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Original Article

Percutaneous coronary intervention in elderly patients: clinical benefits and challenges from single center experience

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Abstract: Objectives: Elderly patients who present with acute myocardial infarction are at increased risk for adverse outcomes owing to higher comorbidity burden and complicated coronary anatomy. We evaluated the three-year outcomes following coronary revascularization compared to conservative management among elderly patients presenting with acute myocardial infarction. Methods: 155 patients over 75 years of age who were admitted for acute myocardial infarction underwent invasive treatment with coronary angioplasty (n=58) or only medical treatment (n=97). The Kaplan-Meier log rank test was used to compare 3-year survival and rehospitalization probability and the Mantel-Cox log rank test was used to compare mean survival time between groups. Results: In the Invasive treatment group (ITG) cohort, 3-year survival probability was 74.1% as compared to 29.9% in the Conservative treatment group (CTG) cohort (P<0.001). Mean survival time at 3 years of follow-up was 31.50 (95% CI 29.35-33.65) months among ITG patients versus 24.65 (95% CI 22.71-26.59) months among CTG patients (P<0.001). Mean time to rehospitalization at 3 years was 34.05 (95% CI 32.37-35.72) in the ITG cohort compared to 30.03 (95% CI 28.13-31.93) in the CTG cohort (P=0.004). Conclusion: Coronary revascularization among elderly patients with acute myocardial infarction reduces both all-cause mortality and cardiovascular events at 3-year follow-up. However, rates of rehospitalizations remain statistically similar between groups. Moreover, invasive treatment imparted improved rehospitalization probability compared to conservative treatment. This observation can be partially explained by a reduction in the frequency of myocardial infarction among those who underwent invasive treatment. While a thorough clinical assessment is required prior to treatment determination among elderly patients with acute myocardial infarction, coronary revascularization should be strongly considered as an intervention that likely improves overall survival probability.

Keywords: Elderly patients, acute myocardial infarction, coronary angioplasty, pharmacologic treatment, comorbid diseases, mortality, rehospitalization

Introduction

In contemporary cardiological practice, the number of elderly individuals treated with percutaneous coronary intervention (PCI) is increasing [1-3]. Elderly patients typically carry multiple cardiovascular risk factors and a greater burden of ischemic disease, warranting PCI more frequently than younger patients. Accordingly, older patients likely derive greater benefit from revascularization [4-8]. However, increasing age poses a higher risk for periprocedural complications secondary to age-related physiological changes, frailty, and comorbidities [9-11].

Common comorbid conditions among the elderly population including cancer, peptic ulcer disease, gastritis, chronic obstructive pulmonary disease, diabetes mellitus, chronic kidney disease, and congestive heart failure are considered independent risk factors for coronary

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angiography and may provoke periprocedural complications [12-16]. Moreover, data obtained from several investigations have shown that age ≥75 years is a negative predictor of undergoing PCI [17]. Thus, the clinical decision on whether to proceed with invasive therapy continues to be controversial and requires an individualized approach in contemporary practice [1, 17-19].

The aim

The aim of this study was to compare the invasive and conservative strategies in elderly patients admitted with acute Myocardial infarction (MI) and to analyze the overall survival and rehospitalization rates by Kaplan-Meier analysis.

Materials and methods

Study design

We retrospectively investigated 155 patients ≥75 years old admitted with acute MI to the Department of General and Invasive Cardiology at the University Hospital of Yerevan State Medical University between 2014 and 2018. Patients had either received invasive or conservative management. The definition of acute myocardial infarction was adhered to the standards of the European Society of Cardiology for definition of myocardial infarction and acute coronary syndrome (ACS) [20]. The treating physician made the final diagnosis ST-elevation myocardial infarction (STEMI) in case of presence of ST-elevation on electrocardiogram or new left bundle - branch block on in addition to suspicious ongoing ischemia [21]. Troponin elevation was reported in all patients. Non-ST-elevation myocardial infarction (NSTEMI) was defined as an acute hospital admission characterized by chest pain associated with typical ischemic changes on electrocardiogram and a significant rise in cardiac troponin relative to specific parameters of the assay used. Patients with NSTEMI underwent invasive therapy within 72 hours of presentation.

The standard treatment for STEMI and NSTEMI was provided in accordance with the guidelines of the European Society of Cardiology with diagnostic coronary angiography followed by coronary angioplasty when appropriate. In all patients second generation drug-eluting stents were used for PCI.

