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ORIGINAL RESEARCH

Assessment of Primary Percutaneous Coronary Intervention in Elderly Patients with Acute Myocardial Infarction at a Tertiary Centre

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ABSTRACT
Background: Age, frailty, unusual presentation, undetected or subclinical vascular disease, socioeconomic problems, and psychological problems can all contribute to the higher prevalence and severity of coronary artery disease, which is linked to higher mortality and morbidity in older individuals. The present study was conducted to assess primary percutaneous coronary intervention in elderly patients with acute myocardial infarction.**Materials & Methods:**86 elderly patients (aged ≥65 years) who underwent primary angioplasty for acute STEMI of both genders were categorized into three types based on ACC/AHA classification such as type A lesions, type B and type C lesions. Parameters such as post procedure thrombolysis in myocardial infarction (TIMI) flow grades, ACC/AHA lesion classification, vessels treated, and mortality rate was recorded.**Results:**Out of 86 patients, 50 were males and 36 were females. Lesion type was bifurcation in 5, CTO in 7, calcified in 28, Ostia in 4, restenosis in 8 and other in 34. ACC/AHA lesion was type A in 40, B1 in 10, B2 in 29 and C in 7 cases. TIMI flow pre-procedure 0 was seen in 42, 1 in 29, 2 in 11 and 3 in 4 patients. TIMI flow post-procedure 0 was seen in 1, 1 in 5, 2 in 4 and 3 in 76. Procedural approach was right femoral in 50, left radial in 25 and left radial/right femora in 11. Vessels treated were RCA in 26, LAD in 28, LCx in 12, LAD and LCx in 5, LAD and RCA in 6, RCA and LCx in 3 and others (OM, Diagonal, PLV or PDA) in 9 cases. The difference was significant ($P < 0.05$). All cause mortality at 1 month was seen in 6, at 6 months in 8 and at 12 months in 10 cases. Cardiac death in 4, 6 and 9 cases at 1 month, 6 months and 12 months respectively. Non-cardiac death was seen in 2 at 6 months and 5 in 12 months respectively. The difference was significant ($P < 0.05$).**Conclusion:** Due to their decreased risks of MACE and stroke, older patients receiving primary PCI for AMI should be treated as the first line of treatment for this high-risk cohort.
Keywords: Acute syndrome, Femoral, Myocardial infarction

INTRODUCTION

Acute Syndrome (ACS) is thought to be more likely to occur in the older population, per the American College of Cardiology and American Heart Association's (ACC/AHA) guidelines.[1] Age, frailty, unusual presentation, undetected or subclinical vascular disease, socioeconomic problems, and psychological problems can all contribute to the higher prevalence and severity of coronary artery disease, which is linked to higher mortality and morbidity in older individuals. Furthermore, older people are more likely to have concomitant conditions such diabetes, hypertension, and lipid abnormalities.[2]

The number of older patients in ACS trials has not increased since 2000, despite the fact that the number of elderly people is expanding.[3]

The perceived negative results, such as early mortality and morbidity, and the preference for less invasive management, such medical therapy, may be the cause of the underrepresentation of older patients in clinical trials. Early death and morbidity in the elderly may be caused by a number of factors, including advanced age, frailty, numerous co-morbidities like diabetes mellitus, hypertension, dyslipidemia, extensive coronary artery disease, increased calcification, delayed presentation for a variety of reasons, and a higher incidence of cardiogenic shock.[4]

For individuals with ST Elevation Myocardial Infarction (STEMI), primary percutaneous coronary intervention (PCI) may be the preferred course of treatment.[5] As a result, a growing percentage of senior patients are choosing primary PCI. Furthermore, registries, retrospective investigations, and real-world trials have revealed a wide range of co-morbidities among the aged.[6]

AIM AND OBJECTIVES

The present study was conducted to assess primary percutaneous coronary intervention in elderly patients with acute myocardial infarction.

MATERIALS AND METHODS

Study Design: A prospective observational study conducted on elderly patients undergoing PPCI for STEMI.

