

RAISED MODIFIED SHOCK INDEX (MSI) AS A PREDICTOR OF IN-HOSPITAL MORTALITY IN PATIENTS WITH ST-SEGMENT ELEVATION MYOCARDIAL INFARCTION (STEMI)

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Contribution

MA conceived, designed and did statistical analysis & manuscript writing. UMB did data collection. MHH did review and final approval of manuscript. All authors contributed equally.

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ABSTRACT

Objective: To determine association of a raised modified shock index (MSI) with in-hospital mortality in patients with ST-segment elevation myocardial infarction (STEMI).

Methodology: It was a cross sectional study conducted at Cardiology Department, Jinnah Hospital Lahore. Duration of the study was 6 months period from 1st November, 2016 to 30th April, 2017. The patients were divided into two groups, normal MSI and raised MSI. The cohort was followed up for 7 days for adverse outcome i.e. in hospital mortality. All the collected data was entered and analyzed on SPSS version 17.

Results: The mean age of the patients in normal MSI group was 57.42 ± 11.32 years and in raised MSI group was 56.03 ± 12.48 years. Male to female ratio of the patients was 0.9:1. In hospital mortality occurred in 27 (22.50%) patients. Statistically 5.75 times protective effect of in-hospital mortality was noted in normal MSI group compared to raise group patients i.e. RR=5.7500 [95% CI; 2.1160 to 15.6252].

Conclusion: The study concluded that normal MSI index has protective effect on in-hospital mortality as compared to raised MSI patients.

Key Words: Mortality, Myocardial Infarction, In-Hospital, MSI.

INTRODUCTION

Coronary artery disease is a major cause of mortality and morbidity not only in developing countries but also the developed ones.¹ Every year around 3 million people have STEMI, while NSTEMI occurs in 4 million throughout the world. STEMI occurs about twice as often in men as women.² ST elevation myocardial infarction (STEMI) is a serious health risk and one of the most common presentation in our cardiac emergencies. Presently, various clinical parameters including heart rate (HR), pulse rate (PR), blood pressure (BP), shock index (SI), and modified shock index (MSI) are analyzed to predict the severity of serious patients at an emergency room in various retrospective studies.

Shock Index is calculated by dividing HR by systolic blood pressure (SBP).^{4,6} In the patients with hypovolemic shock SI has also been studied to foresee the clinical severity. Previous studies have found that patients with SI more than 0.9 had a greater mortality rate. It was observed that HR > 120 beats per minute, SBP < 90 mmHg and DBP < 60 mmHg in emergency patients associated with higher mortality rates. Incorporation of DBP in the assessment of these patients was recommended.⁶ So Modified Shock Index is thought to be more valid. We were able to retrieve only one study evaluating the predictive value of MSI in patients with ST elevation MI.^{4,6} In one study of patients who underwent primary percutaneous coronary intervention, SI was used to anticipate long-term clinical outcomes. In another study conducted in patients with STEMI to determine the association of MSI for adverse clinical outcomes within 7-days of admission in patients with ST, out of 160 total patients 49 had elevated MSI (≥ 1.4). The increased MSI group had significantly higher all-cause mortality than the normal MSI group (all-cause mortality 20.4% vs 3.6%, $p < .05$; MACE rate 44.9% vs 15.3%, ($p < .05$)).³

Worldwide, trauma still remains the topmost cause of mortality despite recent advances in the management. Modified shock index is an objective way to determine the seriousness of situation. It has not been studied so far for its association with STEMI in our local population. MSI may prove to be a cost-effective method to predict prognosis and mortality related to coronary artery disease for Pakistani population.

Objective of our study was to determine association of a raised modified shock index (MSI) with in-hospital mortality in patients with ST-segment elevation myocardial infarction (STEMI).

