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Is there any relationship between triglyceride and hemogram indices in insulin resistance?

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ABSTRACT

Objectives: We aimed to evaluate the correlation of triglyceride (TG) level with hemogram and biochemical parameters in non-diabetic but insulin resistant and non-insulin resistant obese patients.

Methods: Patients with diabetes, neurological, cardiac and rheumatological diseases were not included in the study. Statistical analysis was performed by recording the hemogram and all biochemical parameters of the patients. The patients were divided into 2 groups. Patients with a HOMA-IR level below 2.7 in group 1 and patients with a HOMA-IR level above 2.7 in group 2.

Results: 70 patients were selected for our study. 24 of these were assigned as those without insulin resistance and were named Group 1 and 46 of these patients were assigned as those with insulin resistance were named Group 2. TG level was found to be lower in Group 1(80.05 + 32.17) compared to Group 2 (176.67 + 16.21) (p = 0.0001).

There was no significant correlation between TG level and hemogram parameters in group 1. In Group 2, TG level and hematocrit (r = 0.475; p = 0.001) showed a significant positive correlation, while platelet lymphocyte ratio (r = 0.474; p = 0.001) showed a significant negative correlation. In Group 2, TG and ferritin (r = 0.421; p = 0.004) showed a significant positive correlation.

Conclusion: In obese patients without diabetes, triglyceride levels were found to be high in those with high insulin resistance. The significant correlation of triglyceride level with hct, PLR and ferritin in insulin resistance reveals the importance of these parameters in the atherosclerotic process.

Keywords: Insulin Resistance, Triglycerides, Hematocrit, Lymphocytes, Blood Platelets, Ferritin

Insulin resistance is an important and reversible risk factor for diabetes. [1] Hypertriglyceridemia (HTG) has an important place in metabolic disorders. Lifestyle factors and genetic play important role in the pathophysiology of hypertriglyceridemia. HTG, in cases of accompanying insulin resistance, is an indispensable fact that cardiovascular diseases (CVD) are also increasing. [2] HTG is also a risk for the formation of pancreatitis. [3] In this study, we performed evaluated the relationship between biochemical parameters and hemogram with TG levels, especially in patients with and without insulin resistance.

METHODS

Patients aged 18-75 years were included in this study. Patients with cardiac, rheumatological, neu-

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rological, diseases, diabetes, and malignancies were not included. Hemogram and all biochemical parameters of the patients were recorded as laboratory findings studied in a single center when they applied to the internal medicine clinic. Patients divided into two groups: Group 1 patients with HOMA-IR level below 2.7; Group 2 Patients HOMA-IR level above 2,7. In these groups, triglyceride levels was compared with hemogram parameters such as hb (hemoglobin), Hct (hematocrit), MCV (mean erythrocyte volume), platelet, MPV (mean platelet volume), PDW (platelet distribution width), WBC (leukocyte), lymphocyte, neutrophil, PLR (platelet/lymphocyte ratio). NLR (neutrophil/lymphocyte ratio) Triglyceride levels were also compared with other biochemical parameters such as age, BMI (body mass index), ALT (alanine aminotransferase), AST (aspartate aminotransferase), GGT (gammaglutamyl transferase), FBC (fasting blood sugar), HOMA-IR (Insulin resistance), Insulin, HbA1C was BUN (blood urea nitrogen), Creatinine, HDL (high-density lipoprotein), LDL (low-density lipoprotein), ferritin, TSH (Thyroid-stimulating hormone) and CRP (C-reactive Protein).

T test was used for statistical comparison. SPSS for Windows V.24.0 (SPSS Inc. Chicago, IL) package program was used for statistical evaluations. Obtained values were given as mean ± standard deviation or as numbers and percentages. The level of significance in the evaluations was accepted as $p < 0.05$. Whether the data met the parametric conditions for the measurement variables of the two groups was evaluated using the Kolmogorov Smirnov Test.

