

Short-term Prognostic Value of Admission Cardiac Troponin T, C-Reactive Protein and Echocardiographic Regional Wall Motion Abnormalities in Patients with Acute ST Elevation Myocardial Infarction

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ABSTRACT

Introduction: With increasing burden of Coronary Artery Disease (CAD) and ST-Elevation Myocardial Infarction (STEMI) in India, early risk stratification of patients is as important as making a correct diagnosis. Cardiac Troponin T (cTnT), C-Reactive Protein (CRP) and echocardiographic Regional Wall Motion Abnormalities (RWMA) are used to assess the patients of STEMI at presentation. The short term prognostic importance of these parameters also need to be known.

Aim: To study the prognostic values of admission cTnT, CRP and echocardiographic RWMA in patients with acute STEMI.

Materials and Methods: Fifty patients of STEMI were evaluated from January 2017 to July 2017 by Troponin-T (positive >0.18 ng/mL), CRP (positive >3 mg/L) and echocardiography (positive with presence of RWMA) on day one. The patients were divided into three groups: Group 1: patients with all the three parameters positive, Group 2: patients with all three parameters negative, Group 3: patients with one or two parameters positive. The

end points observed were heart failure Left Ventricular Ejection Fraction (LVEF) <40% assessed by Echocardiography (ECG) at day 28, significant ventricular ectopics (>class II by Lown's classification) and mortality at day 30 in the groups. Chi-square test for equality of proportions was used to analyse the difference in outcome in the groups.

Results: The mean age of patients was 54 years. There were 25 (50%) patients in group 1, 14 (28%) patients in group 2 and 11 (22%) patients in group 3. Twelve (24%) patients had heart failure with 9 (18%) in group 1 and 3 (6%) in group 3 ($p<0.05$). The 9 (18%) patients had significant ventricular ectopics with 8 (16%) patients in group 1 and 1 (2%) patients in group 3 ($p<0.05$). Mortality was found in 9 (18%) patients with 8 (16%) patients in group 1 and 1 (2%) patients in group 3 ($p<0.05$).

Conclusion: Acute STEMI with high cTnT, CRP and presence of RWMA on ECG at admission need more aggressive management and close follow-up.

Keywords: Coronary artery disease, Heart failure, Heart patients, Ventricular ectopics

INTRODUCTION

Coronary Artery Disease (CAD) is considered as a major cause of mortality in India and worldwide [1]. Previous studies have reported that about 40-60% patients with Acute Coronary syndrome (ACS) have STEMI. Several studies from different regions of India have showed that Indians with ACS have higher proportion of STEMI compared to developed countries [2-5]. The health economy in India is a reflection of mixed economy and as a result these patients who come from low socio-economic background and with delayed presentation are less likely to get evidence based treatment and thus have higher 30 day mortality [6].

Early risk stratification of STEMI is as important as making a diagnosis and it is usually done at the time of first medical contact. Coronary angiography is the gold standard for risk stratification of these patients. But the problem in India is that usually the patients first present at primary or secondary care centers, which are usually not equipped with advanced techniques for coronary angiography to be performed [6].

The cTnT is the most reliable for diagnosis of STEMI. Also, there is evidence suggesting that elevated cTnT at admission is associated with an increased cardiac risk in patients with STEMI [7-10]. Similarly inflammatory marker CRP level at admission can also be used as a prognostic marker in patients with STEMI [11,12]. Two dimensional echocardiography non invasive and relatively inexpensive technique can also provide prognostic information in STEMI [13,14]. Even

though, there is evidence regarding the above mentioned parameters individually giving prognostic information in patients with STEMI, they have not been studied together. Thus, this study was planned to study the short term prognostic significance of admission cTnT, CRP and echocardiographic RWMA in patients with STEMI.

MATERIALS AND METHODS

This was a hospital-based observational study carried out in Department of Medicine in Hind Institute of Medical Sciences, Barabanki, Uttar Pradesh, India, from January 2017 to July 2017. The study was approved by the Institutional Ethical Committee (HIMS/IRB/2017/018), and written informed consent was obtained from each patient.

Inclusion criteria: Fifty patients of more than 18 years of age who had chest pain and discomfort for atleast 30 minutes and 12 lead Electrocardiography (ECG) with STEMI as per standard guidelines were included in the study.

