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Research Article

Mucin2 and Lipid Profile Estimation in *Giardia Lamblia* Infected Patients: A Case-control Study

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I N F O

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A B S T R A C T

Introduction: Globally, Giardia duodenalis (G. lamblia) is a protozoan parasite that has the ability to cause sporadic or epidemic infectious diarrhoea. Giardia infection is a crucial cause of waterborne and foodborne disease, outbreaks in the daycare centre, and international travel-related infection. This study aimed to evaluate the effects of Giardia lamblia infection on serum MUC2 and lipid profile.

Patients and Methods: From March to April 2021, a case-control study was conducted on 48 patients with giardiasis who attended AL-Hakeem Hospital in Najaf Province in Iraq and 24 healthy adults as a control group. Stool examinations were done using standard techniques for the identification of the parasitic infection.

Results: The results showed a significantly higher concentration (130.57 ± 4.04 ng/ml, and 130.11 ± 3.6 ng/ml) ($p < 0.05$ of MUC2 in G. lamblia infected patients (males and females) in comparison to the individuals of the control group. In addition, significantly higher concentrations ($p < 0.05$) of cholesterol, VLDL, TG, and LDL were found in comparison to the control individuals, whereas the concentration of HDL was significantly lower ($p < 0.05$ in patients infected with G. lamblia as compared to the control group.

Conclusion: The current study revealed that MUC2 and lipid profile are valuable biomarkers that help in the diagnosis of G. lamblia parasite infection.

Keywords: Giardia Lamblia, MUC2, Lipid Profile

Introduction

Giardia lamblia is a zoonotic enteroparasite. It is a binucleate, flagellated protozoan parasite that proliferates extracellularly in a non-invasive pathological way in the duodenum and jejunum of vertebrates, leading to a diarrhoeal disease called giardiasis.[1] Giardia infection occurs through contaminated food and water. Human infections are either asymptomatic or appear with diarrhoea, abdominal pain, gas, bloating, malabsorptive features, and loss of weight. Severe giardia infection leads to malabsorption and manifests as diarrhoea with profuse and greasy stool.[2]

According to the recent WHO-provided data, G. lamblia is the

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third commonest microbial cause of diarrhoea worldwide with more than 300 million registered cases every year.[3] Giardia infection was previously associated with the WHO initiative of neglected diseases and is directly associated with poor drinking water quality and poverty.[4] G. lamblia infection has also been linked to the development of chronic fatigue and irritable bowel syndrome.[5] More than 200 million persons are estimated to be infected with acute or chronic giardia infection, and rates of infection reach 90% in endemic areas.[6]

Mucin2 is an oligomeric protein mucous gel-forming, also called MUC2. It covers the intestinal epithelium, respiratory epithelium, and the mucous membrane of other organs, and is hypothesised as a barrier that provides protection and lubrication against infectious microorganisms at mucous membranes. It is an essential component of both the inner and outer layers of the mucous of the large intestine and may have a role in the separation of bacteria from the inner layer of the mucous.[7]

Cholesterol is a lipoprotein consisting of protein and fat. It is categorised into three types: very low-density lipoprotein (VLDL), low-density lipoprotein (LDL), and high-density lipoprotein (HDL), and each affects the human body differently. HDL is known as 'good' cholesterol because it aids the transfer of what is called bad cholesterol to the liver from other body tissues for removal.[8]

Cholesterol is a major component of the parasitic membrane and has an important effect on the organising, efficient functioning and division of the cell.[9] Giardia obtains lipid de nova from the dietary products of the host's small intestine because it is unable to synthesise lipid de nova. Lipid malabsorption is one of the main complications of giardiasis. Foul-smelling and greasy stools are the signs of the disease.[10]

The results of the current study may provide important information regarding the effects of giardiasis on serum mucin2 and lipid profile.

Materials and Method

The present Case-control study was carried out from March to April 2021. Forty-eight patients infected with Giardia lamblia who attended AL-Hakeem Hospital in Najaf city (28 males and 20 females) and 24 randomly selected healthy controls, who had no clinical evidence of any type of disease (14 males and 10 females) were enrolled in this study.

Exclusion Criteria

Any patient with giardiasis on treatment, patient with chronic loss of appetite and/ or weight for any cause rather than giardiasis, febrile patient, diabetic patient, obese patient, and/ or patient with mixed intestinal parasitic infection was excluded from the study.

Stool Sample Collection and Detection of Giardia lamblia Parasite

Stool specimens were collected in clean stool containers. A microscopic diagnosis of Giardia was performed immediately after the collection of the stool sample. A small amount of stool sample was taken, processed, and examined microscopically using the direct smear method to determine the parasites.

