

In-hospital and six-month outcomes of elderly patients undergoing primary percutaneous coronary intervention for acute ST-elevation myocardial infarction

Fereydoon Noohi⁽¹⁾, Isa Hashemi⁽²⁾, **Hamid Reza Sanati⁽¹⁾**,
Mohammad Mehdi Peighambari⁽¹⁾, Majid Kiavar⁽¹⁾, Mohsen Maadani⁽¹⁾,
Hossein Ali Bassiri⁽¹⁾, Ali Zahedmehr⁽¹⁾, Farshad Shakerian⁽¹⁾, Ata Firouzi⁽¹⁾,
Reza Kiani⁽¹⁾, Seifollah Abdi⁽¹⁾

Original Article

Abstract

BACKGROUND: Elderly patients constitute a rapidly growing proportion of the population, and hence the increasing rises in the number of patients with ST-segment-elevation myocardial infarction (STEMI). Primary percutaneous coronary intervention (PCI), which is now established as the preferred reperfusion strategy in STEMI patients, has been inadequately investigated in this high-risk group. The aim of the present study was to investigate the in-hospital and 6-month outcomes of primary PCI in elderly patients (≥ 75 years) with STEMI.

METHODS: A total of 100 elderly patients with STEMI including those with cardiogenic shock were included. Primary PCI procedures were performed in a tertiary referral center between 2009 and 2014. In-hospital and 6-month outcomes of patients were recorded and analyzed.

RESULTS: The average age of the patients was 79.6 ± 3.8 years (range = 75-90 years) and 27.0% were women. Cardiovascular risk factors and prior events were common. Nearly, half of the patients had three-vessel disease and the left anterior descending artery (LAD) was the most common infarct-related artery. The presence of cardiogenic shock but not the other variables was associated with less anatomic and procedural success ($P < 0.001$). It was also the major independent predictors of 6-month mortality in the patients aged ≥ 75 years, [hazard ratio (HR) = 8.02; 95% confidence interval (CI): 1.75-25.97, $P < 0.001$]. In-hospital mortality was 2.4% in the patients without and 83.0% in those with cardiogenic shock.

CONCLUSION: Primary PCI in aged patients could be associated with low complication rates and improved survival if performed in high-volume centers with experienced operators. Considering the very high rate of mortality in patients with cardiogenic shock, there should be measures to treat these patients before the onset of hemodynamic instability.

Keywords: Cardiogenic Shock; Elderly; Percutaneous Coronary Intervention

Date of submission: 23 May 2015, *Date of acceptance:* 30 Aug 2015

Introduction

Population growth and advanced health care have conferred an increase in life expectancy among elderly patients. It is predicted that the proportion of octogenarians will probably have tripled by the year 2050.¹ Coronary artery diseases (CADs) and its associated acute events such as ST-segment-elevation myocardial infarction (STEMI) are very frequent in the aged population and cause significant morbidity and mortality. Primary percutaneous coronary intervention (PCI) is currently the method of choice and the best reperfusion strategy for patients presenting with

STEMI in that it has reduced the rates of cardiac mortality and re-infarction over the last decades.^{2,3} Even though elderly patients constitute a major high-risk population of patients with STEMI who might benefit from more invasive therapies, they are frequently excluded from clinical trials owing to higher morbidity and mortality associated with the primary PCI.⁴ Worse outcome is influenced not only by the extensive CAD but also by more complex comorbidities.⁵ In addition, elderly patients are more likely to suffer from complications following revascularization procedures.⁶ The existing literature contains no research on the

1- Cardiovascular Intervention Research Center, Rajaie Cardiovascular Medical and Research Center, Iran University of Medical Sciences, Tehran, Iran

2- Rajaie Cardiovascular Medical and Research Center AND Department of Cardiology, Iran University of Medical Sciences, Tehran, Iran
Correspondence to: Hamid Reza Sanati, Email: sanati56@yahoo.com

outcome of primary PCI in elderly Iranian patients. We, therefore, sought to evaluate the in-hospital and mid-term outcomes of primary PCI in patients aged ≥ 75 years old, who presented with acute STEMI in a high-volume tertiary center.

