Efficacy of Quantitative Troponin I in Predicting Cardiovascular Outcome in ST Segment Elevation Myocardial Infarction / Non-ST Segment Elevation Myocardial Infarction (STEMI / NSTEMI) Patients - A Retrospective Study from a Centre in South India

Jisa George[1], Malathy A.R.[2]

[1, 2] Department of General Medicine, ESIMC & PGIMSR, Chennai, Tamil Nadu, India.

ABSTRACT

BACKGROUND

Cardiac biomarkers like troponin play a very important role in the diagnosis of acute myocardial infarction. In a developing country like India, though the burden of cardiovascular diseases is on the rise, majority of the patients with acute coronary syndrome do not have access to primary percutaneous coronary intervention (PCI) facilities. Few Indian studies have looked into the utility of the quantitative troponin levels in predicting the cardiovascular outcome of non-ST segment elevation myocardial infarction / ST segment elevation myocardial infarction STEMI / NSTEMI patients; this study was conducted to find out the same.

METHODS

A retrospective analysis of the medical records of intensive care units (ICU) patients more than 18 years of age admitted with diagnosis of STEMI / NSTEMI for a duration of 12 months was done. The comorbidities, treatment, coronary artery disease (CAD) risk factors, cardiovascular complications and quantitative troponin levels were noted.

RESULTS

Retrospective analysis of 124 patient records was done which revealed that 74.8 % presented with STEMI and the rest were diagnosed to have NSTEMI. 39.5 % were hypertensive and 47 % were diabetic. The mean troponin values were higher in the patients who died and developed cardiac complications like left ventricular failure and cardiogenic shock. However, statistical significance was seen only for troponin values and left ventricular failure (LVF).

CONCLUSIONS

The quantitative levels of a simple biomarker like troponin I used for the diagnosis of acute myocardial infarction could also be used to predict the cardiovascular outcome and prognosis of the patient. A higher baseline troponin value during the diagnosis could possibly alert the treating primary physician for a referral to a specialised cardiac centre and likely need for early revascularisation, which is of importance in a developing country like India with compromised resources.

KEYWORDS

Quantitative Troponin I, STEMI, NSTEMI

Corresponding Author:
Dr. Jisa George,
Assistant Professor,
Department of General Medicine,
ESIMC & PGIMSR, KK NAGAR,
Chennai - 600078, Tamil Nadu, India.
E-mail: jisageorgy@gmail.com

DOI: 10.18410/jebmh/2021/171

How to Cite This Article:
George J, Malathy AR. Efficacy of Quantitative troponin i in predicting cardiovascular outcome in ST segment elevation myocardial infarction / non-ST segment elevation myocardial infarction STEMI / NSTEMI patients - a retrospective study from a centre in South India. J Evid Based Med Healthc 2021;8(14):877-881. DOI: 10.18410/jebmh/2021/171

Submission 25-09-2020,
Peer Review 05-10-2020,
Acceptance 16-02-2021,
Published 05-04-2021.

BACKGROUND

Cardiovascular disease is one of the rising and major causes of morbidity and mortality in the Indian sub-continent. India has the highest burden of acute coronary syndrome as per the CREATE registry. Laboratory biomarkers associated with acute myocardial infarction especially troponin has played a major role in establishing the diagnosis and also in guiding the treatment.[1] In a country like India, facilities for primary percutaneous coronary intervention (PCI) or immediate revascularisation may not be available at every tertiary care centre. In such a scenario, most of the centres would do thrombolysis in case of STEMI (ST elevation myocardial infarction) and manage conservatively with medical management and then plan for cardiac revascularisation at the earliest.

The peak troponin levels during myocardial infarction have been shown to corelate with infarct size and left ventricular ejection fraction which ultimately are important determinants of mortality.[2] Few Indian studies have evaluated the magnitude of index troponin I elevation and the in-hospital cardiovascular outcome and mortality. The magnitude of troponin I elevation could guide the treating physician in a non PCI facility centre, to plan for urgent referral for revascularisation to a higher cardiac centre. It is in this context that our study is carried out to analyse the utility of quantitative troponin I to predict the outcome in myocardial infarction patients.

Objectives

To assess the capacity of troponin I levels to predict the cardiovascular outcome among ICU patients admitted with STEMI / NSTEMI.

