The relationship between C-reactive protein and the lapse of time since the onset of the symptoms after acute myocardial infarction: an prospective-observational study

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Abstract

Objective: It is important to know the elapsed symptom-to-door (StD) time between the emergence of ST-elevation myocardial infarction (STEMI) symptoms and admission to the hospital in terms of the selection of appropriate treatment and prognosis. In this study, we aimed to assess the relationship between serum C-reactive protein (CRP) and StD time after STEMI.

Methods: 436 of the patients admitted to our center with STEMI between August 2012-February 2013 (338 male, mean age, 63.9±12.8) were included in this prospective-observational cohort study. Blood samples were obtained from laboratory results of the first reference period. Patients were divided into four groups according to the duration of StD time [0-1. hour; group 1 (G1), 1-3. hour; group 2 (G2), 3-6. hour; group 3 (G3), 6-12. hour; group 4 (G4)]. Statistical analysis was performed via chi-squre test, ANOVA test, Pearson's correlation analysis and receiver operator charecteristic (ROC) analysis.

Results: As the time progressed, an increase in CRP levels was observed. The difference among the means of the G1-G3 ($p=0.002$), G1-G4 ($p<0.001$), G2-G4 ($p<0.001$) and G3-G4 ($p<0.001$) groups was found to be statistically significant. There was a good correlation between the StD time and CRP levels ($r=0.676$). ROC analysis of the predictive value of CRP for the third hour was determined as 0.78 mg/dL, respectively (AUC was 0.824; 95% C.I. was 0.785-0.859; 73.9% sensitivity, 78.1% specificity).

Conclusion: According to serum CRP levels after STEMI at hospital admission, StD time can be estimated. *(Anadolu Kardiyol Derg 2014; 14: 599-605)*

Key words: ST elevation myocardial infarction, C-reactive protein, symptom-to-door time, specificity, sensitivity

Introduction

ST elevation myocardial infarction (STEMI) is one of the most important health problems that threaten the human life all over the world (1, 2). As the main reason of STEMI, the formation of thrombi blocking the blood flow in coronary arteries due to the rupture of atherosclerotic plaques can be shown (3). As the other causes; vasculitis, coronary embolic events, congenital abnormalities, coronary spasm, increased blood viscosity, the sudden increase in myocardial oxygen demand and trauma can be considered (4).

In recent years, the relationship between atherosclerosis and inflammation is frequently emphasized and large-scale researches are being done on this issue. C-reactive protein (CRP) is a substance of protein structure from pentraxin family. CRP is produced predominantly in the liver as part of the acute phase response. CRP is also expressed in vascular smooth muscle cells and atherosclerotic plaques. After acute coronary syndromes (ACS), as the time progresses, depending on the increase in inflammation, serum CRP levels are elevated. Blood CRP levels rise to peak level within 24-48 hours, and are decreased to normal levels within 3-7 days after ACS (5-9).

The lapse of time between the onset of the symptoms and admission to hospital is known as symptom-to-door (StD) time. Properly detection of the StD time has a prognostic significance. The longer the period after STEMI, the occurrence of myocardial damage and cardiac complications are more likely to progress (10, 11). In current guidelines, the benefits of reperfusion in the first 12 hours after STEMI is emphasized. Especially, successfully implemented reperfusion in first 3 hours is reported to have more prognostic utility. For this purpose, the selection of appropriate reperfusion strategy is an important discussion

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topic. For the treatment of reperfusion, fibrinolysis and primary percutaneous coronary intervention (PPCI) techniques can be applied. The method of PPCI should be preferred in a 24 h a day/7 days a week center in which coronary intervention facility is realized. When the transfer time from the centers without coronary intervention laboratory does not exceed 120 minutes and the door to balloon (DtB) time does not exceed 90 minutes, PPCI should be preferred again for revascularization. If these periods are not provided, fibrinolytic therapy could be performed on the patients. It is known that reperfusion strategy with fibrinolytic drugs might be as useful as PPCI from the onset of symptom to the third hour. For the determination of these periods, objective data are needed as well as the subjective patient history (12, 13).

