

Original article:

Carotid Doppler assessment of CAD patients undergoing Off Pump CABG: A useful investigation or unnecessary burden

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Abstract:

Carotid artery ultrasound screening before Off Pump Coronary Artery Bypass Grafting (OP CABG) to identify carotid artery disease requiring revascularization before or during CABG, with the expectation of reducing perioperative neurologic events, is a routine in many institutes across the world. However this practice is contrary to guidelines recommending screening in selected patients only^{8,9}. As carotid artery disease might be a surrogate marker for diffuse atherosclerotic disease rather than a direct etiologic factor for post CABG neurological event {Fig 1}. We conducted a prospective observational study to assess the perioperative neurological outcome in patients of Coronary Artery disease undergoing Off Pump CABG, having done preoperative carotid ultrasound Doppler study.

Keywords: Carotid artery ultrasound, Off Pump CABG

Introduction:

Anastasiadis K, et all and Naylor AR (1) showed that routine carotid assessment may not be cost effective in asymptomatic patients. Gerraty R et all and Naylor AR (2) found out that the benefit of prophylactic carotid revascularization in patients with asymptomatic unilateral carotid disease is controversial. Sheiman and colleagues, used 7 risk factors (history of carotid artery disease, prior cerebrovascular event, hypertension, diabetes, peripheral artery disease, smoking, left main coronary disease, and female gender) to predict which patients have carotid artery disease. The presence of any 1 of these factors was 100% sensitive, but only 30% specific, in detecting patients with $\geq 50\%$ carotid stenosis. Similarly, Cornily and colleagues, found that risk factors including age >70 years, history of cerebrovascular disease, diabetes mellitus, peripheral artery disease, or carotid bruit on physical examination could have detected 11 of 12 patients with significant carotid artery stenosis.

Material and methods:

Study included hundred patients with coronary artery disease admitted at our institute. Study period was from October 19 to February 21 who underwent Off Pump CABG(OPCABG) and immediate post operative neurological outcome was assessed in terms of stroke, seizures and TIA.

Inclusion criteria

1. All patients with coronary Artery disease fit for OP CABG
2. Asymptomatic patients for any neurological event.
3. No previous history of stroke, seizure and TIA.

Exclusion criteria

1. Patients with coronary artery disease and valvular heart disease undergoing both procedures.
2. Patients with history of stroke, seizures and TIA.
3. Symptomatic patients for neurological event.
4. Patients with preoperative arrhythmias.

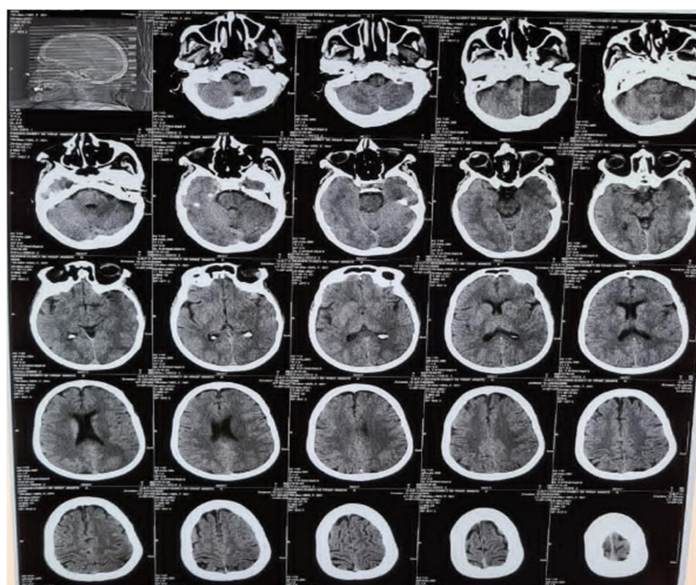


Fig 1 CT Picture showing left basal ganglia infarct in a 55 yr old female following OPCABG with normal preoperative carotid doppler study

Table 1:-Distribution of socio-demographic characteristics of study subjects.

Socio-demographic characteristics		
Age(years)		
Mean ± SD	53.16 ± 10.4	
Median(25th-75th percentile)	50(46-60)	
Range	30-76	
Gender		
Female	4	4.00%
Male	96	96.00%

Table 2:-Distribution of single/double/triple vessel disease of study subjects.

Single/double/triple vessel disease	Frequency	Percentage
Single vessel disease	0	0.00%
Double vessel disease	12	12.00%
Triple vessel disease	88	88.00%
Total	100	100.00%

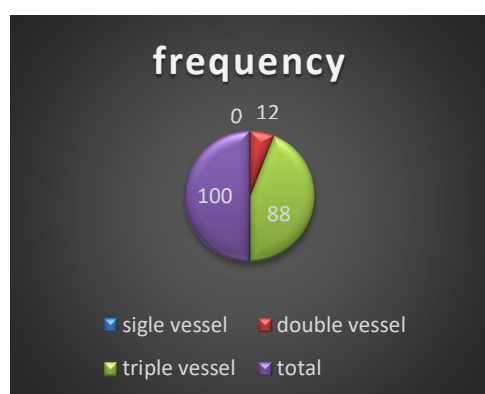


Table 3:-Distribution of co-morbidities of study subjects.

