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ORIGINAL ARTICLE / ARAŞTIRMA YAZISI

Cardiology / Kardiyoloji

The Role of Mitral Annular Calcification in Predicting One-Month Mortality in Patients with STEMI Undergoing Primary Percutaneous Coronary Intervention

Ufuk Sadık Ceylan[1], **Can Yücel Karabay**[1]

[1]Siyami Ersek Thoracic and Cardiovascular Surgery Training and Research Hospital, Department of Cardiology, Uskudar, Istanbul, Turkey

Ufuk Sadık CEYLAN

Can Yücel KARABAY

ABSTRACT

Purpose: Numerous cardiovascular disorders have been related to mitral annular calcification (MAC). This study looked at the effects of mitral annular calcification on one-month mortality in ST-segment elevation myocardial infarction (STEMI) patients.

Methods: This single-center, retrospective observational study was carried out between 2017 and 2021. The study included 1541 patients who presented to the Dr. Siyami Ersek Hospital emergency department with a diagnosis of STEMI and underwent primary percutaneous intervention. The patients' clinical and demographic characteristics were investigated. Images taken during percutaneous intervention using angiography were used to assess the presence of MAC in patients. According to death, the patients were split into two groups, and a statistical analysis was done.

Results: The median age of 1541 STEMI patients included in the study was 59 years (51, 68) and 78% were male. While MAC was present in 134 patients (8.7%) in the whole group, the frequency of MAC was significantly higher in the deceased compared to the survivors (19% vs. 7.8%, p<0.001). The presence of MAC (OR = 2.84, 95% CI 1.68-4.63, p<0.001) was associated with death. In multivariable analysis hypertension (OR = 1.6, 95% CI 1.02-2.54, p = 0.043), platelet count (OR = 1, 95% CI 1.00-1.01, p = 0.02), LVEF (OR = 0.98, 95% CI 0.96-1.00, p = 0.024) and MAC (OR = 2.68, 95% CI 1.55- 4.50, p<0.001) were found to be independent predictors of death.

Conclusion: In STEMI patients, increased one-month mortality is strongly correlated with the presence of MAC during fluoroscopic primary percutaneous intervention.

Keywords: Mortality, Mitral valve, ST Elevation Myocardial Infarction

Correspondence: Ufuk Sadık Ceylan
Siyami Ersek Thoracic and Cardiovascular Surgery Training and Research Hospital, Department of Cardiology, Uskudar, Istanbul, Turkey
Phone: +902165424444
E-mail: ufukceylan@gmail.com

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Primer Perkütan Koroner Girişim Yapilan STEMI Hastalarinda Mitral Anüler Kalsifikasyonun Bir Aylik Mortaliteyi Öngörmedeki Yeri

ÖZET

Amaç: Mitral anüler kalsifikasyonun (MAK) çeşitli kardiyovasküler hastalıklarla ilişkilendirilen bir tablodur. Bu çalışmada STEMI hastalarında mitral anüler kalsifikasyonun bir aylık mortalitedeki etkisi araştırmayı amaçladık.

Yöntem: 2017-2021 yılları arasında yapılan tek merkezli gözlemsel retrospektif bir çalışmadır. Dr.Siyami Ersek Hastanesi acil servisine başvuran STEMI tanısı konarak primer perkütan girişim uygulanan 1541 hasta çalışmaya dahil edildi. Hastaların demografik, klinik özellikleri incelenmiştir. Hastalarda MAK varlığı perkütan girişim sırasındaki anjiyografi görüntüleri üzeriden değerlendirildi. Hastalar ölüme göre ikiye ayrılarak istatistiksel incelemesi yapılmıştır.

Bulgular: Çalışmaya dahil edilen 1541 STEMI hastasının median yaşı 59 yıl (51, 68) ve %78 erkekti. Tüm grupta 134 hastada (%8.7) MAK varken, ölenlerde, sağ kalanlara göre MAK sıklığı belirgin daha fazlaydı (%19 vs %7.8, p<0.001). MAK (OR=2.84, 95% CI 1.68-4.63, p<0.001) varlığı ölüm ile ilişkili bulundu. Multivariable analizde hipertansiyon (OR=1.6, 95% CI 1.02-2.54, p=0.043), platelet sayısı (OR=1, 95% CI 1.00-1.01, p=0.02), LVEF (OR=0.98, 95% CI 0.96-1.00, p=0.024) ve MAK (OR=2.68, 95% CI 1.55- 4.50, p<0.001) ölüm için bağımsız prediktörler olarak bulundu.

