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# Correlation of Ct Findings of Stroke with External Carotid Doppler with Lipid Profile and Blood Sugar Level

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## ABSTRACT

To study the role of colour Doppler of carotid arteries, lipid profile and blood glucose levels and their association in patients with CT findings of stroke. To study carotid arteries with respect to morphology of plaque and degree of stenosis with the size of stroke on CT.The study included 140 patients with CT findings of stroke .There were 94 male patients and 46 female patients. Intima-media thickness was increased more on ipsilateral side of the stroke. The most common location of plaque was the carotid bifurcation. The most common type of plaque was the echogenic by the calcific plaque.

**Keywords:** carotid arteries, blood glucose, stroke and atherosclerosis.

## 1. INTRODUCTION

Stroke is defined as "abrupt onset of a neurologic deficit that is attributable to a focal vascular cause". 1 Approximately 80% cases of stroke are due to cerebral ischemia.2 Incidence and prevalence of stroke has risen exponentially worldwide in last few decades and incidence of stroke is also rising among Indians. 3,4 Physicians are trying to identify the stroke prone population in whom timely intervention may avert stroke and its accompanying disability.5Indian population is relatively young [Indian population≥ 60 years: 7.5% ] compared to the west [e.g. British population aged ≥65 year ], but the stroke in India has already attained epidemic proportions [annual incidence of stroke: 13 per 100,000 in 1969 -7 and 145 per 100,000per year during 2003-06].6,7,8,9Stroke is a major health issue not only because it is the second major cause of death but also because it leaves patients with several residual disabilities like physical dependence, cognitive decline, dementia, depression, andseizures. The costs involved in caring for these patients are enormous and have adverse social implications. 10,11,12

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Carotid intima media thickness (CIMT) is now used commonly as a non-invasive test for assessment of degree of atherosclerosis. Duplex ultrasound is non-expensive, non-invasive and can provide functional and anatomical information about vessel stenosis and plaque morphology.13,14 Colour duplex flow ultrasonography has thus become the most widely used noninvasive method of assessing extracranial cerebrovascular occlusive disease because it avoids the expense and risk of routine arteriography. The sensitivity and specificity of carotid duplex US range from 90% to 95% for measurement of carotid diameter reduction, and for detection of minimal atherosclerotic plaque. 15,16,17

## 2. MATERIALS AND METHODS

During the study period one hundred and forty patients admitted to SREE BALAJI MEDICAL COLLEGE AND HOSPITAL with CT findings of stroke were subjected to external carotid Doppler along with assessment of lipid profile and blood glucose levels.Doppler examinations were done on SIEMENS Acusson S2000 ultrasound machine and CT scans were done

### STUDY DESIGN

Prospective study where patients presenting with CT findings of stroke were subjected to carotid Doppler examination along with assessment of lipid profile and blood glucose levels and to find a correlation if any between the above parameters at the end of the study.

### INCLUSION CRITERIA

1. All patients presenting with CT findings ofstroke.

### EXCLUSION CRITERIA

1. Patients with CT findings of vertebro-basilar insufficiency.
2. Patients with haemorrhage onCT.
3. Known cases of deep vein thrombosis, arrhythmias, atrial fibrillation and intracranialtumours.

**SOURCE OF DATA** Patients who were admitted at the SREE BALAJI MEDICAL COLLEGE AND HOSPITAL, CHENNAI.

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**METHOD OF PERFORMING EXAMINATION**

In each patient , the common and internal carotid arteries of both sides were evaluated sonographically, using high frequency linear probe (9 MHz).

The patient was placed in supine position and the examiner seated near the patient's head. Tilting the patient's head away from the side being examined facilitates neck exposure. With this technique, two parallel echogenic lines separated by an anechoic space can be visualized at levels of the artery wall. These lines aregenerated by the blood-intima and media-adventitial interfaces. The distance between the two lines gives a reliable index of the thickness of the intimal-media complex (21). The IMT of the common and internal carotid arteries was measured within 1 cm of the carotid bulb. IMT of only the plaque-free segments was recorded. Presence of plaques was also noted.

