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Association between C-Reactive protein to serum albumin ratio and thrombus load in patients with acute myocardial infarction

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Abstract

Background: As indicators for systemic inflammation, elevated C-reactive protein (CRP) and reduced albumin levels were demonstrated to be predictive of unfavourable cardiovascular events (CV events). Moreover, it was proposed that the new Ratio between CRP and Albumin (CAR) was more sensitive and selective for assessing the systemic inflammatory status in non-cardiac illnesses than the predictive value of these 2 indicators independently. The purpose of this study was to assess the relationship between the ratio of CAR and coronary thrombus load in individuals with acute myocardial infarction (AMI).

Methods: This prospective cross-sectional study was carried out 100 patients with STEMI undergoing primary PCI and Patients with Non-STEMI undergoing for coronary angiography as soon as possible. Patients were divided into 2 groups: low thrombus load (grades 1-2) and high-thrombus load (grades 3 and 4). All patients underwent full history taking, complete clinical examination, standard 12-lead ECG, resting trans-thoracic echocardiography (TTE), laboratory investigations: including troponin I or T, serum albumin, serum CRP and other routine laboratory tests including serum creatinine, hemoglobin level and total lipid profile, CAR.

Results: CRP was significantly higher in the high thrombus load ($p = 0.03$) and albumin was significantly higher in low thrombus load ($p = 0.004$). CAR was significantly higher in the high thrombus load ($p = 0.02$). A significant positive correlation was found between CRP, CAR and NLR and thrombus load grade ($P = 0.017$, < 0.001 respectively) and a significant negative correlation was found between albumin and thrombus load grade ($p = 0.007$). In univariate regression analysis, CRP Albumin and CAR were significant predictor for thrombus while NLR was insignificant predictor for thrombus.

Conclusions: The level of CRP, Alb and CAR also increased troponin level is considered as a good predictor for myocardial infarction.

Keywords: C-reactive protein, albumin, ratio between CRP and albumin, myocardial infarction

Introduction

Acute coronary syndrome (ACS) refers to a range of clinical manifestations ranging from ST-segment elevation myocardial infarction (STEMI) through non-ST-segment elevation myocardial infarction (NSTEMI) or unstable angina. ACS is nearly invariably accompanied with break of an atherosclerotic thrombus patch and partial or total occlusion of the infarct-involved artery^[1].

It is the major cause of death from cardiovascular disease (CV) and requires rapid diagnosis and intervention. Luminal thrombus as a result of ruptured coronary thrombus patch is regarded as the fundamental mechanism of ACS. 15% of moderate- and high-risk patients with ACS had preprocedural thrombus, and intracoronary thrombus load was a robust predictor of unfavourable outcomes including stent thrombosis, myocardial infarction, and death^[1].

Percutaneous coronary intervention (PCI) to restore coronary flow in an infarct-related artery lowers myocardial damage and improves ventricular function and long-term results. In contrast, myocardial salvage may be diminished despite the restoration of coronary flow if the thrombotic load in a coronary artery is greater. This "no-reflow" condition is caused by

an impairment in microvascular perfusion caused by the distal embolization of thrombotic material. Recent investigations have established the close connection between inflammation and atherosclerosis [2,3].

As indicators for systemic inflammation, elevated C-reactive protein (CRP) and reduced albumin levels were demonstrated to be predictive of unfavourable cardiovascular events) CV(events). Additionally, it was proposed that the new Ratio between CRP and Albumin (CAR) was more sensitive and selective for assessing the systemic inflammatory status in non-cardiac illnesses than the predictive value of these two indicators independently [4,5].

It is essential to determine the intracoronary thrombus load and associated angiographic milieu in order to control difficulties during the surgery and prevent poor outcomes [5]. This study sought to determine the relationship between CAR and coronary thrombus load in individuals with acute myocardial infarction (AMI).

