J. Cardiovasc Disease Res., 2020; 11(3): 44 – 47
A Multifaceted Peer Reviewed Journal in the field of Cardiology
www.jcdronline.org | www.journalonweb.com/jcdr
P – ISSN: 0975 – 3583 Online: 0976 – 2833

Hematological Parameters for Predicting Failure of Thrombolytic Therapy after ST-Elevation Myocardial Infarction

Abhishek Rathore*[1], Nitish Kumar Ranjan[1], Kanchanahalli Siddegowda Sadananda[2], Cholenahally Nanjappa Manjunath[3]

[1]Ex post-graduate in cardiology M.D., D.M., Department of Cardiology, Sri Jayadeva Institute of Cardiovascular Science and Research, Mysore, India

[2]Professor of Cardiology M.D., D.M., Department of Cardiology, Sri Jayadeva Institute of Cardiovascular Science and Research, Mysore, India

[3]Director and Professor of Cardiology M.D., D.M., Department of Cardiology, Sri Jayadeva Institute of Cardiovascular Science and Research, Mysore, India

*Corresponding author: *Dr. Abhishek Rathore*
557, Krishna Aashiyana, Khatiwala Tank, Indore-452014, India
E-mail: drabhishek.ind8@gmail.com

ABSTRACT

Aim: To predict the failure of thrombolytic therapy by hematological parameters after ST-Elevation myocardial infarction.

Material and methods: A total of 41 patients with failed thrombolysis and 31 patients with successful thrombolysis after ST-elevation myocardial infarction were taken. Hemoglobin concentration, red blood cell count, red cell distribution width, white blood count, Neutrophil %, Lymphocyte %, Neutrophil/lymphocyte ratio, platelet count, mean platelet volume, platelet distribution width, large platelet concentration ratio, HBA1c, and Troponin I was taken.

Results: The mean age of patients with failed thrombolysis was higher than the patients with successful thrombolysis (56.02 ± 11.2 vs 44.6 ± 11.6, $p < 0.05$). The heart rate, hemoglobin concentration, red blood cell count and neutrophil/lymphocytic ratio of patients belonging to a group with failed thrombolysis were significantly less than that of successful thrombolysis group.

Conclusion: Among hematological parameters, hemoglobin concentration, red blood cell count, and neutrophil-lymphocyte ratio can be used to predict the successfulness of thrombolytic therapy.

Keywords: Hematological parameters, Thrombolytic therapy, ST-elevation myocardial infarction

Correspondence:
Abhishek Rathore
Professor of Cardiology, MD. DM
Department of Cardiology, Sri Jayadeva Institute of Cardiovascular Science and Research
Mysore, India
E-mail Address:
drabhishek.ind8@gmail.com

Submitted: 03-06-2020
Revision: 28-06-2020
Accepted Date: 12-07-2020

DOI: 10.31838/jcdr.2020.11.03.11

INTRODUCTION

An acute coronary syndrome is a major cause of death worldwide [1]. A timely diagnosis and appropriate treatment strategy are crucial to prevent morbidity and mortality. Thrombolytic therapy, being easily available, affordable plays a major role in ST-elevation myocardial infarction before the invention of percutaneous coronary intervention. As thrombolytic therapy is not always effective in ST-elevation myocardial infarction (STEMI), it may lead to dreadful cardiovascular complications, including death. There is a need for a few indices or parameters which can predict the failure of thrombolytic therapy so that timely percutaneous therapy can be done. As timely percutaneous therapy achieves rapid reperfusion, thereby reducing infarct size, preserving left ventricular function and improving survival. The present study is aimed at identifying hematological parameters that can predict the failure of thrombolytic therapy after ST-elevation myocardial infarction.

METHODS

This is a retrospective observational study. A total of 41 patients with failed thrombolysis and 31 patients with successful thrombolysis who were admitted to Sri Jayadeva Institute of Cardiovascular Science and Research, Mysore between January 2016 to April 2016. These patients were thrombolysed with streptokinase after diagnosing ST-elevation myocardial infarction (STEMI) on an electrocardiogram.

Inclusion criteria

All patients with STEMI (less than 12 hr duration) without any contraindication for thrombolytic therapy.

Exclusion criteria

Patients with sepsis, autoimmune disorders, heart failure, renal or hepatic failure, steroid users, and malignancy.

