ISSN: 0975-3583,0976-2833 VOL15, ISSUE 06, 2024

Assessment Of Biochemical Parameters In Patient Of Acute Myocardial Infarction With And Without Diabetes- A Comparative Analysis

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Abstract

Background: Diabetes is a metabolic disorder characterized by enhanced production of free radicals hence oxidative stress.**Aim and Objective: T**o evaluate the activity of cardiac and antioxidant enzymes in diabetic and non-diabetic acute myocardial infarction (AMI) patients. **Methods:** This case–control study was conducted on 150 subjects (70–85 years). Subjects were divided into three groups (Normal, N; Non-diabetic AMI, N-AMI; and Diabetic AMI, D-AMI). Each individual was subjected to a detailed history, clinical examination, and cardiovascular parameters analysis (fasting blood sugar, HbA1c, systolic and diasystolic blood pressure, total cholesterol (TC), triglycerides (TG), low-density lipoprotein (LDL), high-density lipoprotein (HDL), TC/HDL and LDL/HDL ratios). Cardiac markers (Troponin-I, creatine phosphokinase (CPK), lactate dehydrogenase (LDH), C-reactive protein (CRP) and aspartate aminotransferase (AST)) and oxidative stress markers (superoxide dismutase (SOD), malondialdehyde (MDA), glutathione (GSH), catalase (CAT)) were also assessed. All these parameters were compared between diabetic and non-diabetic AMI patients. **Results:** D-AMI individuals had high level of TC, TG, LDL, and low level of HDL in comparison to N-AMI individuals. Study suggests that cardiac markers such as Troponin I, CPK, AST, LDH, and CRP levels were significantly increased in patients suffering from myocardial infarction with diabetes mellitus (DM) compared to patients of myocardial infarction without DM. The activity levels of antioxidant SOD and GSH were lower in D-AMI patients than in N-AMI. However,

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 06, 2024

levels of MDA and CAT were higher in D-AMI than in N-AMI controls. **Conclusion:** Study suggests elevated cardiac markers and reduced antioxidants in D-AMI patients compared to N-AMI patients.

Keywords: antioxidant, enzymes, Diabetic, acute myocardial infarction

Introduction

Diabetes mellitus is a worldwide health problem predisposing to markedly increased cardiovascular mortality and morbidity [1]. Lipid abnormalities significantly contribute to the increased risk of cardiovascular disease and other morbidity in diabetics [2]. Diabetes mellitus (DM) increases the incidence of cardiovascular diseases (CVDs) and increases the risk of CVD-induced mortality in diabetic subjects compared to non-diabetic subjects.[3] Coronary artery disease (CAD) contributed to myocardial infarction (MI) and heart failure, attributed to most of the mortalities around the globe. [4]

Acute myocardial infarction (AMI) is associated with obstruction of coronary artery, myocardial ischemia leading to myocardial necrosis and generation of reactive oxygen species (ROS). [5] Previous studies show that hyperglycemia promotes ROS-induced complications of heart by reacting with lipids, protein, and DNA7 ; this oxidative damage is rescued by myocardial antioxidants. [6] Several studies depicted that antioxidants functioning is diminished in diabetic subjects, [7] which may further augment the oxidative stress-induced pathogenesis of AMI.[8] Diabetes, dyslipidemia, hypertension, family history, obesity, and smoking are well documented risk factors for the development of AMI.[9]The purpose of the study was to assess the oxidative stressinduced damage to heart in diabetic and non-diabetic AMI patients. This study emphasizes that antioxidants imbalance may be a key indicator of diabetes-induced myocardial damage as other indicators such as ECG and cardiac biomarkers.