Materials and Methods

A retrospective evaluation of the primary PCI database was performed between April 2009 and May 2014. The local Ethics Committee of Rajaie Cardiovascular, Medical and Research Center, Iran University of Medical Sciences, Tehran, Iran, approved the trial design.

A total of 656 primary PCI-treated patients were initially evaluated. The inclusion criteria were comprised age > 75 years and chest pain accompanied by ST-segment-elevation in at least two contiguous leads presenting within the first 12 hours after the symptom onset or after 12 hours in the case of persistent chest pain. Notably, patients with hemodynamic instability or cardiogenic shock at the time of presentation or during the hospital course were not excluded from the study. Cardiogenic shock patients were considered eligible if they presented within 36 hours after the initiation of chest pain and no more than 18 hours after the development of shock. Patients with inability to receive dual antiplatelet therapy, the presence of the left main involvement, severe CAD or mechanical complications of MI requiring surgical intervention and extreme comorbidities precluding primary PCI as a therapeutic option were excluded. Finally, a total of 100 consecutive elderly patients were selected and analyzed.

The study patients received the same routine preparation protocol for coronary angiography and primary PCI, including 325 mg of the loading dose of aspirin and 300-600 mg of the loading dose of clopidogrel before the procedure. Primary PCI procedures were performed via routine standards by an experienced team. The intention to treat was for culprit lesions, and multivessel PCI was performed in cardiogenic shock patients who were unresponsive to the culprit PCI. The in-hospital and 6-month clinical outcomes of the patients were recorded using the hospital data registry, patients' files, and telephone calls. Anatomical success was defined as the attainment of a residual diameter stenosis $< 20\%$ and normal epicardial flow based on thrombolysis in myocardial infarction grading (TIMI-3 flow). Procedural success was considered as anatomical success without the occurrence of major complications (i.e. death, MI, or urgent

revascularization) during the hospital course.

Statistical analysis was performed using SPSS software (version 16, SPSS Inc., Chicago, IL, USA). The results are presented as means \pm standard deviation (SD) for the continuous variables and as percentages for the categorical data. The chi-square test was used to compare the numerical variables. 6-month cumulative survival rates were assessed with the Kaplan-Meier curve. Cox regression model was implemented to determine the independent predictors of 6-month cumulative mortality and clinical success. A $P < 0.050$ was considered a significant.

Results

About 100 primary PCI patients over the age of 75 were included. The average age of the patients was 79.6 ± 3.8 years (range = 75-90 years) and 27% were women. The baseline clinical characteristics of the study patients are summarized in table 1. Hypertension was the most common risk factor (53%), and 74% of the cases had, at least, one of the four known risk factors for atherosclerosis. 18% of the patients presented with or developed cardiogenic shock on admission or during the hospital course. Previous cardiovascular events and interventions were also fairly common. The procedural angiographic and interventional characteristics of the patients are depicted in table 2.

Table 1. Baseline characteristics of the patients

| 100 patients | Prevalence |
|----------------------------|------------------|
| Age (year) (mean \pm SD) | 79.60 \pm 3.86 |
| Sex (%) | |
| Male | 73 |
| Female | 27 |
| Risk factors (%) | |
| Smoking | 18 |
| Hypertension | 53 |
| Dyslipidemia | 30 |
| Diabetes | 37 |
| Past medical history (%) | |
| MI | 31 |
| PCI | 13 |
| CABG | 4 |
| CVA | 6 |
| CKD | 8 |
| Cardiogenic shock (%) | 18 |

MI: Myocardial infarction; PCI: Percutaneous coronary intervention; CABG: Coronary artery bypass grafting; CVA: Cerebrovascular accident; CKD: Chronic kidney disease; SD: Standard deviation

Table 2. Angiographic and procedural data

| Variables | Prevalence (%) |
|---------------------------|----------------|
| Disease extension | |
| Single-vessel disease | 25 |
| Two-vessel disease | 28 |
| Three-vessel disease | 47 |
| Infarct-related artery | |
| LAD | 50 |
| RCA | 33 |
| LCX | 14 |
| Venous graft | 3 |
| Post-procedural TIMI flow | |
| III | 73 |
| II | 17 |
| 0-I | 10 |

LAD: Left anterior descending artery; RCA: Right coronary artery; LCX: Left circumflex artery; TIMI flow: Thrombolysis in myocardial infarction