The extent, location, and characteristics of atherosclerotic plaque in the common carotid artery (CCA) and internal carotid artery (ICA) were documented with gray-scale imaging. The vessels were imaged as completely as possible, with caudal angulation of the transducer in the supraclavicular region and cephalic angulation at the level of the mandible. Colour Doppler imaging was performed to detect areas of abnormal blood flow that require Doppler spectral analysis. Pulsed wave (PW) Doppler spectral analysis was performed, and the velocity of blood flow in the mid-CCA and proximal ICA as well as proximal to, at, and immediately distal to the diseased areas was measured. Evaluation of the external carotid artery (ECA) was also performed .Colour Doppler imaging of both vertebral

A detailed medical history, including the family history of Type-2 Diabetes, history of smoking and consumption of alcohol was obtained. A general physical examination and systemic examination of the study subjects was performed. Routine biochemical data like the blood sugar and lipid profiles were obtained in each individual.

## 3. RESULTS

**Table 8 : Showing distribution of males and females**

| | | |
|---|---|---|
| NUMBER OFMALES | 94 | (67.14 %) |
| NUMBER OFFEMALES | 46 | (32.86 %) |
| TOTAL NUMBER OF PATIENTS | 140 | (100 %) |

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**Figure 9: Showing normal carotid intima-mediathickness**

