FACTORS ASSOCIATED WITH EARLY OUTCOMES AFTER PRIMARY PERCUTANEOUS CORONARY INTERVENTION IN PATIENTS AGED ≥75 YEARS WITH ST-ELEVATION MYOCARDIAL INFARCTION

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ABSTRACT

Objective: To evaluate several factors affecting the outcome of percutaneous coronary intervention (PCI) within 30 days in patients aged ≥75 years with ST-elevation myocardial infarction (STEMI).

Subjects and Methods: A cross-sectional descriptive study was conducted on 104 patients aged ≥75 years who were diagnosed with ST-elevation myocardial infarction (STEMI) and indicated for primary percutaneous coronary intervention (PCI) at the Vietnam National Heart Institute – Bach Mai Hospital, Hanoi Heart Hospital, and Huu Nghi Hospital from 2018 to 2021.

Results: The incidence of major adverse cardiovascular events (MACE) was 10.6%. Age ≥85 years (OR = 5.37; p = 0.006), Killip class III and IV (OR = 4.74; p = 0.028), TIMI score >6 (OR = 9.79; p = 0.011), CK-MB >39 U/L (OR = 4.11; p = 0.032), elevated Troponin T >4084.2 ng/L (OR = 6.19; p = 0.008), and ST elevation ≥4.0 mm (OR = 6.24; p = 0.003) were associated with an increased risk of MACE within 30 days after primary PCI in elderly patients.

Conclusion: Factors associated with adverse outcomes after primary PCI in patients aged ≥75 years with STEMI within 30 days included advanced age, high Killip class, TIMI score >6, elevated CK-MB, Troponin T levels, and ST elevation ≥4.0 mm.

Keywords: Primary coronary intervention, myocardial infarction, ST elevation, ≥75 years old.

1. INTRODUCTION

Myocardial infarction (MI) is a leading medical emergency among cardiovascular diseases, characterized by high morbidity and mortality rates, especially in the elderly [1].The goal of treatment for ST-elevation myocardial infarction (STEMI) is to promptly restore perfusion to the ischemic myocardium by recanalizing the occluded or significantly narrowed coronary artery as early as possible. Early reperfusion therapy helps reduce complications and mortality associated with the disease [1], [2]. Current treatment strategies for STEMI include medical therapy, percutaneous coronary intervention (PCI), and coronary artery bypass grafting (CABG). Among these, PCI has emerged over the past few decades as a primary and preferred treatment modality due to its high success rate and favorable short- and long-term clinical outcomes [2]. In practice, numerous factors influence the outcomes of primary PCI in patients with STEMI, including the time from symptom onset to hospital admission, the technical expertise and experience of the interventional cardiologist, as well as patient-related factors such as age, physical condition, mental status, and the presence of comorbidities [2]. In particular, elderly patients with STEMI are more likely to present with atypical symptoms and often arrive at the hospital later than younger patients, which significantly affects the effectiveness of primary PCI. Given these challenges, this study aims to: "Evaluate several factors influencing the 30-day outcomes of primary percutaneous coronary intervention in patients aged ≥75 years with ST-elevation myocardial infarction.".

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2. STUDY SUBJECTS AND METHODS

2.1. Study Subjects

The study included patients aged 75 years or older, diagnosed with ST-elevation myocardial infarction (STEMI) and indicated for primary percutaneous coronary intervention (PCI) at the Vietnam National Heart Institute – Bach Mai Hospital, Hanoi Heart Hospital, and Huu Nghi Hospital between 2018 and 2021.

- Inclusion Criteria

+ Patients aged 75 years or older, diagnosed with ST-elevation myocardial infarction (STEMI), indicated for primary percutaneous coronary intervention (PCI) between 2018 and 2021 at the study sites, and who provided informed consent to participate in the study.

+ The diagnosis of ST-elevation myocardial infarction (STEMI) was based on the Fourth Universal Definition of Myocardial Infarction consensus in 2018. The indication for primary percutaneous coronary intervention (PCI) was guided by the 2017 European Society of Cardiology (ESC) guidelines, as well as recommendations from the Vietnam Society of Cardiology and the Ministry of Health in 2019.

- Exclusion Criteria

Patients with contraindications to antiplatelet therapy, those who experienced a cerebrovascular accident or gastrointestinal bleeding within the past 3 months, patients with severe renal or hepatic failure, and those with terminal-stage cancer were excluded from the study.

