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K. H. I. ILYAS

THE BIOCHEMICAL PARAMETERS OF DYSLIPIDEMIA IN T2DM DIABETES PATIENTS

Educational Institution "Grodno State University named after Yanka Kupala", Grodno, Republic of Belarus

This systematic review's objective is to assess the biochemical indicators of dyslipidemia in people with T2DM mellitus and its consequences. Using the databases from Google Scholar, Web of Science, and PubMed, we carried out a systematic review. We looked for papers that were published between 2018 and 2023. Search criteria included "dyslipidemia," "T2DM diabetes mellitus," "biochemical parameters," and "complications." Studies on the biochemical characteristics of dyslipidemia in T2DM patients and its consequences were included in our review. The search returned total 682 articles, there were 404 articles from Google Scholar, 258 articles from Web of Science, and 20 articles from PubMed. Results revealed an association between T2DM and dyslipidemia, the study also revealed increased levels of low density lipoprotein, triglycerides and elevated levels of inflammation markers. The T2DM in comparison to healthy controls was related to high levels of low density lipoprotein over 200 mg/dL, triglycerides over 400 mg/dL, cholesterol over 300 mg/dL.

*Key words***:** T2DM, cardiovascular diseases, biochemical parameters, dyslipidemia.

Introduction. Diabetes mellitus, specifically T2DM diabetes, has become a prevalent worldwide epidemic, impacting a significant number of individuals [1]. The condition under consideration is a metabolic anomaly that is typified by elevated levels of glucose in the blood, which is caused by impairments in the secretion of insulin, its action, or both [2]. T2DM diabetes is frequently linked with metabolic irregularities such as dyslipidemia, in addition to increased blood glucose levels [3–5]. Dyslipidemia, characterized by an atypical lipid profile, is a prevalent metabolic anomaly that is frequently encountered in patients diagnosed with T2DM diabetes [6, 7]. The condition is distinguished by elevated levels of “total cholesterol” (TC), “low-density lipoprotein cholesterol” (LDL-C), “triglycerides” (TG), and diminished levels of “high-density lipoprotein cholesterol” (HDL-C) [8, 9].

The coexistence of dyslipidemia and T2DM diabetes significantly increases the likelihood of cardiovascular complications, including atherosclerosis, coronary artery disease, and stroke [10, 11, 12]. Comprehending the complex interconnection between dyslipidemia and T2DM diabetes is imperative for the efficacious control and avoidance of related complications [13, 14]. This systematic review's objective is to assess the biochemical indicators of dyslipidemia in people with T2DM mellitus and its consequences. The ultimate objective is to enhance lipid management and alleviate the impact of diabetic complications among Patients afflicted with T2DM diabetes.

Materials and methods of research. Using the databases from Google Scholar, Web of Science, and PubMed, we carried out a systematic review. We looked for papers that were published between 2018 and 2023. Search criteria included "dyslipidemia," "T2DM mellitus," "biochemical parameters," and "complications." Studies on the biochemical characteristics of dyslipidemia in T2DM patients and its consequences were included in our review. The search returned 404 articles from Google Scholar, 258 articles from Web of Science, and 20 articles from PubMed.

The inclusion criteria include observational studies that look at the relationship between T2DM diabetes and dyslipidemia. Studies that provide data on one or more biochemical factors associated with dyslipidemia, such as total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides. Studies that detail cardiovascular disease, nephropathy, and retinopathy as well as other consequences related to dyslipidemia in people with T2DM diabetes.

Exclusion Criteria are studies that don't include any information on dyslipidemia-related biochemical markers and studies that primarily examine type 1 diabetes or other forms of diabetes.

Results and its discussion. A total of 14 studies were chosen from the papers we filtered. The following information was taken from each study: author name, year of publication, study design, sample size, participant age range, gender distribution, biochemical parameters assessed (e.g., total cholesterol, LDL

cholesterol, HDL cholesterol, triglycerides), and complications related to dyslipidemia in people with T2DM diabetes.

