This article can be cited as: Andishmand A, Namayandeh SM, Ziafat M. Incidence of major adverse cardiac and cerebrovascular events following primary percutaneous coronary intervention in central iran. Cardiovasc Biomed J. 2024; 4(2): 22-29.

Original Article

Incidence of major adverse cardiac and cerebrovascular events following primary percutaneous coronary intervention in central iran

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Article Information:
Received: 23 Sep 2024; Revised: 17 Jan 2025; Accepted: 18 Jan 2025 DOI: 10.18502/cbj.v4i2.17791

Abstract

Objectives: ST-segment elevation myocardial infarction (STEMI) is a critical form of acute coronary syndrome that requires immediate myocardial reperfusion to reduce infarct size and enhance patient outcomes. Despite improvements in the management of STEMI, it continues to be a global contributor to mortality. This study aimed to evaluate the long-term prognosis and outcomes of STEMI patients by investigating the incidence of major adverse cardiac and cerebrovascular events (MACCE).

Methods: This prospective cohort study enrolled 305 patients diagnosed with STEMI between March 2016 and February 2017 in Afshar Hospital, a tertiary cardiac hospital in central Iran. The researchers performed Primary percutaneous coronary intervention (PCI) using drug-eluting stents (DES), and patients received standard medical therapy. Data on major adverse cardiac and cerebrovascular events (MACCE), demographic characteristics, clinical factors, and procedural details were collected through patient interviews, medical records, and the myocardial infarction registry database.

Results: The overall success rate of primary PCI was 92.8%. Hypertension was the most prevalent risk factor for coronary artery disease (41.1%). During the one-year follow-up, the incidence of MACCE was 15.1% (46 patients), with death being the most common occurring in 33 patients (10.8%). Mortality rates were highest within the first six months. The multivariate logistic regression analysis revealed that age (P=0.001) and stent length exceeding 30 mm (P=0.036) were significant predictors of mortality.

Conclusions: This study provides important insights into primary PCI outcomes in STEMI patients in central Iran. The findings indicate a high success rate for PCI and emphasize the necessity for timely and appropriate management. MACCE incidence, especially mortality, highlights the importance of ongoing surveillance and comprehensive follow-up care.

Keywords: major adverse cardiac and cerebrovascular events (MACCE), myocardial infarction, primary percutaneous coronary intervention (PPCI), ST-elevation myocardial infarction (STEMI)

Introduction

ST-segment elevation myocardial infarction (STEMI) is a manifestation of acute coronary syndrome resulting from the obstruction of one or more coronary arteries [1]. This obstruction compromises myocardial perfusion, leading to ischemia and subsequent

necrosis [2]. Rapid myocardial reperfusion is the primary treatment strategy in STEMI cases, with a recommended timeframe of 60-90 minutes to minimize infarct size and reduce fatal outcomes [3, 4]. Reperfusion therapy can be achieved through pharmacological thrombolysis or mechanical intervention, such as primary percutaneous coronary intervention (PCI) [5].Extensive evidence from reperfusion trials has favored PCI as the preferred approach over thrombolytic therapy [6]. Despite advancements in the management of STEMI and a decline in associated mortality rates, it remains a significant cause of death, responsible for one-third of all deaths in developed countries [7, 8]. This reduction in mortality can be attributed to improvements in diagnostic techniques, treatment modalities, and secondary prevention strategies implemented in recent years [9]. However, the one-year mortality rate following myocardial infarction still ranges from 7% to 18% [10-12]. The objective of this study was to examine the frequency of major adverse cardiac and cerebrovascular events (MACCE) within a one-year follow-up period among patients diagnosed with myocardial infarction who underwent primary percutaneous coronary intervention (PCI) in central Iran. By evaluating the occurrence of MACCE, encompassing mortality, non-fatal infarction, cerebrovascular accidents (CVAs), and repeat revascularization, the research aimed to provide valuable insights into the long-term prognosis and outcomes of individuals with ST-segment elevation myocardial infarction (STEMI) in the region. Determining the rate of MACCE in this specific population will aid in identifying high-risk subgroups and facilitate the development of targeted interventions to enhance patient outcomes and minimize adverse events following myocardial infarction.

