Correlation of Carotid Intima-Media Thickness and Femoral Intima-Media Thickness to Coronary Artery Disease in Diabetic Patients

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Abstract

Introduction: There is no doubt that the detection, identification and early diagnosis of coronary atherosclerosis is currently a matter of extreme importance. By mean of ultrasonography we are able to examine the different layers of the wall of the carotid and femoral arteries.

Methods: 30 diabetic, asymptomatic patients, all of them will be subjected to vascular ultrasonography of both carotid and femoral arteries (IMT measurement) and the result will be correlated with stress ECG test.

Result: in our study, 30 diabetic patient, majority of then had atherosclerotic risk factors and positive stress ECG test.
Intimal media thickness above 1.0 mm is considered abnormal (> 1.0 mm). increasing IMT is show with greater numbers of risk factors include dyslipidemia, hypertension and smoking.

Conclusion: diabetes mellitus is an important risk factor that affect the relationship between CAD and carotid arterial disease.

Keyword: carotid and femoral IMT is higher in CAD.

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List of Abbreviations

IMT	Intima-media thickness
INCFIMT	Increased common femoral artery intima-media thickness
INCCIMT	Increased common carotid intima-media thickness
INCIMT	Increased both carotid and femoral intima-media thickness
CFA	Common femoral artery
CCA	Common carotid artery
LAD	Left anterior descending
LDL	Low density lipoprotein
NIDDM	Non-insulin dependent diabetes mellitus
PDAY	Patho-biological determinants of atherosclerosis in youth
RCA	Right coronary artery
TG	Triglyceride
HDL	High density lipoprotein
CHD	Coronary heart disease
VLDL	Very low density lipoprotein
IDL	Intermediate density lipoprotein
CIMT	Carotid intima-media thickness
CVD	Cardiovascular disease
MPHR	Maximum predicted heart rate
MET	Metabolic equivalent
VAM-1	Vascular cell adhesion molecule-1
FH	Familial hypercholesterolemia
CAHD	Coronary atherosclerotic heart disease
LVF	Left ventricular failure
PMNs	Polymorphonuclear neutrophils
TZD	Thiazolidinediones

Aim of the Work

The purpose of our work is to study the relation between the extent of carotid and femoral artery intima media thickness (IMT) as assessed by ultrasonography and clinical status and the extent of coronary atherosclerosis provided by coronary angiography and clinical status in diabetics patients.

Discussion

There is no doubt that the detection, identification and early diagnosis of coronary atherosclerosis is a matter of extreme importance. Coronary angiography is considered the gold standard for assessing the severity and extent of CAD. However it is an invasive maneuver that has its own risks costs and complications which limit its use as a routine in diagnosing CAD. Duplex ultrasound is a non-invasive rapid and easily reproducible tool for assessment of IMT of carotid and femoral arteries. By means of ultrasonography we are able to examine and explore the IMT of the wall of carotid and femoral arteries. In this way we can form an idea about structural changes and alteration in the arterial wall[121]. The question arises, if and to what extent the condition of the peripheral arterial vessel wall could be a reflection of the condition of the coronary arterial wall[122].

Atherosclerosis is a systemic disease initially characterized by impairment of functional properties of the vascular wall[123].
Many studies have demonstrated a correlation between the presence of CAD and peripheral atherosclerosis[124,125,126].

Many studies related carotid disease and coronary heart disease, and there have been areas of research:

1- The prevalence and degree of carotid intima media thickness has been related to the risk factors for cardoivascular[127,128] disease and to the risk of development of coronary heart disease in cohort studies of asymptomatic normal subjects[u84,85,86,88].

These studies have demonstrated a strong association between carotid, femoral disease and coronary heart disease.

The value of non invasive measurement of carotid and peripheral vascular disease in the prediction of severe coronary artery disease has been proved in cohort studies of patients with suspected ischemic heart disease[129,130].

Non-invasive measurements of carotid and peripheral vascular disease was found valuable in excluding severe coronary artery disease in certain subsets of the population with possibility of CAD. (in patients with no previous ischemic symptoms[131].

Most of these studies focus on the use of a single ultrasonographic parameter like the IMT of carotid arteries, however, none of these studies attempted to define multiple quantitative variables that would help to predict the severity and extent of CAD.

For each patient included full clinical evaluation, laboratory evaluation vascular duplex, exercise stress ECG and coronary angiography were done.

The result of each procedure will be discussed:

Clinical evaluation:

In our work we intended to include diabetic patients who are older than 39 years and has a higher prevalence of peripheral atherosclerosis.

- IMT is strongly affected by age as demonstrated in NILS-LSA, EAS and AXA studies and by Lausanne et al[24,38,63-67,132].
- There was no statistically significant difference in any of the traditional cardiovascular risk factors between the normal and CAD group in diabetic patients including, hypertension, dyslipidemia and smoking. These risk factors are independently correlating with the degree of intimal thickening[39,46,66,68,69,70,71].

There was no statistically significant difference between the increasing IMT and the number or risk factors.

In contrast to our findings a significant correlation was found between IMT in diabetic patients and the presence of hypertension and total cholesterol[136].

These findings are in concordance with the findings of NOVOS et al[126] who confirmed that higher values of IMT was in patients with coronary risk factors in comparison to patients without risk factors, carotid IMT has been shown to be related to age and diabetes, while age and male gender were related to femoral atherosclerosis.

Laboratory:

Apart from statistically significant higher fasting blood glucose in the CAD group (241 mg/dL vs 178 mg/dL, P = 0.019), there was no statistically significant difference between the normal and CAD group regarding the other laboratory investigations including lipid profile.

