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EVALUATION OF CAROTID ARTERY INTIMA-MEDIA THICKNESS AND ITS RELATIONSHIP WITH ATHEROSCLEROTIC RISK FACTORS IN HYPERTENSION AND TYPE 2 DIABETES MELLITUS: A OBSERVATIONAL STUDY.

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ABSTRACT

Background: Cardiovascular diseases play a major role in the mortality rates of individuals suffering from diabetes mellitus (DM). The American Heart Association identifies carotid artery intima media thickness (CIMT) as a reliable, non-invasive, and economical approach for evaluating sub-clinical atherosclerosis. This research sought to investigate CIMT and its correlation with atherosclerotic risk factors in patients diagnosed with hypertension and type 2 DM**.**

Methods: The research involved 100 adult patients over the age of 30 of both genders, diagnosed with type 2 diabetes mellitus and admitted to the inpatient department. CIMT measurements were taken using a Philips Epiq 7G ultrasound machine equipped with a high-frequency (3 to 12 MHz) linear transducer.

Results: The participants had an average age of 57.40 ± 8.0 years, with 62% identifying as male. Among them, 17 patients were diagnosed with atheroembolic disease. The mean carotid intima-media thickness (CIMT) was measured at 0.72 ± 0.21 mm, with 30 patients presenting a high CIMT (>0.9 mm). The high-CIMT group demonstrated significantly greater mean body mass index and waist circumference ($p < 0.05$). Furthermore, both mean HbA1c and mean post-prandial blood sugar levels were notably higher in this subgroup ($p < 0.05$). Additionally, the mean creatinine levels and lipid profiles were significantly elevated in the high-CIMT group ($p < 0.05$). Importantly, 43.33% of patients in the high-CIMT group exhibited signs of atheroembolic disease, in contrast to just 5.71% in the low-CIMT group.

Conclusion: A significant number of patients with type 2 diabetes mellitus showed increased carotid intima-media thickness (CIMT). Additionally, individuals with higher CIMT levels had a markedly greater occurrence of atherosclerotic risk factors, indicating that CIMT is a strong marker for atherosclerosis.

Keywords: Carotid artery intima media thickness, atherosclerosis, type 2 diabetes mellitus

INTRODUCTION

Diabetes mellitus (DM) represents a significant global health issue, impacting millions of

individuals around the world. The majority of these cases are classified as type 2 DM, accounting for 91% of the total, as reported by the International Diabetes Federation (IDF). Approximately three-quarters of DM patients reside in low- and middle-income countries, such as India. The prevalence of DM is anticipated to double over the next two decades, driven by increasing life expectancy, a rise in obesity rates, and greater exposure to various risk factors.[1,2] One critical reason for the 2–4 times higher mortality rate from cardiovascular diseases among diabetic patients compared to the general population is the onset of premature and severe atherosclerosis. Additionally, cerebrovascular complications are prevalent among DM patients, with the risk of stroke being approximately four times greater in this group[3]. Consequently, the diagnosis and management of the various complications associated with DM, particularly macrovascular issues like coronary artery disease and cerebrovascular disease, are essential components of diabetes care. It is evident that the risk of atherosclerosis is closely linked with type 2 DM.[4]

Coronary and cerebral angiography are considered the gold standard for assessing the extent of coronary atherosclerosis. However, this angiographic evaluation is expensive, requires specialized tertiary care facilities, and involves certain risks.[5] It is important to recognize that atherosclerosis is a widespread condition affecting the coronary, carotid, and cerebral arteries alike. Therefore, the ultrasonographic assessment of carotid arterial wall thickness serves as a valuable non-invasive method for evaluating the degree of atherosclerosis[6]. This technique correlates well with histological analyses of the carotid arteries.