Materials and Methods

Population and design

This prospective cohort study enrolled 305 patients diagnosed with STEMI between March 2016 and February 2017 in Afshar Hospital, a tertiary cardiac hospital in central Iran. The study received approval from the ethics committee of Shahid Sadoughi Medical School. Eligible participants were individuals with acute myocardial infarction who did not have contraindications for coronary angiography and percutaneous coronary intervention (PCI).The diagnosis of STEMI was based on the presence of ischemic symptoms lasting at least 30 minutes within the previous 12 hours, accompanied by persistent ST-segment elevation of ≥2 mm in at least two precordial leads or ≥1 mm in two contiguous limb leads, or the presence of a new left bundle branch block (LBBB). Confirmation of myocardial infarction was determined by elevated cardiac troponin (cTn) levels above the 99th percentile upper reference limit (URL), indicating a rise and/or fall in cTn values. The exclusion criteria included patients who received thrombolytic therapy or those who died either before or during PCI. Upon admission to the emergency room, all patients received a chewable aspirin dose of 325 mg, a loading dose of clopidogrel (Plavix) 600 mg, and atorvastatin 40 mg. Coronary angiography and PCI of the culprit vessel were performed via femoral artery access. Unfractionated heparin (UFH) was administered intravenously at a dose of 70-100 units/kg to achieve an activated clotting time (ACT) of 250-300 seconds. In cases with a high clot burden, two separate doses of 180 mcg/kg of integrin were administered intra-coronary, followed by thrombosuction using an export catheter. In all PCI procedures, the patients received Drug-eluting stents (DES). The success was due to achieving a final angiography result of Thrombolysis in Myocardial Infarction (TIMI) flow grade 3. Then, the coronary care unit admitted the patients and, if uncomplicated, discharged on the third day. The researchers performed transthoracic two-dimensional and color Doppler echocardiography to diagnose mechanical complications of myocardial infarction and assess left and right ventricular function. At the time of discharge, patients were prescribed 80 mg of aspirin, 75 mg of clopidogrel (Plavix), 40-80 mg of atorvastatin, beta-blockers, and an angiotensin-converting enzyme (ACE) inhibitor or angiotensin receptor blocker (ARB). They were fully informed about secondary prevention measures and encouraged to participate in cardiac rehabilitation programs while being informed about the recurrence of cardiac symptoms. A general physician interviewed patients at the follow-up clinic to assess cardiac symptoms, medication side effects, and medication adherence. The clinic arranged a consultation with a cardiologist if necessary. The researchers interviewed patients who did not return for follow-up visits.

Data Collection and Statistical Analysis

The study utilized the myocardial infarction registry

database of Afshar Hospital, which contained a comprehensive set of demographic, clinical, laboratory, and pharmacological data. The primary endpoints of the study included all-cause mortality; non-fatal myocardial infarction, cerebrovascular accidents (CVAs), and revascularization.The collected data were subjected to thorough statistical analysis using SPSS software (version 19, SPSS Inc, USA). Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as percentages and numbers. The statistical significance of differences between groups was evaluated using the t-test for continuous variables and the chi-square test for categorical variables. To identify predictors of mortality while controlling for confounding variables, a multivariate logistic regression analysis was conducted, considering a range of potential factors. Survival analysis was performed using the Kaplan-Meier method, and the log-rank test was utilized to compare survival curves among different groups. Statistical significance was determined at a p-value of less than 0.05.