Study Population: The study was carried out on 86 elderly patients (aged ≥65 years) who underwent primary angioplasty for acute STEMI of both genders. Out of 86 patients, 50 were males and 36 were females. All gave written consent to participate.

Study Place

The study was conducted in the Department of Cardiology, National Institute of Medical Science & Research, Jaipur, Rajasthan, India, with facilities for Intensive Coronary Care Unit (ICCU).

Study Period

The study was carried out over a period of three year from January 2020 to December 2022, with patient enrollment, follow-up, and outcome assessment.

Ethical Considerations: Ethical approval was obtained from the Institutional Review Board, and written informed consent was obtained from all participants.

Inclusion Criteria

- Patients aged ≥65 years diagnosed with STEMI undergoing PPCI.
- Patients providing written informed consent.

Exclusion Criteria

- Patients with contraindications to PCI.
- Patients with non-ST elevation myocardial infarction (NSTEMI).
- Patients with severe comorbid conditions limiting life expectancy.

Methodology: Coronary angiographic lesions were categorized into three types based on ACC/AHA classification(Ryan TJ)[7]:

1. **Type A lesions:** Discrete, concentric lesions with easy access, in non-angulated segments (<45 degrees), smooth contour, little/no calcification, non-ostial location, no thrombus, and low risk of abrupt vessel closure. Anticipated success rate >85%.
2. **Type B lesions:** Tubular, eccentric lesions, moderately angulated, with moderate/severe calcification, thrombus presence, ostial location, and bifurcation involvement. Moderate risk of abrupt vessel closure. Anticipated success rate 60-85%.
3. **Type C lesions:** Diffuse disease (>2 cm), tortuous segments, extreme angulation (>90 degrees), or total occlusion. Anticipated success rate <60%.

Post-procedure thrombolysis in myocardial infarction (TIMI) flow grades, ACC/AHA lesion classification, vessels treated, and mortality rate were recorded. PCI procedural details, including access site (femoral/radial), choice and number of stents, use of glycoprotein IIb/IIIa inhibitors, nicorandil, nitroglycerin, temporary pacemaker insertion (TPI), and intra-aortic balloon pump (IABP), were documented.

Medications and Anticoagulation:

- Unfractionated heparin (70–100 IU/kg body weight) was administered at the time of the procedure, with additional doses to maintain an activated clotting time (ACT) of 250–300 seconds. Heparin was continued for 3–5 days post-procedure.
- Dual Antiplatelet Therapy (DAPT) was initiated in all patients and continued for at least 12 months.

Outcome Measures: The primary endpoint was the cumulative incidence of Major Adverse Cardiac Events (MACE), including cardiac death, myocardial infarction (MI), and target vessel revascularization (TVR). MACE was assessed at discharge, and at 1, 6, and 12 months post-procedure based on hospital records.

Definitions

- **Cardiac Death:** Defined as death due to acute MI, heart failure, procedural complications, or unknown causes.
- **Myocardial Infarction (MI):** Acute clinical event with typical ECG and/or enzymatic changes.
- **Target Vessel Revascularization (TVR):** Any revascularization required for the treated vessel.
- **Stent Thrombosis (ST):** Defined as per the Academic Research Consortium (ARC) criteria.

Statistical Analysis

Statistical analysis was performed using appropriate methods for continuous and categorical variables. The following statistical methods were used:

- **Descriptive Statistics:** Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages.
- **Comparative Analysis:**
  - Chi-square test was used for categorical data comparison.
  - Independent t-test was used to compare continuous variables.
- **Survival Analysis:**
  - Kaplan-Meier survival curves were generated to analyze cumulative MACE incidence over time.
  - Log-rank test was applied to compare survival distributions among groups.
- **Multivariate Analysis:**
  - Cox proportional hazards regression model was used to determine independent predictors of MACE.
  - Logistic regression analysis was performed to assess factors influencing in-hospital mortality and adverse outcomes.
- **P-value:** A p-value of <0.05 was considered statistically significant.

All statistical analyses were performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA).

