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Original Research

Clinical characteristics and outcomes in acute myocardial infarction patients aged ≥65 years in Western Romania

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Older age is known as a negative prognostic parameter in patients with acute myocardial infarction (AMI). In this study, we aimed to investigate age-related differences in treatment protocols, in-hospital and 1-year mortality. This retrospective observational single-center study enrolled consecutive AMI patients with an urgent percutaneous coronary intervention (PCI) as the main method of myocardial revascularization. The patients divided were divided by age into group I (≥65 years) and group II (<65 years). The primary endpoint was in-hospital mortality, the secondary endpoints were 1-year mortality and rehospitalization rates. Of the 522 admitted with AMI, 476 were enrolled in the study. The mean age was 67 ± 13 years; 62% were men. Group I patients had a significantly lower rate of performed PCI (65% vs. 79%, $P < 0.001$). 53 patients (12.3%) died during hospitalization, and this proportion was notably higher in the older population (20% vs. 6%, $P < 0.0001$). The cardiac causes of death were more frequent in group I patients (12% vs. 5.6%, $P = 0.016$). The multivariate logistic regression selected two variables as independent predictors for the risk of in-hospital death: age ≥65 years ($P = 0.0170$), and Killip class at admission ($P < 0.0001$). The 1-year mortality was 3.3%, slightly higher in group I patients (4.8% vs. 1.5%, $P = 0.05$). In conclusion, patients aged ≥65 years have three times higher in-hospital mortality, but similar 1-year mortality and readmission rates when compared with the younger patients. It is obvious that there is a large potential for improvement of the AMI care in this age group of patients.

Keywords

Acute myocardial infarction; PCI; Age ≥65 years; Prognosis

1. Introduction

Subjects aged ≥65 years are a fast-increasing component of the population and represent a quickly increasing amount of patients admitted with acute myocardial infarction (AMI), either with ST-elevation (STEMI) or without ST-elevation (NSTEMI). Advanced age is a robust predictor of poor outcomes. The majority of AMI trials in Romania have included a small number of elderly patients, and this explains why incomplete data are presented on the management and prognosis of this increasing subgroup of AMI patients.

Standard therapies are not always applied in the elderly, as the evidence of benefit is deficient and the danger of complications is high for this age group [1–3]. These facts can be also explained by some specific clinical characteristics of the elderly at presentation: the symptoms of the ACS may be atypical, the electrocardiographic signs are often less specific and the comorbidities may lead to a confounding clinical picture. All these may lead to diagnostic incertitude and postponed or conservative therapeutic strategies [1].

This situation can be found in Romania too, though aggravated by the small number of catheterization laboratories that are able to perform urgent coronary revascularization (23, for a population of 20 million inhabitants). Our retrospective study is the first one done in Romania addressing AMI patients aged ≥65 years. In-hospital and 1-year mortality, as well as 1-year readmission rate, were evaluated in the elderly and compared with those found in the AMI patients aged <65 years.

2. Material and methods

2.1 Subject selection

This is a retrospective cohort study. Between 1 January and 31 December of 2020, 524 patients with AMI were admitted to the Cardiology Clinic of the Timisoara Institute of Cardiovascular Diseases within the first 12 hours of the onset of the symptoms. In the absence of contraindications, urgent percutaneous coronary intervention (PCI) was done.

The initial evaluation was grounded on the analysis of low and/or high-probability features resulting from symptoms and signs at presentation, 12-lead ECG, and cardiac troponin [4, 5]. The diagnosis of STEMI was grounded on the existence of at minimum 2 of these 3 parameters: (1) typical angina lasting for more than 20 minutes; (2) ST-segment elevation ≥1 mV, lasting for >0.08 sec after the J point, in minimum 2 contiguous leads; (3) temporary increase in cardiac enzymes to at least twofold the upper normal laboratory range [4]. NSTEMI was defined when ST-segment depression or deep T-wave inversion were observed on the ECG, without ST-segment elevation, and/or the biomarkers

of myocardial necrosis were increased (e.g., troponin I $\geq$1 μg/L in our laboratory), in an adequate clinical background (chest pain or angina correspondent) [5].

