# THE RELATION OF CLINICAL CARDIO-VASCULAR DISEASES AND OF CARDIOVASCULAR RISK FACTOR AND THE VALUE OF THE INTIMA THICKNESS OF THE EXTRA CRANIAL CAROTID ARTERIES BY 2D ULTRASONOGRAPHY

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## ABSTRACT

The intima media thickness (IMT) of the extra cranial carotid arteries (ECA) measured by 2 Dimentional ultrasound is a valid estimate of carotid and coronary atherosclerosis and reflects the extent and severity of clinical coronary heart disease (CHD). The value of the IMT of the ECAs was assessed in relation to clinical cardiovascular diseases (CVD) and to risk factors (RFs) of CVD including age, male gender cigarette smoking hypertension, diabetes mellitus (DM), obesity and total serum cholesterol/HDL cholesterol ratio (TSC/HDL C) value>5 in patients who had at least one RF for CHD, using 10 MHz probe. The total of 1170 patients were studied they were divided into four groups according to the value of the IMT of their ECAs Group (1) had an IMT of 0.79 mm or less, it contained 300 patients (25.64%), group (2) had a value of 0.8-0.99 mm and included 262 (24.1%) patients, group no (3) had an IMT of 1-1.29 mm and is comprised of 390 patients (33.33%) and group (4) had IMT of 1.3mm and over and were 199 patients (16.92%). Collected data in group 1 to group 4 in sequence were: mean age of 45.22, 55.26 55.1 and 67.9 years, male gender 31%, 51%, 51% and 53.03% ,smoking rate 16%, 28%, 31.5% and 39.39%. DM in 16%, 21.2%, 28.46% and 37.87%, hypertension in 55%, 58.5%, 66.92% and 74.24%, myocardial infarction (MI) was detected in 66 (22%), 66 (22%), 123(31.15%) and 81(40.9%) patients in these four groups consecutively, angina pectoris (AP) in 81(17%), 51(18%), 84(21.5%) and 27(13.63%) patients, stroke in 18(6%), 18(6.3%), 26(6.92%) and 27(13.63%), cardiomegaly (CMG) in (3%), 18(6.3%), 36(9%) and 36(18.18%), congestive cardiac failure (CCF) in 6(2%), 12(4.2%), 9(2.3%) and I2(10.60%). Risk factors particularly advancement in age, DM, hypertension (numerically the most prevalent), smoking, TSC/HDL C ratio but not BMI were markedly increased in the group of the highest IMT. Conclusion: IMT of the ECAs is shown to be the function of the RF s studied all together and of each one independently, hypertension was the most prevailing RF, The rate of MI, AP, strokes CMG and CCF were related to the IMT level 2D U/S of the ECAs should become more popular in considerations related to assessment of RF of CVD and in the follow up of prevention protocols.

## INTRODUCTION

Atherosclerosis of the extra cranial carotid arteries is associated with that of the coronary arteries and with incident coronary artery disease (CAD), the pathological relation between atherosclerosis of the carotid and of the coronary arteries is as strong as that between any two coronary arteries. [1] Patients with transient ischemic attacks are known to die more frequently of myocardial infarction than of stroke, there is an increased risk of both stroke and CAD in relation to severity of carotid artery stenosis as measured by Doppler U/S, [2] individuals with carotid artery stenosis <30% have stroke event rate of 1% per year and CAD events of 2% per year, and those with a >75% stenosis have stroke events of 6% and CAD events of 8% per year [2] coronary events rate in patients with extra cranial carotid artery stenosis and no prior history of coronary artery disease was 4.4% per year while it was 5.6% per year in individuals who had both extra cranial carotid artery stenosis and CAD [3] therefore extra cranial carotid artery stenosis is a good indicator to co-existing coronary artery disease.[2,3] It is becoming vividly apparent that the characteristics of the atheromatous plaques more than the extent of the arterial stenosis are responsible for the sudden rupture and for the clinical events, the vulnerable plaques have large lipid core and thin fibrous cap a highly active inflammatory component. [4] In addition many risk factors that are associated with cardiovascular diseases (CVD) namely smoking, diabetes mellitus and hypertension may be associated with larger diameter of the coronary arteries.[5,6] Ultrasound (US) is a useful tool for the study of carotid atherosclerosis,[6] Doppler U/S identifies stenotic carotid arteries. [7] 2D U/S is a reliable