The values of the measurement variables were compared between groups using the Student's t-test, those that did not fit the normal distribution, and the Mann-Whitney-U test. Spearman was used in correlation analysis and kruskal valis was used in comparison of 2 different groups.

RESULTS

70 patients were selected for our study. 24 of these were assigned as those without insulin resistance and were named Group 1 and 46 of these patients were assigned as those with insulin resistance were named Group 2. TG level was found to be lower in Group 1(80.05 + 32.17) compared to Group 2 (176.67 + 16.21) ($p = 0.0001$). Group 2 was accepted as HTG. While no significant correlation was found between TG level and hemogram parameters in Group 1, Hb (r = 0.404; $p = 0.005$), Hct (r = 0.475; $p = 0.001$), MCV (r = 0.424; $p = 0.003$), in Group 2, WBC (r = 0.335; $p = 0.023$) showed a significant positive correlation with lymphocyte (r = 0.406; $p = 0.005$), while it showed a significant negative correlation with PLR (r = 0.474; $p = 0.001$) (Table 1).In the correlation analysis between triglyceride and biochemical parameters, TG showed a positive correlation with age (r = 0.429; $p = 0.036$) and TSH (r = 0.441; $p = 0.031$) in Group 1, while ALT (r = -0.473; $p = 0.020$) showed a negative correlation with In Group 2, TG and AST (r = 0.350; $p = 0.017$), ALT (r = 0.353; $p = 0.016$), GGT (r = 0.381; $p = 0.009$), BUN (r = 0.365; $p = 0.013$), Positive with creatinine (r = 0.286; $p = 0.054$), Total cholesterol (r = 0.567; $p = 0.0001$), LDL (r = 0.531; $p = 0.0001$) and

Table 1. Correlation of triglyceride level with hemogram parameters

Triglyceride	Group 1 n = 24		Group 2 n = 46	
	R value	*P* value	R value	*P* value
Hemoglobin	-0.017	0.935	0.404**	**0.005**
Hematocrit	-0.216	0.311	0.475**	**0.001**
MCV	0.211	0.322	0.424**	**0.003**
Platelet	0.205	0.336	-0.035	0.816
PDW	0.223	0.296	0.007	0.962
MPV	-0.107	0.620	-0.013	0.932
Leucocyte	0.140	0.514	0.335*	**0.023**
Neutrophil	0.038	0.861	0.079	0.602
Lymphocyte	0.084	0.695	0.406**	**0.005**
NLR	-0.073	0.736	-0.233	0.119
PLR	0.071	0.740	-0.474**	**0.001**

MCV: mean corpuscular volume; PDW: platelet distribution width; MPV: mean platelet volume; NLR: neutrophils/lymphocyte ratio; PLR: platelet/lymphocyte ratio

Table 2. Correlation of triglyceride level with biochemical parameters

Triglyceride	Group 1 n = 24		Group 2 n = 46	
	R value	*P* value	R value	*P* value
Age	0.429*	**0.036**	0.096	0.524
BMI	-0.137	0.524	0.038	0.800
AST	-0.243	0.253	0.350*	**0.017**
ALT	-0.473*	**0.020**	0.353*	**0.016**
GGT	-0.110	0.608	0.381**	**0.009**
Glucose	0.040	0.854	0.268	0.072
Insulin	0.156	0.467	0.049	0.748
HOMA-IR	0.131	0.542	0.223	0.136
HbA1c	-0.245	0.249	0.223	0.137
BUN	0.045	0.835	0.365*	**0.013**
Creatinine	-0.376	0.070	0.286	**0.054**
Total cholesterol	0.345	0.099	0.567**	**0.000**
LDL	0.221	0.300	0.531**	**0.000**
HDL	-0.251	0.248	-0.496**	**0.000**
TSH	0.441*	**0.031**	0.196	0.192
Ferritin	-0.122	0.571	0.421**	**0.004**
CRP	0.365	0.080	-0.206	0.170

BMI: Body mass index; AST: Aspartate aminotransferase; ALT: Alanine aminotransferase; GGT: γ-glutamyl transferase; HOMA-IR: homeostasis model assessment of insulinresistance; HbA1c: Hemoglobin A1c; BUN: blood urea nitrogen; LDL: low density lipoprotein-cholesterol; HDL: high density lipoprotein cholesterol;TSH: thyroid-stimulating hormone ;CRP: C-reactive protein

ferritin (r = 0.421; $p = 0.004$) while it correlated negatively with HDL (r = -0.496; $p = 0.0001$) (Table 2).

