Triglyceride and High density lipoprotein Cholesterol ratio in Patients with Acute Coronary Syndrome

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ABSTRACT

Background: Ischemic heart disease remains the first killer and common silent disease in the world. The lipid profile plays the essential role in ischemic heart disease development via atherogenesis process by depositing inside coronary arteries wall with lipid oxidation, which leads to artery narrowing then blockage.

Aim of the study: To estimate the prevalence of triglyceride and high density lipoprotein cholesterol ratio among 100 acute coronary syndrome patients and compared to among a sample of 100 control persons.

Methodology: Blood samples were taken from sample (n=100) of acute coronary syndrome inpatients from coronary care unit, and control (n=100) of non acute coronary syndrome outpatients recorded during the period from 1/7/2013 to 30/11/2013 at Baghdad Teaching Hospital. The patients'age , sex , body mass index , waist circumference, diabetes mellitus, hypertension, smoking, previous history of ischemic heart disease and types of acute coronary syndrome were collected by questionnaire, hospital administration and nursing data in coordination with the department physicians. SPSS version 15 was used as the tool for statistical analysis.

Results: The mean age was 60.7±8.2 years in patients group and 58.3±9.3 years in control, and there were 63 males and 37 females in patients group compared to 64 males and 36 females in control group, P>0.05. The mean waist circumference in male patients was 96.5 ± 12.7cm and in control it was 93.5 ± 8.1cm . Among female patients the waist circumference was 93.3 ± 11.9 cm , compared to 86.6 ± 6.4 cm in control, P>0.05 . The mean body mass index in patients was 27 ± 2.8 kg/m^2 and in control it was 26.7 ± 4.7 kg/m^2, P>0.05. Among patients the smokers were 57 cases while among control they represented 46 smokers , P>0.05. Regarding distribution of risk factors, hypertension , diabetes mellitus and ischemic heart disease were

present in 47, 36 and 32 patients respectively, and it were present in 35, 28 and 21 control, respectively, P>0.05. The prevalence of types of acute coronary syndrome among the patients, 36 had unstable angina, 33 had ST-elevation myocardial infarction and 31 had Non ST-elevation myocardial infarction. The mean high density lipoprotein cholesterol in male and female acute coronary syndrome patients was lower than that of control, it was 37.5 ± 9.4 mg/dl in male patients vs. 48.6 ± 7.3 mg/dl in male control, and 37.1 ± 7.8 mg/dl in female patients vs. 51.1 ± 9.3 mg/dl in female control, P<0.001. The percentage of triglyceride (≥150 mg/dl) in the study was (72%) among acute coronary syndrome patients , and (<150 mg/dl) was (28%) in acute coronary syndrome patients , while in control persons ,triglyceride (≥150 mg/dl) was (30%) , and (<150 mg/dl) was (70%) among control persons. The percentage of High density lipoprotein cholesterol (<40 mg/dl) in male patients was (42%) and (≥ 40 mg/dl) was (21%) , and in female patients (< 50 mg/dl) was (36%) and (≥ 50 mg/dl) was (1%). The mean triglycerides showed a significant differences in different type groups of patients; the unstable angina patients had the lower triglyceride levels than patients with ST-elevation myocardial infarction and non ST-elevation myocardial infarction types, the mean triglyceride was 187.6 ± 62 mg\dl in unstable angina patients , 218.8 ± 63.3 in ST-elevation myocardial infarction patients and it was 219.5± 62.3 in non ST-elevation myocardial infarction patients, P=0.031.The percentage of triglyceride/high density lipoprotein cholesterol ratio (≥5) in acute coronary syndrome patients was 58% , while in control persons was 10%.

Conclusion: Hypertriglyceridemia has been found to be an associated risk factor for the development of acute coronary syndrome. Lower concentrations of serum high density lipoprotein cholesterol, has been found to be an associated risk factor for the development of acute coronary syndrome. The ratio of triglycerides to high density lipoprotein cholesterol was found to be an associated risk factor for the development of acute coronary syndrome. The triglyceride level has showing a difference in different type groups of acute coronary syndrome; the unstable angina cases has the lower triglyceride level than patients with ST-elevation myocardial infarction and non ST-elevation myocardial infarction types .

INTRODUCTION

Background

Ischemic heart disease (IHD) is one of the commonest causes of death in developing and developed world[1]. According to WHO statistics the age-adjusted mortality rates from IHD are one of the highest worldwide [2]. It is projected that IHD will be the leading cause of death in developing countries by the year 2020 [3,4]. One possible explanation is the high prevalence rate of IHD risk factors[5]. Moreover, IHD is the main cause of death in the United States of America among human adults representing approximately one-third of all dead people, who are over the age of 35 years [6].

Ischemic heart disease develops through narrowing of the coronary arteries which leads to death of portion of the heart muscle because of lacking of blood flow that supply oxygen and nutrition, and leads to heart attack. The coronary disease has two characteristics when compared with other organs disease. First, it is very commonly latent, which develops to an advanced stage before the patient notices any symptoms. Secondly, the number of symptoms attributable to heart disease is limited and it is similar to many different pathologies through a final common symptomatic pathway. IHD mortality in North America and Western Europe in the recent decades has been successfully reduced by the treatment, while in contrast, it has increased in Asia and Eastern Europe [7].

Ischemic heart disease development and progression is stimulated by environmental and/or genetic factors . The environmental factors include tobacco use, diabetes mellitus (DM) , and hypertension [8]. In most cases, IHD has a multifactorial genetic basis, involving a number of

genes and environmental factors, which are interacting to determine whether or not the disease will develop as well as its severity [9].

Several biochemical processes participating in IHD development, include lipid and apolipoprotein metabolism, inflammatory response, endothelial function, platelets function, thrombosis, fibrinolysis, and blood pressure regulation [10].

Lipid profile plays the essential role of lipid deposition in artery wall and IHD development, by accumulating the LDL-C inside layers of artery wall, except HDL-C which has beneficial effects for a number of reasons by decreasing lipid oxidation after depositing in blood vessels, leading to retarding IHD development. Moreover, in other observational studies were shown that each 1-mg/dL decrease in plasma HDL-C concentration is associated with a 2% to 3% increased risk of IHD . So, HDL-C is called "good cholesterol" according to its beneficial role in blood vessels by many mechanisms to prevent LDL-C from depositing on blood arteries, while LDL-C is called "bad cholesterol" due to its accumulation inside arteries [11].Unfortunately, systematically documented data on IHD prevalence, incidence and rate of cardiovascular risk factors in developing countries are scarce [12,13] .