Sonuç: Floroskopik olarak primer perkütan girişim sırasında MAK görülmesi STEMI hastalarında bir aylık artmış mortalite ile yakından ilişkilidir.

Anahtar Kelimeler: Mitral kapak, ST Elevasyonlu Miyokard Infarktüsü, mortalite

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Although STEMI mortality has decreased recently due to advances in technology and the widespread use of interventional therapies, STEMI still accounts for the majority of in-hospital and global mortality in patients with cardiovascular disease (1).

Chronic degenerative development in the fibrous basis of the mitral valve is known as mitral annular calcification (MAC) (2). Until recently, the optimum technique for MAC diagnosis was thought to be echocardiography (3). Recently, the idea that computed tomography is a more accurate diagnostic method has emerged, since it is difficult to differentiate calcification and tight collagen deposition which gives intense echogenicity with echocardiography (4, 5). MAC can be seen and diagnosed during coronary angiography (6). MAC is connected to cardiovascular conditions and events such coronary artery disease (CAD), atherosclerosis of the carotid and aortic arteries, stroke, atrial fibrillation and heart failure. It has also been linked to mortality in the Framingham Heart Study (7). However, no study has examined the relationship between MAC and mortality in STEMI patients who underwent primary percutaneous intervention, therefore we planned to look into it in our study.

MATERIAL AND METHODS

Our research is a retrospective observational single-center study. The study comprised 1541 STEMI patients who underwent primary percutaneous intervention and were admitted to the emergency service of the Dr. Siyami Ersek Hospital between 2017 and 2021. Their median age was 59 years (51, 68), and 78% of them were men. Primary percutaneous intervention images, one-month follow-up and patient data of the patients were accessed from the hospital electronic database.

Patient population and data collection

Patients who applied to our hospital between 2017 and 2021 and met the criteria for STEMI according to the universal myocardial infarction (MI) guideline were included (8). The clinical and angiographic demographic data of the patients were recorded by scanning them retrospectively from the files. Each patient's TIMI (Thrombolysis in Myocardial Infarction) score was calculated. TIMI ≤ 2 was defined as no reflow if the patient did not have residual stenosis, spasm, distal embolization, or dissection. More than 50% stenosis in at least one major artery other than the culprit lesion was defined as multivessel disease (MVD). Peripheral blood samples of the patients were taken from the antecubital vein and the results of the blood immediately sent to the laboratory were recorded (Hdl, WBC, Hgb, Platelet, Troponin, Total Cholesterol, Creatinine, Triglyceride). Angiographic diagnosis of MAC was made with the joint decision of the two researchers, by retrospectively viewing cineangiographic images.

Statistical method

The patients were divided into two groups based on death before the patients' demographic and clinical characteristics were examined. Continuous variables were represented by medians and quartiles as opposed to categorical variables, which were represented by numbers and percentages. The Mann-Whitney U test was used to assess differences between deceased and surviving groups. To determine how categorical variables vary between groups, the chi-square test was used. A univariate logistic regression analysis was then used to calculate each variable's impact on the risk of mortality. Odds ratios and 95% confidence intervals were used to present the results. In the univariate analysis, $p < 0.05$ was considered significant. The multivariate logistic regression analysis was then performed on the variables with a p-value of 0.05 or above in the univariate analysis. For this analysis, a significance level of $p < 0.05$ was accepted. The statistical analysis was completed using R 4.01 (R software, Vienna, Austria).

RESULTS

The median age of 1541 STEMI patients enrolled in the study was 59 years (51, 68) and 78% were male. During the 1-month follow-up, 113 patients (7.3%) died. Table-1 shows whether the variables between the deceased and surviving groups are different. While MAC was present in 134 patients (8.7%) in the whole group, the frequency of MAC was significantly higher in the deceased compared to the survivors (19 % vs. 7.8 %, $p<0.001$). Differences for other variables can be seen in Table-1.