Blood Specimens Collection

Five ml of blood was aspirated from each patient infected with *G. lamblia* and all non-infected control individuals. Sterile plain tubes were used to collect the blood samples and then the blood was left at room temperature (30 min). After that, centrifugation was performed at 3000 rpm (5 min). Then sterile tubes were used to collect the sera, and these sera were kept at deep freeze (-20 ^{o}C) until use.

Serological Marker Detection

Human mucin2 protein (MUC2) was measured in this study. The used kit was intended for the quantification of the serum level of this immunological biomarker (Elabscience Company, Bulgaria) and the level of biomarker in the serum was determined by the ELISA technique according to the manufacturer's procedure.

Estimation of Lipid Profile

Cholesterol, triglycerides (TG), very low-density lipoprotein (VLDL), low-density lipoprotein (LDL), and high-density lipoprotein (HDL) levels in serum were measured by the enzymatic method (Biolabo France kit). The levels of lipids in serum were determined by a spectrophotometer according to the manufacturer's procedure.

Statistical Analysis

The analysis of data was done by Graph-pad prism (version 10 computer software). The comparisons between the patients and control groups were analysed by t-test. A statistically significant p-value was less than 0.05.

Ethics Approval and Consent to Participate

All procedures were performed in compliance with The Code of Ethics of the World Medical Association (Declaration of Helsinki). The Kufa Medical College Ethical Committee approved the protocol of this study. Informed consent was obtained from each patient and healthy person.

Results

The results of the present study showed that the MUC2 mean concentration was 130.57 ± 4.04 ng/ml and 130.11 ± 3.6 ng/ml in female and male patients infected with G. lamblia respectively which were significantly higher ($p < 0.05$ in comparison to the female and male control individuals (93.421 ± 1.8 ng/ml and 94.079 ± 3.1 ng/ml respectively)

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(Figure 1). The current study showed significantly higher ($p < 0.05$ mean serum concentrations of cholesterol (121.58 ± 3.6 mg/dl), VLDL (36.944 ± 1 mg/dl), TG (133.08 ± 1.3 mg/dl), and LDL (118.08 ± 1.7 mg/dl) in patients with giardiasis in comparison to the control individuals (102.61 ± 1.9 mg/dl, 25.025 ± 1.2 mg/dl, 96.306 ± 4.2 mg/dl and 88.006 ± 3.9 mg/dl respectively) (Figures 2-5), while the serum concentration of HDL was significantly lower ($p < 0.05$ (39.67 ± 2.1 mg/ml) in patients infected with G. lamblia in comparison with the control group (54.75 ± 3.9 mg/dl) (Figure 6).

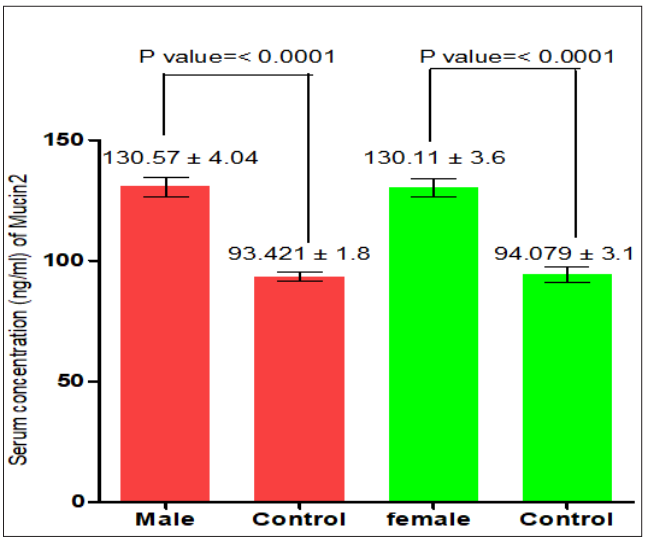

Figure 1.Serum Concentration of MUC2 (mg/ml) of Patients Infected with *G. lamblia* and Control Group

