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Original Research Article

White blood cell count on admission as prognostic marker for assessment of severity of acute myocardial infarction

Vibhuti Jain, Akhlesh Kumar Jain*

Shalby Hospital, Indore, Madhya Pradesh, India

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***Correspondence:**
Dr. Akhlesh Kumar Jain,
E-mail: drakhleshj@yahoo.com

ABSTRACT

Background: High white blood cell/leucocyte counts were predicted as important biomarkers for future cardiovascular events in both healthy individuals and are having history myocardial infarction. The aim of the study was to assess the role of leucocytes as predictors of morbidity and mortality during the hospitalization of patients with acute myocardial infarction.
Methods: This was a prospective study conducted on 79 patients with evolving STEMI attending the emergency department of Maharaja Yeshwant Rao Hospital, Indore during the period from November 2004 to July 2005. Blood total leucocyte count (TLC) was done in all the patients. All-cause mortality rate during the follow up period was defined as the primary end point of the study. Composite of death, reinfarction and heart failure till follow up day were defined as the secondary outcomes.
Results: The mean age of the patients was 55.9±10.4 years. Male dominance was (86%) seen in the study. The mean TLC in the study population was 12345±4922/cumm. A total of 16 (20.2%) patients were died during 3 months of follow up. Statistically significant difference ($p<0.001$) was seen for characteristics such as age, risk index score, mean blood pressure heart rate and the Kilip class between survivors and non-survivors. The mean difference of TLC and mean CKMB was greater in non-survivors compared to survivors but the difference was not significant ($p=0.177$). Age, risk index, Kilip class, serum creatinine and baseline TLC, was found to affect the occurrence of the events significantly with a p value of less than 0.05.
Conclusions: The findings conclude that the high blood leucocyte count was proved to be an important prognostic factor for assessing the severity of acute myocardial infarction in study population.

Keywords: White blood cells, Prognostic markers, Acute myocardial infarction

INTRODUCTION

Acute myocardial infarction (AMI) represents, the increasingly severe manifestation of the clinical spectrum of coronary artery diseases (CAD), is usually responsible for approximately half of the deaths due to CAD.[1] The pathophysiologic events of acute myocardial infarction is the rupture of an atherosclerotic plaque in an epicardial coronary artery, exposing sub endothelial tissue to a subsequent thrombogenic material, leading to complete occlusion of infarct related artery.[2]

There are several techniques available, such as echocardiography, coronary angiography nuclear scanning, MRI and CT to predict the risk amongst patients with CAD.[3] Though highly predictive these modalities are costly and need expertise. Hence there is need for identification of simple baseline clinical and demographic parameters and routinely ordered investigations, which may provide valuable, add on information for identification of high-risk patients. A benefit of using such approach is that it can be utilized even in resource-limited.

One such baseline parameter used to identify the incidence of AMI is white blood cell/leucocyte count. Leucocyte is one inflammatory biomarker and estimation of and quantification of leucocyte in blood is very reliable, cheap and available worldwide.[4] Leucocytosis leads to extensive myocardial infarction by involving pathologic mechanisms such as inflammation leading to hypercoagubility state and microvascular obstruction.[5] Many studies demonstrated the role of leukocytosis for possible future cardiovascular events in both healthy individuals and in patienst with history of MI.[6-9]

The present study was done to investigate the role of leucocytes as predictors of morbidity and mortality during the hospitalization of patients with acute myocardial infarction

METHODS

One hundred eighty patients who presented to emergency department of Maharaja Yeshwant Rao Hospital, Indore with suspected acute coronary syndrome, from November 2004 to July 2005 were screened. Of them 79 patients with evolving STEMI within 12 hours of symptom onset were included in the present study.

Inclusion criteria were patients with AMI with typical ischemic chest pain/symptom ≥30 minute duration with either new or presumed new ST segments elevation >1 mm at the J-point in two or more contagious leads or new onset LBBB on ECG and patients with symptom onset within 12 hours of presentation.

Exclusion criteria were patients with advanced history of blood disorders, advanced neoplasms, who refused to give consent and patients who were anticipated for poor compliance with follow-up.

After getting approval from Institutional ethics committee, a written informed consent was obtained from all patients for the participation in the study. If patient was in severe pain or not fully conscious consent was taken from the legally accepted representative in presence of an impartial witness.

