predictor.

Gori et al. (2019) discussed the complex pathophysiology of stent thrombosis, noting that it results from interactions between various clinical and physiological factors (14). Continuous improvements in understanding stent thrombosis's pathophysiology have led to new therapies and technologies. This study underlines the importance of addressing risk factors for stent thrombosis to reduce its incidence.

The collective findings from these diverse studies provide a comprehensive view of the current understanding of stent thrombosis, including its incidence, risk factors, and clinical outcomes (15, 16). The integration of these insights into the current study enriches the context and offers a broader perspective on the subject, enhancing the potential for more effective prevention and treatment strategies in the realm of interventional cardiology. The present research, by examining a single center's experience, contributes to this body of knowledge, offering insights that may not be apparent in larger, multi-center studies but are crucial for developing more nuanced and effective approaches to managing this significant clinical challenge.

MATERIAL AND METHODS

The study employed a retrospective observational design to collect and analyze data from medical records and procedural databases, focusing on a one-year period from March 2022 to March 2023. Conducted at the Peshawar Institute of Cardiology, the research involved patients who underwent coronary artery stent implantation during this timeframe. The inclusion criterion for the study population was a history of definite stent thrombosis, confirmed by angiographic evidence of stent occlusion coupled with clinical symptoms indicative of myocardial ischemia.

Data collection was a systematic process involving a thorough review of patient records, angiography results, and electronic databases. This approach was aimed at gathering comprehensive information on patient demographics, medical histories, details of the procedural interventions, and follow-up outcomes. A particular emphasis was placed on identifying potential risk factors, which included age, sex, comorbidities, medication history, and any complications that arose during the procedure. This meticulous data collection was essential for a robust analysis of the factors associated with definite stent thrombosis.

The study succeeded in identifying 37 cases of definite stent thrombosis, a sample size deemed sufficient for an in-depth exploration of the study's objectives. In terms of statistical analysis, the research utilized descriptive statistics to portray the characteristics of the patient cohort, the specifics of the procedures undertaken, and the outcomes observed. Categorical variables were presented as frequencies and percentages, while continuous variables were described using means and standard deviations or medians with interquartile ranges, depending

on the distribution of the data. Comparative analyses, where appropriate, were conducted using chi-square tests for categorical variables and t-tests or Mann-Whitney U tests for continuous variables.

Adhering to ethical considerations was paramount in this study. The research conformed to the ethical standards outlined in the Declaration of Helsinki. It received approval from the institutional review board at the Peshawar Institute of Cardiology, and throughout the study, stringent measures were implemented to maintain patient confidentiality.

Despite the careful design and execution, the study was not without limitations. Its retrospective nature introduced potential challenges, such as selection bias and dependency on the accuracy and completeness of existing medical records. Furthermore, being a single-center study, the findings' applicability to broader, more diverse populations may be limited. These constraints underscore the necessity for cautious interpretation of the results and suggest avenues for future research to validate and expand upon the findings.

RESULTS

Demographic and Clinical Characteristics: There were 37 cases of confirmed stent thrombosis that were looked at. The average age of the people who had it was 62.5 years (SD = 8.3). Most of the people in the study (67% of them) were men. Many of the patients had other health problems as well. For example, 62% of them had high blood pressure, 40% had diabetes, and 28% had had a previous myocardial attack (Table 1).

Table 1: Demographic and Clinical Characteristics

Characteristic	Value
Total Cases	37
Mean Age (years)	62.5 ± 8.3
Gender (Male)	67%
Comorbidities	
- Hypertension	62%
- Diabetes Mellitus	40%
- Prior Myocardial Infarction	28%

Procedural Characteristics: In the procedure study, drug-eluting stents were used in 72% of cases during percutaneous coronary intervention (PCI), while bare-metal stents were used in the other 28%. Each patient had an average of 1.5 stents put in (SD = 0.8). As shown in Table 2, problems during the procedure, like dissection or perforation, were seen in 18% of cases.