STEMI is followed with strong systemic inflammatory response to myocardial damage (14). After STEMI, based on an increase in serum CRP levels, information about StD time can be achieved. A study directly examining the relationship between StD and CRP levels were not found in the literature. In this study, we aimed to assess the relationship between CRP levels in the blood and StD time after STEMI. Besides, we aimed to evaluate the importance of CRP for the determination of the first three-hour period in which the revascularization strategy to be applied after STEMI and the benefits of it are most noticeable.

Methods

Study design

This prospective observational cohort study was carried out between August 2012-February 2013 in Trabzon, Turkey.

Study population and protocol

We evaluated 523 patients, admitted to Trabzon Ahi Evren Thoracic and Cardiovascular Surgery Training and Research Hospital with STEMI. 436 of these patients (338 male, mean age; 63.9±12.8) who met the criteria for admission and had STEMI for the first time were included in the study. The patients who had infection, heart muscle disease, or chronic inflammatory disease were not included in the study. At hospital admission, the patients who had cardiogenic shock, renal failure (creatinine>2.5 mg/dL), or with a history of cerebrovascular events were not accepted in the study. The patients whose symptom onset time was unknown or StD time was longer than 12 hours were excluded from the study.

Patients were divided into four groups according to their admissions to the hospital. Patients presenting within the first hour (h) were included in the first group (G1) (n=97), whereas the ones presenting between 1-3 h were included in the second group (G2) (n=136). The patients presenting in 3-6 h were included in the third group (G3) (n=98) and the others presenting in 6-12 h were included in the fourth group (G4) (n=105).

Blood samples were drawn from the vein of each subject immediately after presentation to the emergency department. From these samples, cardiac enzymes, liver function tests, kidney function tests, complete blood count, thyroid function tests and CRP levels were determined.

The patients were prospectively followed for a period of three months.

Informed consent was obtained from all subjects, and the investigation conforms to the principles outlined in the Declaration of Helsinki. The study protocol was approved by the Ethics Committee Kartal Koşuyolu Education and Research Hospital, İstanbul, Turkey.

Study variables

Baseline clinical and demographical properties of study population were recorded. The predictor (grouping) variable was StD time, and the primary outcome variable was CRP.

Clinical examinations

Patients' invasive treatment methods applied during primary percutaneous coronary intervention (PPCI), balloon and stent diameters and lengths were recorded. The diameters of the vessels with lesion were calculated from the coronary angiography examinations. Due to CRP increase with the prevalence of atherosclerosis, SYNTAX scores (SS) were calculated by two different cardiologists. It was evaluated that whether there was a difference between groups in terms of the prevalence of CAD with the help of SS. The SS was calculated by using dedicated software (version 2.11). Each coronary lesion producing ≥50% luminal obstruction in vessels with a diameter ≥1.5 mm was separately scored and added to provide the vessel SS, and then summed to provide the overall patient SS (www.syntaxscore.com).

Echocardiographic evaluations were performed with a Vivid 3 ultrasound system (GE Healthcare, Wauwatosa, WI, US) with a 2.5-Mhz transducer. The studies were performed with the patients in the left lateral decubitus position in the parasternal and apical four-chamber views. Ejection fractions of all patients were calculated by the modified Simpson method when they first admitted to the emergency service. Left ventricular mass (LVM) and left ventricular mass index (LVMI) were calculated by the Devereux formula cited in American Society Echocardiography guidelines. For this purpose, with echocardiography; interventricular septum, left ventricular end-diastolic diameter and left ventricular posterior wall thickness were measured from the parasternal long-axis window.