Hematological parameters were analyzed from blood samples taken during hospitalization. Parameters were hemoglobin, red blood cell count, red cell distribution width, white blood cell count, neutrophil count, lymphocyte count, neutrophil/lymphocyte ratio, platelet count, mean platelet volume, platelet distribution width, and large platelet concentration ratio. Also, HBA1c, troponin I, and ejection fraction on echocardiography were taken.

Patients were treated with anticoagulants, antiplatelets, statins, beta-blockers, and angiotensin-converting enzyme inhibitors/ angiotensin receptor blockers, and other supportive measures.

Informed consent was taken from all patients and our study is approved by our local ethics committee.

Successful thrombolysis is defined as recanalization of the culprit artery with residual lesion less than 50% on coronary angiography after thrombolytic therapy (streptokinase only).

We have not taken merely the resolution of ST-segment and chest pain relief after 90 minutes of thrombolytic therapy as criteria for successful thrombolysis. Because we have

observed in many patients who have >50% resolution of ST-segment at 90 minutes and chest pain relief >80%, but on angiography has >70% stenosis.

STATISTICAL ANALYSIS

The data were analyzed using SPSS (Statistical Package for Social Sciences) 20.0 version, IBM. The data was analyzed for probability distribution using the Kolmogorov Smirnov test, p-value >0.05 indicated that the data were normally distributed. Thus parametric tests of significance were applied. Descriptive statistics were performed. The comparison between the groups was done using the Independent t-test. The correlation between the parameters was analyzed using Pearsons's correlation coefficient. The p value<0.05 was considered statistically significant. The confidence level was set at 95%.

RESULTS

The study included patients who received thrombolytic therapy and did not benefit (group 1) and patients who got benefits (group 2). There were 41 patients in group 1 and 31 in group 2. Thus, the total number of study subjects was 72

The mean age of patients belonging to group 1 with failed thrombolysis was 56.02±11.2 years which was significantly greater than the mean age of patients belonging to group 2 (44.6 ± 11.6, $p < 0.05$). The study included predominantly males than females in both groups ($p < 0.05$) (Table 1).

Out of many variables taken into consideration in this study, the mean heart rate, hemoglobin concentration, red blood cell count, and neutrophil-lymphocyte ratio (N/L ratio) were significantly correlated and were lower in group 1 with failed thrombolysis than group 2 (Table 1 and 2).

A cut-off value cannot be calculated for the parameters which have a high correlation as AUROC was < 0.5 (Table 3).

DISCUSSION

Thrombolytic therapy remains the only mode of reperfusion before the introduction of percutaneous coronary intervention (PCI). Thrombolytic therapy is not always effective in most cases, as its patency rate is 60-68% with streptokinase, 73-84% with alteplase, 84% with reteplase, and 85% with tenecteplase, even when a patient presents within window period after the onset of STEMI.[2] After an ACS, timely reperfusion of the infarct-related artery is needed to prevent mortality and morbidity from cardiovascular complications. So, there is a need for some parameters which can predict the failure of thrombolytic therapy so that timely PCI can be done and prevent cardiovascular complications eg, heart failure, arrhythmia, reinfarction, cardiogenic shock, and death. It is well known from previous studies that patients with diabetes, hypertension, long door to needle time, type of thrombolytic agent (streptokinase), and old age have a high probability of failed thrombolysis.[3] In the present study, we tried to find out if there are some other parameters ie, hematological parameters which can predict the failure of thrombolytic therapy. We have chosen hematological parameters as they are well known to be associated with the acute coronary syndrome.[4]

Inflammation is considered to play a key role in the pathogenesis of plaque formation and its rupture leading to the acute coronary syndrome. This inflammation leading to acute coronary syndrome releases various biomarkers in the blood which have various diagnostic and prognostic values.[5,6] High white blood cell count is found to be associated with a greater extent of coronary involvement and increased cardiovascular mortality in acute coronary syndromes.[7,8] Also, there is evidence that suggests that WBCs may directly contribute to thrombus formation in acute coronary syndrome.[6] In our study, we found a high neutrophil-lymphocyte ratio in patients with successful thrombolysis. This successfulness of thrombolytic therapy can be attributed to a high thrombotic burden, instead of atherosclerotic burden leading to acute coronary syndrome (ACS). While lymphocytes could limit inflammation, lower the lymphocyte count, the higher the atherosclerosis progression and adverse clinical outcomes in heart failure and acute coronary syndrome patients.[9,10] In a few studies, platelet indices have also been studied and were found to be associated with coronary artery disease severity.[11] In atherosclerosis, platelets are involved with chemotactic proteins, growth factors, and inflammatory and mitogenic factors. More severe coronary artery disease cause the increasing generation of larger platelets with higher mean platelet volume from bone marrow. And the large and high amounts of platelets may form atherosclerotic plaques and may lead to the progression of atherosclerosis and lead to ACS.[12] With this background, we hypothesize that these hematological parameters can be used to predict the failure of thrombolysis after ACS.

