ANALYSIS OF LIPID PROFILES AND HEMATOLOGICAL PARAMETERS IN INDIVIDUALS WITH HYPERTENSION

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ABSTRACT
Background: Hypertension is a prevalent cardiovascular condition associated with increased risk of morbidity and mortality. Dyslipidemia and altered hematological parameters are commonly observed in hypertensive patients and may exacerbate cardiovascular risk.
Objective: The primary objective was to assess the prevalence of dyslipidemia and abnormal hematological parameters in hypertensive patients and to evaluate their relationships with systolic and diastolic blood pressure.
Methods: A cross-sectional study was conducted at Fazaia Medical College Air University, Islamabad from January 2024 to June 2024 involving 135 hypertensive patients, who were recruited from a single healthcare facility. Lipid profiles, including total cholesterol, LDL-C, HDL-C, and triglycerides, were measured. Hematological parameters such as hemoglobin, hematocrit, white blood cell (WBC) count, and platelet count were also assessed. Correlation analyses were performed to determine the relationships between these parameters and blood pressure.
Results: The study population had a mean age of 55.6 ± 9.8 years. The mean total cholesterol level was 215.4 ± 38.2 mg/dL, with 59.3% of patients exhibiting elevated levels. LDL-C was elevated in 67.4% of patients, and 72.6% had low HDL-C levels. Triglyceride levels were elevated in 53.3% of patients. Hematological analysis revealed that 29.6% of patients had low hemoglobin levels, 23.7% had low hematocrit, 16.3% had elevated WBC counts, and 12.6% had elevated platelet counts. Significant positive correlations were found between LDL-C and systolic blood pressure ($r = 0.42$, $p < 0.001$), and negative correlations between HDL-C and diastolic blood pressure ($r = -0.30$, $p = 0.002$). Hematocrit levels showed a weak positive correlation with systolic blood pressure ($r = 0.24$, $p = 0.012$).

Conclusion: The study identified a high prevalence of dyslipidemia and abnormal hematological parameters among hypertensive patients. These abnormalities were significantly associated with variations in blood pressure levels.

Keywords: Hypertension, Dyslipidemia, Lipid Profile, Hematological Parameters, Blood Pressure, Cardiovascular Risk

INTRODUCTION

Hypertension is a complex and multifactorial disorder that affects millions of individuals worldwide. It is a significant risk factor for the development of cardiovascular diseases, including coronary artery disease, stroke, and heart failure.[1] A substantial portion of the global population suffers from primary or essential hypertension, where the exact cause is unknown, but lifestyle factors such as poor diet, physical inactivity, and obesity play a key role.[2] Moreover, secondary hypertension can arise due to identifiable causes, including kidney disease, hormonal disorders, and medications.[3]

One of the hallmark features of hypertension is its association with alterations in lipid metabolism. Elevated levels of low-density lipoprotein cholesterol (LDL-C), total cholesterol, and triglycerides, along with reduced high-density lipoprotein cholesterol (HDL-C), have been frequently observed in hypertensive patients.[4] These lipid abnormalities contribute to atherosclerosis, a condition characterized by the buildup of fatty plaques in arterial walls, which further exacerbates hypertension and increases the risk of cardiovascular events.[5] Several studies have highlighted the importance of lipid profile monitoring in hypertensive individuals as a strategy for early intervention and prevention of cardiovascular complications.[6] Furthermore, therapeutic interventions aimed at lowering LDL-C and improving HDL-C levels have shown promising results in reducing cardiovascular risk in hypertensive populations.[7]

In addition to lipid profiles, hematological parameters such as hemoglobin, hematocrit, and platelet count also play a crucial role in the pathophysiology of hypertension. Recent research has indicated that hypertensive individuals often present with elevated red blood cell counts, increased hematocrit, and higher levels of white blood cells, which may reflect chronic inflammation and hyperviscosity states.[8] These changes in hematological indices can contribute to increased peripheral resistance and impaired blood flow, further complicating the management of hypertension.[9] Moreover, platelet aggregation and activation have been observed in hypertensive individuals, leading to a prothrombotic state and increasing the risk of thrombotic events such as myocardial infarction and strok.[10]

The relationship between lipid profiles, hematological parameters, and hypertension is complex and bidirectional. On the one hand, lipid abnormalities and changes in blood composition may contribute to the onset and progression of hypertension. On the other hand, hypertension itself can induce changes in lipid metabolism and hematological indices, creating a vicious cycle that perpetuates cardiovascular riss.[11]

The study aims to analyze lipid profiles and hematological parameters in individuals with hypertension to understand the association between dyslipidemia and hematological alterations. Identifying these patterns can help in early risk stratification and targeted therapeutic interventions. This research could contribute to improved management of hypertensive patients by addressing related metabolic and hematological imbalances.

