Original Article

Relative Frequency and Characteristics of Carotid Artery Stenosis in Hospitalized Acute Ischemic Stroke Patients: A Retrospective Analysis

Mahendra Javali*, Usha Holla**

Abstract

Background: Carotid artery stenosis has been associated with ischemic events of the brain. However, itÿÿs frequency and thus, impact has not been clearly established in an Indian setting. *Aim:* This study was done to find the frequency of carotid artery stenosis in hospitalized ischemic stroke patients of above 45 years of age, as well as the risk factors associated with its presence. *Materials and methods:* A retrospective study was done on 128 patients hospitalized with acute ischemic stroke during the years 2011 and 2012 in a hospital in Southern India aged 45 years or older, excluding those with vasculitis. The data was collected using a clinical proforma and included details obtained on clinical examination, biochemical parameters, radiological investigations including CV Doppler and MR Angiography. CV Doppler findings were used as the basis of evaluation of carotid artery stenosis and degree of the same. Statistical analysis between the various parameters and presence of carotid artery stenosis was done using SPSS v 17. *Results:* Out of 128 patients, 34 (26.6%) were females and 94 (73.5%) males. The frequency of carotid artery stenosis was found to be 26.6%. Dyslipidemia was found to be a risk factor statistically significant with carotid artery stenosis. *Conclusion:* Carotid artery stenosis was found to be quite prevalent among ischemic stroke patients. This signifies the need for early detection as well as examination of plaque morphology for identification of those at risk of developing cerebral ischemia.

Keywords: Carotid Artery Stenosis; Dyslipidemia; Stroke and Risk Factors.

Introduction

Stroke is defined by"rapidly developing clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin" [1]. Stroke is the third most common cause of death in the world.During the last three decades there has been a decline in the incidence of stroke in the western population while the burden of thedisease in South Asian countries (India, Pakistan, Bangladesh and Sri Lanka) has increased and is expected to rise further. It accounts for 1.2% of the total deaths in India and is the leading cause of acquired disability [2].

Clinically, stroke is the result of a disturbance of cerebral circulation, either due to occlusion of main blood vessel due to thrombo-embolism or rupture of a blood vessel. About 85% of all strokes are of ischemic origin, caused by thrombotic or embolic blockage of a cerebral artery. Blockages in the large neck arteries cause 20-30% of the ischemic type and are associated with a 3-fold increased risk of an early second stroke[3.]

Current techniques for the assessment of carotid artery disease include colour Doppler Ultrasound, Digital Subtraction Angiography, Magnetic Resonance Angiography and CT Angiography. Duplex Ultrasonography provides information about the degree of carotid stenosis, the velocity and character of blood flow and plaque morphology [3].

The frequency of atherosclerotic changes in the carotid artery has been proven to be prevalent in the Indian population, where co morbidities like

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hypertension, diabetes mellitus, smoking etc. are quite rampant [4,5]. However, the percentage of those individuals with haemodynamically significant stenosis has not been clearly established.

Materials and Methods

The study was retrospective and conducted on the patients of a hospital in Southern India diagnosed and admitted for acute ischemic stroke during 2011 and 2012. The patients selected for the study included those who belonged to the age group of >45 years of age, with history of one or more episodes of acute ischemic strokes and/or transient ischemic attacks and admitted under department of neurology during the period of Jan 2011 to Dec 2012. The sample size of the study was 128.

Those with haemorrhagic stroke, Vasculitis or those who had not undergone CV Doppler/ MR Angiogram of neck vessels were excluded from the study.

The details of the patients considered for the study were collected based on the clinical proforma.

History: inclusive of general history, history of presenting complaints, stroke history. Other associated problems such as hypertension, Diabetes mellitus, hyperhomocysteinemia, cardiac disorders such as IHD/ RHD etc., chronic smoking (those with a smoking index >300 – number of cigarettes/day multiplied by number of years of consumption), alcohol abuse (fulfilling the criteria of consumption of >80 gm alcohol per day for 10 years), impaired cholesterol levels, history of old cerebro vascular accidents etc. The blood pressure on admission was noted.

Blood investigations included haemoglobin levels, total cholesterol, HDL, LDL, triglycerides levels, fasting blood sugars, post prandial blood sugars, HbA1c levels, serum homocysteine, VDRL and HIV results. The values were analysed using standard references.