Khavandi et al. conducted a study to explicate the physiological and metabolic modifications in lipids that manifest in patients diagnosed with T2DM diabetes. The present investigation concerns the differentiation between lipid and lipoprotein metabolism that characterizes the dyslipidemia evident in persons afflicted with "insulin resistance" and T2DM diabetes. The relevance of the recently released AHA/ADA treatment guidelines for individuals with dyslipidemia is currently under examination. It provide a current overview of the pathophysiology of diabetic dyslipidemia, with a particular focus on the involvement of various apolipoproteins, including apoC-III. Additionally, we highlight recent research and novel therapeutic agents for managing lipid disorders in patients diagnosed with T2DM mellitus [15].

Müller-Wieland et al. conducted a clinical trial to evaluate the effectiveness and safety of alirocumab, a PCSK9 inhibitor, compared to standard lipid-lowering care in individuals with T2DM and mixed dyslipidemia who are at a high risk of cardiovascular disease and have inadequately controlled non-HDL-C levels despite receiving the maximum tolerated dose of statin therapy. The study's design and rationale are centered on this objective. The study aims to evaluate the effectiveness and safety of alirocumab compared to standard lipid-lowering care in individuals with T2DM and mixed dyslipidemia who are at a heightened risk for cardiovascular disease. The primary measure of effectiveness will be (non-HDL-C) [16].

Klisic et al. aims to investigate the potential benefits of identifying markers associated with oxidative stress, inflammation, and dyslipidemia in predicting non-alcoholic fatty liver disease (NAFLD) in individuals with T2DM mellitus (DM2), as assessed by the fatty liver index (FLI). The implementation of a multimarker approach that encompasses biomarkers associated with oxidative stress, dyslipidemia, and inflammation may prove advantageous in the identification of individuals with diabetes who are at an elevated risk of developing fatty liver disease [17].

Shahwan et al. aims to investigate the frequency of dyslipidemia among individuals diagnosed with T2DM mellitus (DM) and to establish a correlation between dyslipidemia and other healthcare and biochemical parameters. A cross-sectional study Dyslipidemia exhibits a high prevalence among individuals with diabetes, particularly in those who have inadequate glycemic control. This necessitates the implementation of early and comprehensive lipid profile screening. There exists a pressing need for interventions aimed at achieving strict glycemic control, optimal lipid profile management, and lifestyle modifications among all individuals diagnosed with diabetes in order to attain a target HbA1C value of≤7 [18].

Malindisa et al. induced across-sectional study to assess the prevalence of non-communicable diseases (NCDs) among young adults residing in an urban low- and middle-income country (LMIC) context, with a specific focus on Tanzania. An alarming incidence of diabetes, impaired glucose tolerance, hypertension, overweight, obesity, and dyslipidemia was noted among the young adult population in Mwanza. The present study underscores the imperative of implementing coordinated endeavors aimed at addressing non-communicable diseases (NCDs) among the young adult population in Tanzania [19].

Al-Kaaby et al. promoted a cross-sectional study to investigate certain biochemical parameters that are linked to T2DM mellitus within the geographical region of Misan province. The findings suggest a noteworthy rise (p<0,05) in blood glucose levels and HbA1C levels across all diabetes groups in comparable to control group. The levels of cholesterol, triglyceride, LDL, and VLDL exhibited a significant increase (p<0,05) in all diabetes groups as compared to the control group. The study findings indicate a statistically significant reduction (p<0,05) in HDL levels across all diabetes groups in comparison to the control group, when age and duration were taken into account. Elevated levels of cholesterol, triglyceride, LDL, and VLDL, coupled with reduced levels of HDL, are recognized as risk factors for the development of coronary heart disease [20].

Thakur et al. conducted a cross-sectional study and a case control to investigate the anthropometric and biochemical parameters of individuals diagnosed with (T2DM) residing in rural regions of Sirmaur district who seek medical attention at Dr. Yashwant Singh Parmar Government Medical College and Hospital in Nahan, Himachal Pradesh, India. In addition to examining the potential correlation between the variables of interest and to assess the potential risk of coronary heart disease (CHD) in relation to patients and to identify the presence of Metabolic Syndrome among them. Anthropometric indices have been found to be reliable indicators of T2DM Mellitus (T2DM) and patients with this condition often exhibit asymptomatic dyslipidemia. T2DM has a notable impact on an individual's overall health, particularly in relation to the risk factors associated with "coronary heart disease" (CHD). The implementation of prompt lifestyle modifications and pharmacological interventions, coupled with consistent monitoring, has the potential to mitigate risk factors and minimize related complications [21].

