Hypercholesterolemia as a risk factor for coronary heart disease

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A R T I C L E   I N F O

A B S T R A C T

Familial Hypercholesterolemia (FH) is a genetic disorder, an expression of a defect in the gene that is responsible for the production of LDL-C receptor. The current study was designed to determine the FH patients in the city of Sulaymaniyah for both sexes. The study included 213 samples, the number of males was 99 and the number of females was 114, both sexes ranged from (30-79) years.

The results of cholesterol, triglyceride, high density lipoprotein (HDL-C), and low-density lipoprotein (LDL-C) in patients with hypercholesterolemia showed highly significant ($P < 0.01$) for cholesterol and triglyceride in patients with compared healthy people. (HDL-C and LDL-C) showed a significant decrease ($P < 0.01$) in the concentration of HDL-C in patients with hypercholesterolemia compared to their level of concentration in healthy individuals, in relation to low-density lipoprotein (LDL-C) -C is the other ($P < 0.01$) in the concentration level in patients with hypercholesterolemia compared to the level of concentration of healthy.

As concerns the effect of hypercholesterolemia on coronary heart disease, the results showed a significant increase ($P < 0.01$) in cholesterol, triglycerides and   LDL-C with a significant decrease in HDL-C concentration in people with heart disease compared with healthy people.

Introduction

Hypercholesterolemia (High blood cholesterol or blood lipid abnormalities) is a high cholesterol level in the blood . one type of hyperlipidemia is high blood lipids . It is recommended to reduce saturated fats to reduce the level of cholesterol and LDL in adults , In people with hypercholesterolemia (e.g. *Familial hypercholesterolemia* (FH)) (1).

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FH is a genetic disorder, an expression of a defect in the gene that is responsible for the production of low-density lipoprotein (LDL-C receptor) (2) .

Cholesterol is a substance that is insoluble in water which is transported through blood plasma within the protein molecules (lipoproteins) . lipoprotein is classified at the expense of density into: Chylomicron , very low-density lipoprotein (VLDL) , low-density lipoprotein (LDL) , Medium density lipoprotein (IDL) and high-density lipoprotein (HDL) . All lipoproteins are included in their cholesterol structure, and LDL in the blood may be due to high fat content in food, obesity, and genetic diseases.

Examples of this are mutations in the receptor of LDL in FH , or other diseases such as diabetes or hypothyroidism (3) .

FH is primarily caused by mutations in the receptor of the gene (LDLR) and there are over 700 mutations described by the scientists . The most common cause of FH is a defect gene produced for low-density fatty protein (LDLR) gene . Actually , there are more than 1000 different mutations in coded genes for LDL-receptor (LDLR) and apolipoprotein (apoB) and the Proprotein Convertase Subtilisin Kexin type 9 (PCSK9) is the cause of (FH) (3) . In such a transformation of the disease-causing mutation , it can be determined by DNA with varying proportions of patients suffering from FH clinical, ranging from 20% to more than 90% with the highest rates of detection in children (4) .

Methods

1. Samples Collections:

The study was conducted for the period from October 2015 to July 2016 in the Central Laboratory in Sulaymaniyah , which collected during this period (213) samples from males and females . The number of males was (99) and the number of females was (114) and their ages ranged from both sexes (30-79 years). Blood samples were obtained from a vein of 10ml in the early morning hours, with some information that belongs to each of them. Blood samples were placed in the test tubes and centrifuged at 3500 rpm for 15 minutes to get Blood Serum where they were placed in a new plastic test tubes. All the information was recorded and the Lipid profile was examined in the central laboratory to measure the total cholesterol and concentration of triglycerides (TG) and (LDL-C) and (HDL-C).

2. Estimation of Cholesterol in Blood

Cholesterol was estimated in serum using several analysis kits of the French company Biolabo . The enzyme method (5) was used in estimating the amount of cholesterol .

