Cholecalciferol Levels and Cardiac Biomarkers in Type 2 Diabetes Mellitus: A Correlative Study & Clinical Implications

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ABSTRACT:
Cardiovascular complications are more frequently linked to cholecalciferol (vitamin D3) deficiencies, especially in people with Type 2 Diabetes Mellitus (T2DM) [1]. This study looked at the relationship between cardiac biomarkers and serum cholecalciferol levels in a sample of 201 individuals with type 2 diabetes that had been diagnosed. Important cardiac biomarkers, including High-sensitivity C-reactive protein (HsCRP), Troponin T, Troponin I, B-type natriuretic peptide (BNP) and C-reactive protein (CRP), were tested to assess cardiovascular disease risk. The study looked at the relationship between elevated levels of cardiac biomarkers and cholecalciferol (vitamin D3) deficiency to evaluate the potential impact of vitamin D3 on cardiovascular physiology. Study demonstrated a significant association between low cholecalciferol levels and the biomarkers evaluated, indicating that T2DM patients with vitamin D3 deficiencies may face a higher risk of developing cardiovascular disease.
Keywords: Chronic, Cardiovascular, Myocardial Stress, B-type natriuretic peptide, Troponin T

INTRODUCTION

The chronic, multifactorial condition known as type 2 diabetes mellitus (T2DM) is characterized by persistent hyperglycaemia, relative insulin insufficiency, and insulin resistance [2]. T2DM, one of the most common metabolic diseases in the world, is linked to a number of problems, one of which is a significantly increased risk of cardiovascular diseases (CVD) [3]. Because of a common pathophysiological landscape that includes inflammation, oxidative stress, and dyslipidaemia, people with type 2 diabetes are more at risk for cardiovascular morbidity and mortality [4]. Therefore, finding biomarkers that can more accurately predict cardiovascular risk in individuals with type 2 diabetes is crucial for improving clinical outcomes and creating preventative measures [5]. In this study on the cardiovascular effects of diabetes, cholecalciferol has drawn attention as a possible biomarker. In addition to its well-known function in maintaining calcium balance and bone health, vitamin D3 has a variety of metabolic impacts, such as controlling insulin production and influencing immunological and inflammatory reactions [6]. Reduced vitamin D3 levels have been linked to the development of type 2 diabetes and the advancement of insulin resistance [7]. Additionally, Important signs of myocardial stress and injury are cardiac biomarkers, such as

troponin I, B-type natriuretic peptide (BNP), troponin T, high-sensitivity C-reactive protein (HsCRP), and C-reactive protein (CRP) [8]. Elevated levels of these biomarkers have been associated with poor cardiovascular outcomes in diabetic patients, suggesting they may serve as valuable predictors of cardiovascular risk in this population [9]. This study aims to investigate the association between cholecalciferol and cardiac biomarkers in patients with confirmed T2DM, providing insight into their combined predictive value for cardiovascular risk in this high-risk population. By elucidating these relationships, we aim to enhance our understanding of the potential for cholecalciferol and cardiac biomarkers as prognostic tools for cardiovascular complications in T2DM, ultimately contributing to improved patient care and management.

MATERIAL AND METHODOLOGY:

Out of 201 patients, 60% of the people who were diagnosed with type 2 diabetes and 40% of controlled patients were included in the study. First, a sample was taken after the patient was informed about the study and gave their consent. Between May 2023 and September 2024, samples were collected from several districts in Uttarakhand and processed at DNA Labs A-Centre for Applied Sciences in Dehradun, Uttarakhand. Serum from SST vials was separated by centrifuging blood at 3000 rpm for 10 minutes. Estimation of high-sensitivity C-reactive protein (HsCRP), troponin T, troponin I, B-type natriuretic peptide (BNP), and C-reactive protein (CRP) was done using the turbidimetric immune assay method, and determination of cholecalciferol (Vitamin D3) was performed on the Snibe Maglumi 800, which works on the principle of chemiluminescence assay (CLIA).

