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Cardiology

CAROTID ARTERY STENOSIS (CAS) AND ASSOCIATED RISK FACTORS AMONG PATIENTS OF CAROTID ARTERY DISEASE REPORTING TO A TERTIARY CARE CENTRE OF NEW DELHI, INDIA.

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ABSTRACT Arteriosclerotic Vascular Disease is a syndrome affecting arterial blood vessels. Rupture leads to narrowing, Flow obstruction, infarction and aneurysm Formation with rupture of vessel. Asymptomatic patients have no complaints and can only be detected through screening or by chance. Imaging can be done either by invasive methods like direct angiography of vessels or by non-invasive methods, such as carotid doppler/CT-angiography or MR-angiography.

A retrospective observational study was carried out over a span of 2 yrs among 623 participants undergoing non-emergent coronary angiography and subsequent coronary artery bypass surgery at a tertiary care centre of New Delhi. Carotid Artery Stenosis (CAS) was evaluated by a consultant radiologist. The patients underwent carotid ultrasound and Doppler study within 24 hours of the coronary procedure. Prevalence of Carotid Artery Stenosis (CAS) was found to be 38%. The prevalence of both unilateral and bilateral disease was 19 %. Age and Smoking (Tobacco) was found to be risk factors for CAS. Diabetes (insulin resistance) was also found to be a significant predictor of CAS. Thus the study points toward the relatively wide prevalence of carotid artery disease in neurologically asymptomatic patients undergoing CABG for CAD in the elective setting.

KEYWORDS : Carotid artery, stenosis, disease

Introduction

Arteriosclerotic Vascular Disease is a syndrome affecting arterial blood vessels. It is a chronic inflammatory response in the walls of arteries, in large part due to the accumulation of macrophage white blood cells and promoted by low density lipoproteins without adequate removal of fats and cholesterol from the macrophages by functional high-density lipoproteins is commonly referred to as a hardening or furring of the arteries.[1]

The atheromatous plaque is divided into 3 distinct components:

a. The atheroma which is the nodular accumulation of a soft, flaky, yellowish material at the center of large plaques, composed of macrophages nearest the lumen of the artery
b. Underlying areas of cholesterol crystals
c. Calcification at the outer base of older/more advanced lesions

Rupture leading to Narrowing and Flow obstruction, infarction and aneurysm Formation with rupture of vessel leading to bleeding are two major problems due to atherosclerosis.

Major obstruction may lead to coronary artery disease, cerebral vascular disease and peripheral artery disease among others. Many a times these can be asymptomatic. Other symptoms which may present are angina, MI (ST-E & NST-E), TIA, CVA, claudication, gangrene etc. Stress Testing for CAD detects >70 % narrowing only, proving non-helpful in many cases.

Risk Factors include dyslipidemia, smoking and consumption of tobacco products, hypertension, diabetes mellitus, sleep deprivation, alcohol and certain viral infections.

As asymptomatic carotid artery stenosis (CAS) patients have no complaints, they can only be detected through screening or by chance.[2] Symptoms of carotid artery stenosis include ipsilateral transient visual obscuration from retinal ischemia; contra lateral weakness or numbness of an arm, a leg, or the face, or of a combination of these sites, visual field defect, and aphasia.

Ill-defined episodes of 'dizziness', generalized subjective weakness, syncope or near-syncope episodes, 'blurry vision,' or transient positive visual phenomena do not qualify as symptomatic ischemic events.[3]

Imaging can be done either by invasive methods like direct angiography of vessels or by non-invasive methods, such as carotid doppler/CT-angiography or MR-angiography.[4]

So, a study was conducted to evaluate the severity of stenosis by Doppler ultrasound and to assess associated factors with carotid artery stenosis in the intra-operative management of these patients.