Exclusion criteria: Patients who had renal failure, previous cardiac conditions or patients suffering from acute inflammatory conditions like hepatitis, pneumonia, septicaemia, meningitis or any major trauma or burns were excluded from the study.

All the patients reaching the Outpatient Department of the study centre during the time period mentioned, fulfilling the inclusion criteria and gave consent for participating in the study, formed the sample for the present study.

Socio-demographic data and clinical history of all participants were recorded, and all patients were physically examined. Venous blood sample was taken from all patients at admission for cTnT and CRP measurement. cTnT was measured by third generation electrochemiluminescence Roche Boehringer Mannheim Germany system by sandwich principle. Cut-off point of 0.18 ng/mL was taken as mentioned in the kit. The CRP was measured by immunoturbidometric test and cut-off point of 3 mg/L was taken [15]. Transthoracic echocardiography was done in all patients at admission and assessed for presence or absence of RWMA.

The patients were then divided into three groups according to the positive result of the following parameters:

1. cTnT: positive ≥ 0.18 ng/mL, negative < 0.18 ng/mL
2. CRP: positive ≥ 3 mg/L, negative < 3 mg/L
3. RWMA on echocardiography present then positive and if absent than negative.

Group 1: patients having all three parameters positive.

Group 2: patients having all the parameters negative.

Group 3: patients having one or two parameter positive.

All the patients were observed for 30 days and the end points observed were heart failure which was defined as LVEF $< 40\%$ on ECG done at day 28 of admission. If the patient died before this, then the LVEF recorded during the first ECG done at day one was considered.

The second outcome was presence of ventricular ectopics defined as greater than or equal to class 2 of Lown's classification of ventricular ectopics as was mentioned in the study of Lown B and Wolf M [16]. The third outcome was mortality at day 30 in various groups.

STATISTICAL ANALYSIS

Statistical analysis of data was performed using the Statistical Package for the Social Sciences (SPSS) version 20.0 (SPSS Inc., Chicago, IL, USA) software. Continuous variables were expressed as mean and standard deviation, and categorical variables were expressed in percentages. Chi-square test for equality of proportions was used to analyse the difference in outcome in various groups. The independent sample t-test was used to compare the two mean in the groups. The level of statistical significance was 0.05, and the confidence interval was 95%.

RESULTS

The clinical and demographic characteristics of the patients are in [Table/Fig-1]. The mean duration of chest pain in the patients was 7 hours. The mean cTnT was 2.5 ± 3.4 ng/mL and mean CRP was 10.3 ± 10.4 mg/L in the patients. Out of the 50 patients, 32 (64%) had positive cTnT, 32 (64%) had positive CRP and 34 (68%) had presence of RWMA on echocardiography [Table/Fig-2]. There were 25 (50%) patients in group 1, 14 (28%) in group 2 and 11 (22%) in group [Table/Fig-3].

Heart failure: Total 12 (24%) patients had heart failure with 9 (18%) in group 1 and 3 (6%) in group 3 ($p < 0.008$) [Table/Fig-4]. The mean cTnT was 4.19 ± 2.9 ng/mL, mean CRP was 20.8 ± 14.6 mg/L and mean EF was $28 \pm 8\%$. A comparison of mean cTnT and mean CRP of patients without heart failure was done and the difference was found significant with CRP ($p < 0.0001$) and not with cTnT ($p = 0.174$) [Table/Fig-5]. Eleven (22%) patients with heart failure had presence of RWMA on admission.

Ventricular ectopics: Total 9 (18%) patients had significant ventricular ectopics with 8 (16%) in group 1 and 1 (2%) in group 3 ($p < 0.011$) [Table/Fig-4]. The mean cTnT was 4.4 ± 2.9 ng/mL, mean CRP was 22.7 ± 14.2 mg/L and mean EF was $29 \pm 10\%$. A comparison of mean cTnT and mean CRP of patients without LV ectopics was done and the difference was found significant with CRP ($p < 0.0001$) and not with cTnT ($p = 0.237$) [Table/Fig-5]. All patients with LV ectopics had RWMA on admission.

