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Prevalence of Carotid Wall Abnormalities in Patients with Acute Ischemic Stroke: An Observational Study

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ABSTRACT

Background: Stroke is a significant reason for morbidity and mortality in developing countries. It can be classified as ischemic stroke, haemorrhagic, or subarachnoid strokes. Carotid doppler helps in assessing carotid intima media thickness (CIMT), ulcerations in intima, thrombus, plaque haemorrhage, atherosclerosis plaque characteristics, and stenosis. The aim of the study is to know the prevalence of carotid artery wall abnormalities in acute ischaemic stroke patients and associated risk factors.
Methods: This is a kind of observational study done on 50 patients who were admitted at Fathima Institute of Medical Sciences, Kadapa, Andhra Pradesh, India with acute ischemic stroke. Age, gender, presence of carotid wall abnormalities, smoking, lipid levels and medical comorbidities were assessed.
Results: Among 50 patients, 72% were males. Hypertension was the most common risk factor. The prevalence of carotid wall abnormalities was 78% among patients with acute ischemic stroke. Carotid wall abnormalities were associated with presence of comorbidities like diabetes, HTN and hyperlipidaemia. Carotid wall abnormalities were more commonly seen among smokers compared to non-smokers.
Conclusion: We conclude that patients with acute ischemic stroke show high prevalence of carotid wall abnormalities, which can be considered as one of the main reasons for stroke. They occur mainly due to stenosis at carotid artery bifurcation. A carotid doppler may be used as a non-invasive screening tool for assessing the risk of stroke in predicting and preventing fatal stroke.

Keywords: Carotid wall abnormalities, acute ischemic stroke, atherosclerosis, cerebrovascular accident, carotid doppler

INTRODUCTION

Stroke is a cerebrovascular accident (CVA), that causes significant morbidity and mortality in developing countries. It can be classified as ischemic stroke, haemorrhagic, or subarachnoid types. TOAST grading helps to classify ischemic stroke categories that include large-artery atherosclerosis, small-vessel occlusion, and stroke of unknown aetiology[1]. Ischemic stroke mainly occurs due to a thrombotic or embolic event that leads to decrease in blood flow to brain. In thrombosis, blood flow to brain is interfered within the vessel due to vessel dysfunction, that occurs secondary to atherosclerosis, or fibromuscular dysplasia, In an embolic event, debris from another place blocks blood flow through the affected vessel. The cause affects prognosis and outcomes. [2.3]

Stroke was the 2nd most common cause of death globally in 2019, as per the World Health Organization (WHO). It is responsible for 11% of causes of death worldwide[4]. Every year, 15 million people suffer from stroke worldwide. Among them, 5 million die and 5 million will become permanently disabled. It is less common in people aged below 40 years[5]. South Asians are at more risk of stroke, which constitutes for 40% of global stroke deaths[6]. The incidence of IS is 10 times more compared to haemorrhagic stroke[7]. Women are usually older when they have their strokes[8] and they are more likely to suffer from more stroke events. Computed tomography (CT) and Magnetic Resonance Imaging (MRI) imaging modalities of brain play vital role in the diagnosis of stroke[9]. High cost of the MRI, and easy accessibility of CT scan makes CT the routine investigation in the management of stroke. CT helps to determine the site, size and nature of the lesion[10]. Carotid Doppler helps in assessing carotid intima media thickness (CIMT), ulcerations in intima, thrombus, plaque haemorrhage, atherosclerosis plaque characteristics, and stenosis. B mode US imaging is done by "Pulse echo techniques". Atherosclerotic and age-related changes in vascular system will be reflected by structures of carotid arteries.[11] B scan helps to provide overall view of artery, measure IMT, shows stenosis and presence of plaques.[12] Intima and media show endothelial cells, connective tissue and smooth muscle and they are common sites of lipid deposition and plaque formation.[13] Normal IMT in adults varies from 0.5-0.9 mm and IMT above 0.9 is abnormal and it is linked with presence of sonographically visible plaque. Though the prevalence of stroke was reported in various studies previously, data from south India on carotid wall abnormalities among patients with ischemic stroke was less. The information already available or published was not complete to provide a conclusion to provide preventive management and assess the prognosis of stroke. So, this study was conducted. The study was done with an aim of knowing the prevalence of carotid artery wall abnormalities in acute ischaemic stroke patients.