The involvement of more than one coronary vessel was common, and 47% of the cases were diagnosed to have three-vessel disease. The left anterior descending artery (LAD) was the most common infarct-related artery, followed by the right coronary artery (RCA) (50 and 33%, respectively). Anatomical success was achieved in 73% of the patients. The no-reflow phenomenon (TIMI-0 and TIMI-1) occurred in 10% of the study population and the slow flow (TIMI-2) in 17%. Age, presence of risk factors and baseline morbidities were not associated with the occurrence of the no-reflow/slow flow phenomenon. This was also the case for the extension of the vessel involvement and the culprit artery (Table 3). However, there was a meaningful association between the anatomical success rate and the presence of cardiogenic shock ($P < 0.001$). Cardiogenic shock was also the sole parameter significantly associated with less procedural success. Neither the number of the diseased vessels nor a specific culprit artery had a significant influence on the procedural success rates. The mean duration of hospital stay was 6.3 ± 3.0 days in those discharged alive (range = 2-17 days).

The rate of in-hospital mortality was 17%: 2 (2.4%) cases in the patients without cardiogenic shock and 15 (83%) cases in those with cardiogenic shock. The presence of cardiogenic shock was significantly associated with the occurrence of death during hospitalization ($P < 0.001$). The probability of being free from the occurrence of death was investigated via Kaplan-Meier method which presented in figure 1. The in-hospital and 6-month adverse events are shown in table 4. In a multiple cox regression model, cardiogenic shock [hazard ratio (HR): 8.02, 95% confidence interval (CI): 1.75-

25.97; $P < 0.001$], anatomical success rate (HR: 6.7, 95% CI: 1.16-22.7; $P < 0.001$), and post-procedural stroke (HR: 3.01, 95% CI: 1.01-7.6; $P = 0.026$) were identified as the independent predictors of mortality during the follow-up.

Discussion

Elderly people are the most rapidly growing proportion of the world population, and acute MI is the leading cause of cardiac death in this group. Despite the extensive implementation of mechanical reperfusion therapy, it may be difficult to choose the best reperfusion strategy for elderly patients, who are more likely to have additional comorbidities and risk factors. Although most studies have shown the relative superiority of primary PCI over the other reperfusion strategies or no reperfusion, there are several important factors which limit the widespread use of the former in elderly patients. Elderly patients with acute MI are less often treated with reperfusion therapy than younger patients.⁷ These patients frequently present late after the initiation of MI because of atypical symptoms, impaired pain perception, and delays relating to the family members and health care system. It is also worth bearing in mind that even if primary PCI is performed, it is associated with high rates of early and late complications and limited survival.⁸

Meanwhile, it has been shown that reperfusion therapy, compared with conservative therapies, has significantly reduced 30-day and 1-year mortality rates in elderly acute MI patients.⁹⁻¹² Another reason that renders arriving at a final conclusion complex is that elderly patients with acute MI are frequently excluded from randomized clinical trials.¹³ By comparison with similar studies, ours showed a large proportion of male patients treated with primary PCI. The difference may be due to ethnic differences and the exclusion of the aged and perhaps more disable women from invasive strategy. The elderly patients in the present study had multiple risk factors and advanced CAD; however, primary PCI was associated with an acceptable anatomical and procedural success rates. In addition, the in-hospital mortality rate was considerably low and comparable with that of the younger patients. In those who survived the hospital course, 6-month follow-up also showed improved survival and an event-free course, underscoring once again the importance of the timely application of primary PCI in this high-risk group.

