Clinical research

The significance of transaminase ratio (AST/ALT) in acute myocardial infarction

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Abstract

Introduction: Fernando De Ritis described the significance of the transaminase (AST/ALT) ratio in 1957, and since then it has been commonly used to screen liver diseases. The liver is sensitive to hemodynamic changes because it receives approximately one-quarter of total cardiac output. We aimed to investigate the AST/ALT ratio changes in patients with acute myocardial infarction without any history of liver diseases in the Chinese Han population.
Material and methods: We analyzed a total of 120 patients with acute myocardial infarction admitted to the cardiology department of Zhongnan Hospital of Wuhan University between January 2019 and June 2019. AST/ALT ratio of the first blood test was calculated for all patients.
Results: The mean De Ritis ratio (AST/ALT) was higher in patients with ST-segment elevation myocardial infarction (STEMI) (3.2261 ±2.41379) than in non-ST-segment elevation myocardial infarction (NSTEMI) (2.2089 ±1.63177) patients. The difference was statistically significant (p = 0.002).
Conclusions: AST/ALT ≥ 2.0 has a strong association with total coronary occlusion. We might rely on this test to predict coronary occlusion without age difference.

Key words: De Ritis ratio (AST/ALT), acute myocardial infarction, non-ST-segment elevation myocardial infarction, ST-segment elevation myocardial infarction.

Introduction

The ratio of serum aspartate transaminase (AST) and alanine transaminase (ALT) is a commonly used marker of liver diseases. Fernando De Ritis [1] was first to describe the significance of the AST/ALT ratio in 1957. Acute myocardial infarction (AMI) is a global burden and challenging pathology caused by ischemia, resulting in myocardium necrosis and creating a perfusion imbalance as a consequence of the ischemia [2]. The liver is sensitive to hemodynamic changes because it receives approximately one-quarter of total cardiac output [3]. Although abnormal results of transaminases are often observed in patients with myocardial infarction (MI), the significance of the AST/ALT ratio is unknown in this setting. Cardiac biomarkers such as troponins are often elevated during AMI, and ST-segment changes are the parameters most often used to differentiate and evaluate the degree of coronary occlusion. In clinical practice physicians also encounter AMI patients with an initially normal electrocardiogram (ECG), and often perform a coronary angiogram to evaluate the degree of occlusion. Is there any other non-invasive test to evaluate

the degree of occlusion when there is no evidence of ST-segment changes? We hypothesized that the AST/ALT ratio of the very first blood test at presentation can help evaluate the percentage of occlusion in patients with acute myocardial infarction in the absence of a coronary angiogram. To the best of our knowledge, there are not many available scientific reports that can aid us in verifying our hypothesis. This study aims to investigate the AST/ALT ratio changes in patients with AMI and with no prior history of any kind of liver disease.

Material and methods

This study is a hospital-based prospective observational study conducted in Zhongnan Hospital of Wuhan University, P.R. China. A total of 120 patients who were diagnosed with AMI in the cardiology department of our hospital between January 2019 and June 2019 were randomly enrolled. Patients with a prior history of any liver damage or diseases were excluded from this study. Data were collected from patient medical records. All included patients underwent percutaneous coronary intervention (PCI). Out of all included patients, 76 were ST-segment elevation myocardial infarction (STEMI) patients and 44 were diagnosed with non-ST-segment elevation myocardial infarction (NSTEMI). The diagnosis of NSTEMI and STEMI was made with typical chest pain, 12-lead ECG, and cardiac markers levels [4], according to the European Society of Cardiology (ESC) guidelines [5]. Patients with hepatitis, liver damage, cholestasis, and chronic liver disease were excluded. We also assessed and analyzed the demographic profile of all included patients.

Table I. Baseline characteristics of included patients

Characteristics	*N* (%) or mean ± SD
Age	61.43 ±13.702
Female	28 (23.3)
Male	92 (76.7)
AST/ALT	2.853 ±2.025
TnI	15622.49 ±18893.57
BNP	388.35 ±570.95
CK-MB	109.22 ±178.70
WBC	9.089 ×10^9 ±3.626
Systolic BP	128.52 ±22.551
Diastolic BP	77.90 ±13.739
NSTEMI	44 (36.7)
STEMI	76 (63.3)
Alcohol	19 (15.8)
Diabetes mellitus	18 (15.0)
Dyslipidemia	13 (10.8)
Intervention or surgery	15 (12.5)
Hypertension	72 (60.0)
Prior stroke	9 (7.5)
Smoking	48 (40.0)

SD – standard deviation, BP – blood pressure, TnI – troponin I, BNP – brain natriuretic peptide, CK-MB – creatine kinase MB.

