

Common Carotid Artery Intima Media Thickness Measurement in Cerebral Ischemic Stroke Patients Using Ultrasonography: A Prospective Study

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ABSTRACT

Introduction: Cerebral ischemic stroke is the third leading cause of death in the world. Atherosclerotic changes in carotid artery and ischemic stroke have been studied and found to have a close relationship.

Aim: This study was done to assess the carotid intima media thickness (CIMT) using high frequency sonography and to correlate it with cerebrovascular accidents.

Materials and Methods: This prospective study consists of 50 patients. A purposive sampling technique was used. Various risk factors of ischemic stroke mainly diabetes mellitus, hypertension, family history and smoking were noted. Using high frequency B mode 5-12 MHz linear transducer the data was gathered from ultrasonographic examination of common carotid (CCA)

Statistical Analysis: The data collected was analyzed using SPSS15 for windows. No tests of significance were

applied as this study deals with only frequency distribution of various factors.

Results: The highest incidence of cerebral ischemic stroke was found in males between 60 to 69 Years. In our study we found 72% prevalence of high CIMT (> 0.8mm) in patients with ischemic stroke. Among these 26 were males and 8 were females. Hypertension was found to be the most common risk factor compressing of 17(81%) patients followed by diabetes 5(71.4%) patients and smoking 14(63.3%) patients.

Conclusion: Sonographic evaluation of CIMT is a safe, economic, reproducible and less time consuming imaging technique in the evaluation of people who are at risk of developing cerebral ischemic stroke. This can serve as useful investigation in instituting early treatment modalities.

Keywords: Diabetes mellitus, Hyperlipidemia, Hypertension, Infarct, Smoking, Transient ischemic attack.

INTRODUCTION

Cerebral ischemic stroke is a heterogeneous disease, with different subtypes. Each of these subtypes presents with specific pathogenesis. Increased common carotid artery intima-media thickness (CIMT) has been found to be a marker of atherosclerosis associated with ischemic stroke. CIMT has emerged in recent times as one of the non invasive methods of choice for determining preclinical atherosclerotic changes. Various studies have defined CIMT as the distance between the leading edge of the lumen intima interface (first bright line) and media-adventitia interface (the leading edge

of the second bright line of the posterior wall of the vessel and for the anterior wall) [1].

Patients with ischemic stroke having hypertension, smoking, hypercholesterolemia and diabetes mellitus were found to have higher CIMT values [2]. A recent Indian prospective study on CIMT and its correlation with novel risk factors in ischemic stroke found 71% prevalence of high CIMT in patients with ischemic stroke. Use of tobacco, obesity with high waist: hip ratio, elevated blood pressure, low HDL cholesterol, high LDL cholesterol, abnormal apolipoprotein A-1:B ratio, sedentary lifestyles, decreased consumption

of fruits and vegetables, psychosocial stress, and diabetes mellitus correlate with vascular events [3]. Increased IMT of ICA was found in stroke among young adults aged between 15 to 44 years [4].

Diagnostic modalities in cerebral ischemic stroke:

Appropriate detection and quantification of carotid artery disease has a decisive impact on the patient prognosis. Aggressive and potentially harmful treatments exist for acute ischemic stroke, hence fast and non invasive examination of the intracranial vasculature are need of the day. Ultrasound is the most widespread diagnostic modality in obstructive disease of the arteries supplying the brain. It is a non invasive and low cost investigation [5]. In acute stroke, ultrasound techniques offer bedside options to localize the underlying pathogenic process. There was a high correlation between the Doppler ultrasound results and angiography [6,7]. The transverse images obtained with colour B mode imaging were compared with endarterectomy specimens and was concluded that the colour B mode imaging is accurate in determining stenosis [8]. Also correlation with plain measurements of the corresponding post mortem specimens has proved that colour Doppler sonography permits reliable detection and quantification of carotid artery stenosis and occlusions.

Ambiguous or uncertain findings of sonography might require further diagnostic work up [9]. Patients in whom ultrasonography does not allow a full visualization of carotid bifurcation, angiography is required [10]. Also to identify significant intracranial disease many stroke clinicians recommend angiography after screening with ultrasound before a decision regarding intervention is made [11,12]. Magnetic resonance angiography has developed as an alternative technique to digital subtraction angiography [13]. Previous studies showed CIMT is most common non-invasive test in assessment of atherosclerosis in various arteries and found to have a direct association with stroke incidence. CIMT is a strong predictor of future vascular events than those explained by the risk factors. It has been concluded in a meta-analysis study [14].