Measuring only the intima-media thickness of the common carotid arteries, as opposed to conducting a more extensive carotid Doppler study, is a reliable approach for determining the severity of atherosclerosis.Thesefindings can also be related to systemic generalized atherosclerosis.[7] The carotid artery intima media thickness (CIMT) can be assessed with a high level of accuracy and reproducibility with the help of B mode ultrasonography that provides a dependable and legitimate estimate of the arterial wall thickness.[8] In scientific literature, CIMT in healthy normal middle-aged adults has been defined as 0.6–0.7 mm and a thickness of more than 1.2 mm is deemed to bea plaque.[9] According to study by Van Der Meer et al, CIMT rise in participants over a period of 6.5 years was linked to male gender, body mass index (BMI), smoking, increasing age, and hypertension while no connection was observed with dyslipidemia.[10] However, if we discuss about the related scientific evidence from India, they are scarce. Considering the increasing prevalence of atherosclerotic events, it is important to generate moreevidence related to the predictive utility of non- invasive investigations like CIMT measurement. This may help in early alerting of the clinician with regardsto the cardiovascular event risk, leading to quicker interventions. Hence, it was decided to evaluate the CIMT & it's correlation to atherosclerotic risk factors in type 2 DM patients, at a tertiary care teaching hospital.

This was conducted to create more evidence with regards to assessment of the predictive value of CIMT as an early indicator of atherosclerosis in the DM cases.

METHODS

This was a prospective, observational study conducted between 1st Oct 2007 to 30th Nov 2008. The study was initiated after getting permission from the institutional ethics committee. Inclusion criteria comprised of adult patients of age more than 30 years,of either gender with diagnosed type 2 DM, admitted in the in-patient department (IPD) at Santosh Medical College, Ghaziabad, Uttar Pradesh. The exclusion criteria comprised of type 1 DM patients, patients with cardioembolic stroke, hemorrhagic stroke & stroke due to secondary causes like trauma, impaired coagulation or tumor. Patients who had history of secondary diabetes, congestive cardiac failure, overt renal failure, urinary tract infection or recent intercurrent illnesses were also excluded. Only the patients who fulfilled all the screening criteria were included, only after the patients signed the informed consent document.

The criteria used for diagnosing and/or confirming type 2 diabetes mellitus was as follows:

- Fasting plasma glucose ≥ 126mg/dl, or
- 2 hour postprandial/OGTT plasma glucose ≥ 200mg/dl as per the ADA guidelines.

After enrollment of the patients in the study, demographic details like age and gender were noted down. Detailed history and physical examination wererecorded, which included assessment of anthropometric measurements like weigh, height, body mass index (BMI) and the waist circumference. For measuring waist circumference, a point at the highest point of iliac crest crossing the mid axillary line on the right side of the trunk was taken and the circumference was measured horizontally at normal minimal respiration. Hip circumference was measuredat the widest point between the hip and buttocks. Waist hip ratio (W/H), defined as waist circumferencedivided by hip circumference, was noted down. Routine blood investigation was also conducted toevaluate complete blood count, lipid profile, HbA1c, renal as well as liver function tests. Carotid artery intima-media thickness (CIMT) was assessed using a Philips Epiq 7G ultrasound machine equipped with a high-frequency linear transducer (3 to 12 MHz). Trained personnel conducted scans on both the right and left extracranial carotid arteries. IMT measurements were taken from six specific arterial segments: the near and far walls of the distal 6 mm of the common carotid artery, the carotid bulb, and the proximal 6 mm of the internal carotid artery on both sides. The final CIMT value was determined as the average of the IMT measurements from these various locations.

Following data collection, the information was entered into a Microsoft Excel spreadsheet. Data analysis was performed using Graphpad InStat.v3.0 statistical software (USA). Quantitative data, including anthropometric details, blood parameters, and CIMT measurements, were summarized using mean and standard deviation. Descriptive statistics were employed to analyze the distribution of patients by age, gender, and medical history. Patients were categorized into two groups based on a defined CIMT cutoff (<0.9 and >0.9). Continuous parameters were compared between these two sub- groups using an unpaired t-test. Additionally, associations between comorbidities (such as hypertension), BMI, and waist-hip ratio with CIMT status (>0.9 and <0.9) were evaluated using the chi-square test. A p-value of less than 0.05 was deemed statistically significant.