2.2. Study Period and Location: From June 2018 to December 2021 at the Vietnam National Heart Institute – Bach Mai Hospital, Hanoi Heart Hospital, and Huu Nghi Hospital..

2.3. Study Design and Methods

2.3.1. Study Design: A descriptive cross-sectional study with analytical components..

2.2.2. Sample Size and Sampling Method:

Convenience sampling was used, selecting all patients who met the inclusion and exclusion criteria during the study period. In practice, we enrolled 104 eligible patients during the study period. Due to the COVID-19 pandemic occurring during data collection, only 104 patients were recruited..

2.3.4. Percutaneous Coronary Intervention Technique

- Step 1: Vascular access via the radial artery or femoral artery

- Step 2: Coronary angiography

- Step 3: Insertion of the guiding catheter

- Step 4: Administration of heparin to the patient

- Step 5: Perform coronary intervention: Maneuver the 0.014-inch guidewire by bending its tip at a 45–60° angle to navigate through the coronary artery branches and across the lesion. Advance the guidewire through the lesion, then continue to push it toward the distal segment of the coronary artery (avoiding entry into small branches or advancing too far). Perform balloon angioplasty to dilate the lesion site, deploy the stent, post-dilate the stent, and perform angiographic verification.

- Step 6: Remove the vascular access device and apply compression.

- Step 7: Provide post-procedure care to the patient after device removal.

2.4. Research Variables

Evaluation of the impact of various factors on major cardiovascular events within 30 days after intervention, including:

- The influence of anthropometric characteristics and risk factors

- The influence of clinical characteristics

- The influence of paraclinical features

- The influence of cardiac enzyme profiles

- The influence of electrocardiogram (ECG) and echocardiographic findings

- The influence of coronary artery lesions

2.5. Standards Applied in the Study

The study utilized scoring systems including the TIMI (Thrombolysis in Myocardial Infarction) flow grade (0–3) to assess coronary artery blood flow, the Killip classification (I–IV), the GRACE 2.0 score, and the TIMI Risk Score.

**** Major Cardiovascular Events***

Major complications that may occur after PCI include death, myocardial infarction, stroke, and other complications such as vascular injury, contrast-induced nephropathy, and bleeding. However, our study focuses specifically on major cardiovascular events including death, recurrent myocardial infarction, and cerebral stroke.

- All-Cause Mortality: at the end of the study period, all deaths from any cause were recorded. Mortality inludes cardiovascular death, non-cardiovascular death, and death of unknown cause. Among these, all-cause mortality is a commonly used variable in clinical studies related to PCI [3].

- Recurrent Myocardial Infarction (Re-MI): Re-MI refers to patients who experience a repeat myocardial infarction requiring intervention. It is one of the most common complications following PCI, often caused by procedural factors such as slow flow phenomenon, side branch loss, and other technical complications during the procedure... [4].

- Stroke: according to the "Standardized Neurological Criteria Recommendations for Cardiovascular Clinical Trials" by the European Society of Cardiology (ESC), stroke is defined as the sudden onset of neurological deficits with focal rather than diffuse symptoms, lasting more than 24 hours or resulting in death within 24 hours, excluding traumatic brain injury. Magnetic resonance imaging (MRI), computed tomography (CT), or both are the imaging modalities used to diagnose stroke, with the lesion location corresponding to the clinical stroke symptoms [5]

2.6. Data Analysis: The data were entered and processed using medical statistical methods with SPSS software version 26.0

2.7. Research Ethics: The study was approved by the Ethics Committee of the Institute of Clinical Medical and Pharmaceutical Sciences 108, and received approval from the Vietnam National Heart Institute – Bach Mai Hospital, Hanoi Heart Hospital, and Huu Nghi Hospital..

