

A STUDY ON PREVALENCE OF CAROTID ARTERY STENOSIS IN ACUTE ISCHAEMIC STROKE PATIENTS

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ABSTRACT**BACKGROUND**

Acute ischaemic stroke remains the second most leading cause of death throughout the world and 85% of strokes are due to infarction. Carotid atherosclerosis remains an important contributor to the ischaemic stroke patients. Internal carotid artery is the commonest site of atherosclerosis and occurs predominantly in diabetic, hypertensive, dyslipidaemic patients.

The aim of our study is to find the prevalence of carotid artery stenosis in acute ischaemic patients and association with risk factors like diabetes mellitus, hypertension, dyslipidaemia.

MATERIALS AND METHODS

We conducted a cross sectional study of 75 patients admitted in Chengalpattu Medical College over a period of 6 months. Patients who were aged 18-80 years with acute ischaemic stroke less than 2 weeks were selected and included based on inclusion criteria. All patients were systematically analysed including colour Doppler of extracranial arteries and vertebral arteries.

RESULTS

Statistical analysis was carried out for 75 subjects. Age, presence of diabetes, hypertension, smoking, alcoholism and hyperlipidaemia were analysed in patients with and without carotid stenosis admitted for acute ischaemic stroke. The statistical significance was calculated using Chi-square test. Prevalence of carotid artery stenosis found to be about 46% among the ischaemic stroke patients enrolled in our study group. The prevalence of carotid artery stenosis rises with old age (66%), male gender (53%), smoking (75%), DM (74%), HT (74%) & Hyperlipidaemia (80%). DM, HT, Smoking and Hyperlipidaemia act as risk factors for carotid atherosclerosis.

CONCLUSION

Carotid artery stenosis is one of the common cause of acute ischaemic stroke. So patients with DM, HT, Smoking and Hyperlipidaemia need to have their carotid arteries screened regularly to detect asymptomatic carotid artery stenosis and if present they should strictly control their blood glucose, blood pressure and lipids and start antiplatelet drugs and statins for the purpose of plaque regression and primary prevention of stroke. Surgical intervention like carotid endarterectomy should be done in selected cases for secondary prevention of stroke.

KEYWORDS

Acute Ischaemic Stroke, Carotid Atherosclerosis, Colour Doppler of Carotid Artery, Carotid Artery Stenosis, Carotid Endarterectomy.

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BACKGROUND

Stroke (CVA) still remains the second leading cause of death throughout the world⁽¹⁾ after Coronary Heart Disease. 85% of stroke cases are due to infarction and 15% are due to haemorrhage. Carotid atherosclerosis remains an important cause of acute ischaemic stroke.⁽²⁾

Carotid atherosclerosis predominantly occurs in patients with risk factors like diabetes mellitus, hypertension, smoking and dyslipidaemia.^{3,4,5} The internal carotid artery is the commonest site of atherosclerosis next to abdominal aorta followed by the common carotid artery. The extracranial part

of internal carotid artery is the commonest site of atherosclerosis than the intracranial part of internal carotid artery.^{6,7,8}

Carotid atherosclerosis will lead to plaque formation and these plaques slowly increase in size and cause significant stenosis.^{9,10} Atherosclerotic plaques disrupt the endothelium and then produce ulcer as the endothelium is breached, platelets adhere to the vessel wall and a haemostatic plug is formed. This platelet nidus initiates the coagulation cascade and thrombus is formed which occludes the vessel lumen.

Thrombus formation on an atherosclerotic plaque will lead to distal embolisation and causes occlusion of blood vessels or a severe stenosis may decrease perfusion, resulting in infarction of the brain tissue.^{11,12} Atherosclerotic plaques and stenosis can be easily detected by non-invasive (ultrasound) imaging of the carotid arteries which has high sensitivity and specificity in detecting carotid artery stenosis. Patients with carotid artery stenosis are at higher risk of recurrence after a stroke/TIA.^{13,14}

In our study, we attempted to find out the prevalence of carotid artery stenosis in ischaemic stroke patients and irrespective of their risk for recurrence aggressive secondary

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preventive measures can be directed to those patients admitted in Chengalpattu Medical College.