C-reactive protein

Venous blood samples for assay of CRP was centrifuged for 15 minutes at 3000 rev/min rate. Beckman Coulter AU680 CRP Latex, Ireland kit was used for the analysis. 0.5 mg/dL was indicated as the reference for the limit value (cut-off) of CRP.

Symptom-to-door time and door-to-balloon time

Our center is a tertiary hospital and coronary intervention facilities are available 24 hours a day, 7 days a week. The records of patients are kept on a regular basis since they are admitted to the emergency service. Besides these data, the onset of symptoms were learnt from the patients themselves or

their relatives. The moment of patient admission in the emergency service was identified as door-time. By calculating the difference between the two periods, symptom-to-door time was found. The moment of the patient's coronary balloon had been inflated was recorded in the angiography laboratory. The elapsed time from the patient's admission to the emergency service to inflating the balloon was calculated as door to balloon time.

Statistical analysis

SPSS 17 (SPSS Inc, Chicago, IL, USA) and MedCalc software, (release 12.3.0.0, MedCa Software, Belgium) were used for statistical analysis. Qualitative data were expressed as mean±standard deviation, and quantitative values were expressed as a percentage. Chi-square analysis was performed for nominal data. Kolmogorov-Smirnov test was used to evaluate whether the numerical variables were normally distributed or not. Groups and subgroups showed normal distribution. ANOVA test was used to compare the groups and Tukey test was used for posthoc analysis. Pearson correlation analysis was performed to evaluate the relationship between CRP levels and StD time. Receiver operator characteristic (ROC) analysis was performed in order to detect the appropriate revascularization method and to determine the CRP level which might predict the first three-hour period in which prognostically maximum benefit was ensured. To make a ROC analysis, the patients were divided into two groups; as the ones presenting before and after three hours. The area under the ROC curve analysis, confidence intervals, sensitivity and specificity values were determined. The calculated p values less than 0.05 were considered statistically significant.

Results

Baseline demographics and characteristics

There was no significant difference between the groups in terms of demographic data. SYNTAX score, ejection fraction, and length of hospitalization were similar. There were no statistically significant differences in terms of risk factors possessed (Table 1).

Table 1. There were no significant difference between the groups in terms of demographic, laboratory and general properties