Patients and Methods

This prospective cross-sectional study was carried out 100 patients with STEMI undergoing primary PCI and Patients with Non-STEMI undergoing for coronary angiography as soon as possible from January 2020 until June 2020 at the department of cardiology Tanta university hospitals, Egypt. Ethics Committee of faculty of medicine, Tanta University gave approval to the study conduction. An informed consent was obtained from each participant in the study.

The exclusion criteria include patients presented with unstable angina, history of coronary artery bypass graft (CABG) and/or prior PCI, patients with thyroid dysfunction, patients with active malignancy, patients with chronic kidney disease (>stage2), patients with acute STEMI treated with thrombolytic agents, patients with acute inflammation and infection, patients with severe trauma and patients with liver failure.

Patients were divided into 2 groups: low thrombus load (grades 1-2) and high-thrombus load (grades 3 and 4)

All patients in this study were subjected to the following: full history taking, complete clinical examination, standard 12-leads ECG, resting trans-thoracic echocardiography (TTE), laboratory investigations: including troponin I or T, serum albumin, serum CRP and other routine laboratory tests including serum creatinine, hemoglobin level and total lipid profile, Ratio between CRP and Albumin (CAR) was measured as the ratio of CRP to albumin level multiplied by 100, coronary angiography, angiographic analysis and follow up of the patients during in-hospital period by monitoring vital signs, laboratory investigations as CBC, serum creatinine and other investigations as ECG and echocardiography.

Primary end points of the study include Successful PCI with good result or Major adverse cardiovascular events (MACE) such as: sudden cardiac death, acute heart failure, ventricular arrhythmia, re-infarction during in hospital period.

Statistical analysis

Once data was collected, a code sheet was developed. Organization, tabulation, presentation and analysis of data were performed by using SPSS (Statistical Package for the Social Sciences) V25 of IBM, USA. Mean and standard deviation were used for quantitative presentation of data. Categorical variables were presented as frequencies and percentages. Unpaired student t-test was used to compare means of 2 independent quantitative variables. Pearson correlation was used to assess the correlation between 2 quantitative variables. Statistical significance was assessed at P values less than 0.05

Results

Regarding angiographic thrombus load grades, 12 (12%) patients were grade 1, 25 (25%) patients were grade 2, 40 (40%) patients were grade 3, and 23 (23%) patients were grade 4.

All patients were classified according to the grade into low thrombus load, and it was 37 (37%) patients, and high thrombus load and it was 63 (63%) (Figures.1 & 2)

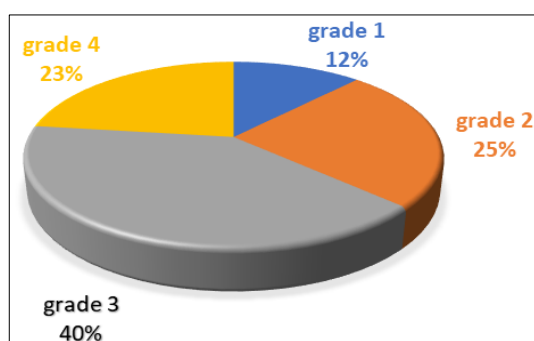


Fig 1: Angiographic thrombus load grades among the study participants

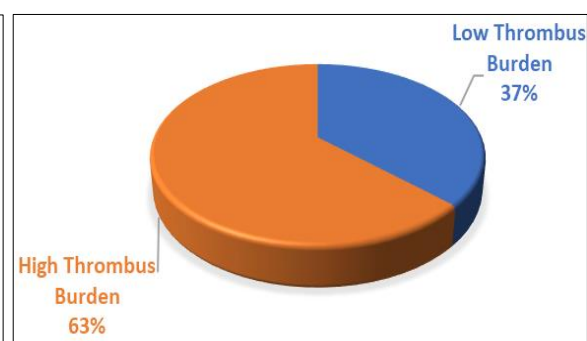


Fig 2: Thrombus load categories among the study participants

There was an insignificant difference between the two groups as regard age, gender and risk factors for thrombus formation. (Table.1).

