

## FREQUENCY OF SEVERE CAROTID ARTERY STENOSIS IN DIABETIC PATIENTS HAVING TRIPLE VESSEL CORONARY ARTERY DISEASE

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### Contribution

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

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### ABSTRACT

**Objective:** To determine the frequency of severe carotid artery stenosis in diabetic patients having triple vessel coronary artery disease.

**Methodology:** It was a cross-sectional study conducted from July 2011 to January 2012. Seventy four diabetic patients having triple vessel disease (TVD) were included in the study. Carotid Doppler scan was done in all patients. Severe carotid artery stenosis was diagnosed with the help of Doppler diagnostic criteria that was peak systolic velocity of  $> 2.3$  m/ sec of internal carotid artery (ICA) or peak diastolic velocity of  $> 1.00$  m/sec of ICA or ICA/common carotid artery (CCA) systolic ratio of  $> 4$  and confirmed by two Radiologist Data was entered on the proforma attached.

**Results:** Out of total 74 patients males were 74% and females were 26%. Their mean age was  $56.95 \pm 8.77$  years. Patients having DM for more than 10 years were 41 (55.40%). Mean duration of DM was  $9.4 \pm 4.8$  years. Severe carotid artery stenosis i.e. 70 % stenosis was found in 8 patients (10.8 %) of the study population. Out of these 8 patients right carotid was involved in 5 patients while the remaining 3 patients had stenosis of the left carotid artery.

**Conclusion:** Severe carotid artery stenosis is found in significant number (10.8%) of diabetic patients having triple vessel disease.

**Keywords:** Carotid Artery Stenosis, Triple Vessel Disease, Carotid Doppler scan.

## INTRODUCTION:

Atherosclerosis is a generalized disease; thus carotid artery involvement in patients with coronary artery disease (CAD) is expected.<sup>1</sup> Atherosclerosis of coronary arteries commonly cause myocardial infarction (MI) and angina pectoris and atherosclerosis of arteries supplying the central nervous system (CNS) causes stroke and transient ischemic attack (TIA).<sup>2</sup> Coronary artery disease (CAD) is the leading cause of death in the developed nations and is increasing rapidly in the developing nations. Migrant south Asians residing in the west have one of the highest rates of coronary artery disease (CAD) in the world. One in four middle- aged adults in Pakistan have established CAD.<sup>3</sup> There is a high prevalence of carotid artery disease in patients with triple vessel disease (TVD) 11.7% or left main coronary artery disease (LMCA) 15.4% while only 2% with two vessel disease.<sup>1</sup> Diabetes mellitus increases the risk of coronary artery disease as well as the risk of cerebrovascular events 2 to 4 times. Diabetes mellitus has a significant association with carotid artery disease. Patients with concomitant carotid and CAD are at risk of stroke while undergoing CABG. Stroke rate was higher in the perioperative period in patients with severe (>70%) carotid artery stenosis than in patients with <70% carotid artery stenosis.<sup>1</sup> Extra cerebral carotid artery stenosis is the most important predictor of stroke in patients undergoing CABG.<sup>4</sup> Identification of the patients with critical carotid artery disease (> 70 % stenosis) with the help of carotid Doppler before CABG may decrease the postoperative neurological complications.<sup>5</sup> The 30-day mortality was ten times greater in the patients who have stroke after the CABG than that of those who did not suffer from stroke (17.6 vs. 1.7%) after the CABG.<sup>6</sup> Color doppler evaluation is very sensitive in the diagnosis of carotid artery stenosis. It enables the approach to extra cranial carotids, which is the most affected segment of the carotid arteries. It is accurate in estimation of stenosis degree and plaque characteristics, as a potential source of embolus, and measurement of the carotid artery flow velocities for the better estimation of the carotid stenosis.<sup>7</sup> In patients with severe carotid artery stenosis; different treatment strategies like carotid artery stenting or carotid endarterectomies can be employed before or during surgical intervention.<sup>7</sup> This study was designed to highlight the importance of diagnosing and treating critical carotid artery stenosis in patients with TVD who are at high risk for the neurological complications during CABG. The aim of this study was to determine the frequency of severe carotid artery stenosis in diabetic patients having triple vessel coronary artery disease.

