Original Article

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A Study of Concentration of hsCRP and Troponin T in NSTEMI and STEMI Patients

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Abstract

Aim: Our recent studies have shown that to investigate the concentration of hsCRP and Troponin-T in NSTEMI and STEMI patients. Myocardial infarction is the impairment of heart function due to inadequate blood flow to the heart compared to its need, caused by obstructive changes in the coronary circulation to the heart. Cardiac Troponin T is a twin filament protein which takes part in cardiac muscle contraction. Cardiac Troponin T is not normally present in serum unless cardiac cell necrosis has occurred. High sensitivity C-reactive protein, a systemic inflammatory marker is considered to be an independent risk marker of cardiovascular disease. *Design/Methods:* Acute myocardial infarction was studied in three groups, namely Control, NSTEMI and STEMI patients. *Results:* In NSTEMI and STEMI groups, mean serum levels of hsCRP and Troponin T is higher than the mean serum control group. *Discussion:* The serum levels of hsCRP and Troponin T were significantly increased in first, second and third day of NSTEMI and STEMI myocardial infarction patients compared with control normal subjects. *Conclusions:* The concentration of hsCRP and Troponin T is a useful index, not only in the diagnosis and prognosis, but also in some critical situations of taking some important decisions.

Keywords: hsCRP; Troponin-T; ST Segment elevation Myocardial infarction; Non-ST Segment elevation Myocardial infarction.

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Introduction

Coronary heart disease and its major manifestations myocardial infarction, which in turn results when blood supply is so much deprived sufficient to cause focal or massive necrosis of cardiac muscle was a medical rarity prior to first World War.[1,2]

WHO has declared CVD as a modern epidemic. Myocardial infarction is myocardial necrosis occurring as a result of critical imbalance between coronary blood supply and myocardial demand. Myocardial infarction is the "impairment of heart function due to inadequate blood flow to the heart compared to its need, caused by obstructive changes in the coronary circulation to the heart." In more than 90% of cases, the cause of myocardial ischemia is reduced blood flow due to obstructive atherosclerotic plaque lesions in one of the three large coronary arteries or its branches.[3]

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The possibility of suffering acute myocardial infarction in this age group is 8 times higher than in people of a less advanced age. More than 50% of in hospital mortality from acute myocardial infarction occurs in subjects older than 65 years.[4]

Elderly patients with acute myocardial infarction have been reported to present with more atypical symptoms like atypical chest pain, dyspnea, giddiness and also have highest rate of complication like CCF, cardiogenic shock, arrhythmias with higher mortality. They are treated less aggressively than the younger.[5-9]

Although, chest pain is the most common presentation of acute myocardial infarction (AMI) in elderly patients, they are also known to present with atypical symptoms such as giddiness, dyspnea, vomiting, sweating and epigastric pain in the absence of chest pain.[10] Modifiable risk factors are serum lipids, lipoproteins, hypertension (HTN), diabetes mellitus (DM), smoking and tobacco chewing etc. Non-modifiable risk factors are age, sex, genetics, and family history.

Interestingly overtime, the patterns of MI presentation have changed as there is an increasing incidence of myocardial infarction without ST-segment elevation (NSTEMI), with concurrent decrease in the incidence of ST-segment elevation myocardial infarction (STEMI).[11]

Earlier LDL was thought to be a marker for risk of the disease and was later replaced by HDL. Now attention has been directed towards identifying components of HDL because there was inconsistency in correlation between HDL and risk of coronary heart disease.[12]

The availability of serum cardiac markers with markedly enhanced sensitivity for myocardial damage enables to diagnosis AMI in about one-third of patients who would not have fulfilled the criteria for myocardial infarction.