METHODOLOGY

A Cross sectional study was conducted at Department of Cardiology, Jinnah Hospital Lahore from 1st November, 2016 to 30th April, 2017. Subjects between 35 – 75 years of age of either gender were included. New cases of STEMI

defined by the presence of ST-segment elevation in two consecutive leads of ≥ 2 mm in males or ≥ 1.5 mm in females in leads V2-V3 and/or of ≥ 1 mm in other adjacent chest leads or the limb leads or the presence of new left bundle branch blocks and ischemic chest pain for ≥ 30 minutes presenting to emergency department within 12 hours from the beginning of symptoms determined by history were selected through a non-probability / consecutive sampling with 95 % confidence interval and 80% power of study, taking in hospital mortality 20.4% vs 3.6%, in raised and normal MSI group. Patients with connective tissue disorders like systemic lupus erythematosus, cancer diseases, recent intracranial or intraspinal surgical procedure or major trauma and end stage renal disease (serum creatinine > 2mg/dl) were excluded. Modified shock index (MSI) was calculated at the time of admission at coronary care emergency department. Patients was divided in to two groups (with and without raised MSI). Informed consent was obtained from all patients. Modified shock index was measured using formula $MSI = HR/MAP$. $MAP = [(DBP \times 2) + SBP]/3$. $MSI > 1.4$ will be labelled as raised. In hospital mortality was defined as death within 7 days of start of symptoms of STEMI.

Subjects were followed for 7 days for adverse outcome i.e. in hospital mortality. Association between MSI and in-hospital mortality was determined in terms of relative risk. Data collected was entered and analyzed in the SPSS version 17. For quantitative variables like age and MSI; mean with standard deviation was calculated and for categorical variables like gender and in-hospital mortality; frequency and percentages were calculated. Relative risk was calculated to determine the association between raised MSI and in-hospital mortality among patients with ST segment elevation MI. $RR > 1$ was considered as significant. Data was stratified for age, gender and MSI score to address the effect modifier post stratification adjusted RR was calculated with $RR > 1$ as significant.

RESULTS

In this present study total 120 cases participated. The mean age of the patients in normal MSI group was 57.42 ± 11.32 years and its mean value in raised MSI group was 56.03 ± 12.48 years. About 58(48.33%) patients were males. The male to female ratio of the patients was 0.9:1. Mean value MSI of the patients was 1.54 ± 0.52 with minimum and maximum MSI values of 0.8 & 2.5 respectively (Table 1). In this study in hospital mortality occurred in 27(22.50%) patients and it was not occurred in 93(77.50%) patients. The study results showed that the in-hospital mortality occurred in 27 cases in which 4 were from normal MSI and 23 were from raised MSI group. Similarly in-hospital did not occur in 93 cases in which 56 were from normal MSI group and 37 were from raised MSI group. Statistically 5.75 times protective effect of in-hospital mortality was noted in raised MSI group compared to normal

group patients i.e. RR=5.75 [95% CI; 2.1160 to 15.6252].

The study results showed that in ≤ 50 years patients, the in-hospital mortality occurred in 12 cases in which 1 case was from normal MSI group and 11 were from raised MSI group; similarly, in >50 years patients, the in-hospital mortality occurred in 15 cases in which 3 cases were from normal MSI group and 12 were from raised MSI group. Statistically insignificant risk was noted in ≤ 50 years patients i.e. RR=0.1558 [95% CI; 0.0224 to 1.0825]; statistically 0.312 times protective effect was found in normal MSI group patients compared to raised MSI group patients i.e.

RR=0.1957 [95% CI; 0.0597 to 0.6416]. The study results showed that in male patients, the in-hospital mortality occurred in 13 cases in which 2 cases were from normal MSI group and 11 were from raised MSI group; similarly, in female patients, the in-hospital mortality occurred in 14 cases in which 2 cases were from normal MSI group and 12 were from raised MSI group. Statistically 0.1584 & 0.1897 times protective effect was found in raised MSI group patients compared to normal MSI group patients i.e. RR=0.1584 [95% CI; 0.0384 to 0.6522]&0.1897 [95% CI; 0.0462 to 0.7779] respectively (Table 2).