Results

Baseline characteristics

The study initially enrolled a total of 320 patients, of which 305 met the eligibility criteria. Among them,2.2% (7 patients) experienced failed percutaneous coronary intervention (PCI), 1.9% (6 patients) underwent urgent coronary artery bypass graft (CABG) surgery, and 0.6% (2 patients) received medical treatment. The mean age of the patients was 58.9 ± 13.2 years, with 78.4% males and 21.6% females. Common risk factors observed included hypertension (41.1%), tobacco smoking (38.2%), diabetes mellitus (38.1%), hyperlipidemia (31.8%), and a family history of coronary artery disease (CAD) (32.1%). Laboratory test results revealed the following values: blood sugar levels of 179.7 ± 86 mg/dL, creatinine levels of 1.19 ± 0.35 mg/dL, hemoglobin levels of 14.4 ± 1.8 g/dL, platelet count of 218,800 ± 52,460 per microliter, LDL cholesterol levels of 121 ± 32.8 mg/dL, HDL cholesterol levels of 32.7 ± 7.6 mg/dL, and uric acid levels of 4.9 ± 1.7 mg/dL. Regarding the extent of coronary artery disease (CAD), one-vessel disease was present in 35.9% of patients, two-vessel disease in 37.4%, three-vessel disease in 26.5%, and left main disease in 3%. In terms of the myocardial infarction (MI) territory, the left anterior descending artery (LAD) was affected in 53.4% of cases, the left circumflex artery (LCX) in 13.3%, and the right coronary artery (RCA) in 33.3%. The door-to-balloon time was 40.1 ± 14.2 minutes. The overall success rate of primary PCI (PPCI) was 92.8%. Out of the treated patients, 300 (98.4%) received drug-eluting stents (DES), and 5 (1.6%) underwent balloon angioplasty (POBA). The mean stent length was 31.9 ± 15 mm, and the mean stent diameter was 2.9 ± 0.4 mm. The mean duration of hospital stay for the included patients was 3.4 ± 1.4 days Table 1.

Table1. Clinical, laboratory, and procedural characteristics of the patients

Character	Value
Age (yr)	58.9 ± 13.2
Sex	
-male	(239)78.4%
-female	(66)21.6%
Risk factors	
-Hypertension	(125)41.1%
-smoking	(117)38.2%
-diabetes mellitus	(116)38.1%
-Hyperlipidemia	(97)31.8%
-Family history of CAD	(98)32.1%
BMI > = 30 kg/ m^2	(56)18.3%
History	
-previous PCI	(41)13.4%
-previous CABG	((16)5.4%
-CKD	(4)1.3%

Character	Value
-CVA	(5)1.7%
-COPD	(3)1%
Lab tests	
-BS	179.7 ± 86
-Cr	1.19 ± 0.35
-Hb	14.4 ± 1.8
-Platelet	218800 ± 52460
-LDL	121 ± 32.8
-HDL	32.7 ± 7.6
-Uric acid	4.9 ± 1.7
Extent of CAD	
One vessle disease	(110)35.9%
Two vessle disease	(114)37.4%
Three vessle disease	(81)26.5%
Left main disease (isolated or non-isolated)	(9)3%
LVEF(%)	43.5±6.7
Door to balloon time (min)	40.1±14.2
MI territory	
-LAD	(163)53.4%
-LCX	(41)13.3%
-RCA	(101)33.3%
Type of PCI	
-Stenting	(300)98.4%
-Balloon angioplasty	(5)1.6%
Stent length(mm)	31.9 ± 15
Stent diameter(mm)	2.9 ± 0.4
TIMI flow (post PCI)	
0	(3)1.5%
I	(3)1.5%
II	(8)4.1%
III	(180)92.8%
Duration of hospital stay	3.4 ± 1.4
Door to balloon time	15.84 ±13.9

BMI: Body mass index, PCI: Percutaneous coronary intervention, CABG: Coronary artery bypass graft, CKD: Chronic kidney disease, CVA: Cerebrovascular accident, COPD: Chronic obstructive pulmonary disease, BS: Blood sugar, Cr: Creatinine, Hb: Hemoglobin, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, LAD: Left anterior descending artery, LCX: Left circumflex artery, RCA: Right coronary artery

Follow up

During the study period, a notable proportion of patients experienced adverse outcomes. Specifically, 10.8% (33 individuals) of the total patients died. Additionally, 1.2% (4 patients) encountered non-fatal myocardial infarction (MI), 0.6% (2 patients) experienced cerebrovascular accidents (CVAs), and 2.5% (7 patients) necessitated repeat revascularization procedures. Overall, 15.1% (46 patients) of the study population encountered at least one of these complications Table 2.