Troponin is a protein complex that confers calcium sensitivity to muscle. Troponin has three subunits cTnI, cTnT and Tnc. Cardiac Troponin T is a twin filament protein which takes part in cardiac muscle contraction. It is not normally present in serum unless cardiac cell necrosis has occurred. Thus, it is more cardiac specific. Recent studies have shown that Cardiac Troponin T measurements acts as a specific and sensitive indicator of myocardial infarction and the prognostic value of the Cardiac Troponin T is independent of other risk factors such as age, sex and ECG abnormalities.[13]

Atherosclerosis is an inflammatory process. hsCRP role in atherosclerosis is proven in many studies and hsCRP was the strongest uni variate predictor of the risk of cardiovascular event. Amongst the markers for this vascular inflammation high sensitive C reactive protein (hs-CRP) has been found to be the most credible, consistent and sensitive conformed by innumerous studies conducted at various centers all over the world. Hs-CRP is also economical and easily available, hence feasible for any setup.[14]

High sensitivity C-reactive protein (hsCRP), a systemic inflammatory marker, is considered to be an independent risk marker of cardiovascular disease.[15] hsCRP concentrations predict vascular risk even when cholesterol concentrations are low and also patients with low LDL-C and high hsCRP are at a higher risk of future coronary events.[16]

Materials and Methods

Chemicals

Troponin T and hsCRP kits were purchased from immune diagnostic kits, USA and all the other chemicals used were of analytical grade.

Experimental Design

Ninety patients in the 40-60 age group admitted in the intensive care unit of Meenakshi Medical College Hospital and Research Institute, Kanchipuram, Tamil Nadu for the study. The study was conducted during the period from January 2018 to December 2018. This includes 60 male and female patients with acute myocardial infarction in whom a provisional diagnosis was made with specific change in electrocardiogram, indicating STEMI patients. Patients demographic data, including sex, age, and risk factors for cardiac events including high-risk age (men >45, women >55 years old), smoking history, medical history of hypertension, hyperlipidemia, diabetes, and a positive family history, drug history, presence of arrhythmia, laboratory data, ECG, and echocardiography findings were recorded. An informed consent was obtained from all the subjects participating in the present study.

The patients were divided into three groups are included:

Group- I: Patients were ultimately discharged in good condition (control)

Group- II: Patients were admitted with NSTEMI myocardial infarction patients

Group-III: Patients were admitted with STEMI myocardial infarction patients

ECG

Twelve leads electrocardiography was done to all patients using a United States of America made Philips ECG model page writer 2002 HP 6550. Interpretation was done by the investigator with assistance of experienced cardiologist.

Biochemical parameters

Serum hsCRP and serum Troponin T were the biochemical parameters estimated in the study population by using Immunoenzymometric assay.

Collection of blood sample

The blood samples of the respondents were collected after an overnight fast. The blood drawn was allowed to coagulate and the serum was separated by centrifuging and stored at –20°C until assayed.

Statistical Analysis

Data were analyzed using the SPSS software package, version 17.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed using range, mean, SD, and median, whereas qualitative data were expressed as frequency and percentage. Qualitative data were analyzed using the χ^2 -test; also, exact tests such as Fisher's exact were used to compare the two groups. Non-normally distributed quantitative data were analyzed using the Mann–Whitney test to compare the two groups. The Pearson coefficient was used to analyze the correlation between any two variables. P value was assumed to be statistically significant at 0.05.

Ethical Concern

Ethical clearance was obtained from the Ethical committee meeting conducted at Meenakshi Medical College and Hospital Kanchipuram.

Results

Presentation according to ECG in myocardial infarction patients

Table 1 shows the presentation according to ECG in myocardial infarction. This table demonstrates the percentage of STEMI, NSTEMI of male and female in myocardial infarction patients attending Meenakshi Medical College, Enathur, Kanchipuram. The percentage of presentation according to ECG with male STEMI, Male NSTEMI, Female STEMI and Female NSTEMI levels were respectively 74%, 26%, 71% and 29%.

Table 1: Presentation according to ECG in myocardial infarction patients

Gender	STEMI	NSTEMI
Male	39 (74%)	14 (26%)
Female	5 (71%)	2 (29%)

Presentation according to ECG variation in first three days STEMI and NSTEMI patients

Table 2 shows the presentation according to ECG variation in first three days in myocardial infarction patients. In first day STEMI patients ECG variation significantly increased compared to second and third days but no significantly changes in NSTEMI patients entire three days.