3. RESEARCH RESULTS

Table 1. The Impact of Anthropometric Characteristics and Risk Factors on Major Cardiovascular Events in Patients Within 30 Days Post-Intervention

Index \ MACE		Yes (n=11)		No (n=93)		OR (95%CI), p
		n	%	n	%	
Age	≥85	6	29,1	17	73,9	5,37 (1,18-24,56), p=0,006
	75-<85	5	6,2	76	93,8	
Sex	Male	6	9,0	61	91,0	0,63 (0,18-2,22), p=0,472
	Female	5	13,5	32	86,5	
Hypertension (HTN)	Yes	11	11,7	83	88,3	-
	No	0	0,0	10	100,0	
Diabetes Mellitus (DM)	Yes	7	18,4	31	81,6	3,50 (0,95-12,87), p=0,059
	No	4	6,1	62	93,9	
History of lipid metabolic disorders	Yes	7	9,9	64	90,1	0,79 (0,22-2,92), p=0,727
	No	4	12,1	29	87,9	
History of coronary intervention	Yes	2	11,8	15	88,2	1,16 (0,23-5,89), p=0,862
	No	9	10,3	78	89,7	
Total		11	10,6	93	89,4	

Assessment: Patients aged ≥85 years have a 5.37-fold higher risk of experiencing composite major adverse cardiovascular events (MACE) compared to patients aged <85 years, which is statistically significant (95% CI: 1.18–24.56).

Table 2. The Impact of Clinical Characteristics on Major Cardiovascular Events in the Study Group Within 30 Days Post-Intervention

Index \ MACE		Yes (n=11)		No (n=93)		OR (95%CI), p
		n	%	n	%	
Typical angina	Yes	4	6,8	55	93,2	0,40 (0,11-1,44), p=0,160
	No	7	15,6	38	84,4	
Bleeding risk	Yes	5	12,8	34	87,2	1,45 (0,41-5,10), p=0,566
	No	6	9,2	59	90,8	
Killip	III, IV	4	28,6	10	71,4	4,74 (1,18-19,09), p=0,028
	I, II	7	7,8	83	92,7	
TIMI Risk Score	>6	10	17,5	47	82,5	9,79 (1,28-43,71), p=0,011
	≤6	1	2,1	46	97,9	

Index \ MACE		Yes (n=11)		No (n=93)		OR (95%CI), p
		n	%	n	%	
GRACE Score	>149,38	11	14,1	67	85,9	-
	≤149,38	0	0,0	26	100,0	
Total		11	10,6	93	89,4	

Assessment: Patients classified as Killip III and IV have a 4.74-fold higher risk of major adverse cardiovascular events (MACE) compared to those classified as Killip I and II, which is statistically significant (95% CI: 1.18–19.09). Patients with a TIMI Risk Score >6 have a 9.79-fold higher risk of MACE compared to those with a TIMI Risk Score ≤6, also statistically significant (95% CI: 1.28–43.71).

Table 3. Impact of Paraclinical Parameters on Major Adverse Cardiovascular Events in Patients Within 30 Days After Intervention

MACE Index		Yes (n=11)		No (n=93)		OR (95%CI), p
		n	%	n	%	
Creatinin	>115µmol/l	7	21,2	26	78,8	4,51 (1,03-20,46), p=0,016
	≤115µmol/l	4	5,6	67	94,4	
Glomerular Filtration Rate - GFR <60 (ml/ph)	Yes	6	22,2	21	77,8	4,11 (1,14-14,84), p=0,031
	No	5	6,5	72	93,5	
Glucose	≥7,0mmol/l	8	12,1	58	87,9	1,61 (0,40-6,47), p=0,503
	<7,0 mmol/l	3	7,9	35	92,1	
Dyslipidemia	Yes	8	10,5	68	89,5	0,98 (0,24-3,99), p=0,978
	No	3	10,7	25	89,3	
Anemia	Yes	4	10,0	36	90,0	0,91 (0,25-3,31), p=0,880
	No	7	10,9	57	89,1	
Platelets	Elevated	1	9,1	10	90,9	0,83 (0,10-7,18), p=0,866
	Not Elevated	10	10,8	83	89,2	
Total		11	10,6	93	89,4	

Patients with elevated creatinine levels prior to intervention had a 4.51-fold higher risk of experiencing major adverse cardiovascular events (MACE) compared to those without elevated creatinine, which was statistically significant (95% CI: 1.03–20.46). Patients with an estimated glomerular filtration rate (GFR) <60 mL/min had a 4.11-fold higher risk of MACE compared to those without impaired renal function, also statistically significant (95% CI: 1.14–14.84).