The PCI was performed and the associated pharmacological treatment was administered according to the European Society of Cardiology (ESC) guidelines [4, 5]. All patients were given a loading dose of 300–600 mg clopidogrel. They habitually received before PCI 5000 IU unfractionated heparin and 300–500 mg aspirin. Glycoprotein IIb/IIIa inhibitors were administered when the operator considered it necessary. If a coronary stent was implanted, clopidogrel was prescribed for 12 months, associated with aspirin.

The inclusion criteria were a confirmed diagnosis of AMI in patients hospitalized within the first 12 hours of the symptoms onset and the absence of exclusion criteria.

Exclusion criteria were: PCI-related or CABG-related AMI, the presence of diseases worsening the long-term prognosis such as severe primary cardiomyopathy, severe valvular diseases or congenital heart diseases, kidney dysfunction, liver cirrhosis, a malignant tumor, and severe infection.

2.2 Ethics

The study was advised by the Ethics Commission of the Victor Babes" University of Medicine and Pharmacy. All patients provided written informed consent for participation in the study, in accordance with the Human Rights Declaration of Helsinki.

2.3 Data extraction

Baseline data were taken from hospital records and comprised gender, age, Killip functional class on admission, medical history, 12 leads resting electrocardiogram, laboratory data, echocardiographic data, and the results of the coronary angiography.

Medical history integrated information about smoking status, obesity, diabetes, old myocardial infarction, history of stroke, hypertension, peripheral artery disease, chronic obstructive pulmonary disease, chronic kidney disease. The cardiac biomarkers determined at admission were: MB fraction of creatine kinase (CK) and cardiac troponin levels. Further laboratory records were: blood cell count, serum hemoglobin, serum glucose, serum creatinine, estimated glomerular filtration, serum electrolytes, and lipogram.

Medical treatment reports were accomplished at discharge and at the 1-year follow-up.

The cause of death was determined from hospital records, or by a phone conversation with the patient's physician for those who died at home.

All causes of readmissions were noted during the 1-year follow-up period. The causes of readmissions were determined by utilizing the hospital records.

2.4 Endpoints

The primary endpoint was in-hospital mortality, stated as the death of any cause in the course of the hospitalization for AMI. As cardiac deaths were regarded as those due to AMI, heart failure, cardiogenic shock, acute pulmonary edema, cardiac rupture, or ventricular fibrillation. Noncardiac deaths were stated as deaths having an extra-cardiac cause, e.g., stroke, sepsis, acute renal failure.

The secondary endpoints were mortality and readmission rates throughout the 1-year follow-up phase. 1-year mortality included all-cause (cardiac and non-cardiac) deaths. 1-year readmissions included as causes recurrent myocardial infarction (MI), stent thrombosis, stroke, and bleeding. Recurrent MI was defined using the Academic Research Consortium criteria [6]. Bleeding complications were stated using the Bleeding Academic Research Consortium and the Thrombolysis In Myocardial Infarction bleeding classifications [7, 8]. Stroke was diagnosed in the presence of an irreversible neurological deficit, as stated by a neurologist, and based on supporting evidence, such as brain images.

2.5 Definition of covariates

Important coronary stenosis was stated when a reduction in the internal diameter of at least 75% in the anterior descending, circumferential or right coronary artery and at least 50% in the left main coronary trunk was seen. Multivessel coronary artery disease was stated when important stenosis in several coronary arteries was documented [4, 5].

PCI-related AMI (type 4) was defined as an AMI occurring $\leq$48 hours after the index procedure, associated with an increase of cardiac troponin values $>$5 times 99th percentile upper range level (URL) [9].

CABG-related AMI (type 5) was defined as an AMI occurring $\leq$48 hours after the index procedure associated with an elevation of cardiac troponin levels values $>$10 times 99th percentile U.R.L [9].

