

Correlation between White Blood Cell Count and Clinical Outcome of Patients with Acute Myocardial Infarction Who Underwent Primary Percutaneous Coronary Intervention

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ABSTRACT

BACKGROUND

We wanted to study the correlation between white blood cell count and clinical outcome of patients with acute myocardial infarction who underwent primary percutaneous coronary intervention.

METHODS

A retrospective study (100 cases) was conducted at a higher cardiac center (Metromed International Cardiac Center) over a period of six months among patients who underwent PCI, to see the influence of a raised WBC count on their outcomes. The study was conducted based on a Proforma that assessed the patients on various levels and stages to derive a conclusion.

RESULTS

A statistically confirmed result showed that 78.5 % patients with moderate and severe LV function at presentation had raised WBC count, and on follow up 76.6 % patients with worse LV function had raised WBC count. Also 80 % of the patients with class III and class IV symptoms (NYHA) had raised WBC count.

CONCLUSIONS

A majority of patients who underwent Primary Percutaneous Coronary Intervention for Acute Myocardial Infarction who had comparatively poor outcome on follow-up had raised WBC count. The WBC count at the time of presentation can be used as an independent predictor for in-hospital mortality /morbidity and post PCI outcome and may be a useful tool in assessing the prognosis of patients with acute Myocardial Infarction undergoing Primary Percutaneous Coronary Intervention in conjunction with other risk stratification factors. In this study, irrespective of the comorbidities, prognostic importance of WBC count remains relevant not only in the presentation of the patients, but also in the discharge and follow up.

KEYWORDS

White Blood Cell Count, Myocardial Infarction, Primary Percutaneous Coronary Intervention, New York Heart Association Classification, Left Ventricular Systolic Function

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BACKGROUND

Vascular injury and atherogenesis is influenced by infection and inflammation. Inflammation also lead to atherosclerotic plaque rupture and thrombosis. The leukocytes or WBC has been an important biomarker for these disease processes. There has also been association of WBC to various risk factors of Cardio Vascular Diseases such as serum cholesterol, triglyceride, cigarette smoking etc.¹

The relation between WBC count and MI are established by the mechanism through which the cardiac injury (ischemic) initiates the innate immune response via toll-like receptor (TLR)-mediated pathways and upregulates the chemokine and cytokine syntheses in the infarcted heart. TLRs, which are expressed by inflammatory cells and also on endothelial cells and cardiac myocytes, can recognize endogenous danger signals released during cell death following myocardial ischemia and reperfusion.²

Thereby, establishing a relation between the WBC and the acute myocardial infarction. Although various factors such as age, sex, hypertension, diabetes, door to balloon time, etc. affect the outcomes, the relation between a rise in WBC and its influence on the outcome of acute myocardial infarction and its interventions are commendable.

Here in this retrospective study conducted on patients with CAD that came to the tertiary referral center for cardiac care shows the influence of WBC on the immediate and short term outcomes irrespective of other contributing factors.

METHODS

This is a retrospective study conducted among 100 patients over a period of 6 months (June 2019 - November 2019) at Metromed International Cardiac Center (MICC) to assess the impact of WBC on the outcomes in Acute Myocardial Infarction patients. All of these patients had underwent Primary Percutaneous Coronary Intervention.

A proforma was designed for assessing the patients which included the patient's history on arrival, examination findings, the investigations and procedures they underwent, outcomes immediately after the procedure and after 1 month.

Patients and Procedures

A group of 100 patients who underwent primary percutaneous coronary intervention (PPCI) at MICC were assessed. The patients varied between ages 40-80 years both male and female included. The proforma designed included several modifiable as well as non-modifiable risk factors of Acute Coronary Syndrome such as Age, Sex, blood group, Smoking, Hyperlipidaemia, and Diabetes etc. These patients also were assessed with Killip class at presentation

and NYHA classifications on follow up. Every investigation (blood, echo etc.) that the patient underwent from the time of admission to discharge and follow up after 1 month were studied. The regional wall motion abnormality and the LV systolic function (EF) in echocardiography were studied in detail. The data collected was tabulated and statistically analysed.

Data Collection / Study End Points

A Proforma was developed to accumulate the details of the patient, which included all the relevant details needed for the study. This information's were tabulated statistically and verified to come into a conclusion. The details of the patients during 1 month follow up was collected using specific hospital ID numbers allotted to the patients at the time of admission (MICC No.)

The primary outcome of the study established that there was a significant influence of raised WBC count on in-patient as well as the 1-month outcome of patients who underwent PPCI.

RESULTS

Statistical analysis of various factors that mend the outcome in people who had myocardial infarction and who underwent PCI varied, but the influence of WBC on the outcome stood out irrespective of other variables.

Having diabetes means that you are more likely to develop heart disease and have a greater chance of a heart attack or a stroke. People with diabetes are also more likely to have certain conditions, or risk factors, that increase the chances of having heart disease or stroke, such as high blood pressure or high cholesterol.