Table-1: Baseline clinical characteristics by death status

Variable	All (n = 1541)	Alive (n = 1428)	Death (n = 113)	p value
Age, years	59 (51, 68)	58 (51, 68)	67 (56, 75)	<0.001
Sex, male	1.206 (78%)	1.116 (78%)	90 (80%)	0.711
HT, yes %	743 (48%)	668 (47%)	75 (66%)	<0.001
Family history, yes %	402 (27%)	381 (27%)	21 (19%)	0.069
DM, yes %	440 (29%)	396 (28%)	44 (39%)	0.012
Previous MI, yes %	324 (21%)	287 (20%)	37 (33%)	0.002
Previous Revascularization, yes %	299 (19%)	266 (19%)	33 (29%)	0.007
Hyperlipidemia, yes %	102 (6.6%)	96 (6.7%)	6 (5.3%)	0.562
Smoking, yes %	837 (54%)	787 (55%)	50 (44%)	0.027
MI pattern, Anterior MI	627 (41%)	582 (41%)	45 (40%)	0.846
KILLIP, class II-IV	160 (11%)	140 (10.0%)	20 (18%)	0.007
Systolic BP, mmHg	132 (112, 152)	132 (112, 152)	130 (110, 150)	0.776
Diastolic BP, mmHg	76 (68, 90)	76 (68, 90)	72 (60, 90)	0.378
Heartrate, beat/min	81 (68, 95)	81 (68, 95)	84 (75, 100)	0.002
LVEF, %	48 (40, 55)	48 (40, 55)	43 (30, 50)	<0.001
Antiplatelet, yes %	314 (20%)	285 (20%)	29 (26%)	0.149
ACE, yes %	257 (17%)	234 (17%)	23 (21%)	0.297
BB, yes %	183 (12%)	167 (12%)	16 (15%)	0.461
Statin, yes %	178 (12%)	164 (11%)	14 (12%)	0.772
HDL, mg/dl	34 (29, 40)	34 (29, 41)	34 (28, 39)	0.574
WBC	11.7 (9.4, 14.4)	11.7 (9.4, 14.3)	11.4 (9.0, 15.7)	0.124
Hgb, gr/L	13.80 (12.40, 15.00)	13.80 (12.47, 15.00)	13.60 (11.00, 14.50)	<0.001
Plt	232 (194, 277)	231 (194, 275)	241 (194, 314)	0.002
Troponin	27 (8, 50)	27 (8, 50)	29 (6, 54)	0.08
Total Cholesterol	175 (149, 207)	177 (150, 207)	166 (146, 197)	0.039
Creatinine, mg/dl	0.83 (0.74, 1.04)	0.83 (0.74, 1.03)	0.93 (0.76, 1.14)	0.04
Tg	132 (96, 181)	133 (96, 183)	124 (89, 158)	0.015
TIMI, 0-2	458 (30%)	419 (29%)	39 (35%)	0.248
MVD, yes %	682 (44%)	617 (43%)	65 (58%)	0.004
MAC, yes %	134 (8.7%)	112 (7.8%)	22 (19%)	<0.001

ACE: Angiotensin converting Enzyme, BB: Beta Blocker, BP: Blood pressure, DM: Diabetes Mellitus, HDL: High-density lipoprotein, Hgb: Hemoglobin, HT: Hypertension, LVEF: Left ventricle ejection fraction, MAC: Mitral Annular Calcification, MI: Myocardial Infarction, MVD: Multivessel coronary artery disease, Plt: Platelet, Tg: Triglyceride, TIMI: Thrombolysis In Myocardial Infarction, WBC: White blood cell