DISCUSSION

In this study, we evaluated the relationship between HTG and hemogram indices in patients with insulin resistance. The main link in this relationship may be inflammation and oxidative stress. Blood cell count is a commonly applied detection method. Among the blood cells, white blood cell count (WBC) and erythrocyte blood cell (RBC) count are associated with insulin resistance and metabolic syndrome. [4-6] In this study, we also found that HTG in patients with insulin resistance; we found that it showed positive correlation with WBC, lymphocyte, Hb and Hct. We did not find a relationship between TG and hemogram parameters in our control group patients without insulin resistance. Hct is the most important determining factor for blood flow velocity. If Hct is elevated, blood viscosity increases markedly, which also reduces blood flow velocity and glucose delivery from the blood to the muscles. This leads to insulin resistance. [7] In fact, some studies have found that phlebotomy significantly improves insulin resistance and diabetes. [8, 9] When hypertriglyceridemia is added to it, blood viscosity increases even more. [10]

Total white blood cell, subtypes and their ratios (Neutrophil, Platelet, Eosinophil-Lymphocyte ratio; NLR, PLR, ELR ratio) in other blood parameters have been used as an indicator of chronic inflammation recently. [11-16] PLR is an inflammatory parameter that has been defined in recent years and can be easily calculated from a complete blood count. It has been reported that severity of inflammation is associated with the high PLR. [17] In our study, we found that HTG showed a negative correlation with the PLR. PLR is an indicator that shows changes in lymphocyte and platelet counts due to prothrombotic and acute inflammatory conditions. PLR has been studied, especially in neoplastic diseases accompanied by thrombosis and immunosuppression. In the literature, it has been suggested that PLR has prognostic importance in cardiovascular diseases and diabetes mellitus, hypertension, hepatic cirrhosis, familial Mediterranean fever and malignancies. [18] Many large-scale studies have used the variation in PRL to predict the severity of inflammation in rheumatic diseases. [19]

Ferritin concentration, another parameter of ours, is

associated with metabolic syndrome [20, 21] and non-alcoholic hepatosteatosis; [22] and these abnormalities can also lead to carotid atherosclerosis. [23] In our study, it was found that TG levels were positively correlated with ferritin in patients with insulin resistance. In a study, it was found that insulin resistance and liver enzyme levels improved when iron was removed by phlebotomy in patients with familial hypertriglyceridemia. [24] Looking at other parameters, high serum LDL cholesterol level is an important risk factor for cardiovascular disease (CVD), especially for coronary artery disease.

Lowering LDL cholesterol levels lowers the risks of CVD and reduces its mortality and morbidity. [25-26] However, the role of high triglyceride levels in CVD is still controversial. The atherogenic effect of triglycerides has long been unclear. Controversy over hypertriglyceridemia as an independent risk factor for CVD has arisen in part because high triglyceride levels are often a component of atherogenic dyslipidemia, which are associated with increased levels of LDL cholesterol and lower HDL cholesterol levels. Today, however, results from large studies show that high levels of fasted or fed triglycerides, particularly triglyceride-rich lipoproteins, and their residues, are independently associated with an increased risk of CVD. [27, 28] In our study, we found that high TG levels were associated with hypercholesterolemia and negatively correlated with HDL cholesterol levels. The presence of hypercholesterolemia and hypertriglyceridemia in insulin resistant patients are serious risk factors for CVD.

