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RESEARCH ARTICLE

Relationship between Atherosclerosis Risk Factors and Carotid Artery Stenosis in Patients Undergoing Coronary Artery Bypass Graft

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ABSTRACT

Background: **Evaluation of the risk factors of atherosclerosis and carotid artery stenosis have been subjected to several investigations. The present study was conducted to determine the degree of carotid artery stenosis and investigate the relationship between atherosclerosis risk factors and coronary artery involvement in coronary artery bypass graft (CABG) patients.**

Methods: **This cross-sectional study was conducted on 450 CABG candidate patients who visited Shahid Beheshti Hospital in Qom. The patients were divided into 4 groups according to the degree of carotid artery stenosis and were examined in terms of risk factors for atherosclerosis and coronary artery involvement. Finally, the data were analyzed using SPSS statistical software.**

Results: **In total, about 18% of the patients had carotid artery stenosis, of them 13.6% had stenosis of less than 50%, 3.2% had stenosis of 50%–70%, and 1.2% had stenosis of more than 70%. Age, history of hypertension (HTN), hyperlipidemia, and previous history of cerebrovascular accident (CVA) showed a significant relationship with carotid artery stenosis. However, gender, BMI, diabetes, history of smoking, history of angiography and lipid profile of the patients did not show a significant relationship. Also, the incidence of CVA after CABG was 1.2%.**

Conclusion: **The present study showed that old age, HTN, hyperlipidemia, and history of CVA are directly related to the severity of carotid artery stenosis.**

Keywords: Angiography, CABG, CVA.

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1. Introduction

Atherosclerosis is one of the main causes of death and disability in developed countries. There are many generalized and systemic risk factors that predispose to atherosclerosis. This affects the circulatory system and leads to specific clinical manifestations, for instance, atherosclerosis of the coronary arteries commonly causes myocardial infarction and angina pectoris, and atherosclerosis of the nervous system arteries often causes brain ischemia and strokes [1]. Timely diagnosis of asymptomatic carotid artery stenosis will be very important in reducing the risk of cerebrovascular accidents and preventing disability [2]. There are different methods to check carotid artery plaques, however, doppler ultrasound is the method that is preferably used to screen neck artery stenosis because of its low cost, non-invasiveness, lack of side effects, and high sensitivity and specificity [3]. The prevalence of CVA in patients who are candidates for CABG is about 1.2%–5.2%, and regardless of mortality, CVA is the most serious complication in surgery, which causes an increase in the cost of the patients and the duration of hospitalization [4].

In the past few decades, several imaging methods such as angiography, magnetic resonance angiography (MRA), multislice CT, digital subtraction angiography, doppler sonography, etc. have been used to determine the severity of atherosclerotic stenosis of carotid arteries. Due to its reliable results, simplicity and cost-effectiveness, doppler

sonography has been emphasized more as a diagnostic method in the evaluation of carotid artery stenosis, so even some studies have mentioned it as a gold standard method [5]. Ultrasound of the carotid arteries is routinely used to investigate the etiology of cerebral ischemia [6]. This study aims to investigate the relationship between atherosclerosis risk factors and the severity of coronary artery disease and carotid artery stenosis in patients undergoing CABG.

2. Methods

This was a cross-sectional study. 450 patients who underwent CABG at Shahid Beheshti Hospital in Qom were included in this study. Patients whose information was incomplete or had a history of endarterectomy and carotid stenting were excluded from the study. Finally, 339 patients were examined and underwent carotid doppler ultrasound. The severity of coronary artery disease and carotid artery stenosis were checked by a cardiologist. Atherosclerosis risk factors including age, sex, weight, history of hypertension, diabetes, smoking, hyperlipidemia, and history of CVA were also investigated. Then, according to the severity of carotid artery stenosis, the patients were divided into 4 groups: normal, less than 50% stenosis, 50%–70% stenosis, and more than 70% stenosis. Then the risk factors of atherosclerosis, severity of coronary artery disease and CVA incidence were examined.

The data collection of the questionnaires was analyzed by SPSS software. The chi-square method was used to analyze data related to qualitative variables and the independent t-test method was used to analyze quantitative data and a p-value less than 0.05 was considered significant.

3. Results

In general, 339 patients were classified into four groups (Table I). 278 patients (82%) in the normal carotid group, 46 patients (13.6%) in the group with carotid stenosis >50%, 11 patients (3.2%) in the group with stenosis 50%–70% and 4 patients (2.1%) were in the group with stenosis above 70%. The evaluation of the measured parameters is as follows:

Age: The average age of the studied patients was 61.09 ± 10.37 years, with an age range of 37 to 87 years. The one-way analysis of the variance test showed that the difference between the groups in terms of age was statistically significant ($p = 0.024$). Thus, the group with normal carotid had a lower average age compared to other groups (Table II).