A patient was stated to be hypertensive when his blood pressure was $\geq$140/90 mmHg during hospitalization, when previously diagnosed with hypertension, or when taking antihypertensive medication [10]. Valvulopathies were diagnosed by history, physical examination, and echocardiography [11]. The diagnosis of peripheral artery disease diagnosis was grounded on history, physical examination, ankle-brachial index, and Duplex ultrasound [12]. Hypercholesterolemia was stated by history, the current use of lipid-lowering agents, or laboratory determinations (total cholesterol $\geq$6.22 mmol/L or low-density lipoprotein cholesterol $\geq$4.14 mmol/L [13]. Chronic kidney disease was diagnosed when the estimated glomerular filtration rate was below 60 mL/min/1.73 m^2 [14]. Obesity was defined when the body mass index exceeded 30 kg/m^2 [15]. Diabetes mellitus was diagnosed when glycated hemoglobin was $\geq$6.5%, fasting plasma glucose level $\geq$7.0 mmol/L (126 mg/dL), or when plasma glucose was $\geq$11 mmol/L (200 mg/dL) at two hours after 75 g oral glucose load [15]. Chronic obstructive pulmonary disease diagnosis was based on GOLD criteria [16].

Echocardiographic examination was performed during the first 24 hours of hospital admission, using a VIVID S5 ultrasonograph device. LVEF was calculated using the Simpson method. The E/A ratio was determined by means of the antegrade mitral flow [17].

Table 1. Baseline characteristics of the AMI patients.

	Group I	Group II	*P* value
	Age ≥65 years	Age <65 years	
	n = 264	n = 212	
Mean age, years (X ± 1 SD)	75.9 ± 7.2	53.5 ± 8	**<0.0001**
Male sex (n, %)	135 (51%)	159 (75%)	**<0.0001**
Smokers (n, %)	91 (34%)	121 (57%)	**<0.0001**
Obesity (n, %)	66 (25%)	53 (25%)	1
Diabetes mellitus (n, %)	77 (29%)	53 (25%)	0.33
Hypercholesterolemia (n, %)	185 (70%)	153 (72%)	0.63
COPD (n, %)	79 (30%)	53 (25%)	0.22
Chronic kindey disease (n, %)	50 (19%)	23 (11%)	**0.01**
Systemic hypertension (n, %)	224 (85%)	161 (76%)	**0.01**
Peripheral artery disease (n, %)	20 (7.4%)	8 (4%)	0.11
History of stroke (n, %)	55 (21%)	28 (13%)	**0.02**
Old myocardial infarction (n, %)	32 (12%)	19 (9%)	0.29
Previous PCI (n, %)	21 (8%)	11 (5%)	0.18
Previous CABG (n, %)	5 (2%)	2 (0.8%)	0.27
Known congestive heart failure	63 (24%)	27 (12.5%)	**<0.002**
STEMI (n, %)	230 (87%)	201 (95%)	**0.003**
NSTEMI (n, %)	34 (13%)	11 (5%)	**0.003**
Killip class at admission	2.4 ± 1	2.1 ± 0.9	**0.0007**
Heart rate at admission (X ± 1 SD)	80.5 ± 19.9	80.2 ± 18	0.86
Systolic BP at admission (X ± 1 SD)	128 ± 27	131 ± 26	0.35
Diastolic BP at admission (X ± 1 SD)	73.5 ± 17.1	77.6 ± 17.1	0.05
Atrial Fibrillation at admission (n, %)	62 (23.3%)	23 (11%)	**0.0005**
- acute (n, %)	32 (12.3%)	14 (6.6%)	**0.03**
- persistent (n, %)	30 (11%)	9 (4.4%)	**0.008**
Recenl LBBB at admission (n, %)	11 (4%)	4 (1.7%)	0.14
AV block at admission (n, %)	26 (10%)	4 (1.7%)	0.0002
- 2nd degree (n, %)	5 (2%)	2 (0.09%)	0.05
- 3rd degree (n, %)	21 (8%)	12 (0.09%)	<0.0001
Ventricular fibrillation at admission (n, %)	24 (9%)	14 (6.6%)	0.56
LVEF at admission <40% (n, %)	153 (58%)	87 (41%)	**0.0002**
E/A ratio at admission <1 (n, %)	182 (69%)	119 (56%)	**0.003**
Scr (μmol/L, mean ± SD)	103.75 ± 81.18	75.79 ± 33.93	**<0.0001**
BNP (pg/mL, mean ± SD)	881.69 ± 248.13	834.79 ± 259.99	**0.04**
CK-MB μg/L, (mean ± SD)	50.01 ± 18.94	51.34 ± 13.36	0.38
Tpn-I (μg/L, mean ± SD)	14.98 ± 2.17	14.69 ± 2.37	0.165