Table 1: Age, gender and risk factors in the two groups

		Low Thrombus Load (n =37)	High Thrombus Load (n =63)	P value
Age		58.43 ± 12.13	56.71 ± 17.03	0.592
Gender	Male	20 (54.05%)	37 (58.73%)	0.68
	Female	17 (45.95%)	26 (41.27%)	
Diabetes		9 (24.32%)	24 (38.10%)	0.19

Hypertension	16 (43.24%)	28 (44.44%)	0.907
Smoking	16 (43.24%)	29 (46.03%)	0.837
Dyslipidemia	16 (43.24%)	31 (49.21%)	0.679
History of CAD	8 (21.62%)	13 (20.63%)	0.907
Family history of CAD	4 (10.81%)	13 (20.63%)	0.275

CAD: Coronary artery disease

There was an insignificant difference in systolic blood pressure, heart rate, ejection fraction and the incidence of

MACE (Sudden cardiac death, acute HF, arrhythmia and reinfarction) between the two groups. (Table.2)

Table 2: systolic blood pressure, heart rate, ejection fraction and the incidence of MACE (Sudden cardiac death, acute HF, arrhythmia and reinfarction) between the two groups

	Low Thrombus Load (n =37)	High Thrombus Load (n =63)	P value
Systolic blood pressure (mmHg)	127.29±12.23	129.08±22.02	0.65
Heart rate (beat per minute)	74.73±18.43	72.16±17.07	0.48
EF (%)	43.40±3.75	45.19±6.41	0.13
MACE	0 (0%)	0 (0%)	0.741
	1 (2.7%)	2 (3.17%)	
	2 (5.41%)	3 (4.76%)	
	0 (0%)	1 (1.59%)	

EF: Ejection fraction, MACE: major adverse cardiac events, *Statistically significant as $p < 0.05$

Preoperatively, regarding the complete blood count between the two groups, there was an insignificant difference in hemoglobin and platelets count between the two groups. WBCs, neutrophils to lymphocyte ratio and creatinine were significantly higher in high thrombus load ($p < 0.001$). C-reactive protein was significantly higher in the high

thrombus load ($p = 0.03$) and albumin was significantly higher in low thrombus load ($p = 0.004$).

Ratio between CRP and Albumin was significantly higher in the high thrombus load ($p = 0.02$).

Troponin was significantly higher in the high thrombus load ($p < 0.001$) (table.3)

Table 3: Preoperative complete blood count, CRP, albumin, CAR and troponin in the two groups

	Low Thrombus Load (n =37)	High Thrombus Load (n =63)	P value
Hemoglobin (g/dL)	12.57±1.79	12.65±1.25	0.78
Platelets ($\times 10^3 \mu/L$)	216.22±80.01	220.71±81.36	0.79
WBCs ($\times 10^3 \mu/L$)	8.48±2.17	10.25±2.18	<0.001*
NLR	5.71±1.63	7.39±1.35	<0.001*
Creatinine (mg/dL)	1.02±0.17	1.22±0.18	0.019*
CRP (mg/dL)	0.57±1.34	1.66±2.75	0.03*
Albumin (g/dL)	3.95±0.88	3.36±1.01	0.004*
CAR	23±12.96	30.09±15.64	0.02*
Troponin (mg/L)	5.32±2.13	8.98±2.87	<0.001*

CRP: C-reactive protein, CAR: Ratio between CRP and Albumin, *Statistically significant as $p < 0.05$

The complete blood count, creatinine, CRP, albumin, CAR and troponin were insignificantly different in the follow up between both groups.

