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# Predictors and outcomes of new-onset atrial fibrillation in patients with acute myocardial infarction

## Prediktori i ishod novonastale atrijumske fibrilacije kod bolesnika sa akutnim infarktom miokarda

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**Abstract**

**Background/Aim.** The onset of atrial fibrillation (AF) in the acute phase of myocardial infarction (MI) may be a predictor of poor prognosis. The aim of our study was to examine this relationship. **Methods.** Six hundred patients were enrolled in the study and divided into two groups. The first group included 48 patients with new-onset AF and the second group of 552 patients without this arrhythmia. Patients with previously registered AF were excluded from the study. We investigated the correlation between new-onset AF and intra-hospital mortality as well as mortality during the follow-up period of 48 months. We also analyzed predictors of this arrhythmia. **Results.** New-onset AF was registered in 48 (8%) patients. The independent predictors of this arrhythmia were older age, particularly more than 70 years [odds ratio 2.37; 95% confidence interval (CI) 1.23–4.58) and increased body mass index (odds ratio 1.17; 95% CI 1.04–1.33). Patients with new-onset AF had a higher mortality during the hospital course than patients without AF, but this difference was not statistically significant (10.4% *vs* 5.6%, $p$ = 0.179). Patients with this arrhythmia had also a higher mortality after follow-up period of 48 months than patients without AF (33.3 % *vs* 17.8%, $p$ = 0.009). Major adverse cardiac and cardiovascular events (MACCE) defined as death, recurrent MI, revascularization, and stroke were more after registered in patients with new-onset AF than in those with no this arrhythmia after follow-up period of 48 months (52.1% *vs* 33.9%, $p$ = 0.011). However, multivariate Cox's regression analysis demonstrated that new-onset AF was not an independent predictor of mortality during the follow-up period of 48 months (HR 0.68; 95% CI 0.38–1.20; $p$ = 0.182). **Conclusion.** New-onset AF in patients with MI was associated with a higher mortality as well as MACCE after the follow-up period of 48 months but was not an independent predictor of mortality during this period.

**Key words:**
**myocardial infarction; atrial fibrillation; risk factors; aged; obesity; prognosis; mortality; sensitivity and specificity.**

**Apstrakt**

**Uvod/Cilj.** Pojava atrijalne fibrilacije (AF) u akutnoj fazi infarkta miokarda (MI) može biti prediktor loše prognoze. Cilj naše studije bio je da ispitamo ovu povezanost. **Metode.** Ukupno, 600 bolesnika je uključeno u istraživanje i podijeljeno u dve grupe. Prva grupa je obuhvatila bolesnike sa novonastalom AF, dok je druga grupa obuhvatila bolesnika bez ove aritmije. Bolesnici sa ranije registrovanom AF isključeni bili su iz istraživanja. Ispitivana je korelacija između novonastale AF i intrahospitalnog odnosno mortaliteta u toku perioda praćenja od 48 mjeseci. Takođe, analizirani su prediktori novonastale AF. **Rezultati.** Novonastala AF registrovana je kod 48 (8%) bolesnika. Nezavisni prediktor novonastale AF bilo je životno doba, naročito preko 70 godina [*odds ratio* 2,37; confidence interval (CI) 1,23–4,58), a potom i povišeni indeks telesne mase (*odds ratio* 1,17; 95% CI 1,04–1,33). Bolesnici sa novonastalom AF imali su povišeni intrahospitalni mortalitet u odnosu na one bez tog poremećaja srčanog ritma, ali ova razlika nije bila statistički značajna (10,4% *vs* 5,6%; $p$ = 0,179. Bolesnici sa novonastalom AF imali su povišeni mortalitet nakon perioda praćenja od 48 meseci (33,3 % *vs* 17,8%; $p$ = 0,009). Veliki neželjeni kardiovaskularni događaji (*major adverse cardiac and cardiovascular events* – MACCE) koji obuhvataju smrt, ponovni MI, odnosno revaskularizaciju i šlog, bili su češće prisutni kod bolesnika sa novonastalom AF (52,1% *vs* 33,9%; $p$ = 0,011) tokom perioda praćenja od 48 meseci. Međutim, u multivarijantnom Cox regresionom modelu novonastala AF nije identifikovana kao nezavisni prediktor mortaliteta tokom perioda praćenja od 48 meseci (HR 0.68; 95% CI 0.38–1.20; $p$ = 0.182). **Zaključak.** Novonastala AF kod bolesnika sa MI bila je povezana sa povišenim mortalitetom odnosno MACCE tokom perioda praćenja od 48 meseci, ali nije bila nezavisni prediktor mortaliteta tokom ovog perioda.