Kumar et al [14] observed significantly higher total cholesterol (TC) and triglyceride (TG) levels and lower high-density lipoprotein cholesterol (HDL-C) levels in AMI patients. The risk of AMI was associated with a decrease in HDL-C, in both Asians and non-Asians [15]. Lower concentrations of serum HDL-C (less than 40mg/dl in men & less than 50mg/dl in women) and higher serum TG (TG $\geq$ 150 mg/dL) were found to be an independent risk factors for the development of coronary artery disease, whereas a low TG - high HDL-C level (TG $\leq$ 97 mg/dL) and (HDL-C $\geq$ 57 mg/dL) is associated with a low risk[16-21].Large prospective epidemiological studies such as the Framingham heart study in the United States &the PROCAM study in the Europe have found that low HDL-C is independently associated with increased risk for coronary artery disease [22].

The most common lipid abnormalities in patients with DM are an elevation in total plasma triglycerides (TG) mainly very low density lipoprotein (VLDL) and reduction in HDL-C [23-26].

Randomized controlled trials have demonstrated that lipid-lowering therapy improves all-cause mortality and morbidity in patients with risk factors for, and with established, IHD [29–31]. However, many patients still develop atherosclerotic complications despite being on lipid-lowering therapy and/or having target low lipid profiles. In randomized trials involving patients with IHD, major adverse cardiac events (MACE) were noted in 8–22% of patients on lipid-lowering therapy despite achieving target lipid levels [29–37].The management of dyslipidemia after myocardial infarction is an important aspect of post-myocardial infarction care [38].

The role of lipids and lipoproteins as important risk factors of ischemic heart disease (IHD) is well established. Plasma triglycerides and high-density lipoprotein cholesterol are two other lipid variables that over the years have attracted attention in cardiovascular epidemiology. Recently, much more attention has been paid to the relationship between triglycerides, HDL-C, and risk of IHD because the combined lipid profile of a high fasting triglyceride level and a low HDL-C level is the characteristic dyslipidemia in the metabolic syndrome X. Fasting hypertriglyceridemia is a strong risk factor of IHD independent of other major risk factors of IHD, and that the combined lipid profile of a high fasting triglyceride level and a low HDL-C level, the characteristic dyslipidemia in the metabolic syndrome X, is a very strong and important risk factor of IHD, at least as strong and important as a high LDL-C level [39].

REVIEW OF LITERATURE

Ischemic heart disease (IHD) is a branch of coronary vascular disease (CVD) and a common form of heart disease. It is considered insidious and dangerous disease in the world, and the major source of morbidity and mortality in developed world [40]. However, during the past 40 years, there had been an increasing awareness to evaluate the IHD risk factor in asymptomatic individuals [41].

Ischemic heart disease development is characterized by hard LDL-cholesterol (plaques) which are adiposities in the arterial wall of coronary with developing the buildup of blockage , leading to heart attack, ischemic condition, or suddenly death. Two coronaries arise from the aorta, which is adjacent to the heart. The plaques can cause a tiny initial clot to form , which can obstruct the blood flow to the heart muscle (as shown in fig.1). The presentation of IHD include: cardiac pain: chest, throat, arms, epigastrium or back, nausea and vomiting, collapse /syncope, anxiety and fear of impending death [42] .

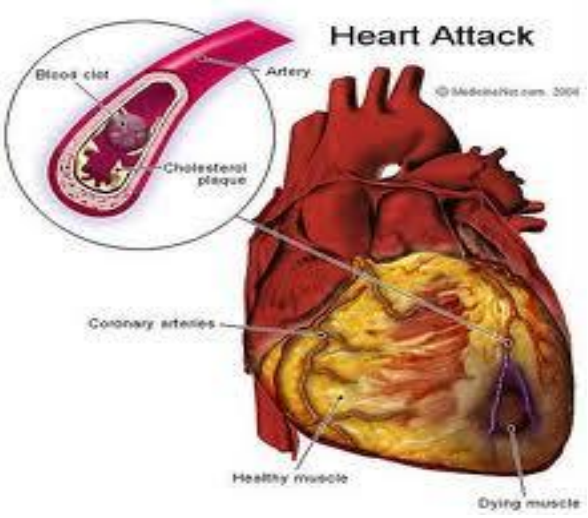


Fig. 1 Coronary arteries and veins [43]

1. Ischemic heart disease development :

1.1 Atherosclerosis "Arteriosclerosis": Atherosclerosis word is of Greek origin and literally means gradual focal buildup and accumulation of lipid and fibrous tissue in plaques in the wall of arteries . Coronary artery atherosclerosis refers to the presence of atherosclerotic changes within the walls of the coronary arteries, it causes impairment or obstruction of normal blood flow with produced myocardial ischemia [44].

Atherosclerosis is initiate mostly from mixture of cholesterol, lipids, calcium, fibrous tissue such as collagen, and other waste products, which are depositing in the layers of the arteries .Buildup of fatty plaque called atherosclerosis [45] (Fig. 2).

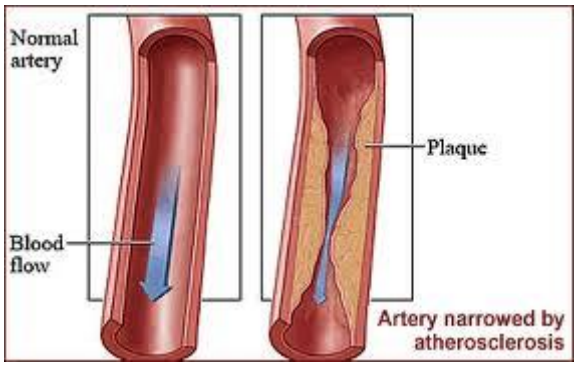


Fig. 2 The difference between normal and narrowing artery [45]

Atherosclerosis developed by a multifactorial from genetics and environmental factors that play a role in the pathophysiology of the disease. On the other side, the environmental factors such as cigarette smoking, arterial hypertension and dietary cholesterol consumption are associated with an increased risk of IHD. In addition, the atherosclerosis more related to lipid profile such as cholesterol, triglyceride, HDL-C and LDL-C depending on several epidemiological and genetic studies were confirmed the association between elevated HDL-C level and protection against atherogenesis . Therefore, the process of lipid deposition in the wall of blood vessels called atherogenesis [46] .

1.2 Atherogenesis: is a process of arterial narrowing with atherosclerotic plaque development, whereas the accumulation of plaque in an artery wall is a chronic disease that begins early in life [10].

