Pak Heart J

FREQUENCY OF CAROTID ARTERY STENOSIS IN PATIENTS WITH SIGNIFICANT CORONARY ARTERY DISEASE

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Date Received: July 09, 2014
Date Revised: August 18, 2014
Date Accepted:October 02, 2014

Contribution
All the authors contributed significantly to the research that resulted in the submitted manuscript.

All authors declare no conflict of interest.

This article may be cited as: Goher F, Hussain S, Siddique S. Frequency of carotid artery stenosis in patients with significant coronary artery disease. Pak Heart J 2014;47(4): 188 - 92.

ABSTRACT

Objective: To determine the frequency of significant carotid artery stenosis (CAS) (⩾ 50%) in patients with significant coronary artery disease (CAD) (⩾ 50%) on Coronary Angiography.

Methodology: This cross-sectional study was carried out in Department of Cardiology, Shaikh Zayed Hospital, Lahore, Pakistan from December 2008 to June 2009. Total150 patients with significant CAD (⩾ 50%) of any coronary vessel diagnosed on the basis conventional coronary angiography) were included. Ultrasonographic scanning of the carotid arteries and its branches was performed using a tomographic ultrasound system with a high frequency (7.5MHz) linear transducer. CAS was considered significant when there were ⩾ 50% stenosis of common carotid artery or its main branches, on Carotid Doppler scan.

Results: Out of 150 patients, there were 102(68%) male and 48(32%) female patients. Mean age was 55.56 years (SD±10.99). Among those, the distribution of significant CAD was 30 (20.0%), 37 (24.7%) and 83 (55.3%) in patients with single, double and triple vessel CAD, respectively. Significant ultrasongraphic carotid stenosis was observed in 49 out of 150 patients (32.7%). Among those, the distribution of significant CAS was 6 out of 30 (20.0%), 10 out of 37(27%) and 33 out of 87 (55.3%) in patients with single, double and triple vessel CAD, respectively. Statistical analysis showed that the extent of CAD was significantly associated with the presence of carotid stenosis.

Conclusion: In conclusion, frequency of significant CAS in patients with CAD is high in local population and screening of CAS should be recommended in patients with CAD, especially in older patients with multivessel CAD.

Key Words: Atherosclerosis, Coronary Artery Disease, Carotid Artery Stenosis, Carotid Doppler Scan, Coronary Angiography

INTRODUCTION

Coronary artery disease (CAD) and cerebrovascular disease are the leading causes of death world over. Their incidence increases with ageand mostly occurs due to atherosclerosis.[1-2]

Atherosclerosis is a systemic disease process and large sections of the arterial tree will suffer from atherosclerosis, especially when exposed to elevated risk factor levels.[3] The American Heart Association has identified several risk factors for coronary heart disease. Some of them can be modified, treated or controlled, and some can't. The more risk factors a person has, the greater the chance that he or she will develop heart disease. Also, the greater the level of each risk factor, the greater the risk. Non-modifiable risk factors for atherosclerosis include age, sex, family history, race and ethnicity. Modifiable risk factors include hypertension (HTN), diabetes mellitus (DM), hyper lipidemia, smoking, alcohol abuse and physical inactivity.[4]

Coronary, carotid, and peripheral arterial disease each reflects advanced atherosclerosis. The extent of atherosclerosis differs across vessels like the femoral arteries, the abdominal aorta, the coronary arteries, and the carotid arteries. This has been shown in a study which reported a five-fold difference in extent of atherosclerosis between the common carotid arteries and coronary arteries, a three-fold difference between common carotid arteries and the femoral arteries, and a 1.5-fold difference between the coronary and femoral arteries.[3]

Cardiovascular and cerebrovascular events have been used as reliable end points for atherosclerosis intervention trials and epidemiological cohort studies. Multivariate stepwise logistic regression analysis showed that age and the extent of CAD were independently related to the presence of carotid stenosis. The distribution of carotid stenosis in the groups with degree of CAD was 14.5%, 21.4% and 36.0% in patients with one, two and three vessel CAD, respectively. The prevalence rate of carotid artery stenosis in patients with CAD was 25.4%.[5] Patients with severe CAD (i.e. three-vessel or left main stem) had a higher prevalence of $\geqslant$ 50% carotid stenosis as compared to patients without severe CAD.[6] Several studies have reported the coexistence of cerebrovascular and coronary artery disease. The prevalence of carotid artery disease (stenosis >50%) has been investigated and found to be high (26%) in patients with chronic stable angina, silent ischemia and acute coronary syndrome.[7]

