

ORIGINAL ARTICLE

ASSOCIATION OF CAROTID ARTERY INTIMA MEDIA THICKNESS WITH ISCHEMIC STROKE PATIENTS

MD. JASIM UDDIN¹, AMINUR RAHMAN², MD. RAFIQUUL ISLAM³, MD. SHAHIDULLAH SABUJ⁴,
ABDULLAH AL MAMUN⁵, NILOY RANJAN ROY⁶

Abstract

Background: Atherosclerotic risk factors frequently lead to ischemic stroke. The thickness of the carotid intima-media thickness (CIMT) is a significant indicator for early atherosclerosis alterations. The aim of the study is to evaluate the association between ischemic stroke patients and CIMT.

Methods: A total of 50 patients were recruited in this cross-sectional descriptive study which was carried out in the Department of Neurology, BSMMU, from January 2015 to June 2016. All patients of ischemic stroke were confirmed by history, examination and CT scan of head/MRI of brain. Carotid ultrasound scan was done to detect intima-media thickness (IMT) of both sided carotid bifurcation, common carotid and internal carotid artery and performed by a single sonographer at the Department of Neurology, BSMMU. **Results:** This population has a total of 27 male and 23 female with mean age 60.7± 13.6 years. Maximum patients (72%) were found to be above 50 year of age. After risk factor stratification among the study population, HTN, dyslipidemia was the most followed by positive family history, smoker, DM, IHD. Among study population 45 cases were anterior circulation stroke and only 5 cases were posterior circulation stroke. Maximum mean IMT=1.2± 0.3, minimum mean IMT=1.0±0.10 mm and least IMT was 0.7mm. (Normal CIMT value is < 0.8mm). The mean IMT was higher at symptomatic side in comparison to the asymptomatic side. Higher IMT was found mostly at the carotid bifurcation and higher IMT at one site was significantly correlated with other sites ($r= +0.435, p=0.002$), there was also correlation between IMT and risk factor ($r=+0.265, p=0.063$). Increased IMT was more marked in patients with risk factors in comparison to without risk factor, like smoker & nonsmoker but not statistically significant (ORR=2.00, 95% CI 0.636-6.286, $p=0.233$). **Conclusion:** The present Study found that extra-cranial carotid artery intima media thickness (IMT) was higher than normal level in ischemic stroke patients. Higher CIMT was found at symptomatic side in comparison to the asymptomatic side.

Key words: Ischemic stroke, Carotid artery intima media thickness.

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Introduction:

Stroke is a focal central neurological deficit of vascular cause. Up to half of all the strokes and TIA are due to embolism from an atheromatous plaque at the origin of internal carotid artery¹.

Atherosclerosis is a diffuse generalized inflammatory process mainly affecting the medium and large sized arteries like carotid, coronary, renal & femoral arteries. Intima media thickness of carotid artery-CIMT correlates well the degree of atherosclerosis.

1. Assistant Professor, Dept of Neurology, Sylhet MAG Osmani Medical College, Sylhet, Bangladesh
2. Assistant Professor, Dept of Neurology, Sir Salimullah Medical College, Mitford, Dhaka, Bangladesh
3. Professor, Dept of Neurology, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
4. Associate Professor, Dept of Neurology, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
5. Emergency Medical officer, National Institute of Neuroscience Hospital, Dhaka, Bangladesh
6. Consultant Neurology, Kormitola General Hospital, Dhaka, Bangladesh

Address of Correspondence: Dr. Md. Jasim Uddin Assistant Professor, Dept of Neurology, Sylhet MAG Osmani Medical College, Sylhet, Bangladesh. E-mail: jasim27ssmc@gmail.com

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It is thought to be an indicator of atherosclerosis. There are various methods for determining the degree of atherosclerosis but high resolution B-mode ultrasonography has emerged to be the most convenient tool. The procedure is widely accepted, non-invasive, safe, no long term or short term harm to the patients².

Atherosclerosis in major intracranial arteries leads to changes ranging from minor wall thickening to hemodynamically significant luminal stenosis and is one of the most common causes of stroke worldwide³. The CIMT is a marker generalized atherosclerosis, and provides a noninvasive method for the risk assessment of stroke⁴. In the ARIC study (The atherosclerosis risk in community) - increased CIMT may be used as a predictive tool for predicting the future ischemic stroke and as a monitoring tool in lipid lowering medication^{5, 6}.