To the best of our knowledge, there is no such study that predicts failed thrombolysis from hematological parameters.

LIMITATIONS

It is a single-center study and to validate these results further large studies are required.

CONCLUSION

Hematological parameters can be used as a predictor of failure of thrombolysis. Among hematological parameters, hemoglobin concentration, red blood cell count, and neutrophil-lymphocyte ratio can be used to predict the successfulness of thrombolytic therapy.

SOURCE OF SUPPORT

Nil

ACKNOWLEDGMENT

Nil

CONFLICTS OF INTEREST

Nil

AUTHORS CONTRIBUTION

This manuscript has been read and approved by all the authors, the requirements for authorship as stated earlier in this document have been met, and that each author believes that the manuscript represents honest work.

REFERENCES

1. Lopez AD, Mathers CD, Ezzati M, et al. Global and regional burden of disease and risk factors, 2001: Systematic analysis of population health data. Lancet. 2006; 367: 1747-57.
2. O'Gara PT, Kushner FG, Ascheim DD, Casey DE Jr, Chung MK, de Lemos JA et al. 2013 ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction. J Am Coll Cardiol. 2013 ; 61 (4): e78-e140.
3. Lee YY, Tee MH, Zurkurnai Y, Than W, Sapawi M and Suhairi I. Thrombolytic failure with streptokinase in acute myocardial infarction using electrocardiogram criteria. Singapore Med J. 2008; 49(4):304-10.
4. Budziannowski J, Pieszko K, Burchardt P, Rzezniczak J and Hiczkiewicz J. The role of hematological indices in patients with acute coronary syndrome. Dis Markers. 2017; 2017:3041565
5. Sabatine MS, Morrow DA, Cannon CP, Murphy SA, Demopoulos LA, diBattiste PM, et al. Relationship between baseline white blood cell count and degree of coronary artery disease and mortality in patients with acute coronary syndromes: a TACTICS-TIMI 18 (Treat Angina with Aggrastat and determine Cost of Therapy with an Invasive or Conservative Strategy-Thrombolysis in Myocardial Infarction 18 trial) substudy. J Am Coll Cardiol. 2002; 40: 1761-8.
6. Libby P, Simon DI. Inflammation and thrombosis: the clot thickens. Circulation.2001;103:1718-1720.
7. Haim M, Boyko V, Goldbourt U, Battler A, Behar S. Predictive value of elevated white blood cell count in patients with pre-existing coronary heart disease: The Bezafibrate Infarction Prevention Study. Arch Intern Med. 2004; 164(4):433-439.
8. Ates AH, Canpolat U, Yorgun H, Kaya EB, Sunman H, Demiri E, et al. Total white blood cell count is associated with the presence, severity, and extent of coronary atherosclerosis detected by dual-source multislice computed tomographic coronary angiography. Cardiol J 2011;18:371-7.
9. Vaduganathan M, Ambrosy AP, Greene SJ, Mentz RJ, Subacius HP, Maggioni AP.et al., "Predictive value of low relative lymphocyte count in patients hospitalized for heart failure with reduced ejection fraction: insights from the EVEREST trial." Circulation: Heart Failure. 2012; 5(6): 750–758.
10. Zouridakis EG, Garcia-Moll X, Kaski JC. "Usefulness of the blood lymphocyte count in predicting recurrent instability and death in patients with unstable angina pectoris," Am J Cardiol. 2000; 86(4):449–451.
11. Murat SN, Duran M, Kalay N, Gunebakmaz O, Akpek M, Doger C. et al., Relation between mean platelet volume and severity of atherosclerosis in patients with acute coronary syndromes. Angiology 2013;64:131-136.
12. Gawaz M, Langer H, May AE. Platelets in inflammation and atherogenesis. J Clin Invest 2005;115:3378-3384.

TABLES

Table 1: Comparison of mean of different parameters between Group 1 and Group 2.