Note: Statistically significant values are shown in bold ($P < 0.05$).

Abbreviations: AMI, acute myocardial infarction; STEMI, acute myocardial infarction woth persistent ST-segment elevation; NSTEMI, acute myocardial infarction without ST-segment elevation; BP, blood pressure; LBBB, left ventricular blood pressure; AV, atrio-ventricular; PCI, Percutaneous coronary intervention; CABG, Coronary artery bypass grafting; LVEF, Left ventricular ejection fraction; E/A—the ratio of peak velocity blood flow in early diastole to peak velocity flow in late diastole; Scr, Serum creatinine; BNP, Brain natriuretic peptide; CK-MB, Creatine kinase-MB; Tpn-I, Troponin-I; LWWH, Low molecular weight heparin; ACEI, Angiotensin-converting enzyme inhibitor; ARB, Angiotensin receptor blocker; CCB, Calcium antagonists.

We used the classification the Killip classification of heart failure severity in AMI patients [18].

2.6 Statistical analysis

Data were collected and analyzed using the MedCalc Statistical Software version 19.1.7 (MedCalc Software Ltd, Ostend, Belgium) for Windows. Data are given as mean ± SD for continuous variables, and as frequencies and percentages for categorical variables. The comparisons between two groups of continuous data were analyzed using *t*-tests, while the comparisons of categorical data were studied using Chi-square tests. To evaluate the participation of each parameter in the evaluated outcomes, univariate and multivariate logistic regression models were used. Cox regression analysis was performed to calculate hazard ratios (HRs)

and 95% confidence intervals (CIs). All basal parameters that could be associated with hospital readmission at univariate analysis were included in multivariate logistic regression analysis with the forward stepwise method. The discriminative capacity of the analyzed parameters was assessed by means of the receiver operating characteristic (ROC) curves. The threshold for statistical significance was established at a *P*-value of <0.05. All *P*-values were results of two-tailed tests.

3. Results

3.1 Baseline characteristics

Of the 522 admitted with ACS, 476 were registered in the research. The mean age was 67.38 ± 13.4 years (32–95 years). 294 (61.7%) were men. According to the age at admission, AMI patients were separated into group I (≥65 years, n = 264) and group II (<65 years, n = 212). The demographics, cardiovascular history, and risk factors of the two patient groups are shown in Table 1. Compared to group II, the group I patients were more often women ($P < 0.0001$), less often current smokers ($P < 0.0001$), with a history of systemic hypertension ($P = 0.01$), diabetes ($P = 0.041$), stroke ($P = 0.02$), congestive heart failure ($P < 0.002$), and chronic kidney disease ($P = 0.01$). The values of serum creatinine and brain natriuretic peptide were higher in group I patients ($P < 0.0001$, respectively $P = 0.04$). The elderly patients presented more often NSTEMI ($P = 0.003$), a higher functional class Killip ($P < 0.001$), atrial fibrillation ($P < 0.001$), 3rd atrioventricular block ($P < 0.0001$), left ventricular ejection fraction <40% ($P = 0.0002$), and left ventricular diastolic dysfunction ($P = 0.003$).