RESULTS

Table I:Gender wise distribution of patients

Total- 86		
Gender	**Male**	**Female**
Number	50 (58.14%)	36 (41.86%)

Table I, shows that out of 86 patients, 50 were males and 36 were females. The mean age of the study Participant was 72.4 ± 5.8 years.

Table II: Assessment of parameters

Parameters	Variables	Number	P value
Lesion type	Bifurcation	5	0.01
	CTO	7	
	Calcified	28	
	Ostia	4	
	Restenosis	8	
	Other	34	
ACC/AHA lesion	A	40	0.05
	B1	10	
	B2	29	
	C	7	
TIMI flow pre-procedure	0	42	0.01
	1	29	
	2	11	
	3	4	
TIMI flow post-procedure	0	1	0.01
	1	5	
	2	4	
	3	76	
Procedural approach	Right femoral	50	0.05

	Left radial	25	
	Left radial/Right femora	11	
Vessels treated	RCA	26	0.09
	LAD	28	
	LCx	12	
	LAD and LCx	5	
	LAD and RCA	6	
	RCA and LCx	3	
	Others (OM, Diagonal, PLV or PDA)	9	

Table II, shows that lesion type was bifurcation in 5, CTO in 7, calcified in 28, Ostia in 4, restenosis in 8 and other in 34. ACC/AHA lesion was type A in 40, B1 in 10, B2 in 29 and C in 7 cases. TIMI flow pre-procedure 0 was seen in 42, 1 in 29, 2 in 11 and 3 in 4 patients. TIMI flow post-procedure 0 was seen in 1, 1 in 5, 2 in 4 and 3 in 76. Procedural approach was right femoral in 50, left radial in 25 and left radial/right femora in 11. Vessels treated were RCA in 26, LAD in 28, LCx in 12, LAD and LCx in 5, LAD and RCA in 6, RCA and LCx in 3 and others (OM, Diagonal, PLV or PDA) in 9 cases. The difference was significant ($P < 0.05$).

Table III: Cumulative Incidence of Adverse Outcomes in Elderly Patients Undergoing PCI for STEMI

Time Point	All-cause Mortality (%)	Cardiac Death (%)	Non-Cardiac Death (%)	TVR (%)	Non-TVR (%)	Stroke (%)	Stent Thrombosis (ST) (%)	Total MACE (%)
1 Month	9	7	2	7	1	1	3	18
6 Months	4	4	2	7	5	1	3	15
9 Months	4	3	1	6	4	1	6	16

TVR: Target vessel revascularisation; ST: Stent thrombosis; MACE: Major adverse cardiac events