	Group 1 (n=97)	Group 2 (n=136)	Group 3 (n=98)	Gorup 4 (n=105)	*F	*P
Age, years	62.7 (±13.2)	62.8 (±13.3)	63.9 (±12.3)	66.3 (±12.0)	1.817	0.14
BMI, kg/m^2	27.7 (±2.9)	27.7 (±3.3)	28.2 (±3.5)	28.2 (±3.0)	0.835	0.47
BSA, m^2	1.91 (±0.10)	2.12 (±0.18)	1.91 (±0.13)	1.90 (±0.12)	0.900	0.44
HR, minute	73.1 (±27.0)	71.1 (±20.8)	74.8 (±21.3)	74.9 (±28.2)	0.602	0.62
SBP, mm Hg	128.4 (±30.2)	133.4 (±29.7)	130.2 (±30.0)	132.7 (±32.3)	0.580	0.61
DBP, mm Hg	77.9 (±19.5)	81.3 (±17.9)	78.3 (±18.3)	81.9 (±20.9)	1.098	0.35
SYNTAX score	21.7 (±9.1)	22.6 (±9.4)	21.4 (±9.7)	23.9 (±7.7)	1.405	0.24
EF, %	42.2 (±7.9)	42.3 (±8.6)	40.4 (±9.3)	39.7 (±8.7)	2.218	0.08
LVM, gr	216.4 (±52.4)	217.6 (±49.2)	232.1 (±58.3)	228.6 (±58.1)	1.118	0.34
LVMI, gr/m^2	112.4 (±28.4)	113.6 (±25.7)	121.5 (±32.6)	120.4 (±30.6)	1.352	0.25
Intensive care, days	3.7 (±1.5)	3.5 (±1.1)	3.9 (±1.8)	4.0 (±2.3)	1.812	0.14
Hospital stay, days	6.6 (±2.1)	6.7 (±3.0)	6.7 (±2.9)	6.9 (±3.1)	0.158	0.92
DM, n (%)	11 (12.2%)	24 (18.6%)	22 (23.9%)	20 (20.8%)	-	0.22
HT, n (%)	50 (55.6%)	83 (64.3%)	59 (64.1%)	60 (62.5%)	-	0.55
Hyperlipidemia, n (%)	60 (74.1%)	84 (64.7%)	50 (56.1%)	56 (65.8%)	-	0.24
Smoking, n (%)	46 (51.1%)	68 (52.7%)	45 (48.9%)	44 (45.8%)	-	0.76
Troponin-I, ng/mL	57.3 (±53.8)	69.0 (±65.0)	56.4 (±60.5)	55.0 (±48.6)	0.470	0.70
LDL, mg/dL	131.4 (±38.8)	135.3 (±34.7)	136.5 (±37.8)	136.4 (±43.0)	0.351	0.78
PBG, mg/dL	133.3 (±39.6)	144.3 (±68.4)	149.2 (±65.5)	148.1 (±68.5)	0.706	0.50
Creatinin, mg/dL	0.95 (±0.26)	0.87(±0.26)	0.99 (±0.30)	1.08 (±0.39)	5.113	0.07
Hemoglobin, g/dL	14.2 (±2.0)	14.5 (±1.8)	13.6 (±1.7)	13.4 (±1.7)	3.322	0.02
WBC, 10^3/µL	10.8 (±3.3)	10.9 (±3.4)	10.9 (±3.4)	11.4 (±3.2)	0.607	0.61
TSH, uIU/mL	1.40 (±1.28)	1.26 (±1.07)	1.34 (±1.53)	2.42 (±2.19)	3.680	0.01

Data are presented as mean±SD or number (percentage)
*Chi-square and ANOVA with posthoc Tukey test
BMI - body mass index; BSA - body surface area; CRP - C-reactive protein; DBP - diastolic blood pressure; DM - diabetes mellitus; EF - ejection fraction; HR - heart rate; HT - hypertension; LV Mass - left ventricle mass; LVMI - left ventricle mass index; PBG - postprandial blood glucose; SBP - systolic blood pressure; TSH - thyroid stimulating hormone, WBC - white blood cell

Laboratory findings

When laboratory data were evaluated, the mean CRP of the groups was found to be different. As the time progressed, an increase in CRP levels was observed (Fig. 1). There was no significant difference between the means of the G1-G2 (CRP, G1; 0.42 mg/dL and G2; 0.71 mg/dL, p=0.398). The difference between the mean of the G1-G3 was statistically significant (CRP, G1; 0.42 mg/dL and G3; 1.15 mg/dL, p=0.002). It was determined that the difference between the G1-G4 was significant (CRP, G1; 0.42 mg/dL and G4, 2.81 mg/dL, p<0.001). The G2-G3 had no statistical difference in terms of CRP means (CRP, G2; 0.71 mg/dL and G3; 1.15 mg/dL, p=0.08). The difference in CRP means of G2-G4 (CRP, G2; 0.71 mg/dL and G4; 2.81 mg/dL, p<0.001) and G3-G4 groups was found to be statistically significant (CRP, G3; 1.15 mg/dL and G4; 2.81 mg/dL, p<0.001). There was no significant difference between other laboratory parameters (Table 1).

