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Blood Sugar Concentration, HbA1C, and Lipid Profile in Heart Patients

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Abstract: ***The study included 45 samples (30 patients with heart disease and have diabetes and 15 patients with Type 2 DM), their age between (40-60) years for both gender. Samples were collected from Kirkuk general hospital from April 2023 to September 2023. The individuals of this study were divided into two groups: The first group was for patients with heart disease n (30), and the second group for individual have diabetes only n (15). Result: Heart disease patients had higher mean serum cholesterol, triglyceride, LDL, and VLDL levels (225.1±25.2, 209.5±8.3, 140.7±17.9, 41.9±4.61) compared to diabetes patients (196.3±27.2, 165±6.1, 119.67±15.2, 33.00±3.22) at a P-value < 0.05. HDL levels were similar across groups at P > 0.05. The research demonstrates the mean FBS and HbA1C of 30 heart disease and 15 diabetic patients. The study found that heart disease patients had higher mean serum FBS and HbA1C levels (282.8±36.41 mg/dl, 10.35±3.18%) compared to diabetes patients (175.2±32.79 mg/dl, 8.22±2.51%). A P-value < 0.05. Conclusion: The study concluded appositive association between dyslipidemia and heart disease in which increased cholesterol, triglyceride, low-density lipoprotein (LDL), very-low-density lipoprotein (VLDL), fasting blood glucose and HbA1C and no differences between heart disease and diabetes patients.***

Keyword: HbA1C, Lipid Profile, Heart Patients.

1. INTRODUCTION

Cardiovascular disease (CVD) encompasses several conditions that impact the heart or blood vessels, such as coronary heart disease characterized by arterial blockages. CVD is the primary cause of illness and death globally, responsible for around 30% of all fatalities according to data from the WHO. The World Health Organization (WHO) has estimated that around 17.3 million individuals succumbed to CVD in 2016. Furthermore, it is projected that the number of deaths would escalate to 23.3 million by the year 2030. [1, 2]. Heart disease is a broad phrase that denotes abnormal functioning of the heart. Heart disease encompasses a range of conditions, such as coronary heart disease (CHD), heart failure, atrial fibrillation, valvular disease, sudden cardiac death (SCD), sick sinus syndrome (SSS), cardiomyopathy,

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and aortic aneurysms [3,4]. The primary conventional risk factors for coronary heart disease (CHD) are age, elevated body mass index, male sex, type 2 diabetes, hypertension, and dyslipidemia [5]. Atherosclerosis is the primary underlying factor responsible for coronary heart disease (CHD). The process begins with alterations in the endothelium and culminates in the development of atherosclerotic plaques. Atheroma causes stenosis of the coronary artery, resulting in decreased perfusion to the myocardium [6].

Heart disease is the primary cause of mortality in elderly individuals. Women have a greater incidence of hypertensive heart disease, while males have a larger prevalence of CHD. Among women, the prevalence of CHD rises with age. However, once women with CHD have a myocardial infarction, they no longer maintain their superiority over males [7].

Multiple studies have shown the significance of the lipid profile in the advancement of CVD. Elevations in triglyceride (TG) and total cholesterol (TC) levels may impact the narrowing and blockage of blood arteries in the heart, which are strongly associated with the risk of CVD. Furthermore, elevations in the level of low-density lipoprotein cholesterol (LDL-C) may lead to the development of arteriosclerosis due to the buildup of LDL-C in the inner layer of the artery, which in turn can stimulate the production of blood platelets. Nevertheless, individuals with elevated levels of high-density lipoprotein cholesterol (HDL-C) may see a decrease in their risk of CVD. Thus, those who have high levels of HDL-C and low levels of non-HDL-C may have a reduced risk of CVD [8,9].

Glycated hemoglobin (HbA1c) is a substance that forms when hemoglobin is exposed to glucose, without the involvement of enzymes. It measures the typical amount of glucose in the blood during the usual lifespan of a red blood cell, which is around 120 days. This measurement is much higher in those with long-term high blood sugar levels. HbA1c assessments have been considered the most reliable method for assessing glycemic control in diabetes patients for over three decades [10].