**Ključne reči:**
**infarkt miokarda; fibrilacija pretkomora; faktori rizika; stare osobe; gojaznost; prognoza; mortalitet; osetljivost i specifičnost.**

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## Introduction

New-onset atrial fibrillation (AF) frequently complicates acute phase of myocardial infarction (MI) with the incidence of 6–21% [1, 2].

The large epidemiological studies demonstrated that new-onset AF is associated with high mortality and adverse events in patients with MI [1–7]. However, the outcome of this association is still unclear. Thromboembolic complications are one of the known mechanisms [1–7]. Patients with new-onset AF are older as well as with higher rate of hypertension (HTA) and heart failure (HF) which may contribute to worse outcome [1–7]. AF may precipitate the occurrence of severe ventricular arrhythmias which may lead to sudden death in these patients [8]. A large number of research have been done in patients with ST elevation myocardial infarction (STEMI), but some studies have also included patients with non-ST elevation myocardial infarction (NSTEMI) [3, 7, 9]. However, there are a small number of studies that examined association between new-onset AF and clinical outcomes among patients with both STEMI and NSTEMI [2].

Furthermore, some studies showed a higher mortality in patients with new-onset AF, but this arrhythmia was not an independent predictor of mortality [10–12]. This was the reason why we performed this research.

Its aim was to assess the impact of new-onset AF on mortality during the hospital period as well as mortality after a follow-up of 48 months in patients with MI, both STEMI, and NSTEMI, as well as predictors of new-onset AF.

## Methods

This prospective study enrolled 600 patients with both STEMI and NSTEMI admitted to the Coronary Care Unit (CCU) of the Department of Cardiology, Clinical Center of Montenegro, between January 2009 to December 2010, after the approval by the local Ethics Committee.

Inclusion criteria involved patients aged 18 or older with MI both STEMI and NSTEMI, and in sinus rhythm on admission. Patients were divided into two groups: the first group which included patients with new-onset AF, i.e. developed during the hospital period, and the second group which included patients without AF registered previously as well as during the hospital period.

Permanent AF on admission or AF registered before, age < 18 years, congenital cardiac disease, severe valvular disease and healed endocarditis were exclusion criteria. Diagnosis of acute MI was determined according to the European Society of Cardiology Clinical Practical Guidelines for STEMI and NSTEMI [13, 14].

The irregular rhythm on electrocardiography (ECG) with the lack of discernible P waves and duration more than 30 seconds not presented at hospital admission defined AF. All patients were continuously monitored by ECG during the whole period in the CCU. In patients with palpitations after the CCU period, permanent ECG monitoring was performed to confirm or exclude AF.

Echocardiography also was performed but with a delay of least 5 days of admission due to minimizing the impact of myocardial stunning [15–17]. Simpson's method was used to assess left ventricular ejection fraction (LV-EF). Mitral regurgitation (MR) was estimated as mild when the jet area was under than 20%, moderate in patients in whom the jet area was between 20–40% and severe with the jet area more than 40% of the left atrial (LA) area [18]. LA diameter was determined by parasternal long axis view using a systolic frame in M-mode imaging.

Thrombolytic therapy was applied or primary percutaneous coronary intervention (PCI) was performed within 24 hours of the onset of symptoms in patients with STEMI as well as other therapy such as aspirin, heparin, angiotensin converting enzyme (ACE) inhibitors, ß-blockade, and statins which was also performed in NSTEMI patients.

Patients were followed-up 48 months after being discharged from the hospital. The assessment was made 1 month after discharge and thereafter every 6 months until the study was completed.

Follow-up data were obtained for 99% of patients.

### *Statistical analysis*

Continuous variables were presented as either means (± SD) or median values and categorical variables as numbers or percentages. Unpaired *t*-test was used for comparing continuous variables, and $\chi^2$ and Fisher's and Mann-Whitney's test for categorical variables of baseline characteristics. The relationship between patient's variables and new-onset AF was determined by univariate and multivariate logistic analysis. The crude cumulative incidence of mortality according to the AF status was illustrated by Kaplan-Meier plot and survival rate was assessed by Log Rank test. The prognostic effect of new-onset AF on mortality during the follow-up period of 48 months was examined using Cox's proportional hazards models. *P* value < 0.05 was considered as significant. Statistical analysis was performed using IBM SPSS Statistics 22 (SPSS Inc., Chicago, IL, USA).