All the patients were subjected to thorough clinical evaluation, standard 12-lead electrocardiography and blood sample was drawn for laboratory evaluation. All patients were also evaluated for major conventional risk factors including hypertension, diabetes mellitus, smoking, and previous cardio-vascular event like previous MI, and stroke. Patients received usual line of management as per the guidelines set by the treating unit. Several parameters including age, sex, gender, mortality rate, location of myocardial infarction were also studied.

Patients were followed in the hospital for clinical course and any complication till discharge and subsequently till 90-day period.

Data were analysed using SPSS statistical package version 10 software. Continuous data are expressed as the mean value ±SD. Comparison between two groups was performed by using unpaired t-test for the continuous variables. Chi-square test was used to compare the categorical (non-continuous) variables using Pearson chi square test. Probability values are two sided throughout and $p<0.05$ was considered statistically significant.

RESULTS

A total of 180 patients were initially screened, of whom 101 were excluded. Finally 79 patients with evolving ST-elevation myocardial infarction (STEMI) within 12 hours of symptom onset were participated in the study. The demographic, clinical and laboratory characteristics were given in Table 1. The mean age of the patients was 55.9± 10.4 years (range 32-80 years), of them 68 (86%) were males and 43 (55%) were younger than 60 years of age. History of hypertension was present in 17 (22%) patients, 5 (6%) patients had diabetes and 11(14 %) had history of previous myocardial infarction and prior history of CVA was present in 7 (9%) of the patients. The mean total leucocyte count (TLC) was 12345±4922/cumm. The mean serum creatinine was 1.1±0.5 mg/dl and the mean level of creatine kinase-MB level (CKMB) was 84.4 ± 96.5 U/L. The mean systolic blood pressure was 126± 32 mmHg, and the mean heart rate was 85±18 beats/min. The mean Killip class for all the patients at presentation to the hospital was 1.4±0.8.

Table 1: Baseline characteristics of study participants.

Characteristics	Minimum	Maximum	Mean (n=79)	Std. deviation
Age (years)	32.00	80.00	55.92	10.48
Risk index	6.14	91.43	23.46	14.44
Killip class	1.00	4.00	1.36	0.78
Total leucocyte count/cumm	1300.00	25200.00	12345.31	4953.28
Creatinine (mg%)	0.61	3.90	1.1094	0.4567
CKMB (U/lit)	11.00	550.00	84.4177	97.1873
Systolic blood pressure (mmHg)	50.00	210.00	126.4304	32.6562
Heart rate/min	36.00	126.00	85.3544	18.5348
Time to initiate treatment (hours)	1.00	12.00	6.87	3.04

Continued.

Characteristics	
Location of infarction	**N (%)**
Anterior	49 (62)
Non anterior	30 (38)
Associated disease	**N (%)**
Hypertension	17 (22)
Previous MI	11 (14)
Diabetes mellitus	5 (6)
Old CVA	7 (9)
History of smoking	53 (67)

Table 2: Comparison of difference in baseline characters amongst survivors and non survivors with AMI.

Characteristics	Survived vs. died	Mean	Std. deviation	t	P value
Age	Survived	54.09	9.97	3.261	0.002*
	Died	63.12	9.54		
Risk index	Survived	19.39	8.18	5.987	<0.001*
	Died	39.52	21.53		
Killip class	Survived	1.11	0.31	7.490	<0.001*
	Died	2.37	1.20		
Creatinine	Survived	1.01	0.22	3.820	<0.001*
	Died	1.46	0.83		
Total leucocyte count	Survived	11964.76	4758.56	1.362	0.177
	Died	13843.75	5566.32		
CKMB	Survived	74.9841	79.9081	1.734	0.087
	Died	121.56	144.49		
Systolic blood pressure (mmHg)	Survived	129.36	30.66	1.601	0.114
	Died	114.8750	38.45		
Heart rate	Survived	81.88	18.21	3.352	0.001*
	Died	99.00	12.89		
Time to initial treatment (hours)	Survived	6.42	3.00	2.775	0.007*
	Died	8.68	2.54		

*Statistically significant.

Table 3: Comparison of difference in baseline characters with reference to secondary outcome events of AMI.