Methods

Subjects and study design

This case–control study included 150 subjects; out of which, 50 subjects (30 males and 20 females) were with normal blood glucose level and with normal ECG (Normal, N), 50 subjects (30 males and 20 females) were with normal blood glucose level and AMI (non-diabetic and AMI, N-AMI), and 50 subjects (30 males and 20 females) were with diabetes and AMI (Diabetic and AMI, D-AMI), visiting the outpatient clinic at Department of Cardiology and Biochemistry at SSIMS, Bhilia from 2023 to 2044. Diabetes was diagnosed by analyzing the level of glycated hemoglobin level (HbA1c > 6.5%). Diagnosed cases of diabetic and non-diabetic AMI patients were included after obtaining a written consent from their caretakers to take part in the study. Questionnaires were duly filled in with bio-data of the patients,

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 06, 2024

detailed medical history, blood pressure, electrocardiography (ECG), complete blood count (CBC) along with available additional information.

Inclusion criteria and exclusion criteria

Subjects of all ages and both genders with the history of AMI were included. AMI diagnosis was based on a history of chest pain, ECG changes, and elevated cardiac enzymes. Diabetic and non-diabetic AMI patients were included in this study. The control subjects were selected on basis of being normotensive and with normal ECG. Subjects who have the history of smoking, obesity, or any other disease were excluded from this study.

Collection of blood and isolation of serum

Blood samples were collected from Department of Cardiology and Biochemistry, SSIMS, Bhilai. Preprandial venous blood were drawn from the cubital vein of all subjects.

Evaluation of cardiovascular parameters

Serum levels of TC, TG, and HDL were measured spectrophotometrically using commercial assay kits. LDL was calculated by using the Friedewald formula.

Analysis of cardiac markers

Levels of various cardiac enzymes, including troponin-I (TnI), CPK, LDH, AST, and CRP, were assessed using commercial kits.

Estimation of oxidative stress

Oxidative stress was measured by analyzing the serum levels of MDA, CAT, SOD, and GSH at the central clinical lab, department of biochemistry.

Statistical analysis

Mean ± SD were calculated for all the parameters to examine and were differentiated by the student's t-test using SPSS 23. P-values considered significant were as follows: $P < 0.05$ is significant, and $P > 0.001$ is highly significant.

Results

Demographic characteristics of subjects Study subjects were divided on the basis of health conditions into the N group, normal (50 subjects); the N-AMI group, non-diabetic with AMI (50 subjects); and the D-AMI group, diabetic with AMI (50 subjects). N-AMI patients had a mean age of 80.14 ± 7.56 years, whereas D-AMI

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patients had a mean age of 68.08 ± 7.52 years. Systolic blood pressure (SBP) and diasystolic pressure (DBP) were high in D-AMI and N-AMI compared with the normal group. Fasting blood glucose (FBG) and HbA1c levels were significantly high in the D-AMI group ($p < 0.001$) compared with the N-AMI and normal groups. The results of basic demographic characteristics are illustrated in Table 1.

Table No. 1: General Demographic Characteristics.

Characteristics	**N group (50 subjects)**	**N-AMI group (50 subjects)**	**D-AMI group (50 subjects)**	**p-Value**
	Mean± SD	**Mean± SD**	**Mean± SD**	
Sex (Male: female)	30:20	30:20	30:20	<0.001
Age (years)	79.12± 8.48	80.14±7.56	68.08±7.52	<0.001
FBG (mm/L)	4.21± 0.73	6.05±0.97	7.97±1.08	<0.001
HbA1c (%)	3.88± 0.59	6.63±0.83	8.95±1.14	<0.001
SBP (mm Hg)	117.62±9.98	132.64±7.21	162.5±13.81	<0.001
DBP (mm Hg)	81.12± 6.42	86.98±7.14	90.6±13.56	<0.001

Table No. 2: Evaluation of cardiovascular parameters

Parameters	**N group (50 subjects) Mean± SD**	N-**AMI Group (50 subjects) Mean± SD**	**D-AMI group (50 subjects) Mean± SD**
Cholesterol mg/dl	143.5±0.72	204.7±0.26	245.2±0.02
Triglycerides (mg/dl)	95.6±0.52	271.2±4.9	280.8±12.7
HDL Cholesterol (mg/dl)	45.5±0.30	30.7±0.34	24.8±0.85
LDL (mg/dl)	170±0.52	212±0.22	242±0.77
VLDL (mg/dl)	19±0.12	23±0.52	28±0.13