## Results

A total of 600 patients with MI were enrolled in this study. AF was registered in 48 (8%) patients during the hospital course. The baseline characteristics of patients in regards to the presence or absence of new-onset AF are listed in Table 1.

During the hospital course, 212 (73.1%) patients with STEMI as well as 140 (45.2%) patients with NSTEMI underwent PCI ($p < 0.001$).

### *Predictors of new-onset atrial fibrillation during the hospital course*

The strongest predictors of new-onset AF during the hospital course were older patients, particularly more than 70 years, and with increased body mass index (BMI) (Table 2). The other parameters such as heart rate above more than 80 bpm on admission and Killip class after adjustment by logistic analysis were not independent.

**Table 1**

**Baseline characteristics in regards to the presence or absence of new-onset atrial fibrillation (AF)**

| Characteristics | AF group n = 48 | No AF group n = 552 | *p* |
|---|---|---|---|
| Age (years), $\bar{x} \pm SD$ | 69.9 ± 9.4 | 63.1 ± 11.4 | < 0.001 |
| Gender, n (%) | | | |
| male | 32 (66.7) | 393 (71.2) | 0.508 |
| female | 16 (33.3) | 159 (28.8) | |
| MI, n (%) | | | |
| STEMI | 26 (54.2) | 264 (47.8) | 0.399 |
| NSTEMI | 22 (45.8) | 288 (52.2) | |
| Previous MI, n (%) | 14 (29.2) | 120 (21.7) | 0.236 |
| Previous CABG, n (%) | 4 (8.3) | 48 (8.7) | 1.000 |
| Killip class, n (%) | | | |
| I | 35 (72.9) | 486 (88.0) | |
| II | 9 (18.8) | 55 (10.0) | 0.002 |
| III | 3 (6.3) | 7 (1.3) | |
| IV | 1 (2.1) | 4 (0.7) | |
| Previous HF, n (%) | 6 (12.5) | 33 (6.0) | 0.116 |
| Diabetes mellitus, n (%) | 15 (31.3) | 152 (27.5) | 0.582 |
| Diabetic neuropathy, n (%) | 15 (31.3) | 119 (21.6) | 0.122 |
| COPD, n (%) | 14 (29.2) | 166 (30.1) | 0.889 |
| CKD, n (%) | 17 (35.4) | 170 (30.8) | 0.507 |
| BMI ($kg/m^2$), $\bar{x} \pm SD$ | 28.0 ± 2.6 | 26.7 ± 2.6 | 0.001 |
| Dyslipidemia, n (%) | 17 (35.4) | 180 (32.6) | 0.691 |
| Smoking, n (%) | 23 (47.9) | 273 (49.5) | 0.838 |
| Previous CVI, n (%) | 3 (6.3) | 24 (4.3) | 0.469 |
| HTA, n (%) | 26 (54.2) | 268 (48.6) | 0.455 |
| LV-EF (%),$\bar{x} \pm SD$ | 41.7 ± 4.6 | 43.9 ± 4.9 | 0.003 |
| LA (mm), $\bar{x} \pm SD$ | 43.6 ± 3.9 | 40.4 ± 3.6 | < 0.001 |
| MR, n (%) | | | |
| none | 8 (16.7) | 303 (55.0) | < 0.001 |
| mild | 28 (58.3) | 208 (37.7) | |
| moderate-severe | 12 (25.0) | 40 (7.3) | |
| Heart rate on admission (bpm), median (range) | 85.5 (55.0–122.0) | 77.0 (43.0–125.0) | < 0.001 |
| HTA on admission (mmHg), median (range) | | | |
| systolic blood pressure | 158 (201–85) | 154 (194–87) | 0.657 |
| diastolic blood pressure | 81 (132–47) | 80 (128–50) | |
| Localization of STEMI, n (%) | | | |
| anterior | 14 (53.8) | 113 (42.8) | 0.279 |
| inferior | 12 (46.2) | 151 (57.2) | |
| PCI during the hospital course, n (%) | 30 (62.5) | 322 (58.3) | 0.574 |
| Thrombolytic therapy, n (%) | 17 (65.4) | 192 (72.7) | 0.930 |
| Primary PCI, n (%) | 4 (15.4) | 49 (18.6) | 0.720 |
| VT during the hospital course, n (%) | 9 (18.8) | 42 (7.6) | 0.014 |