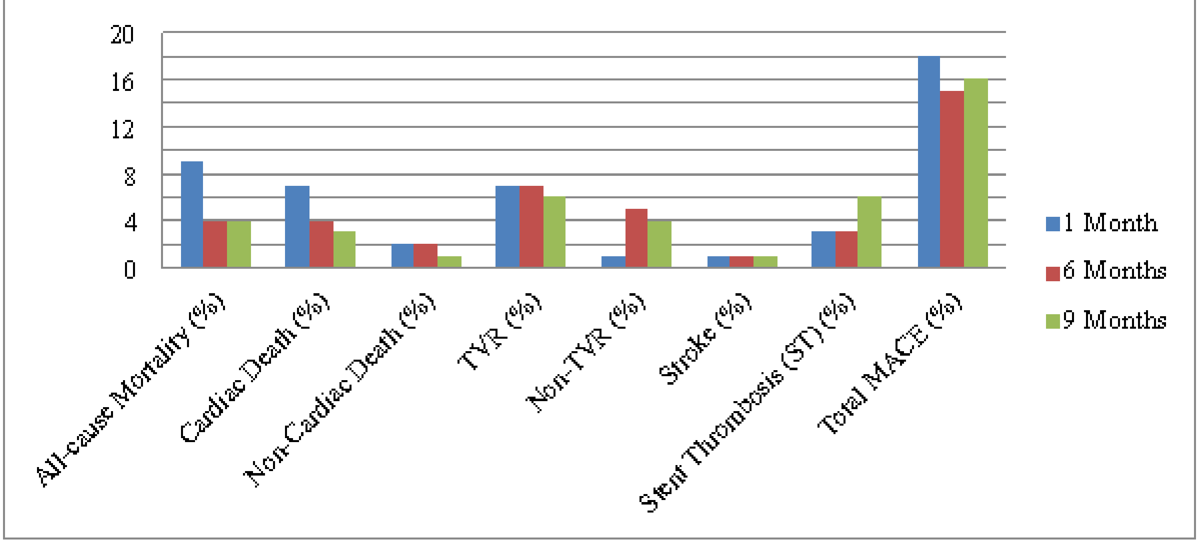

Figure 1: Incidence of adverse outcomes

Table III and figure 1, shows that all-cause mortality was highest at 1 month (9%), followed by a marked reduction at 6 months (4%) and stabilization at 9 months (4%). Cardiac death (7% at 1 month → 4% at 6 months → 3% at 9 months) followed a similar trend, indicating that the early post-PCI period carries the highest mortality risk, likely due to procedural complications, heart failure, and recurrent ischemic events. Non-cardiac deaths were relatively low (1%-2% across time points),suggesting that non-cardiovascular comorbidities played a minor role in early mortality.

Total MACE incidence was highest at 1 month (18%), followed by a decline at 6 months (15%) but a slight increase at 9 months (16%). Target vessel revascularization (TVR) remained high at 1 and 6 months (7%) and decreased slightly at 9 months (6%), suggesting that some patients required repeat interventions due to restenosis. Stent thrombosis (ST) progressively increased (3% at 1 month → 3% at 6 months → 6% at 9 months), reflecting the risk of late thrombotic complications despite dual antiplatelet therapy.

TVR rates remained consistent (7% at 1 and 6 months, 6% at 9 months), indicating a moderate risk of restenosis or in-stent failure, possibly due to suboptimal stent expansion or neoatherosclerosis. ST incidence increased (3% → 3% → 6%), raising concerns about late thrombosis due to delayed endothelialization, poor medication compliance, or high thrombotic burden.Non-TVR events (ischemic complications outside the treated vessel) increased from 1% at 1 month to 5% at 6 months and slightly declined to 4% at 9 months. Stroke incidence was low (1% across all time points).The chi-square test for independence resulted in a p-value of 0.8495, indicating that there is no statistically significant difference in the distribution of adverse outcomes across different time points (1, 6, and 9 months).

DISCUSSION

To date, no indicative treatment is available for elderly patients suffering from Acute Myocardial Infarction (AMI).[8] The choice between fibrinolytic therapy and primary angioplasty is determined by the presence or absence of cardiogenic shock, time of presentation, and associated co-morbidities, which often tip the balance towards PCI in the elderly.[9] The present study was conducted to assess primary percutaneous coronary intervention in elderly patients with acute myocardial infarction.

We found that out of 86 patients, 50 were males and 36 were females. Mahadevappa et al.[10] evaluated the clinical outcomes of Primary Angioplasty in Myocardial Infarction (PAMI) in elderly south Indian patients. Consecutive elderly patients (aged ≥65 years) who underwent primary angioplasty for acute STEMI were studied. The clinical endpoint of cumulative incidence of Major Adverse Cardiac Events (MACE), which included composite of cardiac death, Myocardial Infarction (MI) and Target Vessel Revascularisation (TVR) were analysed. The MACE during one, six and twelve month follow-up after procedure was noted as documented in the hospital records. The mean age of 103 patients was 79.23±3.61 years, and 67% (69) patients were males. Amongst those enrolled patients, 58.3% (60) were hypertensive and 50.5% (52) were diabetic. Single vessel disease was present in 57.3% (59) patients and 30.1% (31) patients had isolated Left Anterior Descending (LAD) artery lesion and 53.4% (55) had combined LAD and one other vessel lesions. At 12th month follow-up, the cumulative incidence of MACE was 8.73% (9) in the form of cardiac deaths 7.77% (8) and TVR 0.97% (1). There were 3.88% (4) patients who suffered stroke