Carotid artery stenosis can be assessed by noninvasive high-resolution B-mode ultrasonography of the carotid arteries. Carotid artery ultrasonography combines B-mode ultrasound image with a Doppler ultrasound assessment of blood flow velocity. These plaques change the blood flow haemodynamics and increases the systolic flow velocity. With this increased systolic flow velocity, the stenosis can be detected and its severity can be assessed, and this can be helpful for further management of ischaemic stroke patients with carotid artery stenosis.

Aims and Objectives

1. To find out the prevalence of carotid artery stenosis in acute ischaemic stroke patients.
2. To find out the association between carotid artery stenosis and factors such as diabetes mellitus, hypertension, hyperlipidaemia, smoking and age.

MATERIALS AND METHODS

It is a cross sectional study of 75 patients admitted in the Chengalpattu Medical College during the period Jan. 2016 to June 2016. Inclusion criteria were all patients of both sexes between 18 to 80 years with stroke of less than 2 weeks' duration with CT brain showing acute infarct admitted in Department of Medicine, Chengalpattu Medical College. Those patients with stroke more than 2 weeks, haemorrhagic stroke, malignancy, HIV, tuberculosis, metabolic or haemodynamically unstable patients, any other chronic serious illness and those who have not given consent for the study are excluded from this study. All the patients were asked about detailed medical history and examined systematically by clinical examination, investigations like CBC, RFT, Electrolytes, LFT, Fasting Blood sugar, Fasting Lipid profile, Urine Analysis, ECG, Echocardiography, CT Brain plain study, Colour Doppler of Extracranial arteries and Vertebral arteries. Systolic and diastolic velocity of blood flow, carotid intima-media thickness, presence of atheromatous plaque and thrombus was looked for and then the percentage of stenosis of the affected arteries were calculated with coordination from our Radiology Department.

Observation and Analysis

Statistical analysis was carried out for 75 subjects. Age, presence of diabetes, hypertension, smoking, alcoholism and hyperlipidaemia were analysed in patients with and without carotid stenosis admitted for acute ischaemic stroke. The statistical significance was calculated using Chi- square test.

RESULTS

We included 75 patients with acute ischaemic stroke in our study and all of them had a carotid Doppler done.

No. of Patients in whom Carotid Doppler was Done	Patients with Carotid Stenosis	Percentage	Patients without Carotid Stenosis
75	35	46%	40

Table 1. Prevalence of Carotid Stenosis in Acute Ischaemic Stroke Patients

Characteristics	Present	Absent
Diabetes	27	48
Hypertension	39	36
Smoking	37	38
Increased total cholesterol	41	34
Increased LDL	31	44
Decreased HDL	16	59
Increased TGL	40	35

Table 2. Patient Characteristics

Age Group	Total	Carotid Stenosis	No Stenosis
<50	31	9	22
50-59	32	18	14
>60	12	8	4

Table 3. Age Distribution of Carotid Stenosis in Stroke Patients

Age	Percentage of Patients
<50	29%
50-59	56%
>60	66%

Table 4. Percentage of Patients with Carotid Stenosis in Different Age Groups

P=0.03046

It was found that percentage of patients with carotid stenosis was increasing with increase in age and there was a statistically significant association between age and carotid stenosis (p<0.05).

In our study out of 20 young stroke patients between 15-45 years, 5 patients had carotid stenosis. The prevalence of stenosis was about 25% in those patients.

Sex	Total	Stenosis	No Stenosis
Male	60	32	28
Female	15	3	12
Total	75	35	40

Table 5. Sex Distribution of Carotid Stenosis

P= 0.02064

Sex	Percentage of Patients
Male	53%
Female	20%

Table 6. Percentage of Male and Female Patients with Carotid Stenosis

P<0.001

It was found that more male patients had carotid stenosis than female patients and it was statistically significant.

Risk Factor Analysis in Carotid Stenosis Patients

	Total	Stenosis	No Stenosis
DM	27	20	7
Non-DM	48	15	33
Total	75	35	40

Table 7. Correlation between Diabetes Mellitus and Carotid Stenosis

P=0.00036

There was a correlation between DM and carotid stenosis. More DM patients had carotid stenosis than Non - DM patients and it was statistically significant.