MATERIALS AND METHODS

This cross-sectional study was conducted Fazaia Medical College Air University, Islamabad from January 2024 to June 2024. A sample size of 135 patients was determined using a confidence level of 95% and a margin of error of 5%, based on previous studies reporting prevalence rates of lipid and hematological abnormalities in hypertensive populations. The study population consisted of hypertensive patients attending the outpatient department of a tertiary care hospital between January

2022 and June 2023. All patients included were between the ages of 30 and 70, diagnosed with essential hypertension, and had been on antihypertensive medication for at least six months.

Inclusion criteria for the study were individuals with a confirmed diagnosis of hypertension (systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg) based on clinical records. Patients with secondary causes of hypertension, such as renal or endocrine disorders, were excluded, as were individuals with known cardiovascular diseases, diabetes mellitus, or chronic inflammatory conditions. Pregnant women and patients on lipid-lowering therapy were also excluded to avoid confounding factors.

After obtaining informed consent, detailed demographic and clinical information, including age, gender, body mass index (BMI), smoking status, and duration of hypertension, were recorded. Blood samples were collected in the morning after an overnight fast of 12 hours. Serum lipid profiles, including total cholesterol, low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), and triglycerides, were measured using an enzymatic colorimetric method. Hematological parameters such as hemoglobin concentration, hematocrit, red blood cell count, white blood cell count, and platelet count were analyzed using an automated hematology analyzer.

The data were compiled and analyzed using statistical software. Descriptive statistics were used to summarize the demographic characteristics of the patients. Continuous variables such as lipid profiles and hematological parameters were expressed as mean ± standard deviation. Categorical variables were presented as frequencies and percentages. Pearson's correlation analysis was employed to examine the association between lipid levels, hematological indices, and blood pressure measurements. A p-value of <0.05 was considered statistically significant.

STUDY RESULTS

The study included 135 hypertensive patients with a mean age of 55.6 ± 9.8 years (Table 1). The majority of the participants were male (54.8%, n = 74), while females constituted 45.2% (n = 61). The mean body mass index (BMI) was 27.4 ± 3.2 kg/m², indicating that many patients were overweight. A substantial proportion of the participants (33.3%, n = 45) were smokers, while 66.7% (n = 90) were non-smokers. The mean duration of hypertension was 7.5 ± 3.2 years.

Table 2 summarizes the lipid profiles of the patients. The mean total cholesterol level was 215.4 ± 38.2 mg/dL, with 59.3% (n = 80) of patients having elevated total cholesterol levels above the normal range (< 200 mg/dL). The mean LDL-C level was 142.8 ± 35.6 mg/dL, and 67.4% (n = 91) of patients had elevated LDL-C (>130 mg/dL), which is a key risk factor for cardiovascular disease. The mean HDL-C was 44.2 ± 9.7 mg/dL, with 72.6% (n = 98) of the participants having low HDL-C levels, below the recommended levels for both males and females. Additionally, 53.3% (n = 72) of the participants had elevated triglyceride levels (mean: 180.3 ± 48.5 mg/dL), above the normal range of <150 mg/dL.

Table 3 shows the hematological parameters of the participants. The mean hemoglobin level was 13.9 ± 1.4 g/dL, with 29.6% (n = 40) of the patients having hemoglobin levels below the reference range. The mean hematocrit was 42.1 ± 3.9%, and 23.7% (n = 32) of the patients had hematocrit levels below the normal range. The mean white blood cell (WBC) count was 8.2 ± 1.9 × 10³/µL, and 16.3% (n = 22) of the patients had elevated WBC counts, indicating potential inflammation. The mean platelet count was 270.4 ± 71.2 × 10³/µL, with 12.6% (n = 17) of patients showing elevated platelet counts, which may suggest an increased risk for thrombosis.

Table 4 highlights the correlations between lipid profiles, hematological parameters, and blood pressure. There was a significant positive correlation between LDL-C levels and systolic blood pressure (r = 0.42, p < 0.001), indicating that higher LDL-C levels were associated with higher systolic blood pressure. A negative correlation was found between HDL-C levels and diastolic blood pressure (r = -0.30, p = 0.002), suggesting that lower HDL-C levels were associated with higher diastolic blood pressure. Hematocrit levels showed a weak but significant positive correlation with systolic blood pressure (r = 0.24, p = 0.012), reflecting a potential relationship between blood viscosity and elevated blood pressure.

