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Volume 2 • Issue 1 • 2018

Scientia Ricerca

Mini Review

Therapeutic Advances in Cardiology

ISSN: 2575-5161

Benefits of Cimt in Diagnosis of Coronary Artherosclerosis

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Received: March 05, 2018; **Published:** May 18, 2018

Abstract

Early detection and outcome of atherosclerosis has been seen in patients of coronary artery diseases. Although various methods of measurement atherosclerosis such as carotid intima-media thickness (CIMT), pulse wave velocity (PWV), and coronary calcium score (CCS). In this review article we will try and evaluate benefits of CIMT for determination of artherosclerosis. The benefit of CIMT measurement to predict the risk of CAD in patients with risk factors hypertension, diabetes and smoking. Clinical and research use of CIMT as a surrogate marker for anti-atherosclerotic therapy.

Keywords: *CAD (coronary artery diseases); Carotid intima-media thickness (CIMT); CB carotid bulb; CCA (Common carotid artery);*

Volume 2 Issue 1 May 2018

Introduction

Different methods can be used to diagnose atherosclerosis in early pre-clinical stage. Measures including carotid intima-media thickness (CIMT), pulse wave velocity (PWV), and coronary calcium score (CCS) were used to evaluated atherosclerosis for the detection of coronary artery disease (CAD). CAD patients had higher CIMT values on both sides [1]. Following were the advantages of measurement of CIMT [2]

- Easily determination of carotid artery thickness at site of common carotid, carotid bulb and internal carotid artery.
- Repeated and reproducible and non-invasive technique.
- No discomfort to patient.
- Determination of plaque while performing CIMT measurement.
- Safer technique than CCS.
- Outcome of therapy by measuring CIMT before and after.

The study by Chao et al analyzed the relationship between carotid atherosclerosis and stable angiographic CAD. CIMT was found not to be an independent predictor of CAD in patients less than 60 years old, but that IMT-CB could predict CAD in patients above 60 years old, after adjustment for traditional risk factors. Carotid plaques in the CCA or CB were strongly correlated with CAD in all patients, carotid plaques are a strong predictor of stable CAD. However, CIMT-CB could predict stable CAD only in patients over 60 years of age. [3]

Carotid intima-media thickness (CIMT) has been shown to predict cardiovascular (CV) risk in multiple large studies. [5,6] Careful evaluation of CIMT studies reveals discrepancies in the comprehensiveness with which CIMT is assessed-the number of carotid segments evaluated (common carotid artery [CCA], internal carotid artery [ICA], or the carotid bulb), the type of measurements made (mean or maximum of single measurements, mean of the mean, or mean of the maximum for multiple measurements), the number of imaging angles used, whether plaques were included in the intima-media thickness (IMT) measurement, the report of adjusted or unadjusted models, risk association versus risk prediction, and the arbitrary cutoff points for CIMT and for plaque to predict risk.

Meta-analyses suggest that CCA-IMT alone only minimally improves predictive power beyond traditional risk factors, whereas inclusion of the carotid bulb and ICA-IMT improves prediction of both cardiac risk and stroke risk. Carotid plaque appears to be a more powerful predictor of CV risk compared with CIMT alone. Quantitative measures of plaques such as plaque number, plaque thickness, plaque area, and 3-dimensional assessment of plaque volume are more sensitive in predicting CV risk than simply determining presence of plaque. IMT measurement at the CCA, carotid bulb, and ICA that allows inclusion of plaque in the IMT measurement or CCA-IMT measurement along with plaque assessment in all carotid segments is emerging as the focus of carotid artery ultrasound imaging for CV risk prediction. [7]

Of the other methods of determining atherosclerosis, MRI measurements of wall thickness include the adventitia and may be sensitive to adventitial thickening that results from vasa vasorum proliferation as a sign of early plaque development. MRI also has the ability to image the entire circumference of the carotid wall, including the outer wall of the carotid bulb where plaque forms in its earliest stage, and identify plaque components include the lipid core, fibrous cap, and intra plaque hemorrhage that cause plaque vulnerability and cardiovascular risk. MRI has emerged as a superior noninvasive modality to characterize plaque features and image the arterial wall. Wall thickness measurements by MRI may have greater clinical utility compared with CIMT measurements by ultrasound. CIMT measurements include the sum of the intima and media, whereas MRI measurements can also include the adventitia. The adventitia is important for defining vascular inflammation because it is the source of vasa vasorum that proliferate into the arterial wall with intimal thickening and might be useful for detecting early plaque. [7]

