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Correlations Between Femoral Intima-media Thickness and Cardiovascular Risk Factors in Patients with Ischemic Heart Disease

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ABSTRACT

Background: Atherosclerosis has a systemic impact, producing gradual stenoses of the main vessels, and many imaging techniques have been developed in order to detect and quantify the atherosclerotic lesions. Peripheral artery disease has been shown to be associated with the presence of coronary heart disease, at the same time with carotid artery involvement. The utility of the carotid artery intima-media thickness (IMT) in predicting cardiovascular events caused by atherosclerosis, led to the idea that assessing the femoral artery IMT could have a similar impact. **Study aim:** We sought to determine the correlations between the femoral IMT, the degree of left ventricular systolic dysfunction and cardiovascular risk factors in patients with established diagnosis of ischemic heart disease. **Material and methods:** We prospectively included 27 patients with diagnosed ischemic heart disease. The ankle-brachial index (ABI) was assessed for the anterior and posterior tibial arteries. The left ventricular ejection fraction (LVEF) was determined by echocardiography. The femoral IMT was measured by peripheral vascular ultrasound, at the common femoral artery, 1 cm proximally from the bifurcation. The patients were divided into 2 groups: Group 1 – patients with IMT<0.9mm, and Group 2: patients with IMT >0.9 mm. **Results:** The mean age of the study population was 65.52 ± 11.44 years, and 77.77% were males. The mean glycemia levels were 99.89 ± 30.34 mg/dl, total cholesterol: 176.81 ± 43.09 mg/dl and the mean triglyceride level 140 ± 65.12mg/dl. The mean LEVF was 49.98% ± 12.73%, and femoral IMT 0.75 mm ± 0.25 mm. IMT significantly correlated with cholesterol levels (R = 0.383, p = 0.048), anterior and posterior tibial artery pressures (R = 0.450, p = 0.018, R = 0.418, p = 0.029 respectively) and ABI (R = 0.623, p = 0.005). There was no significant correlation between the LVEF and the IMT (R = -0.143, p = 0.475). There was a significant difference between the 2 groups regarding the minimum anterior tibial artery pressure (95.57 mmHg vs. 63.5 mmHg, p = 0.0011) and the minimum ABI (0.85 vs. 0.5, p = 0.015), and the femoral IMT (p = 0.0001). For patients with a femoral IMT >0.9 mm, a significant correlation was found between ABI and femoral IMT (R = -0.710, p <0.0001). **Conclusion:** The femoral intima-media thickness, assessed with peripheral vascular ultrasound, could be a new marker in evaluating the global cardiovascular risk in patients with ischemic heart disease. Femoral IMT could become a new marker for systemic atherosclerosis.

Keywords: atheroclerosis, femoral artery intima-media thickness, cardiovascular events

INTRODUCTION

Cardiovascular diseases are the main cause of death worldwide, causing 25–40% of all deaths.[1] The main pathogenetic processes involved in the development of cardiovascular disease are represented by atherogenesis and atherosclerosis. Atherosclerosis develops slowly, producing gradual narrowing of the vessels and symptoms of variable severity, but it can also cause acute thrombotic events resulting in myocardial infarction, stroke and lower limb ischemia. Given that atherosclerosis is a systemic process, it has an impact on all organs. Thus, certain markers of end-organ damage can predict the total cardiovascular risk in patients with atherosclerotic disease.[2]

Due to the systemic nature of atherosclerosis, attempts have been made to identify factors that contribute to the acceleration of this process, factors which established over time as cardiovascular risk factors. In the meantime, emphasis has been also put on creating methods that can detect and quantify atherosclerotic lesions to better predict mortality and morbidity.

Peripheral arterial disease (PAD) is one of the manifestations of atherosclerosis and is frequently associated with carotid artery atherosclerosis and ischemic heart disease.[3] Its prevalence increases with age, affecting 15–20% of the population over 65.[4,5] Studies have shown that patients with PAD will probably die of CAD.[6] Besides this association, PAD has an important socio-economic impact in itself, as it often results in critical limb ischemia and amputation, both with a very high mortality rate.

Because of the huge burden it represents, numerous imaging techniques have been developed to detect and quantify atherosclerotic lesions. Ultrasound imaging has a great contribution in establishing carotid intima-media thickness (IMT) as a surrogate marker for subclinical atherosclerosis, showing that increased values are correlated with the incidence of coronary events.[7]

Also, according to current ESC guidelines, Doppler ultrasound has a class IB indication as first-line method to confirm and localize lower extremity arterial disease lesions.[8]

In recent years, based on the evidence that carotid artery IMT can be used as a surrogate marker to predict cardiovascular events caused by atherosclerosis, studies have begun to establish whether the measurement of femoral artery IMT could have the same impact. The Bogalusa Heart Study established that similarly to carotid IMT, femoral IMT is also correlated with the presence and number of cardiovascular risk factors, and that ultrasonography of the femoral artery in conjunction with multiple risk factor profiling can be helpful for risk stratification in patients with atherisclerotic disease.[9]

The aim of our study was to determine whether femoral intima-media thickness correlates with the degree of left ventricular systolic function impairment and cardiovascular risk factors in patients with established diagnosis of ischemic heart disease.

