Original Article

Study of Correlation between Iron Deficiency Anemia and Serum Lipid Profile in a Tertiary Care Center

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ABSTRACT

Introduction: Looking at the health status of our country Nepal, iron deficiency anemia fits rightly in our socioeconomic status and dyslipidemia is the rising one along with being more highlighted these days. Some studies show an association between iron deficiency anemia and dyslipidemia but the data are controversial. Therefore, this study is aimed to find the relationship between iron deficiency anemia and serum lipid profile in the Nepalese context.

Materials and Methods: A cross-sectional study was conducted in KIST Medical College and Teaching Hospital from June 2019 to August 2020. 76 Iron deficiency anemia and 75 age and sex-matched healthy control were investigated for any possible changes in serum lipid profile: triglyceride, low-density lipoprotein, high-density lipoprotein, and total cholesterol.

Results: The mean triglyceride in case and control was 92.96 mg/dl and 99.87 mg/dl respectively. The difference between these two groups was statistically significant (p=<0.001). Moreover, serum total cholesterol level in the case (138.82 mg/dl) was significantly lower than the control (146.67 mg/dl). The mean high-density lipoprotein was almost the same in anemic and non-anemic groups, p=<0.001. While the mean low-density lipoprotein in the iron-deficiency anemia group was significantly lower than the control group (p=<0.001).

Conclusions: In this study, the values of the lipid profile parameters: triglyceride, low-density lipoprotein, high-density lipoprotein, and total cholesterol in cases were found to be lower than those in the controls.

Keywords: Dyslipidemia; Iron deficiency anemia; Lipid profile

INTRODUCTION

Anemia, a decrease in the total red cell mass. World Health Organization defines anemia as a reduction of hematocrit value below the normal limits of hemoglobin levels below13 gm/dl in men over 15 years of age, below 12 gm/dl in non-pregnant women over 15 years, and below 11 gm/dl in pregnant women.[1]Anemia is a major public health problems in both developed and developing countries, where 20% world's population are estimated to be anemic by WHO (World Health Organization). Generally, 50% of cases of anemia are due to iron deficiency anemia (IDA).[2] According to the Nepal Demographic and Health Survey (DHS) 2011, the prevalence of anemia among children <5 years old was 46.6% and 34.4% in women of reproductive age.[3]

Dyslipidemia also occurs irrelevant to socio-economic status.[4] Elevation of serum lipid levels, especially low-density lipoprotein (LDL) increases the risk of atherosclerosis predisposing to coronary artery disease (CAD).[5,6] several studies suggest that increased iron load promotes oxidation of low-density lipoprotein (LDL) which subsequently increases the risk of myocardial infarction which is the cause of morbidity and mortality.[7,8] Researches are showing an association between IDA and dyslipidemia done both in humans and in animals.[9] Study done in male Sprague- Dawley rats with IDA showed increased triglyceride and chylomicron levels.[10] While another study done in young Korean girls with severe IDA reported lower levels of triglyceride and total cholesterol which returned to normal after iron therapy.[11] Although the results are controversial, most of the researches is based on the hypothesis that iron plays a role in hepatic lipogenesis.[12]Looking at the health status of our country Nepal, IDA fits rightly in our socioeconomic status[3] and dyslipidemia is the rising one along with being more highlighted these days.

With respect to the research perspective, knowledge and data seem to be limited and non-seems to have been done extensively in humans. Therefore, in this present study, we attempt to find the relationship between (IDA and serum lipid profile, i.e., by comparing serum total cholesterol, low-density lipoprotein, high-density lipoprotein, and triglyceride in patients of IDA and healthy control.