Methodology

A retrospective observational study was carried out over a span of 2 yrs. The records selected were the ones whose patients reported to the cardiovascular science center of a large, tertiary teaching hospital in North India. All records of neurologically asymptomatic patients with Coronary Artery Disease scheduled for CABG with CPB were included in the study. Patients with previously known carotid artery disease, history of having undergone carotid artery endarterectomy or stroke or neurological symptoms attributable to Carotid Artery Stenosis, hemo-dynamically unstable patients, patients who were unable to lie down supine for assessment, patients with arrhythmias or valve disease, and those presenting for emergency CABG were excluded from the study.

Carotid Artery Stenosis (CAS) was evaluated by a consultant radiologist having more than two years of vascular Doppler imaging experience who was blinded to clinical and coronary angiographic data, assessed atherosclerosis of both the left and right Internal Carotid Artery (ICA) using SonoSite M-Turbo machine (Sonosite Bothell, WA USA) with a linear 10-5 MHZ probe.

ICA atherosclerosis was evaluated by the maximum percentage of diameter reduction recorded by B-mode ultrasound, and by the peak systolic velocity (PSV) and peak diastolic velocity per Doppler. Lesion severity was defined as the greatest stenosis observed either on the right or left ICA.

Ultrasound and Doppler findings were classified as Normal / No stenosis (No Carotid stenosis with ICA PSV < 125cm/s, No plaque, ICA/CCA <2 and ICA EDV <40cm/s), Mild / Clinically normal stenosis (<50% Carotid Stenosis, ICA PSV <125 cm/s, Plaque estimate <50%, ICA/CCA ratio <2, and ICA EDV <40 cm/s), and Definite Stenosis (>50% Carotid Stenosis, ICA PSV >125 cm/s, Plaque estimate >50%, ICA/CCV ratio >2, and ICA EDV <40 cm/s).[5]

Ethics

Ethical approval regarding the study was taken from the Hospital authorities. Written consent was taken from patient or attendant for use of data for statistical purposes at the time of admission, as per hospital policy.

Statistical Analysis

Data was entered in Microsoft Excel and analysis was performed using SPSS version 17.0. Chi-square test was used to compare categorical variables and analysis of variance or the Mann-Whitney test was used to compare continuous variables. Regression analysis was used to identify the predictive value of various factors for the presence of >50% carotid artery stenosis. For each test, a p-value < 0.05 was considered significant.

Results

The present study involved 623 participants undergoing non-emergent coronary angiography and subsequent coronary artery bypass surgery between 1st January 2014 and 31st December 2015. The patients underwent carotid ultrasound and Doppler study within 24 hours of the coronary procedure. The carotid artery stenosis was categorized under

two groups: <50% and >50% stenosis. All selected patients (after scrutinizing from inclusion and exclusion criteria) were evaluated.

Table 1: Distribution of patients according severity of stenosis.

Severity of stenosis	No disease	Unilateral disease	Bilateral disease	Total No of Cases
Normal	383 (62%)	--	--	383 (62%)
Mild	--	99 (16%)	73 (12%)	172 (28%)
Moderate/Severe	--	19 (3%)	43 (7%)	62 (10%)
Total	383 (62%)	118 (19%)	116 (19%)	618 (100%)

In the present study, the prevalence of Carotid Artery Stenosis (CAS) was found to be 38% which is consistent with that reported (6.1% to 66%), 28 % had <50% degree of CAS, 8 % had 50% – 69% stenosis, and 2% had >70% stenosis. None of the 618 patients studied had "near occlusion" or "total occlusion" of the carotid arteries. (Table 1)

The prevalence of both unilateral and bilateral disease was 19 %. 57.16 % of the patients with <50% CAS had unilateral disease. In patients with >50% CAS 70 % had bilateral CAS. The patients with severe CAS >70% had bilateral stenotic lesions affecting the carotid arteries.

Table 2: Distribution of study participants according to risk factors.