3.2 Angiographic data and therapeutical interventions

Table 2 presents the data of emergency coronagraphy. No angiography could be done in 5 (1.9%) of group I patients and 2 (0.09%) patients of group II ($P = 0.66$), because of severe kidney failure. Group II patients had a significantly higher proportion of monovascular coronary disease ($P = 0.0001$), a significantly lower proportion of triple vessel disease ($P = 0.03$), and had a significantly higher rate of interventional revascularization by PCI (79% vs. 65%, ($P = 0.0008$). The rate of coronary artery bypass graft was 2.6% in group II and 2% in group I ($P = 0.66$). Regarding the concomitant medication, diuretics were more often administered in group I patients ($P = 0.02$).

3.3 Total mortality

The total all-cause mortality rate, including in-hospital and 1-year mortality, was 14.3% (n = 67). The number of deaths was 50 (18.9%) for group I and 17 (8%) for group II, $P = 0.0004$.

3.4 In-hospital mortality

During the hospitalization for AMI, 53 patients (12.3%) died, 39 being from group I (20%), and 14 from group II (6%), $P < 0.0001$. The cardiac causes of death (n = 44, 9.2%) were more frequent in group I patients (n = 32, 12%), $P = 0.016$, while the noncardiac causes had similar frequencies in the two groups (see Table 3, Fig. 1).

Table 2. Angiographic data and therapeutical interventions.

	Group I	Group II	*P* value
	Age ≥65 years	Age <65 years	
	n = 264	n = 212	
No angiography performed	5 (1.9%)	2 (0.09%)	0.05
Angiographic findings			
- Single vessel disease	100 (38%)	119 (56%)	**0.0001**
- Dual vessel disease	55 (21%)	36 (17%)	0.27
- Triple vessel disease	66 (25%)	36 (17%)	**0.03**
- Left main disease	40 (15%)	21 (10%)	0.10
Interventional revascularization:	177 (67%)	174 (82%)	**0.0002**
- PCI	172 (65%)	168 (79%)	**0.0008**
- CABG	5 (2%)	6 (2.6%)	0.66
Concomitant drug therapy			
- Clopidogrel	254 (96.3)	209 (98.7%)	0.10
- Aspirin	256 (97.2%)	210 (99.2%)	0.11
- LMWH	2145 (92.9%)	203 (95.9%)	0.16
- Betablockers			
- Statin	200 (76.1%)	72 (81.3%)	0.17
- ACEI/BRA	251 (95.2%)	206 (97.2%)	0.26
- CCB	190 (72.2%)	156 (73.8%)	0.69
- Diuretics	93 (35.3%)	65 (30.5%)	0.27
	94 (35.5%)	54 (25.6%)	**0.02**

Note: Statistically significant values are shown in bold ($P < 0.05$).

Abbreviations: AMI, acute myocardial infarction; STEMI, acute myocardial infarction woth persistent ST-segment elevation; NSTEMI, acute myocardial infarction without ST-segment elevation; BP, blood pressure; LBBB, left ventricular blood pressure; AV, atrio-ventricular; PCI, Percutaneous coronary intervention; CABG, Coronary artery bypass grafting; LVEF, Left ventricular ejection fraction; E/A—the ratio of peak velocity blood flow in early diastole to peak velocity flow in late diastole; Scr, Serum creatinine; BNP, Brain natriuretic peptide; CK-MB, Creatine kinase-MB; Tpn-I, Troponin-I; LWWH, Low molecular weight heparin; ACEI, Angiotensin-converting enzyme inhibitor; ARB, Angiotensin receptor blocker; CCB, Calcium antagonists.