2. Risk factors of ischemic heart disease:

2.1 Modifiable IHD risk factors:

a. Hypertension: is defined as a systolic blood pressure in excess of 140 mmHg or a diastolic blood pressure above 90 mmHg . Uncontrolled high blood pressure can result in hardening and thickening of the coronary arteries, narrowing the channel through which blood can flow. In addition, it was indicated that the elderly are particularly predisposed to hypertension, with up to 75% of people over 75 years of age qualifying for IHD diagnosis. There appears to be an approximately linear relation between blood pressure elevation and increased the incidence of

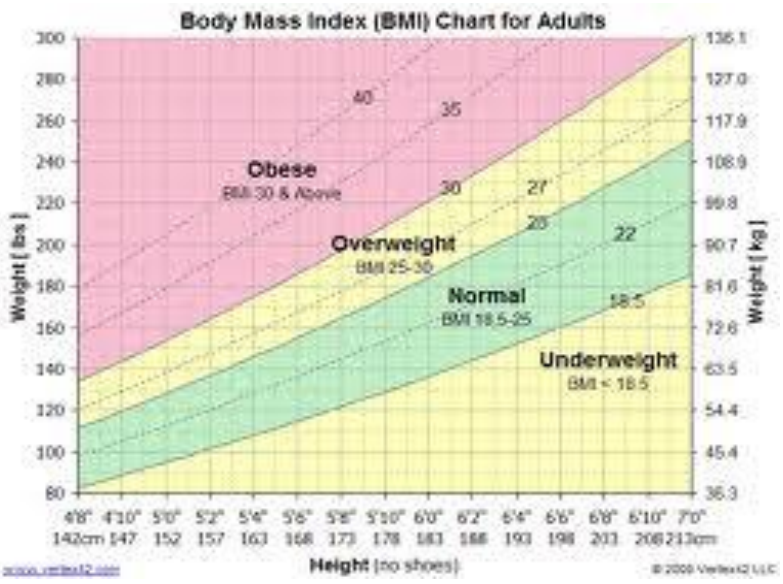
atherosclerotic vascular disease [47]. Therefore , the hypertension considers the main risk factor of IHD development in many populations [48].

b. Hypercholesterolemia : defined as an increased in serum cholesterol level due to environmental or genetic factor. Many previous studies indicated that the prime causative and actual factor of the heart disease is high cholesterol level[49]. The association between lipid profiles and IHD development is determining via cholesterol levels . The cholesterol is the essential player of lipid profiles in atherogenesis process of IHD progressive, which is the main IHD indicator and IHD monitor. However, the hypercholesterolemia reported to be strongly associated with enhancing oxidative stress, via increased lipid peroxidation and tends to increase the susceptibility of LDL-C to oxidation [50]. The genetic relation is considered as one of risk factors, however the presence of genetic factor such as familial hypercholesterolemia (FH) is the first entity directly associated with the development of premature atherosclerosis and IHD [8].

C. Cigarette smoking: Cigarette smoke contains over 4,000 known components, which is considering one of the main risk factors of IHD development in the most of population. Many studies observed the presence of a strong association with the cigarette smoking and many other diseases, the cigarette smoking more linked to heart diseases. The nicotine constricts blood vessels, and carbon monoxide (CO) can damage their inner lining, making them more susceptible to atherosclerosis. However in both animal and human models, several studies have demonstrated that the cigarette smoking exposure were associated with a decrease in vasodilatory function . Cigarette smoking could promote atherosclerosis, in part , by its effects on lipid profile. Smokers have significantly higher serum cholesterol, triglyceride, and LDL-C levels, but HDL-C is lowering in smokers than in nonsmokers [51]. It was estimated that the smoking increases atherosclerotic disease by 50% and doubles the incidence of IHD [52, 53].

d. Diabetes mellitus (DM): is defined as an increased of blood glucose level (hyperglycemia). Recent and previous studies observed the presence of a strong association between IHD development and DM,

therefore the DM is consider one of the main risk factor of IHD development [54]. In DM patients the risk of coronary atherosclerosis are elevated three- to five fold greater than in non diabetics despite controlling for other risk factors [55].



e. Body mass index (BMI) : The body mass index is a key index measurement for relating a person's body weight to their height . It had been used by the World Health Organization (WHO) as the standard for recording obesity statistics since the early 1980s [56]. Body mass index is a statistical measurement that compares a person's weight and height, though it does no actually measure the percentage of body fat, but it is a useful tool to estimate a healthy body weight based on how tall a person is . Due to its ease of measurement and calculation, this is the most widely used diagnostic tool to identify weight problem . Body mass index was defined as the individual's body weight divided by the square of his height . While the calculation of BMI equation is by dividing the person's weight (in kilograms) at their height (in meters squared) , and the formulas universally used in medicine produce a unit of measure of kg/m^2 [50]. BMI can also be determined by using a BMI chart (fig. 3) [57] .

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$$\text{BMI}= \frac{weight(kg)}{height^2(m^2)}$$

Fig. 3 BMI chart (57)

The overweight was defined as BMI 25-30 kg/m^2 for males and females but the obesity was defined as BMI ≥ 30 kg/m^2 [(7)].

2.2 Non modifiable IHD risk Factors :

a. Age: is among the most important risk factors for predicting incident cardiovascular disease . Based on previous experience studies in the United States the average risk of developing cardiovascular disease for a 30-34 years old male is 3%, this number raises some seven fold to 21% for a comparable individual aged 60-64 years [(58)]. The exact importance of age-related risk compared with other cardiovascular disease risk factors illustrated by the Framingham Heart Study that has resulted in a 14-point scoring system to predict incident 10-year cardiovascular disease . In this system, the increasing risk characterized by a higher score, up to 7 points can be attributed to age alone [(8)]. In addition, the cumulative risk for IHD in males by age 70 years is 35% and by age 90 years is 49% . While the women typically develop IHD about 10 years later than men with a cumulative risk of 24% and 32% by ages 70 and 90 years , respectively. Therefore they considered a disease of advancing age is approximately 15% of cases are diagnosed before age 65 years . In addition , the individuals with genetic predisposition to atherosclerosis are at the greatest risk for developing IHD , especially at early ages [(10)].

b. Family history of early heart disease: The premature IHD is known to have a particularly strong genetic component. Previous data suggested that the genetic factors are more likely to affect young rather than old people [(9)].

c. Gender or sex; is important risk factor in incidence of IHD and many studies noted difference between male and female in IHD distribution among population. Also the distribution differs from population to other. However, numerous observational studies have indicated that males exhibit excess risk for cardiovascular disease compared with age-matched women[59] . A woman´s risk rises once she enters menopause, this speculation depends on estrogens hormone, and will offer a protective effecting role to women body system , and cardiovascular disease accelerates in women after menopause [60]. The strength of the relationship between low HDL-C levels and increased IHD risk also is significant in elderly individuals and may be greater in women than in men . Alternatively, some of this apparent protection could be due to the fact, that women exhibit relatively higher concentrations of HDL-C than do age-matched men [8].

