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A Study of Some Physiological and Biochemical Variables for Patients with Coronary Artery Disease[1]

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ABSTRACT

The current study aimed to investigate some physiological and biochemical variables for patients with atherosclerosis of the heart, as some functional and metabolic criteria, and to compare the results of patients with the control group (healthy ones) and the study sample include (120) volunteers whose ages ranged from (30 – 96 years) from the residents of Wasit and Dhi Qar governorates, as data were collected for the samples of the current study to include the age group, where the results of the study sample showed the highest rates of patients within the age group (50-69 years) compared with the control group and for both sexes. Whereas, the laboratory tests of the biochemical-metabolic criteria indicated that there were significant differences in the concentrations of lipids in blood serum samples between the two groups of patients and the control with statistical significance, as the concentrations of lipids increased in each of cholesterol, triglycerides TG, low-density lipoproteins (LDL) and very low-density lipoproteins (VLDL), and a decrease in the level of High-density lipoproteins (HDL) in patients with atherosclerosis compared with the control group for both sexes, in addition, the results of the study showed that significant changes in the levels of the two biomarkers of atherosclerosis, as a significant increase was observed in the levels of OPG and endothelin ET in the serum of atherosclerosis patients of both sexes, compared to the control group, respectively. It is concluded from this study that the changes in serum levels of OPG and endothelin ET, as the results showed that males are more susceptible to atherosclerosis than females, and it also showed that the older the age, the greater the risk factors for atherosclerosis.

Keywords: *physiological; biochemical variables; coronary artery disease.*

INTRODUCTION

Atheriosclerosis is a special disease that affects the lining of blood vessels, including the coronary, cerebral, and peripheral arteries (Hadeel, 2021), and it is an inflammatory disease that results from the accumulation of fat locally on the lining of blood vessels which from the structure of fibrofatty, especially in the lining of medium sized muscular arteries and Large elastic arteries cause obstruction of blood flow (Al-Rufaie, *et al*., 2022). The accumulation of these fats leads to narrowing of the artery and causes a stroke, expansion of blood vessels in the abdomen, myocardial infarction (angina pectoris) and heart attack, and ultimately leads tosudden death (Nick *et al*., 2015). This accumulation is formed over the years and does not appear Any direct symptoms or signs, in diseases of atherosclerosis, for example, the disease develops and reaches advanced stages before the patient shows any pathological symptoms until the blood flow is severely affected, which leads to a decrease in the nutrition of the organs (Hadeel, 2021). The type of affected organ, and in most cases more than one organ suffers from a lack of blood supply as a result of blockage of the arteries that feed them due to atherosclerosis. Thrombus is associated with rupture or erosion of the lesion (Thomas, 2015).

MATERIALS AND METHODS

Study sample: The study samples collected patients coming to hospitals and health clinics in the cities of Kut and Nasiriyah for both sexes, within the period confined between (20/1/2022) to (30/5/2022) as sample collection centers, where the sample ages ranged from (30->70). years), and the sample was divided into two groups of patients and healthy, according to three age groups, which are (30-49 years), (50-69 years) and (> 70 years), The total number of samples (120)

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people of both sexes, classified into two parts. The first is represented by the control group to include (40) to include volunteers (20) males and (20) females, their ages ranged from (30 -> 70 years), and the second section of the sample included the test group of patients with atherosclerosis to include (80) people with (40) males And (40) females, their ages ranged from (30 -> 70 years), and they were diagnosed with atherosclerosis by the specialist doctor.

STUDY CRITERIA

The concentrations of cholesterol (Donald, 1997), triglycerides (Schettler and Nussel, 1975), and high-density lipoprotein (HDL) in blood serum were measured (Giovanni and Harold, 1973) using the enzymatic analysis kit manufactured by (Giesse, Inc) of Italian origin and through (Cecil instruments). While the level of low-density lipoprotein (LDL) was calculated according to the following equation (Li et al., 1994.(

LDL concentration (mg/dL) = Cholesterol concentration - HDL concentration + VLDL concentration

The very low-density lipoprotein (VLDL) level was measured according to the following equation (Fatma, 2009)

VLDL concentration (mg/dL) = triglyceride concentration (TG/5)

The level of the two biomarkers, osteoprotegerin and endothelin, was measured in the serum by means of the analysis kit manufactured by (Spinreact) of German origin and through the enzyme-linked immunosorbent assay (ELISA).

