Original Article

Association of Hypertension with Angiographic Patterns and Severity Among the Patients with Coronary Artery Disease

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Abstract

Introduction: Incidence of coronary artery disease (CAD) is twofold higher in hypertensive subjects. According to past clinical trials and observational studies, hypertension and CAD have a strong etiological connection. The aim of the present study was to compare coronary angiographic patterns in hypertensive and normotensive patients.

Methods: This cross sectional comparative study was carried out in the inpatient department of cardiology, Mymensingh Medical College Hospital from July 2022 to June 2024. Patients with age >18 years of both sexes with or without hypertension who were admitted for coronary angiogram were included in the study. Patients were classified into two groups: Group A: Hypertensive group and Group B: Normotensive group.

Results: Out of 152 patients, 76 patients were in group A (hypertensive) and 76 patients in group B (normotensive). The mean age of the patients was 52.3±10.5 years in group A (hypertensive) and 52.0±12.0 years in group B (normotensive). Male patients were predominant in both groups, 54(71.1%) in group A and 60(78.9%) in group B. Single vessel disease was significantly lower in group A (26.3% vs 50.0%) and triple vessel disease (28.9% vs 7.9%) & left main disease (28.9% vs 5.3%) were significantly higher in group A than group B (28.9% vs 7.9%). Regarding Gensini score, moderate to severe coronary artery disease (≥36) was significantly higher in group A (hypertensive) than group B (normotensive) (39.5% vs 10.5%; p=0.001).

Conclusion: Hypertension has been significantly associated with severity of CAD in terms of complex lesions like left main disease, triple vessels disease and Gensini score (moderate to severe coronary artery disease).

Key words: hypertension; coronary artery disease; Gensini score.

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Introduction

Globally, one of the most leading causes of mortality and disability is coronary artery disease (CAD). Incidence of CAD is twofold higher in hypertensive subjects. Hypertension increases atherosclerosis in the form of fatty streaks, fibrous plaques, advanced lesions with calcification which increases the degree of arterial stenosis in different vascular beds. The heart and blood vessels are both included in cardiovascular disease (CVD), and acute coronary syndrome (ACS) is a critical component of both [1]. Nearly one-third of individuals suffer from hypertension, which is closely linked to cardiovascular morbidity and death [2]. The clinical sequelae of CAD remain by far the most common cause of death in patients with hypertension [3].

The complex pathophysiological mechanism underlying blood pressure as a risk factor for coronary artery disease (CAD) includes the physically impact of blood pressure on the development of atherosclerotic plaque as well as the connection between pulsatile hemodynamics/arterial stiffness and coronary perfusion [4]. The degree, features, or risk of major adverse cardiac events (MACE) have been investigated in studies on the association between hypertension and coronary atherosclerotic plaque stenosis [5]. The presence of hypertension provides a milieu for cardiac ischemic events through its direct effect on the coronary arterial tree, through its accelerating effects on atheroma, through increase in shear stress on plaques, and

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through its adverse functional effects on the coronary circulation [3]. These effects are accentuated by the presence of LVH [3].

It is unclear, how well HTN can diagnose severity of coronary artery disease (CAD). Hypertension raises the possibility of developing three-vessel disease and the distribution, severity, and extension of coronary stenosis are comparable to those of patients with normotension [6]. Blood pressure (BP) and coronary heart disease have a strong etiological connection, according to past clinical trials and observational studies [7]. Therefore, the present study was intended compared between coronary angiographic patterns in hypertensive and normotensive patients.

