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Research Article

A Comparative Study of Lipid Profile and Blood Pressure Control in Hypertensive Patients with and Without Coronary Artery Disease

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ABSTRACT

Background: Both hypertension and dyslipidemia are important risk factors for cardiovascular disease and often appear in conjunction with one another, adding to the development and progression of coronary artery disease (CAD). Identification of differences in lipid profile characteristics and blood pressure control among hypertensive patients with and without CAD may assist in improving cardiovascular risk stratification and management.

Objective: To compare the lipid profile and blood pressure control in the hypertensive patients with and without coronary artery disease.

Methods: This comparative cross-sectional study was conducted at Amna Inayat Medical College, Sheikhupura, Pakistan, and Government Kot Khawaja Saeed Teaching Hospital, Lahore, Pakistan, from January 2024 to June 2025. A total of 120 hypertensive patients were enrolled and divided equally into two groups: hypertensive patients with documented CAD (n=60) and hypertensive patients without CAD (n=60). Demographic features, clinical parameters, blood pressure reading and fasting lipid profile were evaluated. Data were analyzed with SPSS version 26.0, and the statistical significance level was set at $p<0.05$.

Results: CAD patients had significantly longer duration of hypertension and significantly older age compared to the non CAD patients. Total cholesterol (223.8±35.7 vs. 191.2±30.4 mg/dL), LDL cholesterol (145.6±27.9 vs. 117.4±23.6 mg/dL), and triglyceride levels (190.4±48.3 vs. 154.6±41.5 mg/dL) were significantly higher in the CAD group ($p<0.001$). On the other hand, there were much lower levels of HDL in CAD patients (39.2±7.8 vs. 47.8±8.9 mg/dL, $p<0.001$). Only 43.3% of CAD patients achieved adequate blood pressure control compared to 70.0% of patients without CAD ($p=0.003$).

Conclusion: Hypertensive patients with coronary artery disease have significant differences in lipid profile compared to hypertensive patients without CAD and also have poorer BP control. Dyslipidemia and hypertension should be well controlled to minimize cardiovascular risk and promote better long-term outcomes.

Keywords: Hypertension, Coronary Artery Disease, Dyslipidemia, Lipid Profile, Blood Pressure Control, Cardiovascular Risk.

INTRODUCTION

Hypertension continues to be a very common chronic cardiovascular disease and is a major cause of early morbidity and mortality throughout the world[1]. Epidemiological estimates globally indicate that at least one billion adults are already living with Hypertension and the number is steadily increasing as a result of the increasing ageing population, urbanization, sedentary lifestyle, obesity, and unhealthy eating habits[2]. Constant high levels of arterial blood pressure have harmful effects on the cardiovascular system, including endothelial damage, vascular remodeling, oxidative stress and chronic, low-grade inflammation. These pathophysiological

changes greatly contribute to cardiovascular adverse events such as myocardial infarction, stroke, heart failure, peripheral arterial disease, and chronic kidney disease. Thus, blood pressure control is a major goal in cardiovascular disease prevention and treatment[3].

The most common form of atherosclerotic cardiovascular disease is coronary artery disease (CAD) and is a leading cause of death worldwide[4]. It is a chronic condition that progresses over a period of time and involves the buildup of lipids, inflammatory cells and fibrous tissue in the walls of the coronary arteries, leading to a progressive narrowing of the lumen and reduced myocardial perfusion[5]. High blood pressure is known to accelerate endothelial dysfunction and to contribute to the development of atherosclerotic plaques and is therefore considered as one of the most important modifiable risk factors of CAD. A large number of clinical studies have shown that hypertensive people are significantly more likely to develop coronary artery disease than normotensive people[6].

Another important risk factor for cardiovascular disease and a key factor in the development and progression of atherosclerosis is dyslipidemia[7]. Abnormal lipid metabolism is characterized by elevated concentrations of total cholesterol, low-density lipoprotein cholesterol (LDL-C), and triglycerides, along with reduced levels of high-density lipoprotein cholesterol (HDL-C). LDL-C directly affects atheroma formation by depositing cholesterol in the intima of the arteries, while HDL-C has protective effects by promoting reverse cholesterol transport and thus decreasing vascular inflammation. Dyslipidemia in combination with hypertension has a synergistic impact and significantly raises the risk of cardiovascular outcomes and coronary artery disease[8,9].