3. Estimation of Triglyceride (TG) in Blood

Triglycerides in the serum were estimated using a kit of French company Biolabo analysis on method (6) by using enzymatic method to quantify triglycerides .

4. Estimation of Serum HDL-Cholesterol

HDL-C is estimated in serum using several French company Biolabo kits (7) .

5. Estimation of Serum LDL-Cholesterol

LDL-C is estimated in serum using several analysis kits of French company Biolabo (6).

Result & Discussion

1. Lipid profile:

1.1 - Fats:

Table (1) shows the results of statistical analysis of the concentration level of each (cholesterol, TG) in patients with Hypercholesterolemia compared to healthy, as The of cholesterol has been observed in patients with hypercholesterol amounting to (239.34 ± 6.66 mg ⁄dl) while the mean of the healthy (163.30 ± 3.86 mg ⁄ dl) and this is what agrees with (8) who confirmed high total cholesterol of the hypercholesterolemia patients in Brazil compared with the healthy cholesterol (9). The high level of cholesterol concentration for Iranian patients was also indicated by Hypercholesterol compared to the healthy. Cholesterol is higher than normal when some diseases are infected including atherosclerosis and heart disease (10) and this increase is caused by

nutritional causes which cause high plasma fat concentrations (11). Concentration body fat depends on the balance between the amount of its entry and the process of removing it in stable condition, the metabolism is constant where the condition of anabolism and catabolism is equal (12). When the concentration of cholesterol is very high, daptation process is low so that cholesterol cannot inhibit the process of cholesterol processing in the liver, so the cholesterol taken leads to the deposition of cholesterol esters in the lining of the blood vessels, thereby reducing blood vessels, thus lowering the flow of the blood stream (13). They found that statins (the so-called HMG-COA reductase inhibitor) are commonly used to treat hypercholesterolemia as the diet is ineffective and other substances that can be used to treat the disease such as nicotinic acid and colostramine. Statins can reduce total cholesterol by about 50% in most people and they are also effective in lowering mortality in people who have had previous cardiovascular disease. There is a debate about its effectiveness with those who have hypercholesterolemia without any other health problems (14) .With respect to Triglyceride (TG) , the concentration in patients with hypercholesterolemia was (245.36 ± 8.35 mg / dl) , higher than the healthy concentration of (105.98 ± 2.84 mg / dl) . There was a significant difference between the two groups (Table 1) , (15) and (16) who noted the rise of TG in people with cardiovascular disease, noting that TG are a risk factor and independent of these diseases, and (17) noted the high concentration of TG in patients with compared with healthy patients , Where he saw a significant increase in the cases of patients compared to healthy (7.14) for people with hypercholesterolemia and (16.9) for individuals with hyperglycemia . TG is a great source of energy in the human body and most of them are stored in fatty tissue cells and some of

others are stored in skeletal muscles as well as in plasma (18). The hydrolysis of TG froms the fatty tissue, muscles and plasma which lead to the release of lipid acids to mitochondrial skeletal muscles to complete the oxidation process for the processing of energy for vital events and a fraction of the total energy produced by (TG) in the plasma during the biological activity because the fatty acid degradation is slow (19) and thus deposition of these triglycerides on the walls of the blood vessels (20) .

Table (1): Total concentration of Total cholesterol and Triglyceride (TG) in patients with hypercholesterolemia compared to healthy patients.

Lipid profile	Groups	Mean ± SE	t. value	p.value
Cholesterol mg∕dl	Patients	239.34 ±6.66	-17.315	≤ 0.01
	healthy	163.30 ± 3.86		
Triglyceride mg∕dl	patients	245.36 ± 8.35	-14.293	≤ 0.01
	healthy	105.98 ± 2.84		

1.2- Lipoproteins :