Table 1: Descriptive Statistics among Groups (n=60)

Variable	Mean	SD	Minimum	Maximum
Age	56.7	12.5	35	60
MSI	1.54	0.52	0.8	2.5

Table 2: In Patient's Mortality among Subjects, Age and Gender Distribution in Study Population (n=60)

	In-hospital Mortality	Study Groups		Total	RR 95% CI
		Raised MSI	Normal MSI		
In-hospital Mortality	Yes	23	4	27	RR = 5.7500 CI= [2.1160 to 15.6252]
	No	37	56	93	
Age					
≤ 50	Yes	11	1	12	0.1558 [0.0224 to 1.0825]
	No	13	13	26	
> 50	Yes	12	3	15	0.1957 [0.0597 to 0.6416]
	No	24	43	67	
Gender					
Male	Yes	11	2	13	0.1584 [0.0384 to 0.6522]
	No	16	29	45	
Female	Yes	12	2	14	0.1897 [0.0462 to 0.7779]
	No	21	27	48	

DISCUSSION

The increasing use of mortality rates to assess hospital quality has intensified their importance.^{7,8} In spite of great advances in diagnosis and management, STEMI, it remains a major public health problem in the industrialized world and is on the rise in developing countries. The shock index is a measure of hemodynamics and its normal range is 0.5 to 0.7. The clinical use of this index is to evaluate hypovolemic shock and severity of other types of shock. A patient with normal vital signs on the triage desk, MSI can be calculated to decide whether the condition of the patients is critical.^{9,10}

In our study, the results showed that in-hospital mortality occurred in total 27 cases, out of which 4 were from normal MSI and 23 were from raised MSI group. Statistically 5.75 times protective effect of in-hospital mortality was noted in raised MSI group i.e. RR=5.75 [95% CI; 2.1160 to 15.6252]. Thus, in patients with STEMI, MSI is a good tool to foresee in-hospital mortality.

A study by Shangguan Q et al presented that both increased SI and increased MSI predicted higher MACE rates.¹¹ Though, when the odds ratios of various clinical outcomes like all-cause mortality (6.8 vs 3.4), cardiogenic shock (3.0 vs 1.6), life-threatening arrhythmias (9.1 vs 4.6), and MACE

(6.8 vs 3.4) were compared in two these were higher increased MSI group than increased SI group.

Kim SY et al presented that the percentage of cases classified as unstable was greater among non-survivors than survivors for the SI (36.6% vs. 1.8%, $p < 0.001$), the MSI (38.6% vs. 2.2%, $p < 0.001$), and the Age SI (69.4% vs. 21.3%, $p < 0.001$). Non-survivors had higher median values than survivors on the SI (0.84 vs. 0.57, $p < 0.001$), MSI (0.79 vs. 1.14, $p < 0.001$), and Age SI (64.0 vs. 41.5, $p < 0.001$).¹² In one study, shock-index was concluded as a novel predictor of long-term outcome following primary percutaneous coronary intervention.⁵

In another study conducted in patients with STEMI to determine the association of MSI for adverse clinical outcomes within 7-days of admission in patients with ST, out of 160 total patients 49 had elevated MSI (≥ 1.4). The increased MSI group had significantly higher all-cause mortality than the normal MSI group (all-cause mortality 20.4% vs 3.6%, $p < .05$; MACE rate 44.9% vs 15.3%, $p < .05$). Ye-cheng Liu et al demonstrated that the MSI in emergency patients is a good tool to predict clinical outcome like mortality as MSI also uses BBP in addition to heart rate and SBP.⁶ While SI in emergency patients is not significantly interrelated to the mortality rate.

A study by Mohammad Gouda et al showed that the raised MSI in patients with STEMI who underwent PCI was correlated with a significant increase rate of various clinical outcomes like cardiogenic shock, arrhythmia, arrest, bleeding, HF and mortality.¹³ In another recent study of 1140 patients of STEMI done by Gloria Abreu et al, who were managed with either pharmacological or mechanical reperfusion, depicted that with MSI > 1.3 a statistically significant increased frequency of in-hospital mechanical complications, fatal arrhythmia, and mortality seen.¹⁴

"In the study by Sebastian J Re instadler et al on 788 STEMI patients showed that those patients having raised shock index (≥ 0.62) had statistically significant increased incidence of MACE like mortality, re infarction and HF (10.9% vs. 3.8%, $p < 0.001$) in comparison to those patients having normal shock index value.¹⁵

CONCLUSION

In this study we concluded that MSI is a significant indicator for the prediction of mortality rate and should be used for predicting the mortality rate. There is increased protective effect of normal MSI patients against in patient mortality as compared to raised MSI patients.

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