Study Of Correlation Between Carotid Intima –Media Thickness And Dyslipidemia In Otherwise Asymptomatic Individuals

Dr.Sudipta Saha ,Dr.Krishnendu Sarkar ,Dr.Kosturi Dakshit ,Dr.Nupur Basu ,Dr.Debashis Dakshit ,Dr.Ruchi Bansal ,Dr.Mayukh Saha

1,4(Associate Professor,Department Of Radiodiagnosis,Medical College And Hospital,Kolkata,West Bengal)
2,6(Assistant Professor,Department Of Radiodiagnosis,Medical College And Hospital,Kolkata,West Bengal)
3(Senior Resident ,Department Of Community Medicine,Lokmanya Tilak Municipal Medical College & General Hospital,Mumbai,Maharastra)
5(Professor & Hod,Department Of Radiodiagnosis,Medical College And Hospital ,Kolkata,West Bengal)
7(Junior Resident,Department Of Radiodiagnosis,Medical College And Hospital ,Kolkata,West Bengal)
Corresponding Author:Dr.Mayukh Saha Junior Resident,Department Of Radiodiagnosis,Medical College And Hospital,Kolkata,West Bengal)

Abstract
Background
Non communicable disease is a major concern worldwide in current scenario and for upcoming days. They include Ischemic stroke, Myocardial Infraction etc. Atherosclerosis is the major underlying factor which causes luminal narrowing, stenosis and reduced perfusion in subsequent episodes. Combined carotid intima –media thickness(CIMT) is a marker of atherosclerosis. Increased intima-media thickness is a non-invasive marker of arterial wall alteration, which can easily be assessed in carotid arteries by high resolution B-mode ultrasound study.
Objectives
The objective was to know the association between carotid intima medial thickness (CIMT) and dyslipidemia.
Materials and methods
This study was conducted between March 2023 and March 2024 at Department of Radiodiagnosis in collaboration with Department of Medicine at Medical college and Hospital, Kolkata. Total 100 patients were selected randomly who met the inclusion criteria. Among total patients, 48 were males and 52 were females. Carotid artery ultrasound assessment was performed by B-mode ultrasound with linear probe GE LOGIQ P9 with the patient lying in supine position and the carotid arteries (CCA, ICA) in the longitudinal and transverse planes on both sides were carefully scanned. The blood parameters such as LDL, HDL, total cholesterol, triglyceride and VLDL were estimated by using laboratory technique. Data was collected using a predetermined proforma and statistical analyses were done.
Results
Our study suggests that both common carotid artery IMT and internal carotid artery IMT was increased in a step wise fashion with raising tertiles of LDL (P<0.01) and total cholesterol (P<0.01). There was decreasing trend in both CCA-IMT and ICA IMT with increasing tertiles of HDL (P<0.01). No direct correlation was found between CCA-IMT and ICA-IMT with either VLDL or TG. Our study showed that cholesterol, LDL, Cholesterol, LDL/HDL ratio have positive association with CIMT.
Conclusion
We concluded that CIMT and lipid profile both can be useful screening test for the person who are at highest risk to get stroke, hypertension, and obesity. CIMT is an objective measure of subclinical atherosclerosis, which is a non-invasive, less expensive   and less time taking   and easy reproducible way of demonstrating subclinical atherosclerosis. Thus, it can serve as a window for atherosclerosis status in other major arteries like coronary artery and cerebral arteries and by this simple non invasive screening we can prevent major health emergency like CVA or CVD by using prophylactic lipid lowering agents (eg. Statin group of medicine).
Keywords: *Atherosclerosis, Hypertension ,Lipid profile, Age, Carotid-intima media thickness.*