Alterations in levels of all the lipid constituents among all groups are presented in Table 2. The D-AMI group showed a significant increase in TC (245.2±0.02 mg/dL), TG (280.8±12.7 mg/dL), and LDL (242±0.77 mg/dL) levels compared to those of the N-AMI group for TC (204.7±0.26 mg/dL), TG (271.2±4.9 mg/dL), and LDL (212±0.22 mg/dL), and the N group for TC (143.5±0.72 mg/dL), TG (95.6±0.52 mg/dL), and LDL (170±0.52 mg/dL), respectively. Whereas, the D-AMI group showed a significantly lower level of HDL (24.8±0.85 mg/dL) in comparison to the

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N-AMI group (30.7±0.34 mg/dL) and the N group (45.5±0.30 mg/dL), respectively. Also, D-AMI subjects showed high values of TC/HDL and LDL/HDL ratios compared to N-AMI.

Table No. 3: Evaluation of cardiac markers

Characteristics	N group (50 subjects) Mean± SD	O-AMI group (50 P- subjects) Mean± SD	D-AMI group (50 subjects) Mean± SD
CRP(mg/L)	3.5±0.71	5.27±0.44	7.85±0.32
troponin-I (ng/dl)	1.5 ± 0.25	2.9 ± 0.42	4.1 ± 0.61
CPK(IU/L)	125.8±6.2	351.2±19.21	1092.0±29.1
LDH (IU/L)	210.6±12.6	624.0±109.1	1011.5±35.61
AST(IU/L)	42.61±2.61	90.0± 4.26	106.0± 3.65

D-AMI patients had a significantly higher level of CRP (106.0± 3.65 mg/L) as compared to N-AMI (5.27±0.44 mg/L) patients. TROP-I level was also found to be significantly higher in D-AMI patients (4.1 ± 0.61 ng/mL) than in the in the N-AMI group (2.9 ± 0.42 ng/mL). The data demonstrated significant elevations of CPK (1092.0±29.1IU/L) in D-AMI patients compared to N-AMI for CPK (351.2±19.21IU/L). The level of LDH was found to be elevated in the serum of D-AMI (1011.5±35.61 IU/L) compared to N-AMI (624.0±109.1 IU/L). Similar to LDH, D-AMI patients showed significant elevations of AST (106.0± 3.65 IU/L) compared to those of N-AMI patients (90.0± 4.26 IU/L).

Table No. 4: Assessment of oxidative stress markers

Characteristics	N group (50 subjects) Mean± SD	N -AMI group (50 subjects) Mean± SD	D-AMI group (50 subjects) Mean± SD
MDA(µmol/L)	2.6±1.53	3.97±0.12	4.95±0.55
SOD	0.62±0.18	0.96±0.22	0.77±0.17
CAT	0.56±0.11	0.58±0.17	0.60±0.1
GSH(mmol/L)	5.4±0.73	3.44±1.23	2.43±1.13

Oxidative stress induced in AMI was measured by evaluating levels of MDA, SOD, GSH, and CAT. There was an increase in MDA level (4.95±0.55) and CAT activity

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(0.60±0.1) in the D-AMI group compared to the N-AMI group for MDA (3.97±0.12) and CAT (0.58±0.17). Compared with the N-AMI group, SOD activity (0.96±0.22) and GSH level (3.44±1.23) were decreased in the D-AMI group for SOD (0.77±0.17) and GSH (0.96±0.22), respectively.

Discussion

The present study shows a significant increase in lipid parameters (total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL), and cardiac markers, i.e., troponin-I (TnI), creatine phosphokinase (CPK), lactate dehydrogenase (LDH), aspartate aminotransferase (AST), and C-reactive protein (CRP) within 12 h after the onset of chest pain in D-AMI patients compared to N-AMI patients. Oxidative stress markers such as malondialdehyde (MDA), catalase (CAT), superoxide dismutase (SOD), and glutathione (GSH) also increased in D-AMI patients compared to N-AMI patients. Study results suggest that antioxidant-based interventions in D-AMI patients might assist in reducing oxidative stress-induced damage in D-AMI patients.