## METHODOLOGY

This Cross-sectional study was conducted in Ch. Pervaiz

Elahi Institute of Cardiology from July, 2011 to January , 2012. Diabetic patients having triple vessel coronary artery disease, of all age groups and either sex were included in the study. Patients with neck swellings, history of Neck surgery, previous carotid intervention, valvular heart disease or with risk factors like hypertension, smoking and hyperlipidemia were excluded from the study. Thus Seventy four patients were included in the study. Diabetic patients consisted of both new and old diabetics. Old diabetes was diagnosed on history (previously diagnosed and taking medicine for diabetes). Laboratory investigations were carried out to diagnose new diabetic patients who were having TVD. They were diagnosed with diabetes mellitus with the help of the following criteria: fasting plasma glucose level 126 mg/dl or higher on more than one occasion. HbA1c value of 8% was taken as cut off point between controlled and uncontrolled DM. Informed consent was taken from all patients. Data like age, sex, duration and control of diabetes was recorded. Carotid Doppler ultrasonography was done in all diabetic patients having TVD to look for the carotid artery disease. At the level of CCA and ICA, both peak systolic and diastolic velocities were measured and their ratios ICA/CCA were also calculated. The diagnostic criteria for the severe carotid artery stenosis was defined as peak systolic velocity of > 2.3 m/ sec of ICA or peak diastolic velocity of >1.00 m/sec of ICA or ICA/CCA systolic ratio of >4 and confirmed by two radiologists. The data was analyzed with SPSS 10 version for windows. Numerical variables were presented as mean and standard deviation. Qualitative variables were presented as frequency and percentage. Stratification was done on age, sex, duration and control of DM, to see the effect of these variables on study. Confounding variables like age, sex, duration of DM and control of DM were controlled by making stratified tables. No statistical test was applied because this was a descriptive study.

## RESULT

Out of total 74 patients males were 74% and females were 26%. Their mean age was  $56.95 \pm 8.77$  years. Patients having DM for more than 10 years were 41(55.40%) while 33 (44.60%) had DM for less than 10 years. Mean duration of DM was  $9.4 \pm 4.8$  years. Diabetics was controlled in 44(59.5%) patients while it was uncontrolled in 30(40.5%) patients. All the patients in study population underwent carotid Doppler USG and severe carotid artery stenosis was diagnosed in the 10.8% of total study population. Out of these 8 patients, right carotid artery was involved in 5 patients while the remaining 3 patients showed stenosis of the left carotid artery. Among these 8 patients, 6 were males (75%) and 2 were females (25%). Duration of DM was more than 10 years in 5 patients (62.5%) and remaining 3 patients (37.5%) were having DM for less than 10 years . Diabetes was controlled in 5 (62.5%) five of these patients.

**Table 1: Stratification of cases by age in relation to stenosis**

Age (Year)	Stenosis	
	With Stenosis Number (%)	Without Stenosis Number (%)
30-40	-	02 (3.0%)
41-50	1(12.5%)	10 (15.1%)
51-60	4(50.0%)	35 (53.0%)
61-70	2 (25.0%)	15 (22.7%)
>70	1 (12.5%)	04 (6.0%)
Total	8	66
Mean $\pm$ SD	59.12 $\pm$ 8.28	56.0 $\pm$ 8.8

The mean age of these patients with significant carotid artery stenosis was 59.12 years as compared to 56.0 years of patients who did not have significant stenosis (Table 01). There were more males in both the groups (Table 02). Stratification of patients having DM >10 years showed 62.5% patients have significant carotid artery stenosis while 59.0% patients do not have significant stenosis. (Table 03). Stratification of patients in relation to control of DM showed 62.5% patients with controlled DM had significant stenosis while 63.6% patients of controlled DM had no significant stenosis. For uncontrolled DM 37.5% patients had significant stenosis while 36.4% patients had no significant stenosis. (Table 04).

## DISCUSSION

In this study we looked for the frequency of severe carotid artery stenosis with the help of Doppler ultrasound in diabetic patients having TVD. Carotid Doppler can be used as a screening test to rule out significant carotid artery disease. It is a noninvasive, cost-effective, sensitive and specific test. Magnetic resonance angiography is more accurate than Doppler ultrasound in defining significant obstructive lesions and has comparable accuracy to catheter based angiography. The use of contrast-enhanced MR angiography is useful in certain situations but is not essential in all cases.<sup>8</sup> It is thus possible to accurately

categorize the degree of stenosis of the extra cranial internal carotid artery from a combination of ultrasound and magnetic resonance angiography. The adoption of this combination for the investigation of patients before carotid endarterectomy or stenting removes the risk associated with conventional angiography and represents an important advance in the management of carotid stenosis.<sup>9</sup> Coronary revascularization in patients without evidence of carotid atheroma carries a risk of stroke of approximately 1%-2%, but in the presence of an operated major carotid artery stenosis it is associated with a 14% risk of peri-operative stroke.<sup>9</sup> Potential causes of neurological deficit include reduced cerebral perfusion across hemodynamically significant stenosis or embolization from cardiac, aortic or carotid thrombi.<sup>8</sup> According to Taylor PR, extra cerebral carotid artery stenosis is the most important predictor of stroke in patients undergoing CABG. Stroke is an important cause of morbidity and mortality following CABG. In an effort to reduce the stroke rate many institutions perform routine preoperative non-invasive assessment of carotid arteries.<sup>3</sup> Majority of our study population i.e. 82.4 % were more than 50 years of age because atherosclerosis is usually manifested at advanced age. Tanimoto S et al also noted that combined CAD and carotid artery involvement was more prevalent in older age group. Screening of carotid artery stenosis is thus recommended in older patients with