Table 2: Presentation according to ECG variation in first three days STEMI and NSTEMI patients

Days	STEMI	NSTEMI
First	Increased	No change
Second	Slightly decreased	No change
Third	Decreased	No change

hsCRP in Myocardial infarction patients

In our study, the three categories of hsCRP values were classified. The observed mean hsCRP values of first day of Normal, STEMI and NSTEMI myocardial infarction patients were 0.82 ± 0.08, 2.21 ± 0.21 and 2.22 ± 0.22 respectively. In second day observed mean hsCRP values of Normal, STEMI and NSTEMI myocardial infarction patients were 0.82 ± 0.08, 2.43 ± 0.23 and 2.4 ± 0.23 and third day observed mean hsCRP values of Normal, STEMI and NSTEMI myocardial infarction patients were 0.81 ± 0.08, 2.47 ± 0.25 and 2.18 ± 0.25 as shown in **Figure 1.** The levels of hsCRP in STEMI and NSTEMI myocardial infarction patients were significantly increased (p > 0.001) when compared with normal control groups. In first two days STEMI patients were no significance when compared with NSTEMI patients but third day were significantly (p > 0.001) decreased NSTEMI patients compared with STEMI patients.

Troponin -T in Myocardial infarction patients

Table 3: Troponin -T in Myocardial infarction patients

Days	Control	STEMI	NSTEMI
First	0.014 ± 0.001	2.47 ± 0.26a*	2.55 ± 0.24b#
Second	0.013 ± 0.001	1.26 ± 0.13a*	1.81 ± 0.15b#
Third	0.014 ± 0.001	0.71 ± 0.06a*	0.69 ± 0.06bNS

Each value is expressed as mean ± SD for ninty patients sample
a : as compared with Normal control group
b : as compared with STEMI Group
Statistical significance: *p < 0.001 @ p < 0.01 #p < 0.05, NS - Not significant

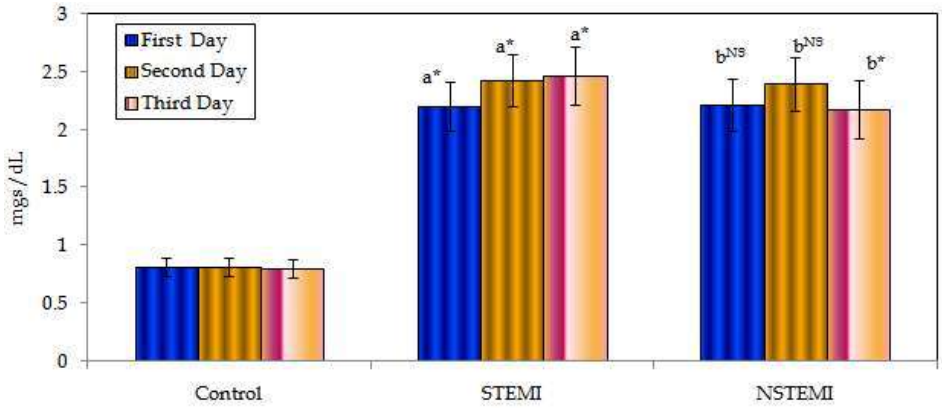

Fig. 1: hsCRP in MI Patients

Each value is expressed as mean + SD for ninety patients sample
a : as compared with normal control group
b : as compared with STEMI group
Statistical significance: *p < 0.001 @p < 0.01 #p < 0.05, NS — Not significant

The observed results in Table 3 clearly reveals that the three categories of Troponin -T values were classified. The observed mean Troponin-T values of first day of Normal, STEMI and NSTEMI myocardial infarction patients were 0.014 ± 0.001, 2.27 ± 0.26 and 2.55 ± 0.24 respectively. In second day observed mean Troponin-T values of Normal, STEMI and NSTEMI myocardial infarction patients were 0.013 ± 0.001, 1.26 ± 0.13 and 21.81 ± 0.15 and in third day observed mean Troponin-T values of Normal, STEMI and NSTEMI myocardial infarction patients were 0.014 ± 0.001, 0.71 ± 0.06 and 0.69 ± 0.06 as shown in Table 3.

Discussion

MI is myocardial necrosis occurring as a result of critical imbalance between coronary blood supply and myocardial demand. Myocardial infarction is the "impairment of heart function due to inadequate blood flow to the heart compared to its need, caused by obstructive changes in the coronary circulation to the heart." In more than 90% of cases, the cause of myocardial ischemia is reduced blood flow due to obstructive atherosclerotic plaque lesions in one of the three large coronary arteries or its branches.