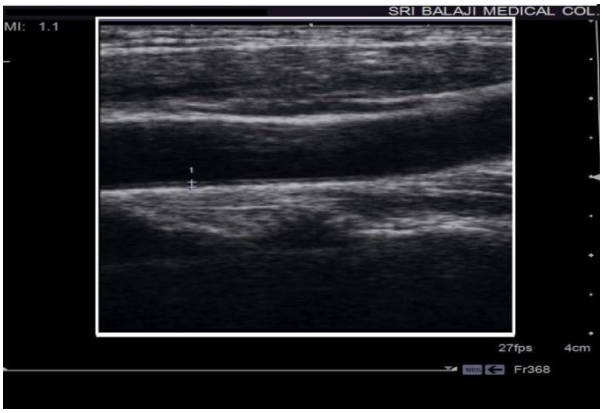


**Chart 13 : Showing the distribution of patients with altered lipid profile**

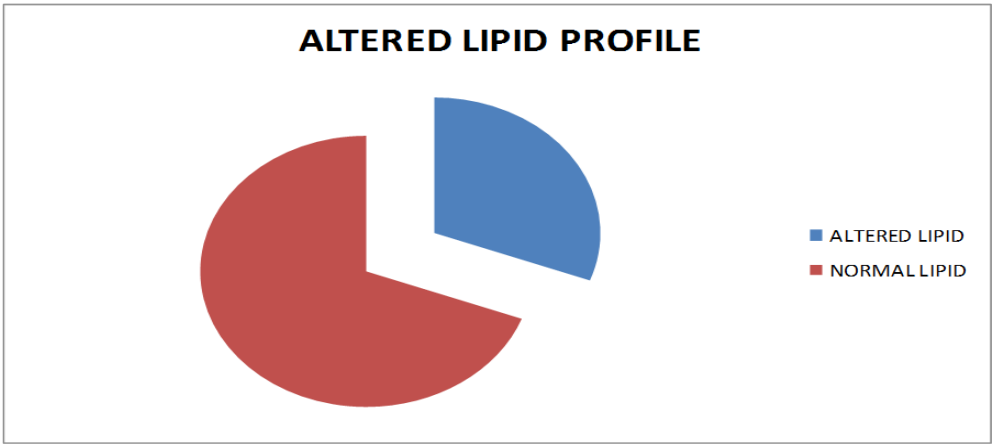


**Chart 15 : Showing the distribution of patients with increased blood sugar at the time of admission**

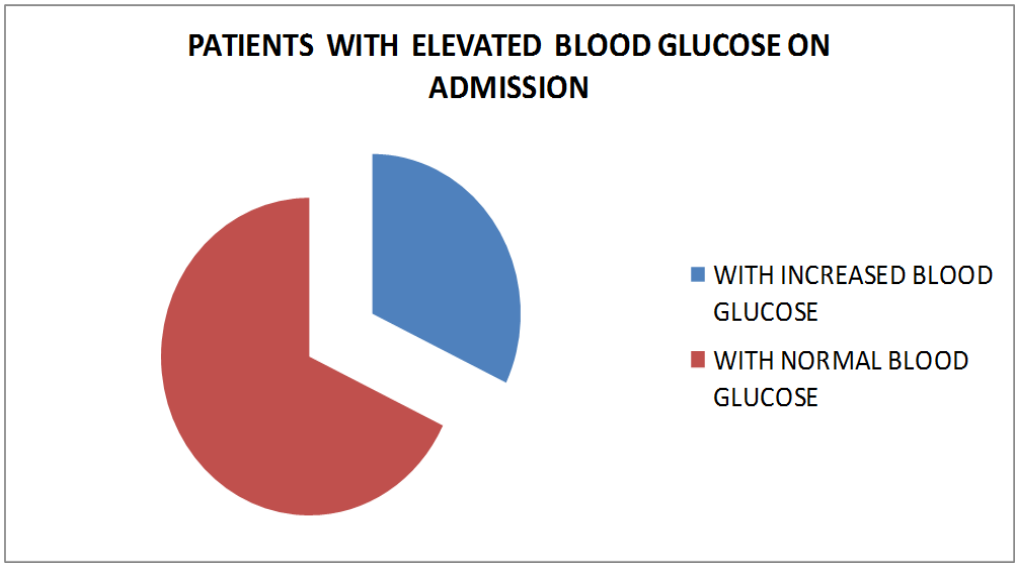

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**Chart 16 : Showing the total number of diabetics and non-diabetics in the study group**