Objectives:

1. To identify the associated risk factors for acute ischemic stroke
2. To know the role of carotid doppler in detecting stroke

MATERIALS AND METHODS

Type of study: This is a kind of observational study done on 50 patients admitted with acute ischemic stroke at Fathima Institute of Medical Sciences, Kadapa, Andhra Pradesh, India.

Duration of study: The study was done for a period of 6 months from March 2022 to September 2022.

Sampling method: Convenience sampling

Sample size calculation:

As per the study done by Kars CJ et al.[14] 2.5% of patients with acute IS show carotid abnormalities like webs

Considering the prevalence as 2.5%, the sample size is estimated as follows:

$N=Z^2PQ/E^2$

N=Sample size

P=Prevalence

Q=1-P

N=38

Confidence levels -95%(power)

Error-5%

38 is the minimum sample size. So, we included 50 patients in our study, considering few losses to follow up.

Inclusion criteria

- Patients aged above 18 years, of any gender, found to have ischemic stroke with CT showing infarct
- Patients who provided informed consent to participate in the study.

Exclusion criteria

1. 1.Patients with incomplete data

2. Pregnant and lactating women
3. Patients with haemorrhagic stroke

PROCEDURE

After taking demography, medical history for knowing medical comorbidities and past history of addictions like smoking, physical examination was conducted. Following investigations were done:

1. Electrocardiogram (ECG) findings
2. CT assessment-area involved
3. Carotid doppler

Carotid Doppler examination

Patients are made to lie in supine position for this exam.

Transducer positions are used to assess carotid arteries in long axis planes, that shows common carotid and internal carotid arteries.

Images are viewed and recorded.

Systolic and diastolic velocity of blood flow, CIMT, presence of atheromatous plaque and thrombus were recorded and % of stenosis was calculated.

Material used: Carotid doppler was done using Esote ultrasonography (USG) machine.

Ethical considerations: The current study was conducted after taking approval from the institutional ethics committee. Informed consent was taken from each patient.

STATISTICAL ANALYSIS

Data analysis was done using Epi Info software version 7.2.5. The results were expressed as mean ± S.D, percentages. Z test and T test was used to identify factors associated with carotid wall abnormalities. P value < 0.05 was considered significant.

RESULTS

The current study included 50 patients with stroke.

Age: The mean age of patients was 61.9 ±4.4years. The age of patients ranged from 36 to 78 years. Most of the patients were aged 61-70 years.

Age	Frequency	Percentage
18-30	1	2%
31-40	2	4%
41-50	10	20%
51-60	14	28%
61-70	16	32%
71-80	7	14%

Table 1 illustrates age distribution of patients

Gender: 72% of patients were males.
Smoking: It was seen in 28 males among 36 males present in the study.

Medical comorbidities:

All patients had comorbidities. Hypertension (HTN) alone was seen in 34 patients. Diabetes alone was seen in 12 patients, coronary artery disease (CAD) alone was seen in 2 patients, hypothyroidism was seen in 2 patients. Both HTN and diabetes were seen in 10 patients. Hypertension, diabetes and CAD were seen in 6 patients.

Comorbidities	Frequency	Percentage
HTN alone	34	68%
Diabetes alone	12	24%
CAD alone	2	4%
Hypothyroidism alone	2	4%

Table 2 illustrates medical comorbidities among study population

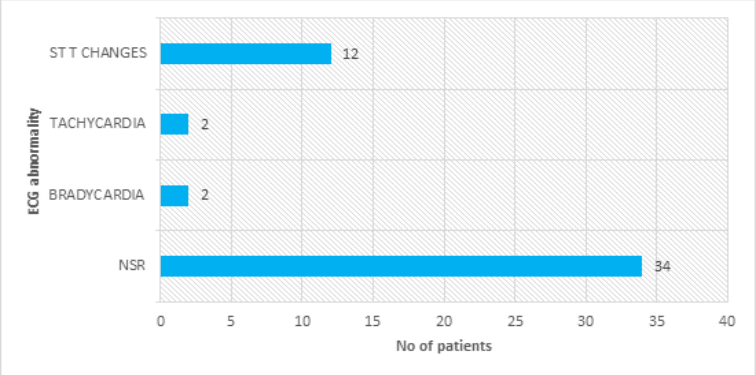
Hyperlipidaemia and lipid levels:

Hyperlipidaemia was seen in 62% of patients. The mean total cholesterol was 162±32.7 mg/dl. The mean triglyceride levels were 144.5±23.2mg/dl. The mean low-density lipoprotein (LDL) levels were 115.5±24.9 mg/dl. The mean high-density lipoprotein (HDL) levels were 33.2±4.2mg/dl. The mean very low-density lipoprotein (VLDL) levels were 22.3±9.6 mg/dl.

Parameter	Range	Mean	Standard Deviation
Total cholesterol	91 to 161 mg/dl	162 mg/dl	32.7 mg/dl
Triglycerides	68 to 389mg/dl	144.5 mg/dl	23.2 mg/dl
LDL	34 to 188 mg/dl	115.5 mg/dl	24.9 mg/dl
HDL	15 to 48 mg/dl	33.2 mg/dl	4.2 mg/dl
VLDL	24 to 110 mg/dl	22.3 mg/dl	9.6 mg/dl

Table 3 illustrates mean lipid levels in the study population.

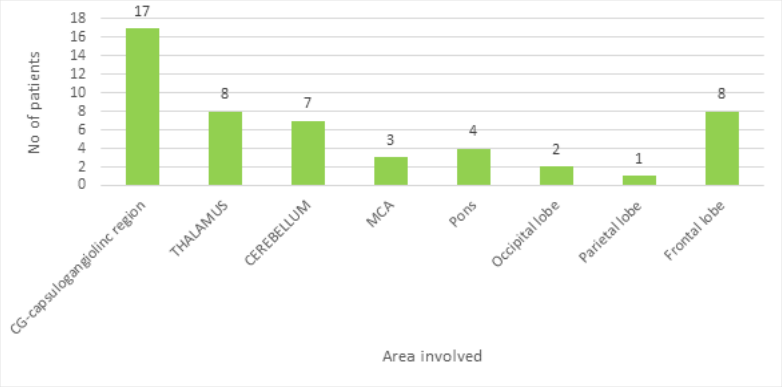
ECG findings: Normal sinus rhythm (NSR) was seen in 34 patients. Sinus bradycardia alone was seen in 2 patients, sinus tachycardia was seen in 2 patients and ST-T wave changes were seen in 12 patients.



Graph 2: ECG findings of study patients

Area involved as per CT:

Capsuloganglionic region is most commonly involved. Thalamus and frontal lobes are next most common areas involved.

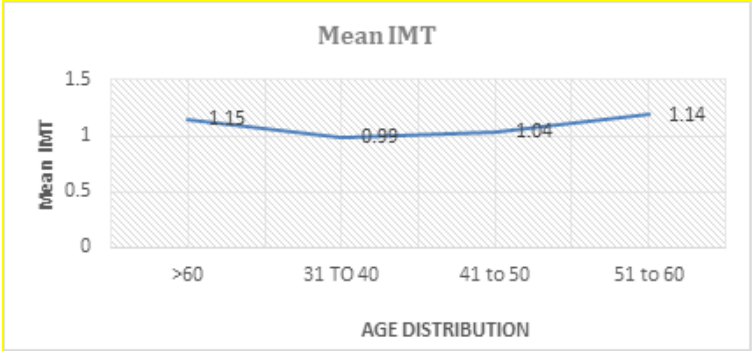


Graph 3: Region involved as per CT findings

Prevalence of carotid wall abnormalities:

CIM thickness above or equal to 0.9 mm in either right or left arteries- is identified as presence of carotid wall abnormality. It was seen in 78% patients with IS.