I. Introduction

Dyslipidemias are among the major modifiable risk factors for development of atherosclerosis. The carotid intima-media thickness (CIMT) creates prognostic information for future cardio-vascular disease (CVD) and an abnormally increased CIMT as an early indicator of atherosclerosis. Common dyslipidemias are combined hyperlipidemia, simple hypercholesterolemia, metabolic Syndrome (Syndrome X), isolated low high-density lipoproten cholesterol, and isolated hypertriglyceridemia(2,3,4). The dyslipidemia also leads to atherosclerosis due to abnormal lipid level in blood. The patients suffering from sequel of atherosclerosis such as coronary artery disease, myocardial infarction, cerebro-vascular disease meet the clinician at a time when the only treatment option is to minimize the debility already incurred. Moreover, atherosclerosis is responsible for several clinical syndromes that collectively account for large number of morbidity and mortality(7,8). Presently, the challenge is to identify the process of atherosclerosis before patient's symptom arises, which can provide us with an opportunity to halt the process of atheroma development and subsequent development of plaque vulnerability. To assess the subclinical atherosclerosis various options are available as per researcher. The carotid intima medial thickness was estimated earlier by Pignoli et al., in which it is measured as the distance from leading edge of first echogenic line to leading edge of second echogenic line in B-mode carotid ultrasonography. The first line represents the lumen intimal interphase the collagen containing upper layer of tunica adventitia forms the second line. Extra cranial carotid arteries are superficial, easily accessible and any early change in tunica intima-media of carotid arteries can be easily detected by ultrasonography scanning. It is relatively less expensive, on invasive, less time consuming and reproducible. CIMT has been used as a subclinical index of atherosclerosis. Few studies have shown an association between CIMT and dyslipidemia, which lead to myocardial infarction or stroke in elderly or middle-aged subject and the study is lacking in West Bengal, India. The study of association between CIMT and dyslipidemia in subjects is of a research interest because the prevalence and incidence of atherosclerotic vascular disease in Indian population is much higher than western population. Moreover, the measurement of CIMT is serving as a predictor of coronary heart disease which has association with dyslipidemia(1,5,6).

II. Material And Methods

This study was conducted between March 2023 and March 2024 at Department of Radiodiagnosis in collaboration with Department of Medicine at Medical college and Hospital, Kolkata. Total 100 patients were studied those who are having dyslipidemia.The age group was between 4th -7th decade.

Study design: case control study.

Study duration: march 2023 to march 2024

Study location : department of radiodiagnosis in association with department of medicine at medical college and hospital ,kolkata.

Sample size: 100 patients

Sample size calculation: The sample size was estimated on the basis of a single proportion design.

Ethical clearence: This study has the approval of the institute Ethical committee of Medical College &Hospital, Kolkata.

Inclusion criteria:
☐ Age 40-70.
☐ Both the sexes.
☐ Dyslipidemia after the age of 40 as per important criteria.
☐ Not on any lipid lowering agent.
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Exclusion criteria:
☐ Hemorrhagic stroke
☐ Neurological deficit secondary to epilepsy.
☐ Patient with past history of connective tissue disorder/vacuities.
☐ Head injury
☐ Intracranial neoplasm
☐ Aneurysm
☐ A-V malformations

 H/O intake of any lipid lowering agents.

Procedure Methodology

History and general physical examination. Patients were asked about the presence of dyslipidemia, whether the individual is on any type of lipid lowering medication, whether the individual is having any familial disorder ,whether the individual has any major illness history etc.

CAROTID ARTERY ULTRASOUND: Carotid artery Doppler study was performed using high resolution B Mode 7.5-10 MHz linear transducers with patients in supine position.CIMT is anechoic zone between two echogenic lines, first echo is lumen-intima surface, second echo is caused by media-adventia interface.CIMT is measured at 3 levels in both the carotid arteries and in areas free of plaque-

- Common carotid artery
- Bifurcation of common carotid artery
- Internal carotid artery

Highest value in each carotid is taken and average of 2 measures is taken as CIMT.

Assessment of dyslipidemia: Fasting blood was obtained for serum total cholesterol and HDL cholesterol. Serum triglyceride and very low-density lipoprotein (VLDL) was estimated by standardized laboratory techniques. LDL cholesterol was estimated by using the formula of Friedewald et al.