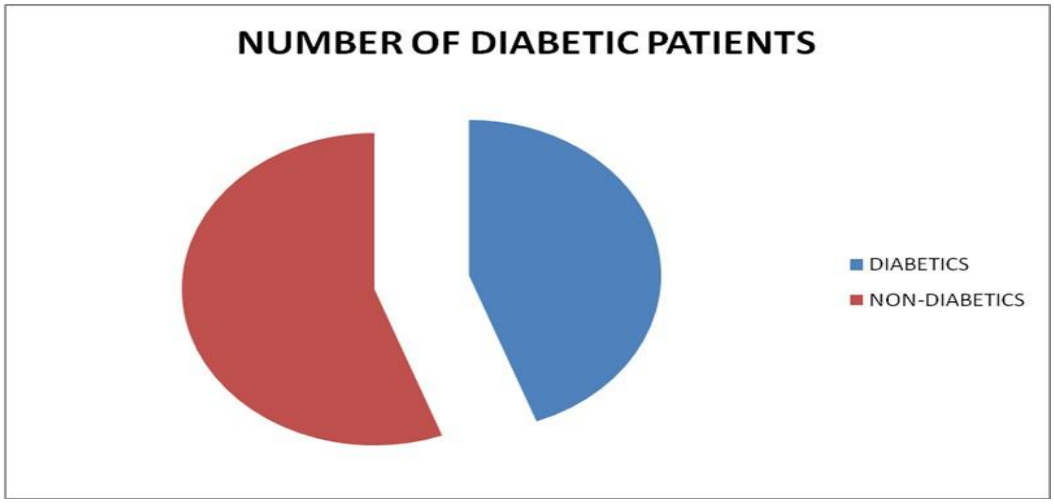


Figure 10 Showing increased intima-media thickness

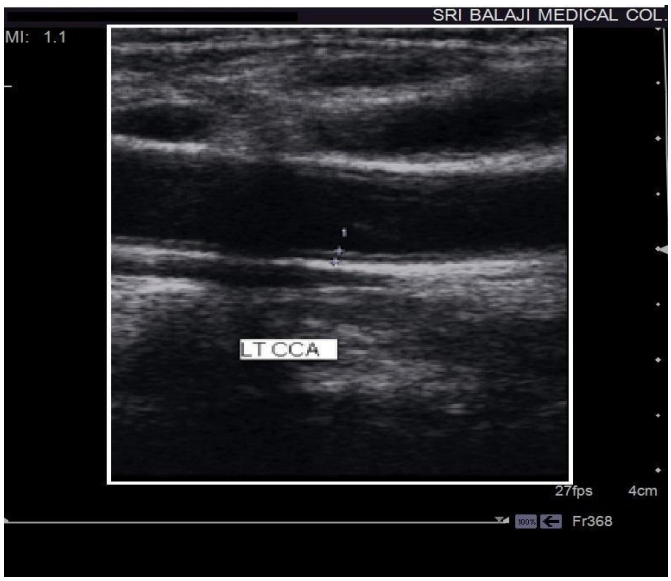


**Table 14 : Showing the total number of non-diabetic patients with increased intima-media thickness**

| NUMBER OF NON-DIABETIC PATIENTS WITH INCREASED IMT | TOTAL NUMBER OF NON-DIABETIC PATIENTS | PERCENTAGE OF NON- DIABETIC PATIENTS WITH INCREASED IMT |
|---|---|---|
| 51 | 78 (100 %) | 65.4% |

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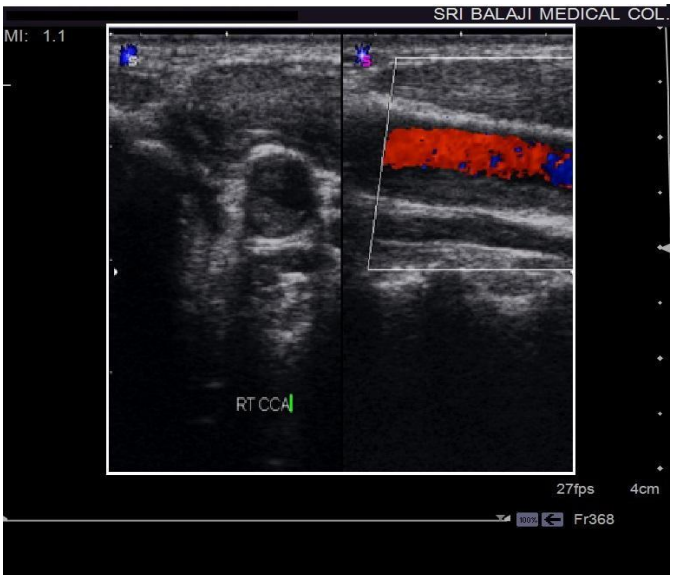
Figure 11: USG image showing fibro-fatty plaque(echogenic) .Note the plaque causing narrowing of the lumen on transverse view and on Doppler colour not filling up the region of the plaque.