In univariate analysis, advanced age (OR = 1.03, 95 % CI 1.02-1.05, p<0.001), hypertension (OR = 2.25, 95 % CI 1.51-3.39, p<0.001), diabetes mellitus (OR = 1.66, 95 % CI 1.11-2.46, p = 0.012), previous history of MI (OR = 1.94, 95 % CI 1.27-2.91, p = 0.002), previous coronary revascularization (OR = 1.8, 95 % CI 1.16-2.74, p = 0.007), smoking (OR = 0.65, 95 % CI 0.44-0.95, p = 0.027), heart rate (OR = 1.01, 95 % CI 1.00-1.02, p = 0.002), left ventricular ejection fraction (LVEF) (OR = 0.96, 95 % CI 0.95-0.98, p<0.001), hemoglobin (OR = 0.85, 95 % CI 0.78-0.93, p<0.001), platelet count (OR = 1, 95 % CI 1.00-1.01, p = 0.002), creatinine (OR = 1.18, 95 % CI 0.99-1.37, p = 0.04), MVD (OR = 1.78, 95 % CI 1.21-2.63, p = 0.004), and MAC (OR = 2.84, 95 % CI 1.68-4.63, p<0.001) was found to be associated with death. These variables, which were associated with death in the univariate analysis, were included in the multivariable analysis. In multivariable analysis, hypertension (OR = 1.6, 95 % CI 1.02-2.54, p = 0.043), platelet count (OR = 1, 95 % CI 1.00-1.01, p = 0.02), LVEF (OR = 0.98, 95 % CI 0.96- 1.00, p = 0.024) and MAC (OR = 2.68, 95 % CI 1.55- 4.50, p<0.001) were found to be independent predictors of death. The significance levels of the variables in explaining the variance in death according to the partial X2 values are shown in figure-1. Accordingly, MAC was the variable that explained the variance in death the most. While the multivariable model was R2 = 0.085 and AUC = 0.701 without including MAC, it was observed that there was a significant improvement in model performance when MAC was included (R2 = 0.103, AUC = 0.718). A significant difference was observed between the AUC values of the two models with the Delong test (p = 0.01) (figure-2).

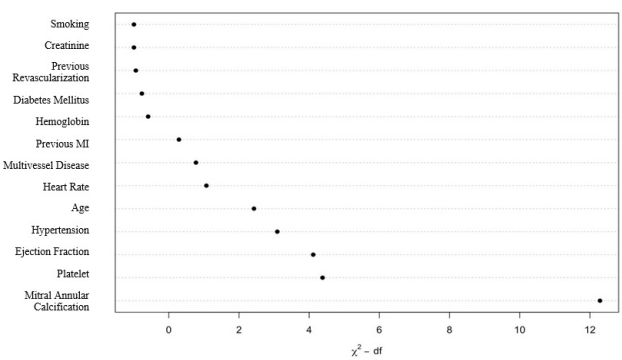

Figure1. *The significance levels of the variables in explaining the variance in death according to the Partial X2 values*

Table-2: Univariate and multivariable logistic regression analysis for the determination of mortality-related factors

Variable	Univariable OR	95% CI	p value	Multivariable OR	95% CI	p value
Age, years	1.03	1.02-1.05	<0.001	1.02	1.00- 1.04	0.064
Sex, male	0.91	0.56-1.44	0.711			
HT, yes %	2.25	1.51-3.39	<0.001	1.6	1.02- 2.54	0.043
Family history, yes %	0.63	0.38-1.02	0.069			
DM, yes %	1.66	1.11-2.46	0.012	0.9	0.57- 1.39	0.629
Previous MI, yes %	1.94	1.27-2.91	0.002	1.75	0.62- 4.37	0.256
Previous Revascularization, yes %	1.8	1.16-2.74	0.007	0.88	0.34- 2.52	0.805
Hyperlipidemia, yes %	0.78	0.30-1.68	0.562			
Smoking, yes %	0.65	0.44-0.95	0.027	1.02	0.65- 1.60	0.942
MI pattern, Anterior MI	0.96	0.65-1.42	0.846			
KILLIP, class II-IV	2.03	1.19-3.34	0.007			
Systolic BP, mmHg	1	0.99-1.01	0.776			
Diastolic BP, mmHg	0.99	0.98-1.01	0.378			
Heartrate, beat/min	1.01	1.00-1.02	0.002	1.01	1.00- 1.02	0.15
LVEF, %	0.96	0.95-0.98	<0.001	0.98	0.96- 1.00	0.024
Antiplatelet, yes %	1.38	0.88-2.13	0.149			
ACE, yes %	1.29	0.78-2.06	0.297			
BB, yes %	1.23	0.68-2.09	0.461			
Statin, yes %	1.09	0.58-1.89	0.772			
HDL, mg/dl	0.99	0.97-1.01	0.574			
WBC	1.02	0.99-1.05	0.124			
Hgb, gr/L	0.85	0.78-0.93	<0.001	0.97	0.87- 1.07	0.522
Plt	1	1.00-1.01	0.002	1	1.00- 1.01	0.02
Troponin	1	1.00-1.00	0.08			
Total Cholesterol	1	0.99-1.00	0.039			
Creatinine, mg/dl	1.18	0.99-1.37	0.04	0.99	0.79- 1.19	0.941
Tg	1	0.99-1.00	0.015			
TIMI, 0-2	1.27	0.84-1.89	0.248			
MVD, yes %	1.78	1.21-2.63	0.004	1.33	0.87- 2.03	0.183
MAC, yes %	2.84	1.68-4.63	<0.001	2.68	1.55- 4.50	<0.001

