Carotid Intimomedial Thickness – A Non-Invasive Index of Vascular Health

Sumedh S Hoskote*, Shashank R Joshi**

In 1986, the use of ultrasound imaging to measure the intima and media of the carotid arteries was reported for the first time. The in vivo use of ultrasound imaging for assessment of atherosclerotic changes in the carotid arteries was first reported in 1991 from Finland. Over the years, this modality of investigation has been extensively studied and, today, the carotid intimomedial thickness (CIMT) is regarded as one of the most reliable markers for atherosclerotic vascular changes.

In India, the burden of chronic non-communicable diseases, like atherosclerosis, is on the rise and, increasingly, efforts need to be focussed on their early detection and treatment. Asian Indians are an ethnically vulnerable race for developing metabolic syndrome and diabetes, both of which are well-known contributors to the pathogenesis of atherosclerotic vascular disease. Sub-clinical diabetes is an important vascular risk for Asian Indians. Apart from these, atherosclerosis is also known to develop in patients of hypertension, chronic autoimmune vasculitides or arthritis, polycystic ovarian syndrome and in patients receiving dialysis. The importance of preventive screening, risk stratification and management of atherosclerosis cannot be overemphasized.

The CIMT has been shown in numerous studies to be a non-invasive, economical, reliable and sensitive marker for atherosclerosis. To measure the CIMT, duplex scanning of the carotid arteries is performed. This refers to the use of Doppler (to estimate blood flow characteristics) in conjunction with conventional 2-dimensional (B-mode) ultrasound. Depending on the scanning protocol used, specific pre-determined bilateral sites in the vicinity of the carotid bifurcation are selected for measurement of parameters. The images obtained using the 8-mode scan are then measured for the intima-media thickness, while the Doppler assessment is used to gauge the impedance to blood flow caused by the narrowing induced by the plaque. Use of computer software can provide a more accurate reading, a reduction in analysis time and elimination of inter-observer bias.

The CIMT has been applied in various clinical scenarios. The most extensive use of this modality occurs in risk-stratification for stroke. In patients recovering from stroke, the CIMT can be used as a predictor of long-term functional outcome. The CIMT is also a reliable marker for coronary atherosclerosis and peripheral vascular disease. A meta-analysis of the predictive value of the CIMT reported that the risk for stroke is more closely tied to the CIMT than the risk for CAD. It also finds application in the field of research, where therapeutic options are being studied for cardiovascular benefits. Awaiting actual clinical endpoints of atherosclerosis (myocardial infarction, stroke, death) is often impractical and unethical while evaluating modes of treatment. In such situations, the CIMT acts as a surrogate marker and provides evidence of disease status before and after the intervention. The CIMT is useful tool to prevent stroke in patient undergoing vascular interventions (angiography, angioplasty or bypass surgery). The CIMT has also been used in diseases such as rheumatoid arthritis and giant-cell arthritis to predict accelerated atherosclerosis in these patients.

A study published in the current issue of JAPI by Agarwal et al.10 examined the CIMT in Indian diabetic patients. The study found a higher CIMT in diabetics who had coronary artery disease (CAD), even when the CAD was not clinically overt. This led the authors to conclude that the CIMT is a reliable surrogate marker for subclinical CAD in diabetic patients.

Another study published in the current issue, by Mahajan et al.,11 is only the second Indian study examining the extent of atherosclerosis in patients with rheumatoid arthritis (RA). The authors conclude that patients with RA had significantly greater CIMT values than age-sex-matched controls, indicating the association of rheumatoid arthritis with premature atherosclerosis.

As regards coronary and cerebrovascular risk-stratification, the gold-standard test is the radiocontrast angiography. This offers the added benefit of revealing the number of coronary or cerebral arteries involved and the degree of block in each. However, the procedure carries anesthetic risk, is more expensive and may be unsuitable in certain patient subsets (e.g. in renal failure). The alternatives to angiography, apart from CIMT, are use of computed tomography (CT) or, more recently, magnetic resonance imaging (MRI) for angiography, or the use of an intravascular ultrasound probe to visualize intimal plaques.

*Research Associate, Joshi Clinic, **Endocrinologist, Lilavati Hospital, Bhattia Hospital and Joshi Clinic; Department of Endocrinology, Seth GS Medical College and KEM Hospital, Mumbai.
Their applications are limited, as use of CT involves heavy radiation exposure (~100 times a plain chest X-ray) and use of radiocontrast, MRI involves a high cost, while intravascular ultrasound is an invasive technique. The CIMT, apart from being non-invasive and inexpensive, can be used safely in patients with low glomerular filtration rate, who may be at an increased risk of developing contrast nephropathy.

Research is ongoing on other modalities to detect subclinical atherosclerosis and predict coronary and cerebrovascular events. The coronary artery calcium (CAC) is a CT-based measurement of calcium deposits in the coronary arteries, and has been shown as a better predictor of cardiovascular risk than CIMT. However, this modality does have the disadvantage of exposing the patient to radiation. The resistive index (RI) is a measure of impedance to blood flow and has been measured for the carotids to assess subclinical atherosclerosis. A 6-year study compared RI and CIMT for their value in detecting and measuring progression of subclinical atherosclerosis. The study found that CIMT is a better modality for measuring disease progression, in addition to being a reliable predictor of subclinical atherosclerosis.

A relatively new measure, the coronary artery inter-adventitial distance, is also being evaluated and has been found to be a good predictor of cardiovascular risk. Recently, the ankle-brachial index has also been studied as a clinical aid to estimate subclinical atherosclerosis and its use has been suggested as a precursor to CIMT measurement.

Given the strong body of evidence for its use, carotid doppler and CIMT should become routine screening tools for atherosclerosis in India. We have a population with a high incidence of diabetes, a high prevalence of dyslipidemia and, with increasing urbanization, an ever-increasing population with detrimental lifestyle changes. Detection and appropriate management of subclinical atherosclerosis will go a long way in preventing life-threatening complications related to atherosclerosis, thus prolonging survival and increasing quality of life.

REFERENCES