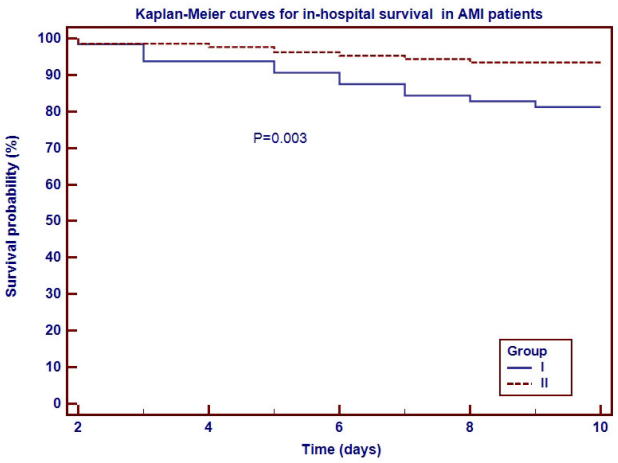

Fig. 1. Kaplan-Meier curves for in-hospital mortality.

Table 3. Comparison regarding mortality rates and death causes of AMI patients.

	Group I	Group II	*P* value
	Age ≥65 years	Age <65 years	
	n = 264	n = 212	
Total mortality n = 67 (14.3%)	50 (18.9%)	17 (8%)	**0.0004**
In hospital mortality n = 53 (12.3%)	39 (20%)	14 (6%)	**<0.0001**
Cardiac causes n = 44 (9.2%)	32 (12%)	12 (5.6%)	**0.016**
- Ventricular fibrillation	14 (5%)	5 (2.3%)	0.12
- Electromechanical dissociation	5 (1.8%)	2 (0.9%)	0.40
- Cardiogenic shock	10 (3.7%)	3 (1.4%)	0.12
- Acute pulmonary edema	3 (1.1%)	2 (0.9%)	0.82
Noncardiac causes n = 9 (1.8%)	7 (2.6%)	2 (0.9%)	0.17
- Acute renal failure	3 (1.1%)	1 (0.9%)	0.83
- Bleeding	2 (0.7%)	1 (0.9%)	0.80
- Stroke	1 (0.3%)	-	
- Sepsis	1 (0.3%)	-	
Discharged patients n = 423	Group I	Group II	*P* value
	Age ≥65 years	Age <65 years	
	n = 225	n = 198	
Medication at discharge			
Clopidogrel	180 (80%)	168 (85%)	0.17
Aspirin	193 (86%)	167 (84%)	0.56
Betablockers	143 (64%)	144 (73%)	**0.04**
Statin	182 (81%)	170 (86%)	0.16
ACEI/BRA	161 (72%)	154 (78%)	0.15
Oral anticoagulants	62 (26%)	23 (12%)	**0.0003**
CCB	90 (40%)	61 (31%)	0.05
Diuretics	80 (35%)	52 (26%)	**0.045**
1-year mortality n = 14 (3.3%) Causes:	11 (4.8%)	3 (1.5%)	0.05
Recurrent myocardial infarction	3 (1.3%)	2 (1%)	0.77
Congestive heart failure	5 (2.2%)	1 (0.5%)	0.13
Stroke	2 (0.9%)	-	
Bleeding	1 (0.4%)	-	

Note: Statistically significant values are shown in bold ($P < 0.05$).

Abbreviations: ACEI, Angiotensinconverting enzyme inhibitor; ARB, Angiotensin receptor blocker; CCB, Calcium antagonists.

The relative risk for in-hospital death for Group I patients was 2.5 (95% CI 1.12–5.77), $P = 0.001$, and 0.39 for Group II patients (95% CI 0.17–0.88).

The multivariate logistic regression selected two parameters as independent predictors for in-hospital death. These parameters were age ≥65 years ($P = 0.017$, 95% CI 0.512–0.626) and Killip functional class ($P < 0.0001$, 95% CI 0.738–0.835). When comparing the ROC curves for these parameters, the Killip class was a more powerful predictor (AUC = 0.786) than age ≥65 years (AUC = 0.569), $P < 0.0001$ (Fig. 2).

3.5 1-year mortality

423 AMI patients were discharged alive (88.8%). Group I patients received at discharge more often oral anticoagulants ($P = 0.0003$) and diuretics ($P = 0.045$). and less often betablockers ($P = 0.04$).