Parameter	Result	Percentage (%)
Age (years)		
(mean \pm SD)	54 \pm 7	
Age wise distribution of patients		
31-40 years	9	18
41-50 years	13	26
More than 50 years	28	56
Sex (M/F)	35/15	70/30
Duration of chest pain in hours		
(mean \pm SD)	7.15 \pm 2	
Smokers	25	50
Medical history		
Diabetes mellitus	16	32
Hypertension	27	54
Diagnosis		
Anterior wall STEMI	29	58
Inferior wall STEMI	17	34
Lateral wall STEMI	4	8
cTnT (ng/mL)		
Mean value in ng/mL	2.5 \pm 3.4	
a. Positive (> 0.18 ng/mL)	32	64
b. Negative (< 0.18 ng/mL)	18	36
CRP (mg/L)		
Mean value in mg/L	10.3 \pm 10.4	
a. Positive (> 3 mg/L)	32	64
b. Negative (< 3 mg/L)	18	36
Echocardiography at admission		
a. RWMA present	34	68
b. RWMA absent	16	32

[Table/Fig-1]: Clinical and demographic characteristics of the patients.

STEMI: ST elevation myocardial infarction; cTnT: Cardiac troponin T; CRP: C-reactive protein; RWMA: Regional wall motion abnormalities

Diagnosis	Troponin T positive (> 0.18 ng/mL) n=32 (%)	CRP positive (> 3 mg/L) n=32 (%)	Presence of RWMA n=34 (%)
Anterior wall STEMI	24 (75)	22 (69)	24 (71)
Inferior wall STEMI	6 (19)	10 (31)	9 (26)
Lateral wall STEMI	2 (6)	0	1 (3)

[Table/Fig-2]: Distribution of patients with positive Troponin T, CRP and presence of RWMA on echocardiography.

STEMI: ST-elevation myocardial infarction; CRP: C-reactive protein; RWMA: Regional wall motion abnormalities

Diagnosis n=50	Group 1 n=25 (%)	Group 2 n=14 (%)	Group 3 n=11 (%)
Anterior wall STEMI	17 (68)	3 (21)	9 (82)
Inferior wall STEMI	8 (32)	8 (57)	1 (9)
Lateral wall STEMI	0	3 (22)	1 (9)

[Table/Fig-3]: Distribution of patients in various groups.

Comparative analysis of the groups	LV EF < 40 (n=12)	Ventricular ectopics (n=9)	Mortality at 30 days (n=9)
Group 1 (n=25)	9 (75%)	8 (89%)	8 (89%)
Group 3 (n=11)	3 (25%)	1 (11%)	1 (11%)
Chi-square and p-value	6.98 $p = 0.008$	6.46 $p = 0.011$	6.46 $p = 0.011$

[Table/Fig-4]: Outcome in various groups.

LV EF: Left ventricular ejection fraction

Mortality: Mortality was found in 9 (18%) patients, with 8 (16%) in group 1 and 1 (2%) in group 3 ($p < 0.011$) [Table/Fig-4]. The mean cTnT was 4.1 ± 2.9 ng/mL, mean CRP was 20.9 ± 14 mg/L and

Outcome	Mean CRP (mg/L)	Mean cTnT (ng/mL)
Heart failure	20.8 ±14.6	4.19±2.9
LVEF <40	7.5±6.5	2.54±3.8
LVEF >40	p<0.0001*	p=0.174
Ventricular ectopics	22.7±14.2	4.4±2.9
Present	7.7±6.2	2.9±3.5
Absent	p<0.0001*	p=0.237
Mortality	20.9±14	4.19±2.9
Present	7.5±5.9	2.54±2.5
Absent	p<0.0001*	p=0.08

[Table/Fig-5]: Comparison of mean CRP and mean cTnT in patients with and without complications.

CRP: C-reactive protein; cTnT: cardiac Troponin T; LVEF: Left ventricular ejection fraction
p* <0.05 statistically significant

mean EF was 29%. A comparison of mean cTnT and mean CRP of patients without mortality was done and the difference was found significant with CRP (p<0.001) and not with cTnT (p=0.08) [Table/Fig-5].

DISCUSSION

This observational study looked at short-term prognostic value of admission cTnT, CRP and RWMA on ECG in STEMI patients. There is no such study published where these three parameters together have been used in risk stratification for STEMI patients.