STATISTICAL ANALYSIS

The well-known statistical system SPSS-version 25 was used and one-way variance analysis (ANOVA) to compare the averages of the samples, followed by the least significant difference test (LSD) to determine the significant differences of the studied variables in the blood serum of patients atheroscles and compare them with group controls at the probability level ($P \leq 0.05$).

RESULTS AND DISCUSSION

The results of the study sample indicated in Table (1) that the highest percentage of the number of patients with atherosclerosis was among males within the age group (50-69 years) out of 80 participants, as it recorded (27.5%) for males and (26.3%) for females for the same category. in the highest percentage (16.3%) for females and (12.5%) for males was observed in the group of patients with atherosclerosis for the age group (70 < years), while the lowest percentage was in the number of infections with atherosclerosis in the age group (30-49 years). and for both males (10%) and females (7.5%) for the same category.

Table (1): Distribution of percentages (%) of the group of patients with atherosclerosis according to age groups and sex

Age categories (year)	Males		Females	
	The number	Percentage	The number	Percentage
30-49	8	10%	6	7.5%
50-69	22	27.5%	21	26.3%
> 70	10	12.5%	13	16.3%
The total	40	50%	40	50%

The results of the current study indicate that most cases of atherosclerosis, which threaten the patient's ability occur during the late and middle stages of life, and the risk of this disease increases with increasing age. They are high in cholesterol, which in turn is one of the reasons for the protective factors (Joshua *et al*., 2020). It is possible that estrogen has a role in preventing the accumulation of cholesterol as well as its ability to inhibit the process of increasing it to the middle serum layer in the lining of blood vessels, regardless of the level of fast (Xi- Ming et al., 2018) Some functional factors in the autonomic nervous system in because it controls a large part of it, as the process of fat deposition occurs gradually and it is clear that the level of fat in the human body increases with age (Salim *et al*., 2020).

Cholesterol level

The results of the statistical analysis showed that there was a clear increase ($P \leq 0.05$) in the serum cholesterol level for patients with atherosclerosis between males and females, compared to the control group. As it reached a significant increase ($P \leq 0.05$) in the serum cholesterol level in males of the first age group (30-49 years) (30.42 ± 244.01 mg / dL) for patients with atherosclerosis, compared to the least significant difference in the healthy group of the same category (30-49). years) (14.29 ± 172.21 mg / dL), while the highest significant difference was recorded ($P \leq 0.05$) at females and for all age groups (30-49 years) , 50-69 years) , (>70 years) (19.52 ± 232.25 , 2130 ± 223.23 , 24.82 ± 220.30 mg/dl) compared to females of the control group for the two age groups (30-49 years) , (50-69 years) 10.78 ± 165.40 and 13.18 ± 159.34 mg/dl), respectively. While the results of the study showed that there was a clear significant increase ($P \leq 0.05$) in the concentration of cholesterol in males (30-49 years old) (30.42 ± 244.01 mg / dL) for patients with atherosclerosis compared to the group of patients of the second age group (50-69 years) (10.50 ± 173.61 mg/dl). It is also noted that there is no significant khat in cholesterol levels between males and females and for all age groups of the healthy group and the group of female patients as in (Table 2).

Table (2) Cholesterol concentration (mg / dL) in the serum for the two groups of patients with atherosclerosis and the control group

Cholesterol concentration (mg/dL)				
Age categories (year)	patient group		control group	
	Males	Females	Males	Females
30-49	30.42±244.01^{b}	19.52±232.25^{bd}	14.29±172.21^{ad}	10.78±165.40^{ac}
50-69	10.50±173.61^{ac}	21.30±223.23^{bd}	25.54±191.30^{ab}	13.18±159.34^{a}
> 70	19.62±199.87^{ab}	24.82±220.30^{bcd}	27.54±173.27^{ab}	25.57±188.44^{ab}
least significant difference (LSD) = 56.643				

*Values represent (mean ± standard error rate

*The different English letters indicate a significant difference at the level ($P \leq 0.05$).