Statistical analysis

AST/ALT ratio of the very first blood test at presentation was calculated for all patients. Patients were divided into two groups as NSTEMI and STEMI according to the MI redefinition. Normality tests were performed for each variable to assess distribution, and statistical analysis of data was performed using IBM SPSS software for Windows version 22. Comparison of means was performed with the independent *t*-test. The nonparametric data were assessed by the Mann-Whitney *U* test. A value of $p < 0.05$ was considered statistically significant.

Results

Out of 120 enrolled AMI patients in the study, 28 (23.3%) were female and 92 (76.7%) were male. The mean age was 61.43 (61.43 ±13.702). Out of them, 44 were diagnosed as NSTEMI (36.7%) and 76 as STEMI (63.3%) patients. The baseline characteristics of the study population are shown in Table I. In our study, 72 (60.0%) patients had high blood pressure, 48 (40.0%) had a history of smoking, 18 (15.0%) had diabetes mellitus, and 9 (7.5%) patients had recovered from a prior stroke.

The mean AST/ALT ratio of the study group was higher (2.853 ±2.025) compared to the normal range (Table II). The mean De Ritis ratio was higher in patients with STEMI (3.22 ±2.143) than in NSTEMI (2.208 ±1.631) patients. The difference was statistically significant ($p = 0.002$). The Mann-Whitney *U* test also showed a significant difference between NSTEMI and STEMI ($p = 0.01$). In contrast, there was no significant difference between age groups (Table III). In the old population group (age > 65 years), we also found a higher mean AST/ALT ratio (AST/ALT > 2.0) (Table IV). The ROC curve shows an area under curve of 0.629 ($p = 0.019$; 95% CI: 0.529–0.730) (Figure 1). When the AST/ALT ratio is 0.63, the diagnosis is most effective with a sensitivity of 98.7% and a specificity of 95.5% (Figure 1).

Discussion

The liver is a very important organ, as it plays the role of a blood volume reservoir [6]. It is sensitive to hemodynamic changes because it receives approximately 25% of the total cardiac output [7]. Serum aspartate transaminase (AST) is mainly found in the liver, cardiac muscle, and other tissues while serum alanine transaminase

Table II. Population characteristics based on NSTEMI and STEMI

Characteristics	Mean ± SD or *n* (%)		*P*-values
	NSTEMI (*n* = 44)	STEMI (*n* = 76)	
Age	62.43 ±12.580	60.84 ±14.360	0.258
AST/ALT	2.208 ±1.631	3.22 ±2.143	0.002
TnI	16587.47 ±19875.71	15146.61 ±18512.70	0.389
BNP	345.90 ±579.52	411.99 ±568.94	0.524
CK-MB	139.53 ±229.82	85.85 ±123.84	0.010
WBC	8.683 × 10^9 ±3.535	9.323 × 10^9 ±3.680	0.797
SBP	136.89 ±20.909	123.67 ±22.166	0.517
DBP	81.68 ±13.166	75.71 ±13.670	0.913

SD – standard deviation, WBC – white blood cells, SBP – systolic blood pressure, DBP – diastolic blood pressure, TnI – troponin I, BNP – brain natriuretic peptide, CK-MB – creatine kinase MB.

Table III. Population baseline characteristics based on age groups

Characteristics	Mean ± SD or *n* (%)		*P*-values
	< 65 years (*n* = 70 (58.3%))	> 65 years (*n* = 50 (41.7%))	
Age	51.67 ±8.125	75.08 ±6.067	0.012
AST/ALT	2.752 ±2.007	2.994 ±2.061	0.702
TnI	17269.34 ±19964.64	13450.05 ±17351.05	0.055
BNP	378.94 ±502.70	399.87 ±650.08	0.146
CK-MB	116.71 ±187.73	96.81 ±164.78	0.558
WBC	9.601 × 10^9 ±3.421	8.371 × 10^9 ±3.814	0.617
SBP	126.39 ±19.997	131.50 ±25.620	0.009
DBP	79.69 ±11.851	75.40 ±15.802	0.022

WBC – white blood cells, SBP – systolic blood pressure, DBP – diastolic blood pressure, SD – standard deviation, TnI – troponin I, BNP – brain natriuretic peptide, CK-MB – creatine kinase MB. WBC – white blood cells, SBP – systolic blood pressure, DBP – diastolic blood pressure, SD – standard deviation, TnI – troponin I, BNP – brain natriuretic peptide, CK-MB – creatine kinase MB.

Table IV. Population characteristics based on MI and age groups

Parameter	Characteristics	Mean ± SD		*P*-values
		< 65 years	> 65 years	
NSTEMI (*n* = 44)	*n* (%)	25 (56.8)	19 (43.2)	–
	AST/ALT	2.147 ±1.90	2.289 ±1.238	0.408
	WBC	8.94 × 10^9 ±3.192	8.33 × 10^9 ±4.006	0.455
STEMI (*n* = 76)	*n* (%)	45 (59.2)	31 (40.8)	–
	AST/ALT	3.088 ±2.006	3.426 ±2.347	0.227
	WBC	9.96 × 10^9 ± 3.524	8.39 × 10^9 ±3.758	0.872

WBC – white blood cells, SD – standard deviation.

