

## Evaluation of Mean Platelet Volume (MPV) in Patients with Acute Coronary Syndrome

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### Abstract

**Background:** The mean platelet volume (MPV), a reliable indicator of platelet size, might associate with cardiac Troponin (cTnI) in ACS.

**Objectives:** The aim of this study is to investigate the association between mean platelet volume and measurements of Troponin I (cTnI) in patients with suspected diagnosis of ACS. Furthermore, this study will evaluate the diagnostic accuracy of MPV in diagnostic workup of ACS.

**Materials and Methods:** We compared MPV and Troponin I values of 119 patients admitted at emergency department of Hygeia Hospital Tirana with chest pain suggestive of ACS. 69 patients were diagnosed with AMI based on the rise of Troponin I, ECG changes and abnormal coronary angiography, whereas 50 patients resulted negative in all of the above criteria and were categorized in the control group.

Statistical studies were carried out using MedCalc Statistical Software. A comparison of non-parametric values between groups was performed using Mann-Whitney U-test. A nominal significance was taken as a two-tailed  $P$ -value  $<0.05$ . The diagnostic accuracy of MPV for diagnosing ACS was calculated by receiver operating characteristic curve.

**Results:** The patients in Troponin positive group had higher mean MPV values than the control group with normal cardiac Troponin I levels ( $10.89 \pm 1.11$  vs  $8.92 \pm 1.14$  fl with  $p < 0.0001$ ). Specificity, sensitivity and cut-off value of MPV for diagnosing ACS was 94.2%, 72% and  $>9.4$  fl respectively.

**Conclusion:** MPV is a simple laboratory test which can be measured in association with other laboratory biomarkers in stratifying the risk for ACS.

**KEYWORDS:** MPV, ACS, Troponin I, AMI

### INTRODUCTION

Acute coronary syndrome is associated with a spectrum of clinical presentations starting from unstable angina to acute myocardial infarction.[1] Furthermore, management of patients suspected for acute coronary syndrome (ACS) is often challenging despite the remarkable progress in diagnostic guidelines.[4] International Federation of Clinical Chemistry and other organizations such as American College of Cardiology have proposed a clear set of recommendations including biochemical cardiac markers for diagnosing ACS. The two proposed biochemical tests that are commonly used in clinical setting are cardiac Troponin I(cTnI) and cardiac Troponin T (cTnT). Nevertheless, the diagnostic value of measured cardiac Troponins is limited in the time frame 2-4 hours from the onset of clinical symptoms. Also creatine kinase-MB can be used to measure the myocardial damage as it elevates in the first hours and it peaks at 24 hours reaching again

normal level after 72 hours.[5] Hence, it becomes evident that laboratory examinations are of outmost importance in minimizing emergency room delays of patients with cardiac pain. Apart from other well established markers, platelets are documented playing a crucial role in pathogenesis of atherosclerosis and thrombus formation after coronary plaque ruptured.[8, 10] The exact mechanism via which platelet extend their role in pathogenesis is based on the formation of arachidonic acid and prostaglandins. [9] Formation of thromboxane A<sub>2</sub> leads in turn to vasoconstriction and increased production of leukotrienes which causes escalated inflammation response.[6] The above mechanisms are described as being responsible for accelerating thrombus formation and leading to severe thrombotic events.[7] An index of platelet size measured as mean platelet volume (MPV) is an important indicator of platelet activity and platelet function.[11] As such, it can be hypothesized that increased mean platelet volume may be a potential predictor of myocardial damage in ACS which can be used in cardiovascular risk stratification. Furthermore, platelet indices such as MPV and platelet distribution width (PDW) have had extensive use in the diagnosis of Idiopathic Thrombocytopenic Purpura, hematological and myeloproliferative disorders, however such indices have been used very little in the assessment of cardiovascular disorders.[2, 3] The aim of this study was to evaluate the usefulness of MPV volume in acute coronary syndrome.

## MATERIALS AND METHODS

The study was based on hospital observations of 119 patients admitted at the Emergency/Cardiology department of Hygeia Hospital Tirana Albania with chest pain suggestive of ACS. The observations were made during the time period April-march 2015. All patients underwent detailed examinations including history, physical, ECG, angiography and laboratory examinations. Blood samples for hematological examinations were collected using BD vacutainer containing K<sub>2</sub>EDTA and MPV was measured within two hours from time of blood collection using Advia® 2120 Hematology Analyzer (Siemens Healthcare Diagnostics).. Biological samples for cardiac Troponin I (cTnI) measurements were collected with BD vacutainer and analyzed at 4, 6 and 12 hours using ADVIA® CENTAUR CP (Siemens Healthcare Diagnostics). Cut-off value for cardiac Troponin I (cTnI) was < 0.04 ng/ml. All patients underwent 12 lead ECG and angiography examination whenever necessary.