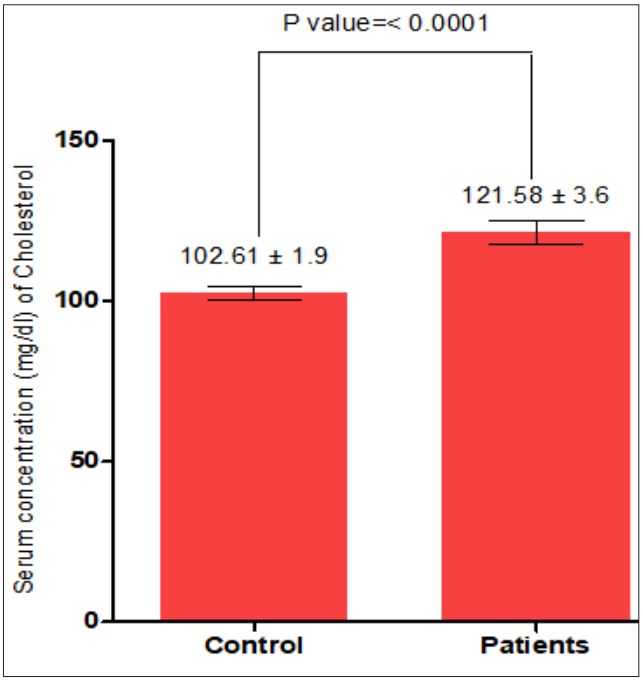

Figure 2.Serum Concentrationof Cholesterol (mg/dl) of Patients Infected with *G. lamblia* and Control Group

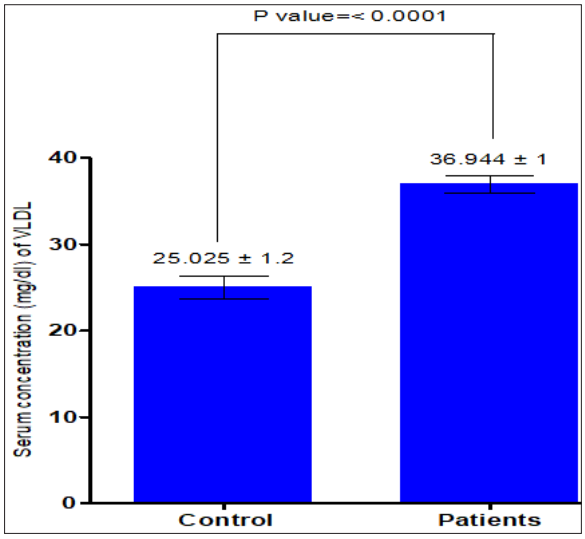

Figure 3.Serum Concentration of VLDL (mg/dl) of Patients Infected with *G. lamblia* and Control Group

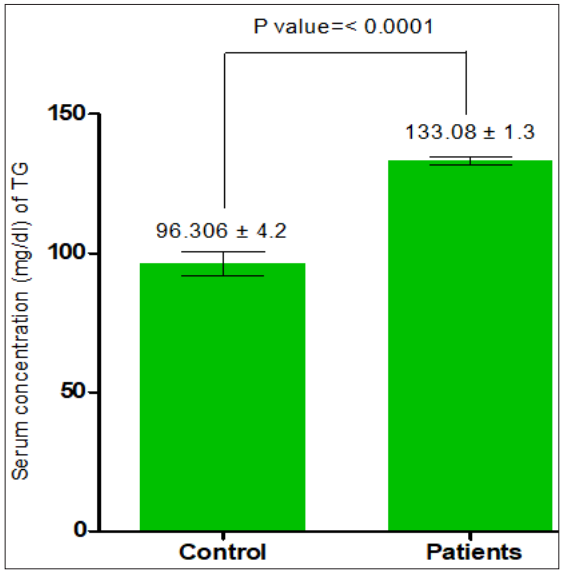

Figure 4.Serum Concentration of TG (mg/dl) of Patients Infected with *G. lamblia* and Control Group

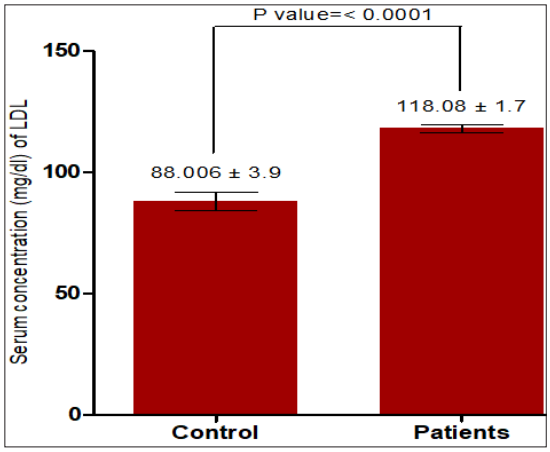

Figure 5.Serum Concentration of LDL (mg/dl) of Patients Infected with *G. lamblia* and Control Group