**MI – myocardial infarction; STEMI – ST elevation myocardial infarction, NSTEMI – Non-ST elevation myocardial infarction; CABG – coronary artery bypass graft; HF – heart failure; COPD – chronic obstructive pulmonary disease; CKD – chronic kidney disease; BMI – body mass index; CVI – cerebrovascular insult; HTA – hypertensio arterialis; LV-EF – left ventricle ejection fraction; LA – left atrium; MR – mitral regurgitation; PCI – percutaneous coronary intervention; VT – ventricular tachycardia.**

**Table 2**

**The predictors of new-onset atrial fibrillation (AF) and echo parameters in patients with myocardial infection (MI)**

| Independent variable | Univariate logistic regression | | Multivariate logistic regression | |
|---|---|---|---|---|
| | OR (95% CI) | *p* | OR (95% CI) | *p* |
| Age (more than 70 years) | 3.32 (1.82–6.04) | < 0.001* | 2.37 (1.23–4.58) | 0.010* |
| Body mass index | 1.22 (1.09–1.37) | 0.001* | 1.17 (1.04–1.33) | 0.012* |
| Heart rate on admission (bpm) | | | | |
| up to 80 | reference category | | reference category | |
| 81–100 | 2.33 (1.21–4.50) | 0.012* | 0.70 (0.28–1.72) | 0.438 |
| more than 100 | 6.37 (2.60–15.60) | < 0.001* | 1.71 (0.40–7.29) | 0.469 |
| Killip class | 1.97 (1.27–3.06) | 0.003* | 0.72 (0.34–1.51) | 0.386 |
| LV-EF | 0.92 (0.87–0.97) | 0.003* | 1.06 (0.97–1.17) | 0.205 |
| Diameter of LA | 1.26 (1.16–1.37) | < 0.001* | 1.18 (1.03–1.33) | 0.015* |
| MR | | | | |
| none | reference category | | reference category | |
| mild | 5.10 (2.28–11.41) | < 0.001* | 3.56 (1.25–10.32) | 0.018* |
| moderate to severe | 11.36 (4.38–29.48) | < 0.001* | 3.32 (0.72–15.365) | 0.124 |

***statistically significant predictors of new-onset AF; LV-EF – left verticle ejection fraction; LA – left atrium; MR – mitral regurgitation; OR – odds ratio; CI – confidence interval.**

predictors of new-onset AF. Echo parameters such as the enlarged diameter of LA as well as presentation of MR significantly correlated with new-onset AF, but LV-EF did not (Table 2). Nevertheless, the other parameters such as gender, STEMI, localization of MI, thrombolytic therapy, PCI as well as CABG during the initial hospital period, previous MI, HF and CVI, diabetes mellitus, diabetic neuropathy, COBP, CKD, dyslipidemia, smoking and HTA were not included in the multivariate logistic regression analyses because univariate logistic regression analyses showed no statistical significance.

A total of 43 (89.6%) patients with new-onset AF were recovered to sinus rhythm during the hospital period. Recurrent AF was registered in 37.5% of patients with new-onset AF during the follow-up period of 48 months.

*Impact of atrial fibrillation on mortality during the hospital period*

A total of 36 (6.0%) patients died during the hospital course. A total of 5 patients (10.4%) with AF died during the hospital course as well as 31 patients (5.6%) without AF, but this difference was not statistically significant ($p$ = 0.179). A total of 3 (11.5%) patients with STEMI and AF died during the hospital course as well as 2 (9.1%) patients with NSTEMI, but with no statistically significant difference ($p > 0.05$).

*Impact of atrial fibrillation on mortality during the follow-up period of 48 month*

A total of 486 (81.0%) patients survived after the follow-up period of 48 months. A total of 16 patients with new-onset AF died after this follow-up period, 8 (30.8%) patients with STEMI and 8 (36.4%) patients with NSTEMI ($p > 0.05$). A total of 16 (33.3%) patients with AF developed during the hospital period as well as 98 (17.8%) those without AF died after the follow-up period of 48 months ($p = 0.009$) (Figure 1).

The correlation between mortality and new-onset AF was assessed using unadjusted and adjusted Cox's proportional hazards model (Table 3).

*Correlation between new-onset AF and major adverse cardiac and cardiovascular events after follow-up period of 48 months*

MACCE defined as death, recurrent MI, revascularization and stroke were registered more often in patients with new-onset AF during the follow-up period of 48 months (Table 4 and Figure 2).

