Carotid Artery Wall Changes as a Prognostic Indicator of Coronary Artery Disease

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Abstract

Aim. The aim of this study is to investigate the prevalence of coronary and carotid arteries atherosclerotic abnormalities, and exactly to examine the predictive value of ultrasonography of carotid artery on the basis of intima - media thickness in coronary artery disease (CAD) evaluation.

Material and metods. The study involved sixty patients (aged 40 to 70 years) who had been referred to our clinical hospital for evaluation of chest pain.

Results. Fifty one patients had increased intima media thickness (IMT) (>0.8). Involvement of coronary arteries regarding one, two or three vessels was 28, 12, 7 and 4%, respectively for left main stenosis- coronary artery disease (LMS- CAD). A significant correlation (p<0.05) was demonstrated between coronary and carotid arteries atherosclerosis.

Conclusion. A great carotid disease sensitivity (85%), acceptable specificity (39%) and positive predictive value (79%) for presence of CAD, make this measurement of IMT and myocardial perfusion imaging (MPI), predictive parameter for CAD presence, useful for noninvasive determination of CAD.

Introduction

Atherosclerosis is a build-up of waxy deposit inside of the blood vessels. Atherosclerosis, a progressive process responsible for most heart disease, is a type of arteriosclerosis or hardening of the arteries. It is characterized by plaque deposits that block the flow of blood. Plaque is made of fatty substances, cholesterol, waste products from the cells, calcium, and fibrin, a stringy material. The plaque formation process stimulates the cells of the artery wall to produce substances that accumulate in the inner layer. The risk factor for coronary artery disease (CAD) are: age, gender (male), heredity (race), tobacco smoke, high blood cholesterol, high blood pressure, physical inac-tivity, obesity and overweight, diabetes mellitus, stress and tthe abuse of alcohol.

A high prevalence of carotid disease (approaches 4%) in patients with CAD can reach 30%–70% and the associated risks imply that screening for carotid atherosclerosis should be considered in all patients with diagnosed coronary artery diseases (1).

Under the general hypothesis that atherosclerosis is a systemic disease, the aim of this study is to compare if increased intima-media thickness and plaque development in the extra cranial carotid arteries reportedly correlates with the prevalence of coronary artery diseases.

Material and methods

The study involved sixty (37 men, 23 women) consecutive patients aged 54.3 ± 7.9 years who had been referred to our clinical hospital for evaluation of chest pain. This study evaluated the correlation between carotid artery disease proved by ultrasonography and coronary artery disease in patients that presented with chest pain, proved by myocardial perfusion imaging. Exclusion criteria were previous myocardial infarction, cerebrovascular disease, valvular heart disease and congenital heart disease.

Myocardial perfusion imaging

Myocardial perfusion imaging utilizes an intravenously administered radiopharmaceutical to depict the distribution of nutritional blood flow in the myocardium (2). Perfusion imaging identifies areas of reduced myocardial blood flow associated with ischemia or scar. Investigation of the patients was done on Gamma spect MEDISO (MEDISO GmbH Schiewenhügel 7 Laer 48366 Germany). As a radiotracer we used sestamibil labiliased Tc-99m-sestamibi. The study was done as one day stress rest study. The stress was done on Treed mill by using Bruce protocol, or with pharmaceutical stressor dipiridamol to perform examination of patients with chest pains episode.

B-mode and Doppler imaging

B-mode ultrasound is relatively inexpensive and safe technique that can non-invasively visualize the lumen and walls of selected carotid arteries.

Measurements were made with a high-resolution B-mode ultrasound scanner Toshiba SSA-340A (Toshiba Medical System Corporation, 1385, Shimoishigami, Otara-Shi, Tochigi, Japan) with a broadband width linear array transducer 5–10 MHz. Measurements of IMT were taken on the distal 10 mm of both right and left common carotid artery in the far wall and in carotid bifurcation (bulb) and thickness of IM complex was measured in internal carotid arteries also (2, 4, 5). Ten determinations were conducted on each side and the average measurement was used for the IMT or the greatest IMT values have been used for analysis (3). Common carotid artery is the preferable site for the measurement of IMT because it is tubular and can be aligned perpendicular to the transducer beam. We measured IMT value as a thickness (mm) from the media-adventitia interface to the intima-lumen interface (1, 3). Reproducibility and yield of the common carotid artery IMT is therefore superior to that of IMT of the carotid bifurcation or internal carotid artery.