Table 4: Complete blood count, creatinine, CRP, albumin, CAR and troponin follow up in the two groups

	Low Thrombus Load (n =37)	High Thrombus Load (n =63)	P value
Hemoglobin (g/dL)	14.05±1.83	14.13±1.36	0.823
Platelets ($\times 10^3 \mu/L$)	224.24±79.09	228.17±80.68	0.815
WBCs ($\times 10^3 \mu/L$)	9.97±2.12	10.73±2.32	0.111
NLR	8.2 ± 1.86	8.77 ± 1.49	0.095
Creatinine (mg/dL)	1.22 ± 0.18	1.27 ± 0.2	0.23
CRP (mg/dL)	1.3 ± 1.7	2.08 ± 2.87	0.14
Albumin (g/dL)	5.44 ± 0.98	5.55 ± 1.27	0.646
CAR	24.55 ± 13.92	26.56 ± 11.62	0.374
Troponin (mg/L)	9.86 ± 2.38	10.41 ± 2.77	0.326

CRP: C-reactive protein, CAR: Ratio between CRP and Albumin, *Statistically significant as $p < 0.05$

There was an insignificant difference between the infarct related artery (LAD, LCx, or RCA) and the presence of

multi vessel disease (1, 2 or 3) between the two groups. (table.5)

Table 5: Infarct related artery and multi vessel disease in the two groups

		Low Thrombus Load (n =37)	High Thrombus Load (n =63)	P value
Infarct related artery	LAD	13 (35.14%)	16 (25.4%)	0.539

	LCx	16 (43.24%)	29 (46.03%)	
	RCA	8 (21.62%)	18 (28.57%)	
Multi vessel disease	1 vessel	22 (59.46%)	30 (47.62%)	0.471
	2 vessels	11 (29.73%)	22 (34.92%)	
	3 vessels	4 (10.81%)	11 (17.46%)	

LAD: Left anterior descending, LCx: left circumflex, RCA: Right coronary artery

A significant positive correlation was found between CRP, CAR and NLR and thrombus load grade ($P = 0.017$, <0.001 respectively) and a significant negative correlation was found between albumin and thrombus load grade ($p = 0.007$). (Table.6)

Table 6: Spearman's Correlation between CRP, albumin, CAR, NLR, and thrombus load grade

	Thrombus load grade	
	R	P value
CRP	0.238	0.017*
Albumin	-0.267	0.007*
CAR	0.516	<0.001 *
NLR	0.406	<0.001 *

OR: Odds ratio, CI: Confidence interval, *Statistically significant as p value

In univariate regression analysis, CRP Albumin and CAR were significant predictor for thrombus while NLR was insignificant predictor for thrombus. (table.7)

Table 7: Univariate logistic regression analysis of CRP, albumin, CAR, NLR for the prediction of thrombus

	OR	95% CI	P value
CRP	4.575	0.848 - 24.673	0.016*
Albumin	0.678	0.358 - 1.282	0.008*
CAR	1.176	1.07 - 1.292	<0.001 *
NLR	1.37	0.955 - 1.96	0.084

Discussion

Our results revealed that most of the participants were had normal blood pressure or slightly elevated systolic blood pressure whether in low or high thrombus loads. Also, heart rate was normal and non-significant between the two groups [6].

These findings are in accordance with those of Duman *et al.* who reported the same findings [7].

Furthermore, our study revealed that in high thrombus load, the Alb level was significantly lower than the low thrombus load showed a negative correlation with thrombus load grade in coronary arteries [6]. This result was combatable to Duman *et al.* who reported lower serum albumin level in high thrombus load [6].

Moreover, our findings observed that the preoperative CAR ratio was significantly higher in the patients in high thrombus load and showed a significant positive correlation with thrombus load grade. These results are in the same line with Çınar *et al.* who reported that CAR were significantly higher in patients with high thrombus load who eventually died (8). Similarly, Duman *et al.* reported that the CAR ratio had a significantly positive correlation with the thrombus load grade. Thus, CAR is considered as an independent predictor for increased thrombus load grade [6].

The current study demonstrated that in high thrombus load, the troponin concentration was highly elevated versus the low thrombus load. Our results agreed with those of Yıldırım *et al.* who revealed that the mean peak troponin

level was significantly higher in the high thrombus load versus the low thrombus load [9].

In the current study, patients were underwent preoperative complete blood picture and the results showed that white blood cells count showed a significant increase within high thrombus load patient [9]. This result was in agreement with Cirakoglu *et al.* whose results showed a significant elevated count of white blood cells in high thrombus load patients [10].