Limitations of this imaging technique. Compared with carotid ultrasound, MRI is more expensive with a cost that can be ten times that of an ultrasound and not easily available. Because of its high purchase cost, MRI scanners tend to be less easily accessible compared with ultrasound systems. The high cost and limited availability of MRI may restrict its use as a first-line screening tool for symptomatic or asymptomatic atherosclerosis. [8]

CIMT is useful for risk prediction of coronary artery disease (CAD) and compares CIMT with other noninvasive modalities measuring carotid wall thick-ness and plaque such as MRI, 3-dimensional (3D) ultrasound, computed tomography (CT), and uorodeoxyglucose positron emission tomography (FDG-PET). [9] The ability to image the entire circumference of the carotid wall, including the outer wall of the carotid bulb where plaque forms in its earliest stage, and identify plaque components such as the lipid core, fibrous cap, and intra plaque hemorrhage that are closely related to plaque vulnerability and cardiovascular risk. Additional research is needed to assess the added prognostic value of MRI measurements of wall and plaque features in risk prediction beyond traditional risk factors.

Carotid IMT score based on normative data, adds to Framingham risk factors and a positive calcium score in predicting first-time CHD in an ethnically diverse cohort multi ethnic cohort of non-Hispanic whites, blacks, Hispanics, and Chinese, the Multi-Ethnic Study of Atherosclerosis (MESA). [10]

The accuracy of measurement of CIMT can be influenced by the specific segment, bulb or common carotid and inclusion of plaque. Age also effects the thickness of carotid arteries. [11] Carotid intima-media thickness measurement is a safe, non-invasive, inexpensive method for detecting subclinical atherosclerotic plaques and carotid artery wall thickening. It is useful tool to predict future patient risk for stroke and MI, is correlated with CV risk factors, and has become a widely used surrogate marker for the clinical trials. [12]

In preventive cardiology and the clinicians should know how best to interpret the results of clinical trials using CIMT as the primary endpoint. Another challenge is how to integrate new imaging measures such as CIMT into clinical practice. [13-15]. CIMT and plaques can be useful in assessment of risk of CAD in patients with family history of CAD, with genetic diseases (familial hypercholesterolemia) and in women with increased risk after 60 years. [16].

Study [17] shown that CIMT and carotid plaque are affected differently by the cardiovascular risk factors. Hypertension is the strongest risk factor that is responsible for increases the CIMT measurements alone and when associated with diabetes, dyslipidemia and smoking. Dyslipidemia and CAD increase the probability of carotid plaque occurrence. [17]

Stroke is a cerebrovascular disease due to pathological changes on the cerebral vessels. Ischemic stroke is the most common type of stroke with a prevalence rate of 85%. Ischemic stroke occurs due to occlusion by emboli or secondary to atherosclerosis. Early stage of atherosclerosis is vessel injury induced by multiple conditions that directly or indirectly injure the vessels. Hypertension is the most common cause of vessel injury. Hypertension or high blood pressure is a major risk factor in stroke. It has a stepping gradient in inducing vessel damage that lead to the vessels becoming stiff [18,19]

Study by Sharma K., *et al*. provide a practical guide for clinicians to use of CIMT and plaque to promote optimal clinical use of CIMT and to researchers to direct CIMT and plaque research towards investigating environmental and genetic factors of diseases causing subclinical atherosclerosis which lead to future discoveries and new anti-atherosclerotic therapies [20].

Conclusion

Although other tools such as MRI, CT, PET, calcium score are being used as techniques to determine atherosclerosis to predicting for risk of coronary artery diseases. But still Carotid intima media thickness measured by B –mode is safe, inexpensive and useful for preventive measures against coronary artery diseases and to evaluate the risk of myocardia infarction and stroke. It can predict the level of aggressive therapy required to prevent serious illness. Also it provides the clinicians and researchers to discover new anti -atherosclerotic therapies.

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