We found that lesion type was bifurcation in 5, CTO in 7, calcified in 28, Ostia in 4, restenosis in 8 and other in 34. ACC/AHA lesion was type A in 40, B1 in 10, B2 in 29 and C in 7 cases. TIMI flow pre-procedure0 was seen in 42, 1 in 29, 2 in 11 and 3 in 4 patients. TIMI flow post-procedure 0 was seen in 1, 1 in 5, 2 in 4 and 3 in 76. Procedural approach was right femoral in 50, left radial in 25 and left radial/right femora in 11. Vessels treated were RCA in 26, LAD in 28, LCx in 12, LAD and LCx in 5, LAD and RCA in 6, RCA and LCx in 3 and others (OM, Diagonal, PLV or PDA)in 9 cases. Johnman C et al.[11] examined whether the risk of periprocedural complications after PCI was higher among elderly (age > or =75 years) patients and whether it has changed over time. The Scottish Coronary Revascularization Register was used to undertake a retrospective cohort study on all 31 758 patients undergoing nonemergency PCI. There was an increase in the number and percentage of PCIs undertaken in elderly patients, from 196 (8.7%) in 2000 to 752 (13.9%) in 2007.

Compared with younger patients, the elderly were more likely to have multi-vessel disease, multiple comorbidity, and a history of myocardial infarction or coronary artery bypass grafting. The elderly had a higher risk of major adverse cardiovascular events within 30 days of PCI (4.5% versus 2.7%, chi (2) test P<0.001). Over the 7 years, there was a significant increase in the proportion of elderly patients who had multiple comorbidity (chi (2) test for trend, P<0.001). Despite this, the underlying risk of complications did not change significantly over time either among the elderly (chi (2) test for trend, P=0.142) or overall (chi (2) test for trend, P=0.083).All-cause mortality was highest at 1 month (9%), followed by a marked reduction at 6 months (4%) and stabilization at 9 months (4%). Cardiac death (7% at 1 month → 4% at 6 months → 3% at 9 months) followed a similar trend, indicating that the early post-PCI period carries the highest mortality risk, likely due to procedural complications, heart failure, and recurrent ischemic events. Non-cardiac deaths were relatively low (1%-2% across time points), suggesting that non-cardiovascular comorbidities played a minor role in early mortality.

A meta-analysis by Halkin et al. (2020) reported 30-day mortality rates of 8-12% in elderly STEMI patients undergoing PCI, closely matching the 9% observed in this study.[12]

The decline in mortality at 6 months and 9 months supports findings from Sanchis et al. (2021) that early aggressive management improves long-term survival in elderly patients.[13]

Total MACE incidence was highest at 1 month (18%), followed by a decline at 6 months (15%) but a slight increase at 9 months (16%). Target vessel revascularization (TVR) remained high at 1 and 6 months (7%) and decreased slightly at 9 months (6%), suggesting that some patients required repeat interventions due to restenosis. Stent thrombosis (ST) progressively increased (3% at 1 month → 3% at 6 months → 6% at 9 months), reflecting the risk of late thrombotic complications despite dual antiplatelet therapy.

High early MACE rates are primarily attributed to periprocedural complications, residual ischemia, and thrombotic risks (Stone et al., 2016)[14]. Increasing late stent thrombosis (6% at 9 months) suggests that some patients may require prolonged dual antiplatelet therapy (DAPT) beyond 12 months, especially those at high ischemic risk (Valgimigli et al., 2018).[15]The slight rebound in MACE at 9 months (16%) suggests late events, possibly driven by stent failure, inadequate medication adherence, or progressive coronary disease.

TVR rates remained consistent (7% at 1 and 6 months, 6% at 9 months), indicating a moderate risk of restenosis or in-stent failure, possibly due to suboptimal stent expansion or neoatherosclerosis. ST incidence increased (3% → 3% → 6%), raising concerns about late thrombosis due to delayed endothelialization, poor medication compliance, or high thrombotic burden.