3. The association of Lipid profile with ischemic heart disease development :

The elevated levels of serum total cholesterol, triglyceride and LDL-C and low levels of HDL-C is called dyslipidaemia , and it is a major risk factor for IHD . However all the components are associated with increased incidence of IHD [61]. Lipid profile (Cholesterol, Triglyceride, and LDL-C) are the essential players compounds in IHD developments , except HDL-C which retards IHD development According to other studies of lipid profile with IHD relationship, multiple epidemiologic studies have established a low level of HDL-C as an independent risk factor for IHD [62]. Moreover, Framingham Heart Study reported 43% to 44% of coronary events occurred in persons with HDL-C levels less than 40 mg/dL [61]. In addition the risk of IHD was approximately doubled with either TGs >200 mg/dl or HDL-C <40 mg/dl . Moreover , the presence of both was associated with a four-fold increase in risk .The high prevalence of familial TG elevations among premature IHD patients further illustrates the importance of hypertriglyceridemia as a IHD risk factor [48].

Another much recently observational study from Jordan kingdom referred that the chronic IHD patients had higher TG and lower HDL-C levels

compared with those without IHD, also it was founded those IHD patients had significantly higher TG and total cholesterol, and lower HDL-C levels than individuals with no IHD . In addition it was reported that the high levels of serum cholesterol and TG were present in at least half of the participants, however only one fifth of IHD patients had hypercholesterolemia, and about half of them had elevated TG [61] .

3.1 Lipid profile and atherogenesis :

The lipids and other fats circulate in the blood via forming lipoproteins particles found in plasma transport lipids including cholesterol, spherical particles with ahydrophobic core contains TG and esterified cholesterol, and apolipoproteins on the surface which consist of : Large: apoB (B-48 and B-100) atherogenic , Smaller: apoA, apoC-II, and apoE , classified based on density and electrophoretic mobility: very low density lipoprotein (VLDL); low density lipoprotein (LDL); Intermediate Density Lipoprotein (IDL); high density lipoprotein(HDL); Lipoprotein-a). Lipid profile consists of cholesterol, LDL, IDL and TG which are the essential players compounds in IHD development forward steps, except HDL which is retarding and inhibit IHD development , by many mechanisms of action [63] (Fig. 4) .

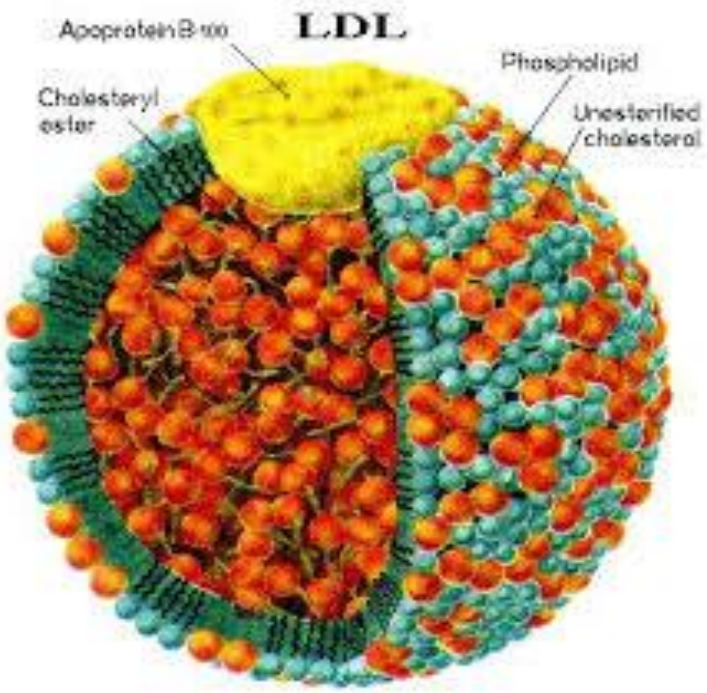

Fig. 4 Low density lipoprotein Composition (64)

a. Total cholesterol (TC) :

The cholesterol compound provided by external source via food intake or internal source via synthesized it in hepatocytes. The cholesterol compound is water-insoluble. Cholesterol is found in every cell wall in the body and plays a critical role in maintaining cell integrity, without it the cells would not be able to maintain their spherical shape. In addition, many hormones inside the body made from cholesterol . Moreover , it is considered the main source to synthesize HDL, LDL, IDL and VLDL-C (63) .

b. High density lipoprotein, low density lipoprotein and very low density lipoprotein :

Low density lipoprotein and high density lipoprotein play the major role in atherogenesis process development or inhibition. It was found that the

oxidized low density lipoprotein (oxLDL) have various biological effects on vessel walls, including stimulation of cytokine production, inhibition of endothelial cell vasodilator function, and stimulation of growth factor production, as well as providing mechanistic links between lipoproteins and the cell biology of atherosclerosis. These observations raise the more general possibility that abnormalities of the oxidation-reduction state in the vessel wall may be an important pathogenic mechanism in atherosclerosis, which lead to start the atherogenesis process in layers of vessel wall. Therefore, LDL-C is called the bad cholesterol [(50)]. In contrast, HDL-C has a reverse relation with IHD development, which is acting as a mop to extract excess cholesterol deposited in blood vessel walls and delivering it back to liver for elimination through gastrointestinal tract, via many of metabolic pathways [(48)]. The Framingham Heart Study observed that the individuals with HDL-C concentrations of ≥ 60mg/dL are protected against the development of IHD even in the presence of elevated serum LDL-C levels[(46)]. In addition low HDL-C and high TG were recognized as independent risk factors of IHD . Therefore, HDL-C is called the good cholesterol [(61)].

c. Triglyceride (TG) :

Triglyceride is a member of chylomicron compounds that sharing in buildup LDL and HDL-C. Several lines of evidence suggest that the association of plasma TGs with IHD is complex, however despite this consensus, uncertainty persists regarding the strength and independence of plasma TGs as a IHD risk factor. In European studies elevation of plasma TG concentration become increasingly established as an independent risk factor for premature IHD. The study of Prospective Cardiovascular Munster (PROCAM) reported that the IHD risk increased proportionately with TGs up to 800 mg/dl. The risk is associated with TGs >200 mg/dl and was dependent on concomitant low HDL or elevated LDL to HDL ratio [(48)].

Aim of the study

This study aimed to assess the prevalence of triglyceride and high density lipoprotein cholesterol ratio among 100 patients of acute coronary syndrome compared with 100 control persons.

