



Saliva Aspartate Aminotransferase in Acute Myocardial Infarction

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Abstract

Background: Precise and quick diagnosis of AMI is of main medical and pecuniary concerns.

Objectives: The aim of this study was to detect saliva total aspartate aminotransferase (AST) activity -as an available guideline- in patients suffering from acute myocardial infarction (AMI).

Methods: A case-control study was performed in 31 subjects as the control group and 31 ones as the AMI group. Saliva and serum total AST activities were measured in the first and second mornings following the AMI by IFCC method. Mann-Whitney U and Spearman rho tests were performed as statistical analyses.

Results: AST activities in both serum and saliva in the resting and stimulated conditions were significantly greater in the AMI than the healthy controls ($P < 0.05$). Furthermore, serum AST showed a significant partial correlation with resting saliva AST in both first and second mornings following the AMI ($\rho = 0.368$, $P = 0.017$ and $\rho = 0.352$, $P = 0.024$, respectively) and also with stimulated saliva AST ($\rho = 0.331$, $P = 0.034$, $\rho = 0.443$, $P = 0.003$, respectively).

Conclusions: It presumes that saliva AST may be used as a biomarker in the patients suffering from acute myocardial infarction.

Keywords: Acute Myocardial Infarction, Saliva, Aspartate Aminotransferase

1. Background

Cardiovascular disease is a widespread etiology of mortality and morbidity worldwide from 1900 (1). Precise and quick diagnosis of acute myocardial infarction (AMI) is of the main medical and cost-effective concerns (2).

following the myocardial necrosis, the cellular membranes are decomposed and intracellular macromolecules are released and enter the blood. Measurement of cardiac biomarkers in the bloodstream is may be helpful to detect or rule out myocardial injury. In addition, serum biomarkers have essential roles in disease diagnosis, ever can be a suitable scale for evaluating the amount of myocardial damage. Therefore, measurements of serologic biomarkers such as aspartate aminotransferase (AST), troponins, and MB isoenzyme of creatine kinase are important components of available indicators of AMI (3-6). AST has widely been used for detection of AMI in clinical practice since the 1950s. It has been shown that the activity of AST increases within 6 hours of damage and achieves its highest in 28 hours, and then subsides to the normal level on the fourth day after the onset of infarction (4). Moreover, it has been indicated that the activity of serum AST is associated with

the size of the infarction (7).

Recently, there has been growing attention to saliva-based evaluation. It has been demonstrated that some indicators are excreted in saliva. Thus the application of saliva as an indicative medium could have important detective and logistical benefits versus serum. Saliva has numerous benefits. Its sampling procedure is secure, non-invasive, inexpensive, and accessible to collect, and it may be frequently applied to the patient without difficulties (8-11). Moreover, by analyzing a salivary sample, it is possible to obtain information on the health status that may or may not be accessible by analyzing the blood sample (12). Consequently, saliva is a potential diagnostic tool and its use for monitoring diseases and general health has become very favorable in health care and medical research.

2. Objectives

To examine whether saliva can be utilized as an available biomarker for the detection of AMI, we evaluated the saliva and serum activities of AST in the people suffering from AMI.

3. Methods

3.1. Study Design

The procedure was approved by the Review Board of AJA University of Medical Sciences, and written informed consent was obtained from all participants.

The data used in this study were extracted from a cross-sectional study, which was conducted in the emergency department of Milad hospital, Tehran, Iran. Patients with typical ischemic chest pain were assessed by electrocardiography and lab evaluation of serum markers of heart degeneration such as CPK, CK-MB isoenzyme, and cTnI. Thirty-one patients (24 males, 7 females, ages ranged from 31 to 84 years) with acute ST-elevation MI and a rise in serum biomarkers of MI, who admitted to the emergency department, participated in the study as the case group.

Thirty-one participants with no predictable heart disease (23 males, 8 females, ages ranged from 32 to 80 years) as the healthy controls were incorporated. These participants were selected from hospital staff or companions who did not have a history of heart disease. The clinical and biochemical features of the study groups are presented in [Table 1](#). The participants with liver disease or poor oral and dental health and periodontal disease were excluded from the study.