Risk Factor		Degree of Stenosis			Total	Chi-square	p-value
		Normal	Mild	Moderate /Severe			
Age (in yrs)	<45	31 (5%)	6 (1%)	6 (1%)	43 (7%)	4.311	0.001*
	46-55	173 (28%)	25 (4%)	0	198 (32%)		
	56-65	136 (22%)	62 (10%)	24 (4%)	222 (36%)		
	>65	43 (7%)	80 (13%)	32 (5%)	154 (25%)		
Tobacco Use	Yes	68 (11%)	80 (13%)	43 (7%)	192 (31%)	3.226	0.012*
	No	315 (51%)	93 (15%)	19 (3.1%)	426 (69%)		
Diabetes	Yes	105 (17%)	111 (18%)	31 (5%)	247 (40%)	5.769	0.001*
	No	278 (45%)	62 (10%)	31 (5%)	371 (60%)		
Dyslipidemia	Yes	31 (5%)	62 (10%)	31 (5%)	124 (20%)	2.886	0.044*
	No	352 (57%)	111 (18%)	31 (5%)	494 (80%)		
Carotid Bruit	Yes	0	0	37 (6%)	37 (6%)	22.463	0.001*
	No	383 (62%)	173 (28%)	25 (4%)	581 (94%)		

Age was found to be an incremental risk factor for CAS in the present study with an increase in the number of patients with CAS with advancing age, mostly above 65 years (18 %). This provides an indication as to obligatory assessment of Carotid Artery disease in older patients reporting with Coronary problems. The gender of the patient did not bear any correlation with CAS in the present study. However, other studies found female gender to be a predictor of carotid stenosis. Smoking (Tobacco use) emerged as an independent risk factor in the present study. Tobacco use, as established globally is the prime factor for atherosclerosis, and this is also implicated in the present study. Diabetes (insulin resistance) was also found to be a significant predictor of CAS. Dyslipidemia was identified as an independent risk factor for CAS in the present study whereas some studies do not identify it as a significant risk factor. In the present study, hypertension was not determined a predictor for CAS. This contrasts with previous studies that found that presence of hypertension was an independent risk factor of CAS. Carotid murmur (bruit) was detected in 15.6 % of the patients who has CAS in the present study. (Table 2)
Of the 618 patients that were included in this study, one patient with critical CAS with 80 % occlusion involving the right ICA was taken up for concomitant carotid endarterectomy and CABG in the same sitting.

Discussion

Prevalence of Carotid Artery Stenosis (CAS) was found to be 38% which is consistent with that reported previously. The prevalence and impact of CAS can thus be considered as equivalent to the rest of the global literature reports available, implicating that similar risk factors are the ones responsible for such situations. Of these patients with CAS in the present study, 28 % had <50% degree of CAS, 8 % had 50% – 69% stenosis, and 2% had >70% stenosis. None of the 618 patients studied had "near conclusion" or "total occlusion" of the carotid arteries.

The prevalence of both unilateral and bilateral disease was 19 %. Also, 57.16 % of the patients with <50% CAS had unilateral disease and 4.29 % had bilateral stenosis of the carotid arteries. In patients with >50% CAS, 30 % had unilateral and 70 % had bilateral CAS. The patients with severe CAS >70% had bilateral stenotic lesions affecting the carotid arteries. In a study comprising of 559 patients, Wanamaker at all determined an incidence of carotid artery disease (>50% stenosis) to be 36 % with 18 % unilateral moderate disease, 10 % bilateral moderate and 8 % severe disease.[5] Al-Fayez et al reported that in their study comparing 102 patients, 86.3 % had CAS while 16.6 % had ≥50% stenosis of both carotids.[6] They found unilateral lesion >50% in 9.8 % of the patients, bilateral lesions >50% in 6.8 % of the patients and 2.9 % with bilateral stenosis >80%. In another study, da Rosa and Portal found prevalence of CAS >50% to be 17.4 % among 393 patients who underwent elective CABG. Of these, 12.0 % had a stenosis between 50 % and 69 %, 7.1 % had a stenosis between 70 % and 99 %, and 0.3 % had an ICA occlusion. About 67.1 % of the patients with a stenosis ≥50% were male.[7] Mahmoudi et al. performed carotid duplex ultrasound in 878 patients before isolated CABG and found that 13 % had a carotid stenosis >75%. Significant predictors for CAS were age >69 and peripheral vascular disease.[8] Shirani et al. reported the prevalence of CS >60% as 6.6 % and 12.5 % in patients who were 65 years and older. They found age >50 years, female gender, hypercholestrolemia, and diabetes mellitus to be independent risk factors for significant CAS.[9]