**Table 2: Stratification of cases by sex in relation to stenosis**

Age (Year)	Stenosis	
	With Stenosis Number (%)	Without Stenosis Number (%)
Male	6(75%)	49 (74.24%)
Female	2(25%)	17 (25.79%)
Total	8 (100.0%)	66 (100.0%)

multilevessel CAD.<sup>10</sup> Bishara RA also mentioned that screening of asymptomatic patients is also recommended in the general population if they are > 60 years of age and have other associated risk factors.<sup>11</sup> Cirilo F et al noted statistically significant correlation between the severity of coronary disease and incidence of severe carotid disease. They found that 14.3% patients with triple vessel disease had severe carotid lesions.<sup>12</sup>In our study Diabetic patients were selected because Diabetes mellitus is one of the major risk factors in ischemic heart disease and atherosclerosis. Diabetes deteriorates the atherosclerotic changes in all the vascular beds. Rath PC et al showed that there was no statistically significant association between carotid artery stenosis and risk factors such as hypertension, smoking and hyperlipidemia. Only diabetes mellitus had a significant association with carotid artery disease (p<0.02).<sup>1</sup> Thourani VH et al described that stroke rates were more frequently noted in diabetic patients than in the non diabetic (2.9 % vs. 1.4 %).<sup>13</sup> Faggioli et al. analyzed patients with no symptoms of cerebral ischemia undergoing CABG for the presence of carotid artery stenosis by noninvasive methods. The prevalence of carotid artery stenosis >75% was 8.7% while 3.5% patients underwent prophylactic

endarterectomy. CABG was performed in 5.2% patient without endarterectomy. The stroke rate (14.3%) was higher in patients with critical stenosis and no endarterectomy.<sup>14</sup> Rath PC et al noted that stroke rates were higher in patients who have > 70 % stenosis than those who have < 70 % carotid artery stenosis (11.1 % vs. 2.5 %) in preoperative assessment. In the present study, we found that 10.8 % of our study population had severe atherosclerotic involvements of carotid arteries i.e. >70 % diameter stenosis. Cirilo F et al showed the risk of peri-operative stroke after CABG ranges in normal patients between 0.2% and 5.3%, but it rises to 15% in patients with a carotid lesion >70%.<sup>12</sup> Rath PC et al also noted 3.7 % patients had severe carotid artery disease in patients undergoing CABG independent of individual risk factors; but in diabetic patients; the prevalence of significant carotid involvement was twice than non-diabetics. Such results are quite similar to our observations in which we selected only diabetic's patients to look for severe carotid artery involvement. Coronary revascularization in patients without evidence of carotid atheroma carries a risk of stroke approximately 1% - 2% but in the presence of unoperated major carotid artery stenosis it is associated with a 14% risk of perioperative

**Table 3: Stratification of cases by Duration of DM in relation to stenosis**

Duration of DM	Stenosis	
	With Stenosis Number (%)	Without Stenosis Number (%)
DM > 10 Years	3 (37.5%)	39 (59.0%)
DM < 10 Year	3 (37.5%)	27 (41.0%)
Total	8 (100.0%)	66 (100.0%)

**Table 4: Stratification of cases by Control of DM in relation to stenosis**

Control of DM	Stenosis	
	With Stenosis Number (%)	Without Stenosis Number (%)
Controlled DM	5 (62.5%)	42 (63.6%)
Uncontrolled DM	3 (37.5%)	27 (36.4%)
Total	8 (100.0%)	66 (100.0%)

stroke.<sup>15</sup> Stroke is a major cause of morbidity and mortality. Barker RA et al showed the 30-day mortality of stroke patients was ten times greater than that of those who did not suffer stroke (17.6 vs. 1.7%).<sup>16</sup> According to Engelmann DT et al patients with TIA or stroke had a significantly longer ICU stay (4 vs. 2 median days) and also longer period of hospital stay (14 vs. 7 median days).<sup>17</sup>

Diabetic patients have a higher incidence of complications after CABG, which increases both morbidity and mortality. Thourani VH found higher incidence of postoperative death (3.9% versus 1.6 %) and stroke (2.9 % versus 1.4 %) in diabetic patients as compared to non diabetic patients.<sup>18</sup> Efforts are being made to decrease these postoperative complications in the diabetic patients. Combined CEA and CABG significantly reduced the incidence of post operative stroke. Furthermore, preoperative screening for carotid disease reduces the risk of neurological complications in patients undergoing CABG alone. Recently, beating heart CABG has become a common practice in many centers. Preoperative routine ultrasound investigation of carotids can help to differentiate those patients with poor preoperative brain circulation which would benefit from an operative approach without extracorporeal circulation.<sup>19</sup>

**LIMITATIONS OF STUDY**

Carotid Doppler is 98% sensitive and 70% specific for diagnosis of carotid artery stenosis while Carotid angiography is gold standard investigation for diagnosis of carotid artery stenosis. We did not confirm our findings with carotid angiography. Although diabetes mellitus is one of the major risk factor for atherosclerosis, other risk factors like smoking, hyperlipidemia and hypertension and other risk factors were not taken into account.