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indicator of wall thickness of the extra cranial carotid arteries and of the intimal-medial thickness (IMT). [8-11] The IMT of the extra cranial carotid arteries of patients >50 years old who have CAD was 2.5 times that of age match control groups [12] The IMT of the extra cranial carotids was suggested as an independent risk factor for coronary disease. [13] Prevalence of myocardial infarction in the highest quartile of the IMT was about 5% whereas for those in the lower quartile was only 2.5% (ARIC study). The object of this study is to find out the relation of the IMT of the extra cranial carotid arteries to various cardiovascular risk factors on one hand and the relation of the IMT with cardiac complications of vascular etiology on the other hand.

## PATIENTS AND METHODS

Medical in-patients and out-patients attendants to Mawani hospital and private clinic over the period January 2001 to January 2003 were taken up, patients enrolled have at least one of the following recognized risk factors (RFs) for cardiovascular diseases (CVDs): hypertension diabetes mellitus, smoking hyper cholesterolaemia, raised body mass index (BMI) over 25, or have an already established clinical CVD were included for prospective analysis. Data were taken regarding identity, age, gender marital state occupation, residence, together with history of smoking, hypertension, diabetes mellitus (DM) myocardial infarction (MI), angina pectoris and peripheral artery disease. The result of physical examination, (BMI), biochemical tests including blood sugar, total serum cholesterol/ HDL-cholesterol, triglycerides, ECG, Chest X-Ray and the results of the IMT of the extra cranial carotid arteries as measured (by the author) using a high resolution linear transducer of 10 KH frequency, for both common carotids external and internal carotids, the mean value of the IMT for the anterior and the posterior walls of these arteries were calculated for each patient to produce the net IMT value, the range of the net IMT values for the patients studied is divided in to four groups starting from normal values passing upwards , the collected data were calculated for each of the IMT four groups.

## RESULTS

The total of 1170 were ultimately enrolled, 541 were males (46.23%) and 629 were females (53.76%), their age ranged between 18-100 years (2 were 100 years old) with a mean of 51.8 years. (Table-1), shows the results of U/S measurements of the IMT of the ECAs the estimated values of the IMT fell in to 4 groups, the first two (<0.79 and <0.99) are decidedly normal figures, and the over 1 mm other two groups were abnormal the rate of smoking, diabetes mellitus, hypertension, body mass index and serum lipid profile is similarly sketched in the Table. Myocardial infarction angina pectoris, strokes, cardiomegaly and congestive heart failure were the clinical syndromes studied in relation to the IMT of the ECAs (Table-2),

(Table-1) demonstrates that the age of patients in these groups increases progressively with a marked step up in the mean age for the >1.3 mm group, the male gender preponderance is equally evident except with the very low <0.79mm group there is a raise in the rate of DM continuous with the IMT level raise: the BMI was generally in the over weight class, the total serum cholesterol/HDL cholesterol was generally over 5, the higher rate of hypertension, MI, Strokes CMG and CCF in the 1.3 mm group is also noticeable. The rise of the rate of angina pectoris stopped at IMT of 1.19 mm.

**Table 1.** Relation of the values of the Intima Media Thickness (IMT) of the extra cranial carotid arteries and cardiovascular risk factors