RESULTS

A total of 100 patients participated in the study. The average age of the participants was determined to be 57.41 ± 8.1 years, with ages ranging from 38 to 76 years. Among the enrolled patients, 62% were male. The average body mass index (BMI) was recorded at 29.39 ± 1.75 kg/m², and the mean waist circumference was found to be 98.94 ± 6.88 cm (refer to Table 1). Notably, 39% of the patients fell within the age group of 51-60 years, while 37% were aged 61-70 years. Additionally, 19% of the participants were between 41-50 years old, and only three patients were under 40 years of age (see Figure 1).

In terms of diabetes mellitus among the participants, the average duration since diagnosis was 6.46 years. The baseline mean fasting blood sugar level was measured at 149.02 ± 33.98 mg/dl, while the mean post-prandial blood glucose level was 230.99

± 64.3 mg/dl. The mean baseline HbA1c was also assessed, yielding a value of 10.96 ± 2.31 g% (refer to Table 2). Of the patients, 49% had diabetes for a duration of 1-5 years, and 41% had diabetes for 6-10 years (see Figure 2). The study identified 66 patients with hypertension. The overall mean systolic blood pressure was calculated to be 146.75 ± 14.72 mm Hg, while the mean diastolic pressure was recorded at 92.84 ± 8.64 mm Hg (refer to Table 3).The mean hemoglobin was calculated to be

13.88 +/- 0.95 g/dl while the mean total WBC count was calculated to be 8327.1 +/- 7537.36 / mm3. The renal function test assessment showed mean urea to be 32.5+/- 9.16 mg/dl while the mean creatinine to be 1.04 +/- 0.31 mg/dl. On assessing the lipid profile of the patients, mean total cholesterol was found to be 210.21 +/- 45.05 mg/dl, mean triglyceride to be

162.1 ± 26.78 mg/dl, mean HDL was 38.74 ± 5.65 mg/dl while mean LDL was calculated to be 128.63 ± 32.74 mg/dl (Table 4). On assessing any evidence or history of atheroembolic disease, 17 patients were found to have atheroembolic disease while remaining 83 patients did not have history or evidence of atheroembolic disease. The mean CIMT on the right side was calculated to be 0.7± 0.23 mm, while the mean CIMT on the left side was found to be 0.73 ±0.23 mm.

The mean CIMT was calculated for each patient first (right + left/2) and then overall mean of the patients was assessed. The average carotid intima-media thickness (CIMT) was determined to be 0.72 ± 0.21 mm. A total of 30 patients exhibited CIMT values exceeding 0.9 mm, indicating elevated levels. The remaining 70 patients had CIMT measurements below 0.9 mm (refer to Table 5). A comparison was made between the high-CIMT (>0.9 mm) and low-CIMT (<0.9 mm) patient groups.
It was observed that the mean body mass index (BMI) was significantly higher in the high-CIMT group ($p<0.05$), and the mean waist circumference was also notably greater in this group ($p<0.05$). The mean age and gender distribution were statistically similar across both sub-groups ($p>0.05$) (see Table 6). The prevalence of hypertension was comparable between the low-CIMT (65.72%) and high-CIMT groups (66.67%) ($p>0.05$) (refer to Table 7). When analyzing the mean systolic blood pressure (SBP) and mean diastolic blood pressure (DBP) between the two sub-groups, no significant differences were identified, indicating comparable blood pressure levels ($p>0.05$) (see Table 8).

In terms of diabetes parameters, the mean HbA1c and mean postprandial blood sugar (PPBS) were significantly higher in the high-CIMT group ($p<0.05$). Although the mean duration of diabetes mellitus (DM) was numerically greater in the high-CIMT group, it was statistically comparable ($p>0.05$). The mean fasting blood sugar (FBS) levels were also found to be similar between the two sub-groups ($p>0.05$) (refer to Table 9). The average hemoglobin levels and mean total leukocyte count (TLC) were similar across both sub-groups.