The decision to provide only optimal medical therapy, but not coronary angioplasty was made by enrolling cardiologist and Heart Team, taking into consideration comorbidities severity, frailty, reduced life expectancy, impaired cognition and possible greater susceptibility to mainly antithrombotic drugs and procedure-related complications. Medical treatment was comparable in both groups except of antithrombotic pre- and postprocedural treatment. Renal function was calculated with Cockcroft-Gault formula and presented as estimated glomerular filtration rate. Patient demographics and treatment data were obtained from chart review. Patient follow-up was performed through communication via telephone. The study protocol was approved by the Ethic Committee of the Yerevan State Medical University.

Study endpoints

The primary endpoint was the assessment of all-cause mortality after 3 years of follow up. Cardiac death was defined as death due to myocardial infarction, stroke or sudden cardiac death.

Secondary endpoints included rehospitalization, necessity for unplanned coronary revascularization, and major bleeding complications. We evaluated major bleeding assessment according to Bleeding Academic Research Consortium (BARC) definition [22]. Kaplan-Meier curves were used for rehospitalizations cardiac death/need for coronary revascularization.

Statistical analysis

Categorical variables are presented as number (percent) and continuous variables are presented as mean ± standard deviation. Mean survival times are displayed with standard error and 95% confidence intervals. Statistical significance was determined using χ^2 criterion for categorical variables or for variables following a non-normal distribution, and the Student's t-criterion for continuous variables. We used χ^2

Table 1. Baseline characteristics of patients in two groups

Groups	ITG n=58	CTG n=97
Average Age (mean, SD)	79±3.8	80±4.1
Sex (n, %)		
Male	22 (37.9%)	48 (49.5%)
Female	36 (62%)	49 (50.5%)
Comorbidity (n, %)		
CKD (GFR<60)	20 (34%)	31 (32%)
HFrEF	32 (55.2%)	58 (59.8%)
Diabetes mellitus	12 (20.7%)	25 (25.8%)
Hypertension	50 (86.2%)	87 (89.7%)
Anemia (HGB<100 g/l)	11(19%)	11 (11.3%)
Smokers	6 (10.3%)	9 (9.3%)
STEMI	29 (50%)	24 (24.74%)
Non-STEMI	29 (50%)	54 (55.67%)
Acute HF	21 (36.2%)	31 (32%)
In hospital bleeding	6 (10.3%)	3 (3.1%)
Multivessel disease	46 (79.3%)	71 (73.2%)
Treatment (n, %)		
Aspirin	56 (96.6%)	90 (92.8%)
Clopidogrel	57 (98.3%)	71 (73.2%)
ACE-I	39 (67.2%)	60 (61.9%)
Beta blocker	47 (81%)	78 (80%)
Unfractionated Heparin/LMH	54 (93.1%)	87 (89.7%)
Spironolactone	35 (60.3%)	59 (60.8%)

ITG: Invasive treatment group; CTG: Conservative treatment group; SD: Standard deviation; CKD: Chronic kidney disease; GFR: Glomerular filtration rate; HFrEF: Heart failure with reduced ejection fraction; HGB: Hemoglobin; STEMI: ST-elevation myocardial infarction; Non-STEMI: non-ST-elevation myocardial infarction; HF: Herat failure; ACE-I: Angiotensin-converting enzyme (ACE) inhibitors; LMH: Low molecular Heparin.

criterion with Yates correction in cases when the frequency of the parameter was lower than the limit of the criterion. Overall survival and rehospitalization probability were assessed using the Kaplan-Meier method and mean survival time was assessed using the Mantel Cox method. A two-tailed *p*-value ≤0.05 was considered significant. All statistical analyses were performed using a package of applied programs by SPSS statistics.

Results

Baseline patient characteristics are displayed in **Table 1**.

Of the 155 patients over 75 years of age who were admitted for acute MI between 2014-2018, 58 (22 male and 36 female) underwent invasive treatment with coronary angioplasty and 97 (48 male and 49 female) underwent treatment with conservative management. The average age of patients in the Invasive treatment group (ITG) was 79±3.8 and in the Conservative treatment group (CTG) was 80±4.1. Across both groups, 53 (34.2%) had STEMI and 102 (65.8%) had non-STEMI. As shown in **Table 1**, cardiovascular risk profiles and comorbidities were comparable in both groups. The most frequent comorbidity was arterial hypertension, followed by Chronic kidney disease (CKD) and diabetes mellitus. Heart failure with reduced ejection fraction (HFrEF) was common in elderly patients with acute MI (55.2% in ITG and 58.8% in CTG) as it was expected (Supplementary Material).

Survival probability at 3 years was 74.1% in the ITG compared to 29.9% in the CTG (P<0.001). Of the 26% patients that died in the ITG, 60% were due to MI, and of the 70% patients that died in the CTG, 54% were due to MI (**Figure 1**). Analysis of the primary outcomes revealed survival benefit in interventional approach over conservative strategy.