*Similar English letters indicate that there is no significant difference at the level ($P > 0.05$).

The results of the study indicate that the increase in serum cholesterol levels for a group of patients with atherosclerosis, which may be attributed to its high concentration due to the increase in the amount of fat in the diets eaten, is therefore an important factor affecting the occurrence and development of chronic diseases (Steinberg, 2013). In addition, food is one of the factors leading to an increase in the level of cholesterol in the blood, and thus causes an increase in the rate of pressure in the body, and it also leads to hardening of the arteries (Ruscica *et al*., 2020). Studies indicate that saturated fatty acids play an important role in raising the level of cholesterol in the blood. Cholesterol in the blood, which poses a risk of atherosclerosis. Also, the high amount of cholesterol in the blood leads to its accumulation on the walls of blood vessels, and with the passage of time, narrowing of the blood vessels occurs, which results in atherosclerosis, which leads to a decrease in the amount of blood flowing through the blood vessels (Ruparelia *et al*., 2020).

Triglyceride level

The results of the statistical analysis of the levels of triglycerides (Triglyceride mg/dL) in serum showed a significant increase ($P \leq 0.05$) in atherosclerosis patients for both sexes compared to the control group (Table 3). The highest rise in the concentration of triglyceride proteins among females of the third age group (>70 years) was 43.13 ± 268.62 (mg / dL) for the group of patients with atherosclerosis compared to the healthy groups of the three age groups (30-49 years) and (50-69 years). and (>70 years) old (29.21 ± 112.23, 14.75 ± 123.27 and 8.16 ± 116.43 mg / dl) respectively, while the highest level of triglycerides was observed in males of the second age group (50-69 years) (72.43 ± 262.10 mg/dL) for patients with atherosclerosis compared to healthy adults (30-49 years) (33.97 ± 164.50 mg/dL). In addition, the highest significant increase ($P \leq 0.05$) in the concentration of triglyceride proteins among females of the third age group (>70 years) was 43.13 ± 268.62 (mg / dL) for the atherosclerosis group, compared to the two age groups (30-49 years) , (50-69 years) (35.75 ± 198.21 , 28.19 ± 182.23 mg / dL) for the same group, respectively, while it was not recorded in the data of the current study that there were any significant differences ($P > 0.05$) in the level of triglycerides in serum between both sexes and for all groups. age group, both in the control group and males in the patients group.

High concentrations of triglycerides (TG) appeared in the serum of patients with atherosclerotic diseases. This may be due to abnormal metabolic factors, such as the oxidation of fats to release adenosine triphosphate as an energy source, despite the presence of an increase in the concentration of glucose in the blood (Bettina, 2005). High triglycerides can also contribute to hardening of the arteries or the thickening of artery walls (atherosclerosis). This increases the risk of stroke, heart attack, and heart disease. High levels of triglycerides can lead to acute pancreatitis (Fernando et al., 2010).

In addition, high triglycerides are often a sign of other conditions that increase the risk of atherosclerotic disease and stroke, including obesity and metabolic syndrome. It is a group of conditions that include too much fat around the waist, high blood pressure, high triglycerides, and abnormal cholesterol levels (Farahnaz *et al*., 2018).

Table (3) the concentration of triglycerides (mg/dL) in the serum for the two groups of patients with atherosclerosis and the healthy group.

Triglyceride protein concentration (mg/dL)				
Age categories (year)	patient group		control group	
	Males	Females	Males	Females
30-49	7.59±224.58^{ab}	35.75±198.21^{ab}	33.97±164.50^{ad}	29.21±112.23^{a}
50-69	72.43±262.10^{bc}	28.19±182.23^{ab}	30.54±183.00^{ab}	14.75±123.27^{a}
> 70	42.32±214.22^{ab}	43.13±268.62^{c}	35.29±183.62^{ab}	8.16±116.43^{ab}
least significant difference (LSD) = 101.217				

*Values represent (mean ± standard error rate

*The different English letters indicate a significant difference at the level ($P \leq 0.05$).