Table 4. Impact of Cardiac Enzyme Levels on Major Adverse Cardiovascular Events in Patients Within 30 Days Post-Intervention

MACE Index*		Yes (n=11)		No (n=93)		OR (95%CI), p
		n	%	n	%	
CK-MB	>39,0 U/L	6	22,2	21	77,8	4,11 (1,14-14,84), p=0,032
	≤39,0 U/L	5	6,5	72	93,5	
Troponin T	>4084,2 ng/L	8	22,2	28	77,8	6,19 (1,53-25,08), p=0,008
	≤4084,2 ng/L	3	4,4	65	95,6	
NT-proBNP	>125 ng/dl	8	10,3	70	89,7	0,88 (0,21-3,58), p=0,876
	≤125 ng/dl	3	11,5	23	88,5	
Total		11	10,6	93	89,4	

** The cut-off point was set at the 25th percentile*

Patients with CK-MB levels >39.0 U/L had a 4.11-fold higher risk of experiencing major adverse cardiovascular events (MACE) compared to those with CK-MB ≤39.0 U/L, with a statistically significant difference (p = 0.032; 95% CI: 1.14–14.84). Patients with Troponin T levels >4084.2 ng/L had a 6.19-fold higher risk of MACE compared to those with Troponin T ≤4084.2 ng/L, also statistically significant (p = 0.008; 95% CI: 1.53–25.08).

Table 5. Impact of Electrocardiographic and Echocardiographic Characteristics on Major Adverse Cardiovascular Events in Patients Within 30 Days Post-Intervention

Index \ MACE		Yes (n=11)		No (n=93)		OR (95%CI), p
		n	%	n	%	
Infarcted area (ECG)	Anteroseptal and large anterior wall infarction	9	17,3	43	82,7	5,23 (1,00-51,61), p=0,026
	Posterior and inferior wall infarction	2	3,9	50	96,1	
ST elevation	≥4,0 mm	6	28,6	15	71,4	6,24 (1,36-28,85), p=0,003
	<4,0 mm	5	6,0	78	94,0	
Total		11	10,6	93	89,4	

Patients with anterior and anteroseptal myocardial infarction had a 5.23-fold higher risk of experiencing MACE compared to those with posterior and inferior infarction, which was statistically significant (95% CI: 1.00–51.61).

Patients with ST elevation ≥4.0 mm had a 6.24-fold higher risk of MACE compared to those with ST elevation <4.0 mm, also with statistical significance (95% CI: 1.36–28.85).

Table 6. The impact of coronary artery lesions on major cardiovascular events in patients within 30 days post-intervention

Index \ MACE		Yes (n=11)		No (n=93)		OR (95%CI), p
		n	%	n	%	
Number of coronary artery lesions	≥2 branches	7	22,6	24	77,4	5,03 (1,14-25,11), p=0,010
	1 branch	4	5,5	69	94,5	
Main Coronary Artery	Yes	1	11,1	8	88,9	1,06 (0,12-9,40), p=0,957
	No	10	10,5	85	89,5	
LAD	Yes	10	12,3	71	87,7	3,10 (0,38-25,57), p=0,294
	No	1	4,3	22	95,7	
LCx	Yes	5	9,8	46	90,2	0,85 (0,24-3,00), p=0,802
	No	6	11,3	47	88,7	
RCA	Yes	5	7,7	60	92,3	0,46 (0,13-1,62), p=0,225
	No	6	15,4	33	84,6	
TIMI	0	10	11,9	74	88,1	2,56 (0,31-21,32), p=0,686
	1-2	1	5,0	19	95,0	
Total		11	10,6	93	89,4	

Patients with lesions in two or more coronary artery branches had a 5.03-fold higher risk of experiencing MACE compared to those with single-branch disease, which was statistically significant (95% CI: 1.14–25.11).

4. DISCUSSION

In Table 1, the analysis of the association between anthropometric factors, underlying diseases, and intervention history with the risk of major adverse cardiovascular events (MACE) within 30 days post-intervention showed that advanced age is a prominent risk factor. Specifically, patients aged ≥85 years had a significantly higher risk of experiencing MACE compared to those aged <85 years, with an odds ratio (OR) of 5.37 (95% CI: 1.18–24.56; p = 0.006), indicating clear statistical significance. This result is consistent with previous studies, which have identified advanced age as a poor prognostic factor in acute coronary syndrome as well as after percutaneous coronary intervention. [6].