The close link between hypertension, dyslipidaemia and coronary artery disease is explained by several mechanisms[10]. High blood pressure causes higher mechanical stress on the vascular endothelium, which results in endothelial dysfunction and more permeable arterial walls for the passage of circulating lipoproteins. At the same time, lipid abnormalities lead to oxidative modification of LDL particles, recruitment of inflammatory cells and formation of atherosclerotic plaques. These processes combine to promote vascular injury and lead to coronary stenosis, plaque instability and myocardial ischemia. Thus, patients with hypertension and dyslipidemia will often have a much higher cardiovascular burden than those with hypertension or dyslipidaemia alone[11,12].

Maintaining optimal blood pressure is an important consideration in cardiovascular risk reduction in patients with hypertension[13]. International guidelines currently focus on the importance of maintaining blood pressures at a target level to avoid target organ damage and prevent cardiovascular events. But it is difficult to reach the desired blood pressure level in daily clinic. Some factors may include advanced age, longstanding hypertension, noncompliance with medications, obesity, diabetes mellitus, and the presence of other cardiovascular disease. Multiple antihypertensive drugs are often needed among patients with known coronary artery disease and even with intensive treatment, patients may have suboptimal control of blood pressure[14].

There has been significant studies of the relationship between lipid abnormalities and blood pressure control. It has been suggested that dyslipidaemia may impact vascular stiffness, endothelial function and arterial compliance, and consequently blood pressure regulation. In addition, uncontrolled hypertension can be detrimental to lipid metabolism, as it can affect insulin sensitivity, inflammatory mechanisms and neurohormonal activity. The complex interaction underlines the need for a careful assessment of both lipid and blood pressure profile in hypertensive patients to assess cardiovascular risk[15,16].

The prevalence of hypertension and cardiovascular diseases like coronary artery diseases has been significantly rising in developing world including Pakistan during the past few decades. The prevalence of cardiovascular disease has increased alarmingly due to rapid urbanization, dietary changes, reduced physical activity, smoking, obesity and metabolic disorders. However, there is not much local data on how different lipid profiles and blood pressure control are among the hypertensive patients with and without coronary artery disease, although the importance of the conditions is increasing. Clinicians may be able to use this knowledge to target those at high risk for greater cardiovascular risk reduction and intervention[17,18].

Comparing hypertensive patient population with or without CAD may yield some idea about the role of dyslipidaemia and poor blood pressure control in CAD. Specific lipid

abnormalities can be identified that can help greatly in the early initiation of lipid lowering drugs and lifestyle changes for the prevention of CAD. Similarly, recognizing patterns of poor blood pressure control among CAD patients may support optimization of antihypertensive treatment strategies and improve long-term cardiovascular outcomes[19,20].

Therefore, this study was conducted to compare lipid profile parameters and blood pressure control among hypertensive patients with and without coronary artery disease. The findings of this study may contribute to improved cardiovascular risk assessment and guide evidence-based strategies for the prevention and management of coronary artery disease in hypertensive populations.

MATERIALS AND METHODS

Study Design and Setting

This comparative cross-sectional study was conducted at Amna Inayat Medical College, Sheikhupura, Pakistan, and Government Kot Khawaja Saeed Teaching Hospital, Lahore, Pakistan, over an eighteen-month period from January 2024 to June 2025. The study was undertaken to evaluate the lipid profile and blood pressure control in the hypertensive patients with and without known coronary artery disease (CAD). After approval by the ethical review committees of the participating institutions, the data collection was conducted in the outpatient and inpatient departments of these institutions.

Study Population and Sampling

Total 120 hypertensive patients participated in the study, in which non-probability consecutive sampling technique was used. The patients were divided into two groups of 60 patients each. The first group consisted of the hypertensive patients who had coronary artery disease documented and the second group of patients with hypertension who did not have coronary artery disease. Sample size has been calculated by using WHO sample size calculator at 80% study power and 95% confidence level based on the difference in lipid profile parameters previously reported among the cardiovascular disease patients. The participants were randomly distributed in both groups for meaningful comparative analysis.