2. RELATED WORK

Heart disease patients with diabetes have higher levels of blood glucose and HbA1C compared to diabetic patients, despite both groups seeing a rise from normal levels. The fasting blood glucose level (FBS) was markedly elevated in diabetic individuals in comparison to the control group. This phenomenon can be attributed to the body's diminished capacity to react to insulin secreted by the pancreatic β-cells in individuals with diabetes, or to insufficient production of insulin by the beta cells. Consequently, glucose accumulates in the bloodstream rather than being absorbed by the body's cells [29].

From previous studies, DeFronzo *et al* [30] obtained similar results, and reported that the fasting blood glucose level in the diabetic group was high, and attributed this to poor diabetes control. While Pari and Latha [31] stated that diabetes mellitus is characterized by hyperglycemia with biochemical changes of glucose. The results of this study showed a significant increase in total cholesterol levels in the group of patient’s diabetes compared to the control group. This may be due to the increase resulting from an increase in the plasma concentration of the low-density lipoproteins VLDL and LDL, which may result from increased hepatic production of VLDL lipoproteins. Or decreased clearance of VLDL and LDL from the circulation.

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These results are consistent with what was confirmed by [32] that excessive production of VLDL leads to an increase in plasma levels of triglycerides, which occurs through the exchange process mediated by cholesterol ester transfer protein (CETP), which leads to a decrease in levels of high-density lipoprotein (HDL), which leads to Incorrect use of glucose causes hyperglycemia and mobilization of fatty acids from adipose tissue. The results also showed averages of the studied variables amounting to 24.433 kg/m2 for body mass index, and 141.23, 186.33, 187.33, 30.466, 194.333, and 39.067 mg/dL for fasting blood sugar, total cholesterol, triglycerides, high-density lipoprotein, and low-density lipoprotein. Density and very low-density lipoprotein, respectively, in the diabetic group [33].

3. METHODOLOGY

3.1 Subjects

The research had a total of 45 samples, with 30 individuals presenting both cardiac disease and diabetes, and 15 patients diagnosed with Type 2 DM. The age range of the participants was between 40 and 60 years, including both genders. Specimens were obtained from Kirkuk general hospital between April 2023 and September 2023. The participants in this research were categorized into two groups: The first group consisted of 30 patients with cardiac disease, while the second group included 15 persons with diabetes only. Data on the clinical history, including age, weight, height, family history of heart disease, and treatment progression, were gathered by a concise questionnaire (Appendix I).

3.2 Sample Collection

Samples for biochemical analysis, venous blood samples were collected from both patients and controls after a minimum 12-hour fasting period. Using a typical method of drawing blood from the inner elbow, two tubes were filled, one containing an anticoagulant called EDTA. Two milliliters of the blood sample were then transferred into a separate tube for the purpose of measuring Hb1AC. The residual blood (3 ml) was transferred to an EDTA-free tube and allowed to coagulate in a water bath at 37°C. Subsequently, the blood samples were obtained by centrifuging the blood at 3000 rpm for 10 minutes, resulting in the isolation of serum. The serum was then divided into two tubes and stored at -20°C until it was needed for analysis. The samples were allowed to thaw at room temperature before measuring the biochemical parameters, which include lipid profile components such as TC, HDL, T.G, LDL, VLDL, and fasting blood glucose (FBG), Serum TC, HDL, T.G, LDL, VLDL, and fasting blood glucose (FBG) were calculated.

a. The measurement of fasting blood glucose was conducted using the BIOLABO reagents kit specifically designed for glucose analysis.
b. Serum cholesterol levels were determined using the BIOLABO reagents kit for cholesterol CHOD PAP in vitro diagnosis. Principle: AL-OMARI *et al* [11] provide a suggested value of less than 200mg/dl.
c. The blood triglyceride level was measured using the BIOLABO reagents kit for triglycerides GPO Method, which is an in vitro diagnostic test. According to AL-OMARI *et al*., [11]. The acceptable range is 35-160 mg/dl.