The higher fasting blood glucose in the CAD group. Points to the important association between diabetes and atherosclerotic coronary artery disease as has been demonstrated by the PDAY study and Robertson et al[133,134].

Serum cholesterol, blood pressure and smoking are modifiable risk factors and are key points to influence and to have effect on CHD mortality and risk in diabetes. Dyslipidemia is regarded as highly predictive cardiovascular disease risk factor but our study had shown no statistically significant difference in any of the traditional cardiovascular risk factor between normal and CAD group.

Vascular duplex:

At the present time B-mode ultrasonography is extensively used to detect early structural changes in carotid and femoral arteries because thickening process in these areas is considered to be a prognostic marker for the development of atherosclerosis and appear to correlate with coronary lesion[126].

We found insignificant correlation between IMT and presence of diabetes mellitus total cholesterol and hypertension (mean CCAIMT = 0.8, 0.83, 0.87 ± 0.18, mean CFAIMT 0.7, 0.74, 0.78 ± 0.17).

These findings are compatible with NOVOS et al[126] and Alan S et al[165] studies whom confirmed that higher value of IMT was in patients with coronary risk factors but without statistically significance.

Correlation between IMT and CAD:

In our study patients with CAD had higher both common carotid and femoral IMT, but without statistical significance regarding % diameter stenosis (mean % diameter stenosis 53.57% ± 37%) vs (37.5% ± 34.5%) p = NS.

Patients with CAD had higher common carotid IMT (INCCIMT) and higher common femoral IMT (INCFIMT), but without statistical significance (mean % diameter stenosis 57.7% ± 35%) vs (35.2% ± 34.6) p =NS (mean % diameter stenosis 61.25% ± 41.7%) vs (42.5% ± 35.3%) p = NS.

This result is not concordant with many previous pathological and ultrasonographic studies which were conducted by young et al[125], Sternby et al[135] and Holme et al[124].

In an older study (1995) by Adams et al[107], they stated that carotid IMT had a low sensitivity and specificity as diagnostic test for CAD.

Comparison between the normal and CAD group:

In our study, patients with CAD had statistically insignificance higher common carotid and femoral IMT compared to normal CA group (p = NS).

Alan S et al[136] had studied the relation between CAD risk factors and IMT in 180 patients whom were diagnosed as having CAD by coronary angiography and had shown a significantly increased IMT value were detected in the CAD group compared to the control group.

Our study is not concordant to this study, the lack of statistical power in our work might have been obviated if larger numbers of patients were studied, and our patient group were asymptomatic.

Pasirski T, et al[137], studied the association between atherosclerotic involvement of peripheral arteries assessed by ultrasound and significant CAD revealed by angiography.

In concordance with our result, this study showed that IMT of common carotid arteries did not differ between groups with and without significant CAD but in common femoral artery, it was greater in non diabetic patients with CAD which is against our result.

The majority of studies addressing the issue of the relation between carotid IMT and CAD had a low diabetes prevalence.

Increased femoral IMT group was found to be more prevalent in patients with CAD, but without statistically significant difference between both groups.

Khoury et al[138], demonstrated increased femoral IMT prevalence of 77% compared to 42% in patients with no CAD, these results were markedly higher than the prevalence of increased femoral IMT in our study. A possible explanation of this discrepancy might be that our study population were diabetics.

It is well established that lower limb atherosclerosis in diabetes is more severe in distal segments of the lower extremity while the proximal segments remains less attenuated compared with non diabetic patients[139].

We found no association between carotid and femoral IMT and the presence of CAD (p = NS).

In contrast to our result, Lekakis et al[106] and Claessens et al[140], demonstrated greater increase in mean CFA IMT in CAD patients ($p < 0.005$).

Mitsushashi et al[108], investigated the relationship between IMT and CAD in 40 type 2 diabetic patients and 40 diabetic control subjects free of CAD. They found that carotid IMT was significantly greater in diabetic patients than the control subjects (1.27 ± 0.07 vs 1.03 ± 0.04 mm, $p < 0.05$).

Similarly Mudrikova et al[141] studied 71 patients with type 2 diabetes mellitus. Patients with CAD had significantly increased IMT of CCA (p = 0.048). These studies findings are not concordant with our study.

An important study agreeing with our finding was conducted by Haffner et al[142] as a part of insulin resistance atherosclerosis (IRAS). They compare the IMT in common carotid artery in 43 diabetic subjects with clinical CAD, and 446 diabetic subjects without clinical CAD. Diabetes was

significantly associated with increased atherosclerosis in the carotid artery even without CAD.

In contrast Lanzer et al[143] Van de feen et al[139], Lüscher et al[144] and Jude et al[145] found that femoral IMT assessment is more useful than carotid IMT in detecting the presence of CAD in diabetics, because lower limb atherosclerotic disease caused by diabetes tend to spare the proximal arteries and involve the more distal vessels.

4- Exercise stress ECG:

In our wok all diabetic patients were exercised according to Bruce protocol.

The majority of our patients had additional risk factors and a positive treadmill test (66.7%).

Patients with positive stress ECG, had a higher both common carotid and femoral IMT, but without statistical significance (p = NS).

Nagai Y et al[146], determined whether CCA IMT is increased in asymptomatic older subjects with an ischemic ST-segment response to treadmill exercise and confirmed that exercise induced ST-segment depression was associated with increased IMT ($p < 0.0001$) in dependent of age and manifest CAD. Our finding are not concordant to this study.

Nowak et al[109], compared carotid ultrasonography and exercise stress test for the diagnosis of CAD in 184 symptomatic patients, evaluated with coronary angiography. The discriminating capacity of the ultrasound procedures was equal to that of exercise test.