Materials and Methods

This cross sectional comparative study was carried out in the inpatient department of cardiology, Mymensingh Medical College Hospital from July 2022 to June 2024. Patients with age >18 years of both sexes with or without hypertension who were admitted for coronary angiogram were included in the study. Exclusion criteria were: history of previous coronary artery bypass grafting (CABG) or percutaneous coronary intervention (PCI); patients with known case of chronic renal disease (CKD); known case of hypothyroidism; patients who were not willing to be part of the study and documented normal epicardial coronaries. Purposive type of non-probability sampling technique was followed. Clinical data (age, history of smoking, alcohol, hypertension, diabetes mellitus and chronic kidney disease) was collected by interview and serum total cholesterol, low density lipoprotein cholesterol (LDL), and high-density lipoprotein (HDL), renal function test was done during admission and was collected from medical records. The participant was classified as hypertensive if a patient had a history of hypertension or currently in taking antihypertensive drugs, or a systolic blood pressure ≥ 140 mm Hg and or a diastolic blood pressure ≥ 90 mm Hg. Patients were classified into two groups: Group A Hypertensive group and Group B: Normotensive group. A total of 152 patients with diagnosed CAD by coronary angiogram were included in the study. Among them 76 patients were in group A (hypertensive) and 76 patients in group B (normotensive). Interpretation of coronary angiogram was done by visual estimation by two experienced cardiologists to assess the severity of coronary artery disease. Severity of coronary stenosis was graded according to the number of major epicardial vessel with significant stenosis by vessel score [8] and Gensini score [9]. Significant coronary stenosis was defined as ≥70% reduction in the arterial lumen area in any coronary channel and ≥50% in the left main artery. Gensini score value 36 was chosen as an appropriate cut-off value and patients was divided into 2 groups, those with a Gensini score <36 points (absent or mild coronary atherosclerosis), and those with a Gensini score >36 points (moderate to severe coronary atherosclerosis).

For whole blood analysis, an automated hematology analyzer (Dymind DH760) was utilized. The automated biochemistry analyzer (Tc6030) was used to collect the biochemical parameters. Blood pressure was measured by adult ALPK2 blood pressure monitoring system. CAG was by Shimadzu Trinias crossover angiographic system – C16/C12/F12 with smart edition. A Pre form semi-structured case record forms were used to collect data, and they were finalized after being prettested. Data were collected from patients or their attendants by face to face interview, clinical examination and laboratory investigations. Informed consent was obtained from all patients or their attendants. The Mymensingh Medical College institutional review board (IRB) approved the study.

The Statistical Package for Social Sciences version 23.0 for Windows (SPSS Inc., Chicago, Illinois, USA) was used to conduct the statistical analyses. The mean value was calculated for continuous variables. The categorical variables were presented by frequencies and percentages. For categorical variables, the chi square test was utilized, and for continuous variables, the unpaired t-test. Binary logistic regression analysis was used to do both univariate and multivariate analyses for patients at risk of hypertension. P values ≤0.05 were regarded as significant.

Results

A total 152 patients with diagnosed CAD by coronary angiogram with or without hypertension were included in the study. Among them 76 patients were in group A (hypertensive) and 76 patients in group B (Normotensive). The mean age was 52.3±10.5 years in group A and 52.0±12.0 years in group B (p=0.875). Male patients were predominant in both groups, 54(71.1%) in group A and 60(78.9%) in group B. The baseline characteristics of the patients were presented in Table 1. Regarding risk factors, diabetes mellitus, dyslipidemia, smoker, obesity and chronic kidney disease were not statistically significant between hypertensive and normotensive group.

Table 1: Baseline characteristics of the patients of both groups (n=152)

Variables	Group-A (n=76)	Group-B (n=76)	p value
	Mean±SD/ n(%)	Mean±SD/ n(%)	
Age (Mean±SD) year	52.3 ± 10.5	52.0 ± 12.0	0.87
Gender			
Male	54(71.1%)	60(78.9%)	0.26
Female	22(28.9%)	16(21.1%)	
Risk factors			
DM	22(28.9%)	28(36.8%)	0.30
Smoking	29(38.2%)	40(52.6%)	0.07
Dyslipidemia	42(55.3%)	50(65.8%)	0.18
Obesity	08(10.5%)	04(5.3%)	0.27
CKD	01(1.3%)	00(0.0%)	0.5

Group A: hypertensive group; Group B: normotensive group; SD: standard deviation; DM: diabetes mellitus; CKD: chronic kidney disease.

Table 2 showed that mean hemoglobin, serum creatinine and random blood sugar (RBS) were not statistically significant between two groups. Mean total cholesterol was significantly lower in group A than group B (161.1±39.4 vs 181.4±56.6 mg/dl). However, mean HDL, LDL and triglyceride were lower in group A than group B, but the difference was not statistically significant between two groups.