Statistical analysis

Data were compiled in MS excel worksheet and analysis done in SSPS VERSION 20 statistical software (for windows).Results was statistically analyzed using following statistical tests:

- Chi-square test
- Multiple regression analysis

-Mean and standard deviation were calculated from the results of individual parameters.
-P value of <0.05 was considered to be significant and P <0.001 as highly significant. The results were calculated within 95% confidence limits.

III.   Result

Among 100 subjects, mean age of the study population was 50.39 ± 2.364 years. Among 100 patients, 48 were males and 52 were females.

Study of LDL level and CIMT: The mean LDL-C was 178.98 ± 43.795 mg/dl. In the participants of the study, LDL was measured, and the values were divided in three tertiles (Table 1). In the first tertile, (37-123 mg/dl) there were total 20 subjects 8 were males and 12 were females. The common carotid artery IMT (CCA-IMT) in this group was 0.778mm. The internal carotid artery IMT (ICA-IMT) was 0.773 mm. In the second tertile (124-154 mg/dl), which included 34 subjects having LDL level between 124 and 154 mg/dl, among them 18 were males and 16 were females. The mean CCA-IMT was 1.386 mm and mean ICA-IMT was 1.418mm. The third tertile (155-299 mg/dl) contained 46 individuals who had LDL levels between 155 to 299 mg/dl. Among them 22 were males and 24 were females. The CCA-IMT was 1.898 mm and ICA IMT was 1.923mm.

There was increasing trend in both CCA-IMT and ICA-IMT through a stepwise fashion across increasing tertiles of LDL (Fig 1). The association between LDL-C and CCA IMT and ICA IMT is statically significant (P<0.01).

Study of HDL level and CIMT: The mean HDL value was 39.65 ± 16.810 mg/dl. In the participant of the study HDL was measured and the values were divided in three tertiles in accordance with insulin resistance atherosclerosis study (IRAS) (Table 2). In the first tertile (11-37 mg/dl), there were 30 subjects among them 12 were male and 18 were female. Then mean CCA-IMT in this group was 1.975mm and mean ICA-IMT was 2.002 mm. In the second tertile (38-48 mg/dl), there were 46 subjects among them 22 were male and 24 were female. The mean CCA-IMT in this group was 1.575 mm and ICA-IMT was 1.571 mm. In the third tertile (49-125 mg/dl), there were 24 subjects among them 14 were male and 10 were female. The mean CCA-IMT and ICA-IMT is this group were 0.934 mm and 0.876 mm respectively. There was a decreasing trend in both CCA-IMT and ICA-IMT in a stepwise fashion across increasing tertile of HDL (Fig 2). A strong negative correlation between HDL-C and CIMT with a significant level at P<0.01.

Study of total cholesterol level and CIMT: The mean total cholesterol (TC) level was 240 ± 42.812 mg/dl. In the study total cholesterol was divided in three tertiles (Table 3). In the first tertile (<200 mg/dl), there were 24 subjects among them 6 were males and 16 were females. The mean CCA-IMT and ICA-IMT in this group was 0.925 and 1.067 mm respectively. In the second tertile (200-239 mg/dl), there were 36 subjects among them 20 were males and 16 were females. The mean CCA-IMT and ICA-IMT in this group was 1.438mm and 1.493 mm respectively. In the third tertile (240 mg/dl), there were 40 subjects

20 among them were males and rest 20 were females. The mean CCA-IMT and ICA-IMT in this group were 1.727 mm and 1.721 mm respectively. There was an increasing trend in both CCA-IMT and ICA-IMT in a stepwise fashion across increasing tertiles of total cholesterol (Fig 3).The TC was significantly (P<0.01) associated with CIMT thickening.

