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Serum Levels of Glutathione and Malondialdehyde in Patients with Type 2 Diabetes with Coronary Heart Disease at Khorramabad Heart Hospital, Western Iran: A Cross-Sectional Study

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A B S T R A C T

Objective: Type 2 diabetes is associated with an increased risk of coronary heart disease (CHD) due to metabolic and oxidative disturbances in the body. Glutathione, a key antioxidant, and malondialdehyde (MDA), an oxidative marker, play crucial roles in evaluating oxidative stress and cellular damage. This study aims to investigate the serum levels of these markers in patients with type 2 diabetes and CHD to better understand the relationship between oxidative stress and cardiovascular disease in this population.

Methods: This cross-sectional study was conducted at Khorramabad Heart Hospital in Western Iran, including 100 patients with type 2 diabetes and CHD (T2DM-CHD) over a two-month period. Blood samples were collected from fasting volunteers in the control group for comparison. After centrifugation and serum separation, biochemical assays were performed to measure serum levels of MDA and glutathione.

Results: The serum level of MDA in the T2DM-CHD group was measured at 19.3 ± 16.8 µmol/mg protein, significantly higher than the control group (6.9 ± 3.3 µmol/mg protein). Additionally, serum glutathione levels in the diabetic group were 15.3 ± 6.5 µmol/mg protein, notably lower compared to the control group (34.8 ± 10 µmol/mg protein).

Conclusion: The study indicates that patients with type 2 diabetes and CHD exhibit elevated levels of MDA and reduced glutathione, reflecting high oxidative stress. This imbalance may contribute to the progression of diabetes-related complications and cardiovascular diseases. Therefore, the use of antioxidants as medications or supplements could be an effective strategy to reduce oxidative stress and improve clinical outcomes in these patients. Further research is needed to determine the optimal type and dose of antioxidants.

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Introduction

Cardiovascular diseases, including coronary artery disease (CAD), are leading causes of mortality worldwide [1]. Many of these conditions are preventable through lifestyle modifications such as a balanced diet, avoidance of tobacco and alcohol, weight management, regular physical activity, and adequate sleep [2]. Diabetes has become increasingly prevalent with urbanization, and type 2 diabetes, in particular, is influenced by lifestyle factors and continues to rise [3]. Type 2 diabetes is characterized by either insufficient insulin production or inadequate utilization of available insulin [4]. As a chronic metabolic disorder, type 2 diabetes can lead to a range of short-term and long-term complications, including cardiovascular, renal, ocular, neurological, dermatological, gastrointestinal, and sexual issues [5]. Cardiovascular complications of diabetes include coronary artery disease, hypertension, and stroke [6].

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Oxidative stress and various reactive oxygen species play a critical role in the development of diabetic nephropathy and insulin resistance, significantly impacting the pathogenesis of diabetes [7]. Insulin resistance in diabetic patients is associated with reduced efficacy of antioxidant enzymes. Thus, with increased oxidative stress markers in diabetes, the use of antioxidants may effectively aid in the treatment, management, and alleviation of diabetes symptoms [8]. Elevated free radical production or decreased antioxidant levels in diabetes can lead to cellular membrane damage, which, if persistent, results in malondialdehyde production and ultimately cell death and widespread disease symptoms [9]. Malondialdehyde (MDA) is a naturally occurring reactive compound formed as a byproduct of lipid peroxidation, commonly used as a marker for oxidative stress and lipid peroxidation in biological systems [10]. Glutathione is a naturally occurring antioxidant in the body that assists in toxin metabolism, free radical degradation, and immune system support [11].

This study aims to thoroughly examine the relationship between serum levels of the antioxidant glutathione and the oxidative marker MDA in patients with type 2 diabetes and coronary artery disease. Specifically, the research seeks to determine the impact of these markers on the progression and severity of cardiovascular diseases and assess their potential in predicting responses to various treatments, thereby aiding in the development of targeted strategies for managing diabetes and coronary artery disease.