Patients with chest pain lasting more than 6 hours, renal failure, hepatic failure, clotting disorders, antiplatelet therapy as well as various myeloproliferative diseases or malignancies were excluded from the study.

The data were analyzed using MedCalc Statistical Software version 13.3.3 (MedCalc Software, Ostend, Belgium; <http://www.medcalc.org>; 2014). Quantitative variables were expressed as mean  $\pm$  standard deviation whereas qualitative variables were expressed as percentages (%). A comparison of non-parametric values between groups was performed using Mann-Whitney U-test. A nominal significance was taken as a two-tailed *P*-value < 0.05. The diagnostic accuracy of MPV for diagnosing ACS was calculated by receiver operating characteristic curve (ROC).

## RESULTS

Of 119 patients admitted at cardiology/emergency department with chest pain 69 (58%) of them were diagnosed with acute myocardial infarction as indicated by elevated cardiac Troponin I values, ECG changes and important angiography findings. 50 (42%) of the patients admitted at the hospital (control group) were below cut off value of cardiac Troponin I (cTnI < 0.04 ng/ml), had no ECG changes and no significant findings during angiographic examinations. Male/female ratio of patients diagnosed with acute myocardial infarction and non-ACS were [53/16] and [28/22] respectively.

**Table 1** shows laboratory data of a patients diagnosed with acute myocardial infarction

**Table 2** shows laboratory data of non-ACS patients admitted with chest pain

**Table 1:** Laboratory data of patients diagnosed with AMI

| Gender                      | TnI Ultra<br><i>Cut off</i> $\geq 0.04$<br>ng/ml<br>$\bar{X} \pm SD$ | Thrombocytes<br>$x10^3 / \mu L$<br>$\bar{X} \pm SD$ | MPV<br>fl<br>$\bar{X} \pm SD$ |
|-----------------------------|--|---|-------------------------------|
| Male<br>(n=53)              | 19.25 $\pm$ 32.1   | 225.54 $\pm$ 56.0                                   | 10.93 $\pm$ 1.08              |
| Female<br>(n=16)            | 10.27 $\pm$ 14.6   | 268.87 $\pm$ 79.7                                   | 10.78 $\pm$ 1.22              |
| Patients<br>total<br>(n=69) | 17,16 $\pm$ 29.1   | 235.59 $\pm$ 64.3                                   | 10.89 $\pm$ 1.11              |

**Table 2:** Laboratory data of patients not diagnosed with ACS

| Gender                      | TnI Ultra<br><i>Cut off</i> $\geq 0.04$<br>ng/ml<br>$\bar{X} \pm SD$ | Thrombocytes<br>$x 10^3 / \mu L$<br>$\bar{X} \pm SD$ | MPV<br>fl<br>$\bar{X} \pm SD$ |
|-----------------------------|--|--|-------------------------------|
| Male<br>(n=28)              | 0.015 $\pm$ 0.01   | 237.42 $\pm$ 66.9                                    | 8.89 $\pm$ 1.12               |
| Female<br>(n=22)            | 0.014 $\pm$ 0.01   | 237.42 $\pm$ 66.9                                    | 8.95 $\pm$ 1.18               |
| Patients<br>total<br>(n=50) | 0.014 $\pm$ 0.01   | 237.42 $\pm$ 66.9                                    | 8.92 $\pm$ 1.14               |

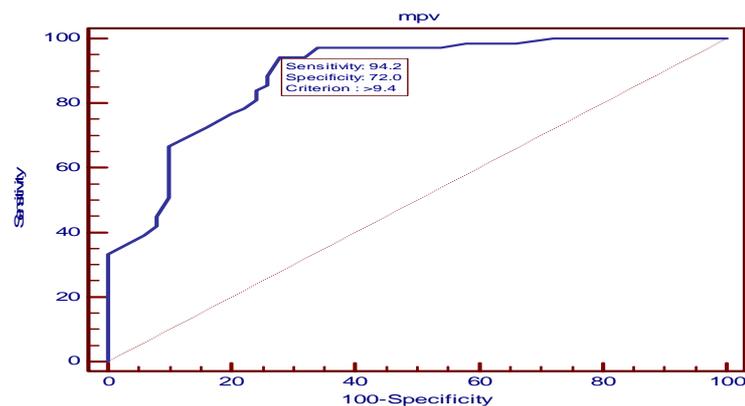
Based on data shown in **table 1** and **table 2** it was found that mean MPV value of AMI patients to be higher than non ACS patients ( $10.89 \pm 1.11$  vs  $8.92 \pm 1.14$  fl, p-value < 0.0001).