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d. The blood high density lipoprotein cholesterol was measured using the BIOLABO reagents kit for HDL-cholesterol (PTA) precipitant in vitro diagnosis. Anticipated outcome: A low level of risk factor is defined as being below 40 mg/dl, while a high level of protective factor is defined as being equal to or more than 60 mg/dl.
Serum low density lipoprotein cholesterol was calculated using an indirect approach. The levels of cholesterol, triglycerides (T.G), and HDL cholesterol were assessed, while LDL cholesterol was derived from the initial data using the Friedewald equation (AL-OMARI *et al*., [11]. Recommended value <130 mg/dl.For the calculation of LDL –Cholesterol Use formula:-

$$\text{LDL (mg /dl)} = \text{Total cholesterol} - \left(\text{HD} + \frac{\text{Conc. of triglyceride}}{5}\right)^*$$

e. To estimate VLDL, divide the triglyceride value by 5 according to this formula [12]:

$$\frac{\text{Conc. of triglyceride}}{5} = \text{VLDL}$$

3.3 Glycated Hemoglobin (HbA1C)

Is a test that determines the proportion of glucose-carrying hemoglobin in red blood cells? Glycosylation, a non-enzyme process, occurs when glucose attaches to hemoglobin. The extent of this binding relies on the quantity of glucose and the duration of the process. HbA1c is a measure of the consistency of blood glucose levels over a period of 8 to 12 weeks, which corresponds to the typical lifetime of a red blood cell. Analytical solutions were used to examine red blood cells that exhibit a reaction with glycated hemoglobin, resulting in the manifestation of a measurable color at a wavelength of 470 nm. This analysis was conducted using the On Call A1C HBA1c Analysis kit manufactured by the American business Acon.

3.4 Statistical Analysis

The results were analyzed according to analysis of variance (F-test) Fisher test, and statistical differences between the arithmetic means were tested using Duncun's multiple range test at the probability level (P>0.05).

4. RESULTS AND DISCUSSION

Table 1: The study shows the mean of cholesterol, triglyceride, HDL, LDL, VLDL among 30 heart disease and 15 diabetes patients. The result demonstrated highest mean of serum cholesterol, triglyceride, LDL, VLDL among heart disease (225.1±25.2, 209.5±8.3, 140.7±17.9, 41.9±4.61) mg/dl respectively when compared with the diabetic patients only (196.3±27.2, 165±6.1, 119.67±15.2, 33.00±3.22) mg/dl. At a P. value ≤ 0.05. While no differences between levels of HDL between two groups at a P. value > 0.05.
Table 2: The study shows the mean of FBS and HbA1C among 30 heart disease and 15 diabetes patients. The result demonstrated highest mean of serum FBS and HbA1C among heart disease (282.8±36.41 mg/dl, 10.35±3.18%) respectively when compared with the diabetic patients only (175.2±32.79 mg/dl, 8.22±2.51%). at a P. value ≤ 0.05.

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Table 3: The study shows no correlation between (TG and Cholesterol), (HDL and Cholesterol), (HDL and TG), (VLDL and HDL) (VLDL and Cholesterol) (VLDL and LDL), (LDL and TG). While a positive correlation between (LDL and Cholesterol), (VLDL and TG) and (FBS and HbA1C). Whereas negative correlation between, (LDL and HDL) in heart disease

Table 1: Level of lipid profile in heart disease and diabetic patient

Studied Groups	**Cholesterol** mg/dl	**TG** mg/dl	**HDL** mg/dl	**LDL** mg/dl	**VLDL** mg/dl
Heart disease (n:30)	225.1±25.2	209.5±8.3	42.5±7.97	140.7±17.9	41.9±4.61
Diabetic patients (n:15)	196.3±27.2	165±6.1	43.33±6.38	119.67±15.2	33.00±3.22
P. value	0.015 **	0.036 *	0.427 ns	0.028 *	0.041 *

Table 2: Level of FBS and HbA1C in heart disease and diabetic patient

Studied Groups	**FBS mg/dl**	**HbA1C %**
Heart disease (n:30)	282.8±36.41	10.35±3.18
Diabetic patients (n:15)	175.2±32.79	8.22±2.51
P. value	0.007 **	0.003 **