Although the mean urea levels were numerically elevated in the high-CIMT group, they were statistically comparable ($p>0.05$). In contrast, the mean creatinine levels were significantly higher in the high-CIMT group compared to the low-CIMT group ($P<0.05$).
The lipid profile was notably poorer in the high-CIMT group, with mean total cholesterol, mean triglycerides, and mean LDL all significantly elevated ($p<0.05$) (Table 10).

When examining the relationship between atheroembolic disease and high CIMT, it was found that 43.33% of patients in the high-CIMT group exhibited evidence of atheroembolism, whereas only 5.71% of patients in the low-CIMT group showed similar evidence. This disparity between the two sub-groups was statistically significant ($p<0.05$) (Table 11).

Table 1: Demographic details of enrolled patients in study (n=100)

Parameter assessed	Calculated value
Mean age (years)	57.40± 8.0
Median age (years)	57.5
Age range (years)	38-76
Number of males	62
Number of females	38
Mean body mass index (BMI) (kg/m2)	28.39 ± 1.75
Mean waist circumference (cm)	97.94 ± 6.88

Table 2: Diabetes mellitus related findings in the study	
Parameter assessed	Calculated value
Mean years of disease	6.36± 3.61
Mean Fasting blood glucose (mg/dl)	149.12 ± 32.98
Mean post-prandial blood glucose (mg/dl)	230.96 ± 64.3
Mean HbA1c (g%)	10.92 ± 2.31

Table 3: Blood pressure related findings in the study	
Parameter assessed	Calculated value
Mean systolic blood pressure (mm Hg)	144.75± 14.72
Mean diastolic blood pressure (mm Hg)	91.84± 8.64
Number of patients with Hypertension	66
Number of patients without Hypertension	34

Table 4: Blood count parameters of patients in the study	
Parameter assessed	Calculated value
Routine blood count	
Mean hemoglobin (g/dl)	13.85± 0.95
Mean total leukocyte count (TLC) (per mm3)	8317.1 ± 7537.36
Renal function test	
Mean urea (mg/dl)	32.5 ± 9.16
Mean creatinine (mg/dl)	1.04± 0.31
Lipid profile	
Mean total cholesterol (mg/dl)	211.21 ± 45.05
Mean triglyceride (mg/dl)	168.1 ±26.78
Mean HDL (mg/dl)	38.74 ± 5.75
Mean LDL (mg/dl)	127.63 ± 32.64

Table 5: Carotid intima media thickness (CIMT) findings in the study	
Parameter assessed	Calculated value
Mean right CIMT (mm)	0.7 ± 0.23
Mean left CIMT (mm)	0.73 ± 0.23
Mean average CIMT (mm)	0.72 ± 0.21
Number of patients with CIMT (< 0.9 mm)	70
Number of patients with CIMT (> 0.9 mm)	30

Table 6: Comparison between demographic features of high CIMT and low CIMT groups			
	Low CIMT (<0.9) (n=70)	High CIMT (>0.9) (n=30)	P value
Mean age	57.9 ± 8.39	56.5 ± 7.42	0.67
Mean BMI (kg/m^2)	27.89 ± 1.61	31.55 ± 1.52	**0.04***
ıist circumference (cm)	96.35 ± 6.9	103.6 ± 5.3	**0.03***
Number of males	42 (60%)	20 (66.67%)	
Number of Females	28 (40%)	10 (33.33%)	0.53

Table 7: Association of Hypertension and increased CIMT thickness in study		
	Low CIMT (<0.9) (n=70)	High CIMT (>0.9) (n=30)

Hypertensive patients	46 (65.72%)	20 (66.67%)
Non-hypertensive patients	24 (34.2%)	10 (33.33%)
P value	0.57 (Not significant)	

Table 8: Comparison between blood pressure of high CIMT and low CIMT groups

	Low CIMT (<0.9) (n=70)	High CIMT (>0.9) (n=30)	P value
Mean SBP (mm Hg)	145.7 ± 15.5	149.2 ± 12.62	0.7
Mean DBP (mm Hg)	92.31 ± 8.3	94.07 ± 9.41	0.73