Radiological investigations include MRI and CT Brain reports which were classified anatomically into anterior or posterior circulation infarcts; based on type of stroke into large vessel infarct, small vessel disease or cardioemblic types; in subjects with carotid artery stenosis into those with infarct in the ipsilateral or contralateral side as that of stenosis, and normal reports.

CV Doppler study and MR Angiogram of neck vessels reports of all patients were collected and those with haemodynamically significant stenosis were categorised based on the percentage of stenosis in these patients and presence of unlilateral or bilateral stenosis.

ECHO and EEG reports were analysed to detect those patients with significant cardiac disease.

The subjects were checked for the presence of any of the major risk factors- Hypertension, Diabetes mellitus, Hyperhomocysteinemia, IHD, Smoking, Alcohol consumption, Old CVD or Dyslipidemia.

Statistical Analysis

All quantitative variables were expressed in terms of mean and standard deviation. All qualitative variables were expressed in terms of proportions. Chi-Square test of statistical significance was used to find the association between various risk factors and carotid artery stenosis. A p value <0.05 was considered as statistically significant. Data was entered in Microsoft Excel and was analysed using the SPSS software version 17.

Results

The study consisted of 128 subjects, the mean age was 64±10.9 (mean ± SD), with minimum age of 45 years and maximum of 98 years, out of which 40 (31.3%) were below 60 years of age while the rest, 88 (68.8%), were above 60 years of age.

The study included 34 (26.6%) females and 94 (73.5%) males.

Blood Investigations

The haemoglobin levels were found to be normal in 63 subjects (52.1%), low for their respective genders in 55 (45.5%) and high in 3 subjects (2.5%) out of 128 subjects.

In total cholesterol values analysed, 117 out of 128 reports were available, out of which 98 (83.8%) had normal values while 19 (16.2%) had high values. In HDL, 116 reports were available, out of which 27 (23.3%) had normal levels while 89 (76.7%) had low levels, for their respective genders. In LDL, 117 reports were available, out of which 100 subjects (85.5%) had normal values while 17 (14.5%) had higher values. In triglyceride values, 114 reports were available, out of which 81 subjects (71.1%) had normal values and 33 (28.9%) with higher values.

In fasting blood sugars, 124 reports were available, out of which 72 (58.1%) showed normal values while 52 (41.9%) had increased levels. In post prandial blood

sugar levels, 94 reports were available, out of which 35 subjects (37.2%) had normal levels while 59 (62.8%) had increased levels.

None of the patients had decreased FBS or PPBS levels.

In HbA1c (Glycated haemoglobin) levels, 49 reports were available, out of which 5 (10.2%) of them had normal values while 44 (89.8%) had higher values.

In serum homocysteine levels, 121 reports were available, out of which 60 subjects (49.6%) had normal values while 61 (50.4%) had higher levels.

VDRL and HIV tests came back negative in all 128 subjects (100%).

Radiological Examinations

MRI and CT Brain: The scans showed 1 subject (0.8%) to have a normal report. 90 subjects (70.3%) had infarcts in the region of anterior circulation, 20 (15.6%) had infarcts in the region of posterior circulation while 17 (13.3%) had infarcts in both regions.

