Original research

STUDY OF CORONARY ARTERY LESIONS IN HYPERTENSIVE PATIENTS WITH AND WITHOUT DIABETES

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ABSTRACT

Objectives: To investigate the imaging characteristics of coronary artery lesions in hypertensive patients with or without diabetes by percutaneous coronary angiography. Determining the relationship between cardiovascular risk factors and levels of coronary artery damage in patients with hypertension.

Methods: A cross - sectional description was carried out in 185 hypertensive patients (49 with diabetes; 136 without diabetes) underwent percutaneous coronary angiography to assess lesion images at the Emergency - Interventional Cardiology Department - Hue Central Hospital and the Cardiology Department - International Medical Center, Hue Central Hospital from April 2020 to July 2021.

Results: Characteristics of coronary artery damage in hypertensive patients by percutaneous coronary angiography: the proportion of patients with significant coronary artery stenosis accounted for 64.90%. Significant lesions in the LAD: 63.20%; RCA: 45.40%, LCx: 35.70% and LM: 1.10%. The coronary artery lesions in patients with diabetes were diffuse, complex, and more severe than in the non - diabetic group, with an average number of obstructive branches over 50% and over 70% in two groups with and without diabetes, respectively. 39 ± 1.81; 1.90 ± 1.57 and 1.71 ± 1.60; 1.40 ± 1.33. The degree of atherosclerosis was more diffuse with a higher Gensini index of 34.22 ± 25.73; 29.59 ± 27.76. The average Syntax score was 10.82 ± 9.00; in the group of patients with diabetes and without diabetes, respectively, 14.32 ± 10.12; 8.67 ± 8.24. Significant coronary artery damage was not related to age, sex, obesity, hypertension class, smoking. Patients with dyslipidemia had a rate of coronary artery stenosis of more than 2.78. Hypertensive patients with diabetes had a higher rate of coronary artery damage 4.72 times. In multivariate analysis with two risk factors, both dyslipidemia and diabetes were independent risk factors for coronary stenosis greater than 70%.

Conclusions: Coronary lesions in patients with diabetes were characterized by diffuse, multi - branch, and complex effects. Dyslipidemia and diabetes were two risk factors that independently affect the degree of significant coronary artery injury.

Keywords: Coronary artery lesion, hypertension, diabetes.

I. INTRODUCTION

Coronary artery disease was a very common among some cardiovascular diseases in developed countries [1]. Coronary artery disease accounts for up to 14% of global deaths and was a major cause of reduced survival years and years lived in corrected disease. The second leading cause of death was brain stroke, accounting for 11.1%. In Vietnam, in 2016, according to statistics from the World Health Organization, cardiovascular disease became the leading cause of death. Of the 77% of non - communicable disease deaths in Vietnam, nearly 70% of deaths were due to cardiovascular disease [2].

Diabetes mellitus was a disease that often accompanies hypertension, and at the same time is the cause of a 2 - 4 - fold increase in the occurrence of coronary artery disease and stroke [3].

In recent years, due to the trend of an aging population, the proportion of patients with hypertension and accompanying diabetes mellitus had been increasing, so coronary artery disease in subjects with many cardiovascular risk factors needs to be detected early to be diagnosed, treatment and prognosis aim to improve quality of life. Therefore, we conducted present study to explore the imaging characteristics of coronary artery lesions in hypertensive patients with or without diabetes mellitus by percutaneous coronary angiography; and determine the association between cardiovascular risk factors and the degree of coronary artery damage in patients with hypertension.

II. MATERIALS AND METHODS

2.1. Research subjects

The study was conducted at the Department of Interventional Cardiology Emergency - Hue Central Hospital and the Department of Cardiology - International medical center - Hue Central Hospital from 4/2020 to 7/2021. Hospitalized patients are divided into two groups: the control group and the disease group.

Disease group: These included 49 patients diagnosed and graded with hypertension as recommended by the Vietnam Heart Association 2018 or has a history of hypertension who were on medication therapy and had diabetes as diagnosed by the American Diabetes Association 2021 [4] or were being treated for diabetes with medications or pre - existing insulin injections.

Inclusion criteria:

- Acute coronary syndrome consists of 3 clinical forms: Unstable angina; Non - ST elevated myocardial infarction; ST elevated myocardial infarction

- Coronary angiography is indicated.

- Diabetes.

- Patients participate voluntarily in research.

Exclusion criteria:

- The patient has contraindications to coronary angiography.

- Patients who do not volunteer, do not cooperate in the research process or the patient's family does not consent to the patient's participation in the study.

Control group: These included of 136 patients admitted to hospital with the diagnosed and graded of hypertension as recommended by the Vietnam Heart Association 2018 or with a history of hypertension who were on medications to exclude diabetes with the diagnostic criteria of the American Diabetes Association 2021 or a history of pre-existing diabetes and meeting the exclusion criteria.