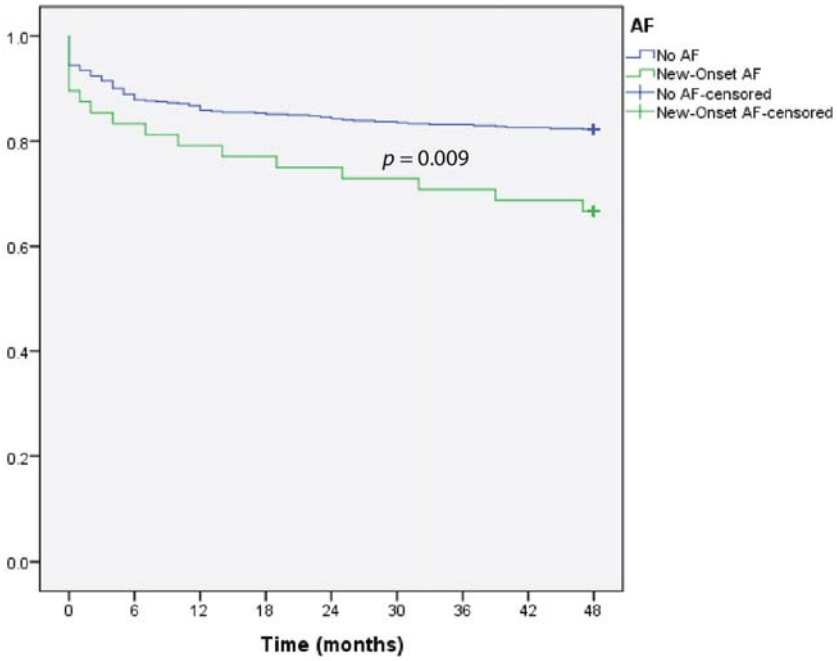


**Fig. 1 – Crude cumulative incidence of mortality during the follow-up period of 48 months presented by Kaplan-Meier plots. AF – atrial fibrillation**

**Table 3**

**Cox's proportional hazard models for mortality predictors during the follow-up period of 48 months**

| Predictors | Univariate Cox's regression model | | Multivariate Cox's regression model | |
|---|---|---|---|---|
| | HR (95% CI) | *p* | HR (95% CI) | *p* |
| Age (more than 70 years) | 2.06 (1.42–2.98) | < 0.001* | 1.42 (0.96–2.08) | 0.078 |
| Killip class | 3.71 (3.00–4.59) | < 0.001* | 2.77 (2.13–3.61) | < 0.001* |
| Body mass index | 1.45 (1.36–1.56) | < 0.001* | 1.35 (1.26–1.45) | < 0.001* |
| Atrial fibrillation | 1.97 (1.16–3.34) | 0.012* | 0.68 (0.38–1.20) | 0.182 |

**HR – hazard ratio; *statistically significant predictors; CI – confidence interval.**

**Table 4**

**Recurrent cardiovascular events after follow-up period of 48 months**

| Recurrent cardiovascular events | AF group n (%) | No AF group n (%) | *p* |
|---|---|---|---|
| MI | 8 (16.7) | 67 (12.1) | 0.363 |
| CABG | 5 (10.4) | 39 (7.1) | 0.384 |
| PCI | 7 (14.6) | 70 (12.7) | 0.705 |
| CVI | 7 (14.6) | 41 (7.4) | 0.093 |
| MACCE | 25 (52.1) | 187 (33.9) | 0.011 |

**AF – atrial fibrillation; MI – myocardial infarction; CABG – coronary artery bypass graft; PCI – percutaneous coronary intervention; CVI – cerebrovascular insult; MACCE – major adverse cardiac and cardiovascular events.**