RESULTS

Between May 2023 and September 2024, a total of 201 samples were collected, comprising 130 females (64.67%) and 71 males (34.33%). Among these, 110 individuals (54.72%) were confirmed to have Type 2 Diabetes Mellitus (T2DM), while 91 individuals (45.28%) were classified as controlled patients. All participants, regardless of gender, were aged between 25 and 75 years. Patients diagnosed with T2DM exhibited a low level of Vitamin D3, with sufficient levels defined as ≤ 30 ng/dl, deficient levels as ≤ 20 ng/dl, and insufficient levels as ≤ 10 ng/dl. The mean Vitamin D3 level among patients with T2DM in the age group of 35 to 75 years was found to be 16.0 ng/dl. The mean HbA1c level for confirmed T2DM patients was 8.72%, which exceeds the reference range of 3.8% to 6.0%. In contrast, the HbA1c level for controlled patients was below the normal threshold at 5.10%. Cardiac Biomarkers were assessed for both confirmed T2DM and controlled patients, revealing relatively elevated levels. The primary cardiac biomarker, Troponin T, had a mean value of <10.12 pg/ml for confirmed T2DM patients, with a reference value of <26.20 pg/ml, while controlled patients exhibited a mean of <2.10 pg/ml. Troponin I levels were <20.14 pg/ml for confirmed T2DM patients and <5.0 pg/ml for controlled patients, with a reference value of 14.0 pg/ml. High-sensitivity C-reactive protein (HsCRP) levels were <0.21 mg/L for confirmed T2DM patients and <0.01 mg/L for controlled patients, with a reference range of <1.00 mg/L. Additionally, B-type natriuretic peptide (BNP) levels were recorded at 98.92 pg/ml for confirmed T2DM patients and <30.00 pg/ml for controlled patients. The mean Vitamin D3 level for confirmed T2DM patients was 16.00 ng/dl, while controlled patients had a mean level of 22.00 ng/dl. The chart shows the comparative mean difference between controlled and confirmed T2DM patients with gender Distribution.

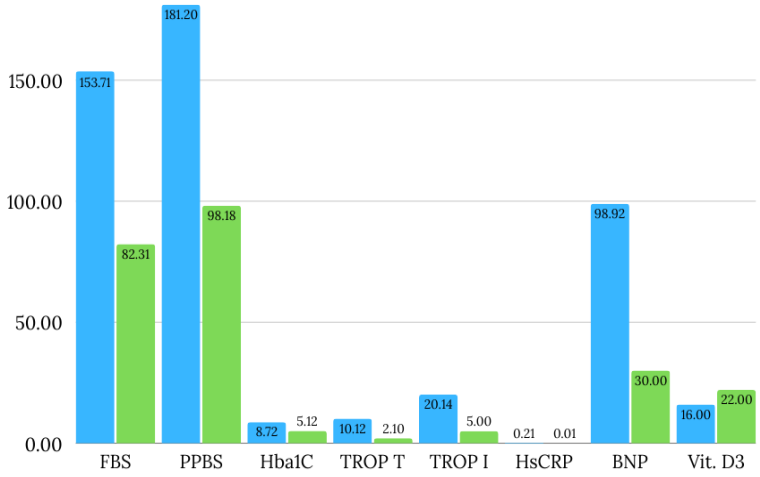

Fig.1 :- Bar graph of comparitive Mean Difference Between Confirmed T2DM and Controlled Patients