We used color Doppler ultrasound to estimate obstructive plaques (causing >50% lumen diameter narrowing) which cause blood flow acceleration at the site of stenosis and a peak systolic velocity >125 cm/sec in the internal carotid artery as an indicator of its hemodynamically significant narrowing (1, 5, 7, 8).

All the ultrasonographic measurements were performed by physician who was not aware of any other data considering these patients. MPI was performed by specialized physician.

Statistical analysis.

The data were analyzed using Statistics for Windows 6.0 software. We used independent t-test to detect statistical significance between IMT of carotid vessel ($p < 0.05$) and normal or abnormal coronary arteries ($p < 0.001$). A value of $p < 0.05$ was considered significant statistically.

Results

The results are shown on Table 1. Fifty one (85%) of patients had increased IMT (>0.8 mm) of carotid artery. Nine (15%) of them had normal carotid

Table 1: Prevalence of CAD according to vessel involvement.

Group	Age (year)	Gender		Doppler, IMT (mm)			Risk Factors			
		M	F	CCA	ICA	ECA	D.M.	Chol.	Smok.	HTA
0 (n = 9)	48.78 ± 6.80	4	5	0.66 ± 0.19	0.78 ± 0.23	0.71 ± 0.21	3	5	7	4
1-VD (n = 28)	53.75 ± 7.23	18	10	1.29 ± 0.16	1.32 ± 0.14	1.32 ± 0.14	6	12	16	16
2-VD (n = 12)	54.75 ± 8.31	7	5	1.58 ± 0.21	1.61 ± 0.21	1.67 ± 0.16	7	12	8	6
3-VD (n= 7)	58.86 ± 8.44	5	2	1.47 ± 0.16	1.49 ± 0.07	1.58 ± 0.17	4	5	3	4
LMS-CAD (n = 4)	62.25 ± 6.60	3	1	1.60 ± 0.19	1.71 ± 0.09	1.66 ± 0.21	2	4	3	4
All Groups (n = 60)	54.37 ± 7.87	37	23	0.66 ± 0.19	0.78 ± 0.23	0.71 ± 0.21	22	38	37	36

M, male; F, female; IMT, intima - media thickness; CCA, central carotid artery; ICA, internal carotid artery; ECA, external carotid artery; D.M., diabetes melitus; Chol., cholesterol; Smok., smoking; HTA, arterial hypertension; VD, vessels disease.
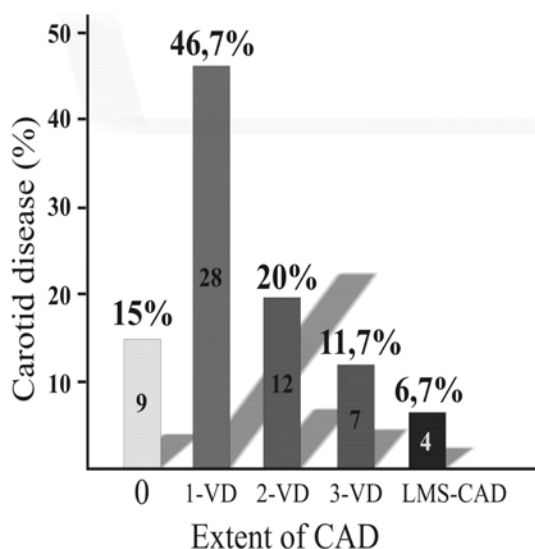
Figure 1: Percentage of prevalence of carotid artery disease according to the extent of CAD by MPI in this study.

ultrasonography. IMT at common carotid artery level was 1.24 ± 0.537 (range 0.43 to 2.45) while in internal carotid artery IMT was 1.19 ± 0.415 (range 0.58 to 2.35). Mean values of parameters showed that carotid artery atherosclerosis was equally present in left and the right carotid arteries.

The prevalence of coronary and carotid arteries atherosclerosis is shown on Fig. 1 and Fig. 2. The coefficient of regression was 0.9106, which shows a strong correlation between above mentioned parameters: CAD and carotid atherosclerosis.