During the 1-year follow-up phase, further 14 patients died. The 1-year mortality was 3.3%, slightly higher in group I patients (4.8% vs. 1.5%, $P = 0.05$), with no notable differences among the causes of death (Table 3).

3.6 1-year readmissions

Throughout the 1-year follow-up phase, 22 patients (5.2%) were rehospitalized. The readmission rate was lower in group I patients, but the difference was not notable ($P = 0.24$). The causes of readmissions had similar frequencies in the two groups (Table 4).

4. Discussion

In Romania, cardiovascular diseases are responsible for 63% of all deaths, while in Europe the proportion is 37%. AMI represents the main cause of death in patients with coronary artery disease. In our country, about 13,000 people experience an AMI every year, and the AMI-related death rates

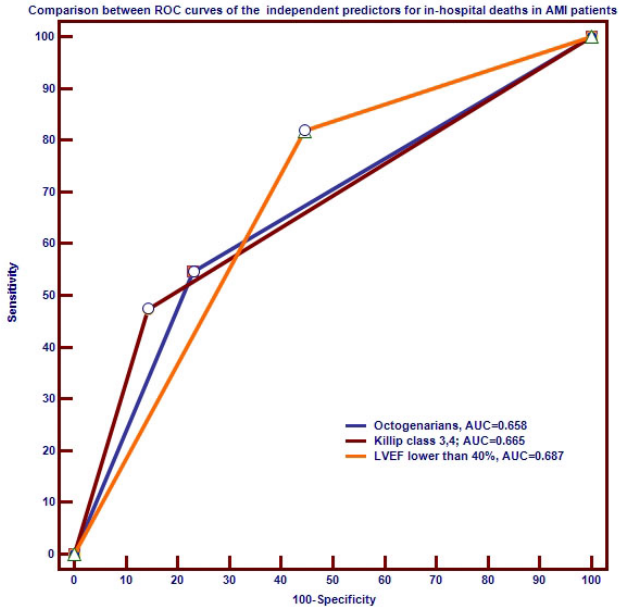

Fig. 2. Comparison of receiver operating characteristic (ROC) curves of independent variables predictive for in-hospital all-cause death risk.

Table 4. Comparison regarding 1-year readmissions of AMI patients.

	Group I	Group II	*P* value
	Age ≥65 years	Age <65 years	
	n = 225	n = 198	
1-year readmissions			
n = 22 (5.2%)	9 (4%)	13 (6.5%)	0.24
Causes:			
Recurrent myocardial infarction	2 (0.9%)	3 (1.5%)	0.56
Congestive heart failure	3 (1.3%)	2 (1%)	0.77
3rd Atrio-Ventricular block	2 (0.9%)	3 (1.5%)	0.56
Stroke	1 (0.4%)	2 (1%)	0.45
Bleeding	1 (0.4%)	3 (1.5%)	0.23

Note: Statistically significant values are shown in bold ($P < 0.05$).

reach disturbing levels. The death risk is greatest during the first 2 hours from the onset of the symptoms. According to the data published by the Romanian Registry for ST-Elevation Myocardial Infarction (RO-STEMI), 52% of deaths take place before the patient reaches the hospital. The death rate drops considerably after admission, reaching 19% on the first day and 8% on the second day of hospitalization. About 21% of deaths occur later on, up to 1 month after the AMI [19].

During the last decades the incidence of AMI, as well as its mortality, has decreased essentially in developed countries [20, 21]. This favorable tendency reflects a change for the better in many parameters that affect the prognosis in patients with AMI. Advanced age, as a parameter we cannot influence, has a negative prognostic impact value in most studies [22]. One of the most potent variables that improve outcomes in AMI patients is the myocardial revascularization by urgent PCI [23]. We applied the standard WHO definition of elderly patients [24].

Our study is the first one performed in Romania addressing AMI patients aged ≥65 years.