Patients and methods

Methods

Study design:

We conducted a cross-sectional study in which we analyzed data from random sample between July 2013 to November 2013. This study was conducted on 100 ACS patients admitted to the Coronary Care Unit (CCU) with admission diagnosis of ACS, who had their lipid profile measured within 24 hours of hospital admission after fasting for 12 hours. Patients whose lipid profiles were measured beyond 24 hours of hospital admission were excluded because the validity of the plasma lipid levels measured beyond 24 hours from the onset of acute coronary syndrome has been questioned [21–26]. Exclusion criteria: hypothyroid patients, renal disorder (nephrotic syndrome), liver diseases (hepatitis), alcoholic patients, patients on lipid lowering agents and steroid drugs. Patients were classified into: STEMI (ST-elevated myocardial infarction, n = 33) NSTEMI (non-ST-elevated myocardial infarction, n = 31) and UA (unstable angina, n = 36), we also included 100 person controls for comparison. UA is defined as angina pectoris or equivalent ischemic chest discomfort with at least one of three features: (1) it occurs at rest (or with minimal exertion), usually lasting >10 minutes; (2) it is severe and of new onset (i.e., within the prior 4–6 weeks); and/or (3) it occurs with a crescendo pattern (i.e., distinctly more severe, prolonged, or frequent than previously). The diagnosis of NSTEMI is established if a patient with the clinical features of UA develops evidence of myocardial necrosis, as reflected by elevated cardiac biomarkers. Patients with STEMI were diagnosed on the basis of the following criteria: (i) continuous chest pain upon presentation, refractory to nitrates, and lasting 30 minutes; (ii) ST-segment elevation of 0.2 mV in 2 contiguous precordial leads, or 0.1 mV in 2 contiguous limb leads, or new left bundle branch block

on admission electrocardiogram; (iii) Elevated cardiac biomarker : *cardiac-specific troponin I* (cTnI).

Sample size and study population:

One hundred patients with acute coronary syndrome and one hundred persons without acute coronary syndrome (control) .

Anthropometric measurements:

We assessed weight and height while the individuals were wearing light clothes, the blood pressure by using mercury sphygmomanometer in both arms, the patient should be relaxed in supine position and arm at the level of the heart. We calculated BMI using the formula: wt (kg)/ht^2(m^2) . The waist circumference was measured using a non-stretchable fiber measuring tape. The subject were asked to stand erect in a relaxed position with both feet together in a flat surface, those patients who couldn't stand, the measurement of waist circumference was done for them in supine position . Waist girth was measured at midpoint between the lower costal margin and the top of the iliac crest at the end of exhalation.

Laboratory analysis:

Venous blood in a fasting state at least 12 hours (overnight) was extracted using a vacutainer in a plan tube for plasma triglyceride (TG), and high density lipoprotein cholesterol (HDL-C) . TG above 150 mg/dl was considered high and HDL-C values below 40 mg /dl for men & below 50 mg/dl for women was considered low according to the latest Adult Treatment Panel (ATP) III. The levels of serum triglycerides and high density lipoprotein cholesterol were analyzed using an Autoanalyzer (Roche, Germany). The measurement were done by enzymatic determination of TG

and HDL-C levels in the serum by using Kits manufactured by Human Laboratories Germany.

Statistical analysis:

By using SPSS (statistical package for social sciences) software for windows, data of studied groups (cases and controls) were entered and analyzed with appropriate statistical tests according to the types and distribution of variables.

Descriptive statistics were presented as frequencies (numbers), proportions (%s), mean and standard deviation (SD).

Chi square test was used to compare frequencies or proportions of each variable in between patients and control. Students' test (independent 2 sample test) was used to compare two means of a continuous variable in between patients and control. ANOVA test was used to compare more than two means.

Level of significance P value ≤ 0.05 considered as significant difference and $P \leq 0.01$ considered as highly significant.

The results were summarized and presented in tables and figures with an explanatory paragraph for each table or figure.

Results:

There were 100 patients with ACS, and 100 control persons enrolled in this study, the demographic characteristics of studied groups were summarized in table 1

1. Age and Sex distribution:

There were 63 males and 37 females in patients group compared to 64 males and 36 females in control group. The mean age was 60.7±8.2 years in patients and 58.3±9.3 years in control. No statistically significant differences had been found in between patients and control neither in age or in sex distribution, in both comparisons $P > 0.05$.

2. Waist circumference and BMI Distribution:

The mean waist circumference in male patients was 96.5 ± 12.7 cm and in control it was 93.5 ± 8.1cm. Among female patients the waist circumference was 93.3 ± 11.9 cm compared to 86.6 ± 6.4 cm in control. However, the differences was statistically not significant, $P>0.05$, in both sexes. The BMI distribution also showed no statistically significant differences in between both studied groups, $P > 0.05$.

3. Smoking:

Among patients the smokers were 57 patients while among control they represented 46 persons, with no statistically significant difference, P>0.05.

Table 1. Demographic characteristics of study groups

Variable		**Cases**		**Control**		***P***
		No.	**%**	**No.**	**%**	
Sex	Male	63	63.0	64	64.0	0.88
	Female	37	37.0	36	36.0	
Age (years)	40-49	13	13.0	19	19.0	0.65
	50-59	36	36.0	31	31.0	
	60-69	34	34.0	35	35.0	
	≥ 70	17	17.0	15	15.0	
	Mean ±SD	**60.7 ± 8.2**		**58.3 ± 9.3**		0.52
	Range	**46 - 75**		**41 - 73**		
Mean waist circumference (cm)	Male	**96.5 ± 12.7**		**93.5 ± 8.1**		0.27
	Female	**93.3 ± 11.9**		**86.6 ± 6.4**		0.12
BMI (kg\m^2)	< 25	20	20.0	24	24.0	0.53

	25 – 29.9	46	46.0	49	49.0	
	≥ 30	34	34.0	27	27.0	
	Mean ±SD	**27.4 ± 2.8**		**26. 7± 4.7**		0.38
Smoking	Yes	57	57.0	46	46.0	0.12
	No	43	43.0	54	54.0	

4. History of chronic diseases:

History of Hypertension, DM and IHD was positive in 47, 36 and 32 patients respectively, and it was positive in 35, 28 and 21 control, respectively as shown in table 2. No statistically significant difference in between patients and control had been found regarding the frequencies of positive history of chronic diseases, in all comparison P>0.05.

Table 2. Frequency Distribution of history of chronic diseases among studied groups.

History		Cases		Control		Total		*P*
		N	%	N	%	N	%	
Hypertension	**Positive**	**47**	**47.0**	**35**	**35.0**	**82**	**41.0**	0.14
	Negative	53	53.0	65	65.0	118	59.0	
Diabetes	**Positive**	**36**	**36.0**	**28**	**28.0**	**64**	**32.0**	0.29

	Negative	64	64.0	72	72.0	136	68.0	
IHD	**Positive**	**32**	**32.0**	**21**	**21.0**	**53**	**26.5**	0.11
	Negative	68	68.0	79	79.0	147	73.5	

5. Types of ACS:

The distribution of types of ACS is shown in figure 5, among the patients with ACS, 36 had UA, 33 had STEMI and 31 had NSTEMI.