Carotid duplex imaging is now recognized as the best non-invasive screening test for carotid artery stenosis.[8-10] It provides measures of intima media thickness and plaque, both widely used as surrogate measures of cardiovascular disease.[11] Atherosclerotic lesions of carotid artery are asymmetric focal thickenings of the innermost layer of the artery, the intima (normal $\leqslant$ 0.08cm).They consist of cells, connective-tissue elements, lipids and debris.[12] The maximum carotid intima-media thickness was significantly higher in the coronary disease group compared to the controls (1.02 vs. 0.80 mm). The average intima-media thickness was also significantly higher in the coronary disease group (0.82 vs. 0.67 mm).[13] Carotid intima media thickness independently predicts future vascular events like myocardial infarction and stroke. Its predictive value is at least as high in younger subjects as in older subjects.[14,15] The management strategy of combined coronary and asymptomatic carotid stenosis should be decided case by case, considering the degree of systemic atherosclerosis, cardiac conditions, and plaque morphology.[16]

Many studies have identified the interrelationship between carotid artery disease and coronary artery disease.[17-18] The purpose of this study was to identify the relationship between atherosclerosis of coronary and carotid arteries in local population.

METHODOLOGY

This cross-sectional study was carried out in Department of Cardiology, Shaikh Zayed Hospital, Lahore from December 2008 to June 2009. Total 150 patients with significant coronary artery disease i.e. $\geqslant$ 50% stenosis in Left main stem or in any one of the three major epicardial vessels or their main branches (single vessel, double vessel or triple vessel disease), on conventional coronary angiography and age >18 years were selected. Informed written consent was taken from all patients. Patients with history of previous carotid endarterectomy or any carotid procedure were excluded. Patients with history of percutaneous coronary intervention prior to index coronary angiogram or coronary artery bypass grafting were also excluded from study.

Ultrasonographic scanning of the carotid arteries was performed using a tomographic ultrasound system with a high frequency (7.5MHz) linear transducer. Scanning of the extracranial carotid arteries in the neck was performed bilaterally in three different longitudinal projections. Carotid artery stenosis was considered significant when there was $\geqslant$ 50% stenosis of common carotid artery or its main branches, on Carotid Doppler scan. Effect modifiers like age, risk factors (HTN, DM, Hyperlipidemia and Smoking) and severity of CAD (single, double or triple vessel) were addressed through stratification.

Clinical characteristics were summarized in terms of frequencies and percentages for categorical variables like gender, coronary angiographic findings (single, double or triple vessel disease) and carotid Doppler findings (significant stenosis of right common carotid, right internal carotid, right external carotid, left common carotid, left

internal carotid or left external carotid artery) were recorded as frequencies and percentages. For numerical variables, mean±1SD were used like age. Study was considered significant if P-value <0.05. Statistical analysis was done by using statistical software SPSS V16.0.

RESULTS

In this study, there were 102 (68%) male patients and 48 (32%) female patients. Mean age was 55.56 years (SD±10.99) with age range of 31-80 years. Maximum patients were in the age of 51-60 years (29.3%) (Table 1).

The risk factors like smoking, diabetes, hypertension and hyperlipidemia were studied with ultrasonographic carotid stenosis. From these factors, hyperlipidemia and HTN were the most common risk factors in our patients contributing 60.7% (n=91) and 60% (n=90) respectively, others were DM 50.7% (n=76) and smoking 43.3% (n=65) (Table 1).

Among 150 patients of significant coronary artery disease, 30 patients (20.0%) had single vessel disease, 37 patients (24.7%) had double vessel disease, and 83 patients (55.3%) had triple vessel disease (Table 1).

Out of 150 patients with significant CAD, 49 (32.7%) patients were found to have significant carotid artery stenosis (⩾ 50%)(Table 1). Among common carotid arteries or its branches, internal carotid arteries (RICA 46.9% and LICA 38.8%) are involved more as compared to external or common carotid arteries (Figure 1). The distribution of ultrasongraphic carotid stenosis in the groups with degree of significant CAD was 6 out of 30 (20.0%), 10 out of 37(27%) and 33 out of 87 (55.3%) in patients with single, double and triple vessel CAD, respectively. The extent of CAD was an independent predictor of the presence of