Gender: 96 cases (28.4%) were women and 243 cases (71.6%) were men. There was no statistically significant difference in the distribution of sexual frequency in different groups ($p = 0.268$).

BMI: The average BMI of the participants was 27.38 ± 4.57. There was no statistically significant difference in the mean BMI between the groups ($p = 0.138$).

HTN: A total of 196 (57.8%) patients had a history of HTN. The frequency of HTN in different groups had a statistically significant difference ($p = 0.036$).

Hyperlipidemia (HLP): A total of 170 patients (50.1%) had a history of HLP which was statistically significant in different groups ($p = 0.014$).

Diabetes: A total of 132 people (38.9%) of the patients had diabetes and there was no statistically significant difference in the incidence of diabetes in different groups ($p = 0.333$).

Smoking: A total of 122 patients (0.36%) were smokers and the history of smoking was not statistically significant in different groups ($p = 0.596$). In total, 14 patients (4.1%) had involvement of one vessel, 68 patients (20.1%) had involvement of two vessels, and 257 patients (75.8%) had involvement of three vessels (Table III). The results of coronary angiography in different groups had no statistically significant difference ($p = 0.181$).

Incidence of CVA: A total of 7 patients (2.1%) had CVA after the operation, but the incidence of CVA was not statistically significantly related to the severity of carotid stenosis ($p = 0.680$).

Previous history of CVA: A total of 10 people (2.9%) had a previous history of CVA and 329 people (97.1%) had no history. The analysis of the results showed that the history of CVA in different groups had a statistically significant difference ($p = 0.019$).

TABLE I: Distribution of Atherosclerosis Risk Factors in the Groups

Group	Normal carotid	Carotid stenosis <50%	Carotid stenosis 50%–70%	Carotid stenosis >70%	Total	P-value*
Patients	278 (82%)	46 (13.6%)	11 (3.2%)	4 (1.2%)	339	–
Age	60/80 ± 10/51	65/16 ± 9/38	65/91 ± 11/04	66/25 ± 10/81	61/09 ± 10/37	0/024
Gender (male)	205 (74/7%)	28 (60/9%)	8 (72/7%)	2 (50%)	243 (71/6%)	0/268
BMI	27/7 ± 4/71	26/82 ± 4/63	25/94 ± 1/59	23/58 ± 4/41	27/38 ± 4/57	0/138
HTN	153 (53%)	34 (73/9%)	8 (72/7%)	1 (25%)	196 (57/8%)	0/036
HLP	128 (46%)	32 (69/6%)	7 (63/6%)	3 (75%)	170 (50/1%)	0/014
DM	104 (37/4%)	19 (41/3%)	7 (63/6%)	2 (50%)	132 (38/9%)	0/333
Smoking	103 (37/1%)	16 (34/8%)	2 (18/2%)	1 (25%)	122 (36%)	0/596
pCVA	6 (2/2%)	2 (4/3%)	2 (18/2%)	0 (0%)	10 (2/9%)	0/019
aCVA	6 (2/2%)	0 (0%)	1 (9/1%)	0 (0%)	7 (2/1%)	0/68

Notes: Data are presented as mean or number (%); Between-group comparisons were assessed using independent samples t-test for the normally distributed value. The categorical variables were compared through using chi-square test. BMI, body mass index; HDL, high-density lipoprotein; HTN, Hypertension; DM, Diabetes mellitus; HLP, Hyperlipidemia; pCVA, previous cerebrovascular accident; aCVA, cerebrovascular accident after surgery.

TABLE II: Distribution of Carotid Stenosis Based on Different Age Groups

Groups	Normal carotid (%)	Carotid stenosis <50 (%)	Carotid stenosis 50–70 (%)	Carotid stenosis >70 (%)
30–45 years	19 (95/00)	1 (5/00)	0 (0/00)	0 (0/00)
46–60 years	126 (86/90)	14 (9/65)	4 (2/75)	1 (0/69)
61–75 years	105 (78/35)	23 (17/16)	4 (2/98)	2 (1/49)
76–90 years	25 (69/44)	7 (19/44)	3 (8/33)	1 (2/77)

TABLE III: Distribution of Coronary Angiography Results in the Groups

Group	1 Vessel coronary artery disease	2 Vessel coronary artery disease	3 Vessel coronary artery disease
Normal	13 (4/7)	62 (22/3)	203 (73)
Carotid stenosis <50%	1 (2/2)	4 (8/7)	41 (89/1)
Carotid stenosis 50%–70%	0 (0/0)	1 (9/1)	10 (90/9)
Carotid stenosis >70%	0 (0/0)	1 (0/25)	3 (0/75)
Total	14 (4/1)	68 (20/1)	257 (75/8)

4. Discussion

In the present study, the relationship between carotid artery stenosis and cardiovascular risk factors was investigated. Among the investigated variables, age, HTN, HLP, and history of CVA had a significant relationship with the severity of carotid artery stenosis.