Among the clinical factors analyzed, Killip classification and TIMI Risk Score showed statistically significant associations with major adverse cardiovascular events (MACE) within 30 days post-intervention. Specifically, patients classified as Killip III and IV had a 4.74-fold higher risk of experiencing MACE compared to those in Killip I and II groups (OR = 4.74; 95% CI: 1.18–19.09; p = 0.028). This finding is consistent with previous studies indicating that the Killip classification is a strong predictor of short-term prognosis in patients with ST-elevation myocardial infarction (STEMI) [7]. Killip classes III and IV typically reflect acute heart failure, pulmonary congestion, or cardiogenic shock, which are high-risk factors during inpatient treatment. Additionally, a TIMI Risk Score greater than 6 was also significantly associated with a higher risk of MACE, with an OR of 9.79 (95% CI: 1.28–43.71; p = 0.011). The TIMI Risk Score is a scoring system designed to assess the risk of early mortality and complications in patients with acute coronary syndrome, and it is particularly useful in guiding treatment strategy selection [8]. These results further reinforce the role of using the TIMI score in clinical practice as a reliable risk stratification tool.

In this study, a CK-MB level > 39.0 U/L was identified as a statistically significant factor associated with the risk of major adverse cardiovascular events (MACE) within the first 30 days after percutaneous coronary intervention (PCI), with an odds ratio (OR) of 4.11 (95% CI: 1.14–14.84; p = 0.032). This finding is consistent with numerous previous studies indicating that CK-MB, a classic marker of myocardial injury, continues to hold prognostic value in the early period following PCI, especially in patients with acute coronary syndrome. According to a study by Apple et al. (2002), CK-MB may reflect the extent of myocardial necrosis, an important factor contributing to post-PCI complications such as arrhythmias, acute heart failure, or coronary restenosis [9]. Although troponin is currently considered the preferred biomarker, CK-MB remains widely used in clinical practice at many centers, especially in patients with underlying renal failure, where troponin results may be confounded. Differences in the predictive value of CK-MB across studies largely stem from the applied cut-off points and the timing of sample collection post-intervention. Findings from this study indicate that CK-MB remains an important marker to monitor during the early post-PCI period. Additionally, a Troponin T level > 4084.2 ng/L was also strongly associated with the risk of MACE within 30 days, with an OR of 6.19 (95% CI: 1.53–25.08; p = 0.008). This result is consistent with the majority of current studies, where troponin, especially high-sensitivity isoforms (hs-cTnT/I) has been established as the strongest prognostic biomarker for both short- and long-term MACE after PCI. In a recent meta-analysis involving over 20,000 patients, DeFilippis et al. (2019) reported that elevated troponin levels post-intervention independently predicted reinfarction, heart failure, or death within 30 days, regardless of the extent of underlying coronary artery disease. [10]. The underlying mechanism may be related to the extent of acute myocardial cell injury, which triggers inflammation, activation of the coagulation system, and endothelial dysfunction factors that collectively contribute to an increased risk of adverse events. Our study results reaffirm the essential role of troponin in early risk assessment post-PCI and suggest that applying specific ROC thresholds tailored to different patient populations could provide greater clinical value.

The results in Table 5 show that patients with lesions in two or more coronary artery branches had a 5.03-fold higher risk of experiencing MACE compared to those with single-vessel disease, which was statistically significant (95% CI: 1.14–25.11). Our findings are not consistent with the study by Nguyen Huy Loi et al., which did not find an association between the number of diseased vessels and mortality in STEMI patients undergoing primary PCI: patients with lesions in two or more coronary arteries did not show an increased risk of mortality after PCI, with an OR of 0.16 (95% CI: 0.021–1.250) [11]. The difference between our results and the previous study may be attributed to the fact that our study focused on MACE in patients aged ≥75 years, whereas the previous study only examined mortality in STEMI patients after PCI.

5. CONCLUSION

In a study of 104 STEMI patients aged 75 years and older, we observed a 10.6% incidence of major adverse cardiovascular events (MACE) within 30 days following PCI. The factors associated with increased risk of MACE after 30 days included age ≥85 years (OR = 5.37; p = 0.006), Killip class III and IV (OR = 4.74; p = 0.028), TIMI score > 6 (OR = 9.79; p = 0.011), CK-MB >39 U/L (OR = 4.11; p = 0.032), elevated Troponin T >4084.2 ng/L (OR = 6.19; p = 0.008), and ST elevation ≥4.0 mm (OR = 6.24; p = 0.003).

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