Age and Intima media thickness (IMT): The following line diagram shown age and mean intima media thickness (IMT). As age increase, the mean IMT increased. Mean IMT among patients aged above 60 years was 1.15 mm, it was 0.99mm in patients aged 31 to 40 years, 1.04 mm in patients aged 41-50 years, 1.14mm in patients aged 51 to 60 years.



Graph 4: Mean IMT as per age of patients

Association between various parameters and carotid wall abnormalities: There is significant association between total cholesterol levels between patients with and without carotid wall abnormalities. Patients with carotid wall abnormalities had more mean total cholesterol levels, more mean age. Males, smokers, hypertensives are more likely to have carotid wall abnormalities.

Parameters	Mean and SD Carotid wall abnormality present(n=39)	Mean and SD Carotid wall abnormality absent(n=11)	P value
HDL	34.1±3	32.3±4.3	0.11
TG	142±24	147±22.3	0.53
LDL	112±21.3	119±31.9	0.395
TC	178±32.1	146±29	0.005
Mean age	65.4±7.8 years	58.4±4.3 years	0.0065
Gender Male	79.4%	45.45%	0.02
Smokers	71.7%	Nil	0.00001
Hypertension presence	82.05%	36.36%	0.00001

Table 4 illustrates association between parameters and carotid wall abnormalities

DISCUSSION

The current study detected carotid wall abnormalities among patients with acute ischemic stroke.

In our study, stroke was commonly seen in patients aged 61 to 70 years and among males. Smoking was seen among 28 males among 36 males included in our study. Prevalence of smoking was 56%. Xing Yi et al.[15] did a study in China and found that 524 patients were having stroke. Among them, females were more compared to males. Gender preponderance is in contrast to the current study findings. Smoking was seen in 139 patients among 524 patients included. These results show stroke patients usually have smoking as addiction.

Hypertension was the most common comorbidity, followed by diabetes among ischemic stroke patients. Hyperlipidaemia was seen in 62% of patients in our study. Johansen reported HTN in 35% of stroke patients; diabetes in 17%; arrhythmias in 15%; coronary heart disease in 13.6%; and congestive heart failure in 5% of patients.[16]

M Habibi et al.[17] reported diabetes in 36% patients, hypertension in 66.9% patients, ischemic heart disease in 20.5% patients, dyslipidaemia in 22.1% patients. Their study results also showed that HTN was commonest comorbidity, similar to our study results.

J Putaala et al.[18] did a study in 2012 in stroke patients and found dyslipidaemia in 45.8% patients, HTN in 35.9% of patients. There was significant association between mean carotid intima media thickness and age, gender, smoking, hypertension and total cholesterol levels. Polak JF et al[19] compared internal carotid artery IMT with common carotid artery IMT. 3316 patients were included. Age and average CCA IMT corresponded to raise of 0.007 mm/y; and it was 0.037 mm/y for ICA IMT. Age and gender constituted for 23.5% to variability of CCA IMT and 22.5% to ICA IMT. Authors concluded that CCA IMT and ICA IMT as important predictors of CVD, with ICA IMT having more area under curve in ROC analysis. R Sahoo et al.[20] did a study on 60 patients with IS and compared them with controls. The mean age was 62 years and most of them were males, similar to our study findings. The mean CIMT in cases was 0.79 and it was 0.6 among controls. Patients with carotid plaque had more increased IMT compared to patients without plaques.

Limitation of our study: Single-center study and small sample size.

We recommend future studies on plaque volume and comparing carotid doppler findings with angiography.

CONCLUSION

Our study showed that the prevalence of carotid wall abnormalities was 78% among patients with IS. We can conclude that patients with acute IS show high prevalence of carotid wall abnormalities, which can be

considered as one of the main reasons for stroke. Carotid wall abnormalities occur mainly due to stenosis at carotid artery bifurcation. Carotid abnormalities were associated with the presence of diabetes mellitus, Hypertension, smoking and high total cholesterol levels. Thus, a carotid doppler may be used as a non-invasive screening tool for assessing the risk of stroke in predicting and preventing fatal stroke.

Declaration by Authors

Ethical Approval: Obtained

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Conflict of Interest: The authors declare no conflict of interest.

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