The aim of this study was to assess the relationship between carotid IMT and ischemic stroke patients who was already diagnosed by history, examination and investigation.

Methods:

This cross-sectional descriptive study was carried out in total of 50 patients in the Department of Neurology, BSMMU, from January 2015 to June 2016. Ischaemic Stroke was diagnosed on basis of clinical findings and subsequent CT scan or MRI findings were taken as study population. Patients with prior carotid endarterectomy or angioplasty or stenting, and hemorrhagic stroke, with ischemic stroke due to non-atherogenic causes such as collagen diseases- Systemic lupus erythematosus (SLE), *Rheumatoid arthritis (RA)*, vasculitis, antiphospholipid antibody syndrome, syphilitic arteritis, endocarditis or valvular heart disease were excluded.

Written consent was taken from all the patients after informing the necessary information regarding the research study. Ultrasound scans of the right and left last distal centimeter of common carotid artery and bifurcation and of first proximal centimeter of internal carotid artery were examined⁷. CIMT measurement was done by 7.5 MHz annular array system by using B-mode imaging of carotid duplex ultrasonography by a single sonographer. Detailed history taking, clinical examination, routine blood chemistry, ECG, carotid Doppler and CT/MRI of brain were undertaken for patients. Then data were collected in a pre-designed structured data collection sheets from primary source starting from the clinical history to laboratory investigations.

All collected data were checked and edited & expressed as Mean +/- SD. After that, data processing and statistical analysis were done by using SPSS (statistical package for social sciences) version 22 software program. Qualitative data were analyzed by

Chi-square test & quantitative data were analyzed by z- test. Values were considered significant if p<0.05 (95% CI- confidence interval). In the study group, the correlation among CIMT level, age of the patient & HbA1c level etc were made by the Pearson’s correlation coefficient test in sub-group analysis. Odds ratio was made to measure risk assessment of ischemic stroke among sub-group like- smoker/ nonsmoker etc.

Operational definition:

Ischemic stroke: An ischemic stroke occurs when blood clots or other particles block the blood vessels to the brain. Fatty deposits called plaque can cause blockages by building up in the blood vessels⁸.

CIMT (Carotid intima media thickness):The thickness of tunica media and intima. Normal CIMT is less than 0.8mm & >0.9mm is significant and almost certainly is indicative of atherosclerosis⁹.

B-mode imaging: Brightness mode imaging of duplex ultrasonogram is used to detect anatomical status of arterial wall whereas the Doppler mode is used to detect hemodynamic status in lumen of artery such as flow velocity and direction of flow. (Duplex= B-mode+ Doppler mode)⁹.

Plaque: The fibro-atheromatic lesion composed of lipid deposits, collagen matrix and smooth muscle cells. CIMT 1.1mm or more is called plaque. Several characteristics of plaques are minimal (1.1-2mm), moderate (2.1-4.0mm), severe (>4.0mm) and surface, echogenicity, texture⁹.

Results:

A total of 50 subjects of ischemic stroke were included in this study. Their mean age was 60.7±13.6 years (SD) and range was 24 to 95 years. Males (54%) were sufferer than females (46%). The findings are shown in Fig. 1 & Fig. 2.

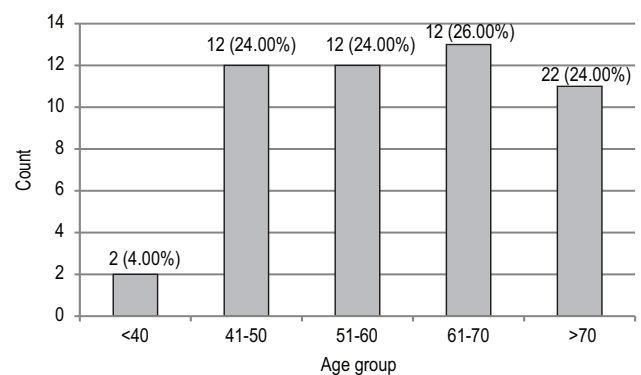


Fig. 1: Bar diagram showing the age distribution of the study subjects

Fig.1 was showing that more than half (74%= 24+24+26) of the study population was within 4th to 7th decade.

Fig.2 was showing, 54% were male and 46% were female.