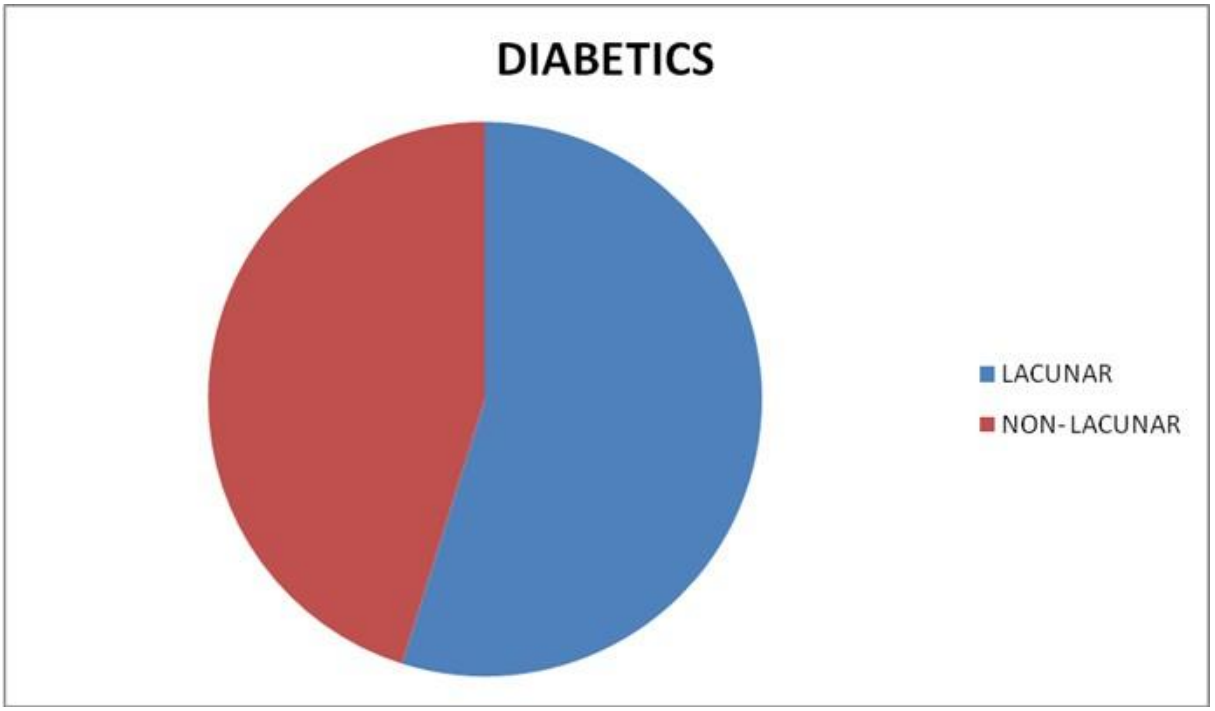




**Chart 20 : Showing the distribution of lacunar and non- lacunar infarcts indiabetics**

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Figure 18 c. CT angiography image showing thrombus in the left internal carotid artery extending from the distal left common carotid artery

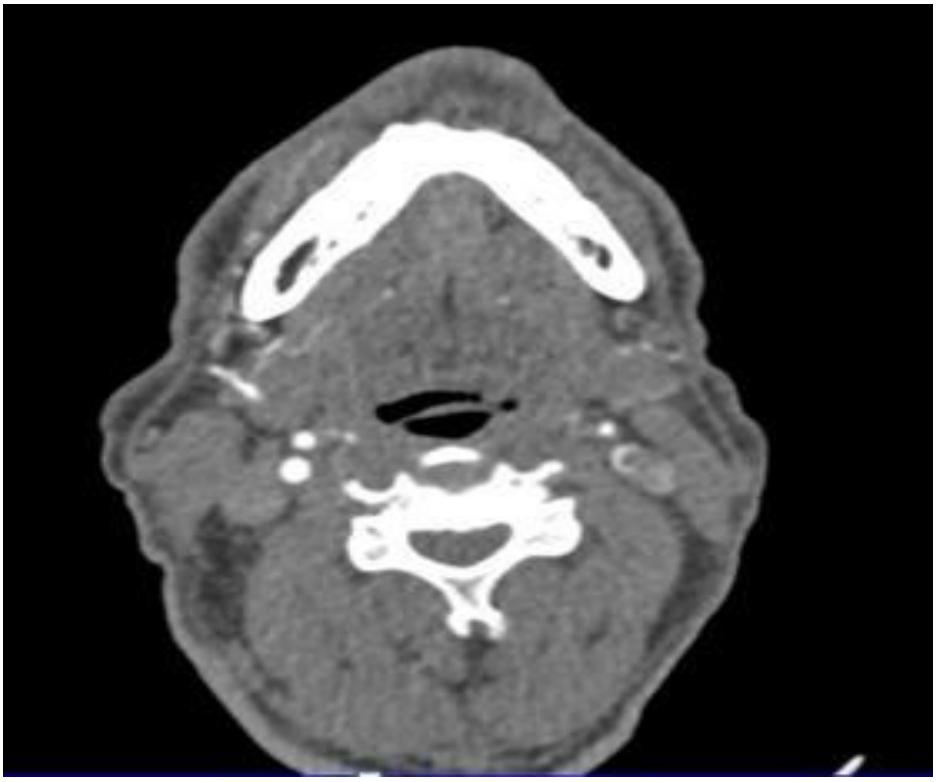

Figure 20. Contrast CT showing an enhancing mass lesion at the bifurcation of the left common carotid displacing the internal and external carotid artery – carotid bodytumour