The results of lipoproteins (LDL-C, HDL-C) were shown in table (2) . There is a significant reduction in the concentration level of high-density lipoproteins (HDL-C) for patients with hypercholesterolemia reached (31.97 ± 0.34 mg∕dl) when compared with their level of concentration in healthy individuals (50.60 ± 0.91 mg∕dl) , for High-Density Lipoprotein LDL-C which was significant in the level of concentration in patients with hypercholesterolemia when it reached (162.85 ± 6.70 mg∕dl) compared to the level of concentration of healthy as it reached (88.96 ± 2.25 mg∕dl) . This in agreement with (21) which showed a significant decrease in the concentration of HDL-C when they were found the relationship between fat in

albumin and the vital factors of inflammation for hypertensive patients hypercholesterolemia. While patients with significant elevated LDL-C concentration were significantly higher compared to healthy people. The main function of HDL-C is the reverse transfer of cholesterol from the various tissues of the body to the liver, and the increase in fat is a hindrance to its work in the transport of cholesterol (22) so the reason may drop HDL-C either to the liver disease, Cholesterol, triglycerides and LDL-C in blood plasma (23). Increased concentrations of cholesterol and triglycerides in the tissues and blood vessels impede and reduce the efficiency of HDL-C in the transport of cholesterol (22) .

The increase in the level of LDL-C and LDL-C concentration is due to the increased intake of fat, as the increase in the amount of cholesterol in the food that reaches the liver leads to the LDL-C receptor activity thus aggregates its molecules with high concentrations in the blood, which can filter through the artery wall and collect causing arteriosclerosis . LDL-C is the main carrier of cholesterol from the liver to the peripheral tissue. It has high cholesterol so that its high concentration leads to atherosclerosis (24) . The high concentration of LDL-C was observed in some cases due to increased levels of Oxidized Low Density Lipoprotein LDL-C (OX-LDL-C) and free radicals in patients with hypercholesterolemia and coronary heart disease in LDL-C receptors in the liver (25) , and the increase of free radicals concentrations in the body to break down beta cells pancreatic causing a decrease in the concentration of insulin and the breakdown of fat cells and thus free fatty acids (FFA) that use the liver large amounts of VLDL to increase the concentration of VLDL , which turns into LDL-C , leading to its high concentration which may

be due to serious complications of high hypercholesterolemia, heart disease (26) .

Table (2): concentration of (HDL-C and LDL-C) in patients with hypercholesterolemia compared to healthy.

Lipid profile	Groups	Mean ± SE	t. value	p.value
HDL mg / dl	Patients	31.97 ± 0.34	21.748	≤ 0.01
	healthy	50.60 ± 0.91		
LDL mg / dl	patients	162.85 ± 6.70	-18.665	≤ 0.01
	healthy	88.96 ± 2.25		

2-The Relationship between Coronary Heart Disease and Hypercholesterolemia

Table (3) shows a significant increase in cholesterol and triglyceride in people with heart disease (Coronary Heart Disease) compared with healthy indiviuals , with mean values in patients (233.48 ± 6.66 mg / dl) and (266.36 ± 7.16 mg / dl) , respectively compared to the healthy group, which had a mean value of cholesterol and triglyceride (156.90 ± 4.73 mg / dl) and (105.11 ± 4.89 mg / dl) , which corresponds to (27) they observed that Coronary Heart Disease patients showed a significant increase at the mean level of 0.01. while HDL showed a significant decrease with mean values in patients (30.75 ± 0.76 mg / dl) compared to healthy (49.57 ± 0.85 mg / dl) , while LDL showed a significant increase at the mean level of 0.01 , the mean of patients was (190.44 ± 5.57 mg / dl) compared with the healthy with a mean of (77.65 ± 3.49 mg / dl) as in Table (3) , which corresponds to (28) when they found a significant reduction in HDL compared to the healthy while there was a significant increase in LDL compared to healthy .

Coronary Heart Disease refers to a group of syndromes that show an imbalance between the demand of O2 for the heart muscle and blood supply.