The one vessel disease is the most prevalent among patients with CAD (46.7%), while 2 or 3 vessel CAD is less frequent among these patients (20% and
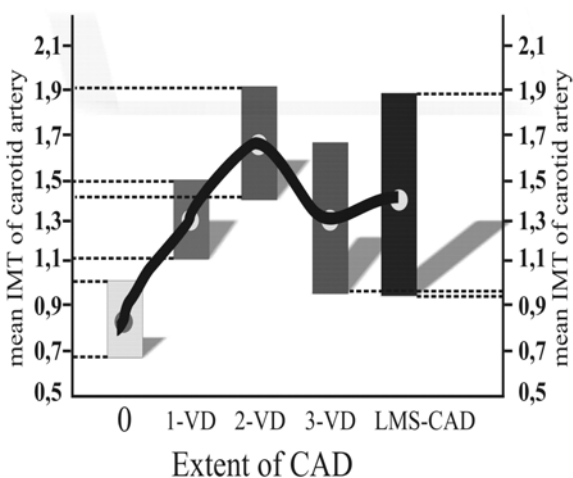

Figure 2: Comparison of mean IMT of carotid artery with extent of coronary artery disease.

11.7%, respectively). Only 6.7% of patients had left main stem coronary artery disease.

The presence of intima - media thickening with over 1.2 mm in the carotid artery in patients and
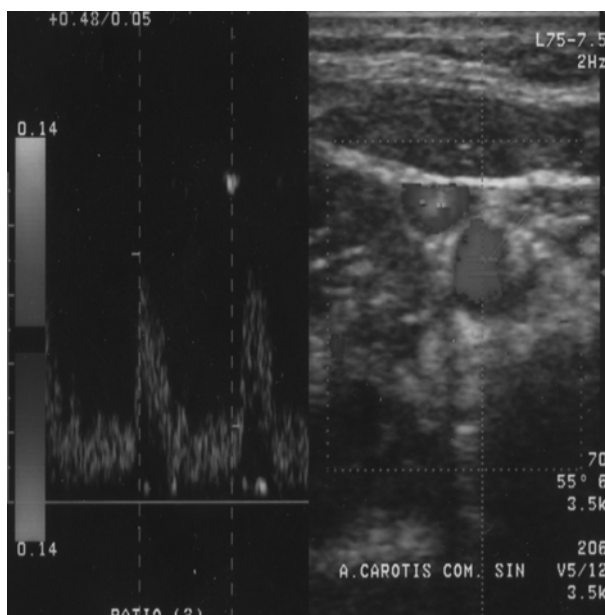

Figure 3: Color Doppler ultrasonography of left CCA.

coronary artery disease is 85% (46,7%, 20%, 11,7% and 6,7%) with respect to the number of vessels disease). IMT sensitivity has value of 85%, acceptable value of specificity 39% and positive predictive value 79% for presence of CAD.
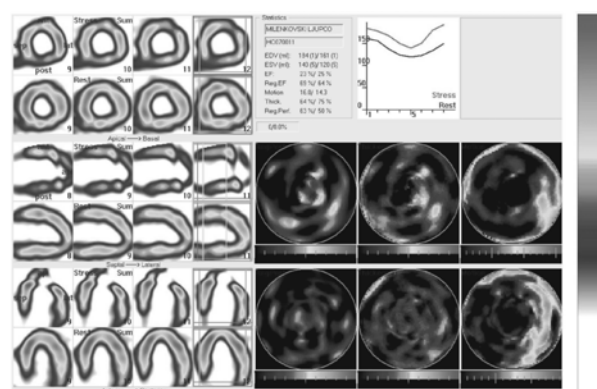

Figure 4: Sample of Myocardial Perfusion Imaging.

Discussion

In our study, intima-media thickness was evaluated in patients with suspected coronary artery disease which was diagnosed by myocardial perfusion

imaging. Using two noninvasive methods we analyze the prevalence of coronary artery disease in this paper. We compared all results get from ultrasound with MPI. The most of the patients with increased IMT had an early CAD. The number of CAD patients with IMT of carotid artery more than 1.2 mm is very high. Thus, endothelial dysfunction showed by IMT, may be an important marker of early atherosclerosis.

The presence of IMT of carotid arteries and plaques is associated with an increased risk of cardio-vascular events in patients with CAD. Percentage of patients with CAD and carotid artery disease is 6 times higher then the percentage of patients without CAD.

We conclude that the Doppler ultrasonography is inexpensive, reliable, valid, simple, non invasive modality for detection of concomitant carotid athermatosis in the patients with coronary artery disease.

This is important, since the detection of carotid disease may modify the treatment strategy of these patients; e.g., more aggressive medical therapy in case of sub clinical carotid atherosclerosis, combined coronary and carotid surgery for patients with critical stenosis in both territories, and staged operations.

By combining the two noninvasive imaging techniques (ultrasound and myocardial perfusion imaging) we produce an useful marker (carotid intima – media thickness) for evaluation of coronary artery disease.

Acknowledgement

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