Table 3: Correlation between parameters in in heart disease and diabetic patient

Parameters		**Cholesterol**	**TG**	**HDL**	**LDL**	**FBG**
TG	r	0.109				
	P. value	0.565				
HDL	r	-0.108	0.236			
	P. value	0.571	0.210			
LDL	r	0.769	-0.076	-0.301		
	P. value	0.000	0.688	0.106		
VLDL	r	0.071	0.955	0.203	0.039	
	P. value	0.708	0.000	0.282	0.837	
FBG	r	0.106	0.141	-0.252	0.131	
	P. value	0.371	0.405	0.088	0.209	
HbA1C	r	0.148	0.161	-0.203	0.111	0.342
	P. value	0.092	0.186	0.044	0.093	0.004

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Discussion

The study shows significant increase TC, TG, LDL, VLDL at (P-value ≤ 0.05) while non-significant differences in level of HDL between heart disease patients diabetic patients at (P-value ≥0.05), although increase the level of lipid in both groups from normal range, that suggested appositive association between dyslipidemia and heart disease. The study done by [13, 14] show dyslipidemia in cardiovascular disease. Other study shows increase TC and TG with normal LDL and low HDL associated with CAD [15]. The lipid profile plays a crucial role in the development of CVD via elevated levels of TG and TC. These elevated levels may impact the narrowing and blockage of blood arteries in the heart, which are strongly associated with the risk of CVD [16]. Furthermore, elevated levels of LDL-C may lead to the development of arteriosclerosis due to the buildup of LDL-C in the inner layer of the artery. This, in turn, can stimulate the production of platelets [17]. Another research indicated a direct correlation between initial cholesterol levels and the occurrence of CVD, such as coronary heart disease and ischemic stroke, in Taiwanese populations. Individuals with elevated baseline levels of apo B had a significantly increased risk of developing coronary heart diseases while aiming to attain target LDL-C levels [18]. The correlation between a decrease in lipid change and all-cause mortality may be attributed to at least two possible processes. The decrease in lipid levels suggests that lipid resistance to oxidative stress may be crucial during cellular involvement in tissue repair [19]. Furthermore, a reduction in lipid levels might impede the binding of lipopolysaccharide derived from bacteria, hence increasing the susceptibility to infection [20]. Furthermore, lipids are crucial for maintaining cell integrity. Reducing lipid alterations may disrupt the structure and proliferation of cells, thereby raising the likelihood of developing immunological and hematological disorders as well as malignancies [21, 22]. Furthermore, the decrease in lipid levels might be ascribed to malnutrition or illnesses in a preclinical state, hence augmenting the likelihood of fatality [23].

Dyslipidaemia is a condition characterized by high levels of LDL-C and low levels of HDL-C. It is a recognized risk factor for the development and advancement of atherosclerosis in CAD [24]. The correlation between the occurrence of CAD and HDL-C levels was more robust compared to LDL levels [25]. Gordon *et al*. [26] observed a 2–3% reduction in CAD risk for every 10 mg•L−1 rise in HDL-C levels. A recent meta-analysis, including 302,430 participants from 68 long-term prospective trials, has provided evidence supporting the significance of measuring HDL-C levels in assessing the risk of CAD [27].

Excessive quantities of certain lipids exacerbate the microvascular and macrovascular complications associated with diabetes. Hypertriglyceridemia is linked to atherosclerosis due to its association with insulin resistance and atherogenic metabolic abnormalities. The small size of triglyceride-enriched lipoproteins allows them to penetrate the blood vessel wall, where they undergo oxidation, bind to receptors on macrophages, and are consumed. This process contributes to the formation of atherosclerotic lesions [28].

5. CONCLUSION

The study concluded the diabetes patients have a risk for development heart disease due to a positive association between dyslipidemia and heart disease in which increased cholesterol,

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triglyceride, low-density lipoprotein (LDL), very-low-density lipoprotein (VLDL), fasting blood glucose and HbA1C and no differences between heart disease and diabetes patients. On the other hand, the diabetes patients have a risk for development heart disease

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