Further calculation, as to investigate possible differences based on gender, revealed that mean MPV values of AMI patients and non ACS patients stratified by gender had no statistically significant changes ( Male<sub>(AMI)</sub>  $10.93 \pm 1.08$  vs Female<sub>(AMI)</sub>  $10.78 \pm 1.22$  fl, P= 0.664) and (Male<sub>(Non-ACS)</sub>  $8.89 \pm 1.12$  VS Female<sub>(non-ACS)</sub>  $8.95 \pm 1.18$  fl, P=0.9221).

Diagnostic accuracy of MPV in acute coronary syndrome was evaluated by receiver operating characteristic curve (ROC).

**Figure 1** shows ROC curve analysis which demonstrates that the admission values of MPV were useful diagnostic tool to detect ACS in patients suffering from chest pain (area under curve [AUC] = 0.886, 95% confidence interval[CI] 0.815 – 0.937, P-value <0.0001). The best specificity, sensitivity and cut-off value for identifying ACS were 94.2%, 72% and >9.4 fl respectively

**Figure 1:** Diagnostic accuracy of mean platelet volume in ACS



## DISCUSSION

Coronary artery disease is the most important cause of mortality and morbidity in industrialized as well as in developing countries. Both endogenous and exogenous risk factors such as smoking, hypercholesterolemia, DM, and hypertension increase the risk of ACS. In this study we examined a platelet index, MPV (mean platelet volume) which appears to be an adequate risk factor for ACS. As reported in our study, MPV was higher in patients diagnosed with acute coronary syndrome than non-ACS patients. The differences were statistically significant and were not gender dependent. Based on such findings we have concluded that larger platelet volumes constitute a higher risk for developing acute coronary syndrome.

## CONCLUSION:

Our data suggest that the increased platelet volume indices contribute to the prethrombotic state in acute ischaemic syndromes and that larger platelets may play a

specific role myocardial infarction. Patients with larger platelets can easily be identified during routine haematological analysis because MPV is a simple and economic laboratory measurement. We suggest that it might be useful as an assisting rule-out test in conjunction with other conventional biochemical cardiac markers in the early prediction of the risk of ACS in patients admitted to the emergency department.

## REFERENCES

1. Chu SG, Becker RC, Berger PB, Bhatt DL, Eikelboom JW et al. Mean platelet volume as a predictor of cardiovascular risk: a systematic review and meta-analysis. *J Thromb Haemost* 2010;8:148-56.
2. Khode V, Sindhur J, Kanbur D, Ruikar K, Nallulwar S. Mean platelet volume and platelet volume indices in patients with stable coronary artery disease and acute myocardial infarction : A case control study. *J Cardiovasc Dis Res.* 2012;3:272-275
3. Endler G, Klimesch A, Plassmann HS, Schillinger M, Exner M et al. Mean platelet volume is an independent risk factor for myocardial infarction but not for coronary artery disease. *British Journal of Haematology* 2002;117: 399-404.
4. Turnbull F. Effects of different blood-pressure lowering regimens on major cardiovascular events: results of prospectively-designed overviews of randomised trials. *Lancet.* 2003;362: 1527-1535.
5. Mirzaie AZ, Abolhasani M, Ahmadinejad B, Panahi M. Platelet count and MPV, routinely measured but ignored parameters used in conjunction with the diagnosis of acute coronary syndrome: single study center in Iranian population. *MJIRI*,2010; 26:17-21.
6. Nadar SK, Blann AD, Kamath S et al. Platelet indexes in relation to target organ damage in high-risk hyper-tensive patients:a substudy of the Anglo-Scandinavian Cardiac Outcomes Trial (ASCOT) *J Am Coll Cardiol.* 2004;44:415-422.
7. Bhayana A, Joshi D. Is large platelet size a risk factor for acute coronary syndrome : A retrospective case-control study. *J MGIMS,* 2009;14: 52 -5.
8. Gawaz M .Role of platelets in coronary thrombosis and reperfusion of ischemic myocardium. *Cardiovascular Research.*2004;61:498–511.
9. Linden MD, Furman MI, Frelinger AI, Barnard MR, Przyklenk SK, Michelson AD. Indices of platelet activation and the stability of coronary artery disease. *Journal of Thrombosis and Haemostasis,*2007; 5: 761–765.
10. Chu H, Chen WL, Huang CC, Huang HY, Kuo HY, Gau CM, et al. Diagnostic performance of mean platelet volume for patients with acute coronary syndrome visiting an emergency department with acute chest pain: the Chinese scenario. *Emerg Med J* 2011;28: 569-74.
11. Mathur A, Robinson MS, Cotton J, Martin JF, Erusalimsky JD. Platelet reactivity in acute coronary syndromes: evidence for differences in platelet behaviour between unstable angina and myocardial infarction. *Thromb Haemost* 2001; 85: 989-94.