Table2. Rate of Major adverse cardiac and cerebrovascular event (MACCE) during one-year follow-up

Event	Number	Percent (%)
Death	33	10.8
Non-fatal MI	4	1.2
Cerebrovascular accident	2	0.6
Repeat revascularization	7	2.5
Total MACCE	46	15.1

The study investigated the factors influencing mortality rates after percutaneous coronary intervention (PPCI). The findings revealed significant associations between several variables and mortality rates. Females had a mortality rate of 16.9%, more than twice that of males (8.4%), with a statistically significant difference. Patients with hypertension had a mortality rate of 14.4%, more than double that of patients without hypertension (6.4%), indicating a significant association. Smoking was associated with lower mortality rates, with smokers having a rate of 2.5% compared to 14.2% for non-smokers, which was statistically significant Table 3.

Table3. Association of Variables with One Year Mortality in Patients Undergoing Percutaneous Coronary Intervention (PCI) for Myocardial Infarction: A Comparative Analysis

Variable	Number	OR	95% CI	P value
Sex Male Female	 8.4% 16.9%	2.218	1.03-4.76	0.04
Hypertension No Yes	 6.4% 14.4%	2.452	1.14-5.24	0.021
Diabetes mellitus No Yes	 7.7% 13.0%	1.804	0.85-3.79	0.12
Smoking No Yes	 14.2%2.5%	0.152	0.04-0.51	0.002
Hyperlipidemia No Yes	 10.1% 8.8%	0.858	0.38-1.93	084
Family history of CAD No Yes	 8.4% 12.5%	1.563	0.73-3.32	0.41
Age <60 >60	 9.4% 11.7%	1.276	0.62-2.62	0.57
Stent length <30mm >30mm	 4.2% 12.4%	3.200	1.15-8.84	0.02
Stent diameter (mm) <3mm >3mm	 9.2% 1.8%	0.182	0.02-1.39	0.081

Multivariate regression analysis

Multivariate regression analysis was conducted to explore the association between various variables and mortality. The results revealed a positive association between age (P=0.001) and stent length exceeding 30mm (P=0.036) and the hard outcome. Conversely, hypertension (P=0.524), tobacco smoking (P=0.111), and hemoglobin level (P=0.540) did not demonstrate statistically significant associations with mortality Table 4.

Table4. Association of Selected Variables with Mortality in Myocardial Infarction Patients Undergoing Primary Percutaneous Coronary Intervention (PCI)

Variable	B	P Value	OR	Lower	Upper
Age	0.170	0.001*	1.185	1.074	1.308
Hypertension	0.375	0.524	1.455	0.459	4.605
Tobacco smoking	-1.398	0.111	0.247	0.044	1.380
Hemoglobin level	0.106	0.540	1.111	0.792	1.559
Stent length >30mm	1.218	0.036*	3.380	1.082	10.553

Survival analysis

The majority of patients (89.2%) survived for at least one year after myocardial infarction (MI). Within the 12-month follow-up period, 10.8% (33 patients) died. The incidence of major adverse cardiac and cerebrovascular events (MACCE) during the follow-up period was higher in men than women(P=0.014). The highest risk of death was observed in the first month, followed by a lowerrisk period, with further slight declines throughout the year Figure 1.

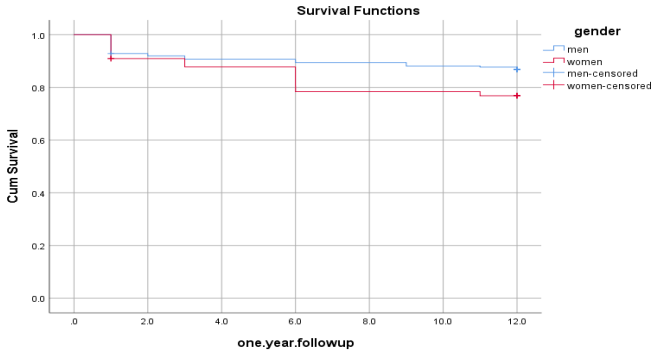

Figure1. The Kaplan-Meier survival curve illustrates the analysis of mortality rates among patients with myocardial infarction (MI) who received primary percutaneous coronary intervention (PCI) over 12-month duration. The survival analysis is stratified based on gender, with the curve representing male patients depicted in blue and female patients in red.