Table 9: Comparison between diabetes parameters of high CIMT and low CIMT

	Low CIMT (<0.9)	High CIMT (>0.9)	P value
Mean duration of	6.18 ± 3.7	6.63 ± 3.42	0.10
Mean HbA1c (g%)	9.78 ± 2.28	11.39 ± 2.33	**0.02***
Mean FBS (mg/dl)	149.1 ± 34.62	148.3 ± 33.02	0.78
Mean PPBS (mg/dl)	221.4 ± 59.3	245.1 ± 66.3	**0.04***

Gender comparison done by Chi-square test, other parameters compared by unpaired t test, P<0.05 consideredsignificant

P value by Chi-square test considered not significant

Table 10: Comparison between other blood parameters of high CIMT and low CIMT

	Low CIMT (<0.9)	High CIMT (>0.9)	P
Mean hemoglobin (g/dl)	13.82 ±0.96	14.02 ± 0.87	0.31
Mean total leukocyte count (TLC) (per	8532.11 ± 1854.68	9082.3 ± 2072	0.27
Renal function test			
Mean urea (mg/dl)	31.76 ± 8.86	35.23 ± 9.75	0.13
Mean creatinine (mg/dl)	1.01 ± 0.29	1.11 ± 0.35	**0.02***
Lipid profile			
Mean total cholesterol	201.59 ± 41.3	230.3 ± 47.66	**0.01***
Mean triglyceride (mg/dl)	156.76 ± 23.93	174.2 ± 30.59	**0.01***
Mean HDL (mg/dl)	38.82 ±5.41	38.53± 6.29	0.82
Mean LDL (mg/dl)	123.1 ± 27.45	142.5 ± 40.25	**0.01***

Table 11: Association of evidence of atheroembolic disease and high CIMT

	Low CIMT (<0.9)	High CIMT (>0.9) (n=30)
Atheroembolic evidence	4 (5.71%)	13 (43.33%)
Atheroembolic evidence	66 (94.29%)	17 (56.67%)
P value	**<0.01* (Significant)**	

DISCUSSION

Patients with type 2 diabetes mellitus (T2DM) are at elevated risk for acquiring cardiovascular diseases (CVD), that are one of the chief reasons of death in these class of patients.[5,6] Given that not all T2DM patients develop CVD, it is important to identify patients with great probability of suffering from these diseases. This early identification can help for efficient early intervention and treatment that could eventually reduce morbidity and mortality. The carotid intima-media thickness (CIMT) is a well- established non-interventional surrogate indicator for the likelihood of cardiovascular (CV) occurrences for the general population.[3,4] Previous studies revealed that basal IMT forecasted the occurrence of CV events in patients with T2DM.[4,7] Based on theseoutcomes, CIMT alterations calculated by repeatedCIMT assessment are generally used as a surrogate incidence of CV events has not yet been fully addressed. In recent times, it was revealed that CIMT advancement was related with the occurrence of stroke in patients not suffering from frequent CV events.[6] On the contrary, while the European Lacipidine Study on Atherosclerosis (ELSA) revealed a positive correlation between baseline CIMT and the stroke incidence, it did not show any relationship between CIMT alteration and the occurrence of stroke.[7]Additionally, a meta-analysis data also indicated that CIMT progression did not have any relationship with CV events in the general population.[8] Thus, it remains controversial whether changes in CIMT can predict CV events in contrast to baseline CIMT. Furthermore, there is also uncertainty about the usefulness of CIMT progression as a predictor of CV events in patients with T2DM. Hence,we decided to evaluate the relationship of CIMT with atherosclerotic risk factors in patients with T2DM.This will help in creating evidence which can help the physicians in classifying high-risk patients early on, so that necessary screening and monitoring foratherosclerosis can be done.