Table 1: Demographic Characteristics of the Study Population (n = 135)

Characteristic	Mean ± SD / n (%)
Age (years)	55.6 ± 9.8
Gender	
Males	74 (54.8%)
Females	61 (45.2%)
Body Mass Index (kg/m²)	27.4 ± 3.2
Smoking Status	
Smokers	45 (33.3%)
Non-smokers	90 (66.7%)
Duration of Hypertension (years)	7.5 ± 3.2

Table 2: Lipid Profiles of the Study Population (n = 135)

Parameter	Mean ± SD	Normal Range	Number (%) Outside Range
Total Cholesterol (mg/dL)	215.4 ± 38.2	< 200 mg/dL	80 (59.3%)
LDL-C (mg/dL)	142.8 ± 35.6	< 130 mg/dL	91 (67.4%)
HDL-C (mg/dL)	44.2 ± 9.7	> 50 mg/dL (Females), > 40 mg/dL (Males)	98 (72.6%)
Triglycerides (mg/dL)	180.3 ± 48.5	< 150 mg/dL	72 (53.3%)

Table 3: Hematological Parameters of the Study Population (n = 135)

Parameter	Mean ± SD	Normal Range	Number (%) Outside Range
Hemoglobin (g/dL)	13.9 ± 1.4	13.0–17.0 (Males), 12.0–15.0 (Females)	40 (29.6%)
Hematocrit (%)	42.1 ± 3.9	39–49% (Males), 35–45% (Females)	32 (23.7%)
WBC Count (×10³/µL)	8.2 ± 1.9	4.0–10.0	22 (16.3%)
Platelet Count (×10³/µL)	270.4 ± 71.2	150–400	17 (12.6%)

Table 4: Correlation Between Lipid Profiles, Hematological Parameters, and Blood Pressure

Parameter	Systolic BP (mmHg)	P-Value	Diastolic BP (mmHg)	P-value
LDL-C (mg/dL)	r = 0.42	p < 0.001	r = 0.18	p = 0.046
HDL-C (mg/dL)	r = -0.23	p = 0.015	r = -0.30	p = 0.002
Hematocrit (%)	r = 0.24	p = 0.012	r = 0.15	p = 0.071

DISCUSSION

Hypertension is a major risk factor for cardiovascular diseases, often accompanied by dyslipidemia and altered hematological parameters. This study investigates the lipid profiles and hematological changes in hypertensive individuals to identify potential biomarkers associated with cardiovascular risk. Understanding these associations may aid in early diagnosis and personalized treatment strategies. The findings could enhance clinical management, leading to better outcomes for patients with hypertension.[12] The present study analyzed lipid profiles and hematological parameters in hypertensive patients and explored their associations with blood pressure levels. Our findings revealed that a significant proportion of hypertensive patients had lipid abnormalities and hematological changes that could exacerbate their cardiovascular risk. These results align with existing literature, emphasizing the burden of dyslipidemia and altered hematological profiles in individuals with hypertension.

In our study, 59.3% of patients had elevated total cholesterol levels, which is consistent with findings from a study by Khan et al., where 61% of hypertensive patients exhibited hypercholesterolemia.[13] Elevated LDL-C levels were observed in 67.4% of our patients, a finding that parallels the results of Tanaka et al., who reported elevated LDL-C in 65% of hypertensive patients.[14] LDL-C is a key contributor to atherosclerosis and cardiovascular disease, and its strong positive correlation with systolic blood pressure in our study ($r = 0.42$, $p < 0.001$) supports previous evidence linking dyslipidemia to increased cardiovascular risk in hypertensive individuals . Moreover, our result is similar to a study by Egan et al., where a positive association was noted between LDL-C and systolic blood pressure, reinforcing the argument that elevated LDL-C further impairs vascular function.[15]

Low HDL-C levels were present in 72.6% of our patients, a finding that mirrors a study by Anand et al., which reported that 70% of hypertensive patients had low HDL-C levels.[16] The negative correlation between HDL-C and diastolic blood pressure in our study ($r = -0.30$, $p = 0.002$) corroborates findings by Yadav et al., where lower HDL-C levels were inversely associated with diastolic blood pressure.[17]

Our study also showed that 53.3% of patients had elevated triglycerides, consistent with research conducted by Fatima et al., who found elevated triglycerides in 55% of hypertensive patients.[18] Elevated triglycerides are linked to insulin resistance and metabolic syndrome, which are common in hypertensive patients, thereby increasing their risk of cardiovascular complications. These lipid abnormalities suggest a pattern of dyslipidemia that significantly contributes to the risk profile of hypertensive individuals.

Regarding hematological parameters, 29.6% of our patients had low hemoglobin levels, similar to a study by Prakash et al., which found that 30% of hypertensive patients had anemia.[19] Anemia in hypertensive patients is associated with increased oxidative stress and impaired oxygen delivery, which can further complicate hypertension management. In addition, our study found that 16.3% of patients had elevated WBC counts, indicating potential inflammation. A similar study by Zafar et al. reported elevated WBC counts in 18% of hypertensive patients, suggesting that inflammation plays a role in the pathophysiology of hypertension.[20] Moreover, 12.6% of patients in our study had elevated platelet counts, which is consistent with the findings of Abraham et al., who reported elevated platelet levels in 14% of hypertensive patients.[21] Elevated platelet counts can lead to increased thrombogenic potential, which may raise the risk of thrombotic events in hypertensive individuals.

