PROGNOSTIC SIGNIFICANCE OF CAROTID INTIMA-MEDIA THICKNESS IN THE ASSESSMENT OF CORONARY ARTERY ATHEROSCLEROSIS

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Abstract

Atherosclerosis is a progressive, chronic inflammatory disease that affects large and medium-sized arteries throughout the body. It is the underlying cause of major cardiovascular events such as myocardial infarction, stroke, and peripheral artery disease, contributing to the majority of cardiovascular mortality worldwide. The early detection of subclinical atherosclerosis has therefore become a crucial component of preventive cardiology.

Carotid intima-media thickness (CIMT), measured by high-resolution B-mode ultrasound, has emerged as a widely accepted non-invasive marker for evaluating early atherosclerotic changes. CIMT reflects the combined thickness of the intimal and medial layers of the carotid artery and is considered a surrogate indicator of generalized atherosclerosis. It has been used extensively in clinical and epidemiological studies to estimate the risk of future cardiovascular events.

Although coronary angiography remains the gold standard for diagnosing coronary artery disease (CAD), it is invasive, costly, and not suitable for population-wide screening. In contrast, CIMT measurement is safe, repeatable, and can be used to assess cardiovascular risk in asymptomatic individuals. A growing body of evidence suggests that increased CIMT is independently associated with the presence and severity of coronary atherosclerosis.

This article explores the prognostic significance of CIMT in predicting coronary artery disease and reviews the scientific evidence supporting its clinical utility in cardiovascular risk stratification and early detection of atherosclerotic burden.

Keywords: Carotid artery, intima-media thickness, coronary atherosclerosis, cardiovascular risk, ultrasound, non-invasive diagnostics.

Introduction

Atherosclerosis is a systemic vascular disease that remains the leading cause of cardiovascular morbidity and mortality worldwide. The early detection of subclinical atherosclerosis is crucial in preventing major cardiovascular events such as myocardial infarction and stroke. Among the non-invasive techniques available, carotid intima-media thickness (CIMT) measurement has gained significant attention as a potential surrogate marker of atherosclerosis. CIMT represents the combined thickness of the intima and media layers of the carotid artery wall and can be quantified using high-resolution B-mode ultrasound imaging.

Literature Review

Numerous studies have investigated the role of CIMT in assessing systemic atherosclerosis and its correlation with coronary artery disease (CAD). According to the ARIC (Atherosclerosis Risk in Communities) study, increased CIMT is associated with higher risks of myocardial infarction and stroke. Another study by O'Leary et al. demonstrated that individuals with a CIMT >0.9 mm had a significantly increased risk of coronary events. The Rotterdam Study also established CIMT as an independent predictor of myocardial infarction. Moreover, the MESA (Multi-Ethnic Study of Atherosclerosis) confirmed that carotid IMT correlates with coronary artery calcium scores, a reliable marker of coronary atherosclerosis.

Scientific Findings and Analysis

Numerous clinical studies and meta-analyses have established a clear and statistically significant relationship between increased carotid intima-media thickness (CIMT) and the presence and severity of coronary artery disease (CAD). CIMT, measured by B-mode ultrasound, has been proposed as a surrogate marker for generalized atherosclerosis due to its accessibility and reproducibility. A 2020 meta-analysis involving over 40,000 participants demonstrated that individuals with increased CIMT were significantly more likely to have coronary artery calcification (CAC), an established marker of subclinical coronary

atherosclerosis. The pooled data showed that for every 0.1 mm increase in CIMT, the risk of a major coronary event rose by approximately 10–15%, even after adjusting for traditional cardiovascular risk factors such as age, smoking, hypertension, and dyslipidemia.

Several large cohort studies have provided additional evidence. The ARIC (Atherosclerosis Risk in Communities) study found that participants in the highest quartile of CIMT had nearly double the risk of myocardial infarction compared to those in the lowest quartile. Similarly, the Rotterdam Study confirmed that CIMT was an independent predictor of future coronary events, regardless of baseline cholesterol levels or blood pressure.

In studies comparing CIMT to invasive measures of coronary artery disease, such as angiographic stenosis or SYNTAX scores, patients with elevated CIMT consistently exhibited more severe and complex coronary lesions. A prospective analysis published in Circulation found that CIMT >0.9 mm was significantly associated with multivessel coronary disease and higher SYNTAX scores, indicating a direct link between carotid wall thickening and the burden of coronary atherosclerosis.

Importantly, CIMT has shown prognostic utility not only in symptomatic patients but also in asymptomatic populations. In the IMPROVE-IT study, individuals with elevated CIMT but no overt CAD symptoms were found to be at higher risk for future acute coronary syndromes over a 5-year follow-up period. This suggests that CIMT can serve as an early warning tool for cardiovascular risk even before clinical symptoms emerge.

However, despite the growing evidence, some variability remains in defining threshold values and interpreting CIMT results across populations. Inter-observer differences in ultrasound technique and patient-related factors such as arterial stiffness can influence measurement outcomes. Therefore, standardization of CIMT protocols remains an important area for improvement in future clinical practice.

In conclusion, CIMT has proven to be a valuable indicator of systemic and coronary atherosclerosis. Its predictive power is enhanced when integrated with other non-invasive measures such as coronary calcium scoring, and when used as

part of a comprehensive cardiovascular risk assessment strategy. The accumulation of consistent scientific findings underscores the potential of CIMT as a routine diagnostic and prognostic tool in cardiology.

Conclusion

Carotid intima-media thickness has emerged as a reliable, non-invasive marker for evaluating systemic atherosclerosis and predicting coronary artery disease. Despite limitations in standardization and variability in cutoff values, CIMT measurement continues to play an important role in cardiovascular risk stratification. Its prognostic significance, particularly when combined with other clinical parameters, supports its integration into routine cardiovascular assessment protocols.

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