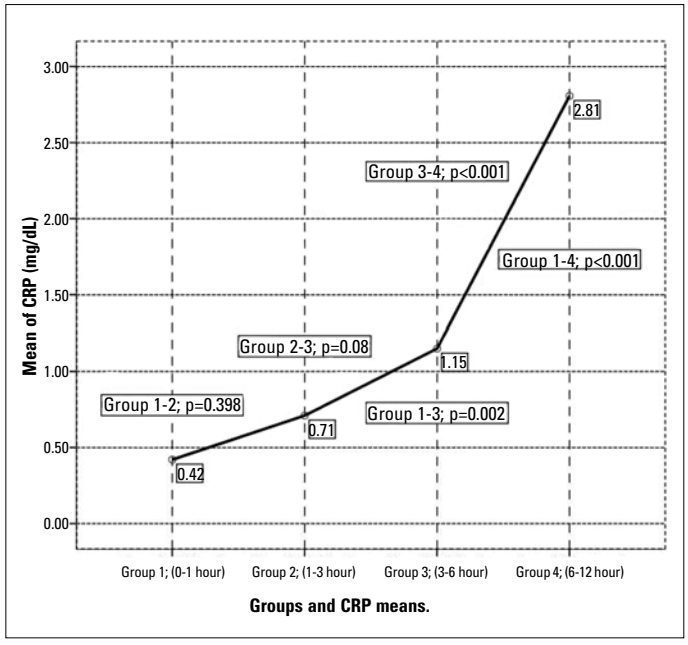

Figure 1. CRP differences between groups. There were statistically significant differences between the G1-G3, G1-G4, G2-G4, G3-G4 groups. There were no statistically significant difference in CRP means between the G1-G2 and G2-G3 groups. It was detected that CRP levels significantly increased as a parallel to the increase in symptom-to-door time (ANOVA with posthoc Tukey test)

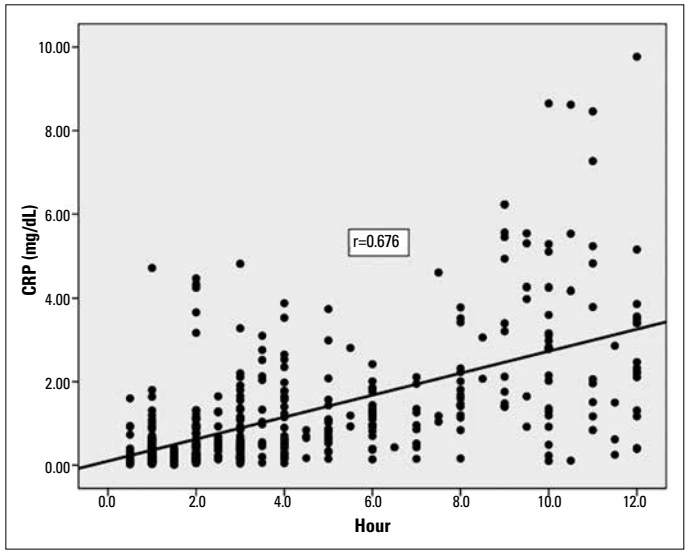

Figure 2. Correlation table. There is a good correlation between CRP levels (mg/dL) and symtom-to-door time (r=0.676), (Pearson correlation analysis)

Correlation and ROC analysis

There was a good correlation between the StD time after STEMI and CRP levels (Fig. 2) (r=0.676). ROC analysis of the predictive value of CRP for the third hour was determined as 0.78 mg/dL, respectively. The area under the curve was calculated as 0.824 and 95% confidence interval (CI) was calculated as 0.785-0.859. 73.9% sensitivity, 95% CI (67.3%-79.8%) and 78.1% specificity, 95% CI (72.2%-83.2%), were determined respectively (p<0.001) (Fig.3).

Coronary angiography and echocardiography

When coronary angiography examinations were evaulated, there was no difference in the infarct related artery and lesion levels. There weren't any differences between the groups in terms of the localization of STEMI (Table 2) and SS means (Table 1). There weren't any significant differences between groups according to the ejection fraction, LVM and LVMI means (Table 1).