In Eatemadifar *et al*.'s study, the only factor related to atherosclerotic plaque in carotid arteries was the age of the subjects, so that people older than 65 years had more carotid plaques (39.1%) [7]. In our study, carotid artery stenosis had a significant relationship with the age of the study subjects, so the prevalence of plaque increased at the age of more than 45 years. In total, 96 patients (28.4%) were women and 243 patients (71.6%) were men. The analysis of the results showed that the distribution of sexual frequency in different groups had no statistically significant difference. In Tarzamni *et al*.'s study, the average age was reported as 58.5. Although patients with plaque in the common carotid and internal carotid were older, no significant relationship between age and the presence of plaque was observed [8]. In the study of Forouzan-Nia *et al*., the average age was 57.6 ± 10.4 years [9]. The average age of the patients in our study was 61.09 ± 10.37 years with an age range of 37 to 87 years. Considering that the average age in our study is higher, significant carotid stenosis is seen at a younger age. In the study of Tarzamni *et al*., no significant difference was seen in the formation of plaque in the common carotid artery between the two sexes, but the stenosis of the left internal carotid artery was observed more in men [8].

In our study, a total of 196 patients (57.8%) had hypertension and 143 patients (42.2%) did not have hypertension. The analysis of the results showed that there was a statistically significant difference in the frequency of hypertension in different groups, but in Samaee's [10] study, there was no significant relationship between the presence and absence of carotid stenosis and blood pressure. In our study, a total of 122 patients (0.36%) were smokers and 217 patients (0.64%) were non-smokers. The analysis of the results showed that the frequency of smoking in different groups does not have a statistically significant difference. Also, in the study of Samaee [10], no significant relationship was observed between the presence of stenosis and its absence with opium consumption. In Tarzamni *et al*.'s study, plaque formation in common carotid and internal carotid arteries was not significantly related to smoking and diabetes mellitus [8]. In our study, 82% of patients had no stenosis and 18% had carotid artery stenosis: 13.6% of these patients had >50% carotid artery stenosis, 3.2% had 50%–70% stenosis, and 1.2% had more than 70% stenosis. In Tarzamni *et al*.'s study, a low prevalence of significant carotid artery stenosis was observed in Iranian patients who underwent cardiac bypass surgery [8]. In Drohomirecka *et al*.'s study, it was conducted on 682 patients. 18% of the patients had a stenosis of more than 50% and 4.5% had a stenosis of more than 70% [11]. The prevalence of carotid artery stenosis of more than 50% in CABG patients has been from 2% to 18% in different studies.

In our study, a total of 38.9% of patients had diabetes and 61.1% did not. The analysis of the results showed that there was no statistically significant difference in the frequency of diabetes in different groups. In Tarzamani *et al*.'s study, plaque formation in the common carotid and internal carotid arteries had no significant relationship with diabetes mellitus [8]. In our study, a total of 2.9% of patients had a history of CVA. Analysis of the results showed that the history of CVA in different groups had a statistically significant difference. This means that more arterial stenosis was observed in patients with a history of CVA. In Drohomirecka *et al*.'s study, the history of CVA was considered one of the independent risk factors of stenosis [11]. The prevalence of previous CVA was 2.6% in Tarzamani *et al*.'s study [8]. Also, in our study, the incidence of CVA after surgery was 1.2%, which is lower than in other studies. In general, the prevalence of CVA after CABG is estimated between 2.5%–2.1% [12].

In several studies, internal carotid artery stenosis has been identified as a risk factor for post-operative CVA, which reduces quality of life and increases mortality [10], [13]. Also, in the study of Kiernan *et al*., the history of previous brain events was identified as one of the important factors of more than 70% of carotid stenosis [12]. Some studies have recommended carotid doppler ultrasound of the carotid arteries before CABG for all candidate patients [11]. In Kiernan *et al*.'s study, no significant difference was observed between lipid abnormalities, diabetes mellitus, and carotid artery stenosis. These results have been obtained in several other studies as well [12]. In the present study, the reason for the non-significance of the relationship between lipid profile and arterial stenosis is probably the previous history of cardiovascular diseases and long-term use of statins. In this study, a total of 14 patients (4.1%) had involvement of one vessel, 67 patients (21.2%) had involvement of two vessels, and 235 patients (74.4%) had involvement of three vessels. The analysis of the results showed that the results of angiography in different groups do not have a statistically significant difference, but as the percentage of carotid artery stenosis

increases, the number of vessels involved in angiography also increases.

5. Conclusion

The present study showed that old age, history of HTN, HLP, and history of CVA are directly related to the severity of carotid artery stenosis. Based on the results obtained from this study, it is recommended to perform a doppler ultrasound of the carotid arteries in CABG candidate patients.

Conflict of Interest

Authors declare that they do not have any conflict of interest.

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