It was observed that 93 (72.6%) of the subjects suffered from large vessel strokes, 13 (10.15%) from small vessel strokes, 16 (12.5%) from both large and small vessel strokes and 6 (4.68%) from cardioembolic type of stroke. ECHO and ECG studies: Out of the available 124 reports, 78 (62.9%) showed normal findings while 46 (37.1%) had abnormalities such atrial fibrillation, left ventricular hypokinesia, diastolic dysfunction etc.
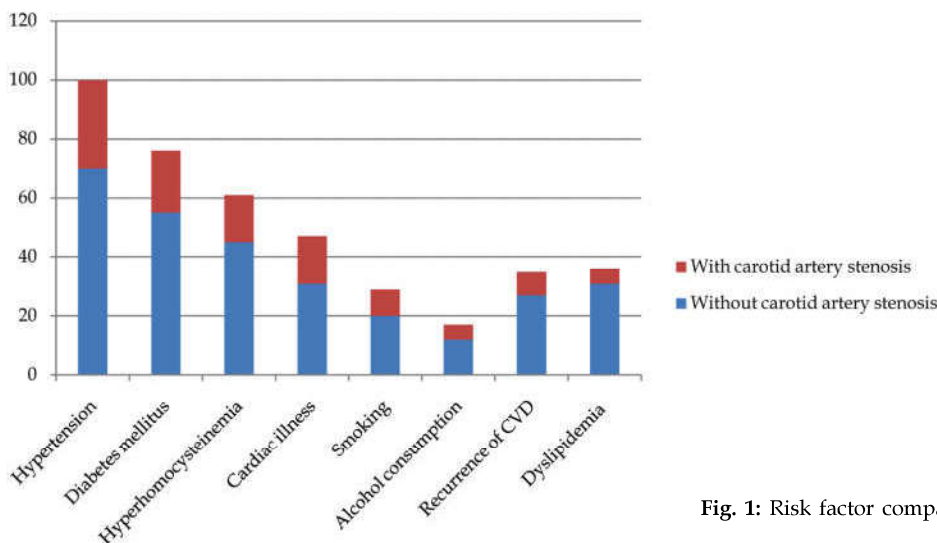
CV Doppler and MR Angiogram of neck vessels: A total of 34 (26.6%) subjects were found to have carotid artery stenosis with an almost equal distribution between right (45%) and left side (55%). The classification based on the degree of carotid artery has been represented in the Table 1. When correlated with the MRI and CT Brain reports, it was found that 24 out of 34 subjects with stenosis (77.4%) had infarcts on the ipsilateral side while 7 (22.6%) had infarcts on the contralateral side as that of the carotid artery involved.

Risk Factors

The risk factors considered for the study were hypertension, Diabetes mellitus, Hyperhomocy-steinemia, significant heart diseases, history of smoking, significant history of alcohol intake, recurrence of stroke and dylipidemia. The comparison of prevalence of various risk factors among all the subjects and among those with carotid artery stenosis is represented in Figure 1 and Table 2.

Table 1: Carotid artery stenosis analysis

Stenosis	Frequency	Percentage	Total
Normal	94	73.4	94
<50%	9	7.1	34(26.56%)
50-69%	10	7.9	
>=70%	15	11.7	
TOTAL	128	100	128
Unilateral	25	73.5	
Bilateral	9	26.5	
TOTAL	34	100	

Fig. 1: Risk factor comparison in all subjects

Mahendra Javali & Usha Holla / Relative Frequency and Characteristics of Carotid Artery Stenosis
in Hospitalized Acute Ischemic Stroke Patients: A Retrospective Analysis

Table 2: Risk factor comparisons among all subjects and those with carotid artery stenosis

1.	Smoker	0	74	25 (73.5%)	99	0.535
		1	20	9 (26.5%)	29 (22.7%)	
2.	Alcoholic	0	82	29 (85.3%)	111	0.775
		1	12	5 (14.7%)	17 (13.3%)	
3.	Recurrence of CVD	0	67	26 (76.5%)	93	0.56
		1	27	8 (23.5%)	35 (27.3%)	
4.	Dyslipidemia	0	63	29 (85.3%)	92	0.042
		1	31	5 (14.7%)	36 (28.1%)	
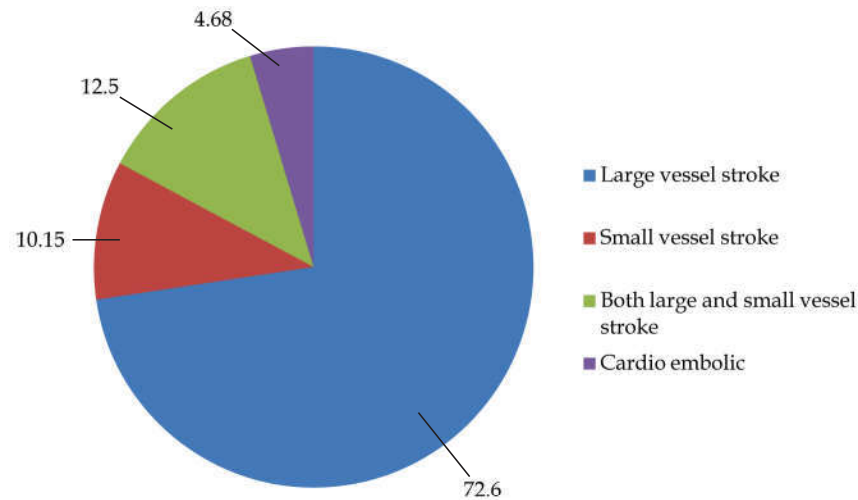
Fig. 2: Vascular classification of stroke