MATERIAL AND METHODS

A cross-sectional study was conducted throughout 14 months from June 2019 to August 2020 among the patients attending outpatient clinic of the Medicine Department of KIST Medical College and Teaching Hospital, Imadol, Lalitpur. Before commencing the study ethical approval was obtained from Institutional Review Committee. Informed and written consent was taken from the participants. Pregnant, those with acute infectious diseases and chronic diseases like heart, liver, renal, and thyroidal diseases were excluded from the study. Likewise, age and sex-matched control were selected from those who came for general health check-ups with no known acute or chronic illness. A total of 76 in the case and 75 in control who were willing to participate were taken for the study.

Venous blood samples were drawn. Hematological parameters, Red Blood Cells (RBC), Hemoglobin (Hb), Hematocrit (HCT), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC), Red Cell Distribution Width (RDW), Platelet (PLT) were measured using SysmexKX-21N cell counter. Biochemical parameters: The iron profile, Iron, TIBC, Ferritin, % of Oxygen saturation, and Lipid profile: Low-Density Lipoprotein cholesterol(LDL-C), High-Density Lipoprotein cholesterol (HDL-C), Triglyceride (TG), Total Cholesterol (TC) were determined enzymatically by Siemens Dimension RXL.

Statistical Analysis

Data were entered in Microsoft Excel. Statistical analysis was performed using version 26 of the Statistical Package for Social Sciences (SPSS Inc, Chicago IL, USA). Data normal distribution was assessed by Kolmogorov- Smirnov test before further analysis. The data were presented as the meanstandard deviation (SD) for continuous deviation. An independent sample t-test was used to compare the mean values of the two groups. Correlation between various parameters was determined with the help of the Pearson method. The value <0.05 were considered statistically significant.

RESULTS

The study was conducted on 141 patients, where 76 were patients with IDA (case) and 75 were the control group. Among the case 76.3% were female and 23.7% were male with a minimum age of 13 years and maximum age of 79 years. Likewise, in the control group, 50.7% were females and 49.3% were males where the minimum age was 15 years and maximum age was 79 years. The mean age in IDA was 45.41±19.49 and in control was 44.93±16.06.

In the table-1, the hemoglobin followed by ferritin TIBC, iron, and %of oxygen saturation was lower in IDA than that of control. This difference between the two groups was significant (p<0.05). Table 2 presented the mean serum levels of triglyceride, total cholesterol, HDL, and LDL. The mean triglyceride in case and control was 92.96 mg/dl and 99.87 mg/dl respectively. The difference between these two groups was statistically significant in this regard (p=<0.001). Moreover, serum cholesterol level in the case (138.82 mg/dl) was significantly lower than in the control (146.67 mg/dl). The mean HDL was almost the same in anemic and non-anemic groups, p=<0.001. While the mean LDL in the IDA group was significantly lower than the control group (p=<0.001).

Table 1: Comparison of hematological and iron profile parameters in case and control

Variables	Case (n=76)	Control (n=75)	p-value
Ferritin (ng/ml)	13.31±10.88	86.33± 31.95	0.001
TIBC (µg/dl)	342.91± 122.75	253.93 ± 71.15	0.001
Iron(µg/dl)	21.74± 9.85	67.44 ± 24.26	0.001
% Oxygen Saturation	7.42 ± 4.68	27.57 ± 8.90	0.001
Hemoglobin(g/dl)	8.72 ± 1.45	15.59 ± 1.60	0.001

Table 2: Comparison of lipid profile parameters in case and control

Variables	Case (n=76)	Control (n=75)	p-value
Total Cholesterol(mg/dl)	138.82 ± 39.18	146.67 ± 28.10	0.001
LDL-C (mg/dl)	85.54 ± 31.89	88.29 ± 22.74	0.001
Triglyceride (TG) (mg/dl)	92.96 ± 45.96	99.87 ± 36.31	0.001
HDL-C (mg/dl)	35.59 ± 7.89	36.75 ± 7.42	0.001

According to table 3, hemoglobin level showed a negative relationship with total cholesterol, LDL-C and TG. In addition, TIBC was found to have a significant correlation with total cholesterol and LDL-C with p values 0.010 and 0.015 respectively. While ferritin had a negative correlation with triglyceride and HDL-C.