Characteristics	Secondary outcome events	Mean	Std. deviation	t value	P value
Age (years)	Event	61.58	10.26	3.373	0.001
	No event	53.45	9.67		
Risk index	Event	33.33	19.66	4.472	<0.001
	No event	19.16	8.62		
Killip class	Event	1.91	1.17	4.597	<0.001
	No event	1.12	0.33		
Creatinine (mg%)	Event	1.3225	0.7181	2.864	0.005
	No event	1.0164	0.2293		
Total leucocyte count/cumm	Event	14008.33	5969.70	2.009	0.048
	No event	11619.63	4300.59		
CKMB (IU/lit)	Event	119.7917	127.48	2.188	0.032
	No event	68.9818	76.95		
Systolic blood pressure (mmHg)	Event	125.6	40.28	0.136	0.892
	No event	126.76	29.13		
Heart rate/min	Event	96.91	17.60	3.999	<0.001
	No event	80.30	16.69		
Time to initiate treatment (hours)	Event	8.39	2.77	3.083	0.003
	No event	6.21	2.93		

Among 79 patients, a total of 16 (20.2%) patients were died during 3 months following the qualifying event, of them 10 died before discharge from the hospital, 2 patients within 30 day and remaining 4 patients subsequently. Remaining 63 patients were doing well till 90 day 0f follow-up. Table 2 presents the comparative difference of baseline characteristics among survivors and non-survivors. Statistically significant difference ($p<0.001$) was seen for characteristics such as age, risk index score, mean blood pressure heart rate and the Kilip class between survivors and non-survivors. The mean difference of TLC and mean CKMB was greater in non-survivors compared to survivors but the difference was not significant ($p=0.177$).

During the study period no event of severe recurrent ischemia, stroke or major hemorrhage was observed in the patients. Out of 79 patients, 27 patients either had reinfarction, heart failure or died by the 90 day of the qualifying event. Of them 16 died, 7 had heart failure and 4 had reinfarction. Most of the outcome events occurred before hospital discharge. Only 6 deaths, 2 event of reinfarction and 2 events of heart failure occurred after the hospital discharge but before 90 day follow up. It is found that age, risk index, Kilip class, serum creatinine and baseline TLC, affect the occurrence of the events significantly with a p value of less than 0.05.

DISCUSSION

Acute myocardial infarction is one of the most serious manifestations of cardiac disease in the past few decades.[10] Study by Bae et al explained that the abnormal levels of WBC, hemoglobin and platelet distribution width acts as important markers in early risk identification in AMI patients.[11]

Several mechanisms explain how leukocytosis is involved in the incidence of AMI in patients. Leucocytes may cause 1. damage to endothelial cells by both proteolytic enzymes and by different oxidative stress mechanisms. Leucocytes may 2. obstructs the microvasculature, 3. induce hypercoagulability and 4. activated monocytes may increase the expressions of tissue factor.[12,13] All these mechanisms lead to activation extrinsic pathway of coagulation system, formation of thrombus and thereby promote infarct expansion.[14-16] Hence it is necessary to observe prognostic value of inflammatory markers in a wide spectrum to diagnose atherosclerotic diseases.

In this study, higher prevalence of AMI was observed in patients with higher TLC. From the data of Table 2 it was clearly evident that patients who are non-survivors (died) had higher mean TLC count, mean CKMB levels, mean serum creatinine levels and mean heart rate compared survivors. This reason for this can be explained by several ways. Firstly, patients with higher leucocyte count (>11.000/µL) may have larger infarct size which can be described by higher CKMB level (121.56±144). Second, the heart rate was higher in patients with increased TLC in AMI patients (99±12). These findings signify that heart rate is an important risk factor in patients with AMI. Third, the base line creatinine level was higher in patients with greater TLC count (1.46±0.43) and it is known that elevated creatinine levels are an important risk factors for developing cardiac events as described in the GRACE (Global Registry of Acute Coronary Events) risk score.[17] These observations were in accordance with findings of Dharma et al.[18]

TLC was significant in determining the composite end point of death, reinfarction and heart failure. These observations are similar to Grazybowski et al which shows a strong association between leucocyte count and in hospital mortality even after adjustment for patient demographics, medical history, presenting clinical characteristics and treatment factors.[19]

CONCLUSION

The findings of the study demonstrate that there is a significant relationship between a high leucocyte count and incidence of AMI. The measurement of leucocycte count is very simple, rapid and cheap method and is available even in rural areas. Thus for patients of AMI who had higher leucocyte count immediate and appropriate treatments are recommended to prevent the further risk.

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