Furthermore, the current study evaluated CRP, albumin, CAR, troponin and complete blood count during the in-hospital period follow up between the two groups. The results reported that there was no statistically significant difference was recorded between both groups. Contrasted to our results, Duman *et al.* showed a significant elevation in CRP, albumin, CAR in high thrombus load and low thrombus load [6].

Our study clarified the MACE: major adverse cardiac events in both groups and found that There was an insignificant difference in ejection fraction and the incidence of MACE (Sudden cardiac death, acute HF, arrhythmia and reinfarction) between the two groups [11]. In the line with our results, Jolly *et al.* stated that among the patients with high thrombus load, the rates of recurrent myocardial infarction, sudden death, cardiogenic shock, heart failure were not significantly different versus low thrombus load patients [11]. In addition, the current study confirmed that the NLR is significantly elevated in high thrombus load and showed a significant positive correlation with thrombus load grade in coronary arteries [12]. These results were in the same line with Yılmaz *et al.* who found that Neutrophil-lymphocyte ratio was significantly increased in the group with coronary thrombus versus non-thrombus group [12].

In our study, the coronary angiography revealed that the participant myocardial infarction patients had thrombotic occlusion in one or more artery of the coronary arteries which are the left anterior descending artery (LAD), distal circumflex artery (LCX) and the proximal right coronary artery (RCA). Moreover, the presence of multi vessel disease was evaluated among all participants and no significant difference were recorded between both groups [13].

These results were similar to Uslu *et al.* who reported that there was no significant difference between high thrombus load and low thrombus loads regarding the thrombotic occlusions in LAD, LCx, or RCA arteries. Furthermore, the multi vessel disease showed insignificant difference between the studied groups [13].

In the present study, the Correlation between CRP, albumin, CAR, NLR, and thrombus load grade were conducted and demonstrated that a significant positive correlation was found between CRP, CAR and NLR and thrombus load grade ($P = 0.017$, <0.001 respectively) and a significant negative correlation was found between albumin and thrombus load grade ($p = 0.007$) [6].

Additionally, Duman *et al.* [6] reported similar results in their study where CRP and CAR ($P < .001$) were significantly positively correlated with thrombus load. In addition, there

was a weakly positive ($P = .013$), moderately negative ($p < .001$), and weakly negative ($P = .029$) correlation between thrombus load and NLR, serum albumin level, and age, respectively.

In our study, one of the most valuable data was the univariate regression analysis of CRP, albumin, CAR, NLR for the prediction of thrombus and highlighted that CRP ($P = 0.016$), Albumin ($P = 0.008$) and CAR ($p < 0.001$) were significant predictor for thrombus in acute myocardial patients [6].

Our results are harmonious with Duman *et al.* (6), who concluded that higher CRP level ($P = .010$), lower serum albumin level (.049), higher CAR ($P = 0.008$), higher NLR ($P = .004$) were significant independent predictors for increased thrombus load.

Limitations include: It was a single centric study with relative small sample size, the prognostic value of CAR could not be assessed in the present study which had a limited number of patients and methods such as cardiac nuclear imaging and cardiac MR, which are more specific and reliable, could be used to evaluate the reperfusion not performed.

We recommend more patients to participate to ensure our results and more statistical tests to make more correlation. The measurements of laboratory investigation should be provided to compare results before and after PCI and Ratio between CRP and Albumin is more reliable prognostic factor for CVD.

Conclusions

There are many factors that can be used as a reflection of increased risk of myocardial injury. The most important of these factors is the level of CRP, Alb and CRP/Alb ratio also increased troponin level is considered as a good predictor for myocardial infarction. Besides, neutrophil/lymphocyte ratio is considered as a valuable biomarker that give important information about prediction thrombus formation. These factors collectively provide an appropriate management of the disease before PCI.