HTG is also associated with non-alcoholic fatty liver disease, and studies have shown that it is more associated with fatty liver, especially when compared to other LDL and HDL cholesterol. [29, 30] We compared triglyceride and liver enzymes, and we found a positive correlation in our study.

CONCLUSION

As a result, TG levels were found to be associated with both hemogram parameters (Hb, Hct, lymphocyte, PRL) and other biochemical parameters (such as cholesterol levels, liver enzymes and ferritin) in patients with insulin resistance when compared with the control group. In some previous studies, it was thought that these values may be related to each other, especially since they are components of the metabolic syndrome. So, to reduce both insulin resistance and TG levels, first of all, dieting, especially reducing carbohydrate intake; doing regular exercise, using drugs that reduce TG levels and reduce insulin resistance will be a precaution for future CVD.

In obese patients without diabetes, triglyceride levels were found to be high in those with high insulin resistance. The significant correlation of triglyceride level with hct, PLR and ferritin in insulin resistance reveals the importance of these parameters in the atherosclerotic process.

Authorship Contributions

Concept: S.C., O.O, Data Collection or Processing: S.C., Analysis or Interpretation: O.O., Literature Search: S.C., Writing: S.C., O.O.

Financial Disclosure

The authors declared that this study received no financial support.

Conflict of Interest

No conflict of interest was declared by the authors.

REFERENCES

1. Ndisang JF, Rastogi S, Vannacci A. Insulin Resistance, Type 1 and Type 2 Diabetes, and Related Complications 2015. J Diabetes Res. 2015;2015:234135. doi: 10.1155/2015/234135. Epub 2015 Jul 28.
2. Nordestgaard BG, Benn M, Schnohr P, Tybjaerg-Hansen A. Nonfasting triglycerides and risk of myocardial infarction, ischemic heart disease, and death in men and women. JAMA. 2007 Jul 18;298(3):299-308. doi: 10.1001/jama.298.3.299.
3. Lahoz C, Mostaza JM. Familial hypertriglyceridemia/polygenic hypertrigliceridemia. Clin Investig Arterioscler. 2021 May;33 Suppl 2:37-42. English, Spanish. doi: 10.1016/j.arteri.2020.12.014.
4. Barbieri M, Ragno E, Benvenuti E, Zito GA, Corsi A, Ferrucci L, Paolisso G. New aspects of the insulin resistance syndrome: impact on haematological parameters. Diabetologia. 2001 Oct;44(10):1232-7. doi: 10.1007/s001250100634.
5. Fan X, Liu EY, Freudenreich O, Park JH, Liu D, Wang J, Yi Z, Goff D, Henderson DC. Higher white blood cell counts are associated with an increased risk for metabolic syndrome and more severe psychopathology in non-diabetic patients with schizophrenia. Schizophr Res. 2010 May;118(1-3):211-7. doi: 10.1016/j.schres.2010.02.1028.
6. Phillips AC, Carroll D, Gale CR, Drayson M, Thomas GN, Batty GD. Lymphocyte sub-population cell counts are associated with the metabolic syndrome and its components in the Vietnam Experience Study. Atherosclerosis. 2010 Nov;213(1):294-8. doi: 10.1016/j.atherosclerosis.2010.08.047.
7. Moan A, Nordby G, Os I, Birkeland KI, Kjeldsen SE. Relationship between hemorrheologic factors and insulin sensitivity in healthy young men. Metabolism. 1994 Apr;43(4):423-7. doi:

10.1016/0026-0495(94)90070-1. Erratum in: Metabolism 1994 Jul;43(7):929.
8. Fernández-Real JM, Peñarroja G, Castro A, García-Bragado F, Hernández-Aguado I, Ricart W. Blood letting in high-ferritin type 2 diabetes: effects on insulin sensitivity and beta-cell function. Diabetes. 2002 Apr;51(4):1000-4. doi: 10.2337/diabetes.51.4.1000.
9. Luque-Ramírez M, Alvarez-Blasco F, Botella-Carretero JI, Sanchón R, San Millán JL, Escobar-Morreale HF. Increased body iron stores of obese women with polycystic ovary syndrome are a consequence of insulin resistance and hyperinsulinism and are not a result of reduced menstrual losses. Diabetes Care. 2007 Sep;30(9):2309-13. doi: 10.2337/dc07-0642.
10. Wu HC, Lee LC, Wang WJ. Plasmapheresis for hypertriglyceridemia: The association between blood viscosity and triglyceride clearance rate. J Clin Lab Anal. 2019 Feb;33(2):e22688. doi: 10.1002/jcla.22688.
11. Kim HS, Jung J, Dong SH, Kim SH, Jung SY, Yeo SG. Association Between High Neutrophil to Lymphocyte Ratio and Delayed Recovery From Bell's Palsy. Clin Exp Otorhinolaryngol. 2019 Aug;12(3):261-266. doi: 10.21053/ceo.2018.01018.
12. Angkananard T, Anothaisintawee T, McEvoy M, Attia J, Thakkinstian A. Neutrophil Lymphocyte Ratio and Cardiovascular Disease Risk: A Systematic Review and Meta-Analysis. Biomed Res Int. 2018 Nov 11;2018:2703518. doi: 10.1155/2018/2703518.
13. Mochimaru T, Ueda S, Suzuki Y, Asano K, Fukunaga K. Neutrophil-to-lymphocyte ratio as a novel independent predictor of severe exacerbation in patients with asthma. Ann Allergy Asthma Immunol. 2019 Mar;122(3):337-339.e1. doi: 10.1016/j.anai.2018.11.029.
14. Renaud S, Seitlinger J, St-Pierre D, Garfinkle R, Al Lawati Y, Guerrera F, Ruffini E, Falcoz PE, Massard G, Ferri L, Spicer J. Prognostic value of neutrophil to lymphocyte ratio in lung metastasectomy for colorectal cancer. Eur J Cardiothorac Surg. 2019 May 1;55(5):948-955. doi: 10.1093/ejcts/ezy388.
15. Hasselbalch IC, Søndergaard HB, Koch-Henriksen N, Olsson A, Ullum H, Sellebjerg F, Oturai AB. The neutrophil-to-lymphocyte ratio is associated with multiple sclerosis. Mult Scler J Exp Transl Clin. 2018 Nov 28;4(4):2055217318813183. doi: 10.1177/2055217318813183.
16. Cho Y, Kim JW, Yoon HI, Lee CG, Keum KC, Lee IJ. The Prognostic Significance of Neutrophil-to-Lymphocyte Ratio in Head and Neck Cancer Patients Treated with Radiotherapy. J Clin Med. 2018 Dec 3;7(12):512. doi: 10.3390/jcm7120512.
17. Elbistanli MS, Koçak HE, Acipayam H, Yiğider AP, Keskin M, Kayhan FT. The Predictive Value of Neutrophil-Lymphocyte and Platelet-Lymphocyte Ratio for the Effusion Viscosity in Otitis Media With Chronic Effusion. J Craniofac Surg. 2017 May;28(3):e244-e247. doi: 10.1097/SCS.0000000000003452.
18. Kara A, Guven M, Yilmaz MS, Demir D, Elden H. Are neutrophil, platelet and eosinophil-to-lymphocyte ratio and red blood cell distribution width can be used for nasal polyposis? Eur Arch Otorhinolaryngol. 2018 Feb;275(2):409-413. doi: 10.1007/s00405-017-4821-3.
19. Gasparyan AY, Ayvazyan L, Mukanova U, Yessirkepov M, Kitas GD. The Platelet-to-Lymphocyte Ratio as an Inflammatory Marker in Rheumatic Diseases. Ann Lab Med. 2019 Jul;39(4):345-357. doi: 10.3343/alm.2019.39.4.345.