In the present study, the majority patients falls in the 51-60 years of age category, with the mean age also falling between the range (57.40 years). Majority of the T2DM patients were found to be having hypertension as well (66%). This is a common phenomenon, and especially since most of the patients were of age more than 50 years, multiple comorbidities were not surprising. The complete blood count results were within normal range, but the kidney function tests revealed higher than normal mean urea (32.5 mg/dl) and serum creatinine also deranged in patients. This was again not surprising as older patients with T2DM are knownto have deranged renal function tests because of associated diabetic nephropathy. The lipid profile of these patients was also found to be deranged, with the mean cholesterol (211.21 mg/dl) and mean triglyceride (168.1 mg/dl) being above the normal range.

On comparing the mean CIMT in the right and left side, no significant difference was found ($p>0.05$).The overall mean CIMT was found to be 0.70 ± 0.23 mm. In the study by Butt et al., the mean CIMT on theright was 0.88 mm while on the left side was found to be 0.93 mm, which was found to be comparable as was the case in our study.[7] The lower mean CIMT in our study may be attributed to the fact that the patients were not newly diagnosed DM patients in our study, and were receiving medications from a long time, which may not be the case in other compared studies.

30% of the T2DM patients in present study were having a CIMT of greater than 0.9 mm. On assessing the available scientific literature, it was found thatCIMT of less than 0.9 mm has been considered normal, while more than 0.9 mm has been considered of higher level. After subdivision of the patients basedon CIMT, it was found that mean BMI as well as the mean waist circumference were significantly higher inthe high-CIMT group ($p<0.05$). This indicates thatobesity may be a factor which can be related to a higher CIMT in the T2DM patients. No significant association was found between high CIMT and hypertension, as both the sub-group of patients had similar hypertension prevalence. The mean SBP as well as DBP were found to be comparable in the sub-group of patients. On comparing the diabetes parameters, it was found that the mean duration, and mean FBS were comparable in both the sub-groups ($p>0.05$). However, the mean HbA1c as well as the mean PPBS were found to be significantly higher in the high-CIMT group ($p<0.05$). This

indicates thatuncontrolled diabetes mellitus may be one of the risk factors for increased CIMT in the patients. Macrovascular disease is the most crucial cause of mortality as well as morbidity in patients with type 2 diabetes. Even when adjusted for predictable risk factors, diabetic patients still show a two to four-fold elevated risk of cardiovascular disease as compared tonon-diabetic individuals. Hence, long-termuncontrolled hyperglycemia, which is known by measuring HbA1c levels, is strongly speculated of supporting atherogenesis. Increased glucose is converted into advanced glycation end products (AGEs) which not only make blood vessels lose its elasticity but also make them stenotic and activates chronic inflammation. In addition, AGEs have been confined to fatty streaks, atherosclerotic lesions, lipid- containing smooth muscle cells, as well as macrophages in patients with diabetes. In the study bySingh et al., patients with high CIMT had greater values of HbA1c as compared to that of normal CIMTpatients and this was nearly significant statistically (P
= 0.06). However, HbA1c levels were significantly associated with stroke patients showing carotid arteries plaque indicator for intervention in multiple clinical studies. However, the relationship between changes in CIMT and the ($P = 0.008$).[10] The mean creatinine was also found to be significantly higher in the high-CIMT sub-group ($p<0.05$), which may be because of uncontrolled nature of diabetes mellitus in these patients leading to nephropathy features. In addition, the mean cholesterol, mean triglyceride as well as mean LDL were found to be significantly higher in the high-CIMT group, which again shows that deranged lipid parameters were more commonly linked to high CIMT in T2DM. Dyslipidemia have been found to speed up the processes which ultimately lead to plaque formation in the circulation in the initial stages of diabetes mellitus, and they may further worsen atherosclerosis in the diabetic patient as were supported by the results noted in our study.[9] The various fractions of lipid profile stated a strong relationship with CIMT in the diabetic This relationship was equally strong with serum total cholesterol, serum triglycerides as well as serum LDL,while serum HDL levels showed no significantrelationship with high or low CIMT noted in the study. The findings of athero-embolic disease were found to be significantly associated with high-CIMT as well ($p<0.05$). Hence, it can be stated that obesity, higher serum diabetes indicators, deranged creatinine as well as deranged lipid profile parameters were found to be significantly linked with high CIMT in thestudy ($p<0.05$).