*Similar English letters indicate that there is no significant difference at the level ($P > 0.05$).

The increase in the concentration of triglycerides (TG) is indirectly associated with a doubling of the risk as a result of the occurrence of atherosclerosis (Shigemasa *et al*., 2017), and the increase in the level of triglycerides appears, which can be explained on the basis of interactions between factors associated with diabetes. and other factors, such as abnormal lipid metabolism that interfere with the massive production of lipoproteins and simultaneously lead to the production of excessive amounts of TG-rich lipoproteins (Han *et al*., 2016).

Level High Density Lipoprotein

The results in the current study, which are mentioned in Table (4), indicated a clear decrease ($P \leq 0.05$) in the concentration of high-density lipoprotein (mg/dL) in the serum, for patients with atherosclerosis, and for both sexes, compared to the control group, as if its level was less low. In males for all age groups (30-49 years) and (50-69 years). and (>70 years), (1.81 ± 31.26, 1.33 ± 30.01 , 2.87 ± 30.59 mg/dL), for the group of patients with atherosclerosis compared to the two age groups (30-49 years), and (>70 years) (2.27 ± 36.61,1.33 ± 35.42 mg/dL). in the healthy group, respectively. While a significant decrease was recorded in the level of (HDL) among females, and for all age groups (30-49 years) and (50-69 years) and (>70 years), (1.21 ± 28.31, 1.63 ± 26.72,1.24 ± 27.64 mg/dL). (Respectively, for the patients group, compared to the control groups for the same age groups, (2.27 ± 36.61, 2.88 ± 33.38, 1.33 ± 35.42 mg/dL), respectively, and it was not observed in the results of the current study that there was any significant difference ($P > 0.05$). in the level of high-density lipoprotein (HDL) in the serum between both sexes, and for all age groups, whether for atherosclerotic patients or control groups.

Table (4) High density lipoprotein concentration (mg/dL) in serum for both groups of patients with atherosclerosis and the healthy group.

High density lipoprotein concentration (mg/dL).				
Age categories (year)	patient group		control group	
	Males	Females	Males	Females
30-49	2.87 ± 30.59^{acd}	1.24 ± 27.64^{ac}	1.33 ± 35.42^{b}	0.94 ± 37.22^{b}
50-69	1.33± 30.01^{ac}	1.63 ± 26.72^{a}	2.88 ± 33.38^{bc}	1.24 ± 37.09^{b}
> 70	1.81 ± 31.26^{acd}	1.21 ± 28.31^{ac}	2.27 ± 36.61^{b}	0.85 ± 36.84^{bd}
least significant difference (LSD) = 3.978				

*Values represent (mean ± standard error rate

*The different English letters indicate a significant difference at the level ($P \leq 0.05$).

*Similar English letters indicate that there is no significant difference at the level ($P > 0.05$).

The results obtained in the current study agreed with what was stated by AL-Neamia (2003), which indicated a decrease in the level of HDL in patients with atherosclerosis, which in turn reflects the excretion of cholesterol from extrahepatic tissues such as cells lining blood vessels, due to the removal of receptors. Required for cellular endocytosis ((Endocytosis of HDL particles)) from the cells of the arterial wall, and the decrease in the concentration of HDL is attributed to several mechanisms that may be due to a weakness in its production and secretion from the liver and intestines or due to its excretion from the bloodstream as a result of the increase in the process of exudation ((extravasations) that results An increase in the perfusion of capillary blood vessels as a result of inflammation, which leads to an increase in HDL perfusion and thus impairs the natural absorption of cholesterol from the arterial walls, which accelerates the development of atherosclerosis (Mika, 2019).