The study subjects have similarities in age, gender, risk factors with the disease group; Volunteer for research.

2.2. Research methodology

Study design: Cross - sectional descriptive.

Sample selection method: Convenient sample

2.3. Data processing

Data processing using SPSS 20.0 medical statistics software. Analysis of the correlation between variables shown through testing Chi squared ($\chi2$), p - value and confidence interval (CI 95%), hazard ratio (OR). Multivariate analysis: Based on the results of univariate analysis to identify variables correlated with coronary stenosis, logistics regression analysis is performed by Enter method.

III. RESULTS

3.1. General characteristics

Table 1: Genneral characteristics of the study subjects

Characteristic	General (n = 185)		Disease group (n = 49)		Control group (n = 136)		p
	Amount	%	Amount	%	Amount	%	
Male	98	53.00	29	59.20	69	50.70	0.31
Female	87	47.00	20	40,80	67	49,30	

Characteristic	General (n = 185)		Disease group (n = 49)		Control group (n = 136)		p
	Amount	%	Amount	%	Amount	%	
Cigarette smoking							
Yes	81	43.80	28	57.10	53	39.00	0.028
No	104	56.20	21	42.90	83	61.00	
Family history of coronary artery disease							
Yes	6	3.20	3	6.10	3	2.20	0.19
No	179	96.80	46	93.90	133	97.80	
Average of age ($\overline{X}\pm$ SD), (year)	68.11 ± 10.76		69.08 ± 10.73		67.76 ± 10.79		0.464
BMI (kg/m²), ($\overline{X}\pm$ SD)	22.33 ± 3.01		22.19 ± 3.05		22.38 ± 3.00		0.714
Mean BP (mmHg), ($\overline{X}\pm$ SD)	142.24 ± 26.28		144.59 ± 25.53		141.4 ± 26.59		0.467
Mean DBP (mmHg), ($\overline{X}\pm$ SD)	80.92 ± 11.97		82.04 ± 11.36		80.51 ± 12.19		0.445
Mean cholesterol ($\overline{X}\pm$ SD)	4.92 ± 1.48		4.64 ± 1.37		5.02 ± 1.5		0.122
Mean triglycerides ($\overline{X}\pm$ SD)	1.96 ± 1.24		2.03 ± 1.13		1.93 ± 1.28		0.636
Mean LDL-C ($\overline{X}\pm$ SD)	2.9 ± 1.31		2.74 ± 1.26		2.97 ± 1.33		0.311
Mean HDL-C ($\overline{X}\pm$ SD)	1.18 ± 0.3		1.06 ± 0.21		1.22 ± 0.32		0.000

On study subjects the mean age was quite high. The mean age was difference between both groups was not statistically significant p > 0.05. BMI, SBP, DBP were similar between both groups. The index HDL-C concentrations varied between both groups with p < 0.05.

Table 2: Characteristic of coronary artery damage

The narrow branch has significance	Disease group (n = 49)		Control group (n = 136)		p	OR; 95%CI
	Amount	%	Amount	%		
LAD						
Yes	30	61.20	58	42.60	0.026	2.123 [1.089 - 4.14]
No	19	38.80	78	57.40		
LCx						
Yes	12	24.50	39	28.70	0.574	0.807 [0.381 - 1.707]
No	37	75.50	97	71.30		
RCA						
Yes	24	49.00	45	33.10	0.049	1.941 [0.999 - 3.772]
No	25	51.00	91	66.90		

Injury to the LM/LAD and RCA were higher in the group of diabetes.

Table 3: Demographics of significant coronary artery lesions

Lesion Artery branch	General		Hypertension and Diabetes		Hypertension		p
	Amount	%	Amount	%	Amount	%	
LAD1							
Yes	51	27.60	16	32.70	35	25.70	0.353
No	134	72.40	33	67.30	101	74.30	
LAD2							
Yes	44	23.80	17	34.70	27	19.90	0.036
No	141	76.20	32	65.30	109	80.10	
LAD3							
Yes	13	7.00	5	10.20	8	5.90	0.344
No	172	93.00	44	89.80	128	94.10	
LCx1							
Yes	12	6.50	2	4.10	10	7.40	0.735
No	173	93.50	47	95.90	126	92.60	
LCx2							
Yes	29	15.70	7	14.30	22	16.20	0.755
No	156	84.30	42	85.70	114	83.80	
RCA1							
Yes	28	15.10	8	16.30	20	14.70	0.86
No	157	84.90	41	83.70	116	85.30	
RCA2							
Yes	42	22.70	15	30.60	27	19.90	0.123
No	143	77.30	34	69.40	109	80.10	
RCA3							
Yes	18	9.70	7	14.30	11	8.10	0.26
No	167	90.30	42	85.70	125	91.90	

The prevalence of LAD1 stenosis was highest at 27.60%. Only the incidence of LAD2 branch stenosis was higher in the group with diabetes than in the group without diabetes with $p < 0.05$.