**CONCLUSION**

Doppler ultrasound screening of carotid arteries in diabetic patients having TVD showed severe carotid artery stenosis in a significant number i.e. 10.8 % of our study population.

**REFERENCES**

1. Rath PC, Agarwala MK, Dhar PK, Lakshmi C, Ahsan SA, Deb T, et al. Carotid artery involvement in patients of atherosclerotic coronary artery disease undergoing coronary artery bypass grafting. *Indian Heart J* 2001;53:761-5.
2. Fauci AS, Martin JB, Braunwald E, Kasper DL, Isselbacher KJ, Hauser SL, et al. Disorders of the cardiovascular system. In: Braunwald E, Fauci AS, Kasper DL, Hauser SL, Longo DL, Jameson JL, editors. *Harrison's principles of internal medicine*. 16th ed. USA: McGraw-Hills; 2005. p. 1229-398.
3. Jafar TH, Jafary FH, Jessani S, Chaturvedi N. Heart disease epidemic in pakistan: women and men at equal risk. *Am Heart J* 2005;150:221-6.
4. Khan AH, Khilji SA. Neurological outcome after coronary artery bypass grafting. *J Ayub Med Coll Abbottabad* 2005;17:18-21.
5. Fukuda I, Osaka M, Nakata H, Sakamoto H. Clinical outcomes for coronary artery bypass grafting in patients with sever carotid occlusive disease. *J Cardiol* 2001;38:303-9.
6. Baker RA, Hallsworth LJ, Knight JL. Stroke after coronary artery bypass grafting. *Ann Thorac Surg* 2005;80:1746-50.
7. Zaidi NR, Khan NA, Dodhy K, Mahmood K. Carotid duplex imaging is better modality than angiography to diagnose carotid artery stenosis in patients for the

- endarterectomy. *Ann King Edward Med Coll* 2004;10:380-3.
8. Young GR, Humphrey PR, Shaw MD, Nixon TE, Smith ET. Comparison of magnetic resonance angiography, duplex ultrasound, and digital subtraction angiography in assessment of extracranial internal carotid artery stenosis. *J Neurol Neurosurg Psychiatry* 1994;57:1466-78.
  9. Johnson MB, Wilkinson ID, Wattam J, Venables GS, Griffiths PD. Comparison of Doppler ultrasound, magnetic resonance angiographic techniques and catheter angiography in evaluation of carotid stenosis. 2000;55:912-20.
  10. Tanimoto S, Ikari Y, Tanabe K, Yachi S, Nakajima H, Nakayama T, et al. Prevalence of carotid artery stenosis in patients with coronary artery disease in Japanese population. *Stroke* 2005;36:2094-8.
  11. Bishara RA, Taha W, Alfarouk MO, Milik IA, Wilson N. Screening for significant carotid artery disease among a cohort of 1,000 Egyptian patients. 2008;16:35-40.
  12. Cirilo F, Renzulli A, Leonardo G, Romano G, deFeo M, Corte AD, et al. Incidence of carotid lesions in patients undergoing coronary artery bypass graft. *Heart Views* 2000;1:402-7.
  13. Thourani VH, Weintraub WS, Stein B, Gebhart SS, Craver JM, Jones EL, et al. Influence of diabetes mellitus on early and late outcome after coronary artery bypass grafting. 1999;67:1045-52.
  14. Faggioli GL, Curl GR, Ricotta JJ. The role of carotid screening before coronary artery bypass. *J Vasc Surg* 1990;12:724-29.
  15. 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.
  16. Baker RA, Hallsworth LJ, Knight JL. Stroke after coronary artery bypass grafting. 2005;80:1746-50.
  17. Baker RA, Hallsworth LJ, Knight JL. Stroke after coronary artery bypass grafting. 2005;80:1746-50.
  18. Thourani VH, Weintraub WS, Stein B, Gebhart SS, Craver JM, Jones EL, et al. Influence of diabetes mellitus on early and late outcome after coronary artery bypass grafting. 1999;67:1045-52.
  19. Schwartz AE, Sandhu AA, Kaplan RJ. Cerebral blood flow is determined by arterial pressure and not cardiopulmonary bypass flow rate. *Ann Thorac Surg* 1995;60:165.