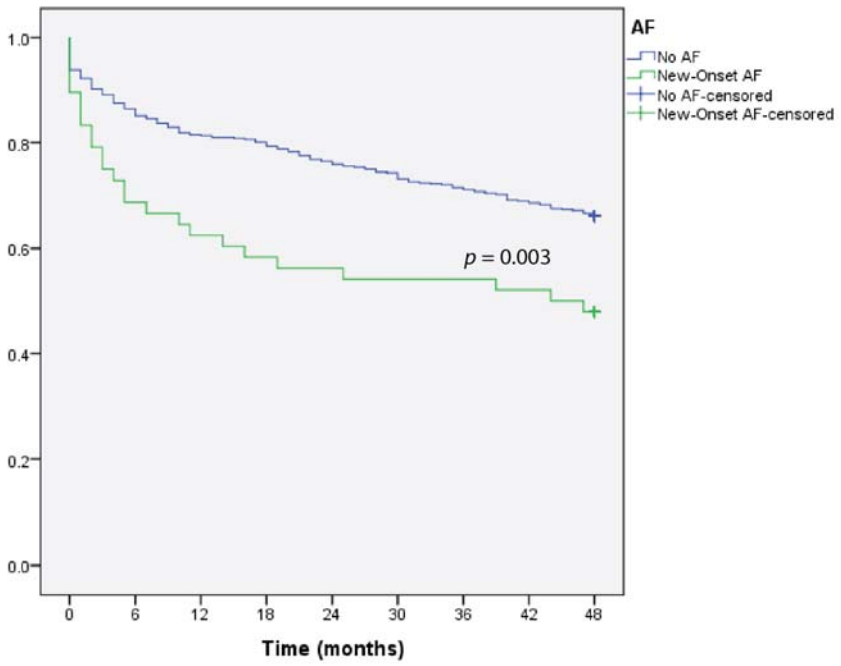


**Fig. 2 – Composite end-point of death, recurrent myocardial infarction, revascularization and stroke during the follow-up period of 48 months presented by Kaplan-Meier plots, *p* = 0.003.**
**AF – atrial fibrillation.**

## Discussion

In our study, we presented the incidence of new-onset AF in STEMI and NSTEMI patients. In accordance with other previous studies, new-onset AF was more frequent in the STEMI group than in the NSTEMI one, but this difference was not statistically significant [1, 2]. The reason of higher incidence of AF in the STEMI population is still undetermined. The incidence of AF in MI with and without ST-segment elevation was also compared and published RICO study, but the result was also without statistical significance (7.6 *vs* 7.7%; $p = 0.334$) [15].

We identified the several important baseline predictors of new-onset AF in the setting of MI. Namely, except for age, this study is one of the first which emphasized that the obesity is an independent predictor of new-onset AF in patients with both STEMI and NSTEMI. The correlation between obesity and new-onset AF in a patient with MI remains unclear. However, according to data from large German AF registry, obesity was present in 25% of patients with AF with BMI of 27.5 kg/m$^2$ [2, 16]. Recent data from a Danish cohort indicates that BMI is incrementally associated with the volume of left atrium which leads to more pronounced trigger activity provoked by a more profound stretching of the pulmonary veins [17]. The enlarged volume of left atrium also may lead to prolongation of ectopic signals with the easier perpetuation of AF [17, 18]. Higher BMI is associated with inflammation which is supported by a recent study demonstrating that gene coding for the interleukin-6 receptor polymorphism is related to AF [19]. Obesity is a major risk factor for obstructive sleep apnea which also may predispose to AF [20]. MR in MI may also lead to both acute overload and enlargement volume of left atrium which through the described mechanisms may initiate and perpetuate AF [17, 21–24]. Unlike the previous study, we did not observe a positive association between MR severity and new-onset AF [25].

In our study we also presented the incidence of new-onset AF in STEMI patients according to the reperfusion regimens. In accordance with a recently published study, there

were no significant differences in the development of new-onset AF according to the reperfusion regimens (primary PCI *vs* thrombolysis) [26, 27].

In the present study we demonstrated a positive association between new-onset AF in patients with MI and complications developed during the hospital course such as HF and cardiogenic shock, but after adjustment for clinical and echo variables the risk associated with AF was attenuated. New-onset AF also was not an independent predictor of mortality during the hospital course. This finding was observed in both STEMI and NSTEMI patients for all of the studied outcomes. In spite of previous studies, there were significant differences in mortality during the hospital period according to the reperfusion regimens (primary PCI *vs* thrombolysis) [28–32].

New-onset AF was correlated with higher mortality after a follow-up period of 48 months. Furthermore, MACCE were more often registered in patients with new-onset AF after a follow-up period of 48 months. This finding was observed in both STEMI and NSTEMI groups. However, after multivariate Cox's regression analysis new-onset AF was not an independent predictor of mortality during the follow-up period of 48 months. This finding is in accordance with data of the study which included 4,108 patients hospitalized due to MI in 16 hospitals [10]. Namely, this study showed that patients with new-onset AF had higher long-term mortality than patients without this arrhythmia, but independent effect of AF on long-term prognosis was not confirmed by using a multivariate analysis [10].

## Conclusion

New-onset AF was common in both patients with STEMI and those with NSTEMI and difference in its incidence between these two groups was not statistically significant. The strongest predictors of new-onset AF were older age and increased BMI. We also registered that echo parameters such as the enlarged diameter of left atrium as well as the presentation of MR were at the significant correlation with new-onset AF. There were no significant differences in mortality during the hospital period between MI patients with and without new-onset AF according to the reperfusion regimens. New-onset AF was associated with higher mortality as well as MACCE during the follow-up period of 48 months but was not an independent predictor of mortality during this period.