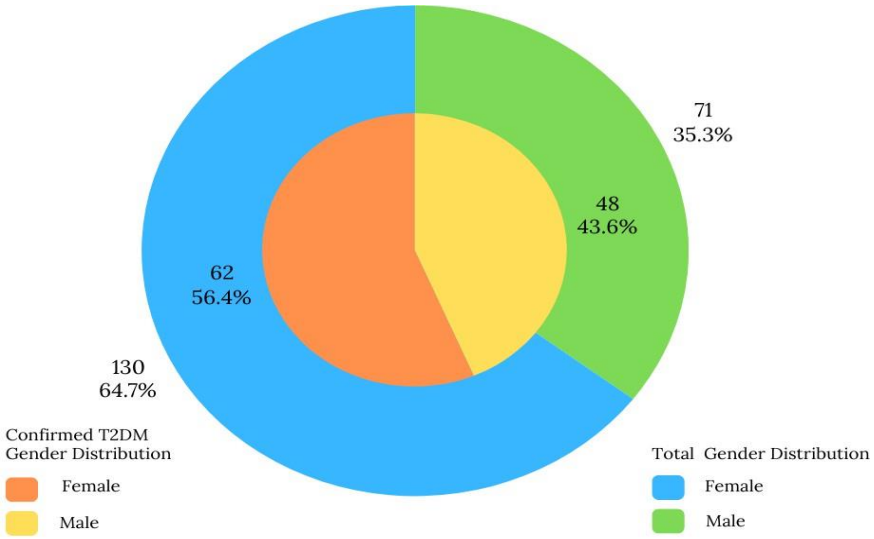

Fig.2 :- Pie Chart of Gender Distribution of total Patients and confirmed T2DM Gender Distribution

Discussion and Conclusion

Discussion: This study examined the relation between Type 2 Diabetes Mellitus (T2DM) and various cardiac biomarkers, focusing on Vitamin D3, HbA1c, and cardiac markers in a cohort of 201 patients aged 25 to 75 years. The sample shows the higher dominance of females (64.67%) than males (34.33%). A considerable proportion of participants (54.72%) were diagnosed with T2DM, while the remaining 45.28% were classified as controlled patients. The low mean Vitamin D3 level (16.0 ng/dl) in T2DM patients compared to in proportion higher level in controlled patients (22.0 ng/dl) aligns with previous research indicating an association between Vitamin D deficiency and increased risk of T2DM. Vitamin D has been incriminate in insulin sensitivity and pancreatic β-cell function, which are crucial in managing glucose levels. The findings that most T2DM patients exhibited insufficient or deficient Vitamin D3 levels suggest that Vitamin D insufficiency may

play a role in the pathogenesis or progression of T2DM. HbA1c levels in T2DM patients averaged 8.72%, notably exceeding the normal range (3.8%–6.0%) and indicating suboptimal glycaemic control. This high HbA1c level is a strong predictor of chronic complications in diabetic patients, as it reflects sustained hyperglycaemia. In contrast, controlled patients maintained an average HbA1c of 5.10%, indicating effective glycaemic regulation and lower associated risks of complications. Cardiac biomarkers showed elevated levels in T2DM patients, suggesting heightened cardiovascular risk, which is consistent with the well-documented association between T2DM and increased cardiovascular morbidity. Troponin T and I levels, although within the normal range, were notably higher in T2DM patients compared to controlled patients, highlighting the possibility of subclinical myocardial stress in diabetic individuals. HsCRP, a marker of systemic inflammation, was also higher among T2DM patients, further indicating an inflammatory state that may predispose them to atherosclerosis and cardiovascular events. BNP, which is elevated in response to cardiac stress, was nearly three times higher in T2DM patients, suggesting increased cardiac workload and possibly early-stage heart failure, even in the absence of acute symptoms. The observed differences in Vitamin D3 and cardiac biomarkers suggest that T2DM management should involve not only glycemic control but also monitoring and managing Vitamin D levels and cardiovascular risk factors. Addressing these areas holistically could mitigate the long-term complications associated with T2DM.

Conclusion: The study highlights the intricate interaction between T2DM, Vitamin D3 levels, and cardiovascular health. T2DM patients shown lower Vitamin D3 levels, higher HbA1c, and compared to patient under control, the increased cardiac Biomarker suggest an increased risk profile for cardiovascular complications. The results emphasize the importance of a comprehensive strategy for managing diabetes, involving consistent monitoring of Vit D3 and cardiac markers to tackle both metabolic and cardiovascular well-being. Future research should further investigate the mechanisms linking Vitamin D deficiency and cardiac risks in T2DM patients, which could lead to improved prevention and management strategies.

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Conflict of Interest

Authors declare no conflict of interest

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