Table 2: Comparison of baseline biochemical patterns (n=152)

Biochemical patterns	Group-A (n=76)	Group-B (n=76)	p value
	Mean±SD	Mean±SD	
Hemoglobin(g/dl)	12.6±1.7	12.7±1.7	0.624
Serum creatinine (mg/dl)	0.94±0.18	0.98±0.16	0.155
RBS (mmol/L)	7.0±2.7	7.1±3.3	0.852
Total cholesterol(mg/dl)	161.1±39.4	181.4±56.6	0.012
HDL(mg/dl)	39.6±7.7	41.0±7.1	0.265
LDL(mg/dl)	92.9±29.7	95.9±31.5	0.547
Triglyceride (mg/dl)	180.9±113.9	203.2±110.8	0.203

Group A: hypertensive group; Group B: normotensive group; SD: standard deviation; RBS: random blood sugar; HDL: high density lipoprotein; LDL: low density lipoprotein.

Table 3 showed that mean septal wall thickness and posterior wall thickness was significant higher in group A than group B. Most of the patients had left ventricular ejection fraction (LVEF) ≥50% in both groups. The mean LVEF was 56.8±7.2% and 58.8±7.9% in group A and group respectively, the difference was not statistically significant between two groups.

Table 3: Distribution of the respondents according to echocardiography (n=152)

Echocardiography	Group-A (n=76)	Group-B (n=76)	p value
	Mean±SD	Mean±SD	
Septal wall thickness (mm)	**9.6**±1.5	**9.1**±1.2	0.024
Posterior wall thickness(mm)	9.9±1.2	9.3±1.4	0.005
LVEF (%)	56.8±7.2	58.8±7.9	0.096

Group A: hypertensive group; Group B: normotensive group; SD: standard deviation; LVEF: left ventricular ejection fraction.

Table 4 showed angiographic features of all patients. Single vessel disease (SVD) was significantly lower in group A than group B (26.3% vs 50.0%). Triple vessel disease (TVD) was significantly higher in group A than group B (28.9% vs 7.9%). However, double vessel disease (DVD) was also higher in group A than group B, but the difference was not statistically significant between two groups. Left main (28.9% vs 5.3%) and ramus intermedius (26.3% vs 5.3%) was significantly higher in group A than group B. Left anterior descending (LAD), left circumflex (LCX) and right coronary artery (RCA) were higher in group A than group B but the difference was insignificant between two groups. Proximal involvement (76.3% vs 50.0%) was significantly higher in group A than group B. However, ostial, mid and distal involvement were not statistically significant between two groups. Lesions ≥70% stenosis of involved vessels was significantly higher in group A than group B (69.7% vs 38.2%).

Table 4: Distribution of the respondents according to angiographic features (n=152)

Variables	Group-A (n=76)	Group-B (n=76)	p value
	n(%)	n(%)	
Number of vessels involved			
Single vessel disease	20 (26.3)	38 (50.0)	0.002
Double vessel disease	34 (44.8)	32 (42.1)	0.743
Triple vessel disease	22 (28.9)	06 (07.9)	0.001
Name of diseased Vessels			
Left Main	22 (28.9)	04 (05.3)	0.001
LAD	46 (60.5)	40 (52.6)	0.326
LCX	46(60.5)	42 (55.3)	0.511
RCA	40 (52.6)	36 (47.4)	0.516
Ramus intermedius	20 (26.3)	04 (05.3)	0.001
Pattern of lesion			
Ostial	06 (07.9)	04 (5.3)	0.513
Proximal	58 (76.3)	38 (50.0)	0.001
Mid	38 (50.0)	40 (52.6%)	0.746
Distal	42 (55.3)	34 (44.7)	0.194
Degree of stenosis of involved vessels			
<70%	23 (30.3)	47 (61.8)	0.001
≥70	53 (69.7)	29 (38.2)	

Group A: hypertensive group; Group B: normotensive group; LAD: Left anterior descending; LCX: left circumflex: RCA: right coronary artery

Regarding Gensini score (Figure 1), moderate to severe coronary artery disease (≥36) was significantly higher in group A (hypertensive) than group B (normotensive) (39.5%vs 10.5%), which was statistically significant.