Co-morbidities	Frequency	Percentage
Diabetes mellitus	40	40.00%
Hypertension	16	16.00%
Smoking	48	48.00%

Table 4:-Descriptive statistics of IMT of common carotid(mm) of study subjects.

IMT of common carotid(mm)	Mean \pm SD	Median(25th-75th percentile)	Range
Right side	0.91 \pm 0.68	0.8(0.6-0.9)	0.5-4
Left side	1.01 \pm 0.57	0.9(0.6-1)	0.5-3.3

Table 5:-Distribution of common carotid luminal stenosis of study subjects.

Common carotid luminal stenosis	Frequency	Percentage
Right side		
Normal	68	68.00%
<30% stenosis	12	12.00%
30-50% stenosis	16	16.00%
>70 stenosis%	4	4.00%
Left side		
Normal	40	40.00%
<30% stenosis	20	20.00%
30-50% stenosis	32	32.00%
50-70% stenosis	4	4.00%
>70 stenosis%	4	4.00%

Table 6:-Distribution of internal carotid stenosis of study subjects.

Internal carotid stenosis	Frequency	Percentage
Right side		
Normal	80	80.00%
<30% stenosis	12	12.00%
30-50% stenosis	8	8.00%
Left side		
Normal	56	56.00%
<30% stenosis	16	16.00%
30-50% stenosis	24	24.00%
50-70% stenosis	4	4.00%

Table 7:-Distribution of external carotid stenosis of study subjects.

External carotid stenosis	Frequency	Percentage
Right side		
Normal	84	84.00%
<30% stenosis	8	8.00%
30-50% stenosis	8	8.00%
Left side		
Normal	68	68.00%
<30% stenosis	12	12.00%
30-50% stenosis	16	16.00%
50-70% stenosis	4	4.00%

Table 8:-Distribution of carotid plaque of study subjects.

Carotid plaque	Frequency	Percentage
Right side		
Absent	60	60.00%
Present	40	40.00%
Left side		
Absent	36	36.00%
Present	64	64.00%

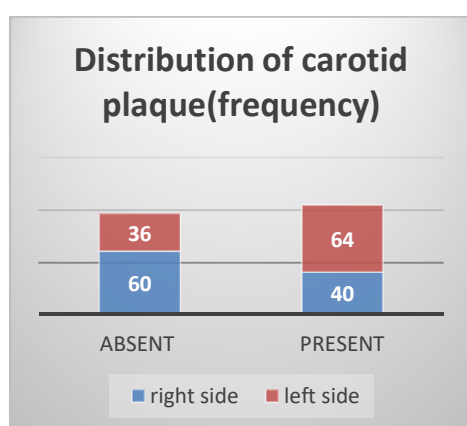


Table 9:-Distribution of outcome of study subjects.

Outcome	Frequency	Percentage
Stroke	4	4.00%
Seizures	0	0.00%
TIA	0	0.00%

Results

Demographic data of the study showed 96% were male patients and 4 % were female patients with mean age 53.16 ± 10.4 . Triple vessel coronary artery disease was found in 88% of the patients with 12% of patients having double vessel disease. Among all patients co morbidities were very common 48% were smokers, 40% had diabetes and 16% were hypertensive. All patients underwent preoperative carotid Doppler ultrasound at our institute, it was found that mean IMT on right side common carotid artery was 0.91 ± 0.68 and mean IMT on left side was 1.01 ± 0.57 . When it comes to luminal stenosis of common carotids, on right side 68% were normal, 12 % had < 30% stenosis, 16% had stenosis between 30 to 50% and only 4 % had significant stenosis of > 70%. On left side only 40% common carotids came out to be disease free, 20% had < 30% stenosis, 32% had stenosis between 30 to 50% , 4% patients had stenosis between 50 to 70% , with only 4 % having significant left sided common carotid stenosis

of > 70%. Internal carotids on right side were normal in 80% of patients, with only 8% had luminal stenosis of < 30% and 8% had stenosis between 30 to 50%. Left sided internal carotids were more diseased with only 68% being normal, 12% had luminal stenosis of 30 to 50%, 16% had stenosis between 50 to 70% and 4% had significant stenosis of > 70%. Carotid plaque was also more common on left side with 64% of patients having plaque in left sided carotids whereas on right side plaque was present only in 40% patients. 4% patients who had significant disease on ultrasound (> 70% stenosis) out of them 50% came out to be normal. On CT angiogram thus raising questions over effectiveness of carotid Doppler in picking up the disease and also points towards the subjective human error component associated with Doppler study. On follow up, only 4% patient had stroke in immediate post op period while no patient had seizures or TIA. Also, among the patients who had stroke, all of them had normal carotid Doppler study in preoperative period.

