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# Carotid Artery Disease In Patients Undergoing Elective Coronary Artery Bypass Surgery

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## ABSTRACT

**Objective:** To determine frequency of carotid artery disease in patients undergoing elective coronary artery bypass grafting (CABG) using Doppler sonography.

**Study Design:** Observational study.

**Place and Duration of Study:** Radiology Department, The Aga Khan University Hospital, Karachi, from January 2005 to September 2008.

**Methodology:** Patients with known cardiovascular disease waiting for CABG surgery were enrolled for carotid artery Doppler sonography. A predefined data entry form was used for data collection. Coronary angiography findings, carotid artery findings and other associated factors were noted from medical and radiological records. Frequency and pattern of carotid artery disease along with associated risk factors were evaluated. Data was entered and analyzed in SPSS version 15. Pearson chi-square for categorical and independent "t" test was applied for continuous variables at 95% confidence level. P-value of less than 0.05 were considered significant.

**Results:** A total of 176 patients (85% male, mean age=65 years) undergoing elective coronary artery bypass grafting were evaluated preoperatively for carotid artery disease by neck color Doppler sonography. Twenty percent of patients were found to have advanced carotid artery disease (> 50% stenosis), 6% had critical stenosis (> 75% stenosis) and 3% had complete stenosis. Frequency of atherosclerotic plaques was 50%, more common on right side and more prevalent in common carotid artery. Family background of carotid or coronary artery disease and history of smoking were significantly associated with presence of carotid artery disease ( $p < 0.05$ ).

**Conclusion:** A sizeable proportion of patients undergoing elective coronary artery bypass grafting surgery for coronary artery disease were found to have coexistent carotid artery disease.

**Key words:** Coronary artery bypass grafting (CABG). Carotid artery disease. Doppler ultrasound.

## INTRODUCTION

Coronary artery bypass grafting (CABG) has been associated with a lower mortality as compared to non invasive management with delayed surgery in high-risk and medium-risk patients with stable coronary artery disease.<sup>1</sup> The procedure itself has multiple complications and postoperative stroke is one of its most catastrophic complications.<sup>2,3</sup> Aggressive diagnostic strategies to predict occurrence of stroke and therapeutic interventions in high risk patients have shown a significant improvement in their clinical outcomes.<sup>4,5</sup> Various studies have attempted to identify clinical predictors of stroke and presence of carotid artery disease having significant contribution towards development of post-operative stroke in patients

undergoing CABG. Some studies have shown a positive correlation between carotid intima-media thickness (IMT) and coronary stenosis.<sup>6,7</sup> Others have cited a poor correlation between carotid IMT and coronary artery disease.<sup>8</sup>

Color Doppler with spectral waveform ultrasound of neck is the most commonly used imaging modality for the pre operative assessment of carotid artery diseases as it is a non-invasive, accurate, cost effective and easily available method.<sup>9-11</sup> Several studies have cited that the prevalence of significant carotid artery stenosis (> 50%) in patients undergoing CABG reaches 18%.<sup>12,13</sup> Studies from neighboring regions have reported a lower prevalence of carotid disease in patients undergoing CABG (1.8% of patients having significant carotid artery stenosis and 1.1% of patients having critical carotid artery stenosis).<sup>14</sup>

Coronary artery disease is common in the local population and CABG is one of the commonly performed procedures. Knowledge of carotid abnormality in the presence of coronary disease is limited. The objective of this study was to determine the frequency and status of carotid disease in patients undergoing CABG for coronary artery stenosis by using Doppler sonography of neck vessels.

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## METHODOLOGY

The participants of the study were selected from the patients presenting to the Aga Khan University Hospital Karachi diagnosed with coronary heart disease. The patients were candidates for CABG from 1st January 2005 till 27th September 2008 and were referred to the Radiology Department for preoperative carotid Doppler examination. Patients with known cases of carotid artery disease, post endarterectomy and unstable patients having difficulty in adopting lying down position for sonographic examination, incomplete medical records or more than one month interval between carotid Doppler and CABG were excluded from this study.

Coronary angiography findings, carotid artery findings and other parameters including age, gender, diabetes, hypertension, hypercholesterolemia, positive family history of coronary or carotid artery disease, previous history of stroke, smoking history and post operative history of stroke and ejection fraction were measured from patients' medical record. All these factors are known to be associated with carotid artery disease.<sup>15</sup> All carotid Doppler examinations were performed on Aloka Japan or GE USA ultrasound apparatus by using 5 or 7 MHZ linear or curvilinear ultrasound probe while the patient was in a supine position with extended neck. Scanning of the common carotid, carotid bifurcation and internal and external carotid along with bilateral vertebral arteries was done in the transverse and longitudinal plane. Interpretations of the image were performed on the monitor as well as on hard copies. All examinations were done by a consultant radiologist having more than two years of vascular Doppler imaging experience. Gray scale imaging was used to evaluate atherosclerotic plaques and intimal thickness (area between two parallel echogenic lines). Combination of gray and color Doppler technique was used to determine the degree of stenosis in the right common carotid, right internal carotid and the left common and left internal carotid arteries. Carotid artery stenosis and peak systolic flow were graded using the criteria defined by the Society of Radiologists in the Ultrasound Consensus Criteria.<sup>16</sup> Categorical variables included presence of carotid disease, diabetes, history of smoking and hypercholesterolemia. Quantitative variables include age of patients and systolic velocities of blood on carotid Doppler. Data was entered and analyzed in SPSS version 15. Pearson chi-square for categorical and an independent "t" test was applied for continuous variables at a 95% confidence level. P-values of less than 0.05 were considered significant.