The mean survival time was 31 months (95% CI 29.35-33.65) in the ITG and 24.6 (95% CI 22.71-26.59) months in the CTG (P<0.001) (**Table 2**).

Rehospitalization probability at 3 years was 51.7% in the ITG compared to 33.2% in the CTG (P<0.01). Of the 41% of patients that were rehospitalized in the ITG, 42% were due to MI and of the 44% of that were rehospitalized in the CTG, 49% were due to MI. Stent thrombosis was reported in 1.7% of cases (**Figure 2**).

There was a mild difference in time to hospitalization between two groups. Mean time to rehospitalization across the entire study population was 31.67 months (95% CI 30.32-33.21). Mean time to rehospitalization in the ITG was 34.05 (95% CI 32.34-35.72) compared to 30.03 (95% CI 28.13-31.93) in the CTG (P=0.004) (**Table 3**).

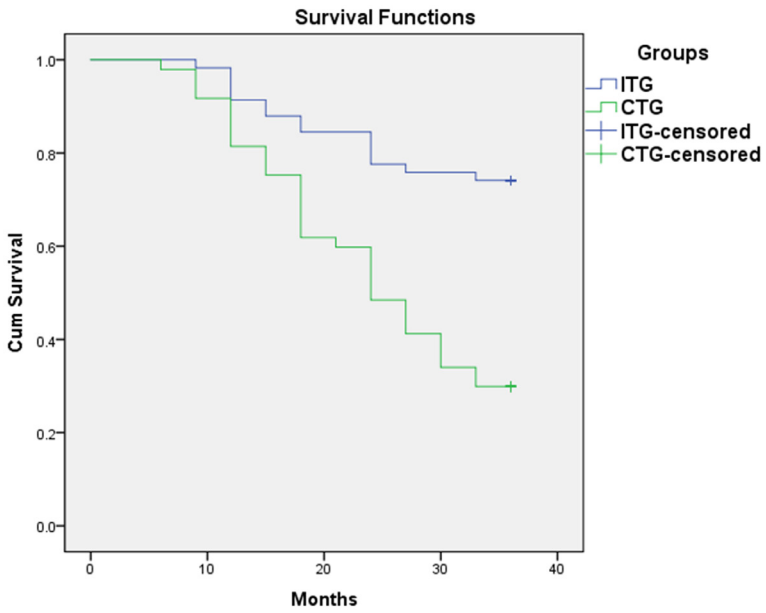

Figure 1. Kaplan-Meyer curves for estimated survival from all-cause death stratified based on the interventon performed and age at the time of myocardial infarction.

Table 2. Means and medians for survival time

Mean[a]				
Groups	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
ITG	31.500	1.098	29.348	33.652
CTG	24.649	.988	22.713	26.586
Overall	27.213	.789	25.667	28.759

[a]Estimation is limited to the largest survival time if it is censored.

Discussion

In this single-center retrospective cohort analysis of 155 patients, we sought to determine the effect of an early invasive treatment approach on mortality and rehospitalization in elderly patients over 75 years of age presenting with acute MI. We demonstrate that invasive treatment with coronary angioplasty is associated with improved survival probability when compared to conservative treatment in this study population. Kaplan-Meyer survival function for rehospitalizations was statistically similar in both groups. Moreover, invasive treatment imparted improved rehospitalization probability compared to conservative treatment. This observation can be partially explained by a reduction in the frequency of MI among those who underwent invasive treatment. However, comporbidities, long term double antiplatelet treatment may contribute to somewhat increased rehospitalizations in ITG and its similar probability with CTG.

The management of acute MI in the elderly population presents several challenges. Notably, older patients carry more comorbidities than, which likely contribute to a higher risk of death in the setting of an acute MI as well as periprocedurally following coronary revascularization [23-28]. Moreover, a higher prevalence of frailty in the elderly population likely further worsens the poor prognosis following acute MI and revascularization in older patients. Indeed, a general trend has been observed wherein an invasive treatment approach with either angioplasty or stenting becomes more frequently delayed or withheld with increasing age [26-28]. Current recommendations from the US emphasize the need to individualize patient treatment, taking into account both the patient's clinical status a long with their comorbidity burden [14, 29-31]. It should be highlighted that there is a paucity of randomized-controlled clinical trial data investigating invasive intervention in a robust population of elderly patients presenting with acute MI, further complicating the clinician's approach to weighing the evidence-based benefits and risks associated with coronary revascularization and increasing age [32-34].