METHODS

This study was a retrospective, observational study carried out in Department of General Medicine, ESIMC & PGIMSR, Chennai. From the following calculation, the required sample size was calculated and rounded off to 124 for this study.

Single Proportion - Absolute Precision	
Expected Proportion *	0.192
Precision (%)	7
Desired confidence level (1 - alpha) %	95
Required sample size	124
Expected proportion of 9.2 % was based on hospital record – one-month data of ICU admission and STEMI / NSTEMI cases.	
Note: The n Master (2.0) software was used to calculate the sample size.	

After obtaining permission from the ethical committee (IEC / 2019 / 1 / 06), the medical records of 124 consecutive patients between 18 - 75 years, admitted in the ICU diagnosed with STEMI and NSTEMI, for duration of 12 months from January 2017 to January 2018, satisfying the inclusion and exclusion criteria were analysed as part of the study. The medical records of consecutive patients aged ≥ 18 years who were admitted in the ICU with diagnosis of STEMI / NSTEMI were included in the study. Patients with elevated serum creatinine > 1.5 mg / dl, known cases of valvular heart disease / left ventricular failure were excluded from the study.

Study Procedure

The data was collected using proforma after the review of the medical records of the patients satisfying inclusion criteria.

Acute ST-elevation myocardial infarction (STEMI) is defined by clinical findings of acute infarction, ST-segment elevation on 12-lead electrocardiogram (ECG) and elevation of serum cardiac enzyme levels (e.g., troponin). Non–ST-segment elevation myocardial infarction (NSTEMI) is the occurrence of angina pectoris or equivalent ischemia associated with myocardial necrosis, as reflected in elevated cardiac biomarkers like troponin.

The comorbidities like hypertension, diabetes and CAD risk factors like smoking were also noted. Blood investigations including cardiac enzymes (troponin I levels), ECG and echocardiography were noted. The study parameters included quantitative troponin levels and the cardiovascular outcome and complications as in hospital mortality, left ventricular failure (defined by clinical features of LV failure and ejection fraction < 45 % as noted from echocardiographic findings), need for rescue PCI and duration of hospital stay was recorded.

Statistical Analysis

Descriptive statistics were calculated for continuous data. Frequency, percentage and ratios were calculated for categorical data. Troponin I values were not normally distributed in all the patients. To compare LVF group, Troponin I values were converted to log-normal distribution. The Levene's test showed insignificant difference in variances of both group of LVF. Hence an independent t test has been applied for troponin I (log) values. The P-value < 0.05 was considered as statistically significant. Data was analysed using Statistical Package for the Social Sciences (SPSS) version 20.

RESULTS

It was observed that among the 124 patients, 92 (74.2 %) were diagnosed with STEMI and 32 (25.8 %) with NSTEMI. Majority of the patients were males (80.6 %). Around 67 % of the patients were in the age group of 40 – 60 years. It is to be noted that 10.4 % of the patients were in the age group 30 - 40 years, which is a worrisome trend and is an indication of the rising trend of the cardiovascular disease in the early to mid-thirties in the Indian population. 22 % of the study population belonged to the elderly age group (> 60 years).

Hypertension (39.5 %) and diabetes mellitus (46 %) were found to be the major co-existing comorbidities. Around 9.7 % of the patients had chronic obstructive pulmonary disease, while 21 % of the patients had previous history of coronary artery disease.

Smoking, a major risk factor for coronary artery disease was seen in 62 (52.4 %) of the patients. 33.9 % of the patients had history of alcohol abuse. It is interesting to note that among the patients presenting with acute myocardial infarction (MI), two of the patients had history of percutaneous coronary intervention (PCI) done previously and 1 had a CABG (coronary artery bypass graft). Two (1.6 %) patients had co-existent active pulmonary tuberculosis and two patients suffered from acute stroke at presentation in addition to the myocardial infarction. Among the patients diagnosed with STEMI, 44 patients (47.8 %) had undergone thrombolysis after admission to the intensive care unit. One STEMI patient underwent autolysis without any thrombolytic agents. One patient had failed thrombolysis and another patient developed streptokinase induced anaphylaxis during the thrombolysis. Around three patients (6.8 %) of the STEMI patients developed bleeding complications following thrombolysis.