References

- Palmerini T, Genereux P, Caixeta A, Cristea E, Lansky A, Mehran R, *et al.* Prognostic Value of the SYNTAX Score in Patients With Acute Coronary Syndromes Undergoing Percutaneous Coronary Intervention: Analysis From the ACUITY (Acute Catheterization and Urgent Intervention Triage Strategy) Trial. *J Am Coll Cardiol.* 2011 Jun 14;57(24):2389-97.
- Raggi P, Genest J, Giles JT, Rayner KJ, Dwivedi G, Beanlands RS, *et al.* Role of inflammation in the pathogenesis of atherosclerosis and therapeutic interventions. *Atherosclerosis.* 2018 Sep 1;276:98-108.
- Sathananthan J, Watson TJ, Murdoch D, Overgaard C, Lee D, Khoo D, *et al.* Management of Intracoronary Thrombus. *Prim Angioplasty.* 2018 Jul 14;119-35.
- Kim MH, Ahn JY, Song JE, Choi H, Ann HW, Kim JK, *et al.* The C-Reactive Protein/Albumin Ratio as an Independent Predictor of Mortality in Patients with Severe Sepsis or Septic Shock Treated with Early Goal-Directed Therapy. *PLoS One.* 2015 Jul 9;10(7):e0132109.
- Ranzani OT, Zampieri FG, Forte DN, Azevedo LCP, Park M. C-Reactive Protein/Albumin Ratio Predicts 90-Day Mortality of Septic Patients. *PLoS One.* 2013 Mar 12;8(3):e59321.
- Duman H, Çinier G, Bakırcı EM, Duman H, Şimşek Z, Hamur H, *et al.* Relationship Between C-Reactive Protein to Albumin Ratio and Thrombus Load in Patients With Acute Coronary Syndrome. *Clin Appl Thromb.* 2019 Jan 28;25.
- Duman H, Çetin M, Durakoğlugil ME, Değirmenci H, Hamur H, Bostan M, *et al.* Relation of angiographic thrombus load with severity of coronary artery disease in patients with ST segment elevation myocardial infarction. *Med Sci Monit.* 2015;21:3540-6.
- Çınar T, Çağdaş M, Rencüzoğulları İ, Karakoyun S, Karabağ Y, Cınar T, *et al.* Prognostic efficacy of C-reactive protein/albumin ratio in ST elevation myocardial infarction. <https://doi.org/101080/1401743120191590628>. 2019 Mar 4 [;53(2):83–90.
- Yıldırım A, Küçükosmanoglu M, Koyunsever NY, Cekici Y, Dogdus M, Saracoglu E, *et al.* Association between serum SCUBE1 levels and thrombus load in patients with ST-segment elevation myocardial infarction. 2020;76(7):777-84. <https://doi.org/101080/0001538520201852753>.
- Cirakoglu OF, Aslan AO, Yilmaz AS, Şahin S, Akyüz AR. Association Between C-Reactive Protein to Albumin Ratio and Left Ventricular Thrombus Formation Following Acute Anterior Myocardial Infarction. *Angiology.* 2020 Oct 1;71(9):804-11.
- Jolly SS, Cairns JA, Lavi S, Cantor WJ, Bernat I, Cheema AN, *et al.* Thrombus Aspiration in Patients With High Thrombus Load in the Total Trial. *J Am Coll Cardiol.* 2018 Oct 2;72(14):1589-96.
- Yilmaz M, Tenekecioglu E, Arslan B, Bekler A, Ozluk OA, Karaagac K, *et al.* White Blood Cell Subtypes and Neutrophil/Lymphocyte Ratio in Prediction of Coronary Thrombus Formation in Non-ST-Segment Elevated Acute Coronary Syndrome. *Clin Appl Thromb.* 2015 Jul 4;21(5):446-52.
- Uslu A, Kup A, Dogan C, Sari M, Cersit S, Aksu U, *et al.* Relationship between epicardial adipose tissue thickness and coronary thrombus load in patients with ST-elevation myocardial infarction. 2020;164(2):141-6. <http://biomed.papers.upol.cz/doi/105507/bp2019038.html>.