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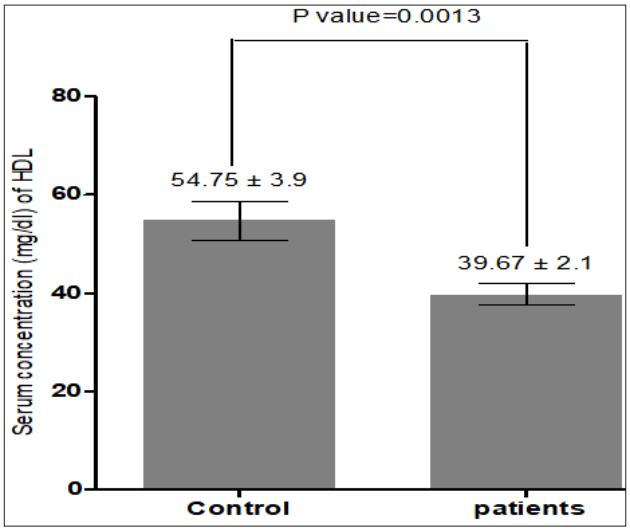

Figure 6.Serum Concentration of HDL (mg/dl) of Patients Infected with *G. lamblia* and Control Individuals

Discussion

The present study's results revealed a significant elevation in the serum mucin2 level of G. lamblia infected patients in comparison to the control individuals. This increase may be due to the pathophysiological mechanism of Giardia trophozoites which leads to the development of diarrhoeal infection, disruption of the mucosal layer of the intestine as well as malabsorptive diarrhoeal disease,[11] and may be due to the mechanism of Giardia infection or intestinal inflammation where the mucin2 protein has an essential effect in the protection of intestinal tissue besides its ability to stimulate immune reaction and body production of cellular motions, and the assembly and attraction of white blood cells to the site of injury, which stimulates the mucous intestinal glands to increase the secretion of mucous to compensate for the shortfall caused by Giardia parasite infection[12]. The above result of the present study was supported by various studies,[13,14] which showed elevated levels of MUC2 mRNA expression after G. lamblia parasite exposure. Also, it is in line with a study by Hasnain SZ et al.[15] that showed an elevated level of MUC2 in parasitic infections.

The current study revealed that the mean serum concentrations of cholesterol, VLDL, TG, and LDL had a significant increase in G. lamblia infected patients compared to the control individuals, while the serum concentration of HDL had a significant decrease in patients with Giardia parasite infection in comparison with the control group. These findings are inconsistent with those of similar studies,[9,16,17,18] where giardiasis disturbs lipid parameters, involving intestinal lipids malabsorption leading to the formation of offensive greasy stool. Our findings agree with numerous similar stuides[9,19] which reported elevated serum concentrations of cholesterol in patients with parasitic disease in comparison with the control group.

Cholesterol is considered a major constituent of eukaryotic membranes and has a significant role in membrane synthesis and function.[9] In Giardia, the biogenesis of the membrane needs cholesterol; since Giardia is incapable to make and produce cholesterol, it gains cholesterol from the upper small intestine.[16]

The increased serum level of VLDL in patients infected with G. Lamblia in comparison to control individuals can be explained by the inflammation which is considered a part of the innate immune response, and therefore, is likely to play an essential effect in protecting the host as a result of the changes in lipids, lipoproteins, and VLDL.[20] The increase of serum level of TG in giardia infected patients in comparison to the control individuals may be due to an elevation in the synthesis and secretion of VLDL as sequelae of an elevated synthesis of fatty acid in the liver, an elevation in lipolysis of the adipose tissue accompanied by the elevated fatty acids transport to the liver, and a decrease in the oxidation of liver fatty acids. These processes increase the fatty acid supply in the liver which stimulates an elevation in the synthesis of triglycerides in the liver.[17,21]

Regarding the intracellular parasites, these parasites acquires host cholesterol that is endocytosed by the LDL pathway; and in the infected cells, this pathway is specifically elevated.[22] These facts support the finding of the current study, which revealed a significant elevation in the serum levels of LDL of giardia-infected patients in comparison to the control individuals. This study's results revealed a significant serum HDL decrease in patients infected with G. lamblia compared to the control group. This decrease may be due to the dysfunction of the biliary gland due to the blockage of bile duct by G. lamblia parasite resulting in lipid loss, which is considered to be one of the complications of giardia infection leading to bad odour faeces accompanied by undigested lipids.[18] The present study disagrees with the finding of Ma'ani N et al.[17] in Iraq that reported a normal value of HDL in patients with giardiasis, while being consistent with various studies which found higher concentrations of serum HDL in patients infected with G. Lamblia parasite in comparison with the healthy group.[9,18,19,20,23,24]

HDL was considered a major carrier in circulation and plays a role in metabolism and transport, and in preventing cholesterol accumulation in the cells of the artery wall.[25]

Conclusion

Giardia lamblia infection is associated with increased serum levels of mucin2 protein (MUC2), cholesterol, VLDL, TG, and LDL but decreased serum level of HDL.

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Conflict of Interest: None

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