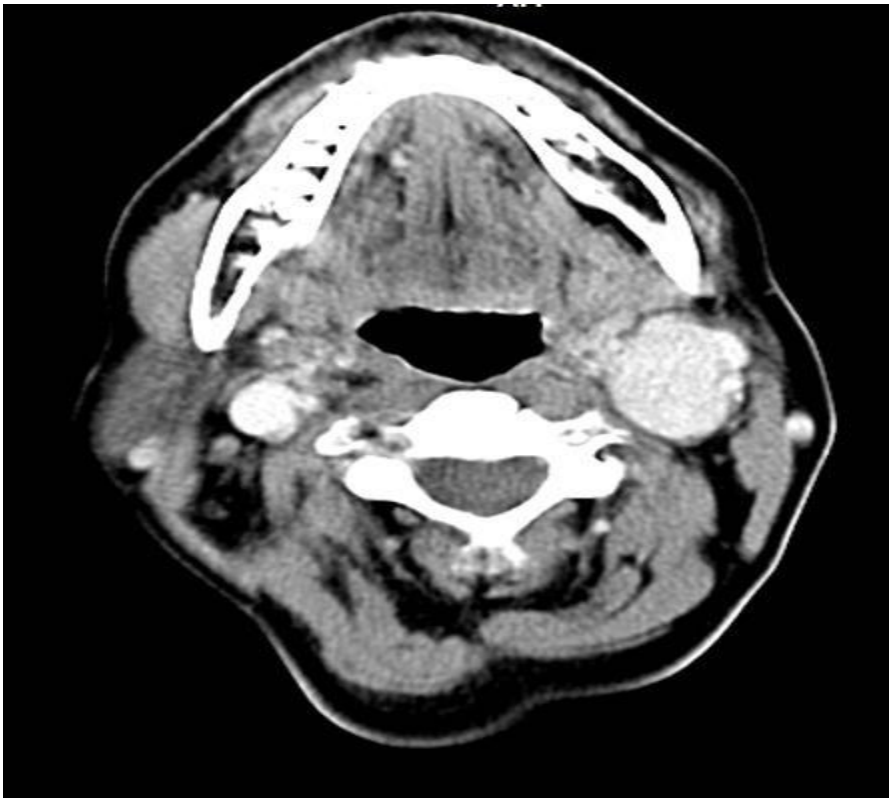

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**Chart 25 : Showing the number of patients having stroke having normal blood glucose, normal lipid profile and normal carotid Dopplerstudy**