AMI is initiated by myocardial ischemia due to enhanced production of ROS, [8] activation of proinflammatory reactions, impaired functioning of antioxidants, and increased lipid peroxidation. [10-12] All these events elicit the activation of plaque, coronary blockage, and ultimately a heart attack. There are numerous risk factors associated with the development of AMI, such as diabetes, dyslipidemia, hypertension, smoking, obesity, advancing age, etc. [5] Bartels et al. [13] reported that diabetes increases the risk of CVD in diabetic subjects compared with non-diabetic subjects. The present study presents the effects of hypertension, diabetes, and dyslipidemia in D-AMI patients. Type 2 diabetes was found to alter lipid and lipoprotein utilization and induce atherogenic dyslipidemia. [14] Our results show significantly higher levels of TC, TG, and LDL, but a low level of HDL in D-AMI patients, and this suggests an important role of atherogenic dyslipidemia in the development of AMI in diabetic subjects. Atherogenic dyslipidemia favors the oxidative modification of proteins along with lipids, especially LDL, and thus induces local and systemic inflammatory responses. [15] These inflammatory responses trigger myocardial tissue injury, which is detected by measuring the CRP level. Indeed, CRP is a systemic inflammation marker and gives prognostic information for cardiovascular events such as atherosclerosis and CAD. [16] In this study, increased CRP was found in D-AMI patients compared to N-AMI.

Heart contractility is evaluated by measuring the myocardial tissue-specific protein Trop I, which is involved in cardiac contractility. Previous studies indicated that Trop I is a highly sensitive and specific marker of myocardial damage and is therefore used as a diagnostic marker for AMI. [17] In this study, a significantly higher level of Trop I was found in D-AMI patients compared to N-AMI patients, indicating that cardiac muscle

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Cell death increases in diabetic subjects. CPK and CK-MB are two important indicators of myocardial necrosis [18], and a significant elevation of CPK and CK-MB was documented in the D-AMI group in this study. We also found a statistically significant difference in LDH and AST values between the D-AMI and N-AMI groups, the two markers being advocated for the diagnosis of infarction previously. [19] Hyperlipidemia and hyperglycemia-induced oxidative stress have been regarded as contributors to the progression of AMI. [20] The oxidative stress results in a disturbance between free radicals and antioxidant defense mechanisms. SOD, one of the important

Defense enzymes catalyze the dismutation of superoxide radicals into either oxygen (O2) or hydrogen peroxide (H2O2). [21] Glutathione peroxidase (GPX) or CAT catalyzes the reduction of H2O2 into H2O; CAT catalyzes this reduction independently without any cofactor, whereas GPX relies on GSH [22]. GSH also inhibits lipid peroxidation. Previous reports showed that lipid peroxidation increased in AMI patients [23], and this increased lipid peroxidation is a consequence of hyperglycemia-induced oxidative stress. This study revealed a significant decrease in antioxidants, including SOD, GSH, and CAT, and an increase in MDA, which is a lipid peroxidation product, in D-AMI patients compared to N-AMI patients.

Conclusion

Our study indicates the significance of atherosclerosis and its associated complications, such as dyslipidemia and inflammation, in D-AMI patients. In conclusion, our study demonstrates a significant increase in traditional cardiac markers (CPK, LDH, and AST) and non-traditional cardiac markers such as CRP in D-AMI patients compared to N-AMI. The study shows a significant increase in the oxidative stress parameter MDA, while levels of antioxidants CAT, SOD, and GSH are reduced in D-AMI patients. These results will be helpful for clinicians in the therapy of MI patients with DM.

Conflicts of interest

The authors have nothing to declare.

