

Inflammatory Markers in Newly Diagnosed Diabetes Mellitus Type 2 (T2DM)

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ABSTRACT

Introduction: Diabetes Mellitus is a common metabolic syndrome in India, characterized by increased glucose levels and hyperglycemia due to modern lifestyle factors like junk food, lack of exercise, and heavy workload. Inflammatory markers like C-Reactive Protein, Superoxide Dismutase, and Malondialdehyde are disrupted, indicating the onset of Diabetes Mellitus type 2 (T2DM). This study aims to estimate these markers and correlate them with newly diagnosed Mellitus type 2 patients.

Aims & Objectives: The study aims to estimate inflammatory markers like hs-CRP, SOD, and MDA in newly diagnosed Diabetes Mellitus type 2 patients, and correlate these markers with the condition.

Materials & Methods: A study of 200 individuals was conducted to assess fasting blood sugar, HbA1c, highly sensitive C-Reactive Protein (hs-CRP), superoxide dismutase, and malondialdehyde levels, excluding those with surgical pancreas removal, cysts, or pancreatic tumours.

Discussion: A study found that newly diagnosed type 2 diabetes patients have higher HbA1c values and fasting blood sugar levels compared to healthy individuals. High-Sensitivity C-Reactive Protein (hs-CRP) and Superoxide Dismutase levels were also higher in these patients compared to the control group. Inflammatory markers showed a significant positive correlation, with only Superoxide Dismutase showing low values in the patients, while hs-CRP and MDA levels increased.

Conclusion & Summary: A study comparing 200 newly diagnosed Type 2 Diabetes Mellitus patients with 200 healthy controls found that they had significantly higher mean HbA1c levels and fasting blood sugar levels compared to the control group. The study also found significant differences in inflammatory and oxidative stress markers, with elevated high-sensitivity C-reactive protein (hs-CRP) and Malondialdehyde (MDA) levels in the diabetic group, and reduced Superoxide Dismutase (SOD) levels in T2DM patients. These findings suggest increased systemic inflammation and oxidative stress in T2DM patients, potentially contributing to early vascular and metabolic complications.

Keywords: Diabetes Mellitus type 2, High Sensitivity C-Reactive Protein, Malondialdehyde, Superoxide Dismutase.

INTRODUCTION

In India metabolic syndromes are common and among all metabolic syndrome, Diabetes Mellitus is the common among all age group due to modern lifestyle, as now-a-days, the use of packed food products and junk food items. Also, due to lack of regular exercise, heavy work load, the stress level also increased which cause the Diabetes Mellitus. Diabetes Mellitus is the condition in which the level of glucose level increases which cause hyperglycaemia. ⁽¹⁾ In case of Diabetes Mellitus, the β cells of Pancreas either not respond or damage or both. Inflammatory Markers such as highly Sensitivity C-Reactive Protein (hs-CRP), Superoxide Dismutase (SOD) and Malondialdehyde (MDA) are also disturbed which indicate the onset of Diabetes Mellitus type 2 (T2DM). Both hs-CRP and MDA gets increased whereas the level of SOD gets low. So, the level of Inflammatory markers is also act as indicator for Metabolic Syndrome also for Diabetes Mellitus type 2 (T2DM). ⁽²⁾ So, in our present study, we estimate the level of Inflammatory markers i.e., hs-CRP, SOD

and MDA and correlate them with newly Diagnosed Mellitus type 2 patients.

Aims & Objectives:

Aim: To estimate the level of Inflammatory Markers i.e., hs-CRP, SOD and MDA among newly Diagnosed Diabetes Mellitus type 2 patients.

Objectives:

- To estimate the level of Fasting Blood Sugar (FBS) and Glycated Hemoglobin (HbA1c) for the detection of Newly Diagnosed Diabetes Mellitus type 2.
- To estimate the level of hs-CRP, SOD and MDA in Newly Diagnosed Diabetes Mellitus type 2 patients.
- To Correlate the inflammatory markers with Newly Diagnosed Diabetes Mellitus type 2.

MATERIALS & METHODS

A total of 200 individuals were selected. Patients with surgical removal of Pancreas, Cyst or tumour in Pancreas, Individuals with aged below 30 years, Pregnant Women were excluded.

S. No.	Parameter	Method
1.	Fasting Blood Sugar	Trinder's (1969) Method ⁽³⁾
2.	HbA1c	Nathan D M et al. (2008) method ⁽⁴⁾
3.	Highly Sensitive C-Reactive Protein (hs-CRP)	Rifai N et al. (2008) method ⁽⁵⁾
4.	Superoxide Dismutase	Marlund and Marklund (1974) ⁽⁶⁾ method.
5.	Malondialdehyde	Jeans CD et al. (1983) ⁽⁷⁾ method

OBSERVATIONS & RESULTS

Table 1: Mean \pm SD of HbA1c, FBS and Inflammatory Markers in Newly Diagnosed Diabetes Mellitus type and Control Group

	Patient Group	Control Group	r-value	p-value
HbA1c (%)	6.86 \pm 0.21	5.215 \pm 0.33	-	-
FBS (mg/dl)	130.36 \pm 2.69	102.45 \pm 9.39	0.91	<0.000
hs-CRP (mg/dl)	3.98 \pm 0.42	2.02 \pm 0.51	0.99	<0.000
SOD (Units/ml)	3.45 \pm 0.57	5.62 \pm 0.97	0.99	<0.000
MDA (mmol/ml)	5.77 \pm 0.68	3.1 \pm 0.57	0.99	<0.000