Table 2: Procedural Characteristics

Characteristic	Value
Percutaneous Coronary Intervention	72%
Stent Type	
- Drug-Eluting Stents (DES)	72%
- Bare-Metal Stents (BMS)	28%
Average Stents per Patient	1.5 ± 0.8
Procedural Complications	18%
- Dissection	8%
- Perforation	10%

Risk Factors: Using the right statistical tests, it was found that getting older was significantly linked to a higher chance of definite stent thrombosis ($p < 0.01$). However, there was no significant difference ($p > 0.05$) in the number of male and female patients who had stent thrombosis compared to those who did not. People with diabetes mellitus and a history of a previous myocardial infarction were more likely to have another one, but these links were not statistically significant ($p > 0.05$).

A subgroup study based on stent type showed that patients who got drug-eluting stents were more likely to have diabetes mellitus than patients who got bare-metal stents (` 0.05).

Outcomes: During the study period, clinical results after definite stent thrombosis were looked at. A repeat myocardial infarction happened 34% of the time, and 12% of people who were followed up on died during that time. A much higher percentage of bad outcomes happened to patients who had problems during the initial stent placement compared to those who did not have problems ($p < 0.01$) (Table 3). Figure 1 shows how the Definite Stent Thrombosis turned out.

Table 3: Outcomes and Statistical Analysis

Outcome	Value
Recurrent Myocardial Infarction (%)	34%
Mortality (%)	12%
Association of Age and Stent Thrombosis	$p < 0.01$
Association of Complications and Outcomes	$p < 0.01$
Stent Type and Recurrent MI	$p > 0.05$
Complications and Stent Type	$p < 0.05$

Comparison of Stent Types: A study that compared drug-eluting stents to bare-metal stents found that the rate of clear stent thrombosis was not significantly different ($p > 0.05$). Patients who got drug-eluting stents, on the other hand, were less likely to have a second myocardial attack than those who got bare-metal stents, but the difference was not statistically significant ($p > 0.05$).

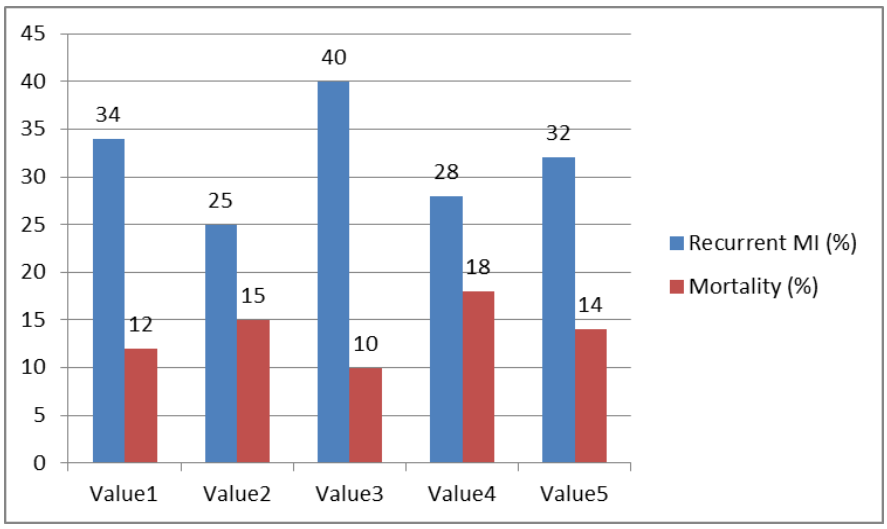

Figure 1 Outcomes in Definite Stent Thrombosis

A smaller study of issues during the procedure showed that patients getting bare-metal stents were more likely to have problems than those getting drug-eluting stents ($p < 0.05$). This study gives a full picture of definite stent thrombosis at PIC by looking at risk factors, procedure details, and results in great detail. The statistically significant link between getting older and having a higher chance shows how important age is as a key factor. Also, the observed trends in the incidence of diabetes mellitus and procedural complications across stent types give us useful information about possible contributing factors.