	Total	Stenosis	No Stenosis
Hypertension	39	29	10
Normal	36	6	30
Total	75	35	40

Table 8. Correlation between Hypertension and Carotid Stenosis

P<0.001. Prevalence of carotid stenosis was more in hypertensive patients than in normotensive patients and it was statistically significant.

	Total	Stenosis	No Stenosis
Smokers	37	28	9
Non-smokers	38	7	31
Total	75	35	40

Table 9. Correlation between Smoking and Carotid Stenosis

P<0.001
Prevalence of carotid stenosis was more in smokers than in non-smokers and it was statistically significant.

	Total	Stenosis	No Stenosis
Cholesterol (>200 mg/dL)	41	25	16
Cholesterol (<200 mg/dL)	34	10	24
Total	75	35	40

Table 10. Correlation between Patients with High Cholesterol and Carotid Stenosis

P= 0.006
Prevalence of carotid stenosis was more in patients with high cholesterol than in patients with normal cholesterol and it was statistically significant.

	Total	Stenosis	No Stenosis
TGL>150	41	28	12
TGL<150	34	7	28
Total	75	35	40

Table 11. Carotid Stenosis in Patients with High TGL

P<0.001
Prevalence of carotid stenosis was more in patients with high TGL than in patients with normal TGL and it was statistically significant.

	Total	Stenosis	No Stenosis
HDL>40	59	22	37
HDL<40	16	13	3
Total	75	35	40

Table 12. Prevalence of Carotid Stenosis in Low HDL Patients

P= 0.002
Prevalence of carotid stenosis was more in patients with Low HDL than in patients with normal HDL and it was statistically significant.

	Total	Stenosis	No Stenosis
LDL>130	31	25	6
LDL<130	44	10	34
Total	75	35	40

Table 13. Carotid Stenosis in Patients with High LDL

P<0.001
Prevalence of carotid stenosis was more in patients with high LDL than in patients with normal LDL and it was statistically significant.

Degree of Stenosis	No. of Cases	Percentage
Mild stenosis (<50%)	13	17%
Moderate stenosis (50-69%)	12	16%
Severe or Significant stenosis (>70%)	10	13%
No stenosis	40	54%

Table 14. Degree of Carotid Stenosis in Ischaemic Stroke Patients

The prevalence of mild stenosis and moderate stenosis were more than severe stenosis. In our study, 2 cases with server stenosis had carotid bruit.

Right	Left
17	18

Table 15. Carotid stenosis on Right side and Left side

P=0.8658
There was no particular side preponderance of carotid stenosis and it was more or less equal on both sides and there was no statistical significance between two sides.

Side	ICA	CCA	Total
Right	12	5	17
Left	13	5	18
Total	25	10	35

Table 16. Site of Carotid Stenosis

P=0.914
It was found that carotid stenosis was more in internal carotid arteries both on Right and Left side than common carotid arteries, but it was not statistically significant.