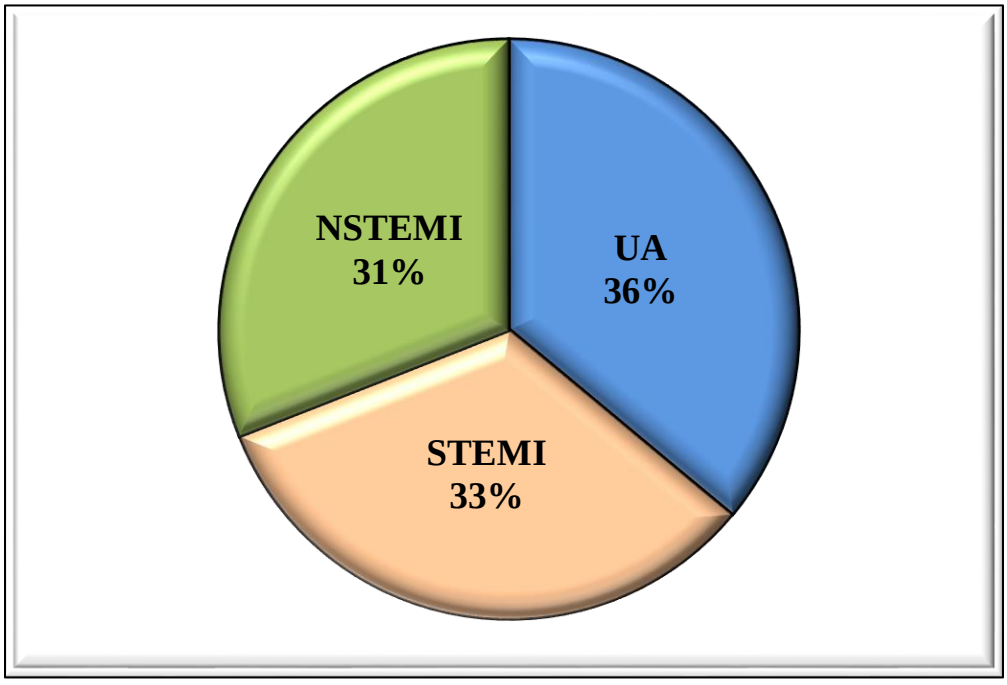

Figure 5. Distribution of Types of acute coronary syndrome in 100 patients with acute coronary syndrome .

6. Comparison of mean HDL-C and TG in between study groups:

With highly significant difference, the mean HDL-C in male and female ACS patients was lower than that of control, it was 37.5 ± 9.4 in male patients vs. 48.6 ± 7.3 in male control, and 37.1 ± 7.8 in female patients vs. 51.1 ± 9.3 in female control , in both comparison P<0.001. The mean triglycerides level in patients group was highly significant higher than that in control group; 207.8 ± 64.7 vs. 131.9 ± 39.1 mg\dl, respectively, P<0.001 as shown in table 3 .

Table 3. Comparison of mean high density lipoprotein cholesterol (according to sex) and triglyceride in between study groups.

Variable		Cases	Control	*P*
		Mean ± SD	Mean + SD	
HDL (mg\dl)	Male	37.5 ± 9.4	48.6 ± 7.3	<0.001 *(hs)*
	Female	37.1 ± 7.8	51.1 ± 9.3	<0.001 *(hs)*

Triglycerides (mg\dl)	207.8 ± 64.7	131.9 ± 39.1	<0.001 *(hs)*
hs = highly significant.			

7. **Distribution of HDL-C categories in patients and control according to gender:**

With highly significant difference, the percentages of HDL-C < 40 mg/dl in male and < 50 mg/dl in female ACS patients (42%,36%) were higher than that of control (8%,16%) respectively, and the percentages of HDL-C ≥ 40 mg/dl in male and ≥ 50 mg/dl in female control (56%,20%) were higher than that of patients (21%,1%) respectively, as shown in figure 6 .

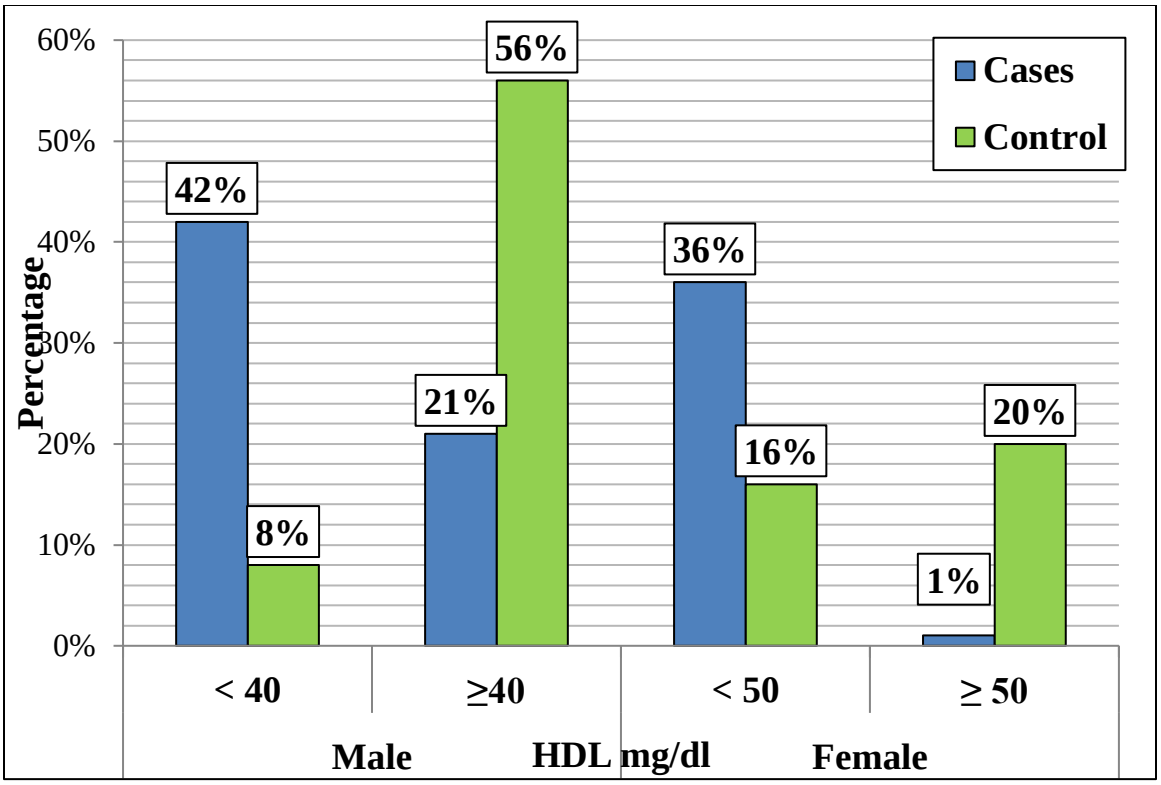

Figure 6. Distribution of high density lipoprotein cholesterol categories in patients and control according to gender.