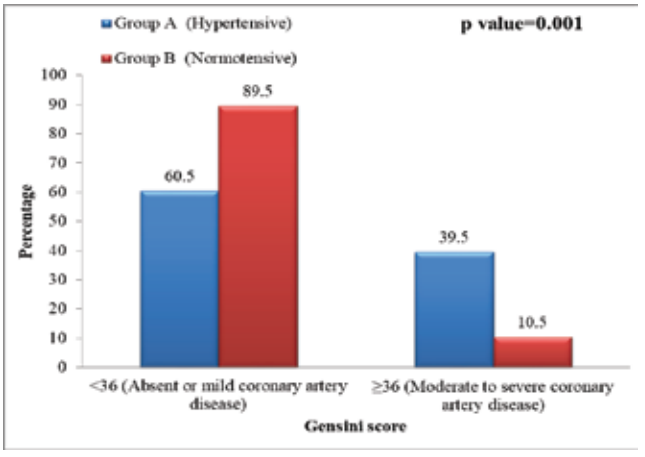


Figure 1: Distribution of the respondents according to Gensini score (n=152)

Discussion

In this study the mean age was 52.3±10.6 years in group A (hypertensive) and 52.0±12.1 years in group B (normotensive). The difference was not statistically significant between two groups. One study from Turkey reported that the mean age 47.2±11.3 years in hypertensive group and 50.4±13.2 years in non-hypertensive group, the difference was not statistically significant between two groups [10]. Nakanishi et al. [11] obtained that the mean age 56.6±11.1 years in hypertension group and 56.3±11.0 years in no hypertension group, no significant difference was found between two groups. Mitsutake et al. [12] also observed that the mean age 65±10 years in hypertension group and 61±12 years in no hypertension group, the difference was not statistically significant between two groups. The above mention findings were almost similar in this study.

Male patients predominated in both groups in the current study: 54 (71.1%) in group A (hypertensive) and 60 (78.9%) in group B (normotensive). The proportion of females in groups A and B was 22 (28.9%) and 16 (21.1%), respectively; this difference was not statistically significant. According to a study by Towab et al. [13], out of the 110 participants, 32.7% were women and 67.3% were men. The majority of patients were male, with a 2:1 male-to-female ratio. Another study showed there were more female patients than male patients in both groups (59% of those with hypertension and 54% of those without) [10]. According to Nakanishi et al. [11], there was no statistically significant difference between the two groups, with males making up 60.8% of the hypertension group and 60.8% of the non-hypertension group. Males made comprised 54.0% of the group with hypertension and 57.0% of the group without it, according to Mitsutake et al. [12]. However, there was no statistically significant difference between the two groups. Our results are in agreement with these findings.

Regarding risk factors, diabetes mellitus, dyslipidaemia, smoking, obesity and CKD were not statistically significant between hypertensive and normotensive group. Similarly, a Turkey study observed that diabetes mellitus, hypertension, dyslipidemia and current smoker were not statistically significant between hypertensive and non-hypertensive group [10]. Nakanishi et al. [11] reported diabetes mellitus, dyslipidemia and smoking were not statistically significant between hypertension and no-hypertension group. Akbarzadeh et al. [14] also documented that patients with hypertension had a greater prevalence of diabetes mellitus than those with normotension (26.6% versus 16.2%, respectively; p=0.001). Patients with hypertension were more likely to have hyperlipidemia than those with normotension (44.3% vs. 32%, p= 0.001). Patients without hypertension smoked more frequently than those with hypertension (54.2% versus 28.1%, respectively.

In the current study the mean hemoglobin, serum creatinine and RBS were not statistically significant between two groups. Towab et al. [13] obtained that the mean serum creatinine 1.6±0.04 mg/dl and mean RBS 7.12±0.75 mmol/l.

In this study, the mean total cholesterol was significantly lower in group A than group B (161.1±39.4 vs 181.4±56.6 mg/dl). However, mean HDL, LDL and triglyceride were lower in group A than group B, but the difference was not statistically significant between two groups. In a study conducted by Towab et al. [13] reported that the mean (±SD) total cholesterol was 177.69±31.55 mg/dl, mean HDL 37.4±7.39 mg/dl, mean LDL 112.99±16.22 mg/dl. Mohammed et al. [15] observed that the mean total cholesterol was 3.9±1mmol/l, mean HDL 1.2±1.4mmol/l and mean LDL 2.4±0.9mg/dl. Mitsutake et al. [12] also documented that mean HDL, LDL and TG were not statistically significant between hypertension and non-hypertension group. These findings are consistent with our findings.