Materials and Methods

This research was conducted in December 2023 at the Khorramabad Heart Hospital. In this cross-sectional study, 100 patients with type 2 diabetes and coronary artery disease (T2DM-CHD) were examined over a two-month period. Blood and serum samples from diabetic patients with cardiovascular disease (T2DM-CHD) and healthy controls were transferred to the Herbal Medicine Research Center at Khorramabad University of Medical Sciences. After obtaining informed consent from all participants, blood samples were collected following an 8-hour fasting period. Blood samples were centrifuged and the serum was separated for biochemical analysis.

Measurement of Glutathione Levels:

The glutathione levels were measured using the method described by Ahmadvand (2012) [12].

Measurement of Malondialdehyde Levels:

The MDA levels were determined based on the method used by Ahmadvand (2014) [13].

Statistical Analysis:

Data were analyzed using independent t-tests. Statistical analysis was performed using SPSS version 13 for Windows. A p-value of less than 0.05 was considered statistically significant.

Results

The results indicated that the serum level of MDA in the T2DM-CHD group was significantly higher than in the control group (P=0.003) (Table 1). Additionally, the serum level of glutathione in the T2DM-CHD group was significantly lower compared to the control group (P=0.002).

Table 1: Serum Levels of Malondialdehyde (MDA) and Glutathione (GSH) in the T2DM-CHD Group

Groups	Malondialdehyde Level (µmol/mg)	Glutathione Level (µmol/mg)	*P*-value
Type 2 Diabetes Mellitus with Coronary Heart Disease (T2DM-CHD).	19.3 ± 16.8	15.3 ± 6.5	P=0.003
Healthy Group (Control)	6.9 ± 3.3	34.8 ± 10.0	P=0.002

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Discussion

Recent studies have shown that type 2 diabetes is associated with an increased risk of coronary artery disease (CHD) and other metabolic complications. Oxidative stress is a key factor in the development and progression of these diseases. MDA and glutathione serve as primary indicators of oxidative stress and antioxidant status, respectively. A detailed examination of changes in these markers can enhance our understanding of pathophysiological mechanisms and inform more effective therapeutic strategies for patients with type 2 diabetes and cardiovascular diseases.

Our study found that in patients with type 2 diabetes and coronary artery disease (T2DM-CHD), serum levels of MDA were significantly higher compared to the control group. Additionally, serum glutathione levels were significantly lower in this group. These findings align with research by Sabzghabaei et al. (2023), which showed that in patients with type 2 diabetes and coronary artery disease, glutathione levels were significantly reduced while MDA levels were elevated, correlating with oxidative damage [14]. Khoshbakht et al. (2024) reported similar findings, with significantly higher MDA levels and lower glutathione levels in diabetic patients with coronary artery disease, highlighting the role of oxidative stress in disease progression [15]. Rezaei et al. (2023) indicated that decreased glutathione levels and increased MDA are associated with cardiovascular risk factors in type 2 diabetes, suggesting these biochemical changes can help identify cardiovascular risks [16]. Mozaffari-Khosravi et al. (2023) demonstrated that type 2 diabetic patients with coronary artery disease have lower glutathione and higher MDA levels, suggesting antioxidant therapies might improve oxidative profiles and reduce cardiovascular risk [17]. Vaisi-Raygani et al. (2024) explored the correlation between glutathione and MDA levels with coronary artery disease in diabetic patients, emphasizing the importance of managing oxidative stress in this population [18].

Conclusion

Significant differences in elevated MDA and reduced glutathione levels in diabetic patients may play a crucial role in the development of adverse outcomes. Increased MDA and decreased antioxidant mechanisms can lead to cellular damage, necessitating higher antioxidant intake for diabetic patients. Therefore, antioxidants, particularly polyphenols known for their anti-diabetic effects, could help reduce blood glucose levels. Identifying and using herbal remedies rich in natural antioxidants could thus enhance overall health and aid in the prevention or treatment of diabetes.

Statements and Declarations

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Competing interests

The authors have no competing interests to declare that are relevant to the content of this article.

Ethics approval

This study was performed in line with the principles of the Declaration of Helsinki.

Consent to participate

Informed consent was obtained from all individual participants included in the study.

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