Haile and Timerga assess the prevalence of dyslipidemia and its correlated risk factors in patients diagnosed with T2DM who receive medical care at Jimma Medical Center (JUMC) located in Jimma, Ethiopia. It was an institution-based- cross-sectional study. The study conducted in the area revealed a significant incidence of dyslipidemia among individuals with T2DM diabetes [22].

Mehalingam et al. at 2020 evaluated the degree of thyroid dysfunction among individuals diagnosed with T2DM mellitus and to ascertain the correlation between thyroid dysfunction and complications arising from diabetes. It was a cross-sectional studythe co-occurrence of thyroid dysfunction and T2DM mellitus is observed in 17,5 % of patients. There was no observed correlation between thyroid dysfunction and diabetic complications [23].

Gazzaz et al. investigate the correlation between dyslipidemia and comorbidities with risk factors in patients diagnosed with type-2 diabetes mellitus (T2DM) who are receiving medical care at King Abdulaziz University Hospital (KAUH) in Jeddah, Saudi Arabia (SA). A cross sectional study comorbidities increased with age, with hypertension, coronary heart disease, and dyslipidemia being the most common. Our research has shed light on the evolving patterns of T2DM symptoms and complications. All of these highly morbid sequelae of this preventable disease can be avoided with efficient management and control by early screening and building healthy lifestyles in our patients [24].

Bawah et al. studied the prevalence of lipid irregularities among individuals diagnosed with T2DM. It was a cross-sectional study. The study revealed a significant prevalence of dyslipidemia among individuals exhibiting elevated levels of total cholesterol (TC), triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), and low levels of high-density lipoprotein cholesterol (HDL-C). These findings corroborate previous claims that individuals with T2DM mellitus are susceptible to the emergence of lipid irregularities [25].

Majeed et al. assessed the efficacy of EOE in mitigating hyperglycemia and dyslipidemia relative to metformin, which is the recommended initial therapy for individuals newly diagnosed with T2DM according to the guidelines of the American Diabetes Association. A randomized open-label, three-arm, comparative, multicenter study. The study findings indicate that the EOE-2 g group exhibited significantly lower levels of FBS, PPBS, and HbA1c when compared to both the metformin and EOE-1 g groups. The study findings indicate that the EOE-2 g group exhibited significantly greater reductions in LDL and TC compared to the EOE-1 g group, and these reductions were found to be similar to those observed in the metformin group. No significant detrimental impacts were noted among any of the subjects involved in the studies. The administration of EOE-1 at a dosage of 1 g and 2 g per day has been deemed safe and efficacious in treating diabetes. Its effectiveness is comparable to that of metformin, a commonly prescribed pharmaceutical drug for diabetes management. The administration of EOE-2 at a dosage of g day−1 exhibited superior effectiveness in decreasing circulating glucose levels compared to metformin [26].

In 2023, Behrouj et al. examined the correlation between the rs17669 polymorphism and the circulating level of miR-122, as well as the risk of developing T2DM mellitus (T2DM) and associated biochemical parameters in both T2DM patients and healthy controls who were matched for comparison. The variant rs17669 of miR-122 does not exhibit any association with the expression of miR-122 or serum parameters associated with T2DM Mellitus. Additionally, it is possible to suggest that the dysregulation of miR-122 is implicated in the development of T2DM by inducing dyslipidemia, hyperglycemia, and insulin resistance [27].

The etiology of dyslipidemia in T2DM Mellitus entails a multifaceted interaction of various metabolic irregularities [28]. Insulin resistance, which is a characteristic feature of T2DM, holds a pivotal position [29]. The development of insulin resistance is associated with heightened lipolysis in adipose tissue, which in turn leads to an upsurge in the concentration of free fatty acids (FFAs) in the circulatory system [30]. Subsequently, the liver uptakes the surplus free fatty acids (FFAs), which results in an escalation of hepatic synthesis of VLDL particles that are abundant in triglycerides (TG) [31].