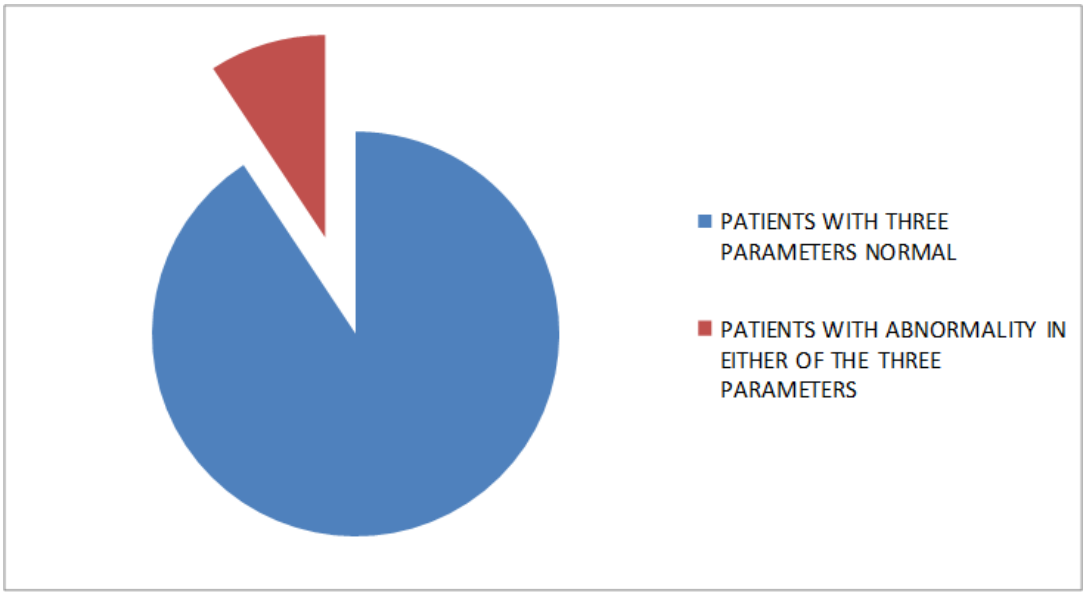


**Table26 : Showing the number of patients having stroke having normal blood glucose,normal lipid profile and normal carotid Dopplerstudy**

| | |
|---|---|
| NUMBER OF PATIENTS WITH ALLTHE THREE PARAMETERS NORMAL | 13(9.29%) |
| NUMBER OF PATIENTS WITH ABNORMALITY IN EITHER OF THE PARAMETERS | 127(90.71%) |
| TOTAL NUMBER OF PATIENTS | 140(100%) |

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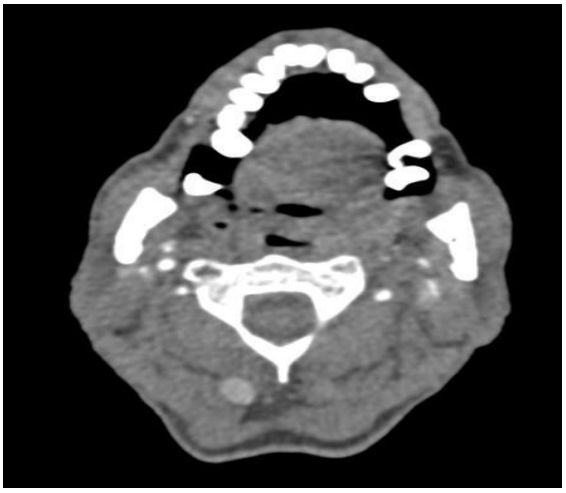
Figure 22b. CT angiography image showing near total occlusion of the left internal carotidartery



## DISCUSSION

### Age , sex and hemispherecorrelation

In our study of 140 patients with CT findings of stroke there were 94 males and 46 females . The mean age of presentation of males was 64yrs and the mean age of presentation of females was 63.38 yrs. About 67 % of the study group was above 60 yrs of age which correlates well with the Asymptomatic Carotid Atherosclerosis Study (ACAS)61 which states that in a stroke subgroup more than 50% of the patients are above the 60 yrs age group .About 13 % of patients were below the age of 50 yrs which is much in line of the ever increasing trend of the stroke in the younger population.It is believed that the average age of patients with stroke in developing countries is 15 years younger than that in developed countries.62,63High-resolution B-mode instruments allow the measurement of the thickness of intima-media complex. Thickening of this complex might represent the initial step of atherosclerosis and hence its measurement is o f clinical importance. 18

IMT was significantly increased in patients ipsilateral to the side of stroke (70.7%). In fact about 53.5% of these patients had bilaterally increased IMT that could be suggestive of a more globally occurring atherosclerotic process.In our study diabetic patients who had stroke had a greater incidence of increased IMT(77.4%) than the non- diabetic patients(65.4%) .Previous studies have shown that the IMT of diabetic individuals is higher than that of non - diabetic individuals. 19-21Carotid IMT represents an alternative technique for assessing atherosclerotic burden and

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future cardiovascular risk.We observed more incidence of lacunar infarcts in diabetic patients(54%) than non-lacunar infarcts(29%) which correlates well with other studies reported in literature. 2,22 This difference is statistically significant with p value of 0.0024(<0.05) and a Z value of 3.033.Diabetics had a higher incidence of calcific plaques than non-diabetics. This difference is statistically significant with p value of 0.0051(<0.05) and a Z value of 2.801.