Table 3. Anatomical and procedural success rates

| Variable | Anatomical success rate (%) | P | Procedural success rate (%) | P |
|-----------------------|-----------------------------|---------|-----------------------------|---------|
| Sex | | 0.880 | | 0.780 |
| Male | 72.6 | | 56.2 | |
| Female | 74.1 | | 59.3 | |
| Diabetes | | 0.990 | | 0.380 |
| Yes | 73.0 | | 51.4 | |
| No | 73.0 | | 60.3 | |
| Hypertension | | 0.880 | | 0.190 |
| Yes | 73.6 | | 50.9 | |
| No | 72.3 | | 63.8 | |
| Hyperlipidemia | | 0.590 | | 0.690 |
| Yes | 76.7 | | 60.0 | |
| No | 71.4 | | 55.7 | |
| Smoking | | 0.270 | | 0.890 |
| Yes | 83.3 | | 55.6 | |
| No | 70.7 | | 57.3 | |
| Prior CABG | | 0.920 | | 0.770 |
| Yes | 75.0 | | 50.0 | |
| No | 72.9 | | 57.3 | |
| Prior PCI | | 0.310 | | 0.120 |
| Yes | 84.6 | | 76.9 | |
| No | 71.3 | | 54.0 | |
| Prior MI | | 0.750 | | 0.770 |
| Yes | 71.0 | | 54.8 | |
| No | 73.9 | | 58.0 | |
| Prior CVA | | 0.550 | | 0.720 |
| Yes | 83.3 | | 50.0 | |
| No | 72.3 | | 57.4 | |
| CKD | | 0.330 | | 0.240 |
| Yes | 87.5 | | 37.5 | |
| No | 71.7 | | 58.7 | |
| Disease extension | | 0.950 | | 0.760 |
| Single-vessel disease | 72.0 | | 60.0 | |
| Two-vessel disease | 71.4 | | 60.6 | |
| Three-vessel disease | 74.5 | | 53.2 | |
| Culprit artery | | 0.500 | | 0.610 |
| LAD | 68.0 | | 52.0 | |
| RCA | 78.8 | | 57.6 | |
| LCX | 71.4 | | 71.4 | |
| Venous graft | 100 | | 66.7 | |
| Cardiogenic shock | | < 0.001 | | < 0.001 |
| Yes | 27.8 | | 11.1 | |
| No | 82.9 | | 67.1 | |

All the associations were assessed via Pearson's chi-square test. $P < 0.050$ considered as statistically significant.

CABG: Coronary artery bypass grafting; PCI: Percutaneous coronary intervention; MI: Myocardial infarction; CVA: Cerebrovascular accident; CKD: Chronic kidney disease; LAD: Left anterior descending artery; RCA: Right coronary artery; LCX: Left circumflex artery

The SHOCK trial (SHould we emergently revascularize Occluded Coronaries in cardiogenic shock) found no benefit with revascularization in patients over 75 years of age complicated by cardiogenic shock; nevertheless, several large observational studies have shown the advantages of early revascularization in the elderly with cardiogenic shock.¹⁴⁻¹⁷ There are also studies revealing extremely high mortality rates in patients aged > 75 years with cardiogenic shock even with the early interventional approach. In the Zeymer et al.¹⁸ registry, 63% of the patients older than 75

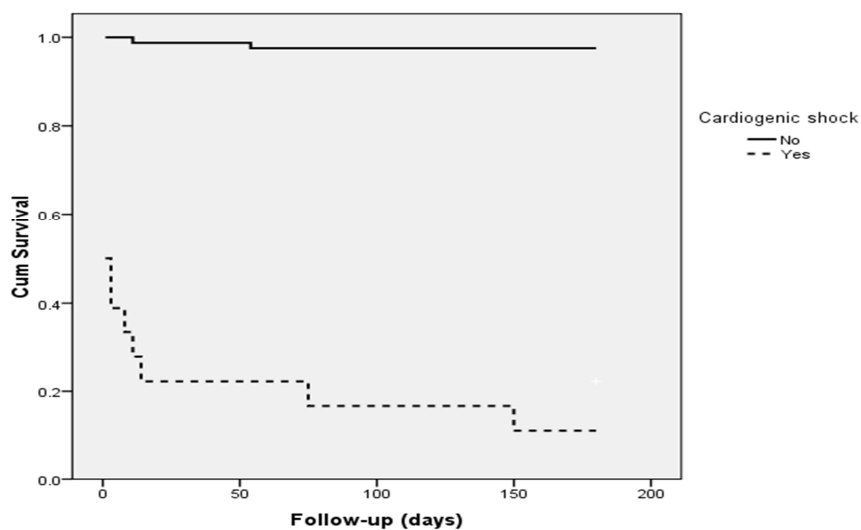
years died. In our study, the cardiogenic shock was the most powerful independent risk factor for poor anatomical and procedural success and finally death following primary PCI. The high mortality rate in our elderly patients with cardiogenic shock might have additional reasons. Our hospital is a tertiary center and, as such, the majority of its patients are referred from other hospitals quite late after the initiation of chest pain or just after the occurrence of cardiogenic shock. In addition, apart from the intra-aortic balloon pump, no other supportive circulatory device was used in our patients.