(ALT) is predominantly found in the liver. The ratio of AST to ALT is commonly used to assess liver cell injury [8]. In AMI, AST and ALT are often elevated, especially in STEMI patients [9]. Lofthus *et al.* recently confirmed in their large study of 1783 patients the elevation of AST in 85.6% and ALT in 48.2% of patients at baseline [10]. In agreement with their study, we also found the ratio of AST to ALT in patients presenting with STEMI more elevated than in NSTEMI patients. In a recent study, Gao *et al.* also demonstrated the potential association of serum transaminases in STEMI patients [11].

Recent data suggested that the AST/ALT ratio might be a strong predictor for long-term mortality after AMI [11]. A similar study by Steininger *et al.* showed the long-term prediction mortality after AMI using the ratio of AST to ALT [12]. Steininger *et al.* found after a median follow-up of 8.6 years that AST (95% confidence interval (CI): 1.09–1.32; $p < 0.001$) and De Ritis ratio (95% CI: 1.18–1.44; $p < 0.001$) were significantly associated with long-term mortality after AMI.

It is well known that STEMI is often associated with total coronary occlusion while NSTEMI is associated with approximately 95% of occlu-

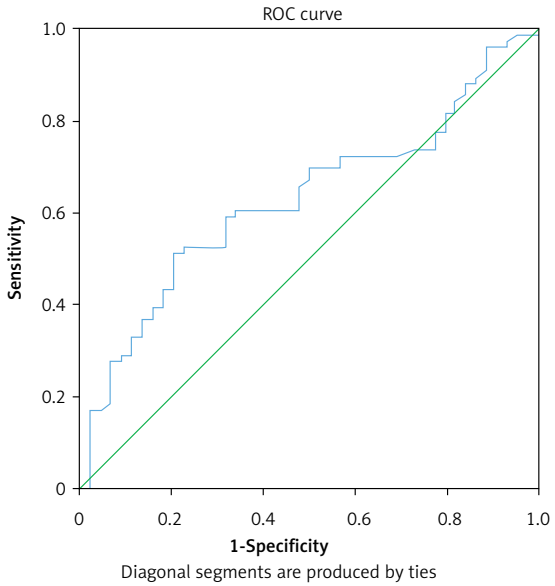

Figure 1. AST/ALT ratio ROC curve

sion. Karwowski *et al.* proved this hypothesis lately in a large multicenter, observational study of 4581 patients with STEMI and 2717 patients with NSTEMI. Their analysis showed total occlusion [13] in 2949 patients with STEMI (64.4%) and 723 patients with NSTEMI (26.6%). In the last few decades, several similar studies have shown a significant relationship between STEMI and total coronary occlusion [14, 15]. Our study indicated a higher AST to ALT ratio associated with STEMI patients. In this regard, we hypothesized that the elevated De Ritis ratio might also be associated with total occlusion.

In the present study, AST/ALT was calculated from 120 patients – 77 (STEMI) were classified as patients with total occlusion, and 44 (NSTEMI) were grouped as non-total occlusion patients. In total, 46 patients in the STEMI group have an AST/ALT ≥ 2.0 (mean = 4.54). In the NSTEMI group 19 patients have an AST/ALT ≥ 2.0 (mean = 3.40). Since STEMI is often associated with total occlusion, we can deduce that AST/ALT ≥ 2.0 in the STEMI group is also associated with total occlusion. In the case of AMI with an initially normal ECG, the AST to ALT ratio of the very first blood test might be the fastest way to estimate the degree of occlusion. To conclude, based on our investigation, the higher the ratio (AST/ALT ≥ 2.0) is, the stronger the association with total occlusion is. To better understand the significance of the AST/ALT ratio in AMI, this study also obtained from the ROC curve the optimal cutoff point of 0.63, which corresponds to the greatest sensitivity of 98.7% (Figure 1). However, further investigations with larger populations need to be conducted to confirm our hypothesis.

Age is one of the main risk factors of myocardial infarction. However, our study showed no association with AST/ALT ratio, i.e. that age does not affect the AST/ALT ratio during AMI. Tables III and IV show no significant difference between age groups.

In conclusion, STEMI patients had a significantly increased AST/ALT ratio, and it might be taken into consideration to predict the percentage of occlusion during AMI. AST/ALT ≥ 2 is a strong predictor of total occlusion during AMI. In summary, in the case of MI with no ST-segment changes, we might rely on the De Ritis ratio to evaluate the degree of coronary occlusion without an age difference.

There are several limitations to the present study. One of the major limitations is that the investigation was a single center-based analysis. No follow-up was done in this study. Unfortunately, our study was not able to investigate full liver function tests of included patients. The current investigation did not include coronary angiogram data.

Conflict of interest

The authors declare no conflict of interest.

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