MATERIAL AND METHODS

This is a prospective study conducted on 27 patients, with an established diagnosis of ischemic heart disease based on previous medical records.

In all patients, demographic data were recorded, including age, height, weight, BMI and abdominal circumference.

Blood pressures were measured at the left arm with the subject in supine position with an automated digital oscillometric BP monitor (OMRON M3 Intellisense; Omron Healthcare Europe, Hoofddorp, the Netherlands) and metabolic profiles were assessed (glycaemia, total cholesterol, triglyceride, uric acid levels using standard laboratory assays).

The ankle-brachial index (ABI) was determined for each pacient bilaterally on the anterior and posterior tibial arteries using peripheral CW Doppler (Bistos BT-200, Korea).

Based on a threshold set for femoral IMT of 0.9 mm, the patients were divided into two groups: Group 1 with IMT <0.9 mm, and Group 2 with IMT >0.9 mm.

Ecocardiography was performed to determine left ventricular ejection fraction by using Simpson's biplane method from apical four-chamber views, and peripheral ultrasound was done to establish femoral IMT with a built-in automated calculation software, measured at the common femoral artery, 1 cm proximally from the bifurcation. Both measurements were performed on an Aloka Prosound alpha 10 ultrasound (Hitachi Aloka, Japan) using 3,5 MhZ phased-array cardiac and 7.5–10 MHz linear probes, respectively.

The study has been carried out in accordance with the code of ethics of the World Medical Association's Declaration of Helsinki. All patients consented with the study, and the study protocol was approved by the ethics committee of the center where the study was conducted and data were analyzed.

Data was analyzed using Graph Pad InStat software. All variables were checked for normality. Data are presented as mean ± SD. The association between parameters was analyzed by Pearson correlation coefficients. Comparison

TABLE 1. Demographic characteristics of the study population

	Mean ± SD
Age (years)	65.52 ± 11.44
Gender, male	21 (77.77%)
BMI (kg/m^2)	28.75 ± 5.52
Abdominal circumference (cm)	104.33 ± 13.5
Systolic blood pressure (mmHg)	126.85 ± 17.27

TABLE 2. Metabolic parameters assessed by using standard laboratory assays

Parameter	Mean ± SD	95% CI
Glycaemia – fasting (mg/dl)	99.89 ± 30.34	87.89–111.89
Total cholesterol (mg/dl)	176.81 ± 43.09	159.77–193.86
Triglycerides (mg/dl)	140 ± 65.12	115.20–166.72
Uric acid (mg/dl)	7.78 ± 2.38	6.838–8.725

between means was performed by using the unpaired t-test. Statistical significance was set at $p < 0.05$.

RESULTS

Demographical characteristics of the 27 patients are summarized in Table 1. The metabolic parameters of patients are shown in Table 2.

The mean left ventricular ejection fraction was 49.98 ± 12.73%, and the average femoral IMT was 0.75 ± 0.25 mm. The mean values of CW Doppler parameters obtained in the study population are summarized in Table 3.

Overall, based on Pearson correlation coefficients, significant correlations were found between femoral IMT and total cholesterol levels (R = 0.383, p = 0.048), anterior and

TABLE 3. Average values of CW Doppler examination

CW Doppler site	Right	Left
Anterior tibial artery (mmHg)	86.04	83.7
Posterior tibial artery (mmHg)	92.52	92.11
Ankle-Brahial Index	0.75	0.72

posterior tibial artery pressures (R = 0.450, p = 0.018 and 0.418, p = 0.029 respectively) and Ankle-Brahial Index (R = 0.623, p = 0.005). All other parameters, summarized in Table 3 were not correlated and did not meet the threshold for statistical significance, including left ventricular ejection fraction (R = -0.143, p = 0.475).

The arterial pressure in the affected limb and the ABI were significantly lower in the group with femoral IMT >0.9 mm as compared to the group of patients with femoral IMT <0.9 mm (p = 0.001, and p = 0.015 respectively) (Figures 1 and 2).

All other parameters showed no statistically significant difference between the study groups (Table 4).

DISCUSSIONS

Based on our data, we established that femoral intima-media thickness correlates with other markers associated with the atherosclerotic process, such as the absolute values of peripheral arterial pressure and the Ankle-Brahial Index. These results bring further arguments in favor of the fact that the existence of cardiovascular risk factors contributes to the progression of atherosclerosis, and that non-invasive, ultrasonographical assessment could be an effective screening method in predicting the risk of cardiovascular events in patients with known ischemic heart disease.