| IMT in mm:<br>Mean IMT in mm: | <0.79<br>0.65 | 0.8-0.99<br>0.91 | 1-1.29 >1.3<br>1.19 1.92 | |
|---|---|---|---|---|
| Age in years Range:<br>Mean: | 18-85<br>(45.22) | 30-85<br>(55.26) | 35-91<br>(55.1) | 39-100<br>(67.9) |
| Gender:<br>*Males*<br>*Females* | <br>93 (31%)<br>207 (69%) | <br>144 (51%)<br>138 (49%) | <br>199(51.0%)<br>191 (48.9%) | <br>105 (53.03%)<br>93 (49.96%) |
| Smoking | 48 (16%) | 81(28%) | 123(31.51%) | 78 (39.39%) |
| Diabetes mellitus | 48 (16%) | 60 (2 1.2%) | 111(28.46%) | 75 (37.87%) |
| BMI | 19-40 (24.16) | 18-39 (23.72) | 16-34(24.49) | 15-37.25(25.1%) |
| TC/HDL-C | 4.1-6.8 (5.5) | 3-7.3(5.3) | 3.1-6.1(5.5) | 2.2-7.15(5.8) |
| No. of patients Total:1170 | 300 (25.64%) | 282 (24.1%) | 390 (33.33%) | 198 (16.92%) |

**MI=myocardial infarction, BMI =body mass index, CMG =cardiomegaly, CCF= congestive heart failure**

**Table 2.** IMT values in relation to clinical cardiovascular diseases.

| IMT in mm:<br>Mean IMT in mm: | <0.79<br>*0.65* | 0.8-0.99<br>0.91 | 1-1.29<br>1.19 | 1.3<br>1.92 |
|---|---|---|---|---|
| MI | 66(22%) | 66 (23%) | 123(31.51%) | 147(74.24%) |
| Angina | 81(17%) | *51(18%)* | 84(21.53%) | 27(13.63%) |
| Strokes | 18(6%) | 18(6.3%) | 27 (6.92%) | 27 (13.63%) |
| CMG | 9 (3%) | 18 (6.3%) | 36(9%) | 36 (18.18%) |
| CCF | 6 (2%) | 12 (4.2%) | 9 (2.3%) | 12 (10.60%) |

## DISCUSSION

This study clearly demonstrates the link between increase in the IMT value and male gender, and a similar relation to the rate of cigarette smoking, and to the rate of having DM, and very impressively with rise of blood pressure hypertension is currently regarded as the most important cause of CVD,[14,15] the TC/HDLC ratio was elevated in all IMT groups but most evidently in the >1.3 mm patients. Strokes were over twice commoner with the higher (>1.3mm) IMT group compared with < 0.79 mm patients, this supports similar observations,[17] CVD including CCF cardiomegaly and MI were also twice as common in the >1.3 mm group, these findings stress the conclusion that it is the extreme rise of the IMT that really produce marked changes in the rate of most FRs and CVDs, the relation of the rate of AP with the IMT was minor and extended only up to patients with IMT of 1.29 mm this may reflect looseness in diagnosis of AP because of reliance on history of chest pain in diagnosis, more strict criteria such as positive

exercise stress test could have led to different results by exclusion of false cases.

***In Conclusion,*** 2D U/S estimation of the IMT of the carotid arteries is therefore a delicate reflection of the underlying RFs for CVDs particularly with IMT levels over 1.3mm, and suggestions of its use [18] in the follow up of response to therapeutic measures directed against hypertension, hyperlipidemia, over weight and other risk factors should be supported, and the association of raised IMT with strokes, MI. CCF and CMG each separately and together may indicate that the IMT is a separate RF on its own and its use should expand particularly in selection of candidates for primary prevention of CVDs in cases with isolated risk factor or equivocal estimated CVD risk. Assessment for patients with AP requires additional diagnostic support by subjective investigations.

# REFERENCES

1. Young W, Gofman JW, Tandy R, Malamud N, Waters ESG, The quantitation of atherosclerosis III: the extent of correlation of degrees of atherosclerosis within and between the coronary and cerebral vascular beds. Am J Cardiol 1960; 300-308.

2. Chamber, BR, Norris JW. Out come in patients with a symptomatic neck bruits.N Engl J M 1986: 315; 860-865.

3. Chimowitz MI, Weiss DG, Cohen SC, Starling M1, Hobson RW. Cardiac prognosis in patients with carotid stenosis and no history of coronary artery disease. Stroke: l994:25; 759-765.