8. **Distribution of triglyceride categories among study groups:**

With highly significant difference, the percentages of triglyceride ≥ 150 mg/dl in male and female ACS patients were higher than that of control (72%,30%) respeptively , and the percentages of triglyceride < 150 mg/dl in male and female control were higher than that of patients (70%,28%) respectively , as shown in figure 7.

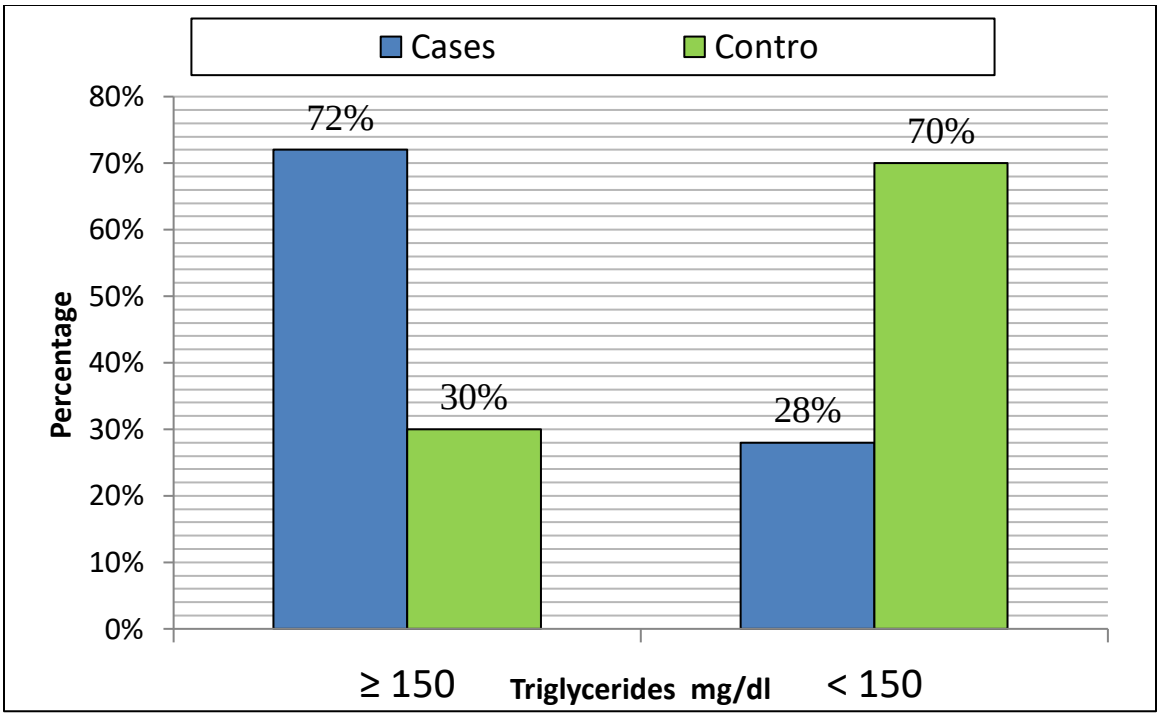

Figure 7. Distribution of triglyceride categories among study groups .

9. Comparison of mean HDL-C and TG of ACS patients according to the types of ACS:

By using the analysis of variances (ANOVA) test to compare the mean HDL-C and TG in ACS patients with different ACS types, no statistically significant difference had been found in mean HDL-C of patients of different types of ACS, in both sexes, P>0.05 as shown in table 4.

The mean triglycerides showed a significant differences in different type groups of patients; the unstable angina cases had the lower TG levels than patients with STEMI and NSTEMI types, the mean TG was 187.6 ± 62

mg\dl in unstable angina patients , 218.8 ± 63.3 in STEMI patients and it was 219.5± 62.3in NSTEMI patients, P=0.031.

Table 4. Comparison in mean high density lipoprotein cholesterol (according to sex) and triglyceride according to the types of ACS .

Parameter		**UA**	**STEMI**	**NSTEMI**	***P***
HDL-C	Male	37.9 ± 9.4	37.7 ± 10.4	36.5 ± 8.0	0.91
	Female	39.1 ± 7.1	36.3 ± 8.7	36.0 ± 8.7	0.60
Triglycerides		187.6 ± 62	218.8 ± 63.3	219.5± 62.3	0.031

10. Comparison of TG/HDL-C ratio between studied groups :

It had been significantly found that ACS patients had higher TG/HDL-C ratio than control; the mean ratio was 6.1 ± 2.3 vs. 2.8 ± 12 respectively. From other point of view 42 (42%) ACS patients had TG/HDL-C ratio of < 5, compared to 90 (90%) control while the ratio of ≥ 5 was found in 58 patients (58%) and only 10 (10%) control, (P value = 0.001) as shown in table 5.

Table 5. Comparison of triglyceride/ high density lipoprotein cholesterol ratio between studied groups .

TG/HDL-C ratio	Cases		Control		Total		P.value
	n	%	n	%	n	%	
< 5	42	42.0	90	90.0	132	66.0	0.001
≥ 5	58	58.0	10	10.0	68	34.0	
Total	100	100.0	100	100.0	200	100.0	
Mean ± SD	6.1 ± 2.3		2.8 ± 1.2		4.5 ± 1.8		0.001

Discussion

In this study, the reference values for optimal and high levels of serum lipid profile based on the world studies as follows; National Cholesterol Education Program (NCEP) Adult Treatment Panel III detected the optimal serum TG level <150 mg/dL, borderline TG high level 150-199 mg/dL and high TG level >199 mg/d . Moreover, the optimal serum HDL-C level ≥ 40 mg/dL for male and ≥50 mg/dL for female. These same values were used in regional studies such as at Jordan[60],Islamic Republic of Iran (Tehran) [6],

and (Qazvin) [7],the epidemiological study of Arab women at Jerusalem of Palestine and Jewish women of Israel[65] , Islamic Republic of Iran (Isfahan) [67], Saudi Arabia[69,70] and Gaza study[73] .

In this study, it was found that the sex risk factor distribution of male and female in ACS was (63%, 37%) and (64%, 36%) in control respectively, no statistically significant differences had been found in between patients and control in sex distribution, in both comparison P>0.05, not similar to Qazvin population [7], the percentage of ACS in male and female was (50.2%,49.8%), (41%,59%) inTehran studies [6], and Jordanian study (78.3%, 21.7%) [60] respectively .

In the current study the mean age of ACS patients was (60.7±8.2) years similar to that in Gaza study (57.27±12.78) years and not similar to Tehran study [6] (54±12) years . The mean age of control was (58.3±9.3) years, no statistically significant differences had been found in between patients and control in age distribution, in both comparison P>0.05. Also it was observed that in the different age groups , that most ACS patients were categorized in the middle group (50-69) years to be 70% among three groups. Tehran study reported that the prevalence of probable ACS patient sexes was different between the age groups between males and females of each group and present a significant differences [6]. Also in other regional studies [7,60,65] there was a difference between age groups of both sex. The comparison of age groups of this study with other studies are difficult, because there were no limited age groups in the most studies, as referred in the Arabic and Jewish study [65].