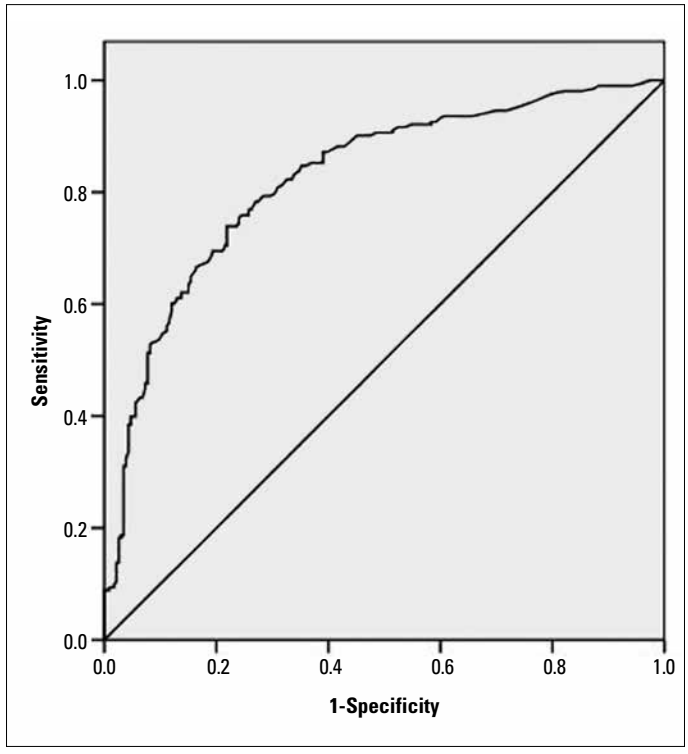

Figure 3. ROC analysis. In our study, patients were divided into two groups as the patients admitted in the first three hours and the ones admitted after the first three hours, and ROC analysis was performed. In ROC analysis, the estimation value of the third hour was determined as 0.78 mg/dL. [Sensitivity 73.9% (95% CI 67.3%-79.8)]. Specificity 78.1% (95% CI 72.2%-83.2). AUC 0.824 (95% CI 0.785-0.859). (Cut-off >0.78) (p<0.001)

Table 2. Angiographic findings of the patients. There were no difference between groups in terms of responsible arteries, arterial diameters, revascularization methods and the placement of the proximal lesions

	Group 1 (n=97)	Group 2 (n=136)	Group 3 (n=98)	Group 4 (n=105)	*P
RCA, n (%)	36 (40.0%)	52 (40.3%)	32 (34.8%)	41 (42.7%)	0.84
RCA proximal, n (%)	17 (47.2%)	24 (46.1%)	17 (53.1%)	18 (43.9%)	0.28
Cx, n (%)	12 (13.3%)	22 (17.1%)	13 (14.1%)	12 (12.5%)	0.84
Cx proximal, n (%)	5 (41.6%)	8 (36.3%)	5 (38.4%)	4 (33.3%)	0.67
LAD, n (%)	42 (53.7%)	54 (41.9%)	47 (48.8%)	43 (52.1%)	0.84
LAD proximal, n (%)	20 (47.6%)	29 (53.7%)	21 (44.6%)	19 (44.1%)	0.33
Vessel diameter in lesion, mm	3.19 (±0.48)	3.25 (±0.41)	3.23 (±0.47)	3.05 (±0.43)	0.06
Coronary ectasia, n (%)	4 (4.4%)	8 (6.2%)	6 (6.5%)	5 (5.2%)	0.92
Only PTCA or medical treatment, n (%)	13 (13.4%)	14 (10.6%)	15 (15.2%)	17 (12.8%)	0.22
PPCI (PTCA+STENT), n (%)	72 (74.2%)	108 (79.4%)	76 (77.6%)	77 (73.3%)	0.83
PPCI+CABG, n (%)	12 (12.4%)	14 (10.3%)	7 (7.1%)	11 (10.5%)	0.13
Anterior MI, n (%)	41 (42.3%)	51 (37.5%)	49 (50.5%)	50 (47.6%)	0.25
Inferior MI, n (%)	27 (27.8%)	46 (33.8%)	19 (19.4%)	24 (22.9%)	0.11
RV-MI, n (%)	29 (29.9%)	39 (28.7%)	30 (30.6%)	31 (29.5%)	0.52