## RESULTS

A total of 176 cases were included (150 males, mean age 65±8 years). Mean ejection fraction on echocardiography was 52±8%. Ninety percent patients had

three vessel coronary disease on conventional angiography. Diabetes was more common in males (82.3%) compared to females (17.7%, p=0.01). There was no other significant difference among male and female participants in the study (p= 0.71) having carotid disease. Positive smoking history was found in 96.7% of males and 3.3% of females (p= 0.04). Presence of hypercholesterolemia was not significantly different between males and females (p= 0.40). Around 96% of males and 3.7% of females had a positive family history of coronary or carotid artery disease (p=0.06). Only 2 patients had a history of alcohol consumption. Normal and abnormal findings in carotid arteries are summarized in Table I. Stenosis of less than 50% in right common carotid, right internal carotid, left common carotid and left internal carotid were detected in 4% (n=7), 3% (n=6), 6% (n=10) and 4% (n=7) of cases respectively. Stenosis of 50% to 75% in right common carotid, right internal carotid, left common carotid and left internal carotid were detected in 2% (n=3), 4% (n=8), 2% (n=4) and 5% (n=9) of cases respectively. Stenosis of 75% to 80% was detected in the left internal carotid artery in 2% (n=4) of cases and in the right internal carotid artery in 1% (n=2). Severe occlusion was detected in the right internal carotid artery in 2% (n=3) while in the left internal carotid artery occlusion was detected in 1% (n=2) of all cases. The peak systolic velocities were higher in both carotid arteries with advanced stage of stenosis (p=0.001). No statistically significant association was found between age and gender with carotid artery disease (p=0.78). Only 2 patients developed post-operative stroke.

**Table I:** Stenosis grading in the carotid arteries of 176 patients who participated in the study.

Grade of stenosis	Carotid artery n (%)			
	Right common	Right Internal	Left common	Left Internal
Normal	81 (46)	93 (53)	74 (42)	93 (53)
Plaque present	85 (48)	64 (36)	88 (50)	61 (35)
Less than 50%	7 (4)	6 (3)	10 (6)	7 (4)
50% to 75%	3 (2)	8 (4)	4 (2)	9 (5)
75% to 80%	-	2 (1)	-	4 (2)
Complete occlusion	-	3 (2)	-	2 (1)

No significant difference was found between age and gender of the participants with carotid artery disease (p = 0.78)

## DISCUSSION

In this study, the proportion of carotid artery disease was determined in patients undergoing CABG for coronary artery stenosis in local settings. The main finding was a high proportion of significant carotid artery disease in the target population (20%), with around half of the cases having normal carotid Doppler findings. Only 6% (n=11) patients had critical (> 75%) carotid stenosis. This finding could be due to multiple social and nutritional risk factors associated with the disease process. This finding is almost consistent with western published data,<sup>12,13,17-19</sup> but higher than Tarzami *et al.*<sup>14</sup>

Stroke is considered one of the most devastating complications following CABG due to its effects often being irreversible, lifelong and potentially debilitating. Various studies have evaluated carotid disease as a risk factor for postoperative stroke.<sup>4,10</sup> One study suggests that as high as one third of post CABG strokes occur as a result of carotid artery disease.<sup>20</sup> Guidelines recommend carotid endarterectomy as a Gold standard for symptomatic patients who have more than 50% narrowing of the internal carotid artery and for asymptomatic patients with 70% or greater narrowing of the internal carotid artery.<sup>18</sup> Different studies recommend concurrent carotid artery stenting as a better procedure along with CABG.<sup>22</sup> Others suggest there is no such difference in terms of outcome between concurrent or staged procedure.<sup>9</sup> Late outcomes of untreated carotid artery disease following cardiovascular operations include transient ischemic attacks and stroke.<sup>13</sup> Multiple studies have attempted to identify the clinical predictors of stroke. Some studies have reported a positive correlation between coronary atherosclerosis and carotid IMT, using one parameter as a surrogate marker of the other parameter.<sup>6</sup> Other studies have cited only a weak correlation between the two parameters.<sup>8</sup> Another study supported the hypothesis that there was a low prevalence of carotid disease in patients undergoing cardiovascular procedures for coronary artery disease.<sup>14</sup> In this study, significant carotid artery stenosis (> 50% stenosis) was found in 20% [n=35] and critical stenosis (> 75% stenosis) in patients undergoing CABG was found in 6% (n=11) of cases, while only 3% (n=5) had almost complete stenosis. The proportion of significant carotid stenosis in our population consistent with local published literature,<sup>2,3</sup> however, was higher than the neighbouring country. Therefore, carotid Doppler ultrasound of neck for carotid artery disease should be done as a part of preoperative screening in patients having coronary artery disease undergoing coronary artery bypass graft surgery.

This study had a few limitations including selection bias as only those patients referred to radiology for carotid Doppler ultrasound examination were selected and from one hospital only. No neck vessels conventional angiogram or cross-sectional imaging was done for carotid artery disease. Inter observer variability of carotid Doppler sonography was not assessed. Only one month follow-up of patients was available.

### CONCLUSION

This study showed a high proportion of marked carotid artery disease in patients undergoing CABG. On the basis of these results, pre-operative screening for carotid is recommended for patients planned for CABG. However, larger, longitudinal, multi-centre studies may be required to establish an association between carotid and coronary artery disease in the local population.

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