Despite impressive strides in diagnosis and management over the last three decades, acute myocardial infarction continues to be a major public health problem in the industrialized world. Although the death rate of MI has declined by about 30% over the last decade, its development is still a fatal event in approximately one-third of the patients.

Prospective epidemiological studies have identified several independent coronary risk factors including smoking, dyslipidemia, hypertension and diabetes mellitus. However half of all myocardial infarctions occur in persons in whom plasma lipid levels are normal. With the recognition that atherosclerosis is an inflammatory process, several plasma markers of inflammation have also been evaluated as potential tools for prediction of the risk of coronary events.

Presentation of MI according to Age

In the present study shows agewise distribution of controls, STEMI and NSTEMI myocardial infarction cases. It included healthy controls with mean age of 48.8 ± 5.3 years, STEMI myocardial infarction cases with mean age of 56.7 ± 6.2 years and NSTEMI myocardial infarction cases with mean age of 57.1 ± 6.3 years.

In patients with STEMI male and female percentage in the present study was (66% and 50%) was comparable with Muellar *et al.*[17] (67% and 51.2%). In patients with NESTEMI, males and female percentage in the present study was 26.6% and 57.1% comparable with Muellar *et al.*[17]

Presentation of MI

About 18.33% of patients with myocardial infarction presented without chest pain (atypical symptoms)

on initial evaluation. Patients experiencing MI without chest pain tended to be older (mean age 64 vs 59) remaining 81.67% of patients with myocardial infarction with chest pain. Chest pain has been reported as the cardinal clinical feature among patients who present with a myocardial infarction. The WHO requires the presence of chest pain as one of the cornerstones features in its diagnosis of myocardial infarction. The rapid early action for coronary treatment study, a randomized controlled clinical trial sponsored by National Institute of health, was designed in Part to test the effect of educating the public about the symptoms of MI and benefits of early treatment.

Presentation according to ECG in MI Patients

The present guidelines pertain to patients presenting with ischemic symptoms and persistent ST-segment elevation on the electrocardiogram (ECG). Most of these patients will show a typical rise in biomarkers of myocardial necrosis and progress to Q-wave myocardial infarction.

Separate guidelines have recently been developed by another Task Force of the ESC for patients presenting with ischemic symptoms but without persistent ST-segment elevation and for patients undergoing myocardial revascularization in general.

In the present study shows that 16 patients (17.77%) presented with NSTEMI. In this group, 14 patients were males (18.2%) and 2 patients were females (15.4%). In 44 patients presented with STEMI symptoms of ECG. In this group, 39 patients were males (50.6%) and 5 patients were females (38.5%).

We have documented a pronounced gender difference with females far out numbering men in the incidence of atypical presentation. (Though statistically not significant may be because of small sample size) This is similar to the results found in the study conducted by Muller RT *et al.*[17]

hsCRP in Myocardial infarction patients

Several acute phase reactants, cytokines, and soluble cellular adhesion molecules have been implicated in this process, with their plasma concentrations increased in a variety of atherosclerotic disease. Furthermore, several prospective studies have shown that hsCRP is a predictor of increased risk for MI, stroke or peripheral vascular disease in asymptomatic individuals with no known coronary heart disease. Moreover, in the physicians health study, among low-risk individuals, hsCRP levels within the normal range were linearly related to the incidence of myocardial infarction over a follow-up period of 8 years.

In our study, the three categories of hsCRP values were classified. The observed mean hsCRP values of first day of Controls, STEMI and NSTEMI myocardial infarction patients were 0.82 ± 0.08, 2.21 ± 0.21 and 2.22 ± 0.22 respectively. In second day observed mean hsCRP values of Normal, STEMI and NSTEMI myocardial infarction patients were 0.82 ± 0.08, 2.43 ± 0.23 and 2.4 ± 0.23 and third day observed mean hsCRP values of Normal, STEMI and NSTEMI myocardial infarction patients were 0.81 ± 0.08, 2.47 ± 0.25 and 2.18 ± 0.25.