Eligibility Criteria

Patients aged 35-80 years with known hypertension for >1 year were included. The diagnosis of coronary artery disease was established from written records of a previous myocardial infarction, coronary angiography with significant coronary artery stenosis, previous percutaneous coronary intervention, coronary artery bypass graft surgery, or from coronary artery investigations. The comparison group consisted of patients with hypertension who had no documented clinical, electrocardiographic, echocardiographic or angiographic evidence of coronary artery disease. Patients were excluded from the study if they had secondary hypertension, acute coronary syndrome within 3 months, congestive heart failure, advanced chronic kidney disease, chronic liver disease, autoimmune diseases, active infections, malignancy, or were unable to provide informed consent.

Data Collection Procedure

All participants had a detailed clinical assessment, obtained after providing written informed consent. Age, sex, body mass index, smoking habits, duration of hypertension, family history of cardiovascular disease, status of diabetes mellitus and the drugs used were documented in a structured data collection form. Each participant underwent a thorough medical history and physical exam. Relevant hospital records and investigation reports were then checked to document the presence or not of coronary artery disease.

Blood pressure measurements were taken with a calibrated mercury sphygmomanometer as per standard clinical procedures. The participants were asked to sit for a minimum of 5 minutes before measuring. Three blood pressure (BP) readings were taken at 2-minute intervals and the average reading was analyzed. Control of blood pressure was evaluated based on guidelines for the management of hypertension. Patients with a systolic blood pressure less than 140 mmHg and a diastolic blood pressure less than 90 mmHg at the time of evaluation were considered to have controlled blood pressure and values above these were considered as uncontrolled blood pressure.

Laboratory Analysis

Following an overnight fasting period of 10 to 12 hours, approximately 5 mL of venous blood was collected from each participant under aseptic conditions. Blood samples were permitted to coagulate, and then centrifuged to remove the serum for biochemical analysis. The serum concentration of total cholesterol, triglycerides, high-density-lipid-cholesterol (HDL-C) and low-density-lipid-cholesterol (LDL-C) were determined by standardized enzymatic colorimetric methods on an automated clinical chemistry analyzer. All laboratory analyses

were carried out following manufacturer's instructions and institutional quality control procedures to ensure reliability and accuracy of results.

Study Variables

The main study variables were the lipid profile parameters and the status of blood pressure control. Blood pressure control was assessed by using SBP and DBP at clinical assessment and lipid profile assessment included Total cholesterol, Triglyceride, HDL-C and LDL-C. Other variables collected for analysis were age, sex, BMI, smoking, duration of hypertension, family history of cardiovascular disease and diabetes mellitus.

Ethical Considerations

The study protocol was approved by the Ethical Review Committees of Amna Inayat Medical College, Sheikhupura, Pakistan and Government Kot Khawaja Saeed Teaching Hospital, Lahore, Pakistan. The study was carried out in line with the principles of Declaration of Helsinki. All were voluntary and written informed consent was signed by all participants before their enrolment. The confidentiality of patient information was preserved during the study and the patient's information collected was used only for research purposes.

Statistical Analysis

Data were entered, coded, and analyzed using Statistical Package for Social Sciences (SPSS) version 26.0. Quantitative measurements were reported as mean ± standard deviation and categorical measurements were reported as frequency and percentage. Independent sample t-test was used for continuous variables to compare between the two groups, those with hypertension and those without hypertension but with coronary artery disease. Chi-square tests were used to test the associations between categorical variables. Statistically significant means a p value of < 0.05. Results were displayed in tables and descriptive paragraphs to ease the comparison between the two study groups to find out any possible differences in the lipid profile parameters and the status of blood pressure control.

RESULTS

A total of 120 hypertensive patients were enrolled in this study, including 60 patients with documented coronary artery disease (CAD) and 60 hypertensive patients without CAD. The mean age of the study population was 59.0 ± 9.3 years, with a male preponderance in both groups. In comparing the demographic and clinical parameters at baseline, it was found that the patients with coronary artery disease were significantly older and had a longer history of hypertension than did those without CAD. Additionally, the BMI and prevalence of DM was significantly higher in patients with CAD, indicating that these patients had more cardiovascular risk factors. There was no difference in gender distribution or smoking status between the two groups, which was not statistically significant (Table 1).