In this study SVD was significantly lower in hypertensive group than normotensive group (26.3% vs 50.0%). TVD was significantly higher in hypertensive group than normotensive group (28.9% vs 7.9%). However, DVD was also higher in group than group B, but the difference was not statistically significant between two groups. Nakanishi et al. [11] revealed that SVD was 12.1% in hypertension group and 9.5% in no hypertension group. DVD was 4.4% and 2.6% in hypertension and no hypertension group respectively. TVD was 2.2% in hypertension group and 1.6% in no hypertension group. A study from Turkey noticed that non-hypertensive group has also more diseased vessels (p<0.001). Akbarzadeh et al. [14] demonstrated that there was a statistically non-significant trend toward a higher frequency of TVD (32% vs. 28%, p=0.1) in the hypertensive group with respect to the number of stenotic coronary arteries. Additionally, individuals with hypertension had a lower prevalence of SVD and DVD. In the group with two vessels disease, this difference was statistically significant (p = 0.03). Mahmoud et al. [16] also discovered that Group I had a higher prevalence of DVD and TVD, whereas Group II had a higher prevalence of SVD (66%) than Group I (43%), p< 0.05. The above mention studies finding were almost similar to this study.

In the present study observed that left main (28.9% vs 5.3%) and ramus intermedius (26.3% vs 5.3%) was significantly higher in hypertensive group A than normotensive group. LAD, LCX and RCA were higher in hypertensive group than normotensive group but the difference was insignificant between two groups. In a study conducted by Shah et al. [17] reported that thirty percent of hypertensives and forty percent of diabetics have involvement in the LAD. In 29% of diabetics and 46% of hypertensives, the LCX was implicated. In 30% of cases of diabetes and 50% of cases of hypertension, the RCA was implicated. Nakanishi et al. [11] obtained that left main was 14.1% in hypertension group

and 12.6% in no hypertension group. Ikbal et al. [18] observed that 9(9.2%) of the patients had LMCA involvement, 56(58%) had LAD, 29(30%) had LCX, 31(32%) had RCA, and 18(19%) had TVD, according to an angiographic investigation. In terms of anatomic vascular affection, Mahmoud et al. [16] also demonstrated that both groups were comparable (e.g., LAD, CX, RCA, proximal and mid lesions). The above mention findings were almost similar in this study.

In current study observed that proximal (76.3% vs 50.0%) was significantly higher in hypertensive group than normotensive group. However, ostial, mid and distal were not statistically significant between two groups. Nakanishi et al. [11] described that proximal was 46.6% in hypertension group and 38.2% in no hypertension group. Mild was 36.0% and 29.0% in hypertension and no hypertension group respectively. Distal was 18.6% in hypertension group and 14.1% in no hypertension group. Significant lesions affecting distal coronary vessels were also observed to be more common in Group I (11%) compared to Group II (2%), $p< 0.05$, according to Mahmoud et al. [16] that are support with my study.

Regarding Gensini score, moderate to severe coronary artery disease (≥36) was significantly higher in group A (hypertensive) than group B (normotensive) (39.5%vs 10.5%). Gensini score was measured for the assessment of the severity of the CAD. Gensini score was calculated by assigning a severity score to each coronary stenosis according to the degree of luminal narrowing and its geographic importance. Reductions of 25%, 50%, 75%, 90%, 99%, and complete occlusion, were given Gensini scores of 1, 2,4, 8, 16, and 32, respectively [19].

This study has several limitations. The whole calculated sample size could not be covered due to time constraint. Purposive sampling technique and lack of randomization were others limitations.

Conclusion

Hypertension has been significantly associated with severity of coronary artery disease in terms of complex lesions like left main disease, triple vessels disease and Gensini score (moderate to severe coronary artery disease). On the other hand, normotensive subjects were found to have minor form of coronary artery disease like < 70% stenosis and less involvement of coronary arteries like single vessel disease. A further study with larger sample, longer period is the recommendations.

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