Study of triglyceride level and CIMT: In the present study triglyceride (TG) level was divided in three tertiles(Table 4). In the first tertile (23-94 mg/dl), there were 10 subjects, 4 among them were males and 6 were females. The mean CCA IMT and ICA IMT in these groups were 0.787mm, and 0.776 mm. In the second tertile (95-154 mg/dl), there were total 33 subjects and 18 among them were males and 6 were females. Mean CCA IMT and ICA IMT in these groups were 1.807 and 1.652 mm respectively. In the third tertile (155-1023 mg/dl), there were 57 subjects among them 26 were males and 31 were females. The mean CCA IMT and ICA IMT in these groups were 1.045 and 1.033 mm. There was no stepwise increase in CCA IMT or ICA IMT across the TG tertiles. The CCA IMT in top tertile is 0.752 mm thinner than the second tertile. The ICA IMT in the top tertile is 0.619 mm thinner than the second tertile. No statistically significant correlation between TG and CIMT was established (P=0.49).

Study of VLDL level and CIMT: In the study, VLDL was divided in three tertiles (Table 5).In the first tertile (1-13 mg/dl), there were 20 subjects among them 8 were males and 12 were females. The mean CCA IMT and ICAIMT in these groups were 1.090 mm and 0.969 mm respectively. In the second tertile (14-26 mg/dl), these were 32 subjects among them 18 were males and 14 were females. The mean CCA IMT and ICA IMT were 1.733 mm and 1.894mm respectively. In the third tertile (27-200 mg/dl), there were 48 subjects among them 20 were males and 28 were females the mean CCA IMT and ICA IMT in this group were 1.420 mm and 1.340 mm. There is no stepwise gradual relationship between increasing VLDL and CCA IMT or ICA IMT. The CCA IMT in the top tertile is 0.313 mm thinner than the second tertile. The ICA-IMT is the top tertile is 0.554 mm thinner than the second tertile. No statistically significant correlation between VLDL and CIMT was found (P = 0.49).

Table 1: Association between LDL and CIMT

LDL (mg/dl)	Number	Males	Females	CCA-IMT (mm)	ICA-IMT (mm)	P value
37-123	20	8	12	0.778	0.773	<0.01
124- 154	34	18	16	1.386	1.418	<0.01
155-259	46	22	24	1.894	1.923	<0.01

Table 2: Association between HDL and CIMT

HDL (mg/dl)	Number	Males	Females	CCA-IMT (mm)	ICA-IMT (mm)	P value
11-37	30	12	18	1.975	2.002	<0.01
38-48	46	22	24	1.575	1.571	<0.01
49-125	24	14	10	0.934	0.876	<0.01

Table 3: Association between TC and CIMT

TC(mg/dl)	Number	Males	Females	CCA-IMT (mm)	ICA-IMT (mm)	P value
<200	24	8	16	0.925	1.067	<0.01
200-239	36	20	16	1.438	1.493	<0.01
>240	40	20	20	1.727	1.721	<0.01

Table 4: Association between TG and CIMT

TG(mg/dl)	Number	Males	Females	CCA-IMT (mm)	ICA-IMT (mm)	P value
23-94	10	04	06	0.787	0.776	=0.49
95-154	33	18	15	1.807	1.652	=0.49
155-1023	57	20	31	1.045	1.033	=0.49

Table 5: Association between VLDL and CIMT

VLDL(mg/dl)	Number	Males	Females	CCA-IMT (mm)	ICA-IMT (mm)	P value
1-13	20	08	12	1.090	0.969	=0.49
14-26	32	18	14	1.733	1.894	=0.49