Low-density lipoprotein level

The concentrations of Low-density lipoprotein (mg/dL) in Table (5) showed different statistical significance among the serum groups of patients with atherosclerosis, compared to the control group, and for both sexes, as the highest significant increase in the concentration of low-density lipoprotein was recorded. LDL)) in females, for all age groups (30-49 years) and (50-69 years). and (>70 years), (19.18±148.22, 14.84 ± 133.73 and 10.460±153.75), respectively, for the group of patients with atherosclerosis, Compared to the second age group (69 - 50 years), (10.31 ± 868.42 mg / dl) for the control group, while a clear increase ($P \leq 0.05$) was observed in the (LDL) concentration, for the first age group of females (30 - 49 years), (10.460 ± 153.75 mg / dL), compared to the first and second age groups (30-49 years) and 59-69 years), (10.14 ± 93.23 , 10.31 ± 86.42 mg / dL) in the control group, while the highest increase in LDL level)) in males, for the early age group (30-49 years), (23.74 ± 149.50 mg / dL) for atherosclerosis, compared to the same group for the late age group (<70 years), (1 0.87 ± 88.78 mg/dl). In addition, the results of the current study did not indicate that there were significant differences ($P > 0.05$) in the levels of low-density lipoprotein (LDL), between both sexes, and for all age groups, for the healthy group and females for the patients group.

Table (5) Low-density lipoprotein concentration (mg/dL) in the serum for the two groups of patients with atherosclerosis and the control group

Low- density lipoprotein concentration (mg/dL).				
Age categories (year)	patient group		control group	
	Males	Females	Males	Females
30-49	23.74± 149.50^{bcd}	10.460±153.75^{b}	5.35±94.56^{ad}	10.14±93.23ac
50-69	14.76±113.83^{ab}	14.84±133.73^{bcd}	21.87±109.60^{ab}	10.31±86.42a
> 70	10.87±88.78^{a}	19.18±148.22^{bc}	21.67±91.82^{ac}	25.4 ±115.45ab
least significant difference (LSD) = 41.894				

*Values represent (mean ± standard error rate)

*The different English letters indicate a significant difference at the level ($P \leq 0.05$).

*Similar English letters indicate that there is no significant difference at the level ($P > 0.05$).

The high level of low-density lipoprotein (LDL) in the blood serum is related to the incidence of atherosclerosis and heart diseases, as it is an indicator of this injury, as it was revealed through several studies that cholesterol is formed or accumulates in the walls of blood arteries through LDL, and that the inability to remove it leads to oxidation of LDL through The surface of the vascular endothelium and an increase in its level in the blood, which results in the arteries supplying the heart with atherosclerosis (Seamus et al.; 2019).

This rise may be due to the destruction of LDL receptors in the liver and thus impeding its removal and increasing its concentration in the blood, as the main component of total cholesterol in the blood serum that increases the risk of atherosclerotic diseases is LDL cholesterol, and therefore high cholesterol promotes the process of sclerosis. and the formation of ulcers in the vascular walls, which in turn increases the permeability of the endothelium to LDL and thus the loss of endothelial activity (Sharon *et al*.; 2003).

Very low-density lipoprotein level

The results in Table (6) showed that there was a significant increase at the probability level ($P \leq 0.05$) in the levels of very low density lipoproteins (VLDL mg / dL) in the serum of atherosclerosis patients compared to the control group, as the highest significant increase was recorded in the level of Very low-density lipoprotein in females of the second age group (50-69 years), (6.41 ± 49.10 mg / dL), for the group of atherosclerosis patients, compared to less superiority in the control group, for all age groups (30-49 years), (50-69 years), (>70 years) (4.11 ± 19.65, 2.34 ± 21.83, and 1.21 ± 19.23 mg/dL), respectively. While there were no significant differences in the data of the current study, in the concentrations of very low-density lipoproteins (VLDL mg / dL) in serum, and for all age groups of the study sample of patients with atherosclerosis or control and for both sexes.

Table (6): Very low-density lipoprotein (mg/dl) in serum for two groups of patients with atherosclerosis and the control group.