Table 4. Short- and long-term adverse events

| Variables | Without shock (n = 82) | With shock (n = 18) | P |
|--------------------------|------------------------|---------------------|-----------|
| Hospital stay (days) | 6.6 | 17.3 | 0.001* |
| Major bleeding [n (%)] | | | |
| In-hospital | 2 (2.4) | 0 (0) | 0.500 |
| 6-month | 0 (0) | 0 (0) | - |
| CVA [n (%)] | | | |
| In-hospital | 0 (0) | 1 (5.6) | 0.480** |
| 6-month | 2 (2.5) | 0 (0) | 0.510** |
| MI [n (%)] | | | |
| In-hospital | 2 (2.4) | 6 (33) | 0.100** |
| 6-month | 0 (0) | 2 (67) | 0.430** |
| Stent thrombosis [n (%)] | | | |
| In-hospital | 2 (2.4) | 0 (0) | 0.500** |
| 6-month | 0 (0) | 0 (0) | - |
| Mortality [n (%)] | | | |
| In-hospital | 2 (2.4) | 15 (83) | < 0.001** |
| 6-month | 0 (0) | 1 (33) | 0.330** |

CVA: Cerebrovascular accident; MI: Myocardial infarction

*Student's t-test, **Pearson's chi-square test

**Figure 1.** Kaplan-Meier estimate of cumulative in-hospital and 6-month survival rates

Limitations

First and foremost among the limitations of the present study is that it is not sufficiently powered because of the small number of the participants. Another shortcoming is that the results of this single referral Centre study may have been influenced by patient selection biases. Our treated patients probably had a high-risk profile compared with the real world presentation of patients with acute MI.

Conclusion

It is widely accepted that primary PCI in the elderly is more challenging, and future prospective studies in the elderly with STEMI are needed to evaluate the effectiveness and safety of primary PCI in this patient population.¹⁹ Our study showed that primary PCI in aged patients could be associated with low complication rates and improved survival if performed in high-volume centers with experienced operators. Given the very high rate of

mortality in patients with cardiogenic shock, there should be measures to treat these patients before the onset of hemodynamic instability.

Acknowledgments

The authors wish to thank Mr. Farshad Amouzadeh for editorial assistance.

Conflict of Interests

Authors have no conflict of interests.