Table 4: Severity of coronary artery lesions in patients with diabetes mellitus

Parameter	General	Diabetes mellitus (n = 49)	Non-Diabetes (n = 136)	p
The number of stenosis branches > 50% ($\overline{X} \pm SD$)	1.89 ± 1.82	2.39 ± 1.81	1.71 ± 1.60	0.026

Parameter	General	Diabetes mellitus (n = 49)	Non-Diabetes (n = 136)	p
The number of stenosis branches > 70% ($\overline{X} \pm SD$)	1.53 ± 1,42	1.9 ± 1,571	1.4 ± 1,33	0.065
Gensini Point ($\overline{X} \pm SD$)	30.82 ± 29.83	34.22 ± 25.73	29.59 ± 27.76	0.38
Syntax Score ($\overline{X} \pm SD$)	10.82 ± 9	14.32 ± 10.12	8.67 ± 8.24	0.032

The number of > 50% narrow branches were greater in the group with diabetes than in the group without diabetes. Syntax scores in the group with diabetes were higher than in the group without diabetes with $p < 0.05$.

Table 5: Association between risk factors, target organ injury and coronary artery stenosis

Element	Stenosis ≥ 70% (n = 125)		Stenosis < 70% and not stenosis (n = 60)		p	OR; 95%CI
	Amount	%	Amount	%		
Age						
≥ 60	98	78.40	47	78.30	0.992	1.004; [0.475 - 2.12]
< 60	27	21.60	13	21.70		
Gender						
Male	72	57.60	26	43.30	0.069	1.776; [0.954 - 3.308]
Female	53	42.40	34	56.70		
BMI						
≥ 23	48	38.40	19	31.70	0.372	1.345; [0.7 - 2.583]
< 23	77	61.60	41	68.30		
Hypertensive grading						
Grade 1	88	70.40	46	76.70	0.255	
Grade 2	19	15.20	4	6.60		
Grade 3	18	14.40	10	16.70		
Diabetes mellitus						
Yes	43	34.40	6	10.00	0.000	4.72; [1.88 - 11.85]
No	82	65.60	54	90.00		
Dyslipidemia						
Yes	106	84.00	40	67.80	0.005	2.789; [1.35 - 5.763]
No	19	16.00	20	32.20		

Element	Stenosis ≥ 70% (n = 125)		Stenosis < 70% and not stenosis (n = 60)		p	OR; 95%CI
	Amount	%	Amount	%		
Family history of CAD						
Yes	5	3.50	1	2.30	0.666	2.458 [0.281 - 21.521]
No	120	96.50	59	97.70		
Cigarette smoking						
Yes	60	48.90	21	27.30	0.095	1.714 [0.908 - 3.238]
No	65	51.10	39	72.70		

The proportion of coronary stenosis patients in group of diabetes was 4.72 times higher than those without diabetes. Dyslipidemia in the 70% stenosis coronary artery group was higher than the under 70% stenosis and non - stenosis group with OR is 2.789; p < 0.05.

Table 6: Results of multivariate analysis of logistics model among several risk factors associated with coronary artery injury on percutaneous coronary angiography.

Parameters	B	OR	95% CI		p
			Lower limit	Upper limit	
Dyslipidemia	1.05	2.857	1.336	6.109	0.007
Diabetes mellitus	1.57	4.805	1.883	12.258	0.001

Diabetes mellitus is the risk factor that has the strongest impact on the injury coronary artery of patients with hypertension and then dyslipidemia.

IV. DISCUSSION

In our study, mean systolic and diastolic blood pressure was higher in the diabetic group than in the non - diabetic group, but this difference was not statistically significant with p > 0.05. Coronary artery disease is caused by the formation of atherosclerotic plaques in the lumen of the vessels, a prolonged slow progressive process with the gradual deposition of lipids in the walls of arteries, which causes the walls of arteries to thicken, harden and lose elasticity. Atheroma causes inflammatory reactions, can grow gradually, causing narrowing of the lumen of the vessels and rupture, easily leading to the formation of blood clots, causing many dangerous complications such as myocardial infarction, cerebral infarction. Overweight and obesity are also risk factors for coronary artery disease. In our study, the results showed that 36.20% of patients were overweight and obese. The mean BMI was 22.33 ± 3.01 kg/m^2, no difference between the two groups. When comparing, we found similarities with author Tran Thi Huynh Nga: the mean BMI value of 2 different genders was not statistically significant [5].