Very Low- density lipoprotein concentration (mg/dL).				
Age categories (year)	patient group		control group	
	Males	Females	Males	Females
30-49	11.54 ± 48.20^{bc}	4.47 ± 35.32^{ab}	4.65 ± 29.32^{ac}	4.11 ± 19.65^{a}
50-69	3.42 ± 40.11^{ab}	6.41± 49.10^{b}	3.42 ± 33.54^{ab}	2.34 ± 21.83^{a}
> 70	5.18 ± 38.34^{ab}	3.65 ± 32.72^{ab}	4.15 ± 32.46^{ab}	1.21 ± 19.23^{ac}
least significant difference (LSD) = 16.578				

*Values represent (mean ± standard error rate)
*The different English letters indicate a significant difference at the level ($P \leq 0.05$).
*Similar English letters indicate that there is no significant difference at the level ($P > 0.05$).

The results of the current study showed that the increase in the concentrations of very low-density lipoproteins in the serum of a group of patients with atherosclerosis may be due to an increase in the absorption of VLDL molecules by the liver, which results in an increase in the concentration of VLDL in the serum, which is the carrier of triglycerides in Plasma (Rashid *et al*.; 2014), and that the increase in the level of (VLDL) in patients with heart disease, diabetes, and atherosclerosis is due to the nature of the relationship between diabetes mellitus, heart disease, and atherosclerosis, which leads to oxidation of low lipoproteins (VLDL), because insulin deficiency Excess induces increased release of VLDL in the liver, with increased TG level, and decreased high-density lipoprotein (HDL) (Bruno, 2015 , Handrean et al., 2016).

Osteoprotegerin level

The results of the current study showed a significant ($P \leq 0.05$) increase in the biomarker of osteoprotegerin (ng / milliliter) in the serum of patients with atherosclerosis compared to the control group and for both sexes. It reached the highest *significant* increase in the concentration of the osteoprotein biomarker (OPG) in males of the first age group (30-49 years) (0.02 ± 1.71 ng / milliliter), for the group of atherosclerosis patients, compared to the least superiority in the control group, and for all age groups (30-49 years), (50-69 years), (>70 years), (0.01 ± 1.40, 0.10 ± 1.48, and 0.11 ± 1.28 ng/mL), respectively. Also, the highest mean in the serum level of osteoprotein (OPG) in females, for the first age group (30-49 years), (0.02 ± 1.77 ng / milliliter), for the sick group compared to healthy females, for all age groups (30-49

years), (50-69 years), and (>70 years) (0.02 ± 1.32, 0.05 ± 1.40, and 0.10 ± 1.28 ng/mL), respectively. In addition, the results at the level of age group and gender showed a clear increase ($p \leq 0.05$).), in the level of osteoprotein (OPG), in males of the first age group (30-49 years), (0.02 ± 1.71 ng / milliliter) with atherosclerotic diseases, compared to the two age groups (50-69 years), (>70 years), (0.09 ± 1.45 and 0.07 ± 1.38 ng/mL), respectively, for the same group. It was also observed in females that the average ($p \leq 0.05$) in the standard level (OPG), for the early age group (30-49 years), was (0.02 ± 1.77 ng / milliliter) for the patients group, compared to the two age groups (50-49 years), (>70 years), (0.11 ± 1.45 and 0.02 ± 1.33 ng / milliliter), respectively, for the same group of patients, while the data of the current study did not record any significant differences ($p > 0.05$) for the average (OPG) in the healthy group, for both sexes for all age groups (Table 7).

Table (7) Osteoprotegerin concentration (ng/mL) in serum for two groups of patients with atherosclerosis and the control group.

Osteoprotegerin concentration (ng/mL)				
Age categories (year)	patient group		control group	
	Males	Females	Males	Females
30-49	0.02 ± 1.71 **b**	0.02 ± 1.77 **b**	0.01 ± 1.40 **a**	0.02 ± 1.32 **a**
50-69	0.09 ± 1.45 **a**	0.11 ± 1.45 **a**	0.10 ± 1.48 **a**	0.05 ± 1.40 **a**
> 70	0.07 ± 1.38 **a**	0.02 ± 1.33 **a**	0.11 ± 1.28 **a**	0.10 ± 1.28 **a**
least significant difference (LSD) = 0.132				

*Values represent (mean ± standard error rate)

*The different English letters indicate a significant difference at the level ($P \leq 0.05$).