Discussion

Stroke is a grave complication of coronary artery bypass grafting (CABG)³. Stroke occurs in 1.3% to 2.0% of patients^{1,4-6}, and results in acute mortality of up to 38%^{7,8}. For this reason, various institutes routinely screen patients undergoing CABG⁹⁻¹⁴. However this practice is contrary to guidelines recommending screening in selected patients only^{15,16}. The causes of stroke in a post-CABG patient can be many, but because most strokes occur ≥ 24 hours of surgery, embolic events are mostly responsible^{17,18-21}. The debris from the atherosclerotic aorta are strongly associated with postoperative stroke^{22,23-25}. They may arise by manipulation of the ascending aorta during aortic clamping, cannulation, and proximal graft anastomosis^{20,26,27}. Other risk factors for perioperative stroke include older age, prior stroke or transient ischemic attack, peripheral artery disease, hypertension, left ventricular dysfunction, preoperative atrial fibrillation^{3,23,26,28-30}, and carotid artery stenosis^{31,21,26,29,32}. Since carotid artery stenosis is not a direct etiologic risk factor for perioperative stroke, routine nonselective screening may not be cost effective^{1,33}. Data from Cleveland Clinic patients undergoing non cardiac surgery demonstrated no association between carotid artery stenosis and stroke (odds ratio 1.0, with a 95% confidence interval of 0.99–1.02) for a 10-unit increase in internal carotid artery peak systolic velocity, the variable used to quantify carotid artery stenosis³⁴. Regardless of whether carotid artery stenosis is an etiologic factor for perioperative stroke, carotid artery ultrasound screening detects only a minority of patients who experience perioperative neurologic events. In the present study only 4% had significant carotid artery disease on routine preoperative carotid Doppler but when a CT Angiography was done to confirm the disease, 50% among them had no carotid disease. For rest 50% preoperative carotid stenting was done and patients were taken up for OP CABG later on but none had neurological event in post operative period. Durand and colleagues⁵, by screening every patient undergoing CABG found that 13.4% had carotid artery stenosis of $\geq 70\%$. Among those who developed postoperative stroke after undergoing CABG, only 19% had carotid artery stenosis of $\geq 70\%$ ipsilateral to the side of the stroke. In the present study also only 4% patients had stroke who underwent off pump CABG among them none had carotid artery disease on pre operative carotid ultrasound. An alternative to routine ultrasound screening is risk profiling. Several groups have identified risk factors associated with significant carotid artery stenosis in patients undergoing CABG like Peripheral artery disease, cerebrovascular disease (prior stroke or transient ischemic attack), and old age were the risk factors most consistently identified in these studies^{2-4,6,37}. Applying carotid disease–screening algorithms to cohorts of ultrasound–screened patients undergoing CABG

showed that most who had significant carotid artery stenosis could be detected^{5,77,82}. Thus, Durand and colleagues⁵ found that a risk-profiling algorithm based on a prior stroke or transient ischemic attack, carotid bruit on exam, or age >65 years would have missed significant carotid disease in only 2.3% of patients undergoing CABG (26 of 1138), although this represented 17% of 152 patients with significant carotid disease, and 582 had a false-positive result⁵. Thus, their selective screening algorithm had a sensitivity and specificity of 83% and 41%, respectively. Sheiman and colleagues, used 7 risk factors (history of carotid artery disease, prior cerebrovascular event, hypertension, diabetes, peripheral artery disease, smoking, left main coronary disease, and female gender) to predict which patients have carotid artery disease. The presence of any 1 of these factors was 100% sensitive, but only 30% specific, in detecting patients with $\geq 50\%$ carotid stenosis. Similarly, Cornily and colleagues, found that risk factors including age >70 years, history of cerebrovascular disease, diabetes mellitus, peripheral artery disease, or carotid bruit on physical examination could have detected 11 of 12 patients with significant carotid artery stenosis. These studies suggest that clinical factors are sensitive in identifying patients with carotid disease, but that specificity is low, requiring more specific screening modalities, such as ultrasound, in more than half of patients. The Society of Thoracic Surgeons and the American College of Cardiology/American Heart Association recommend ultrasound screening for carotid artery stenosis in selected patients only (class IIa recommendation, level of evidence C)^{8,9,42}. The guidelines document¹¹ “2012 Appropriate Use Criteria for Peripheral Vascular Ultrasound and Physiological Testing” rated all clinical scenarios for cerebrovascular duplex scanning before cardiac surgery as uncertain (or “may be appropriate”)⁴³. The Society of Vascular and Interventional Neurology recommends screening of selected patients undergoing CABG (grade B), but screening of all patients was considered a grade D recommendation⁴⁴.

Conclusion

Stroke in post CABG patients is a serious complication with many etiological risk factors including carotid artery disease. But carotid disease might not be strongly related to neurological morbidity in immediate post operative period thus using carotid Doppler screening in selected patients after risk profiling might be cost effective reducing unnecessary burden on patient.

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