3.2. Sampling of Saliva and Serum

Saliva and blood were collected concurrently from each subject on the first and the second mornings following the AMI between 9 A.M. and 12 P.M. The mean time between the onset of symptoms and collecting the first sample was 13 hours (range, 8 - 23 hours). The participants were requested to forbear from brushing teeth, smoking, drinking, and eating for 1 hour before sampling. The sampling of saliva was carried out as follows: the participants cleaned their mouths with tap water and then expectorated 3 mL of their unstimulated saliva in the first microtube. Then the subjects masticated a piece of natural gum with a certain size for 2 minutes and expectorated the stimulated whole saliva into the second tube. Two mL of venous blood was taken after saliva sampling. Immediately after sampling, the samples were centrifuged at 3800 g for 10 minutes, and then the saliva supernatants and serum were separated and kept at -70°C for later AST assays.

3.3. Laboratory Measurements

The International Federation of Clinical Chemistry (IFCC) method was used for measuring the total activity of saliva and serum AST by a photometer and using attributed kits (Pars Azmun, Karaj, Iran), according to the manufacturers' instruction.

3.4. Statistical Analysis

Mann-Whitney U test was applied to evaluate differences between median biomarker activity detected in saliva and serum of the controls and patients with AMI. Spearman rho test and Receiver operating characteristic (ROC) analysis were also used.

4. Results

There was no significant difference in the total serum activity of alanine aminotransferase (ALT) between control individuals (17.4 ± 10.3 U/L) and patients with AMI in the first (16.1 ± 15.4 , $P = 0.689$) or in the second morning following the MI (16.1 ± 14.7 , $P = 0.691$). Moreover, the total serum activity of AST was higher in the patients with AMI than that of the healthy individuals in both the first ($P = 0.001$) and second ($P = 0.001$) mornings following the AMI ([Table 2](#)).

The unstimulated salivary activity of AST was significantly higher in the patients with AMI compared to controls in both the first ($P = 0.008$) and second ($P = 0.031$) mornings following the AMI ([Table 2](#)). The cut-off value of unstimulated salivary AST for detection of AMI was 3 U/L (ROC-area under the curve = 0.86, sensitivity = 77%, and specificity = 87%). There were similarly significant differences in the stimulated saliva AST activity amongst groups in both first ($P = 0.012$) and second ($P = 0.034$) mornings following the AMI ([Table 2](#)).

The stimulated salivary AST cut-off value with sensitivity (75%), specificity (75%) and the area under the ROC curve (0.84) was 4 U/L. Resting saliva AST activity in the first and second mornings following the AMI showed a fairly good correlation with serum AST activity ($\rho = 0.368$, $P = 0.017$ and $\rho = 0.352$, $P = 0.024$, respectively). There is also a fairly good correlation between serum and stimulated saliva AST activity in the first ($\rho = 0.331$, $P = 0.034$) and second mornings following the AMI ($\rho = 0.443$, $P = 0.003$).

5. Discussion

Cardiovascular diseases should be considered a widespread etiology of mortality and morbidity worldwide from 1900. Precise and quick diagnosis of AMI is of main medical and economic importance. Owing to the high cost of cardiac troponin testing compared to the old tests such as AST and ALT, the lack of the typical laboratory in anyplace for the assessment of troponins, and ECG is not specific in the diagnosis of myocardial injury; thus the use of old biological indicators accompanied by clinical signs can be used as a convenient and low-cost screening

Table 1. Basal Clinical Characteristics and Biochemical Parameters of Study Subjects^a

Characteristics	Controls	Acute MI	Test	P Value
Total number, No.	31	31		
Gender, Male, %	23 (74)	24 (77)	F	0.81
Age, y	58.9 ± 12.1	58.6 ± 11.3	T	0.82
Smoking, %	5 (16)	13 (42)	F	0.09
Hypertension, %	9 (29)	15 (48)	F	0.21
Diabetes mellitus, %	11 (35)	13 (42)	F	0.79
Serum enzymes				
Troponin I, U/L		0.16 ± 0.28		
Creatine Phosphokinase, U/L		346 ± 492		
Creatine kinase MB, U/L		61 ± 57		
Lactate dehydrogenase, U/L		717 ± 481		
Alkaline phosphatase, U/L		194 ± 64		
Triglycerides, mg/dL		191 ± 132		
Total cholesterol, mg/dL		179 ± 38		
Low-density lipoprotein, mg/dL		108 ± 29		
High-density lipoprotein, mg/dL		34 ± 9		

Abbreviations: F, Fisher's exact test; T, t- test.