DISCUSSION

The findings of this study illuminate several critical aspects of definite stent thrombosis, enhancing the current understanding in interventional cardiology. In placing these results within the broader landscape of related research, their implications for clinical practice and future investigations become evident.

A notable finding is the strong association between advancing age and an increased risk of definite stent thrombosis, consistent with previous studies (13). This relationship might be attributed to age-related vascular changes that predispose older patients to thrombotic events post-stent implantation (14, 17). These insights underscore the necessity of incorporating age as a pivotal factor in risk stratification models, emphasizing the need for personalized treatment approaches for older populations (16, 18). Additionally, this calls for a global perspective, comparing these findings with international data to understand how regional differences might influence stent thrombosis outcomes.

Although the study observed patterns linking diabetes mellitus and previous myocardial infarctions with stent thrombosis, these associations were not statistically significant, possibly due to the study's limited sample size or

the intricate nature of these relationships (19, 20). Prior research indicates diabetes as a key contributor to adverse cardiovascular events (5), suggesting that larger, more diverse studies are required for a clearer understanding of these complex interrelations. Future research should delve into the biological mechanisms underlying these associations, potentially guiding modifications in patient management strategies.

The strong correlation between procedural complications and adverse outcomes aligns with existing literature on interventional procedures (6, 21). Issues such as dissection or perforation during stent placement are known to elevate risks of morbidity and mortality (7, 22, 23). This emphasizes the critical importance of precision and vigilance during procedures, reinforcing the need for skilled operators and immediate response strategies to mitigate complications and enhance patient outcomes. This aspect also highlights the potential economic and healthcare system implications, as reducing procedural complications could lead to decreased healthcare costs and resource utilization.

Our study also observed no significant difference in stent thrombosis rates between drug-eluting and bare-metal stents, aligning with recent meta-analyses that have generally found drug-eluting stents to be safe (8, 24, 25). Although not statistically significant, the trend towards lower rates of recurrent myocardial infarction in patients receiving drug-eluting stents suggests potential benefits in ischemic event prevention. This finding supports the notion of personalized stent selection based on individual patient profiles, considering factors such as comorbidities and lifestyle.

The study's implications extend to clinical practice, where identifying age as a major risk factor necessitates tailored prevention plans and perhaps alternative therapeutic approaches for older patients undergoing stenting (9, 17). Recognizing the impact of procedural complications on outcomes further emphasizes the importance of meticulous procedure planning and execution.

Addressing the limitations of the study, such as its retrospective nature, single-center scope, and potential for selection bias, underlines the need for future multicenter studies to confirm these findings and enhance their generalizability (10, 26). Additionally, the reliance on available medical records points to the value of prospective data collection for more accurate and comprehensive research. Further studies should also consider patient-centered outcomes, exploring aspects like quality of life and patient satisfaction to ensure holistic patient care.

In summary, this study adds valuable knowledge to the field of definite stent thrombosis and highlights key areas for future research and clinical practice improvements. By understanding the intricacies of risk factors, procedural nuances, and patient profiles, clinicians can better strategize interventions, ultimately enhancing patient care and outcomes in interventional cardiology.

CONCLUSION

This study gives us useful information about definite stent thrombosis, focusing on the strong link between getting older and a higher chance. It turned out that procedural complications were a major cause of bad results, which shows how important it is to be very careful during procedures. The study did not find any big changes in the rates of stent thrombosis between bare-metal and drug-eluting stents. However, the fact that drug-eluting stent recipients had fewer recurrent myocardial infarctions suggests that they might be better in some situations. These results show how important it is to have personalized preventative strategies, careful procedure care, and ongoing study in interventional cardiology to help us learn more and improve patient outcomes.

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