Discussion

This study aimed to investigate the outcomes and factors associated with percutaneous coronary intervention (PCI) in patients diagnosed with ST-segment elevation myocardial infarction (STEMI). The findings provide critical insights into the success rate of primary PCI, the incidence of major adverse cardiac events (MACE), and the prevalence of associated risk factors within this patient population.

Success Rate of Primary PCI

The overall success rate of primary PCI in our study was notably high, at 92.8%. This success rate aligns with previous research that has consistently demonstrated the effectiveness of PCI as a revascularization strategy for patients experiencing STEMI [13, 14]. The high success rate underscores the importance of timely intervention in improving patient outcomes. A significant factor contributing to

this favorable outcome is drug-eluting stents (DES), which were employed in most cases. Drug-eluting stents (DES) are recognized for their ability to lower the risk of restenosis compared to bare-metal stents, decreasing the likelihood of subsequent revascularization procedures [15]. This advantage is particularly crucial in STEMI, where rapid restoration of blood flow is vital to minimizing myocardial damage and improving survival rates.

Patient Demographics and Risk Factors

The mean age of the study population was 58.9 years, with a predominance of male participants (78.4%). These demographics are consistent with established literature indicating that STEMI predominantly affects middle-aged and older adults, with a higher incidence observed in males [16, 17]. Understanding the demographic profile of patients can aid in tailoring preventive measures and treatment strategies. Hypertension emerged as the most prevalent risk factor for coronary artery disease (CAD) in our cohort, affecting 41.1% of participants. This finding is in line with previous studies that have identified hypertension as a significant contributor to the development of CAD [18]. The high prevalence of hypertension highlights the necessity for effective management and control of blood pressure in at-risk populations, which could potentially reduce the incidence of STEMI.

Incidence of Major Adverse Cardiac Events

The incidence of major adverse cardiac and cerebrovascular events (MACCE) was 15.1% in the one-year follow-up period. This rate encompasses various outcomes; including mortality, repeat revascularization, non-fatal myocardial infarction, and cerebrovascular accidents. Within our study, the mortality rate was 10.8%, which is particularly noticeable given that in the first six months of follow-up there were higher rates of (MACCE). Moreover, research across diverse populations has reported that the one-year mortality rate following myocardial infarction ranges from 7% to 18% [19, 20, 21, 22]. These findings underscore the critical need for continued surveillance and the implementation of appropriate management strategies for patients post-primary PCI [23].

Gender Differences in Outcomes

Interestingly, our analysis revealed that women exhibited a higher incidence of MACCE than men during the follow-up period. This gender disparity in outcomes emphasizes the importance of considering gender-specific factors and interventions in the management of STEMI patients undergoing primary PCI. Tailoring treatment approaches based on gender differences can enhance the effectiveness of interventions and improve overall patient outcomes.

Limitations

The study has several limitations that should be considered when interpreting the results. First, the study design was a prospective cohort study, which limits the ability to establish causal relationships between variables. Additionally, the study was conducted at a single center, which may limit the generalizability of the findings to other populations or healthcare settings. Furthermore, the follow-up period of one year may not capture all long-term outcomes and complications associated with STEMI and PCI.

Conclusion

The results of this study provide valuable insights into the factors influencing mortality and the temporal patterns of adverse events in patients with STEMI undergoing primary PCI. Key determinants of patient outcomes identified include age, stent length, and gender. These factors highlight the necessity for personalized and targeted interventions aimed at improving the prognosis of these patients. Our findings reinforce the significance of continuous monitoring and tailored management strategies to optimize outcomes for patients with STEMI. Further investigation into the causes of mortality and adverse events in this population is warranted to identify potential areas for improvement in patient care and outcomes. By addressing these factors, healthcare providers can enhance the quality of care provided to STEMI patients and ultimately reduce mortality and morbidity associated with this condition.

Acknowledgments

We would like to express our sincere appreciation to the staff of the follow-up clinic and the registry unit of the Cardiovascular Research Center of Afshar Hospital for their valuable assistance and support throughout this study.

Conflicts of Interest

The authors have reported no conflicts of interest.

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