^aValues are expressed as frequency (%) or mean ± SD.**Table 2.** Total Activity of AST in Serum, Unstimulated Saliva and Stimulated Saliva in the Controls and Patients with AMI in the First and Second Morning Following the AMI

	Controls	The First Morning Following the AMI	The Second Morning Following the AMI
Serum AST, U/L			
Median ± IQR	18 ± 11	140 ± 213.3, P = 0.001 ^a	84 ± 149, P = 0.001 ^a
Mean ± SD	18.8 ± 6.8	183.7 ± 136.4	130.95 ± 112.9
Unstimulated saliva AST, U/L			
Median ± IQR	0 ± 2	8 ± 11, P = 0.008 ^a	15 ± 15.75, P = 0.031 ^a
Mean ± SD	1.30 ± 2.42	12.00 ± 16.08	18.25 ± 15.64
Stimulated saliva AST, U/L			
Median ± IQR	2 ± 4.5	7 ± 11, P = 0.008 ^a	12 ± 17, P = 0.008 ^a
Mean ± SD	2.83 ± 2.89	10.88 ± 10.23	18.10 ± 22.54

Abbreviations: AMI, acute myocardial infarction; AST, aspartate aminotransferase; IQR, interquartile range.

^aIndicates significant differences compared with the control group using statistical analysis of Mann-Whitney U tests.

test (13). The present study examined the saliva AST activity in the patients with AMI. The results showed that -in a small pilot study with 31 patients- the patients with AMI had significantly higher stimulated and resting saliva AST activities than control subjects. Moreover, poorly noteworthy positive associations were found between serum and both resting and stimulated salivary AST activities.

Transaminases widely distributed throughout the body. Serum AST has a pivotal position in the laboratory identification of liver and skeletal muscle diseases and MI

(5). Although AST has a wide tissue span, has low specificity for heart diseases (4, 14, 15), since 1951, total AST activity in serum has been routinely applied to detect MI (16). The data of the study showed that the patients suffering from AMI had a higher serum AST activity than healthy individuals.

Several studies have reliably confirmed and planned to utilize salivary analyses for detecting, monitoring, or forecasting the prognosis of diseases (17). In line with these studies, it has been shown that salivary CK and CK-MB, tro-

ponin, and CRP, as biomarkers of heart degeneration, were raised in AMI in comparison to the control subjects. In addition, the salivary CK-MB and CPK levels strongly associated with their serum levels (18-23). Accordingly, our study indicated stimulated and unstimulated saliva AST activities were significantly higher in the patients with AMI than the control group. In addition, we showed a moderate correlation between serum and resting saliva AST activities in AMI. Therefore, it can be concluded that measuring saliva-based heart biomarkers can provide an easy diagnostic tool for the diagnosis and treatment of AMI.

To set up saliva as a substitute medium to plasma for different biological assays, levels of the measured parameters in plasma must highly associate with saliva levels. As our data showed, there was a reasonable relationship between serum and saliva AST activities; we can propose that saliva-based assays may have the likelihood to be applied as a point-of-care assay to diagnose AMI by determining saliva AST activity. It has been shown that AST and ALT are found mainly in the heart and liver, respectively. The level of ALT in AMI has been demonstrated with no change or a slight increase (13). This is in agreement with the results of the current study that serum AST but not ALT activities is significantly higher in the patients with AMI compared to the controls.

There were a number of limitations to this study. Non-ST-segment rise MI and unstable angina were not involved in this study, hence the salivary AST activities in these patients remained unidentified. Furthermore, the changes in salivary AST activities at the primary stage of AMI were not assessed in this study. Additionally, as we recruited a highly certain and restricted number of patients, it is not probable to assume the outcomes for the overall population and no assumption can be drawn about the salivary cut-off AST activities.

5.1. Conclusions

It appears that following an AMI, there is an increase in resting and stimulated saliva AST activities similar to what takes place in serum. It presumes that saliva AST can be used as a biomarker in the patients suffering from AMI.

Footnotes

Authors' Contribution: All authors of this original research paper have directly participated in the planning, execution, or analysis of study and all authors have read and approved the final version submitted.

Conflict of Interests: There were no conflict of interests for this study.

Ethical Approval: The protocol was approved by the Review Board of AJA University of Medical Sciences.

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