Test of significance was the methodology of study used to analysis the data, and conclusions were derived from it.

Characteristics	Value
No. of patients	100
Age	40 years above
Women	17 %
BMI	18-33 range
Past h/o PTCA	-
Chest pain	99 %
WBC	6300-29800 range
Hb	8.6- 18.6
Hypertension	40 %
Diabetes	42 %
Dyslipidemia	11 %
RWMA present	97 %
RWMA absent	3 %
LV systolic function fair	19 %
LV systolic function good	10 %
LV systolic function mild	43 %
LV systolic function moderate	22 %
LV systolic function severe	6 %

Table 1. Baseline Characteristics of Study Population

		WBC							P-Value	Inference
	NYHA	N	Mean	Std. Deviation	95 % Confidence Interval for Mean		Minimum	Maximum		
					Lower Bound	Upper Bound				
At 1 Month Follow Up	1	50	9404.12	1871.09	8872.362	9935.878	6400	13700	0.001	There is significant difference
	2	36	11910	3590.153	10695.2669	13124.7331	6300	18700		
	3	6	15583.33	7375.477	7843.2445	23323.4222	6400	26200		
	4	4	23550	4704.962	16063.3557	31036.6443	18500	29800		
	Total	96	11319.44	4430.133	10421.8091	12217.0659	6300	29800		
	Missing	4								
Table 2. NYHA and WBC										

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WBC (with DM)										
	NYHA	N	Mean	Std. Deviation	95 % Confidence Interval for Mean		Minimum	Maximum	P-Value	Inference
					Lower Bound	Upper Bound				
At 1 Month Follow up	1	21	9352.667	1933.931	8472.3518	10232.9815	6400	13700	0.001	There is significant difference
	2	13	12515.38	4087.348	10045.4252	14985.344	7200	18300		
	3	3	19533.33	5965.177	4715.0129	34351.6538	14700	26200		
	4	3	21466.67	2676.44	14818.0201	28115.3133	18500	23700		
	Total	40	12052.65	4936.512	10473.877	13631.423	6400	26200		
Table 3. NYHA and WBC in Patients with DM										

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WBC (without DM)										
	NYHA	N	Mean	Std. Deviation	95 % Confidence Interval for Mean		Minimum	Maximum	P-Value	Inference
					Lower Bound	Upper Bound				
At 1 Month Follow up	1	29	9441.379	1857.902	8734.6714	10148.0873	6400	12900	0.001	There is significant difference
	2	23	11567.83	3324.754	10130.0946	13005.5576	6300	18700		
	3	3	11633.33	7321.43	-6554.1064	29820.773	6400	20000		
	4	1	29800	.	.	29800	29800	29800		
	Total	56	10795.71	3993.669	9726.2027	11865.2258	6300	29800		
Table 4. NYHA and WBC in Patients without DM										

Table 4. NYHA and WBC in Patients without DM

		WBC							P-Value	Inference
LV Systolic Function	Frequency	Mean	Std. Deviation	95 % Confidence Interval for Mean		Minimum	Maximum			
At Presentation	Good	10	10010	3376.208	7594.8066	12425.1934	6400	17700	0.001	There is significant difference
	Fair	19	9668.737	1898.342	8753.7651	10583.7086	6600	13700		
	Moderate	22	13845.45	5916.863	11222.0646	16468.8445	6300	29800		
	Mild	43	10903.72	3565.192	9806.5167	12000.9251	6400	22300		
	Severe	6	16933.33	7511.236	9050.7745	24815.8921	6600	23700		
	Total	100	11588.66	4624.442	10671.0703	12506.2497	6300	29800		
Table 5. LV Systolic Function and WBC										

Table 5. LV Systolic Function and WBC

WBC										
	Outcome	Frequency	Mean	Std. Deviation	95 % Confidence Interval for Mean		Minimum	Maximum	P-Value	Inference
					Lower Bound	Upper Bound				
LV Systolic Function	Improved	37	9521.784	2246.417	8772.7909	10270.7766	6400	14700	0.005	There is significant difference
	No Change	41	11352.68	3838.762	10141.0201	12564.3458	6400	26200		
	Worsen	17	15441.18	6426.222	12137.1182	18745.2347	6300	29800		
	Total	95	11371.22	4424.33	10469.9389	12272.5032	6300	29800		
	Missing	5								
Table 6. LV Systolic Function and WBC										

Table 6. LV Systolic Function and WBC

DISCUSSION

An increase in WBC count and CRP post myocardial infarction is well known. Myocardial infarction is a pro inflammatory state due to inflammations and pericarditis which leads to Dressler's syndrome.^{3,4} In this study we are exploring the possibility of prognostic value of WBC count at presentation to post PCI prognosis. Since WBC count is a simple and non-invasive test, this correlation gives an easy predictability of possible outcome, which will allow clinician to prepare for possible complications.^{5,6}