In the current study, it was observed that the mean of BMI was (27.4±2.8 kg/m^2), which is similar to Gaza study ((28.7±60 kg/m2) , Tehran study [6] (28.2±4.6 kg/m^2), Qazvin study (27.5±90 kg/m^2) [7] and Jordan study (27.5±50 kg/m2) [60]. The BMI distribution also showed no statistically significant differences in between both studied groups, the total mean of BMI in patients was (27.4 ± 2.8 kg/m^2) , and (26. 7± 4.7 kg/m^2) in control, in both comparison P>0.05.

In the current study, the mean waist circumference in male patients was 96.5 ± 12.7 cm and in control it was 93.5 ± 8.1 cm . Among female patients the waist circumference was 93.3 ± 11.9 cm compared to 86.6 ± 6.4 cm in control. However, the differences was statistically not significant, P>0.05, in both sexes.

The prevalence of cigarettes smokers as risk factor was 57.0%, which is higher than (28.0%) in Jordanian study [60], (26.0%) in Jewish[65] , (21.0%) in Palestinian women [65] and (16.1%) in Qazvin study [7], but less than (88.0%) inTehran study[6]. However in this study no significant difference was found between smokers and non smokers regarding the prevalence of IHD (P =0.12). Depending on other studies of non-smokers, we considered the persons reported regular smoking in the prior of 6 months as current smokers [51]. Also we observed the distribution of cigarettes smokers of IHD patients were higher than non smokers .

The prevalence of hypertension as arisk factor was 47.0 % higher than that in Tehran study (38.0%) [6]. Also we observed the distribution of hypertensive patients in ACS patients (47.0%) was lower than non hypertensive ACS patients (53%) .

The prevalence of diabetic patients as risk factor was (36.0%) less than (51.0%) in Jordanian study [60] but more than (13.0%) in Qazvin study[7]. Also we observed the distribution of diabetic patients in ACS patients (36.0%) was lower than non diabetic ACS patients (64.0%) .

The prevalence of history of IHD among patients was (32.0%) and control (21.0%) which is lower among patients with no history of IHD ,(68.0%) in patients and (79.0%) in control .

The prevalence of types of ACS among the patients were 36 patients had UA, 33 patients had STEMI and 31 patients had NSTEMI .

The prevalence of the TG (≥150mg/dl) in this study as risk factor was 72% which was higher than Qazvin study (53.5%) [7] and Jordan study (55%) [60].

Moreover, the mean triglycerides level in patients group was highly significant higher than that in control group; 207.8 ± 64.7 vs. 131.9 ± 39.1 mg\dl, respectively, P<0.001, and is nearly similar to that (176 mg/dl) of Jordan study [60] and not similar to Gaza study [73] (146 mg/dl).

Therefore, the TG is considered important to predict the risk for the development of IHD [66].Only one published study, which found a strong and independent relationship between TGs, and IHD, while In contrast, most other studies have failed to demonstrate a strong independent association [48].

The triglyceride level in this study showed a significant differences in different types of ACS; the unstable angina patients had the lower TG levels than patients with STEMI and NSTEMI types, the mean TG was 187.6 ± 62 mg/dl in unstable angina patients , 218.8 ± 63.3 mg/dl in STEMI patients and it was 219.5± 62.3 mg/dl in NSTEMI patients .

The prevalence of serum HDL-C (<40 mg/dl) in men and (<50 mg/dl) in women as risk factor was (46% and 36%) respectively, which is lower than (62% men and 47% women) in Qazvin study [7] ,Tehran study [6] and the Islamic Republic of Iran study[67] (57% men and 47% women) , and it is lower than (54%) of men in Jordan study and higher than (27%) of women in Jordan study[60], while it is higher than that in Saudi Arabia (28%) of both sexes [69,70] and the United States of America (18% in men and 6% in women) [71]. The Lower HDL-C level and high TG level are recognized as independent coronary risk factors, and these may potentially play a more important role in the pathogenesis of atherosclerosis in this region of the world than hypercholesterolemia [60].

This study, observed that the mean of serum HDL-C in ACS patients was (37.5 ± 9.4 mg/dl in men and 37.1 ± 7.8 mg/dl in women), which is not similar to the study conducted in the Islamic Republic of Iran study[67] (34.5 mg/dL in men and 39.0 mg/dL in women), and lower than those in some European Mediterranean countries (46.2 mg/dl in Italy, 46.6 mg/dl in Spain and 51.1 mg/dL in France) of both sexes [68] and also lower than in Jordan study[60] (39.0 mg/dl in men and 46.5 mg/dl in women) .

The mean HDL-C of both sexes in this study showed no significant differences in different types of ACS; the mean HDL-C in men was (37.9 ± 9.4 mg\dl) and women (39.1 ± 7.1mg/dl) in unstable angina patients ; in STEMI patients it was (37.7 ± 10.4 mg/dl)in men and (36.3 ± 8.7 mg/dl) in women , and in NSTEMI patients it was (36.5 ± 8.0 mg/dl) in men and (36.0 ± 8.7 mg/dl) in women patients.

The mean of triglyceride to HDL-C ratio as risk factor indicator was (6.1 ± 2.3) , which is higher than (5.4) in South India study [72], and (4.7) in Tehran study [6]. The prevalence of total triglyceride to HDL-C ratio in patients (≥ 5) was 58.0% and among control 10.0% . Therefore and according to these results, the triglyceride to HDL-C ratio is associated as a risk factor for the development of ischemic heart disease.

Conclusion

1. Hypertriglyceridemia has been found to be an associated risk factor for the development of acute coronary syndrome.
2. Lower concentrations of serum high density lipoprotein cholesterol has been found to be an associated risk factor for the development of acute coronary syndrome.
3. The ratio of triglycerides to high density lipoprotein cholesterol was found to be an associated risk factor for the development of acute coronary syndrome.
4. The triglyceride level was significantly different in different groups of acute coronary syndrome; the unstable angina patients have the lower triglyceride level than patients with ST-elevated myocardial infarction and non-ST-elevated myocardial infarction types.

Recommendations

1. Further studies on acute coronary syndrome patients and normal population in the same field, are needed to estimate the baseline and differences of all risk factors in our population, for better diagnosis, treatment and monitor.
2. Target triglyceride and high density lipoprotein cholesterol in the primary and secondary prevention of coronary artery disease.
3. Further basic and epidemiological studies are warranted to explore mechanistic explanations for these findings of triglyceride and high density lipoprotein cholesterol in ACS patients.

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