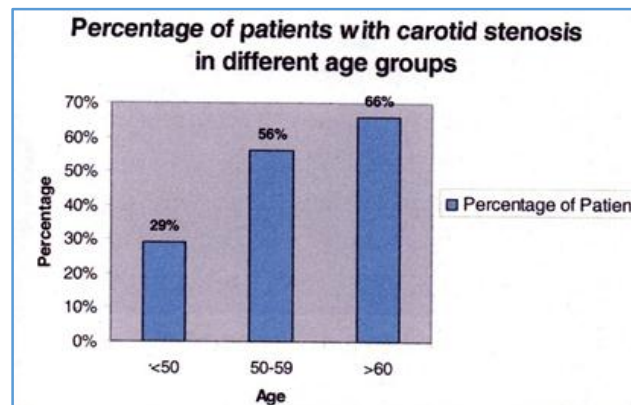


Figure 1

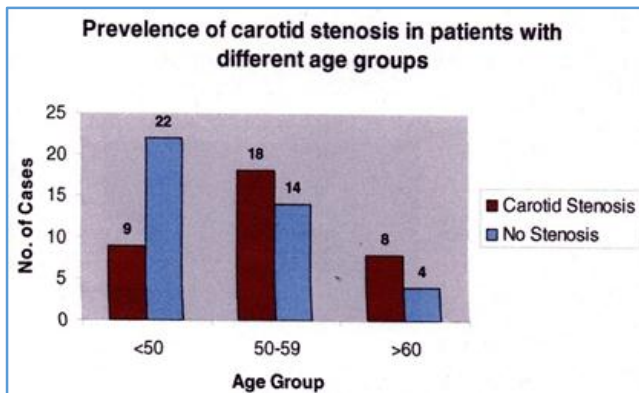


Figure 2

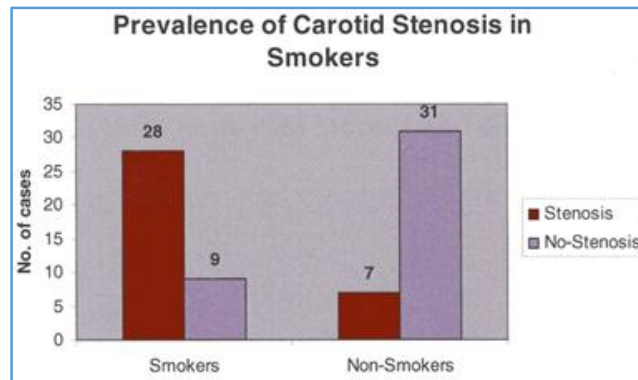


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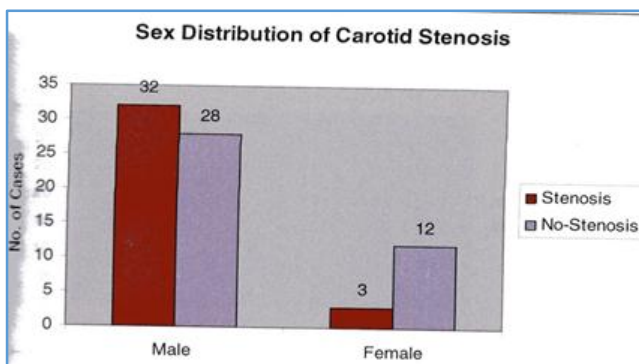


Figure 3

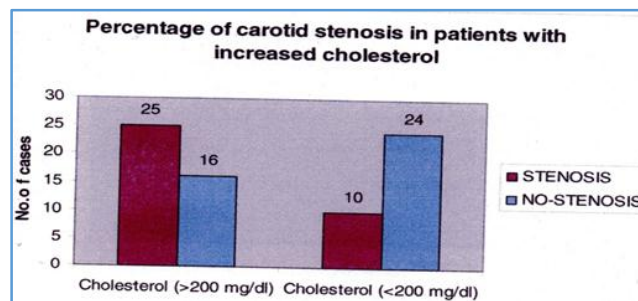


Figure 7

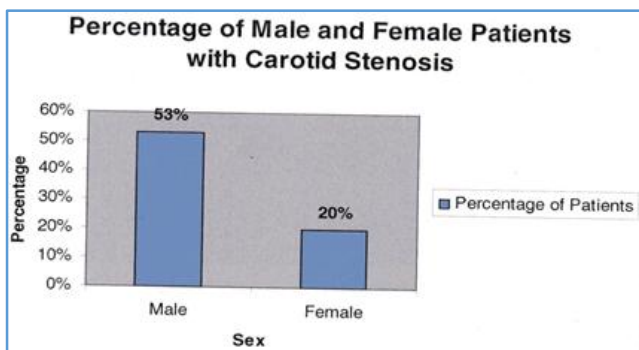


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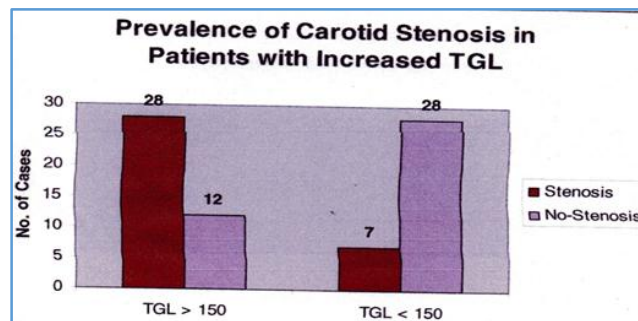