Furthermore, the impairment of hepatic glucose production suppression due to insulin resistance results in hyperglycemia [32]. Elevated levels of blood glucose, or hyperglycemia, stimulate the hepatic production of triglycerides. The elevated levels of triglycerides in T2DM can be attributed to the combined impact of augmented hepatic triglyceride synthesis and hindered clearance of triglyceride-rich lipoproteins [33, 34]. Additionally, insulin resistance has been linked to reduced lipoprotein lipase activity, an enzyme accountable for the elimination of TG-rich lipoproteins [35–37] This results in the postponed clearance of remnants and elevated levels of LDL-C [38]. The metabolic process of HDL-C is also disrupted by insulin resistance, resulting in a decrease in the levels of HDL particles that provide protection [39, 40].

According to estimates, a significant proportion of individuals diagnosed with T2DM - ranging from 70–80 % – also experience dyslipidemia [41]. The elevated occurrence of dyslipidemia and T2DM can be

ascribed to the common risk factors that they share, such as genetic predisposition [42], sedentary lifestyle [43], obesity [44], and poor dietary habits [45]. Moreover, the coexistence of dyslipidemia in T2DM frequently intensifies the metabolic irregularities and elevates the likelihood of encountering cardiovascular complications [46, 47].

The presence of both T2DM and dyslipidemia is associated with a noteworthy elevation in the likelihood of experiencing cardiovascular complications. Increased concentrations of LDL-C and TG, in conjunction with decreased levels of HDL-C, are significant factors in the pathogenesis of atherosclerosis [48, 49], a primary etiology of cardiovascular ailments including coronary artery disease [50], myocardial infarction [51], and stroke [52].

LDL-C, commonly recognized as the unfavorable cholesterol, significantly contributes to the development of atherosclerotic plaques [53]. Conversely, decreased levels of "high-density lipoprotein cholesterol (HDL-C)", also known as the favorable cholesterol [54] impede the process of reverse cholesterol transport [55]. This process is responsible for eliminating surplus cholesterol from peripheral tissues [56, 57]. Furthermore, dyslipidemia in T2DM is linked to a state of inflammation and blood clotting, which exacerbates the likelihood of cardiovascular incidents [58, 59].

In the context of T2DM, the management of dyslipidemia necessitates a comprehensive strategy. The adoption of lifestyle modifications [60], such as the consumption of a nutritious diet [61], consistent engagement in physical exercise [62], and maintenance of a healthy weight [63] are essential in enhancing lipid profiles. Furthermore, pharmacological measures, such as statins, fibrates, and cholesterol absorption inhibitors, may be administered to address particular lipid irregularities [64, 65, 66]. The optimization of diabetes management and regulation of glycemic levels are also factors that positively impact the amelioration of dyslipidemia [67].

Conclusion. Dyslipidemia is a commonly occurring metabolic aberration observed in individuals with T2DM, resulting from insulin resistance and other related factors. The presence of dyslipidemia in patients diagnosed with T2DM is correlated with a significant increase in the probability of encountering cardiovascular complications.

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И. Х. Х. ИЛЬЯС

БИОХИМИЧЕСКИЕ ПАРАМЕТРЫ ДИСЛИПИДЕМИИ У ПАЦИЕНТОВ С САХАРНЫМ ДИАБЕТОМ II ТИПА

Учреждение образования «Гродненский государственный университет имени Янки Купалы», Гродно, Республика Беларусь

Резюме

Целью данного литературного обзора является оценка биохимических показателей дислипидемии у людей с сахарным диабетом II типа и ее последствий. Используя базы данных Google Scholar, Web of Science и PubMed, мы провели систематический обзор. Мы искали статьи, опубликованные в период с 2018 по 2023 год. Критерии поиска включали «дислипидемию», «сахарный диабет II типа», «биохимические параметры» и «осложнения». В наш обзор вошли исследования биохимических особенностей дислипидемии у больных СД2 и его последствий. Всего поиск выдал 682 статьи, 404 статьи из Google Scholar, 258 статей из Web of Science и 20 статей из PubMed. Результаты выявили связь между СД2 и дислипидемией, исследование также выявило повышенный уровень липопротеинов низкой плотности, триглицеридов и повышенный уровень маркеров воспаления. СД2 по сравнению со здоровыми людьми из контрольной группы был связан с высокими уровнями липопротеинов низкой плотности – более 200 мг/дл, триглицеридов – более 400 мг/дл, холестерина – более 300 мг/дл.

Ключевые слова: сахарный диабет II типа, сердечно-сосудистые заболевания, биохимические показатели, дислипидемия.