*Similar English letters indicate that there is no significant difference at the level ($P > 0.05$).

The current study indicates that the rise in the level of biological parameter (OPG) in patients with atherosclerotic diseases in the prime of life. It may be attributed to the high concentrations of OPG, which cause the formation of free radicals (carbonyl radicals, peroxides), which have a significant effect on atherosclerosis, and thus we find that people with heart diseases have an increased concentration of OPG). circulating OPG), and cardiovascular risk factors (including age, smoking, hypertension, insulin resistance, obesity, and diabetes) as well as inflammatory diseases that increase cardiovascular risk, such as inflammatory bowel disease (Stefan *et al*., 2006, Ciriza *et al*., 2015).

Endothelin level

The results of the statistical analysis of the concentration of the biomarker Endothelin (pg/mL) in both groups of atherosclerosis patients and healthy subjects in Table (8) indicated a significant increase ($P \leq 0.05$) in the serum of patients of both sexes compared to the control group. The highest significant increase was recorded ($P \leq 0.05$), in male ET concentration, for all age groups (30-49 years), (50-69 years), (>70 years), (0.62 ± 19.52 0.52 ± 21.11 , 0.95 ± 19.32 pg / milliliter), respectively, in the group with atherosclerosis, compared to the control groups for all age groups (30-49 years), (50-69 years), (>70 years) (0.82 ± 16.39, 0.54 ± 14.22, and ± 0.75). 16.68 pg/mL, respectively. While the highest significant increase was ($P \leq 0.05$) in the concentration of (ET) in females, for the second age group (50-69 years), (0.42 ± 22.12 pg / milliliter) for the patients group, compared to control groups for all age groups (30-49 years).), (50-69 years), (>70 years), (1.87 ± 17.51, 0.50 ± 16.33, and 0.69 ± 14.13 pg/mL), respectively. As for the age groups and gender, the highest clear increase ($P \leq 0.05$) was observed in females, for the middle age group (69-50 years), (0.42 ± 22.12 pg / milliliter), in patients with atherosclerosis, compared to the two age groups (30-49 years).) and (>70 years), (1.68 ± 16.47 and 0.63 ± 16.82 pg/mL), respectively, for the same group. In addition, the current data for the level of vital criterion (ET) did not indicate the existence of any significant differences ($P > 0.05$) between the sexes of the study sample.

Table (8) Endothelin concentration (pg/mL) in serum for the two groups of patients with atherosclerosis and the healthy group.

Endothelin concentration (pg/mL)				
Age categories (year)	patient group		control group	
	Males	Females	Males	Females
30-49	0.62±19.52^{bde}	1.68±16.47^{acd}	0.82±16.39^{acd}	1.87±17.51^{acd}
50-69	0.52±21.11^{be}	0.42±22.12^{e}	0.54±14.22^{a}	0.50±16.33^{acd}
> 70	0.95±19.32^{bc}	0.63±16.82^{ac}	0.75±16.68^{a}	0.69±14.13^{a}
least significant difference (LSD) = 2.053				

*Values represent (mean ± standard error rate)
*The different English letters indicate a significant difference at the level ($P \leq 0.05$).
*Similar English letters indicate that there is no significant difference at the level ($P > 0.05$).

The significant increase in the concentration of endothelin (ET) in patients with atherosclerosis in the current study may be attributed to the increase in the oxidative stress of free radicals (ROS), which leads to a decrease in the biological activity of nitric oxide (NO), and the formation of peroxynitrite), which leads to To increase free radicals in the smooth muscle lining of blood vessels, causing atherosclerosis (Nicole *et al*., 2000 , Feng *et al*., 2005). It leaks into the arteries of endothelin (ET-1), significantly impairing endothelial cell dilatation in healthy subjects (Felix *et al*., 2002), constricts endothelin receptors (ET-1), causing a significant increase in endothelial cell dilatation in patients with atherosclerosis (Subodh, et al., 2001)

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