AIMS

Present study was conducted to assess the CIMT with the help of B mode ultrasonographic imaging in cerebral ischemic stroke and to correlate cerebrovascular accidents with extracranial carotid intima media thickness.

MATERIALS AND METHODS

This prospective study was carried out for a period of two years between the period of June 2010 to June 2012, in a tertiary care hospital.

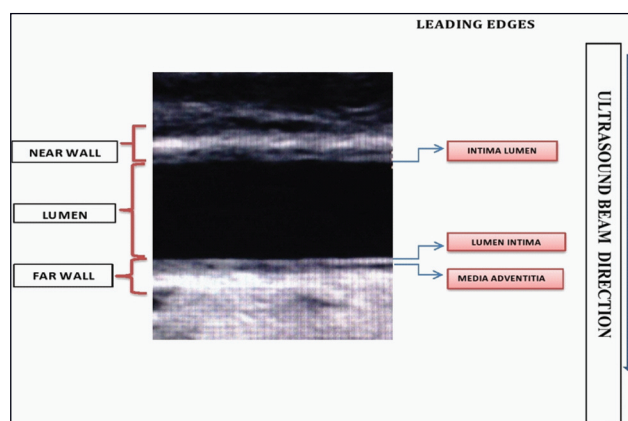
Study population: Sample size of 50 patients belong to age group of 20 to 90 years age were selected, without any age, sex, ethnic or socioeconomic discrimination. Clinical history and physical examination findings were noted on a questionnaire and all the findings were recorded. Presence and absence of diabetes mellitus, hypertension, ischemic heart disease and smoking were documented. All patients underwent a CT-scan study prior to the B mode sonography of carotid arteries.

Sample Size and Sample Technique: Sample size of 50 cases were selected based on purposive sampling technique which is based on inclusion and exclusion criteria.

Inclusion Criteria: All clinically diagnosed cerebral ischemic stroke patients who were referred to the Radiology Department for B mode ultrasonography of carotid arteries.

Exclusion Criteria: 1. Vertebro-basilar insufficiency. 2. Craniocerebral trauma 3.Primary and metastatic cerebral neoplasms.

Data Collection Techniques and Tools: Findings noted in a CT-scan included vascular territory, side, acute or chronic and cortical or subcortical infarct. The data gathered from the ultrasonography of carotid arteries consisted of IMT of CCA: The distance between the leading edge of the first bright line (lumen intima interface) and the leading edge of the second bright line (media-adventitia interface) of the posterior (far) vessel wall [Table/Fig-1].



[Table/Fig-1]: B Mode ultrasonography of Common Carotid Artery wall showing intima and media in longitudinal section.

Equipment: Philips EnVisor C (Philips Medical Systems, Nederland B.V) with a linear array transducer of 7-12MHz used for carotid ultrasound study. Prior CT scan using GE Bright speed Elite, 16 slice CT scanner (GE Healthcare, Milwaukee, WI, USA).

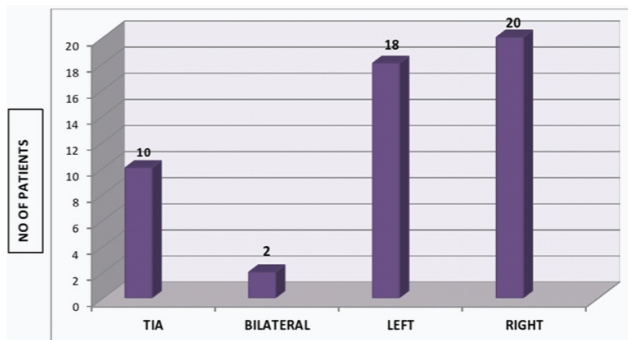
Method of Collection of Data: The proforma was designed based on the study objective and it was modified and used for presentation.

STATISTICAL ANALYSIS

The data collected was analyzed using SPSS 15 for windows and findings were discussed. Tests of significance were not applied as this study deals with only frequency distribution of various factors.