Reference

1. Sies ,H. 2004. Oxidative stress: Oxidants and antioxidants. ;J. New York, Academic press 55:122-125.
2. Halliwell, B., and Whiteman, M., 2001. Measuring reactive species and oxidative damage in vivo and in cell culture: how should you do it, and what do the results mean? [Review] Br J Pharmacol. 142:231–55.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 06, 2024

3. Kalofoutis C, Piperi C, Kalofoutis A, et al., Type II diabetes mellitus and cardiovascular risk factors: current therapeutic approaches. Exp Clin Cardiol. 2007;12:17–
4. Ezekowitz JA, Kaul P, Bakal JA, et al.: Declining in-hospital mortality and increasing heart failure incidence in elderly patients with their first myocardial infarction. J Am Coll Cardiol. 2009;53:13–
5. Kasap S, Gonenç A, Sener DE, and Hisar I. Serum cardiac markers in patients with acute myocardial infarction: oxidative stress, C-reactive protein, and N-terminal probrain natriuretic peptide. J Clin Biochem Nutr. 2007;41:50–
6. Fiorentino TV, Prioletta A, Zuo P, and Folli F. Hyperglycemia-induced oxidative stress and its role in diabetes mellitus-related cardiovascular diseases. Curr Pharm Des. 2013;19:5695–
7. Jimenez-Osorio AS, Picazo A, Gonzalez-Reyes S, et al., Nrf2 and redox status in prediabetic and diabetic patients. Int J Mol Sci. 2014;15:20290–
8. Di Filippo C., Cuzzocrea S., Rossi F., et al. Oxidative stress is the leading cause of acute myocardial infarction in diabetics. Cardiovasc Drug Rev. 2006;24:77–
9. Boyer NM, Laskey WK, Cox M, et al. Trends in clinical, demographic, and biochemical characteristics of patients with acute myocardial infarction from 2003 to 2008: a report from the American Heart Association with the guidelines for the for the coronary artery disease program. J Am Heart Assoc. 2012;1:e001206.
10. Gruzdeva O, Uchasova E, Dyleva Y, et al., Insulin resistance and inflammation markers in myocardial infarction. J Inflamm Res. 2013;6:83–
11. Surekha RH, Srikanth BB, Jharna P, et al. Oxidative stress and total antioxidant status in myocardial infarction. Singap Med J. 2007;48:137–
12. Heinecke JW. Oxidative stress: new approaches to diagnosis and prognosis in atherosclerosis. Am J Cardiol. 2003;91:12A–
13. Bartels DW, Davidson MH, and Gong WC. Type 2 diabetes and cardiovascular disease: reducing the risk. J Manag Care (2 suppl A):2007;(2 suppl A):S2–S15.
14. Krauss RM. Lipids and lipoproteins in patients with type 2 diabetes. Diabetes Care. 2004;27:1496–1496.
15. Stocker R, Keaney Jr. JF. Role of oxidative modifications in atherosclerosis. Physiol Rev. 2004;84:1381–
16. Calabro P, Golia E, Yeh ET. CRP and the risk of atherosclerotic events. Semin Immunopathol. 2009;31:79–
17. Tiwari RP, Jain A, Khan Z, et al. Cardiac troponins I and T: molecular markers for early diagnosis, prognosis, and accurate triaging of patients with acute myocardial infarction. Mol Diagn Ther. 2012;16:371–
18. Alpert JS, Thygesen K, Antman E, Bassand JP. Myocardial infarction redefined—a consensus document of the Joint European Society of Cardiology/American College of Cardiology Committee for the redefinition of myocardial infarction. J Am Coll Cardiol. 2000;36:959–

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 06, 2024

19. Maghamiour N, Safaie N. High creatine kinase (CK)-MB and lactate dehydrogenase in the absence of myocardial injury or infarction: a case report. J Cardiovasc Thorac Res. 2014;6:69–
20. Rodrigo R, Libuy M, Feliu F, and Hasson D. Oxidative stress-related biomarkers in essential hypertension and ischemia-reperfusion myocardial damage. Dis Markers. 2013;35:773–
21. Aquilano K., Baldelli S., and Ciriolo MR. Glutathione: new roles in redox signaling for an old antioxidant. Front Pharmacol. 2014;5:196.
22. Ansley DM, Wang B. Oxidative stress and myocardial injury in the diabetic heart. J Pathol. 2013;229:232–232.
23. Senthil S, Veerappan RM, Ramakrishna Rao M, and Pugalendi KV. Oxidative stress and antioxidants in patients with cardiogenic shock complicate acute myocardial infarction. Clin Chim Acta. 2004;348:131–