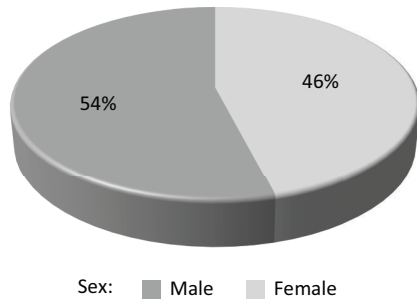


Fig. 2: Pie diagram showing the sex distribution of the study subjects

Table-I
Showing frequency & percentage of comorbidities among patients

Comorbidities	Frequency	Percentage (%)
Family history of stroke	25	50.0
DM	23	46.0
HTN	30	60.0
Smoker	24	48.0
Dyslipidemia	30	60.0
IHD	13	26.0

Table: 1 was showing, 60% of ischemic stroke patients were having hypertension & dyslipidemia and this was followed by positive family history, smoking, diabetes & Ischemic heart disease (IHD).

Table-II
Values of maximum mean IMT in various sites (n=50)

Parameters	Mean±SD	No of Plaque	Mini plaque (1.1-2.0 mm)
Maximum mean IMT (mm)	1.20±0.31		
Rt. CCA	1.00±0.08	16	16
Lt. CCA	1.02±0.10	18	18
Rt. Bifurcation	1.12±0.22	28	27
Lt. Bifurcation	1.14±0.25	28	27
Lt. ICA	1.18±1.13	16	16
Rt. ICA	1.00±0.10	14	14

Table: II was showing that higher IMT & more number of plaques (28+28) were found at both carotid Bifurcation, internal carotid artery (ICA).

Table-III
Distribution of the study patients by plaque (n=50)

Plaque (>1.0mm)	Frequency	Percentage (%)
Present	40	80.0%
Mini plaque (1.1-2.0mm)	38	
Moderate plaque (2.1-4)	2	
Absent	10	20.0
Total	50	100.0

Table: III was showing, among 50 cases, 40 cases were having plaque (38 minimal plaque and only 2 having moderate plaque) and 10 cases have no plaque that means their maximum IMT was less than 1.1mm to 0.7mm. (IMT was detected at common carotid artery (CCA), bifurcation (BIF), ICA of both right side and left side.). Here plaque was defined as >1.1 mm thickness of IMT.

Table-IV
Distribution of plaque at the various sites of carotid arteries.

Site of plaque	Frequency	Percentage (%)
Bifurcation	35	87.5
Both sides	21	
Unilateral	14	
CCA	25	62.5
Both site	9	
Unilateral	16	
ICA	20	50.0
Both site	10	
Unilateral	10	

CCA=Common carotid artery, ICA= Internal carotid artery

Table: IV was showing plaques are found in the various sites of carotid arteries of both sides and same side, indicating systemic nature of atherosclerosis. Number of plaque was mostly found in the Bifurcation followed by CCA & ICA.

Table-V
Relationship of carotid-IMT among stroke sub-types (n=50)

Type of stroke	n	Maximum mean IMT (mm)		Plaque	p value
		Mean±SD	Range		
PACS	31(62.0%)	1.20±0.26	1.00 – 2.10	24	0.93 ^{ns}
TACS	7(14.0%)	1.16±0.62	.00 – 2.10	6	
LACS	7(14.0%)	1.20±0.16	1.00 – 1.40	6	
POCS	5(10.0%)	1.28±0.23	1.00 – 1.60	4	

As comparative analysis was done in more than two groups, p value measured by ANOVA test. ns = not significant.

Table: 5 was showing, anterior circulation stroke was 90% (45) and posterior circulation stroke was 10%(5). Maximum mean IMT was higher the entire sub groups which is not statistically significant (p>0.05) and number of plaques mostly found in the patients with posterior circulation stroke (PACS). PACS= partial anterior circulation stroke, TACS= total anterior circulation stroke, LACS= lacunar stroke, POCS= Posterior circulation stroke.

This study found that vascular risk factors like age, DM, systolic pressure were positively correlated with higher IMT levels and HDL level is negatively correlated. There were also positive correlations among IMT levels of various sites in the same side as well as both sides. Among the different sites in the carotid bed, the highest associations observed between the ipsilateral and contralateral CCA & BIF & BIF & BIF.