All patients were treated at an academic tertiary hospital, able to provide 24/7 catheterizations and to ensure the urgent coronary revascularization interventions for the western region of Romania. All reperfusion procedures were done only by PCI, in a group of successive, unselected AMI patients, with or without ST-segment elevation. The main findings of the present observational cohort study were as follows: patients with AMI ≥65 years treated with urgent PCI showed a worse in-hospital prognosis than those aged <65 years. The in-hospital mortality was 20% in patients aged ≥65 years, versus 6% in patients aged <65 years, $P < 0.0001$. This fact could be justified by the greater rate of comorbidities, the higher Killip class, the higher prevalence of arrhythmias and old congestive heart failure in the elderly. Angiographic data also showed more frequent triple vessel disease in the elderly.

Despite the added, recognized risk factors and the poorer expected outcome in the elderly AMI patients, we found that the rate of diagnostic coronary angiography of was notably lower in this high-risk group (67% vs. 82%, $P < 0.001$). Also, interventional revascularization by primary PCI was done less frequently in the patients aged ≥65 years ($P < 0.001$). CABG was performed in about 2% of all AMI patients, regardless of the age group. On the subject of the concomitant medication, only the diuretics were more often prescribed in the elderly, as they presented more often heart failure.

At discharge, the elderly patients received more often diuretics and oral anticoagulants, and less often beta-blockers. Among the discharged patients, mortality during the 1-year follow-up period was marginally higher in the elderly ($P = 0.05$). The readmission rates were similar ($P = 0.25$) in the two patient groups After discharge, the survivors were followed up for 1 year.

An assessment in relationship with other previously published data in Romania is difficult due to the notably lower catheterization and revascularization rates in the elderly AMI patients, in our country. Mehta *et al.* [25] evaluated in-hospital mortality in STEMI patients (age ≥70 y) and described lower mortality rates compared to our findings (14.4% in PCI-treated patients). Ishihara *et al.* [26] reported the prognosis of a large group of AMI patients. The investigators enrolled only patients that underwent catheterization in the first 24 hours from admission. The in-hospital death rate was two-fold greater in the elderly (≥70 years. Another independent predictor of in-hospital mortality in AMI patients was Killip class at admission ($P < 0.0001$, 95% CI 0.738–0.835).

In our study, the 1-year mortality was 4.8% in the AMI patients ≥65 years, and the 1-year readmission rate was 4%. Both the 1-year mortality and the 1-year readmission rate were not significantly higher when compared to the <65

years AMI patients. Similar findings were reported by Nicolau *et al.* [27] in the ≥70 years population and by Hafiz [28] in the ≥75 years population.

5. Limitations

The current study was observational, non-randomized, conducted in a single center, with no control group. Nonetheless, the research included unselected, successive AMI patients. AMI admitted to a center with readily available catheterization laboratories to perform urgent coronary revascularization, which provides urgent coronary revascularization for the western region of Romania.

Although the angiographic findings were not evaluated by an independent laboratory or in a blinded mode, although, they were assessed by qualified physicians with great experience in interventional cardiology.

6. Conclusions

AMI patients aged ≥65 years develop more severe myocardial injuries and have more complex coronary artery lesions. When compared with the younger group, these patients have higher in-hospital mortality. Age ≥65 years and Killip class at admission were independent predictors of in-hospital mortality. With a three times higher in-hospital mortality, it is obvious that there is a large potential for improvement of the AMI care in this age-group patients.1-year readmissions and mortality in the patients discharged after AMI was not significantly different in the two patient groups.

Author contributions

FC and DAB contributed to the conception and design of the study, collected data, wrote and revised the manuscript; MCT and IMC analysed the data and supervised the manuscript.

Ethics approval and consent to participate

The study was advised by the Ethics Commission of the Victor Babes" University of Medicine and Pharmacy (Ethics approval number: 020). All patients provided written informed consent for participation in the study, in accordance with the Human Rights Declaration of Helsinki.

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Conflict of interest

The authors declare no conflict of interest.

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