First-generation drug-eluting stents (DES) had higher late thrombosis rates, but the newer-generation DES used in this study still exhibited a 6% ST rate, suggesting the need for careful patient selection and post-procedural management.The EXCEL trial (Stone et al., 2016) reported lower TVR rates (4-5%) at 1 year in younger patients, indicating that elderly patients might experience higher rates of restenosis due to vascular calcification and smaller reference vessel diameters.[14]

Stroke incidence was low (1% across all time points), consistent with studies showing that PCI-related strokes are rare but more frequent in elderly patients compared to younger cohorts (Windecker et al., 2014).[16]

Non-TVR events (ischemic complications outside the treated vessel) increased from 1% at 1 month to 5% at 6 months and slightly declined to 4% at 9 months. This suggests progression of coronary artery disease in non-treated segments or subclinical atherosclerosis.

In the HORIZONS-AMI trial, stroke rates after primary PCI were 0.5-1.5% at 1 year, aligning with our findings (1%). Non-TVR complications highlight the need for aggressive secondary prevention, including lipid-lowering therapy, hypertension control, and lifestyle modifications.[17]

Zaman MJ et al.[18] found that older patients were incrementally less likely to receive secondary prevention medicines and intensive management for both ST-elevation myocardial infarction (STEMI) and non-ST elevation myocardial infarction (NSTEMI). In STEMI patients ≥85 years, 55% received reperfusion compared with 84% in those aged 18 to <65 [odds ratio 0.22 (95% CI 0.21, 0.24)]. Not receiving intensive management was associated with worse survival [mean follow-up 2.29 years (SD 1.42)] in all age groups (adjusted for sex, cardiovascular risk factors, co-morbidities, healthcare factors, and case severity), but there was an incremental reduction in survival benefit from intensive management with increasing age. In STEMI patients aged 18-64, 65-74, 75-84, and ≥85, adjusted hazard ratios (HRs) for all-cause mortality comparing conservative treatment to intensive management were 1.98 (1.78, 2.19), 1.65 (1.51, 1.80), 1.62 (1.52, 1.72), and 1.36 (1.27, 1.47), respectively. In NSTEMI patients, the respective HRs were 4.37 (4.00, 4.78), 3.76 (3.54, 3.99), 2.79 (2.67, 2.91), and 1.90 (1.77, 2.04).

LIMITATIONS OF THE STUDY

1. **Single-centreStudy:** The study was conducted at a single tertiary care centre, which may limit the generalizability of the findings.

2. **Small Sample Size:** The relatively small number of patients (n=86) may not fully represent the broader elderly population with AMI undergoing PPCI.
3. **Limited Follow-up Duration:** The study assessed outcomes up to 12 months post-procedure, and longer-term effects remain unknown.
4. **Lack of Control Group:** The absence of a comparative group (such as younger patients or medically managed elderly patients) limits direct comparative analysis.
5. **Confounding Comorbidities:** Elderly patients often have multiple comorbid conditions that can independently influence prognosis, making it challenging to isolate the impact of PPCI alone.

CONCLUSION

Authors found that due to their decreased risks of MACE and stroke, older patients receiving primary PCI for AMI should be treated as the first line of treatment for this high-risk cohort.PPCI in elderly STEMI patients significantly improves TIMI flow post-procedure (p=0.01).High early mortality (9%) highlights the need for meticulous post-procedure care.Stent thrombosis increasing at 9 months (6%) suggests a need for prolonged DAPT adherence. Overall, PPCI remains beneficial but requires close monitoring, tailored anticoagulation, and long-term follow-up.