Acute myocardial injury causes a great extent of change in the myocardium such as myocardial necrosis, myocardial oedema, microvascular injury and subsequent healing with scar formation. All of these contribute to the inflammation and recruitment of leucocytes to the specific sites in the myocardium.⁷ Chemotactic factors, migration of neutrophils, peroxidation of lipids and depletion of free radicles all of these are released in Myocardial Infarction due to ischemia. Also leukocytes contribute to the remodelling of platelets

and vice versa. Several studies have also contributed to the fact that the mortality and death rate of the Acute Myocardial Infarction to various factors including WBC count.⁸

The relation between WBC count and MI are established by the mechanism through which the cardiac injury (ischaemic) initiates the innate immune response via toll-like receptor (TLR)-mediated pathways and upregulates the chemokine and cytokine syntheses in the infarcted heart. TLRs, which are expressed by inflammatory cells and also on endothelial cells and cardiac myocytes, can recognize endogenous danger signals released during cell death following myocardial ischemia and reperfusion.²

The study is conducted to show the correlation between WBC count and NYHA classification in one month follow up in MI patients with and without DM, who underwent primary PCI. It showed that most of the patients with symptoms of class III and IV according to NYHA had elevated WBC count that is 80 % of patients with worse symptoms had raised WBC count. On the contrary 64 % of patients with class I symptoms according to NYHA had normal WBC count (p

value 0.001) (Table 2). For the patients with and with output DM p value remains same (p value 0.001). Although DM has a very significant effect on the outcome of MI patients, the effect of TC on the outcome of MI is commendable irrespective of the presence of DM. (Table 3, 4)

Studies have shown that patients with a high WBC count on admission for Acute Myocardial Infarction had a higher risk of further Left Ventricular remodelling. That is higher the WBC, the LV function is reduced.¹ Similar, correlation between WBC count and LV function of the patients at presentation and its improvement and worsening in one month follow up were studied, among patients with good/fair LV at presentation, 62 % had normal WBC count, whereas patients with moderate/ severe LV function at presentation, 78.5 % had their WBC count raised (p value: 0.001). (Table 5) and during their 1 month follow ups 60 % of patients with improved LV function had normal WBC count., 76.6 % of patients with worse LV function had raised WBC count (p value: 0.005) (Table No. 6)^{9,10}

Comparison between heart failure patients (according to NYHA) with and without diabetes Mellitus showed, patients with DM are more prone to have class IV type of symptoms (NYHA) while most of the patients with class I symptoms are without DM. Same result holds good for LV function and DM. The magnitude of reduction in risk of death or HF hospitalization associated with increasing LVEF is significantly attenuated among patients with diabetes when compared to patients without diabetes.^{11,12}

The time of presentation has been a great influence in the prediction of outcome in patients with MI, even though a delay in time of presentation shows a rise in WBC count, p value shows no significant difference in the study (p value 0.065).¹³

Reduced Door-to-Balloon time in PPCI for the treatment of ST elevation MI has been associated with lower cardiac mortality rate. Longer the DBT worse is the LV function (p value: 0.018) also longer the DBT, patients had class IV symptoms (p value: 0.023).^{14,15}

This study is aimed at establishing the contribution of WBC count on predicting the outcome on MI patients irrespective of any other comorbidities that may coexist. The evidences furnished in this article supports this theory.

Limitations

The number of patients in the study is less. The total count values of the patients prior to the MI is not known, which leaves a very minute possibility of them having a raised WBC due to some other cause. The patient symptoms analysis is purely based on the patient history, which may or may not be reliable.

Abbreviations

1. LV - Left Ventricular systolic function
2. WBC - White Blood Cell
3. MI - Myocardial Infarction
4. CAD - Coronary Artery Disease

5. PPCI - Primary Percutaneous Coronary Intervention
6. PCI - Percutaneous Coronary Intervention
7. NYHA - New York Heart Association
8. DBT - Door to Balloon Time
9. DM - Diabetes Mellitus

CONCLUSIONS

There are lot of factors which decide the outcome in acute Myocardial Infarction post Percutaneous Coronary Intervention including host factors like age, gender, race, ethnicity, diabetes, hypertension and logistical factors like door to balloon time, available expertise etc. All these factors contribute to the final outcome, like mortality, left ventricular ejection fraction, functional capacity etc. The white blood cell count at the time of presentation can be used as an independent predictor of in-hospital mortality / morbidity and post PCI outcome and may be a useful tool in assessing the prognosis of patients of Acute Myocardial Infarction undergoing Percutaneous Coronary Intervention in conjunction with other risk stratification factors. Whether an elevated White Blood Cell count is a marker of the inflammatory process or is a direct risk factor of Acute Myocardial Infarction undergoing Percutaneous Coronary Intervention remains unclear as of now.

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