In the study by Bonora et al., CIMT was raised in T2DM patients who had high central obesity, indicated by increased waist circumference, a finding replicated in our study as well.[9] Another study by Ciccone et al. also found that BMI was strongly associated with CIMT which suggests that central fat accumulation may accelerate the atherosclerotic change and possibly also explain the increased atherosclerosis incidence in patients suffering from obesity.[10] Present study had a lot of strong points. The overall occurrence of high CIMT was assessed, and then relation of various patient factors was analyzed with CIMT in the T2DM patients. This is a definite valuable addition to the Indian evidence in relation to the topic. However, our study did have few limitations. The study was done only at one center, with a limited number of patients. In addition, we did not compare the findings with the non-diabetic patients, and it was a one arm study. Also, the baseline CIMT assessment was only considered in the study. Future studies with larger sample size, conducted at multiple centers and comparative studieswith non-diabetic patients may also help in validating our evidence and confirming our findings.

CONCLUSION

Large number of patients with type 2 DM were found to be having high CIMT. This indicates that DM is associated with atherosclerotic risk in many cases. In addition, the patients with high CIMT were found to have significantly higher BMI and waist circumference, worse glycemic parameters, worse renal function, worse lipid parameters as well as greater evidence of atheroembolic disease which indicates the greater presence of atherosclerotic risk factors in this set of patients. This indicates that CIMThas a great predictive value and can act as an important indicator for

atherosclerosis.

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee

REFERENCES

1. Wong M, Edelstein J, Wollman J, Bond MG. Ultrasonic-pathological comparison of the human arterial wall. Verification of intima-media thickness. ArteriosclerThromb1993;13:482-6.
2. Sinha AK, Eigenbrodt M, Mehta JL. Does carotid intima media thickness indicate coronary atherosclerosis? CurrOpinCardiol2002;17:526-30.
3. Frouse Jr. An evaluation of methods for imaging and quantifying coronary and carotid lumen stenosis and Atherosclerosis. Circulation 1993;87(II):1117-33.
4. Jacoby DS, Mohler ER 3rd, Rader DJ. Noninvasive atherosclerosis imaging for predicting cardiovascular events and assessing therapeutic interventions. CurrAtheroscler Rep 2004;6:20-26.
5. Van der Meer IM, Iglesias del Sol A, Hak AE, Bots ML, Hofman A, Witteman JC, et al. Risk factors for progression of atherosclerosis measured at multiple sites in the arterial tree: The Rotterdam study. Stroke 2003;34:2374-79.
6. Donahoe SM, Stewart GC, McCabe CH, Mohanavelu S, Murphy SA, Cannon CP, et al. Diabetes and mortality following acute coronary syndromes. JAMA 2007;298:765–75.
7. O'Leary DH, Polak JF, Kronmal RA, Manolio TA, Burke GL, Wolfson Jr SK. Carotid-artery intima and media thickness as a risk factor for myocardialinfarction and stroke in older adults, Cardiovascular Health Study Collaborative Research Group. N Engl J Med 1999;340:14–22.
8. Yamasaki Y, Kodama M, Nishizawa H, Sakamoto K, Matsuhisa M, Kajimoto Y, et al. Carotid intima-media thickness in Japanese type 2 diabetic subjects: predictors of progression and relationship with incidentcoronary heart disease. Diab Care 2000;23:1310–15.
9. Bonora E, Tessari R, Micciolo R, Zenere M, Targher G, Padovani R, et al. Intimalmedial thickness of the carotid artery in nondiabetic and NIDDM patients. Relationship with insulin resistance. Diab Care 1997;20:627-31.
10. Ciccone M, Maiorano A, De Pergola G, Minenna A, Giorgino R, Rizzon P. Microcirculatory damage of common carotid artery wall in obese and non-obese subjects. Clin HemorheolMicrocirc1999;21:365-74.