Characteristics (N = 124)	Categories	N (%)
Gender	Male	100 (80.7 %)
	Female	24 (19.4 %)
Age groups (years)	31 - 40	13 (10.4 %)
	41 - 50	41 (33.1 %)
	51 - 60	42 (33.8 %)
	61 - 70	23 (18.5 %)
	71 - 80	5 (4 %)
Comorbidities & risk factors	Hypertension	49 (39.5 %)
	Diabetes mellitus	57 (46 %)
	COPD (Chronic Obstructive Pulmonary Disease)	12 (9.7 %)
	Previous history of CAD	26 (21 %)
	Smoking	65 (52.45)
	Alcohol	42 (33.9 %)
	H / o PTCA / stent	2 (1.6 %)
	Post CABG	2 (1.6 %)
	Diabetic ketoacidosis	1 (0.8 %)
Diagnosis	STEMI	92 (74.2 %)
	NSTEMI	32 (25.8 %)

Table 1. Socio-Demographic and Clinical Characteristics of the Study Population

Outcomes (Clinical & Interventional) (N = 124)	N (%)
Thrombolysis in STEMI patients	44 (47.8 %)
Autolysed	1 (0.8 %)
Failed thrombolysis	1 (2.37 %)
Streptokinase induced anaphylaxis	1 (2.27 %)
Bleeding complications post thrombolysis	3 (6.8 %)
Non-invasive ventilation	23 (15.3 %)
Invasive ventilation	3 (2.4 %)
Use of inotropes	19 (15.3 %)
Rescue PCI	9 (7.2 %)

Table 2. Clinical and Interventional Outcomes of Patients with STEMI / NSTEMI

Complications	Response (N)	Trop I Value (ng / ml) – Mean (Std Deviation)	t-Value [95 % CI]	P-Value
Arrhythmia	Yes (5)	3.53 (3.06)		
	No (119)	7.98 (9.54)		
LV failure	Yes (44)	12.76 (9.44)	3.72 [0.19 – 0.64]	0.0003***
	No (80)	5.71 (9.34)		
Cardiogenic shock	Yes (2)	19.33 (15.1)		
	No (122)	8.03(9.28)		
Mortality	Yes (2)	33.95 (9.47)		
	No (122)	7.79 (9.13)		

Table 3. Cardiovascular Outcome and Comparison of Troponin I Values

*Indicates statistically significant difference between the groups at P < 0.05

During the course of the treatment, 23 (15.3 %) of the MI patients required non-invasive ventilation, while three (2.4 %) patients needed invasive mechanical ventilation. Nineteen (15.3 %) patients required ionotropic support during the ICU stay. Rescue PCI following the failure of thrombolysis and deterioration was needed in 7.2 % of the patients. As our hospital did not have a cardiac catheterisation laboratory facility, the patients had to be referred to cardiac centres with such facility.

Coming to the cardiovascular complications and outcome, around five patients developed arrhythmias during the hospital stay. Among them, three patients developed AV heart block and one patient developed complete heart block. Cardiogenic shock following the acute coronary event was seen in two patients (1.6 %). The troponin values in those patients was 8.65 and 30, respectively.

35.5 % of the patients developed left ventricular failure. The mean troponin I of the patients who developed LVF was 12.76 while those who did not develop LVF was 5.71. Troponin I values were not normally distributed in all the patients. So, to compare LVF and non-LVF group, Troponin I values were converted to log-normal distribution. The Levene's test showed insignificant difference in variances of both group of LVF. Hence, an independent t test has been applied for troponin I (log) values in which mean difference between two LVF groups showed statistically high significant difference at P = 0.0003.

Two patients died after the acute MI during the hospital stay. It is interesting to note that both the patients had a baseline troponin value of 31.9 and 36 respectively. Due to the inequality of sample size among the two groups, comparison of troponin I values could not be done. Both the patients who expired had left ventricular failure and cardiogenic shock.