20. Bozzini C, Girelli D, Olivieri O, Martinelli N, Bassi A, De Matteis G, Tenuti I, Lotto V, Friso S, Pizzolo F, Corrocher R. Prevalence of body iron excess in the metabolic syndrome. Diabetes Care. 2005 Aug;28(8):2061-3. doi: 10.2337/diacare.28.8.2061.
21. Sun L, Franco OH, Hu FB, Cai L, Yu Z, Li H, Ye X, Qi Q, Wang J, Pan A, Liu Y, Lin X. Ferritin concentrations, metabolic syndrome, and type 2 diabetes in middle-aged and elderly chinese. J Clin Endocrinol Metab. 2008 Dec;93(12):4690-6. doi: 10.1210/jc.2008-1159.
22. Trombini P, Piperno A. Ferritin, metabolic syndrome and NAFLD: elective attractions and dangerous liaisons. J Hepatol. 2007 Apr;46(4):549-52. doi: 10.1016/j.jhep.2007.01.004.
23. Kim HC, Kim DJ, Huh KB. Association between nonalcoholic fatty liver disease and carotid intima-media thickness according to the presence of metabolic syndrome. Atherosclerosis. 2009 Jun;204(2):521-5. doi: 10.1016/j.atherosclerosis.2008.09.012.
24. Valenti L, Fracanzani AL, Dongiovanni P, Bugianesi E, Marchesini G, Manzini P, Vanni E, Fargion S. Iron depletion by phlebotomy improves insulin resistance in patients with nonalcoholic fatty liver disease and hyperferritinemia: evidence from a case-control study. Am J Gastroenterol. 2007 Jun;102(6):1251-8. doi: 10.1111/j.1572-0241.2007.01192.x.
25. Reiner Ž. Statins in the primary prevention of cardiovascular disease. Nat Rev Cardiol. 2013 Aug;10(8):453-64. doi: 10.1038/nrcardio.2013.80.
26. Graham I, Cooney MT, Bradley D, Dudina A, Reiner Z. Dyslipidemias in the prevention of cardiovascular disease: risks and causality. Curr Cardiol Rep. 2012 Dec;14(6):709-20. doi: 10.1007/s11886-012-0313-7.
27. Chapman MJ, Ginsberg HN, Amarenco P, Andreotti F, Borén J, Catapano AL, Descamps OS, Fisher E, Kovanen PT, Kuivenhoven JA, Lesnik P, Masana L, Nordestgaard BG, Ray KK, Reiner Z, Taskinen MR, Tokgözoglu L, Tybjærg-Hansen A, Watts GF; European Atherosclerosis Society Consensus Panel. Triglyceride-rich lipoproteins and high-density lipoprotein cholesterol in patients at high risk of cardiovascular disease: evidence and guidance for management. Eur Heart J. 2011 Jun;32(11):1345-61. doi: 10.1093/eurheartj/ehr112.
28. Do, R., Willer, C. J., Schmidt, E. M., Sengupta, S., Gao, C., Peloso, G. M., Gustafsson, S., Kanoni, S., Ganna, A., Chen, J., Buchkovich, M. L., Mora, S., Beckmann, J. S., Bragg-Gresham, J. L., Chang, H. Y., Demirkan, A., Den Hertog, H. M., Donnelly, L. A., Ehret, G. B., Esko, T., … Kathiresan, S. Common variants associated with plasma triglycerides and risk for coronary artery disease. Nature genetics, 2013 45(11), 1345–1352. https://doi.org/10.1038/ng.2795
29. Ma H, Xu C, Xu L, Yu C, Miao M, Li Y. Independent association of HbA1c and nonalcoholic fatty liver disease in an elderly Chinese population. BMC Gastroenterol. 2013 Jan 7;13:3. doi: 10.1186/1471-230X-13-3. PMID: 23294935; PMCID: PMC3543719.
30. Sung KC, Kim BS, Cho YK, Park DI, Woo S, Kim S, Wild SH, Byrne CD. Predicting incident fatty liver using simple cardio-metabolic risk factors at baseline. BMC Gastroenterol. 2012 Jul 6;12:84. doi: 10.1186/1471-230X-12-84.