Age was found to be an incremental risk factor for CAS in the present study with an increase in the number of patients with CAS with advancing age, mostly above 65 years (18 %). This provides an indication as to obligatory assessment of Carotid Artery disease in older patients reporting with Coronary problems. This evaluation compulsion would tend to reduce many false negatives. Faggioli et al too, showed that the rate of significant CAS rose from 3.8 % for patients younger than 60 years to 11.3 % for patients above the age of 65 years.[10] Shirani et al found age >50 years to be an independent risk factor for carotid stenosis with a prevalence of significant stenosis to be 7.9 % for 50 years and over as compared to 1.3 % for <50 years of age.[9] Berens et al. analyzed 1068 patients and found that 15.6 % had carotid stenosis >50% with a 4 % prevalence in those aged <60 that rose to 11 % in patients >60 years and 15 and in those >70 years of age.[11]

The gender of the patient did not bear any correlation with CAS in the present study as was also determined by Al-Fayez et al and Siminelakis et al.[12,13] The present finding thus needs further investigation with an even larger sample size. However, other studies found female gender to be a predictor of carotid stenosis. D'Agostino et al and Durand et al. identified female gender as a risk factor for significant carotid stenosis.[6,14]

Smoking (Tobacco use) emerged as an independent risk factor in the present study. This issimilar to other studies showing smoking to be a significant risk factor.[6,15] Tobacco use, as established globally is the prime factor for atherosclerosis, and this is also implicated in the present study. A tobacco user, reporting with coronary artery disease should mandatorily be subjected to Carotid Artery evaluation as the association is mostly confirmatory.

Diabetes (insulin resistance) was also found to be a significant predictor of CAS in the present study as concluded in several other studies.[15,16] Dyslipidemia was identified as an independent risk factor for CAS in the present study as was also reflected by Shirani et al whereas Fagoli et al did not identify dyslipidemia to be a significant risk factor in their study.[17,18] This result necessitates the evaluation of lifestyle disorders so as to determine the associative conditions that may co-exist with the current cardiovascular issues. In the present study, hypertension was not determined a pred
ictor for CAS.

Carotid murmur (bruit) was detected in 15.6 % of the patients who has CAS in the present study while da Rosa and Portal found it to be 35.5 %.[7] The present study did not find an association of CAS with LM coronary artery (LMCA) disease as has also been reported by Kiernan

and Taqueti.[19]

Al-Faryez et al reported the LMCA disease was an independent risk factor for CAS. In their study, 38 % of the patients with significant LMCA disease were also found to have significant CAS while the overall incidence of LMCA disease in patients undergoing CABG was only 12.7 %.[6]

Conclusion

This study points toward the relatively wide prevalence of carotid artery disease in neurologically asymptomatic patients undergoing CABG for CAD in the elective setting. It highlights the importance of subjecting these patients to evaluation by means of Doppler ultrasound of the carotid vessels in the OR and the subsequent customization of the surgical approach.

Limitation

Carotid angiogram or cross-sectional computed tomographic imaging was not done to corroborate the findings of the colour Doppler examination of the vessels of the neck. Risk stratification of the patient was also not carried out in the preoperative period. An extensive study over a longer period would have demystified the associative risk factors too.

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