Figure 8

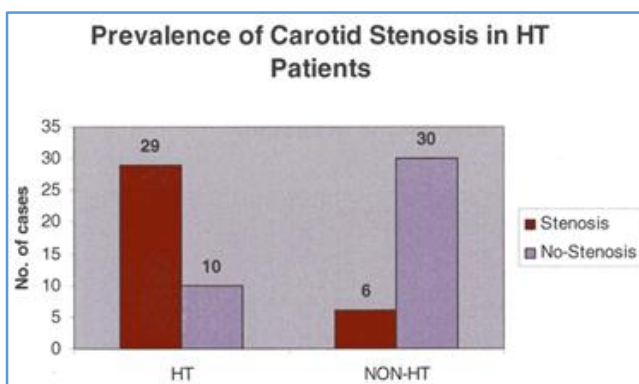


Figure 5

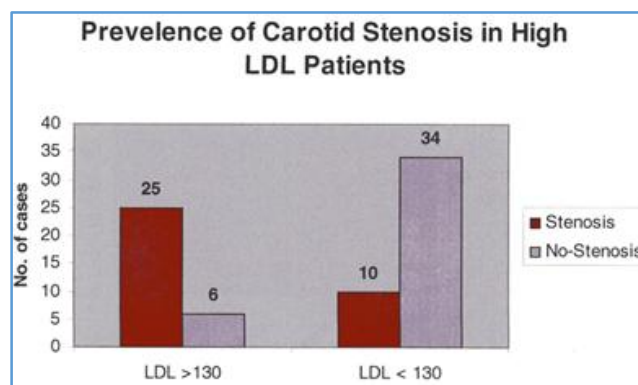


Figure 9

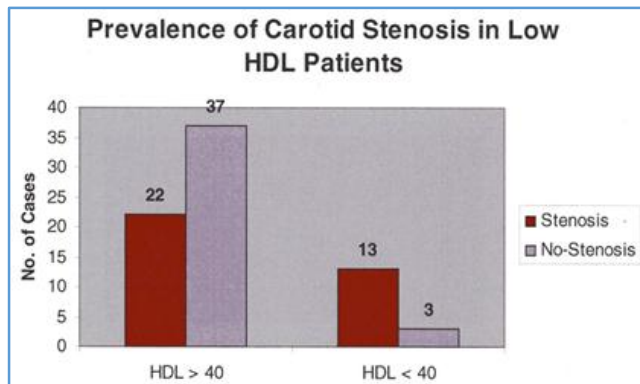


Figure 10

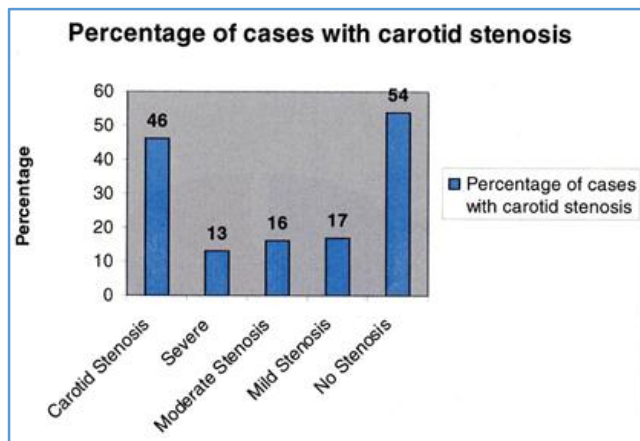


Figure 11

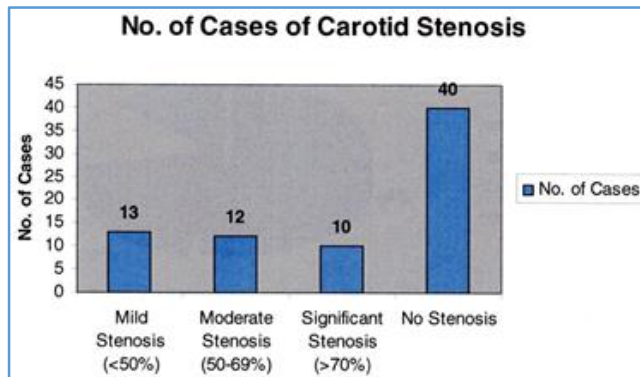


Figure 12

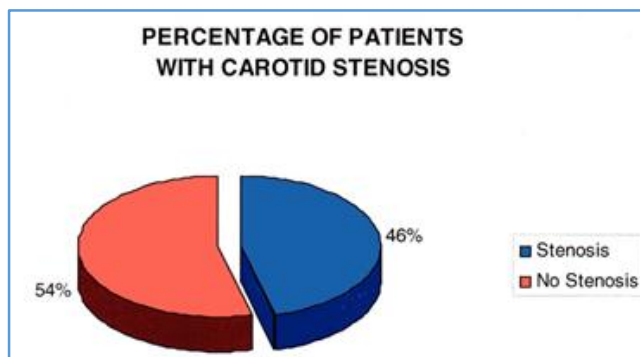


Figure 13

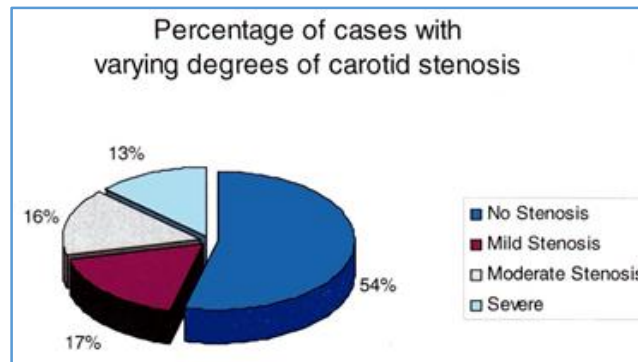


Figure 14

DISCUSSION

Prevalence of carotid stenosis in acute ischaemic stroke patients is about 46% in our study, which is consistent with other studies that was about 43% in ischaemic stroke patients.

The prevalence of patients with significant stenosis (>70%) was about 13% which is associated with increased recurrence of stroke. The prevalence of significant stenosis in studies conducted in western population is about 14% and 21%. This variation could be explained due to racial difference.⁽¹⁴⁾ Extracranial carotid artery stenosis is more common in whites than black and men than women.⁽¹⁴⁾ The prevalence of significant stenosis in a study conducted by M.M. Singh et al was about 32%.

The prevalence of moderate stenosis was about 16%, mild stenosis was 17% and 54% of stroke patients had no carotid stenosis in our study. Asymptomatic carotid stenosis prevalence was found to be >50% in a study conducted in asymptomatic carotid stenosis patients by P.P. Mineva.⁽¹⁵⁾

Analysis of Age with Carotid Stenosis

In our study, the percentage of patients with carotid stenosis was increasing with increase in age.⁽¹⁵⁾ The prevalence in patients <50 years, 50-69 years, >60 years was about 29%, 56%, 66% respectively. A study conducted by K. Rajamani et al clearly showed the increasing incidence of carotid stenosis with older age in African American Men. Carotid stenosis due to atherosclerosis increases with age. The risk of carotid atherosclerosis increases after the mean age of 45 years.