Table 3: Correlation between the lipid profile in case

Variable		TC	LDL-C	TG	HDL-C
Iron	Correlation covariance	0.091	0.066	0.037	-0.066
	P value	0.436	0.569	0.751	0.569
TIBC	Correlation covariance	-0.294	-0.279	-0.035	-0.066
	P value	0.010	0.015	0.751	0.569
Ferritin	Correlation covariance	0.066	0.036	-0.073	-0.044
	P value	0.571	0.759	0.533	0.703
Hemoglobin	Correlation covariance	-0.116	-0.198	-0.065	0.112
	P value	0.320	0.086	0.579	0.337

DISCUSSION

In the present study, the association between lipid profile; total cholesterol, triglyceride, HDL-C, and LDL-C was studying in iron deficiency anemia. The result showed that the values of the total cholesterol, triglyceride, HDL-C, and LDL-C in the iron-deficiency anemia group were lower than that of the control group. According to our study iron deficiency anemia occurred in populations with different age groups.

The findings of the present study concerning lipid profile are similar to that of Shirvani et al., who reported that values of lipid profile including triglyceride and cholesterol were lower in IDA than control even after taking into account the effects of age, gender, and BMI.[13] Study done by Choi et al, also, showed lower total cholesterol and triglyceride levels in severe IDA young Korean girls which went to normal after iron therapy.[11] Similarly, a study done in sickle cell anemia by El-Hazmi et al reported a significantly lower level of cholesterol.[15]

Although our study showed significantly lower total cholesterol and triglyceride levels, Nandyala et al reports IDA group had a significantly abnormal lipid profile with an elevated level of total cholesterol, triglyceride, LDL-C, and VLDL-C. However, after iron supplement treatment there was a significant reduction in triglyceride and VLDL-C along with a lower level of total cholesterol and LDL-C.[16]Likewise, Ohira, et al, the result showed increased serum cholesterol level following the increased hemoglobin through blood transfusion and commenting that the amount of red blood cells probably affects cholesterol synthesis or its displacement from tissue to plasma.[17]

Studies of the association of serum lipid profile with IDA have shown disparate reports. In a study done by Bobade et al., there was a correlation between serum iron levels and increased triglyceride, LDL-C, and VLDL-C levels.[18] The study done by Verma et al, Maram et al, Ghasem et al., anemic patients' blood Hb concentrations were positively correlated with serum total cholesterol and TG concentration.[19,20]However, our study showed a negative correlation between hemoglobin and TC, LDL-C, and TG. And, a significant negative correlation between TIBC, TC, and LDL-C with hemoglobin. This was consistent with the study done by Maram et al.[19]

When defining mechanisms underlying dyslipidemia in IDA, high TG levels have been explained based on impaired carnitine biosynthesis together with the increased synthesis and decreased TG degradation in IDA. While lower serum cholesterol has been related to being due to decreased hepatic synthesis or the dilutional effect of serum. The exact mechanism by which iron regulates or functions in lipid metabolism has not yet been established.[21]

Several factors may lead to hypocholesterolemia with anemia such as plasma dilution, increased erythropoiesis leading to increased cholesterol demand, activation of macrophage system with the release of cytokines as well as increased uptake of cholesterol by the reticuloendothelial system. Thus, anemia may have a protective effect on lipid profile, thereby reducing the risk of CAD.[12] The study done in mice with increased hepatic iron store showed upregulation of several enzymes, including the rate-limiting enzyme of cholesterol biosynthesis "HMG-COA reductase". This fact suggests that hepatic iron loading increases liver cholesterol synthesis. So, iron deficiency may lead to interference with the lipid metabolism.[22]

CONCLUSIONS

In this study, the values of the lipid profile parameters: triglyceride, low-density lipoprotein, high-density lipoprotein, and total cholesterol in cases were found to be lower than that in the controls.

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