Table 1. Demographic and Clinical Characteristics of Hypertensive Patients with and Without Coronary Artery Disease

Variable	CAD Group (N=60)	Non-CAD Group (N=60)	P-Value
Age (Years)	62.4±8.6	55.7±9.1	<0.001
Male Gender, N (%)	39 (65.0)	35 (58.3)	0.452
Female Gender, N (%)	21 (35.0)	25 (41.7)	0.452
BMI (Kg/M²)	29.9±4.3	27.8±3.9	0.006
Duration Of Hypertension (Years)	10.2±4.5	7.3±3.8	<0.001
Diabetes Mellitus, N (%)	34 (56.7)	22 (36.7)	0.028
Current Smokers, N (%)	18 (30.0)	12 (20.0)	0.205

The lipid profile showed significant difference between the hypertensive patients with and without CAD. The CAD group had significantly elevated levels of total cholesterol, low-density lipoprotein cholesterol (LDL-C), and triglycerides than the hypertensive patients without CAD. On the other hand, high density lipoprotein cholesterol (HDL-C) levels were significantly reduced in CAD patients. Mean total cholesterol was 223.8±35.7 mg/dL in the CAD group and 191.2±30.4 mg/dL in the non-CAD group. In the same way, CAD patients had significantly higher LDL-C and lower HDL-C levels which are more proatherogenic lipid pattern. These results indicate that dyslipidemia is well correlated with coronary artery disease among the hypertensive patients (Table 2).

Table 2. Comparison of Lipid Profile Parameters between Study Groups

Lipid Parameter (Mg/Dl)	CAD Group (N=60)	Non-CAD Group (N=60)	P-Value
Total Cholesterol	223.8±35.7	191.2±30.4	<0.001
LDL Cholesterol	145.6±27.9	117.4±23.6	<0.001
HDL Cholesterol	39.2±7.8	47.8±8.9	<0.001
Triglycerides	190.4±48.3	154.6±41.5	<0.001

When the blood pressure measurements were compared, there were significant inferior blood pressure control levels in patients with coronary artery disease who were already hypertensive. CAD group had significantly higher mean values of both systolic and diastolic blood pressure than hypertensive patients without CAD. The mean systolic blood pressure in CAD group was 148.1±16.2 mmHg, and in non-CAD group was 138.7±13.8 mmHg and the mean diastolic blood pressure in CAD group was 89.7±9.6 mmHg, and in non-CAD group was 83.8±8.4 mmHg. Results of treatment evaluation revealed that only 43.3% of the CAD patients had good control of their blood pressure, while 70.0% of the patients without CAD had good control of their blood pressure. Conversely, uncontrolled hypertension was observed in more than half of the CAD patients. These data indicate that patients with hypertension and known coronary artery disease have higher likelihood of failing to reach recommended blood pressure goals and of being at higher cardiovascular risk despite treatment (Table 3).

Table 3. Blood Pressure Measurements and Control Status among Study Participants

Variable	CAD Group (N=60)	Non-CAD Group (N=60)	P-Value
Systolic Blood Pressure (Mmhg)	148.1±16.2	138.7±13.8	<0.001
Diastolic Blood Pressure (Mmhg)	89.7±9.6	83.8±8.4	0.001
Controlled Blood Pressure, N (%)	26 (43.3)	42 (70.0)	0.003
Uncontrolled Blood Pressure, N (%)	34 (56.7)	18 (30.0)	0.003

Overall, the study showed that patients with hypertension and CAD had markedly poorer cardiovascular risk profiles than those with hypertension alone. The coexistence of elevated total cholesterol, increased LDL-C and triglyceride concentrations, reduced HDL-C levels, and inadequate blood pressure control was considerably more common among CAD patients. The results highlight the need for aggressive management of cardiovascular risk factors, particularly lipid lowering, and better control of hypertension, in people with known coronary artery disease.

DISCUSSION

The present study compared lipid profile parameters and blood pressure control among hypertensive patients with and without coronary artery disease and demonstrated significant differences between the two groups[1]. CAD patients with hypertension had significantly higher TC, LDL cholesterol, and triglyceride levels and significantly lower HDL cholesterol levels. Further, blood pressure control was significantly worse in patients with CAD, suggesting that cardiovascular risk factors were higher in patients with CAD. The results further support the known association of dyslipidaemia, uncontrolled hypertension and the occurrence of coronary artery disease[2,3].