Analysis of Sex with Carotid Stenosis

We found that male/female ratio for the carotid stenosis has increased i.e. the prevalence of carotid stenosis was more in males (53%) than females (20%) which was consistent with studies conducted by Jacob et al. It is also shown by Ralph et al that carotid stenosis was more common in males (43%) than females.

Analysis of Risk Factors for Carotid Atherosclerosis

1. Diabetes Mellitus and Carotid Stenosis

In our study, carotid artery stenosis was more prevalent in diabetics (74%) than in non-diabetics (31%) and it was statistically significant (P<0.05). K. Rajamani et al have shown in their study that carotid stenosis was more common in diabetics (22%) which is consistent with our study.

2. Hypertension and Carotid Stenosis

In our study, we found that Hypertension was the major risk factor for carotid stenosis and the prevalence of carotid

stenosis found to be (74%) in systemic hypertensive patients than in normotensive (16%) patients which was also consistent with studies done by Duncan et al, Sutton et al. In their study, it was found that asymptomatic carotid stenosis was found in 25% of adults with systemic hypertension than those without systemic hypertension. Systemic hypertension accelerates carotid stenosis. The predictors of carotid stenosis were systolic BP >160 mmHg and in isolated systolic hypertension patients when diastolic BP was <75 mmHg there was a strong correlation with carotid stenosis.