The improved survival probability associated with coronary angioplasty observed in our study population occurred in the setting of statistically similar age and comorbidity burden between cohorts. Several studies have shown that coronary revascularization during acute MI may be associated with increased mortality

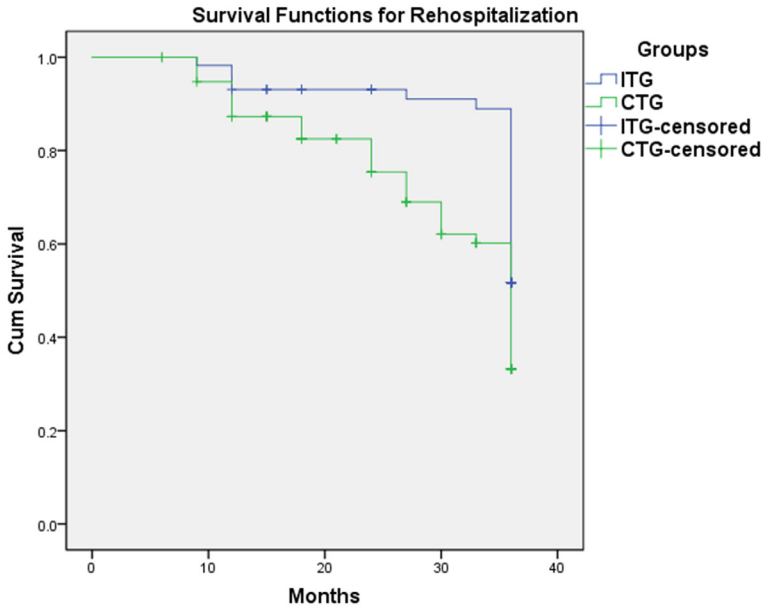

Figure 2. Kaplan-Meier curves for estimated rehospitalizations based on the interventon performed and age at the time of myocardial infarction.

Table 3. Means for survival time in two groups for the rehospitalization

Mean[a]				
Groups	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
ITG	34.045	.856	32.366	35.723
CTG	30.029	.970	28.128	31.929
Overall	31.672	.691	30.317	33.027

[a]Estimation is limited to the largest survival time if it is censored.

in the elderly population [35-37]. Reassuringly, our findings demonstrate that the mortality benefit imparted by improving coronary blood flow likely outweighs the risk of periprocedural complications and death imposed by coronary angioplasty among those with increasing age and number of comorbidities.

It should be mentioned that an invasive treatment approach in older patients with acute MI is associated with an increase in both minor and major bleeding events, possible contributors to mortality at long term follow-up [9, 14, 38, 39]. However, recently, the frequency of bleeding events have decreased, likely because of more selective approaches to antithrombotic treatment following angioplasty [2, 13, 40]. For example, international guidelines recommend the use of glycoprotein IIb/IIIa only for bailout and emergency coronary interventions. More recently, the ACC/AHA/ERS statement on antithrombotic therapy for patients with permanent Atrial fibrillation (AF) and acute MI with subsequent angioplasty recommended short-term triple antithrombotic therapy followed by dual antiplatelet therapy, revised compared to previous recommendations [41]. Accordingly, the implementation of these new recommendations may have contributed to a reduction in periprocedural bleeding complications. We found a significantly higher prevalence of CKD with GFR less than 60 ml/min in both groups. The reasons are most probably multiple and high prevalence of comorbidities with overlapping pathophysiologic mechanisms. There was also high prevalence of HFrEF in elderly patients. Other studies also showed that Heart failure was more frequent in elderly patients compared to younger [4, 34].

The findings of present study can be summarized as follows: a) elderly patients with acute MI treated by invasive strategy showed moderate survival benefit although the risk of mortality remains high in both groups after 3 years of follow up; b) comorbidities such as arterial hypertension, CKD and diabetes mellitus have very high prevalence among elderly patients with acute MI.

Limitations

This is a single center, retrospective study, investigating a relatively small sample size. As with any retrospective analysis, there is a potential for unmeasured confounders. Randomized controlled trials addressing MI outcomes in the elderly population are needed in the future. However, we believe that data received from our study have clinical impor-

tance in setting the treatment approach for such patient population. Moreover, the data from the current study are from over 6 years ago and may not reflect changes in contemporary practice in recent years.

Conclusions

Routine invasive intervention is associated with improved survival and decreased cardiovascular events in elderly patients with acute MI at three-year follow-up. The results of the study support the use of an interventional approach in elderly patients with acute MI. A comprehensive assessment on the clinical status of the patient at presentation can further inform the decision on the path of treatment.

Disclosure of conflict of interest

None.

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