References

- Centers for Disease Control and Prevention (CDC). Public health and aging: trends in aging - united states and worldwide. *MMWR Morb Mortal Wkly Rep* 2003; 52(6): 101-6.
- van de Werf F, Ardissino D, Betriu A, Cokkinos DV, Falk E, Fox KA, et al. Management of acute myocardial infarction in patients presenting with ST-segment elevation. *European Heart Journal* 2003; 24(1): 28-66.
- Alexander KP, Newby LK, Armstrong PW, Cannon CP, Gibler WB, Rich MW, et al. Acute coronary care in the elderly, part II: ST-segment-elevation myocardial infarction: a scientific statement for healthcare professionals from the American Heart Association Council on Clinical Cardiology: in collaboration with the Society of Geriatric Cardiology. *Circulation* 2007; 115(19): 2570-89.
- O'Gara PT, Kushner FG, Ascheim DD, Casey DE, Chung MK, de Lemos JA, et al. 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: executive summary: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation* 2013; 127(4): 529-55.
- Gurwitz JH, Col NF, Avorn J. The exclusion of the elderly and women from clinical trials in acute myocardial infarction. *JAMA* 1992; 268(11): 1417-22.
- Guagliumi G, Stone GW, Cox DA, Stuckey T, Tchong JE, Turco M, et al. Outcome in elderly patients undergoing primary coronary intervention for acute myocardial infarction. *Circulation* 2004; 110: 1596-604.
- Barron HV, Bowlby LJ, Breen T, Rogers WJ, Canto JG, Zhang Y, et al. Use of reperfusion therapy for acute myocardial infarction in the United States: data from the National Registry of Myocardial Infarction 2. *Circulation* 1998; 97(12): 1150-6.
- de Gregorio J, Kobayashi Y, Albiero R, Reimers B, di Mario C, Finci L, et al. Coronary artery stenting in the elderly: short-term outcome and long-term angiographic and clinical follow-up. *J Am Coll Cardiol* 1998; 32(3): 577-83.
- Zhang Q, Zhang RY, Zhang JS, Hu J, Yang ZK, Zheng AF, et al. Outcomes of primary percutaneous coronary intervention for acute ST-elevation myocardial infarction in patients aged over 75 years. *Chin Med J (Engl)* 2006; 119(14): 1151-6.
- Sakai K, Nakagawa Y, Soga Y, Ando K, Yokoi H, Iwabuchi M, et al. Comparison of 30-day outcomes in patients <75 years of age versus ≥75 years of age with acute myocardial infarction treated by primary coronary angioplasty. *Am J Cardiol* 2006; 98(8): 1018-21.
- Ciszewski A, Karcz M, Kepka C, Bekta P, Ksiezycka E, Przulski J, et al. Primary angioplasty in patients ≥ 75 years old with ST-elevation myocardial infarction - one-year follow-up results. *Kardiol Pol* 2008; 66(8): 828-33.
- Zheng X, Li JJ, Yuan JQ, Qin XW, Zhu CG, Guo YL, et al. Coronary intervention in patients ≥75 years old with ST-elevation myocardial infarction: in-hospital and 6-month clinical outcomes. *Chin Med J (Engl)* 2010; 123(16): 2171-5.
- Gottlieb S, Goldbourt U, Boyko V, Barbash G, Mandelzweig L, Reicher-Reiss H, et al. Improved outcome of elderly patients (> or = 75 years of age) with acute myocardial infarction from 1981-1983 to 1992-1994 in Israel. The SPRINT and Thrombolytic Survey Groups. Secondary Prevention Reinfarction Israel Nifedipine Trial. *Circulation* 1997; 95(2): 342-50.
- Hochman JS, Sleeper LA, Webb JG, Dzavik V, Buller CE, Aylward P, et al. Early revascularization and long-term survival in cardiogenic shock complicating acute myocardial infarction. *JAMA* 2006; 295(21): 2511-5.
- Lim HS, Farouque O, Andrianopoulos N, Yan BP, Lim CC, Brennan AL, et al. Survival of elderly patients undergoing percutaneous coronary intervention for acute myocardial infarction complicated by cardiogenic shock. *JACC Cardiovasc Interv* 2009; 2(2): 146-52.
- Dzavik V, Sleeper LA, Cocke TP, Moscucci M, Saucedo J, Hosat S, et al. Early revascularization is associated with improved survival in elderly patients with acute myocardial infarction complicated by cardiogenic shock: a report from the SHOCK Trial Registry. *Eur Heart J* 2003; 24(9): 828-37.
- Migliorini A, Moschi G, Valenti R, Parodi G, Dovellini EV, Carrabba N, et al. Routine percutaneous coronary intervention in elderly patients with cardiogenic shock complicating acute myocardial infarction. *Am Heart J* 2006; 152(5): 903-8.
- Zeymer U, Vogt A, Zahn R, Weber MA, Tebbe U, Gottwik M, et al. Predictors of in-hospital mortality

in 1333 patients with acute myocardial infarction complicated by cardiogenic shock treated with primary percutaneous coronary intervention (PCI); Results of the primary PCI registry of the Arbeitsgemeinschaft Leitende Kardiologische Krankenhausärzte (ALKK). Eur Heart J 2004; 25(4): 322-8.

19. Gao L, Hu X, Liu YQ, Xue Q, Feng QZ. Percutaneous coronary intervention in the elderly with ST-segment elevation myocardial infarction.

Clin Interv Aging 2014; 9: 1241-6.

How to cite this article: Noohi F, Hashemi I, Sanati HR, Peighambari MM, Kiavar M, Maadani M, et al. **In-hospital and six-month outcomes of elderly patients undergoing primary percutaneous coronary intervention for acute ST-elevation myocardial infarction.** ARYA Atheroscler 2016; 12(1): 28-34.