Data presented as number (percentage)
*Chi-squre test
CABG - coronary artery bypass surgery; Cx - circumflex artery; LAD - left anterior descending artery; MI - myocardial infarction; PPCI - primary percuteneous coronary intervention; RCA - right coronary artery; RV-MI - right ventricular- myocardial infarction

Table 3. It was observed that the mortality rate and ventricular arrhythmias in the first three-month period, in and after hospital, was the highest in the fourth group. There was no statistically significant difference in terms of other complications and treatment protocols

	Group 1 (n=97)	Group 2 (n=136)	Group 3 (n=98)	Group 4 (n=105)	*P
Mortality, three months, n (%)	2 (2.1%)	5 (3.7%)	7 (7.1%)	11 (10.5%)	0.034
Mortality, in hospital, n (%)	2 (2.1%)	4 (2.9%)	6 (6.1%)	9 (8.5%)	0.048
Ventricular tachycardia, in hospital, n (%)	9 (9.2%)	18 (13.2%)	18 (18.3%)	20 (19.0%)	0.043
Ventricular fibrillation, in hospital, n (%)	6 (6.1%)	9 (6.6%)	15 (11.0%)	17 (16.1%)	0.016
*Atrioventricular block, in hospital, n (%)	11 (11.3%)	22 (16.1%)	12 (12.2%)	16 (15.2%)	0.69
Re-MI, three months, n (%)	7 (7.2%)	5 (3.6%)	3 (3.0%)	8 (7.6%)	0.28
Statin, n (%)	88 (90.7%)	118 (86.7%)	88 (89.7%)	91 (86.6%)	0.83
Acetylsalicylic acid, n (%)	93 (95.8%)	133 (97.7%)	95 (96.9%)	102 (97.1%)	0.65
Clopidogrel, n (%)	96 (98.9%)	135 (99.2%)	94 (95.9%)	101 (96.1%)	0.95
ACE/ARB, n (%)	89 (91.7%)	121 (88.9%)	92 (93.8%)	94 (89.5%)	0.83
Beta blocker, n (%)	80 (82.4%)	113 (83.0%)	85 (86.7%)	90 (85.7%)	0.70

Data presented as number (percentage)
*Chi-squre test
ACE - angiotensin converting enzyme; ARB - angiotensinogen receptor blocker; Re-MI - myocardial re-infarction.
*;1th, 2nd, 3rd degree.

Cardiac complications

The mortality rates were higher in the G4 in the three-month period in and after hospital (p=0.048 in hospital and the first three months after hospital p=0.034) (Table 3). Ventricular tachycardia (VT) and ventricular fibrillation (VF) ratios in the G4 group within the in hospital period were higher than the other groups (p=0.043 and p=0.016). There was no statistically significant difference in terms of other complications, and treatment protocols (Table 3).

Discussion

In this study, we aimed to show the importance of the relationship between the StD time of the patients admitted to our center with a diagnosis of STEMI and their CRP levels. CRP, one of acute-phase reactants, is synthesized mainly in the liver. CRP is also known to be produced in smooth muscles of coronary arteries, atherosclerotic lesions and endothelium of large vessels apart from the liver (11, 15). After STEMI, CRP levels in blood