RESULTS

Out of 50 patients presented with cerebral ischemic stroke 36(72.0%) were males and 14(28.0%) were females. The highest incidence of cerebral ischemic stroke was found in males between 60 to 69 Years. In our study we found 72% prevalence of high CIMT (> 0.8mm) in patients with ischemic stroke. Among these 26 were males and 8 were females. Hypertension was found to be the most common risk factor compressing of 17(81%) patients followed by diabetes 5(71.4%) patients and smoking 14(63.3%) patients [Table/Fig-2-4].



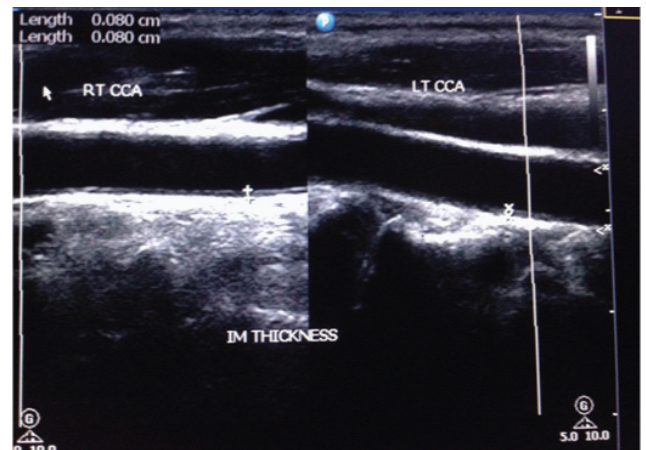
[Table/Fig-2]: Side of the stroke [15].

CT Findings	No. of patients
Normal study	13 (26%)
Lacunar infarcts	13 (26%)
Left MCA infarct	6 (12%)
Right ACA infarct	5 (10%)
Right cerebellar infarct	1 (2%)
Left ACA infarct	1 (2%)
Right MCA infarct	11 (22%)
Total	50 (100%)

[Table/Fig-3]: CT findings in cerebral ischemic stroke.

CIMT	Gender		HTN	Smoking	Diabetes	Total
	Male	Female				
Normal N= 14	10	6	4 (19%)	8 (36.3%)	2 (28.5%)	14 (28%)
High N = 36	26	8	17 (81%)	14 (63.3%)	5 (71.4%)	36 (72%)
Total	36 (72%)	14 (28%)	21 (42%)	22 (44%)	7 (14%)	50 (100%)

[Table/Fig-4]: Showing distribution of carotid intima media thickness (cimt) and relation with other parameters.



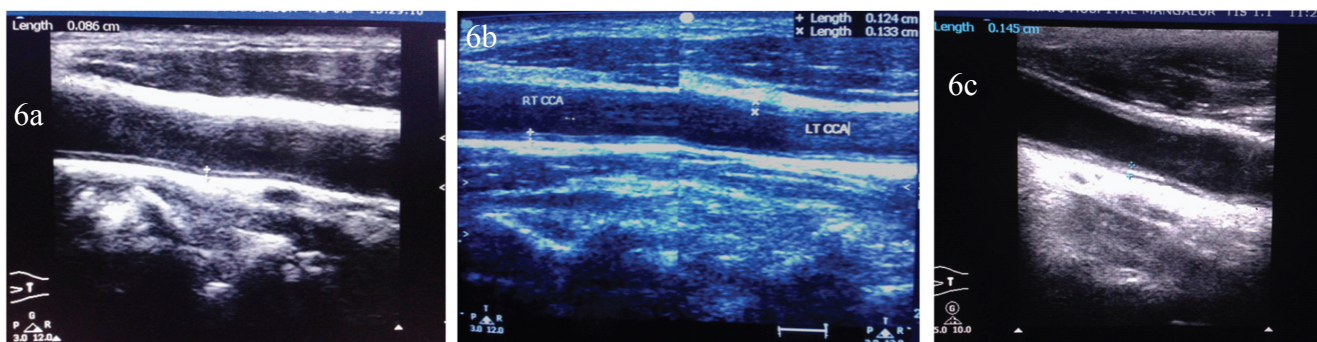
[Table/Fig-5]: A 45 years old male patient with history of transient ischemic attack. Patient had normal CT brain study and IMT within normal limits (<0.08mm).