The mean age of patients was 54 years with predominant males, which is similar to mean age and sex distribution of STEMI patients reported in India (55 years) [2-5]. In the present study, 35% patients were below the age of 50 years. This result supports the fact that young Indians are more prone to CAD and STEMI compared to other populations. There has been a four-fold rise in the prevalence of CAD in last 40 years and the country is heading towards an epidemic of CAD [17]. The rise in prevalence in India is due to changing lifestyle and there is a need to evaluate the risk factors which are making Indians more prone to the disease [18]. Narang U et al., studied the risk factors and demographic profile in patients of acute myocardial infarction in North India. The study found that smoking, sedentary life, uncontrolled diabetes and low HDL cholesterol or High Density Cholesterol (HDL) were the most common conventional risk factors seen in younger population who had myocardial infarction [19].

The mean time delay was for about seven hours in the present study which is possibly responsible for about 18% mortality and complications like heart failure and ectopics in 24% and 18% patients respectively. Khan A et al., studied the determinants of delayed presentation of 1386 patients of STEMI and found that the problem of prehospital delay continues to remain a major hurdle in initiating timely reperfusion therapy in patients with STEMI in India. The major contributors are lack of awareness and poor transportation facilities [20].

Risk stratification of STEMI patients is as important as diagnosis. Various approaches have been described for risk stratification and coronary angiogram remains the gold standard. But the availability of coronary angiogram in India at all centres where STEMI patients are treated is a major problem [6]. The biomarker cTnT has been studied previously for its prognostic importance in STEMI and number of studies have been published in this regard. Prabhakaran SP et al., found that 46% patients with positive cTnT at admission developed complications mortality was seen in 12% patients at 30 days [7]. Yamini N et al., studied 50 patients of myocardial infarction and reported that cTnT not only is useful in diagnosis but also provides prognostic information in these patients [21]. Even the GUSTO II trial found that cTnT was significantly predictive of 30-day mortality in patients with ACS, even after analysis was adjusted for electrocardiographic category and CK-MB level [8].

The inflammatory marker CRP has also been studied previously for its prognostic importance in STEMI patients. Foussas SG et al., found higher mortality rates within 30 days after STEMI in patients with admission CRP levels ≥ 5 mg/L [11]. Bursi F et al., CRP level

at admission is found to be correlated with increase in heart failure (28%) and death (20%) at first year [22].

Similarly, echocardiographic RWMA at admission also have been studied for their prognostic significance in STEMI. Shiina A et al., found that RWMA correlated with angiographic analysis of wall motion abnormalities and found 88% agreement between the two [13] in predicting patients with heart failure STEMI. This is the first study of its kind where all the three parameters are taken into account and assessed for their short term prognostic significance. Results show that in patients with all the parameters positive are more likely to get complications or mortality at 30 day follow-up compared to patients who are negative for these parameters. None of the patient who had all the three parameters negative developed any complication at 30 day follow-up. Thus, instead of taking one parameter as in other studies the three parameters used in the present study can be assessed in patients of STEMI at presentation and when they are negative patients are less likely to develop complications.

Limitation(s)

The study had limited number of patients and thus the data must be interpreted carefully. Biomarkers and inflammatory markers were performed only at admission and were not evaluated with serial measurements. The follow-up period of the study was short. A prospective multicenter study of larger population is desirable.

CONCLUSION(S)

Thus, for early risk stratification of STEMI patient's cTnT, CRP and ECG can be done to identify those patients who require aggressive treatment and care. This can be beneficial and cost-effective in patients in India.