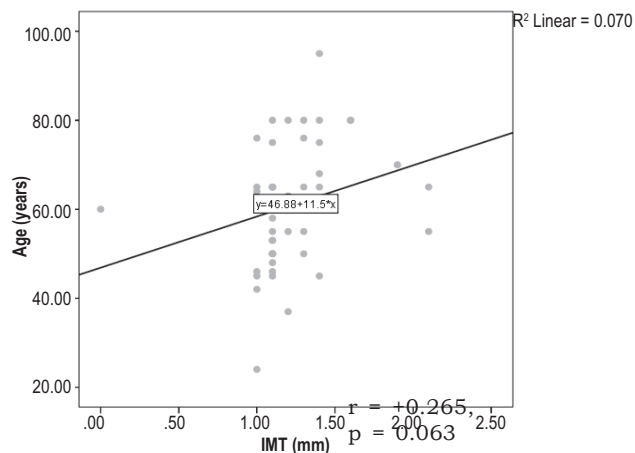


Fig.-3: Scatter diagram showing correlation between age and IMT.

Pearson Correlation test were done, as both IMT and age are quantitative variables.

Fig.3 was showing positive correlation between CIMT and age among study subjects, though which is not statistically significant. (r=+0.265, p>0.05)

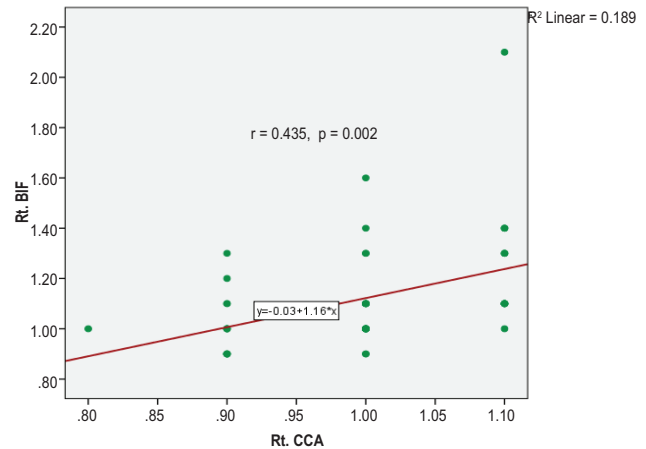


Fig.-4: Scatter diagram showing the correlation between Rt. BIF and Rt. CCA

Pearson Correlation test were done

Fig. 4: was showing the positive correlation between Rt. BIF and Rt. CCA among study subjects which was statistically significant (P=0.002)

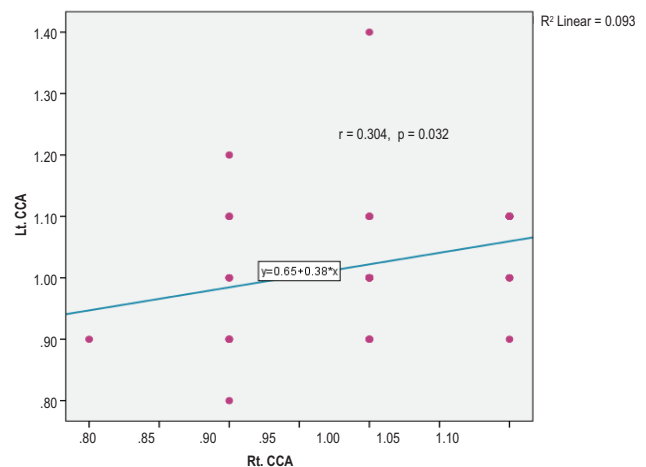


Fig. 5: Scatter diagram showing the positive correlation between Lt. BIF and Lt. CCA.

Pearson Correlation test were done

Fig. 5 was showing the positive correlation between Lt. BIF and Lt. CCA among study subjects which was statistically significant. (p=0.032)

Discussion:

In this study it was found that the mean age of ischemic stroke patients was 60.7±13.6 year. Most of the cases belonged to 5th to 7th decade. Minimum age was 24 and maximum 95 years. This study showed that male patient were 54% and female were 46%. Stroke is a male predominant disease as shown in different studies¹⁰.

The study showed that, out of all patients, 48% were smoker, 52% were nonsmoker, a case control study¹⁰ In our study found that 55% of ischemic stroke patients were smoker but in control group only 33% were smoker and 46% were diabetic and 60% were hypertensive. In the previous analysis of risk factors of hypertension¹¹ was reported in 52.11% and 60% of patients were dyslipidemic and showed that total cholesterol, LDL, HDL, TG were 201.4±31.22, 154.2±32, 36.1±7.51, 260±39.73 (mg/dl) respectively. In a past study found that total cholesterol, LDL, HDL, TG were 201.4±31.22, 114.2±36.1±7.51, 219.2±39.73 (mg/dl) respectively. Family history of stroke was 50% of study population. In similar studies showed that the patient with ischemic stroke had a family history of ischemic stroke was 23%, and 20.4% respectively^{12,13}.