Table 1: Demographic Data and Risk Factors

Variables		n (%)
Sex	Male	102 (68%)
	Female	48 (32%)
Age in Years (mean± 1SD)		55.56±10.99
Risk Factors	Smoking	65(43.3%)
	DM	76(50.7%)
	HTN	90(60.0%)
	Hyperlipidemia	91(60.7%)
Coronary Artery Disease	Single Vessel Disease	30(20%)
	Double Vessel Disease	37(24.7%)
	Triple Vessel Disease	83(55.3%)
Carotid Doppler Findings	Carotid artery stenosis ⩾50	49(32.7%)
	Carotid artery stenosis ⩽50	101(67.3)

Table 2: Frequency of Carotid Artery Stenosis in Different Age Groups

Age	Carotid artery stenosis (<50%) n(%)	Carotid artery stenosis (>50%) n(%)	P-value
31-40	16 (10.7%)	2 (12.5%)	0.015
41-50	43 (28.7%)	8 (18.6%)	
51-60	44 (29.3%)	14 (31.8%)	
61-70	35 (23.3%)	16 (45.7%)	
71-80	12 (8.0%)	9 (75.0%)	

significant carotid artery stenosis (p=0.015) (Table 2).

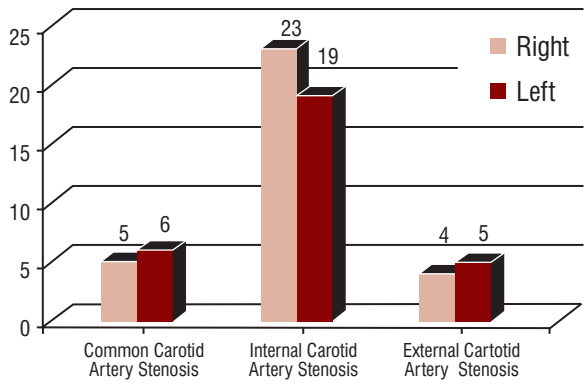
Relationship of significant carotid artery stenosis with various age groups showed that patients having age group 61-70 and 71-80 years, had significant carotid disease, 45.7% and 75.0% respectively. Least number of patients was in 31-40 years age group. Chi-square test was applied which showed that age is a significant predictor of the presence of significant carotid stenosis.

There were total of 102 males and 48 females, among them, 38% males and 11% females had significant carotid artery stenosis. Males had significantly more carotid artery disease as compared to females.

DISCUSSION

Atherosclerosis is a systemic disease process and large sections of the arterial tree will suffer from atherosclerosis, especially when exposed to elevated risk factor levels. [3,19] Non-modifiable risk factors for atherosclerosis include age, sex, family history, race and ethnicity. Modifiable risk factors include hypertension (HTN), diabetes mellitus (DM), hyperlipidemia, smoking, alcohol abuse and physical inactivity.[4] Coronary, carotid, and peripheral arterial disease each reflects advanced atherosclerosis. The extent of atherosclerosis differs across vessels like the femoral arteries, the abdominal aorta, the coronary arteries, and the

Figure 1: Distribution of Carotid Doppler Findings According to Arteries Involved



carotid arteries.

In the 1960s, there were few people in Asia with atherosclerosis in the extracranial carotid artery. But the incidence of extra cranial carotid atherosclerosis has increased in the past few decades with the change in lifestyle toward Western habits.[20]

Cardiovascular diseases are the major cause of mortality all over the world, being responsible for about 50% of all adult deaths. The majority of these deaths are from coronary heart disease.[21] One hundred thousand individuals suffered from an acute MI in Pakistan in year 2002.[22]

It is well known that carotid atherosclerosis strongly correlates with CAD. In the severe CAD patients who were scheduled to undergo CABG, the prevalence of carotid stenosis was 2% to 18% in Western countries.[23] But the prevalence of carotid stenosis in patients with CAD other than the candidates for bypass surgery has not been well evaluated.

Open-heart surgery in patients without carotid atherosclerosis carries a risk of stroke of 1% to 2%, but in the presence of un-operated major carotid stenosis, it is associated with a 14%risk of perioperative stroke.[23-25] Prognosis of CAD has improved in the past few years because of improvement in coronary revascularization. But neurological complications represent the most frequent cause of mortality in patients undergoing myocardial revascularization.[26]

Screening of carotid stenosis in patients with CAD seems insufficient in local population at present, probably because the prevalence rate of asymptomatic carotid stenosis has been considered to be low. In our study, an association between carotid atherosclerosis and coronary artery disease (CAD) has been established; the frequency of significant carotid artery stenosis in patients with significant CAD was 32.7%. Previous studies[5, 27,28] reported there was a significant relation between carotid artery stenosis and severity of CAD in patients undergoing coronary bypass surgery. Our study, including less severe CAD as well as severe CAD, supported these previous studies.