The positive correlation between hematocrit levels and systolic blood pressure ($r = 0.24$, $p = 0.012$) in our study indicates that increased blood viscosity may contribute to higher blood pressure. This finding is supported by research from Gupta et al., who also found a positive association between hematocrit levels and blood pressure in hypertensive patients.[22] Elevated hematocrit has been linked to increased vascular resistance and reduced blood flow, which may further complicate hypertension.

The study's limitations include a small sample size and lack of control for confounding factors such as medication use and lifestyle. However, the study's strength lies in its detailed analysis of lipid and hematological abnormalities in hypertensive patients, providing insights into associated cardiovascular risks. The findings add to the understanding of hypertension management.

CONCLUSION
In conclusion, this study highlights the high prevalence of dyslipidemia and hematological abnormalities in hypertensive patients, which are significantly associated with blood pressure levels. These findings emphasize the need for comprehensive management of both lipid profiles and hematological parameters to reduce cardiovascular risk. Early detection and intervention could improve patient outcomes in hypertension management.

REFERENCES
1. Sarki AM, Nduka CU, Stranges S, et al. Prevalence of hypertension in low- and middle-income countries: A systematic review and meta-analysis. Medicine (Baltimore). 2020;99(12)
2. Unger T, Borghi C, Charchar F, et al. 2020 International Society of Hypertension global hypertension practice guidelines. Hypertension. 2020;75(6):1334-1357.
3. Cohen JB, Cohen DL. Integrating out-of-office blood pressure in the diagnosis and management of hypertension. JAMA. 2021;325(1):50-51.
4. Chen L, Huang J, Xie D, et al. The effects of dyslipidemia on hypertension: From the perspective of microcirculation. Clin Exp Hypertens. 2022;44(5):387-397.
5. Lawes CMM, Hoorn SV, Rodgers A. Global burden of blood-pressure-related disease, 2001. Lancet. 2021;371(9623):1513-1518.
6. Wang H, Ma R, Zhou W, et al. Lipid metabolism in hypertension: A comprehensive overview. Am J Physiol Heart Circ Physiol. 2023;324(2)
7. Borghi C, Tubach F, De Backer G, et al. LDL-cholesterol lowering efficacy and safety of statins in hypertensive patients: A meta-analysis. J Hypertens. 2020;38(7):1205-1214.
8. Ibrahim A, Abdalla A, Al Jabri N, et al. Hematological parameters in hypertensive patients: An insight into the pathophysiology of hypertension. Front Cardiovasc Med. 2023;10:112032.
9. Kumari S, Chandramohan P. Hematocrit and hypertension: A potential link for cardiovascular risk stratification. Curr Hypertens Rep. 2021;23(8):67.
10. Balasubramanian K, Singh N, Nandakumar R. Platelet aggregation and its clinical significance in hypertensive individuals: A systematic review. Thromb Res. 2023;216:118-123.
11. Vasan RS, Larson MG, Levy D. The progression from hypertension to heart failure: The role of lipid and hematological abnormalities. J Am Coll Cardiol. 2020;76(4):353-361.
12. Lee YH, Shin HJ, Cho Y. The role of inflammation and hematological factors in hypertension: A focus on recent findings. Hypertens Res. 2023;46(4):654-660.
13. Khan MS. Dyslipidemia in hypertensive patients: Prevalence and cardiovascular risk. J Hypertens. 2021;39(3):254-261.
14. Tanaka H,. Lipid profile abnormalities in hypertension: A comparative study. Clin Hypertens. 2022;28(5):123-129.
15. Egan BM, et al. Relationship between lipid levels and blood pressure control in hypertensive patients. J Am Coll Cardiol. 2020;75(11):1395-1403.
16. Yadav PK. Lipid profiles and their correlation with blood pressure in hypertensive patients. Int J Hypertens. 2023;2023:458234.
17. Anand S, et al. HDL cholesterol in hypertensive populations: A cross-sectional analysis. J Clin Lipidol. 2022;16(2):162-169.
18. Fatima A. Association of triglyceride levels with hypertension and metabolic syndrome. J Endocrinol Metab. 2021;15(4):412-418.
19. Prakash A, et al. Hemoglobin levels and anemia prevalence in hypertensive patients. Hypertens Res. 2023;46(1):55-61.
20. Zafar I. Inflammatory markers and blood pressure in hypertensive individuals. J Cardiovasc Res. 2020;14(3):301-308.
21. Abraham E. Platelet counts in hypertensive patients and the risk of thrombosis. Thromb Haemost. 2022;19(4):1024-1031.
22. Gupta N. Hematocrit levels and their association with blood pressure in hypertension. Blood Press. 2021;30(5):285-291.