Total 13 (26%) cases of ischemic stroke out of 50 subjects had ischemic heart disease (IHD) in this study. In a past study showed that 10% of patients had ischemic stroke with coronary events^{14, 15}. In this study, among 50 cases, 38 cases had minimal plaque & 2 cases had moderate plaque and the remaining 10 cases having no plaque that means, their IMT were below 1.1mm. In a previous study study found IMT was increased in 85% cases and 15% had normal IMT that is below 0.8mm¹⁵. Carotid ultrasound was done in all 3 segments of both sided carotid arteries and found increased IMT in ipsilateral and contralateral segments indicating that atherosclerosis is wide spread or systemic in nature.

In a past study showed IMT of CCA (common carotid artery) associated with IMT of ICA (internal carotid artery). They found that among the different sites in the carotid bed, the highest association was observed between contralateral CCA sites and between the adjacent ipsilateral bifurcation and ICA sites¹¹. They also provide population based in vivo evidence that with increasing IMT at one site in the carotid bed there is an increase in the average (mean or median) IMT at other sites, supporting the systemic nature of atherosclerosis. In our study, we also found increased IMT at ipsilateral site in the carotid bed in comparison to contralateral site. Increased left bifurcation IMT was positively correlated with IMT of left common carotid artery. ($r=+0.374$, $p=0.007$).

Plaques (> 1.1mm IMT) were found in 80% of the study population at various sites of carotid arteries, mostly found in the bifurcations of carotid artery in both sides. In a past study found that mostly in the right ICA (33%), right bifurcation (18%), right CCA (15%)¹⁶. Another study suggest that presence of plaque but not IMT, is associated with high risk of disease¹¹.

In the present study showed that 31 cases (62%) had PACS, 7 (14%) TACS, 7 (14%) LACS, 5 (10%) POCS, which was consistent with a similar study found PACS 40%, LACS 28.75%, TACS 15% and POCS 10%¹⁶. On multivariate analysis by using ANOVA test, mean IMT more markedly found in the LACS, PACS AND POCS category which was not statistically significant ($P > 0.05$), but a previous study found that mean IMT was more in POCS and TACS category⁶. Plaque was associated with TACS category ($P 0.000$) and in our study more plaque (24 out of 42) was associated with PACS category ($P > 0.05$).

On Pearson correlation tests we found positive relationship between Age & CIMT and among different sites of carotid beds. The previous study found that positive association of CIMT with Systolic blood pressure (SBP), HDL cholesterol¹⁷. A recent study showed age was significantly correlated with carotid atherosclerosis in all groups whereas LDL, TG, Smoking were also significantly correlated with carotid atherosclerosis ($P=0.000$, 0.001 , 0.007 respectively). Among different sites of carotid beds, the highest correlation observed between the ipsilateral and contralateral CCA & BIF, BIF & BIF, indicating systemic nature of atherosclerosis and if IMT of one site is increased, it was associated with increased IMT of other sites or sides which was all most similar with the previous study¹¹. On qualitative data analysis, it was found that patients with risk factors were more risky in developing increased IMT (>1.1mm) than patients without risk factors. In between diabetic and non-diabetic, the OR was 2.00 ($p>0.05$, 95% CI was 0.636-6.286).

Of all risk factors investigated here like age, hypertension, diabetes, dyslipidemia, smoking, positive family history, male sex, ischemic heart diseases were associated with increased CIMT. Increased CIMT was associated with ischemic stroke patients.

Conclusion:

The mean IMT was higher in all most every ischemic stroke patients. Therefore, increased IMT or presence of plaque on carotid duplex ultrasound may be a predictor of ischaemic stroke. CIMT and Carotid Duplex can be used as noninvasive predictive tool

and predictive test for predicting stroke and thus way it will be helpful in primary prevention of stroke.

Limitation of the study:

Although sample size was calculated statistically, this was small in relation to the huge number of population of our country. It was a single-center study done in tertiary care hospital. Since our study was not a prospective case-control study, we could not calculate the hazard ratios for CIMT values.

Conflict of Interest:

The author stated that there is no conflict of interest in this study

Funding:

No specific funding was received for this study.

Ethical consideration:

The study was conducted after approval from the ethical review committee. The confidentiality and anonymity of the study participants were maintained

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