REFERENCES

- World Health Organization. World Health Organization; Geneva, Switzerland: 1998. World Health Statistics Annual.
- Negi PC, Merwaha R, Paday D. Multicentre HP ACS registry. Indian Heart J. 2015;07-027.
- Iqbal F, Barkataki JC. Spectrum of acute coronary syndrome in North Eastern India- A study from a major centre. Indian Heart J. 2013;68(2):128-31.
- Xavier D, Pais P, Devereaux PJ, Xie C, Prabhakaran D, Reddy KS, et al. Treatment and outcomes of acute coronary syndromes in India (CREATE): A prospective analysis of registry data. Lancet. 2008;371(9622):1435-42.
- Mohan PP, Mathew R, Harikrishnan S. Presentation, management, and outcomes of 25 748 acute coronary syndrome admissions in Kerala, India: Results from the Kerala ACS Registry. Eur Heart J. 2013;34(2):121-29.
- Guha S, Sethi R, Ray S, Bahl VK, Shanmugasundaram S, Kerkar P, et al. Cardiological Society of India: Position statement for the management of ST elevation myocardial infarction in India. Indian Heart J. 2017;69(Suppl 1):S63-97.
- Prabhakaran SP, Kannan A. Prognostic significance of troponin T in acute myocardial infarction. Int J Res Med Sci. 2017;5(10):4363-68.
- Ohman EM, Armstrong PW, Christenson RH, Granger CB, Katus HA, Hamm CW, et al. Cardiac troponin T levels for risk stratification in acute myocardial ischemia: GUSTOII Investigators. N Engl J Med. 1996;335(18):1333-41.
- Ohman EM, Armstrong PW, White HD, Granger CB, Wilcox RG, Weaver WD, et al. Risk stratification with a point-of-care cardiac troponin T test in an acute myocardial infarction: The GUSTO-III Investigators. Am J Cardiol. 1999;84(11):1281-86.
- Stubbs P, Collinson P, Moseley D, Greenwood T, Noble M. Prognostic significance of admission troponin T concentrations in patients with myocardial infarction. Circulation. 1996;94(6):1291-97.
- Foussas SG, Zairis MN, Lyras AG, Patsourakos NG, Tsirimpis VG, Katsaros K, et al. Early prognostic usefulness of C-reactive protein added to the Thrombolysis In Myocardial Infarction risk score in acute coronary syndromes. Am J Cardiol. 2005;96(4):533-37.
- Abbate A, Biondi-Zoccai GG, Brugaletta S, Liuzzo G, Biasucci LM. C-reactive protein and other inflammatory biomarkers as predictors of outcome following acute coronary syndromes. Semin Vasc Med. 2003;3(4):375-84.
- Shiina A, Tajik AJ, Smith HC, Lengyel M, Seward JB. Prognostic significance of regional wall motion abnormality in patients with prior myocardial infarction: A prospective correlative study of two-dimensional echocardiography and angiography. Mayo Clin Proc. 1986;61(4):254-62.
- Mollema SA, Nucifora G, Bax JJ. Prognostic value of echocardiography after acute myocardial infarction. Heart. 2009;95(21):1732-45.
- Sheikhas, Yahya S, Sheikh NS, Sheikh AA. C-Reactive Protein as a predictor of adverse outcome in patients with acute coronary syndrome. Heart views. 2012;13(1):07-12.
- Lown B, Wolf M. Approaches to sudden death from coronary heart disease. Circulation. 1971;44(1):130-42.

- [17] Krishnan MN. Coronary heart disease and risk factors in India- On the brink of an epidemic? Indian Heart J. 2012;64(4):364-67.
- [18] Dalal J, Hiremath MS, Das MK, Desai DM, Chopra VK, Biswas AD. Vascular disease in young Indians (20-40 years): Role of ischemic heart disease. J Clin Diagn Res. 2016;10(9):OE08-12.
- [19] Narang U, Gupta A, Gupta S, Gupta N, Joshi S, Sharma S. Risk factors and demographic profile in acute myocardial infarction: A prospective study from tertiary care rural hospital in North India. International Journal of Contemporary Medical Research. 2018;5(6):F14-21.
- [20] Khan A, Phadke MS, Lokhandwala Y, Nathani PJ. A study of prehospital delay patterns in acute myocardial infarction in an urban tertiary care institute in Mumbai. The Journal of the Association of Physicians of India. 2017;65(5):24-27.
- [21] Yamini N, Gopalkrishnan B, Selvan R, Sarvanan D. Troponin T as a prognostic and diagnostic marker for myocardial infarction. GSC Biological and Pharmaceutical Sciences. 2021;14(01):95-100.
- [22] Bursi F, Weston SA, Killian JM, Gabriel SE, Jacobsen SJ, Roger VL. C reactive protein and heart failure after myocardial infarction in the community. AMJMED. 2007;120(7):616-22.

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