In our study, the mean age of the patients was 55.56±10.99 and there were 68% male and 32% female patients. In study of Protack there were 64% male and 36% females[29] and in the study of De Weerd showed that prevalence of carotid artery stenosis increases with age in both men and women, but men at all ages has the higher prevalence estimates[30]; our study also supported these previous studies.

The prevalence of carotid artery stenosis significantly increases with the presence of risk factors (DM, HTN, smoking, hyperlipidemia). Mathiesen reported in his study that age, male gender, smoking, total cholesterol, HDL cholesterol (inverse), diabetes and systolic blood pressure are all independent predictors of carotid artery stenosis.[31] In the study of Tanimoto also reported that the following factors were associated with severity of carotid artery stenosis: age, hypertension, diabetes mellitus, past history of myocardial infarction, previous CABG, and the extent of CAD.[5] In our study, 60.7% patients had history of hyperlipidemia, 60.0% had HTN, 50.7% had DM and 43.3% had smoking and all are significantly associated with carotid artery stenosis.

Therefore, it should be recommended that all the patients with CAD, especially those with multivessel CAD having risk factors for atherosclerosis, undergo carotid ultrasonography for screening of carotid atherosclerosis before treatment for CAD.

CONCLUSION

In conclusion, frequency of significant carotid artery stenosis in patients with CAD is high in local population and age, risk factors (DM, HTN, smoking and hyperlipidemia) and the extent of CAD were significantly related to the presence of carotid stenosis. Therefore, screening of carotid artery stenosis should be recommended in patients with CAD, especially in older patients with multivessel CAD.

REFERENCES

1. Qureshi AM, Jamshaid DT, Siddiqui MA. Stroke: a study of clinical patterns and risk factors. Ann King Edward Med Coll 2003;9:98-100.
2. Gupta R, Joshi P, Mohan V, Reddy S K, Yusuf S. Epidemiology and causation of coronary heart disease and stroke in India. Heart 2008;94:16-26.
3. Bots LM, Baldassarre D, Simon A, Groot de E, O'Leary HD, Riley W, et al. Carotid intima-media thickness and coronary atherosclerosis: weak or strong relations? Eur Heart J 2007;28:398-406.
4. Safeer M, Tariq M, Rehman U. Frequency of risk factors of cerebral infarction in stroke patients. A study of 100 cases in Naseer Teaching Hospital, Peshawar. Pak J Med Sci 2008;24:109-13.
5. Shuzou T, Yuji I, Kengo T, Sen Y, Hiroyoshi N, Tomohiro N, et al. Pravelence of carotid artery stenosis in patients with coronary artery disease in Japanese population. Stroke 2005;36:2094-8.
6. Ambrosetti M, Casorati P, Salerno M, Zambelli M, Pedretti RF, Tramarin R. Newly diagnosed carotid atherosclerosis in patients with coronary artery disease admitted for cardiac rehabilitation. Ital Heart J 2004;5:840-3.
7. Fassiadis N, Adams K, Zayed H, Goss D, Deane C , MacCarthy P, et al. Occult carotid artery disease in

patients who have undergone coronary angioplasty. Interact Cardio Vasc Thorac Surg 2008;7:855-7.