27-200	48	20	28	1.420	1.340	=0.49

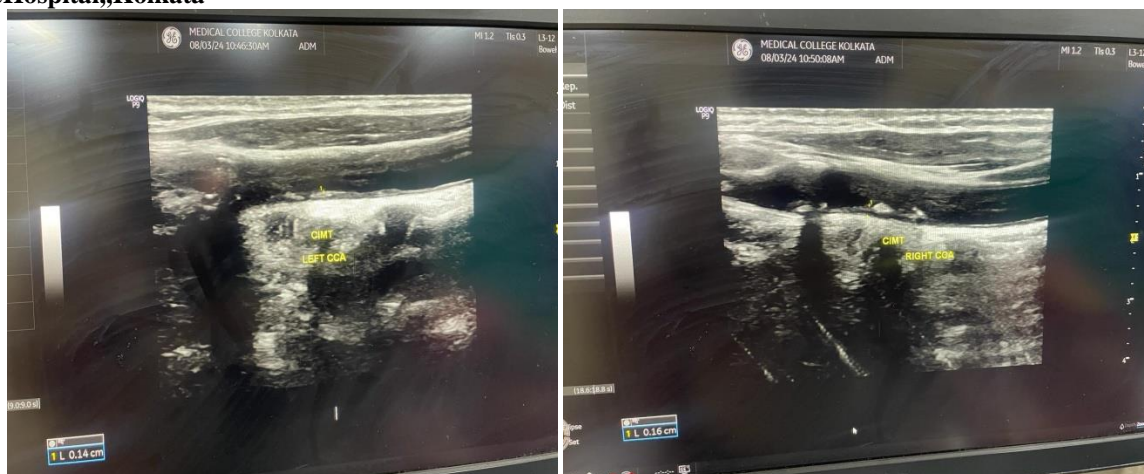**Picture of usg carotid study to look for CIMT in a dyslipidemic individual in Medical college &Hospital,,Kolkata**

Fig1:Increased Intimal thickness(0.14mm) of Left CCA.
Fig2: Increased Intimal thickness(0.16mm) of Right CCA.

IV.   Discussion

In the present study, specific objective of the study was to assess the association between carotid intima media thickness (CIMT) and pattern of dyslipidemia. CIMT is an objective measure of subclinical atherosclerosis as per several researchers. The study was also conducted to verify the role of CIMT in assessment of subclinical atherosclerosis along with pattern of dyslipidemia(4,8). It has already been established that several factors such as aging, hypertension, dyslipidemia, duration of diabetes, and smoking habits were closely associated with increasing of CCA IMT. Both common carotid artery IMT and internal carotid artery IMT was increased in a step wise fashion with raising tertiles of LDL (P<0.01) and total cholesterol (P<0.01). There is decrease in both CCA IMT and ICA IMT with increasing tertiles of HDL (P<0.01). No direct correlation was found between CCA IMT and ICA IMT with either VLDL or TG(1,4,5). The main abnormality is moderately raised triglyceride and decreased HDL cholesterol; LDL and total cholesterol a powerful predictor of cardiovascular risk in non-diabetic population may be normal or slightly raised. But is Indian diabetic dyslipidemic patient LDL is raised, HDL is reduced, and triglyceride is increased; that is why changes of atherosclerosis are increased. The over production of triglyceride rich VLDL by the liver and impaired triglyceride clearance via lipoprotein lipase are contributory factors in diabetic dyslipidemia. Increased lipid exchange with triglyceride rich lipoproteins favour the production of small dense LDL, which is recognized by specific receptors in arterial wall, which is highly atherogenic and small dense HDL (HDL3) which is less atherogenic than relatively depleted HDL2(2,7,9).

No direct correlation was found between CCA IMT and ICA IMT with either VLDL or TG. The mains abnormality is moderately raised triglyceride and decreased HDL cholesterol; LDL and total cholesterol a powerful predictor of cardiovascular risk in non-diabetic population may be normal or slightly raised. But is Indian diabetic dyslipidemic patient LDL is raised, HDL is reduced, and triglyceride is increased; that is why changes of atherosclerosis are increased.

V.   Conclusion

CIMT may be an indicator of endothelial dysfunction and can well become in future an independent risk factor for coronary heart disease and cerebro-vascular accidents. So CIMT may be our objective measure of macro vascular disease in future, depending on which the future doctors will tailor their therapy for atherosclerosis. However, the present study proved that dyslipidemia in subjects may lead to atherosclerosis due to increased CIMT.

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