4. Pasterkamp G. Falk E, Woutman H, Borst C. Techniques characterizing the atherosclerotic plaque; Influence on clinical decision making? J Am Coll Cardiol 2000; 36: I3-2l.

5. Crouse JR III, Goldbourt U, Evans G, Pinsky J, Sharrett AR, Sorlie P, Riley W, et al. For the ARIC investigators: Arterial enlargement in the atherosclerosis. Risk in communities (ARIC) Cohort, Stroke 1994; 25:1354-1359.

6. Kawamori R, Yamasaki Y, Matsushima H, Nishizawa H, Nao K, Hougaku H, Handa N, et al. Prevalence of carotid atherosclerosis in diabetic patients. Ultrasound high-resolution B-mode imaging on carotid arteries, Diabetes-Care. 1992; 15(10): 1290-1294.

7. Pitt B, Rubinfire M, Risk stratification for the detection of preclinical coronary artery disease. Circulation 1999; 99:1610-1612.

8. Kawasaki T, Koga N, Hikichi Y, Otsubo Y, Kondo K, Shiraishi T, et al. Diagnostic accuracy of carotid ultrasonography in screening for coronary artery disease, J-Cardiol. 2000; 36(5): 295-302.

9. Schuhe-Altedorneburg G, Droste DW, Felszeghy S, Kellermann M, Popa V, Hegedus C, et al. Accuracy of in vivo carotid B-mode ultrasound compared with pathological analysis: intima-media thickening, lumen diameter, and cross-sectional area. Stroke. 2001; 32(7): 1520-1524.

10. Fathi R, Marwick TH, Noninvasive tests of vascular function and structure: why and how to perform them. Am-Heart-J. 2001; 141(5): 694-703.

11. Balghith MA, Nissen SE, Coronary atherosclerosis: lessons learned from intravascular ultrasound.Indian-Heart-J. 2000; 52(5): 517-523.

12. Gradus-Pizlo I, Sawada SG, Wright D, Segar DS, Feigenbaum H. Detection of subclinical coronary atherosclerosis using two-dimensional, high-resolution transthoracic echocardiography.J-Am-Coll-Cardiol. 2001; 37(5): 1422-1429.

13. Crouse JR, Toole JF, Mckinney WM, Dignan MB, Howard G, Kahl FR, McM than MR, Harpold JH, Risk factors for extracranial atherosclerosis. Stroke 1987; 18; 990-996.

14. Craven TE, Ryu JE, Espeland MA, Kahi FR, Thompson C. Evaluation of the association between carotid artery atherosclerosis and coronary artery stenosis; A case control study; Circulation 1990; 82:1230-1242.

15. Baldassarre D, Amato M, Bondioli A, Sirtori CR, Tremoli E. Carotid artery intima-media thickness measured by ultrasonography in normal clinical practice correlates well with atherosclerosis risk factors. Stroke. 2000; 3 1(10): 2426-1230.

16. Su TC, Jeng JS, Chien KL, Sung FC, Hsu HC, Lee YT. Hypertension status is the major determinant of carotid atherosclerosis: a community-based study in Taiwan. Stroke. 2001; 32(10): 2265-2271.

17. Schmermund A, Schwartz RS, Adamzik M, Sangiorgi G, Pfeifer EA, Rumberger JA, et al. Coronary atherosclerosis in unheralded sudden coronary death under age 50: histopathologic comparison with 'healthy' subjects dying out of hospital. Atheroc1erosis. 2001; 155(2): 499-508.

18. Agewall S, Fagerberg B, Berglund G, Schmidt C, Wendelhag I, Wikstrand J. Multiple risk intervention trial in high risk hypertensive men: comparison of ultrasound intima-media thickness and clinical outcome during 6 years of follow-up. J.Intern-Med. 2001; 249(4): 305-314.

19. Hedblad B, Wikstrand J, Janzon L, Wedel H, Berglund G. Low-dose metoprolol CRJXL and fluvastatin slow progression of carotid intimamedia thickness: Main results from the Beta-Blocker Cholesterol - Lowering Asymptomatic Plaque Study (BCAPS). Circulation. 2001; 3: 10.