Table 3: Correlation of different cholesterol values with carotid artery stenosis

Sl. No.	Risk Factor	Observation 0= Normal 1=Abnormal	CV Doppler		Total	P value
			0 (n=94)	1 (n=34)		
1	T. CHOL	0	72	26 (92.9%)	98	0.135
		1	17	2 (7.1%)	19 (16.2%)	
2	HDL	0	22	5 (18.5%)	27	0.504
		1	67	22 (81.5%)	89 (76.7%)	
3	LDL	0	74	26 (89.7%)	100	0.461
		1	14	3 (10.3%)	17 (14.5%)	
4	Tg	0	59	22 (84.6%)	81	0.083
		1	29	4 (15.4%)	33 (28.9%)	

The vascular classification of stroke into large vessel, small vessel and cardioembolic has been represented in Figure 2.

The correlation of different cholesterol values with carotid artery stenosis is represented in Table 3.

Discussion

The study shows a prevalence of 26.6%, which is the primary aim. It is a smaller figure when compared to the results of similar studies in Pakistan, which show a prevalence of 39%, 56% and 48.4% respectively [3,6,7]. The prevalence in Norway was found to be 16.3% [8]. The studies conducted in Japan and India measured the prevalence of carotid plaques rather than the haemodynamically significant stenosis and the frequency was found to be 76.2% and 44.1% respectively [9,5]. The other study in India demonstrates prevalence of CIMT of >0.7 mm which was found to be 79% [4].

Though lesser compared to the other studies, there appears to be a high prevalence of carotid stenosis in ischemic stroke patients.

The risk factors proven to be significantly associated with carotid stenosis like hypertension, diabetes mellitus, IHD, smoking, hyperhomocys-teinemia and dyslipidemia were also seen in high

percentages in this study, although only dyslipidemia was proven to be a statistically significant risk factor (p=0.04). The significance of the different cholesterol levels could not be clearly demonstrated due to the absence of many reports.

Advanced age (>60 years of age) as well as male predominance was observed in correlation with carotid artery stenosis. However, it was not statistically significant.

The significance of increased total cholesterol, triglycerides and low HDL-C with carotid artery stenosis has been previously proven [4,10].

The main mechanism of stroke related to pathology of the carotid artery is thought to be embolism from a fissured or ruptured plaque [5]. Recent pathological studies of specimens have shown that plaque vulnerability is related to the size of the atheromatous core, the thickness of the fibrous cap, and inflammation within the cap.

Unstable plaques usually have a thin fibrous cap with a necrotic core situated near the surface and may therefore predispose to rupture, which then exposes the thrombogenic atheroma to circulating blood, thus initiating thrombus formation possibly leading to thromboembolism and subsequent ischemic stroke.

Hyperlipidemic patients are particularly at risk of deposition of fats in arteries and other tissues [11].

Plaques rich in lipids or with a necrotic core (echolucent plaques) are thought to be most prone to rupturing and causing clinical events. Serum triglyceride, serum low density lipoproteins and serum homocysteine were found to be significantly associated with the presence of plaque [5].

Thus close monitoring of cholesterol levels plays a very important role in the prevention of carotid plaque formation and the subsequent development of ischemic stroke.

Conclusion

The frequency of carotid artery stenosis in hospitalized ischemic stroke patients is 26.6%. The incidence of dyslipidemia among stroke patients is significantly associated with carotid stenosis.

The high prevalence of dyslpidemia in correlation with carotid artery stenosis is comparable with previous literature and it signifies the need to examine plaque morphology in these patients to identify the patients at risk of development of a cerebrovascular accident.

Limitations

The CV Doppler test, which was used as the basis for assessment of carotid artery stenosis, was interpreted by more than one radiologist. Hence it was subject to observer variation. A bigger sample size would have been more useful in statistically demonstrating risk factors in carotid artery stenosis.

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