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REFERENCES

1. Sugiura M, Hiraoka K, Ohkawa S. Severity of coronary sclerosis in the aged: A pathological study in 968 consecutive autopsy cases. Japanese Heart Journal. 1976;17(4):471-78.
2. Wilson PW, D'Agostino RB, Levy D, Belanger AM, Silbershatz H, Kannel WB. Prediction of coronary heart disease using risk factor categories. Circulation. 1998;97(18):1837-47.
3. Lee PY, Alexander KP, Hammill BG, Pasquali SK, Peterson ED. Representation of elderly persons and women in published randomised trials of acute coronary syndromes. JAMA. 2001;286(6):708-13.
4. Krumholz HM, Gross CP, Peterson ED, Barron HV, Radford MJ, Parsons LS, et al. Is there evidence of implicit exclusion criteria for elderly subjects in randomised trials? Evidence from the GUSTO-1 study. American Heart Journal. 2003;146(5):839-47.
5. Britton A, McKee M, Black N, McPherson K, Sanderson C, Bain C. Threats to applicability of randomised trials: Exclusions and selective participation. Journal of Health Services Research & Policy. 1999;4(2):112-21.
6. Singh M, Mathew V, Garratt KN, Berger PB, Grill DE, Bell MR, et al. Effect of age on the outcome of angioplasty for acute myocardial infarction among patients treated at the Mayo Clinic. The American Journal of Medicine. 2000;108(3):187-92.
7. Ryan TJ. ACC/AHA task force report: JACC. 1988;12(2):529-45.):
8. Newell MC, Henry JT, Henry TD, Duval S, Browning JA, Christiansen EC, et al. Impact of age on treatment and outcomes in ST-elevation myocardial infarction. American Heart Journal. 2011;161(4):664-72.
9. Yang X, Zhao Y, Wu H, Yan M, Wang Y, Li Y, et al. The coexistence of comorbidities at admission is an independent predictor of 30-day mortality of patients hospitalized with acute myocardial infarction: Analysis of 5523 cases in China. International Journal of Cardiology. 2012;155(3):451-52.
10. Mahadevappa M, Desai N, Kumar Ss, Kulkarni P. Primary Percutaneous Coronary Intervention in Elderly Patients with Acute Myocardial Infarction: A Single Centre Experience from Southern India. Journal of Clinical & Diagnostic Research. 2020 Apr 1;14(4).
11. Johnman C, Oldroyd KG, Mackay DF, Slack R, Pell AC, Flapan AD, et al. Percutaneous coronary intervention in the elderly: Changes in case-mix and periprocedural outcomes in 31,758 patients treated between 2000 and 2007. Circulation Cardiovascular Interventions. 2010;3(4):341-45.
12. Halkin, A., Singh, M., Nikolsky, E., et al. (2020).Outcomes of primary percutaneous coronary intervention in elderly patients with acute myocardial infarction: A systematic review and meta-analysis.Journal of the

American College of Cardiology, 75(10), 1123-1135.

13. Sanchis, J., Núñez, J., Bodí, V., et al. (2021). *Long-term survival and secondary prevention after STEMI in elderly patients undergoing primary PCI.* European Heart Journal, 42(15), 1365-1375.
14. Stone, G. W., Kappetein, A. P., Sabik, J. F., et al. (2016). *Five-year outcomes after PCI or CABG for left main coronary disease: The EXCEL trial.* The New England Journal of Medicine, 375(23), 2223-2235.
15. Valgimigli, M., Bueno, H., Byrne, R. A., et al. (2018). *ESC guidelines for dual antiplatelet therapy in coronary artery disease.* European Heart Journal, 39(3), 213-260.
16. Windecker, S., Kolh, P., Alfonso, F., et al. (2014). *2014 ESC/EACTS guidelines on myocardial revascularization.* European Heart Journal, 35(37), 2541-2619.
17. HORIZONS-AMI Trial Investigators (2010). *Impact of drug-eluting stents versus bare-metal stents in STEMI patients undergoing primary PCI.* Circulation, 121(7), 850-856.
18. Zaman MJ, Stirling S, Shepstone L, Ryding A, Flather M, Bachmann M, et al. The association between older age and receipt of care and outcomes in patients with acute coronary syndromes: A cohort study of the Myocardial Ischaemia National Audit Project (MINAP). European Heart Journal. 2014;35(23):1551-58.