Parameter	Group1-Failed lysis (n=41) Mean	Group2- Succesful lysis (n=31) Mean	P-value
Age	56.02 ± 11.2	44.6 ± 11.6	0.000*
Heart Rate (per min)	77.78 ± 11.3	86 ± 17.5	0.018*
Mean blood pressure (mmHg)	97.6 ± 17.1	95 ± 14.3	0.608
Hemoglobin (gm/dl)	13.0 ± 1.95	14.6 ± 2.97	0.007*
Red blood cell count (millions/cumm)	4.3 ± 0.55	4.9 ± 0.8	0.001*
White blood cell count (cells/cumm)	12058.5 ± 3255.5	12274.2 ± 4411.7	0.812
Neutrophils (%)	74.6 ± 9.4	78.5 ± 9.3	0.079
Lymphocytes (%)	19.1 ± 7.97	15.8 ± 7.9	0.080
N/L ratio	4.7 ± 2.3	6.0 ± 2.5	0.026*
Platelet count (lakh/cumm)	2.5 ± 0.56	2.4419 ± 0.7	0.746
Red cell distribution width (%)	16.1 ± 1.2	16.5 ± 2.5	0.288
Mean platelet volume (femtoliter)	7.7 ± 0.8	7.5 ± 0.56	0.251
Platelet distribution width (%)	11.6 ± 0.9	11.5 ± 1.0	0.916
Large platelet concentration ratio (%)	12.2 ± 3.1	12.3 ± 3.3	0.915
HBA1c (%)	6.7 ± 1.99	6.4 ± 2.3	0.547
Trop I (mg/dl)	0.45 ± 0.1	0.6 ± 0.1	0.461
Syntax score	8.8 ± 6.2	3.4 ± 2.7	0.001*
Duration of pain (hr)	5.2 ± 2.6	4.7 ± 1.5	0.377
Chest pain relief (%)	68.3 ± 24.96	69.0323 ± 28.2	0.907
ST resolution (%)	71.5 ± 15.1	78.6 ± 15.2	0.053
Ejection Fraction(%)	45.4 ± 5.4	46.8 ± 8.7	0.402

*p value<0.05 was considered statistically significant.

Table 2: Correlation between the outcome and different variables.

Parameter	Pearson's correlation	P-value

	coefficient	
Age	0.450	0.000*
Heart rate	-0.277	0.018*
Mean blood presure	0.061	0.608
Hemoglobin	-0.315	0.007*
Red blood cell count	-0.386	0.001*
White blood cell count	-0.029	0.812
Neutrophils %	-0.209	0.079
Lymphocyte %	0.208	0.080
N/L ratio	-0.262	0.026*
Platelets	0.039	0.746
Red cell distribution width	-0.127	0.288
Mean platelet volume	0.137	0.251
Platelet distribution width	0.013	0.916
Large platelet concentration ratio	-0.013	0.915
HBA1c	0.072	0.547
Trop 1	-0.088	0.461
Syntax score	0.376	0.001*
Duration of pain	0.106	0.377
Chest pain relief	-0.014	0.907
ST resolution	-0.229	0.053
Echo	-0.100	0.402

*p-value <0.05 was considered statistically significant.

Table 3: AUROC, sensitivity, and specificity of different variables in predicting outcome.

Parameter	AUROC	Cut off value	Sensitivity	Specificity
Age (in years)	0.758	49.00	0.732	0.742
Heart rate (beat/minute)	0.396*	-	-	-
Mean blood pressure (mm/Hg)	0.528	93.50	0.561	0.516
Hemoglobin (gm%)	0.308*	-	-	-
Red blood cell count	0.247*	-	-	-
White blood cell count	0.475*	-	-	-
Neutrophils %	0.360*	-	-	-
Lymphocyte %	0.666	15.5	0.610	0.645
N/L ratio	0.335*	-	-	-
Platelets	0.537	2.45	0.537	0.581
Red cell distribution width	0.424*	-	-	-
Mean platelet volume	0.576	7.55	0.585	0.645
Platelet distribution width	0.522	11.75	0.610	0.548
Large platelet concentration ratio	0.503	10.70	0.659	0.452
HBA1c	0.618	5.75	0.683	0.613
Trop 1	0.434*	-	-	-
Syntax score	0.834	3.5	0.829	0.774
Duration of pain	0.541	5.25	0.439	0.806
Chest pain relief	0.469*	-	-	-
ST resolution	0.390*	-	-	-
Echo	0.464*	-	-	-

*AUROC<0.5 indicates that the variable is not a good predictor of the outcome.

Cite this article: Abhishek Rathore Hematological Parameters for Predicting Faiure of Thrombolytic Therapy after ST – Elevation Myocardial Infarction. J. Cardiovascular Disease Res. 2020; 11 (3): 44 – 47