The majority of the patients had middle cerebral artery territory involvement followed by the anterior cerebral artery territory.Of the diabetic patients 34 (54.8%) had lacunar infarcts and 28(45.2%) had non lacunar infarcts.Of the non –diabetic patients 23(29.5%) had lacunar and 58(70.5%) had non lacunar infarcts.A high frequency of lacunar strokes is a familiar pattern among South Asians, which suggests a greater prevalence of small-vessel ischemic disease in South Asians. This may be a consequence of abnormal metabolic and glycemic processes. 18

The majority of the infarcts had volume between 1 -10 cc (67.1%), followed by 10-50 cc(21.4%) and more than 50cc (11.55%). Patients with larger volumes of infarct.Studies of cholesterol levels in stroke patients have revealed results varying from insignificant changes to a moderate elevation.24 Our study found a positive correlation between serum Total cholesterol, Triglycerides, LDL levels in patients of stroke.

Involvement of ipsilateral artery by plaque is more than that of contralateral .Ipsilateral involvement and echogenicity is more than contralateral involvement and echogenicity respectively. The most common location of plaque was the carotid bifurcation, where blood flow is less laminar .Probably the laminar blood flow at the site of bifurcation could be the reason for number of plaques at this site, similar findings have been reported from other studies also. 13,19

About 17.8 % of patients had significant carotid stenosis, the figures were similar to that obtained by Khan et al21 found carotid artery stenosis in about 18.18% of patients. Alexandrore et al 23 who reported stenosis of equal or greater than 70% in 17% of 348 patients however lower figures (8%) were also noted by Tan 74 from Taiwan.According to the Trivandrum stroke study by Sapna et al compared to urban stroke patients, rural ones were less likely to be optimally investigated and treated. 25 The Framingham Heart Study and other international prospective epidemiological studies identified the majoratherogenic risk factors for stroke as hypertension, diabetes mellitus, hyperlipidaemia, and smoking. 26

Our study was carried out in a rural setting and nearly 90 % of our patients had one or the other parameters elevated . In a rural set up where accessibility to quality health care is limited these parameters could serve as an relatively cheaper alternative for assessment of risk factors for stroke/recurrent stroke and also to find out the subgroup of patients who need more active

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intervention and intensive care.27Nonetheless a still longer period of follow up of these patients with stroke is required for more intricate looks at these risks factors and their roles in the aetiology of stroke. As progression of the atherosclerotic disease can be stopped by reducing the risk factors and significant(> 70%) stenosis treated surgically/stenting present study highlights the importance of Doppler study in stroke prevention through surveillance for atherosclerosis that predisposes a person to cerebral ischemia. 28-31

**CONCLUSION**

Intima-media thickness was increased more on the side of the symptomatic hemisphere. However in most cases there was increased IMT bilaterally. This is well in synchrony with studies carried out till date.In the study population 10% of patients had complete/near complete thrombosis of the ipsilateral CCA/ICA. These patients generally had a large size of infarct and fared poorly after the stroke. This underlines the importance of doing a Doppler study as immediately as possible after stroke to identify this subgroup of patients.

In developing countries where facilities for Digital subtraction angiography(DSA) is limited as well as invasive and expensive this screening with Doppler would help us identify the subgroup of patients who would need further investigations / thrombolysis and to be able to do it timely in order to prevent the massive cerebral damage known to occur in such cases.All the three investigations taken together can be an inexpensive method to point towards the etiology of ischaemic stroke and thereby reduce the incidence of stroke/ recurrent stroke.These risk factors may help to find out increased predisposition of patients to stroke/recurrent stroke and to consider for prophylactic medication. In patients with ischemic stroke, these markers can be used to monitor and prevent further events by appropriate interventions.

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