Heart disease is one of the most common diseases of death, as in the United States and Europe, and hypercholesterolemia is one of the most common risk factors for coronary artery disease . Men are more affected than women. When cholesterol and TG are high in blood, cholesterol levels increase in the blood vessels. Over time, these excess fats block and narrow the arteries, thus threatening the amount of blood flow in the body and causing atherosclerosis (29) . The narrowing of the arteries around the heart (coronary artery disease) prevents the intake of sufficient oxygen to the blood, which means increased chances of heart attacks . Atherosclerosis is symptomatic symptoms, which causes a decrease in the amount of blood flow . If there is a decrease in the amount of blood flow in the arteries , the coronary arteries cause chest pain, known as the heart attack, and when the mass of the arteries accumulates on the arteries , the inner cavity of the arteries becomes more coarse and can cause a blood clot in the area (30) .

Table (3) : (Cholesterol, triglyceride, HDL, LDL) and coronary heart disease in patients with hypercholesterolemia compared to healthy .

Lipid profile	Groups	Mean ± SE	t. value	p.value
Cholesterol mg∕dl	Patients	233.48 ± 6.66	8.32	≤ 0.01
	healthy	156.90 ± 4.73		
Triglyceride mg∕dl	patients	266.36 ± 7.16	9.03	≤ 0.01
	healthy	105.11 ± 4.89		
HDL mg∕dl	Patients	30.75 ± 0.76	-4.01	≤ 0.01
	healthy	49.57 ± 0.85		
LDL mg∕dl	patients	190.44 ± 5.57	10.30	≤0.01
	healthy	77.65 ± 3.49		

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فرط كولسترول الدم عامل خطر لأمراض القلب التاجية

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الخلاصة:

فرط كولسترول الدم العائلي Familial Hypercholesterolemia (FH) هو إضطراب وراثي وهو تعبير عن خلل في الجين المسؤول عن إنتاج مستقبل Receptor البروتين الدهني منخفض الكثافة Low – Density – Lipoprotein (LDL-C) . صممت الدراسة الحالية لمرضى فرط كولسترول الدم العائلي (FH) في مدينة السليمانية لكلا الجنسين ، وشملت الدراسة (213) عينة وكان عدد الذكور (99) وعدد الأناث (114) وتراوحت أعمار كلا الجنسين من (30-79) سنة .

أشارت نتائج قياس تركيز كل من (الكولسترول ، الدهون الثلاثية ، البروتينات الدهنية عالية الكثافة HDL-C والبروتينات الدهنية واطئة الكثافة LDL-C) لدى المرضى المصابين بفرط كولسترول الدم ارتفاعاً عالي المعنوية ملحوظاً   (0.01 > P) لًلكولسترول والدهون الثلاثية لدى المرضى مقارنةً بالأصحاء ، في حين أظهرت نتائج البروتينات الدهنية (HDL-C و LDL-C) إنخفاضاً معنوياً كبيراً (0.01 > P) في مستوى تركيز البروتينات الدهنية العالية الكثافة HDL-C لدى مرضى فرط كولسترول الدم مقارنةً بمستوى تركيزه لدى الأصحاء ، أمًا بالنسبة للبروتين الدهني المنخفض الكثافة LDL-C فهو الأخر عالي المعنويةً (0.01 > P) في مستوى تركيزه لدى مرضى فرط كولسترول الدم مقارنة بمستوى تركيزه للاصحاء .

أمًا عن تأثير العامل المرضي على المصابين بفرط كولسترول الدم وهو مرض القلب التاجي coronary heart disease ، فقد أظهرت النتائج وجود زيادة معنوية (0.01 > P) في الكولسترول والكليسيريدات الثلاثية TG و LDL-C مع أنخفاض ملحوظ لتراكيز HDL-C لدى الأشخاص المصابين بأمراض القلب مقارنةً بالأصحاء .

- الكلمات المفتاحية : Lipid profile ، coronary heart disease

البحث مستل من أطروحة الباحث الأول .