8. Zaidi RN, Khan AN, Dodhy K, Mahmood K. Carotid duplex imaging is better modality than angiography to diagnose carotid artery stenosis in patients for endartrectomy. Ann King Edward Med Coll 2004;10:380-3.
9. Khan S, Ahmad AS, Khalid M, Rashid A, Mehmood A, Ali A, et al. Role of carotid doppler in coronary artery disease. Pak Armed Forces Med J 2006;56:257-63.
10. Morito N, Inoue Y, Urata M, Yahiro E, Kodama S, Fukuda N, et al. Increased carotid artery plaque score is an independent predictor of the presence and severity of coronary artery disease. J Cardiol 2008;51:25-32.
11. Johnsen SH, Mathiesen EB, Joakimsen D, Stensland E, Wilsgaard T, Lochen ML, et al. Carotid atherosclerosis is a stronger predictor of myocardial infarction in women than in men: a 6-year follow -up study of 6226 persons: the tromso study. Stroke 2007;38:2873-80.
12. Hansson KG. Inflammation, atherosclerosis and coronary artery disease. N Engl J Med 2005;352:1685-95.
13. Hansa G, Bhargava K, Bansal M, Tandon S, Kasliwal RR. Carotid intima- media thickness and coronary artery disease: an Indian perspective. Asian Cardiovasc Thorac Ann 2003;11:217-21.
14. Lorenz MN, Von Kegler S, Steinmetz H, Markus HS, Sitzer M. Carotid intima - media thickening indicates a higher vascular risk across a wide age range: prospective data from the Carotid Atherosclerosis Progression Study (CAPS). Stroke 2006;37:87-92.
15. Kitagawa K, Hougaku H, Yamagami H, Hashimoto H, Itoh T, Shimizu Y, et al. Carotid intima-media thickness and risk of cardiovascular events in high - risk of cardiovascular events in high - risk patients. Results of the Osaka Follow Up Study for Carotid Atherosclerosis 2 (OSACA 2 STUDY). Cerebrovasc Dis 2007;24:35-42.
16. Hidekazu A, Koji H, En'ichi M, Jun T, Katsuhiko H, Norio N, et al. The Management of carotid artery stenosis with coronary artery disease. Surg Cereb Stroke 2004;32:437-42.
17. Kwon TG, Kim KW, Park HW, Jeong JH, Kim KY, Bae JH. Prevalence and significance of carotid plaques in patients with coronary atherosclerosis. Korean Circ J 2009;39:317-21.
18. Roman MJ, Pickering TG, Schwartz JE, Pini R, Devereux RB. Association of carotid atherosclerosis and left ventricular hypertrophy. J Am Coll Cardiol 1995;25:83-90.
19. Amarenco P, Labreuche J, Touboul PJ. High-density lipoprotein-cholesterol and risk of stroke and carotid atherosclerosis: a systematic review. Atherosclerosis 2008;196:489-96.
20. Nagao T, Sadoshima S, Ibayashi S, Takeya Y, Fujishima M. Increase in extracranial atherosclerotic carotid lesions in patients with brain ischemia in Japan. Stroke 1994;25:766-70.
21. Shiwani H A, Aziz A, Shiwani H. Shall we become vegetarian to minimize the risk of coronary heart disease? J Pak Med Assoc 2007;57:46-8.
22. Samad A. Coronary artery disease in Pakistan preventive aspects. Pak J Cardio l 2003;14:59-60.
23. Sheiman RG, Janned'Othée B. Screening carotid sonography before elective coronary artery bypass graft surgery: who needs it? AJR Am J Roentgenol 2007;188:475-9.
24. Dawson DL, Zierler RE, Strandness DE Jr, Clowes AW, Kohler TR. The role of duplex scanning and arteriography before carotid endarterectomy: a prospective study. J Vasc Surg 1993;18:673-80.
25. Pillai L, Gutierrez IZ, Curl GR, Gage AA, Balderman SC, Ricotta JJ. Evaluation and treatment of carotid stenosis in open-heart surgery patients. J Surg Res 1994;57:312-5.
26. Puskas JD, Winston AD, Wright CE, Gott JP, Brown WM, Craver JM, et al. Stroke after coronary artery operation: incidence, correlates, outcome, and cost. Ann Thorac Surg 2000;69:1053-6.
27. Fukuda I, Osaka M, Nakata H, Sakamoto H. Clinical outcome for coronary artery bypass grafting in patients with severe carotid occlusive disease. *J Cardiol* 2001;38:303-9.
28. Najafian J, Fatemi F, Esfahani AM, Najafian A. Relationship between intima-media thickness of carotid arteries and coronary stenosis in angiography. Rawal Med J 2008;33:59-61.
29. Protack CD, Bakken AM, Xu J, Saad WA, Lumsden AB, Davies MG. Metabolic syndrome: a predictor of adverse outcomes after carotid revascularization. J Vasc Surg 2009;49:1172-80.
30. de Weerd M, Greving JP, de Jong AW, Buskens E, Bots ML. Prevalence of asymptomatic carotid artery stenosis according to age and sex: systematic review and metaregression analysis. Stroke 2009;40:1105-13.
31. Mathiesen BE, Joakimsen O, Bønaa HK. Prevalence of and risk factors associated with carotid artery stenosis: the tromsø study. Cerebrovasc Dis 2001;12:44-51.