DISCUSSION

In this retrospective study involving 124 patients of STEMI and NSTEMI, the baseline quantitative troponin values were measured and their cardiovascular outcome in the hospital was noted. In our study population, majority of the patients were males (80.6 %) and majority of the patients (66.14 %) were in the age group of 40 - 60 years. Our study had 10.4 % of the population below the age of 40 years. The INTERHEART study data revealed an acute MI prevalence of 11.7 % among those below 40 years, which was similar to our study. Majority of the patients in this age group were also male (84.6 %). This was in accordance with previous studies which showed a male preponderance for the prevalence of acute coronary syndrome (ACS) especially among the young.[3-4]

In our study, 39.5 % of the patients were hypertensive while 46 % were diabetic. There was higher prevalence of diabetes among the MI patients compared to the reported prevalence in other nations (INTERHEART study) but it was similar to the Indian studies (CREATE registry and Gupta et al.).[1,5] Smoking was a major risk factor for patients who developed STEMI. This was similar to a study by Sharma et al.[6] Our study revealed a higher prevalence of the conventional CAD risk factors among the MI patients.

Among the 124 patients, 92 (74.2 %) were diagnosed with STEMI. Among them 47.8 % received thrombolysis with streptokinase. The thrombolysis rates were higher than

those observed in previous Indian studies.[7] Rest of the STEMI patients could not be thrombolysed due to delayed presentation or contraindications. However, only 1.76 % patients were referred for primary PCI, since our centre did not have catheterisation lab facilities.

Coming to the cardiovascular complications, 4.03 % of the acute MI patients developed arrhythmias most of which were bradyarrhythmia. This observation was less compared to previous Indian studies, Singh et al. noticed 25 % of patients developed arrhythmias. Two patients developed cardiogenic shock and the mean troponin I value in them was 19.33. Around 35 % of our patients developed LV failure. A statistically significant difference ($P < 0.05$) was noticed on comparison of log troponin I values among LVF and non LVF groups. Mission trial has shown that peak troponin levels are a good estimate of infarct size and an independent predictor for left ventricular failure at 3 months.[8] In a case series by Shaikh et al. it was found that higher quantitative troponin I values in first anterior STEMI served as a non-imaging tool to identify patients with LVEF < 40 % needed aggressive early therapy.[9]

Only two patients in our study succumbed to the disease. The lower mortality could be due to early referral of other patients with failed thrombolysis to higher cardiac centres. Both the patients who died had an index troponin value > 30 ng / ml. Both patients were males, diagnosed with STEMI and had bleeding complications following thrombolysis. A study by Jolly SS et al. showed that the extent of quantitative troponin elevation independently predicted mortality as well as in-hospital complications of cardiac arrest, new heart failure and cardiogenic shock.[10] Antman et al. had revealed higher mortality and complications for those with troponin I positivity.[11] Similar findings were also noted by Waxman et al.[12] A study by Bagai et al. concluded that there is a differential relationship between the magnitude of troponin elevation and long-term mortality in ACS patients treated with and without revascularisation.[13] An Indian study by Sarkari et al. also suggested that mortality was higher for patients with high troponin values.[14] Our findings also suggest higher mortality for patients admitted with high index troponin values, though the relationship could not be statistically established due to the inadequate sample size. Several studies have suggested that increased troponin levels may be a marker of extensive coronary disease.[15]

CONCLUSIONS

Majority of the patients with MI were males and had a diagnosis of STEMI and smoking was a major risk factor. Thrombolysis could not be done in most of the cases due to delayed presentation. In a developing country like India, where all the health care facilities are not equipped with catheterisation laboratory, the most widely used management of STEMI patients is thrombolysis, particularly if they present early. Once stabilised, the patients are referred to higher cardiac centres for revascularisation as was done at our centre. The magnitude of troponin I elevation has been shown to be corelating with cardiovascular complications like left ventricular failure. Mortality was also seen in those with higher baseline troponin I levels. There is a need for further studies in the Indian population subset to establish this fact. This will help primary care physicians in decision making of early referral of such MI patients with high troponin I levels and also to predict their prognosis.

Limitations

As it was a retrospective study, we could not follow up the cardiovascular outcome after discharge of the patient. The angiography findings could not be compared with the troponin levels as our centre had no PCI facilities, and we had to refer patients to a higher cardiac centre. The sample size was not sufficient to draw statistical conclusion about mortality and troponin levels.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
Financial or other competing interests: None.
Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

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