3. Smoking and Carotid Stenosis- The Risk Analysis

In our study, we found that the smoking acts as a significant risk factor for carotid artery stenosis. The smokers (75%) had carotid artery stenosis significantly than non-smokers (18%), which is also shown by H.R. Muller et al. Smoking is a major risk factor for carotid stenosis.

4. Hyperlipidaemia and Carotid Stenosis- The Risk Analysis

In our study, among the patients with increased cholesterol (>200 mg/dL) the prevalence of carotid artery stenosis was 61%, the prevalence of carotid artery stenosis with increased TGL (>150 mg/dL) was 70% and increased LDL (>130 mg/dL) was 80%. The prevalence of carotid artery stenosis in patients with normal cholesterol (<200 mg/dL) was 29%, normal TGL (<150 mg/dL) was 20%, normal HDL (>40 mg/dL) and LDL (<130 mg/dL) were found to be 37%, and 22% respectively.

Prevalence of carotid stenosis, just like coronary atherosclerotic disease, increased with Hypercholesterolaemia (>200 mg/dL) and Increased LDL (>130 mg/dL) and decreased HDL (<40 mg/dL).^{16,17,11} They are associated with extracranial large vessel atherosclerosis and also coronary atherosclerosis leads to increase in IMT and plaque formation and stenosis. Extracranial carotid atherosclerosis is associated with major brain vessel occlusion leading to infarction of brain tissue.⁽¹⁷⁾

5. Site and Carotid Stenosis- Analysis

In our study, carotid artery stenosis was found predominantly at the bifurcation of CCA, and the origin of ICA. Carotid artery stenosis was found equal on both sides and was more on ICA than CCA. ICA stenosis was found in 71% of patients and CCA stenosis was found in 28% of patients.

We have found that age, male gender, smoking, DM, HT & Hyperlipidaemia are associated with increased rate of carotid stenosis. In our study, every patient with carotid artery stenosis had one or the other risk factor for Carotid atherosclerosis. In other words, there were no patients with carotid artery stenosis without any risk factor in our study. Hence, asymptomatic patients with these risk factors should be screened for carotid stenosis to prevent stroke.

CONCLUSION

Carotid artery stenosis is one of the common cause of acute ischaemic stroke.

Prevalence of carotid artery stenosis was found to be about 46% among the ischaemic stroke patients enrolled in our study group.

The prevalence of carotid artery stenosis rose with older age, male gender, smoking, DM, HT & Hyperlipidaemia. DM, HT, Smoking and Hyperlipidaemia act as risk factors for carotid atherosclerosis. So patients with DM, HT, Smoking and

Hyperlipidaemia need to have their carotid arteries screened regularly to detect asymptomatic carotid artery stenosis and if present they should strictly control their blood glucose, blood pressure and lipids and start antiplatelet drugs and statins for the purpose of plaque regression and primary prevention of stroke. Patients with stroke who have carotid artery stenosis (symptomatic/significant carotid stenosis) are prone to recurrence of stroke. It is better to advise them to control the risk factors for carotid atherosclerosis/stenosis and should be started on medications like antiplatelet drugs and statins.^{18,19} Surgical intervention like carotid endarterectomy should be done in selected cases for secondary prevention of stroke.²⁰ It can be concluded that Doppler sonography of the carotid arteries in high risk individuals could therefore have profound diagnostic and therapeutic implication (as it is a simple noninvasive screening procedure) in predicting and preventing a potentially fatal and devastating stroke.

Abbreviations

TIA: Transient Ischaemic Attack.
 ICH: Intra Cranial Haemorrhage.
 SAH: Sub Arachnoid Haemorrhage.
 ASD: Atrial Septal Defect.
 DIC: Disseminated Intravascular Coagulation.
 ICA: Internal Carotid Artery.
 CCA: Common Carotid Artery.
 ECA: External Carotid Artery.
 LDL: Low Density Lipoprotein.
 HDL: High Density Lipoprotein.
 OCP: Oral Contraceptive Pills.
 DM: Diabetes Mellitus.
 HT: Hypertension.
 LVH: Left Ventricular Hypertrophy.
 SEC: Spontaneous Echo Contract.
 LVEF: Left Ventricular Ejection Fraction.
 CT: Computed Tomography.
 USG: Ultra Sonography.
 FBS: Fasting Blood Sugar.

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