DISCUSSION

Cerebral ischemic stroke is the third leading cause of death after heart disease and cancer in the developed countries. Atherosclerotic disease involving the extracranial carotid arteries is usually seen within 2 cms of CCA bifurcation [15]. Angiography is the gold standard but is invasive and expensive and involves significant risk to the patients. Sonography is unique among vascular imaging procedures in that it can assess plaque composition. Ultrasonographic evaluation of carotid arteries may be useful for selection of medical and surgical therapy, thus having a prognostic value [16].

CT-scan was done in all these patients. 6 had left MCA territory infarct, 11 patients had right MCA territory infarct. Lacunar infarcts were seen in 13 patients. 5 patients had right ACA territory infarct, one patient had left ACA infarct, one patient had right cerebellar infarct. Normal findings were seen in 13 patients.

Risk factors: Carlene Lawes et al., studied 188000 patients with hypertension out of which 6800 had stroke events [17]. In this study 19(38%) patients were hypertensive. Ladecola et al., had proved that control of blood pressure leads to a substantially lower risk of stroke [13]. Toshifumi Mannami et al., confirmed a positive relationship between smoking and risk of stroke. They estimated that 22% of stroke was attributable to smoking [14]. In our study 20(40%) patients were smokers, out of which significant stenosis was seen in 6(30%). Diabetes mellitus is another risk factor causing atherosclerosis. Lindberg Pertu and Roine Risto in their study had observed that two thirds of all ischemic stroke types on admission had diabetes mellitus [18]. Out of 8(16%) patients who had diabetes mellitus, 3(37%) patients had significant stenosis. Schulz et al., studied the family history of stroke



[Table/Fig-6a-c]: Carotid Doppler studies increased IMT : (A) A 38 years old chronic smoker presented with left hemiparesis. (B) 62 year old female presented with right hemiparesis having history of diabetes mellitus. (C) 50 year old male presented with Left MCA territory infarct showing increased IMT in right CCA.

and found that 23% of stroke patients had a positive family history [19].

The risk factors for cervical atherosclerosis in patients with ischemic stroke and TIA were noted and it was found that patients were above 60 years of age [14]. Increased incidence of stroke patients in our study were found in the age group of 60-69 years which was 32% (16/50) followed by 26% of patients (13/50) in the age group between 70-79 years. Lemolo F et al., showed that only 2.5% of stroke patients were females [20]. In this study, 72% of the patients (36/50) were males and only 28% were females (14/50). In this study family history of stroke was seen in 7 (14%) patients, out of which 3 (42%) had significant stenosis.

A study conducted by Avishek S, et al., [21] showed 71% prevalence of high carotid intima media thickness (CIMT) in patients with cerebral ischemic stroke. In our study we came across 36 (72%) patients with high carotid intima media thickness (>0.8mm) out of which 26 (72.2%) were males and 8 (57.1%) were females. Hypertension was the most common risk factor and was seen in 17 (81%) patients followed by diabetes in 5 (71.4%) patients and smoking in 14 (63.3%) patients.

The present study is a part of already published article by same authors. This study was also performed to evaluate the extracranial carotid arterial system. In this study only CIMT measurements were included in those who presented with cerebral ischemic stroke. The values were correlated with cerebral ischemic stroke with CIMT status [15] [Table/ Fig-5,6a-c].

CONCLUSION

The present clinical study was undertaken to assess the role of CIMT in cerebral ischemic stroke. This study concludes that highest incidence of cerebral ischemic stroke was in the 60-69 years age group consisting of 16 (32%) patients. Cigarette smoking was the most common risk factor associated with stroke/TIA. The prevalence of high carotid

intima media thickness in patients with cerebral ischemic stroke is 72%. Hemiparesis (64%) was the most common presenting symptom followed by TIA (20%) and hemiplegia (8%). From the results observed and discussions outlined in this study, the following broad conclusions can be derived. Measuring the CIMT by sonography in a stroke patients is a non-invasive, economic, safe, reproducible and less time consuming method of demonstrating the cause of cerebral ischemic stroke in the extra cranial carotid artery system. In view of these findings, based on the accuracy of sonography in detecting significant CIMT, IMT of carotid arteries is recommended in patients with cerebral ischemic stroke. In addition carotid sonography can also be used to assess the prognosis in both symptomatic and asymptomatic patients presenting with any of the risk factors for cerebral ischemic stroke.

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