are rapidly increasing due to the severity of the atherosclerotic plaque and the inflammation in myocardial tissue that has a blood flow cut (5, 7, 16). While the myocardial necrosis area gets larger, the intensity of inflammation also grows. This rapid and sudden increase in inflammation itself also damages the myocardial tissue. Roubille et al. (9) indicate that inflammatory biomarkers might contribute to the risk stratification after myocardial infarction. In their study, they showed that the blood levels of biomarkers such as brain natriuretic peptide (BNP), and CRP rised rapidly after myocardial infarction. In our study there were no statistically significant difference in CRP means between the G1-G2 and G2-G3 groups (p=0.398 and p=0.08). There were statistically significant differences between the G1-G3 (p=0.002), G1-G4 (p<0.001), G2-G4 (p<0.001) and G3-G4 groups (p<0.001). The G4 had more CRP average than the other groups. The differences between the CRP means got apparent as the StD time was longer. There was a good correlation between CRP levels and StD time (Fig. 2) (r=0.676). It was detected that CRP levels significantly increased as a parallel to the increase in StD time (p<0.001) (Fig.1).

After STEMI, myocardial tissue can be recovered significantly with an early intervention. To know the StD time, from the onset of symptoms to the admission, is important in term of selecting the appropriate investigation and treatment. Today, the medical and interventional treatments are available for this purpose. In the publications related to myocardial revascularization, the benefits of revascularization performed via medical or interventional procedures in the early stages are highlighted. It is indicated that patients get the highest benefits via re-establishing coronary flow within the first three hours. In addition to this, thrombolytic therapy in patients admitted in first three hours is known to be as effective as primary percutaneous coronary intervention (PPCI). As the time progresses, the superiority of PPCI arises (12, 13, 17). In our study, patients were divided into two groups as; the patients admitted in the first three hours and the ones admitted after the first three hours, and ROC analysis was performed. In ROC analysis, the estimation value of the third hour was determined as 0.78 mg/dL (Fig. 2). This value was found to be approximately 1.5 times of the cut-off value of the used CRP kit. 1.5 times increase of CRP value may be helpful to show that StD time has exceeded three hours.

There was no difference in terms of the localization of infarction and the location of the responsible lesion in the coronary artery between groups (Table 2). As well as these data, CRP reflected myocardial injury (6, 13). LVM and LVMI values were calculated by using the Devereux formula in order to assess the relationship between the myocardial mass and the CRP differences in two groups (14). There was no difference between LVM and LVMI values in echocardiographic calculations (Table 1). There was no difference in terms of responsible artery, arterial diameter, and the placement of the proximal lesion (Table 2). It was concluded that CRP differences between the groups were not associated with the different localization of the increased cardiac mass or lesion. Furthermore, the prevalence of coronary artery disease can be evaluated with SS and may be used in the selection of appropriate methods of revascularization (18, 19). It was shown by Palmerini et al. (20) that SS previously used in patients with stable coronary artery could also be used in ACS patients (20). As the CRP elevation had a relationship between the prevalence of coronary artery disease, SS were also calculated in the study. There were not any significant differences between the means of SS of the groups (p=0.24). According to these results, CRP elevation in our study is associated with the prolongation of StD time rather than the prevalence of CAD.

It is stated that CRP levels after STEMI is a strong predictor of cardiac complications that may arise in the future (9, 14, 21, 22). In our study, it was observed that the mortality rate and ventricular arrhythmias in the first three-month period, in and after hospital, was the highest in the G4 group. This result shows the importance of early revascularization. There is a significant relationship between the StD time after STEMI and the severity of cardiac pathologies (Table 3). High CRP levels in the first reference period are determined as an important finding in terms of showing that it could increase the incidence of cardiac complications.

Study limitations

CRP levels in the blood are associated with the size of the infarction area. In this study, the size of patients' areas of infarction could not be detected. The patients could be followed for a period of three months. This period may not be sufficient in order to detect the complications that may develop over time.

Conclusion

As a result, there is a significant relationship between StD time after STEMI and CRP levels in blood. StD time can be estimated by measuring the blood CRP levels during the first application period. It is beneficial to take the CRP levels into consideration in terms of directing the examination and treatment of patients.

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