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## R E F E R E N C E S

1. *Schmitt J, Duray G, Gersh BJ, Hohnloser SH*. Atrial fibrillation in acute myocardial infarction: A systematic review of the incidence, clinical features and prognostic implications. Eur Heart J 2009; 30(9): 1038−45.
2. *Lopes RD, Pieper KS, Horton JR, Al-Khatib SM, Newby LK, Mehta RH*, et al. Short- and long-term outcomes following atrial fibrillation in patients with acute coronary syndromes with or without ST-segment elevation. Heart 2008; 94(7): 867−73.
3. *Pedersen OD, Bagger H, Køber L, Torp-Pedersen C*. The occurrence and prognostic significance of atrial fibrillation/-flutter following acute myocardial infarction. TRACE Study group. TRAndolapril Cardiac Evalution. Eur Heart J 1999; 20(10): 748−54.
4. *Pizzetti F, Turazza FM, Franzosi MG, Barlera S, Ledda A, Maggioni AP*, et al. Incidence and prognostic significance of atrial fibrillation in acute myocardial infarction: The GISSI-3 data. Heart 2001; 86(5): 527−32.
5. *Crenshaw BS, Ward SR, Granger CB, Stebbins AL, Topol EJ, Califf RM*. Atrial fibrillation in the setting of acute myocardial infarction: The GUSTO-I experience. Global Utilization of Streptokinase and TPA for Occluded Coronary Arteries. J Am Coll Cardiol 1997; 30(2): 406−13.
6. *Rathore SS, Berger AK, Weinfurt KP, Schulman KA, Oetgen WJ, Gersh BJ*, et al. Acute myocardial infarction complicated by atrial fibrillation in the elderly: Prevalence and outcomes. Circulation 2000; 101(9): 969−74.
7. *Al-Khatib SM, Pieper KS, Lee KL, Mahaffey KW, Hochman JS, Pepine CJ*, et al. Atrial fibrillation and mortality among patients with acute coronary syndromes without ST-segment elevation: Results from the PURSUIT trial. Am J Cardiol 2001; 88(1): A7, 76−9.
8. *Sankaranarayanan R, James MA, Nuta B, Townsend M, Kesavan S, Burtchaell S,* et al. Does atrial fibrillation beget ventricular fibrillation in patients with acute myocardial infarction. Pacing Clin Electrophysiol 2008; 31(12): 1612−9.
9. *Mehta RH, Dabbous OH, Granger CB, Kuznetsova P, Kline-Rogers EM, Anderson FA,* et al. Comparison of outcomes of patients with acute coronary syndromes with and without atrial fibrillation. Am J Cardiol 2003; 92(9): 1031−6.
10. *Goldberg RJ, Seeley D, Becker RC, Brady P, Chen ZY, Osganian V*, et al. Impact of atrial fibrillation on the in-hospital and long-term survival of patients with acute myocardial infarction: A community-wide perspective. Am Heart J 1990; 119(5): 996−1001.
11. *Madias JE, Patel DC, Singh D*. Atrial fibrillation in acute myocardial infarction: A prospective study based on data from a consecutive series of patients admitted to the coronary care unit. Clin Cardiol 1996; 19(3): 180−6.
12. *Sugiura T, Iwasaka T, Takahashi N, Nakamura S, Taniguchi H, Nagahama Y,* et al. Atrial fibrillation in inferior wall Q-wave acute myocardial infarction. Am J Cardiol 1991; 67(13): 1135−6.
13. Task Force on the management of ST-segment elevation acute myocardial infarction of the European Society of Cardiology (ESC). Steg G, James S, Atar D, Badano L, Borger M, Di Mario C, et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. Eur Heart J 2012; 33(20): 2569−619.
14. *Roffi M, Patrono C, Collet JP, Mueller C, Valgimigli M, Andreotti F,* et al. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation: Task Force for the Management of Acute Coronary Syndromes in Patients Presenting without Persistent ST-Segment Elevation of the European Society of Cardiology (ESC). Eur Heart J 2016; 37(3): 267−315.
15. *Laurent G, Zeller M, Dentan G, Moreau D, Laurent Y, Beer JC*, et al. Prognostic impact of new onset atrial fibrillation in acute non-ST elevation myocardial infarction data from the RICO survey. Heart 2005; 91(3): 369−70.