In table 1, Mean \pm SD of HbA1c value for patients with newly diagnosed type 2 diabetes is 6.86 \pm 0.21%. The HbA1c mean \pm SD for the control group is 5.215 \pm 0.33%. Additionally, the newly diagnosed T2DM and control groups' mean \pm SD fasting blood

sugar (FBS) values are 130.36 \pm 2.69 mg/dl and 102.45 \pm 9.39 mg/dl, respectively. In a similar vein, the value is higher for patients with newly diagnosed type 2 diabetes than for healthy people in the same age range. Additionally, the p-value is <0.000 and the r-

value of FBS is 0.91, both of which show a substantial positive connection. The study found that the Mean \pm SD of high-Sensitivity C-Reactive Protein (hs-CRP) in Newly Diagnosed Diabetes Mellitus type 2 patients was 3.98 ± 0.42 mg/dl, compared to 2.02 ± 0.51 mg/dl in the control group. The Mean \pm SD of Superoxide Dismutase (SOD) was 3.45 ± 0.57 units/ml, while the Mean \pm SD of Malondialdehyde (MDA) was 5.77 ± 0.68 mmol/ml and 3.1 ± 0.57 mmol/ml for the patients and control group respectively. Inflammatory markers showed a significant positive correlation, with only Superoxide Dismutase showing low values in the patients, while hs-CRP and MDA showed increased levels compared to the control group.

DISCUSSION

The study evaluated inflammatory and oxidative stress markers in newly diagnosed Type 2 Diabetes Mellitus patients and healthy controls. Results showed significant alterations in all three parameters, with a strong positive correlation. High-sensitivity C-reactive protein (hs-CRP) levels were elevated in diabetics, indicating low-grade systemic inflammation. Malondialdehyde (MDA) levels were higher in diabetics, supporting the role of oxidative stress in diabetes pathophysiology. Superoxide dismutase (SOD) activity was reduced in diabetics, suggesting compromised antioxidant defense mechanisms in the early stages of the disease. Our study resemble with Shyam Murarai Garg et al. (2017)⁽⁸⁾, Ramesh SS et al. (2019)⁽⁹⁾, Zephy Doddigarla et al. (2016)⁽¹⁰⁾, Farzana Ganjifrockwala et al. (2016)⁽¹¹⁾, Suchrita Mustur Manohar et al. (2013)⁽¹²⁾, Zahra Arab Sadeghabadi et al. (2019)⁽¹³⁾. So, they suggested that interventions aimed at reducing oxidative stress and inflammation may help manage or prevent T2DM progression. Overall, the findings indicate that newly diagnosed T2DM patients exhibit increased inflammatory and oxidative stress responses, as evidenced by elevated hs-CRP and MDA levels, along with diminished

antioxidant capacity as reflected by reduced SOD activity. The strong positive correlations across these parameters further emphasize their potential utility in early detection and monitoring of inflammatory and oxidative changes in T2DM.

Conclusion: The study shows that newly diagnosed Type 2 Diabetes Mellitus patients have significantly higher mean HbA1c levels ($6.86 \pm 0.21\%$) and higher mean fasting blood sugar (FBS) levels (130.36 ± 2.69 mg/dL) compared to the control group (102.45 ± 9.39 mg/dL). The strong positive correlation between FBS and HbA1c confirms this association, indicating that elevated HbA1c and FBS levels are reliable indicators of glycemic status in diabetic individuals. The study reveals significant differences in inflammatory and oxidative stress markers in newly diagnosed Type 2 Diabetes Mellitus (T2DM) patients compared to healthy controls. Elevated high-sensitivity C-reactive protein (hs-CRP) and Malondialdehyde (MDA) levels were observed in the diabetic group, while reduced Superoxide Dismutase (SOD) levels were found in T2DM patients. These findings suggest increased systemic inflammation and oxidative stress in T2DM patients, potentially contributing to early vascular and metabolic complications. The biomarkers could be useful in early risk stratification and disease progression monitoring.

SUMMARY

A total of 200 newly diagnosed Type 2 Diabetes Mellitus (T2DM) patients were compared with 200 healthy controls. HbA1c was significantly elevated in T2DM patients ($6.86 \pm 0.21\%$) compared to controls ($5.215 \pm 0.33\%$). Fasting Blood Sugar (FBS) also showed a marked increase (130.36 ± 2.69 mg/dL in diabetics vs. 102.45 ± 9.39 mg/dL in controls). hs-CRP: Elevated to 3.98 ± 0.42 mg/dL vs. 2.02 ± 0.51 mg/dL in controls. Malondialdehyde (MDA) increased to 5.77 ± 0.68 mmol/mL from 3.1 ± 0.57 mmol/mL, indicating lipid peroxidation. Superoxide Dismutase (SOD) decreased in

T2DM (3.45 ± 0.57 units/mL) vs. controls (5.62 ± 0.97 units/mL), reflecting reduced antioxidant defense. All three markers showed very high correlations with HbA1c ($r = 0.99$, $p < 0.000$), highlighting the role of inflammation and oxidative stress in early diabetes.

Declaration by Authors

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