ACE: Angiotensin converting Enzyme, BP: Blood pressure, DM: Diabetes Mellitus, Hdl: High-density lipoprotein, Hgb: Hemoglobin, HT: Hypertension, MAC: Mitral Annular Calcification, MI: Myocardial Infarction, MVD: Multivessel coronary artery disease, OR: Odds Ratio, Plt: Platelet, Tg: Triglyceride, TIMI: Thrombolysis In Myocardial Infarction, WBC: White blood cell

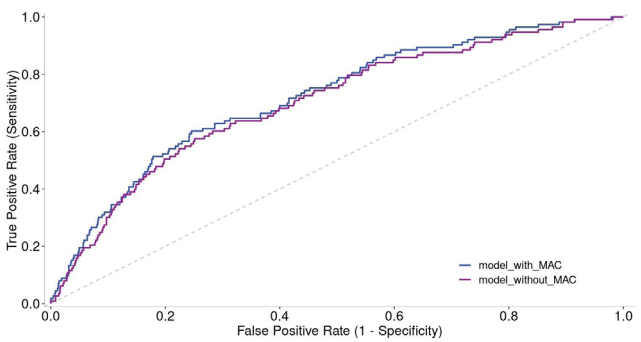

Figure 2. *AUC values of two models*

DISCUSSION

According to the results of our single-center retrospective observational study, MAC was an accurate predictor of mortality in STEMI patients. Advanced age, diabetes mellitus, hypertension, a history of MI, previous coronary revascularization, smoking, heart rate, left ventricular ejection fraction (LVEF), hemoglobin, platelet count, creatinine, and MVD were also related to mortality.

The presence of fluoroscopically detectable MAC in STEMI patients who are undergoing primary intervention affects 1-month mortality. It has been demonstrated that MAC is linked to numerous cardiovascular atherosclerotic disorders (7). It has also been shown to be associated with the prevalence of atherosclerosis in general and cardiovascular mortality in general (9-12). However, no study has examined the connection between MAC and STEMI mortality. To the greatest degree of our knowledge, the current research is the first to address the connection between MAC and mortality in the literature.

The findings of our study are consistent with the previous literature, except for the relationship between MAC and 1-month mortality (13-17). Ali M et al (13) found age, KILLIP II-IV and hypertension as mortality-related factors similar to our study results, but differently, no correlation between heart rate and mortality. Morrow et al (14) also presented KILLIP II-IV and heart rate, which we found related to increased mortality in addition to age, hypertension, and DM, as factors that increase mortality. McNamara et al (15), in their study examining the factors affecting in-hospital mortality after acute MI, found age, hypertension, and presence of heart failure at hospital admission to be related to increased mortality, which is consistent with our study. According to Paul GK et al. (17), STEMI patients' mortality increased with a higher platelet count. In the current study, we also discovered that higher platelet levels were linked to death. Other mortality-related indicators in this study other than MAC are consistent with the state of literature.

The leading diagnostic methods in the diagnosis of MAC are echocardiography and cardiac computed tomography (3-5). However, considering the success of fluoroscopy in demonstrating dense calcific structures, detection of MAC during coronary angiography is quite practical in clinical practice because it does not require additional examination. Due to the nature of the disease in STEMI patients, primary percutaneous intervention is often conducted before echocardiography can be performed. Our study showed that fluoroscopic diagnosis of MAC can provide information about mortality while the patient is still in the catheter room.

Limitations of the Study

The results should always be regarded as suspect in terms of bias because it was a retrospective study conducted at a single center. Prospective randomized studies on the subject should be designed. Since there are no defined criteria for fluoroscopic diagnosis of MAC, the diagnosis was made within the scope of expert opinion.

CONCLUSION

The presence of MAC during fluoroscopic primary percutaneous intervention is closely associated with an increased 1-month mortality in STEMI patients.

DECLARATIONS

Conflict of Interest

The authors state that they do not have any competing interests.

Funding

There is no source of funding.

Ethics Approval

This retrospective study was approved by the Institutional Review Board. This study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

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