Diabetes mellitus was a risk factor for coronary lesion in a multifactorial involvement mechanism. The prevalence of diabetes in our study was 26.5%. Due to differences in study samples, our results were higher with studies such as in Tran Thi Huynh Nga's study of 23.4% [5], of To Thi Mai Hoa the prevalence of diabetes mellitus was 22.6% [3]. Patients with diabetes mellitus type 2 often have other metabolic disorders along with hyperglycemia such as: abdominal obesity, hypertension, dyslipidemia. The condition and diabetes mellitus itself are also a risk of atherosclerosis.

The smoking prevalence in Banning's study was 15.80% in the diabetes group [6], that of Tomizawa

et al. was 34 % [3], and that of Martín - Timón I et al. in the group with hypertension and diabetes, smoking was 28.9% [7]. INTERHEART study found that smoking increased the risk of acute coronary syndrome in men and women by 3.05 - fold and 2.86 - fold, respectively [1, 8].

To Thi Mai Hoa's research showed that for the LAD branch, LAD1 lesions accounted for the highest at 33.90%, followed by LAD2 with 22.60% and finally LAD3 with only 5.4%. For the RCA: RCA1 lesions accounted for 16.10%, RCA2 accounted for 17.20% and RCA3 was 10.80%. As for the LCx branch, the LCx1 branch accounts for 14 % and LCx2 accounts for 10.20% [8]. In other authors' studies, lesions of proximal segments account for a higher proportion than distal segments, and this distribution is also consistent with the general rule. In our study about the LCx and RCA branches: LCx2, RCA2 had a higher proportion of lesions.

Patients over 60 years and older had a stenosis rate above 70% higher than the under 60; however, the difference between both groups was not statistically significant, $p > 0.05$. Thus, the proportion of patient with significant stenosis in hypertension is not related to advanced age, or conversely advanced age does not affect the increase in the incidence of coronary stenosis according to our study. The results of our study do not coincide with the theory in the medical literature nor with other study authors. It is possible that because the study sample was not large, additional samples were needed to clarify the association of age with the degree of coronary stenosis.

Obesity contributes directly to cardiovascular risk factors, including dyslipidemia, diabetes type 2, hypertension, and sleep disturbances. Obesity also leads to the development of cardiovascular disease and cardiovascular disease mortality independent of other cardiovascular risk factors. Obesity accelerates this early atherosclerotic change through several mechanisms, including insulin resistance and inflammation. Systemic-promoting visceral fat and vasculitis, which were fundamental of all aspects of the process of atherosclerosis, from the development of fat streaks to the formation of atherosclerotic thrombosis.

The characteristics of coronary lesions in diabetic patients are confirmed to be diffuse vascular lesions in large and small branches, that worsen if blood glucose control is not adequate. In the study, we did not find that difference slightly from the theory, maybe it's small sample, which only 49 diabetic patients were included in the study.

According to Tran Thi Huynh Nga (2011), the Gensini index in the diabetic group was 38.08 ± 24.9, higher than the non - diabetic group of 30.2 ± 17.5 with $p = 0.04$ [5]. In our study, the Gensini scale, which assesses the degree of coronary artery lesions, showed that the group of patients with diabetes mellitus had higher scores than the group without diabetes at 34.22 ± 25.73, respectively, 29.59 ± 27.76. Syntax scores assessed on 2 groups of subjects with and without diabetes, there was a difference between the 2 groups with $p = 0.032$, the mean values were respectively: 14.32 ± 10.12; 8.67 ± 8.24, as well as the study of Lin et al. (2017) comparing syntax scores between two groups of hypertensive patients with and without diabetes, the Syntax scores were 11.6 ± 8.5, respectively; 10.1 ± 6.9 with $p < 0.01$ [9], Banning's research also showed that the group with diabetes had higher syntax scores than the group without diabetes [6]. Diabetic patients with insulin resistance and dyslipidemia are both risk factors for coronary artery disease, so higher Gensini and Syntax scores are reasonable.

In relation to multivariate analysis with coronary lesions, we found that combined risk factors including dyslipidemia and diabetes mellitus were strongly associated with coronary lesions by more than 70%. In our multivariate analysis, it was found that both diabetes and dyslipidemia had significant effects on coronary artery stenosis independently.

V. CONCLUSIONS

The average number of obstructive branches over 50% and over 70% in the two groups was 2.39 ± 1,81, respectively; 1.90 ± 1.57 and 1.71 ± 1.60; 1.40 ± 1.33. The value of Gensini scale and Syntax score were higher in the group of patients with diabetes than without diabetes. Coronary artery injury had no significance associated with age, gender, obesity, and smoking. Multivariate analysis with two risk factors, both dyslipidemia and diabetes mellitus were independent risk factors with coronary stenosis above 70%.

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