In the present study, The levels of hsCRP in STEMI and NSTEMI myocardial infarction patients were significantly increased ($p > 0.001$) when compared with normal control groups. In first two days STEMI patients were no significance when compared with NSTEMI patients but third day were significantly ($p > 0.001$) decreased NSTEMI patients compared with STEMI patients.

In our study, the levels of hsCRP was found to be significantly elevated ($p < 0.001$) compared with controls. Ridkar PM[15] in his Physician's Health study (prospective study) found higher baseline hsCRP levels were associated with the risk of MI. Benjamin & Ridkar[16] concluded that highest quartile of hsCRP had 3 times the risk of MI than in lowest quartile. Increased concentration of hsCRP was strongly associated with the development of heart failure and risk of death in 30 days. These risks were stable over long periods and were independent of other lipid and non-lipid risk factors.

Anderson in his prospective study showed hsCRP level is fourfold increased than in controls. The proposed increase in hsCRP levels may probably the result of immune activation related to the atherogenic process, the inflammatory mechanisms that lead to acute coronary events and the inflammatory response associated with the necrotic myocardial cells in the post ischemic or reperfused myocardium.

However in patients with CRP levels more than 10 mg/dl other causes of inflammation must be sought for. Thus with this in view, estimation of hsCRP plays an important role in cardiovascular risk detection. This data suggests a strong correlation between high hsCRP and MI. Various studies done across the world have projected similar results.

Troponin -T in myocardial infarction patients

Acute coronary syndrome (ACS) is a term used

to describe a group of conditions resulting from insufficient blood flow to the heart muscle. These conditions range from atypical chest discomfort and nonspecific electrocardiographic changes to a large ST-segment elevation, myocardial infarction and cardiogenic shock.

Troponin T is a member of a group of cardiac regulatory proteins which function to regulate the calcium mediated interaction of muscle filaments actin and myosin resulting in contraction and relaxation of striated muscle.

Troponin T is almost exclusive to the myocardium, with small amounts expressed in skeletal muscle. Insufficient blood flow and oxygen supply to the heart muscle causes necrosis of the myocardium and subsequent release of Troponin T into the bloodstream.

Katus *et al.*[18] Reported 1989 Troponin T in the bloodstream rises to detectable levels after 4–6 hours, peaks at 10–12 hours and can be detected for up to 14 days post infarction.

In the present study, patients with elevated Troponin -T levels on admission had higher incidence of death (15.1%). It was comparable to that of the study by Katus *et al.*[18]

Katus *et al.*[18] showed Troponin T prognostic significance for acute myocardial infarction or death in the same patients with NSTEMI and STEMI. The marker is a sensitive and specific, as confirmed by meta-analysis, and this supports a role in risk stratification.

The observed mean Troponin-T values of first day of Normal, STEMI and NSTEMI myocardial infarction patients were 0.014 ± 0.001, 2.27 ± 0.26 and 2.55 ± 0.24 respectively. In second day observed mean Troponin-T values of Normal, STEMI and NSTEMI myocardial infarction patients were 0.013 ± 0.001, 1.26 ± 0.13 and 1.81 ± 0.15 and in third day observed mean Troponin-T values of Normal, STEMI and NSTEMI myocardial infarction patients were 0.014 ± 0.001, 0.71 ± 0.06 and 0.69 ± 0.06**.** The levels of Troponin T in STEMI and NSTEMI myocardial infarction patients were significantly increased in three days ($p > 0.001$) when compared with normal control groups. In first day STEMI patients were no significance when compared with NSTEMI patients. In second day NSTEMI patients were significantly ($p > 0.001$) increased when compared with STEMI patients but third day were no significance NSTEMI patients compared with STEMI patients.

In the present study, the levels of Troponin T in STEMI and NSTEMI myocardial infarction patients were significantly increased in three days ($p>0.001$) when compared with normal control groups. In first day STEMI patients were no significance when compared with NSTEMI patients. In second day NSTEMI patients were significantly ($p>0.001$) increased when compared with STEMI patients but third day there were no significance NSTEMI patients compared with STEMI patients.

Conclusion

The data obtained from the present study suggest that prognostic marker of hsCRP and Diagnostic marker of Troponin-T may be an important markers for differentiate STEMI and NSTEMI the myocardial infarction patients.

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