The main finding of the study was that the total cholesterol and LDL cholesterol values were significantly higher in patients with CAD among the hypertension group[4]. LDL cholesterol is generally seen as the major atherogenic lipoprotein which deposits cholesterol in the walls of the arteries and leads to the formation of plaques. High LDL-C is associated with endothelial dysfunction, oxidative stress and inflammatory responses that drive the progression of atherosclerosis. The increased level of LDL-C found in the CAD cases in the current study corroborates earlier epidemiological and clinical studies that showed that dyslipidemia is one of the main risk factors for the development and progression of coronary artery disease[5,6].

Another finding of the study was a significantly higher level of triglycerides in CAD patients with hypertension[7]. Hypertriglyceridemia promotes the generation of small dense LDL particles, oxidative modification of lipoproteins, and vascular inflammation, all of which are important to atherogenesis. High triglycerides are often linked to insulin resistance, obesity and metabolic syndrome, all of which can be a risk factor for cardiovascular disease. Thus,

hypertension and hypertriglyceridemia could perhaps act synergistically to promote vascular damage and to make them vulnerable to coronary events[8,9].

The other key discovery was the substantially reduced HDL cholesterol amongst the CAD patients. HDL cholesterol has a protective role in cardiovascular health through reverse cholesterol transport, reduction of oxidative stress and anti-inflammatory effects on the vascular endothelium[10]. Lower HDL-C levels impair these protective effects and are associated with the development of the atherosclerotic disease. In addition, the reduced levels of HDL-C found in the CAD group reinforces the need for a complete lipid management in hypertensive patients who are at risk for cardiovascular complications[11].

The blood pressure control was significantly lower in patients with coronary artery disease and hypertension. Greater than half of the CAD patients did not reach the recommended blood pressure targets while most of the hypertensive patients without CAD had good blood pressure control[12]. Chronically high blood pressure leads to stiffening of the arteries, damage to the artery lining and faster atherosclerosis. Therefore, poor blood pressure control could not only be associated with the development of CAD, but it could also have a negative impact on outcomes for those with existing coronary disease. Such results suggest the importance of more aggressive antihypertensive treatment and regular follow-up for this patient population at high risk for cardiovascular events[13].

The CAD group also had a greater number of individuals with diabetes mellitus and longer duration of hypertension[14]. Both of these have been documented to contribute to cardiovascular morbidity and may to some extent account for the differences in the lipid profile parameters as well as the control of blood pressure. High blood pressure and metabolic abnormalities over time cause damage to the blood vessels, which eventually leads to coronary artery disease. The fact that these risk factors are occurring together in CAD patients highlights the multifaceted nature of cardiovascular disease and the need for strategies to address risk factors in an integrated manner[15].

This study's results have significant clinical applications. In patients with hypertension, an early detection and control of dyslipidemia could delay the atherosclerosis and decrease the risk of CAD[16]. In the same way, optimal blood pressure control is crucial to prevent cardiovascular complications and ensure long-term optimal outcomes. Since there are several risk factors involved in coronary artery disease, lifestyle changes, diet changes, lipid lowering therapy, optimizing antihypertensive treatment, smoking cessation and diabetes management are all necessary[17].

The study has some limitations. The cross-sectional design limits the ability to establish causal relationships between lipid abnormalities, blood pressure control, and coronary artery disease[18]. The study was also carried out in two health care centres with a relatively small sample size, which may not be representative of the general population. Nevertheless, the findings provide valuable insight into the cardiovascular risk profile of hypertensive patients and highlight important targets for preventive and therapeutic interventions[19,20].

CONCLUSION

There were significant differences in the lipid profile and blood pressure control between the group of hypertensive patients with coronary artery disease and the group of hypertensive patients without coronary artery disease. High total cholesterol, LDL cholesterol and triglyceride levels and low HDL cholesterol levels were significantly correlated with the presence of CAD. Further, poor BP control was significantly more prevalent in the coronary artery disease group. The results underscore the need for thorough cardiovascular risk evaluation and comprehensive management of dyslipidemia and hypertension for minimizing the burden of CAD and improving the long-term clinical outcomes in patients with hypertension. Future large-scale prospective studies are suggested to further assess the effects of optimized lipid and blood pressure control on cardiovascular risk reduction in this population.

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