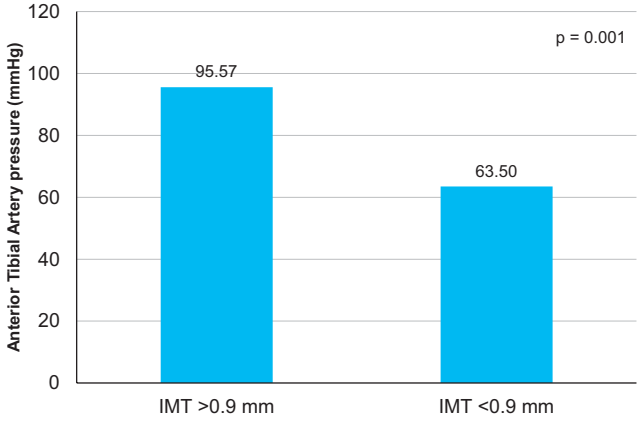

FIGURE 1. The anterior tibial artery pressure (mmHg) in the study groups.

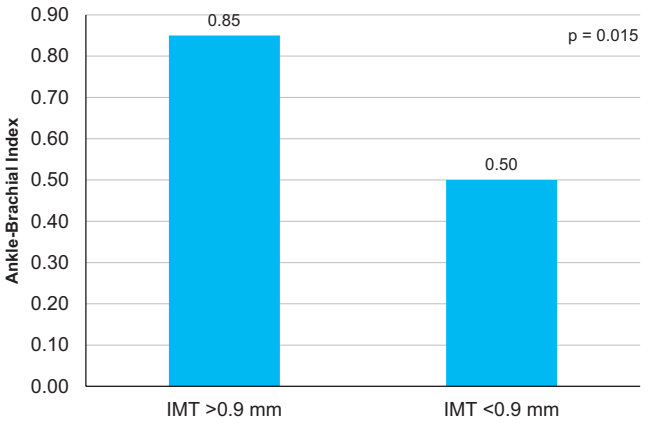

FIGURE 2. The Ankle-Brachial Index in the two groups.

TABLE 4. Comparison of means for the two groups (FIMT <0.9 mm and FIMT >0.9 mm)

Parameters	FIMT <0.9 mm	FIMT >0.9 mm	p value
Age (years)	65.15	66.63	0.71
BMI (kg/m^2)	28.39	29.66	0.58
Abdominal circumference (cm)	104.26	104.5	0.96
Glycaemia (mg/dl)	104.89	88	0.19
Total cholesterol (mg/dl)	182.47	163.37	0.3
Triglycerides (mg/dl)	136.57	151.37	0.59
Uric acid (mg/dl)	7.83	7.63	0.84
LVEF (%)	50.3	49.21	0.84
SBP (mmHg)	127.10	126.25	0.9
Minimum ATA pressure (mmHg)	95.57	63.5	0.001
Minimum ABI	0.85	0.5	0.015

LVEF – left ventricular ejection fraction; SBP – systolic blood pressure; ATA – anterior tibial artery; ABI – Ankle-Brahial Index, FIMT – femoral intima-media thickness

Despite the fact that atherosclerosis is regarded as a systemic disease, studies suggest that some vascular areas are more affected by it than others. Thus, in some cases, femoral intima-media thickness could be a better predictor of cardiovascular mortality than the carotid intima-media thickness.[10,11] However, although carotid intima-media thickness is a well established marker of subclinical organ damage and a good predictor of overall cardiovascular risk, there is paucity of data available for the femoral intima-media thickness, and the necessity of further studies to determine its place among atherosclerotic markers is largely discussed. Some studies report that the total femoral plaque volume rather than the femoral IMT is a more precise predictor of cardiovascular risk.[12]

Even if, in this study carried out on a low number of patients, no correlation was found between the left ventricular systolic function and femoral IMT, there is strong evidence suggesting that the angiographically detected coronary atherosclerosis is correlated with femoral intima- media thickness, laying the basis for further studies which would include other ultrasonographical parameters of left ventricular function.[13] Furthermore, based on data from the Rotterdam study, the authors consider that a follow-up study of the patients could bring more information about the progression of atherosclerosis, and might link the femoral IMT to major adverse cardiovascular events.[14]

Ultrasound imaging of the femoral arteries, alongside with measurements of the carotid arteries is a cost-efficient, non-invasive and reproducible method of assessment in both healthy individuals, and in patients with already established atherosclerotic disease or with known metabolic risk factors. The fact that the femoral intima-media thickness correlates with lipid levels could be used to predict future changes in asymptomatic patients as well.

There is some concern regarding the difficulty of the examination of femoral sites compared to carotid arteries, especially in overweight patients. Also, the differentiation of intima thickening as a sign of atherogenesis from media thickening (suggestive of arterial wall hypertrophy) can represent a challenge in the assessment of an increased IMT.

CONCLUSIONS

The femoral intima-media thickness was correlated with total cholesterol levels, the absolute values of peripheral arterial pressure and the Ankle-Brahial Index.

There was no significant correlation between the left ventricular systolic function and femoral IMT.

Though it is not used for screening in the general population, determining femoral intima-media thickness might be of help in assessing the overall cardiovascular risk of patients with ischemic heart disease. Femoral intima-media thickness could become a new marker of systemic atherosclerosis.

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CONFLICT OF INTEREST

Nothing to disclose.

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