16. *Nabauer M, Gerth A, Limbourg T, Schneider S, Oeff M, Kirchhof P,* et al. The Registry of the German Competence NETwork on Atrial Fibrillation: patient characteristics and initial management. Europace 2009; 11(4): 423−34.
17. *Frost L, Benjamin E, Fenger-Gron M, Pedersen A, Tjonneland A, Overvad K.* Body Fat, Body Fat Distribution, Lean Body Mass and Atrial Fibrillation and Flutter. A Danish Cohort Study. Obesity (Silver Sprint) 2014; 22(6): 1546−52.
18. *Lauer MS, Anderson KM, Kannel WB, Levy D.* The impact of obesity on left ventricular mass and geometry. The Framingham Heart Study. JAMA 1991; 266(2): 231−6.
19. *Schnabel RB, Kerr KF, Lubitz SA, Alkylbekova EL, Marcus GM, Sinner MF*, et al. Large-scale candidate gene analysis in whites and African Americans identifies IL6R polymorphism in relation to atrial fibrillation: The National Heart, Lung, and Blood Institute's Candidate Gene Association Resource (CARe) project. Circ Cardiovasc Genet 2011; 4(5): 557−64.
20. *Gami AS, Pressman G, Caples SM, Kanagala R, Gard JJ, Davison DE*, et al. Association of atrial fibrillation and obstructive sleep apnea. Circulation 2004; 110(4): 364−7.
21. *Ravelli F, Allessie M.* Effects of atrial dilatation on refractory period and vulnerability to atrial fibrillation in the isolated Langendorff-perfused rabbit heart. Circulation 1997; 96(5): 1686−95.
22. *Aronson D, Goldsher N, Zukermann R, Kapeliovich M, Lessick J, Mutlak D,* et al. Ischemic mitral regurgitation and risk of heart failure after myocardial infarction. Arch Intern Med 2006; 166(21): 2362−8.
23. *Bursi F, Enriquez-Sarano M, Jacobsen SJ, Roger VL.* Mitral regurgitation after myocardial infarction: A review. Am J Med 2006; 119(2): 103−12.
24. *Grigioni F, Detaint D, Avierinos JF, Scott C, Tajik J, Enriquez-Sarano M.* Contribution of ischemic mitral regurgitation to congestive heart failure after myocardial infarction. J Am Coll Cardiol 2005; 45(2): 260−7.
25. *Bahouth F, Mutlak D, Furman M, Musallam A, Hammerman H, Lessick J,* et al. Relationship of functional mitral regurgitation to new-onset atrial fibrillation in acute myocardial infarction. Heart 2010; 96(9): 683−8.
26. *Siu CW, Jim M, Ho H, Miu R, Lee SW, Lau C,* et al. Transient atrial fibrillation complicating acute inferior myocardial infarction: implications for future risk of ischemic stroke. Chest 2007; 132(1): 44−9.
27. *Koracevic GP, Petrovic S, Damjanovic M, Stanojlovic T.* Association of stress hyperglycemia and atrial fibrillation in myocardial infarction. Wien KlinWochenschr 2008; 120(13−14): 409−13.
28. *Asanin M, Stankovic S, Mrdovic I, Matic D, Savic L, Majkic-Singh N,* et al. B-type natriuretic peptide predicts new-onset atrial fibrillation in patients with ST-segment elevation myocardial infarction treated by primary percutaneous coronary intervention. Peptides 2012; 35(1): 74−7.
29. *Mrdovic I, Savic L, Krljanac G, Perunicic J, Asanin M, Lasica R,* et al. Incidence, predictors, and 30-day outcomes of new-onset atrial fibrillation after primary percutaneous coronary intervention: Insight into the RISK-PCI trial. Coron Artery Dis 2012; 23(1): 1−8.
30. *Asanin MR, Milika AR, Vasiljevic ZM, Zorana VM, Matic MD, Mihailo MD,* et al. The long-term risk of stroke in patients with acute myocardial infarction complicated with new-onset atrial fibrillation. Clin Cardiol 2009; 32(8): 467−70.
31. *Asanin M, Perunicic J, Mrdovic I, Matic M, Vujisic-Tesic B, Arandjelovic A,* et al. Significance of recurrences of new atrial fibrillation in acute myocardial infarction. Int J Cardiol 2006; 109(2): 235−40.
32. *Asanin M, Perunicic J, Mrdovic I, Matic M, Vujisic-Tesic B, Arandjelovic A,* et al. Prognostic significance of new atrial fibrillation and its relation to heart failure following acute myocardial infarction. Eur J Heart Fail 2005; 7(4): 671−6.

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