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Speckle Tracking of Common Carotid Artery: A New Method for the Evaluation of Mechanical Vascular Function of Atherosclerosis

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As cardiovascular death remains major cause of death worldwide, there are growing needs for risk evaluation for cardiovascular event. Arterial stiffness, which refers to the rigidity of arterial wall, increases in the elderly person as well as patients with atherosclerotic disease. Based on the belief that increased vascular stiffness precedes atherosclerotic vascular event, there were attempt to measure vascular stiffness. In this regard, carotid-femoral pulse wave velocity (PWV) using tonometry has been proven to be simple, noninvasive measurement of vascular stiffness, as it is inversely related with vascular compliance. Stiff and rigid vessel would transfer pulse wave faster and PWV be higher.[1)]

On the other hands, carotid intima-media thickness (CIMT) using ultrasound is well correlated with cardiovascular risk and is commonly used as surrogate marker of systemic atherosclerosis.[2)3)] Current advance in automated imaging analysis made it much easier to obtain CIMT in daily clinic and reproducibility of the measurement got even better.

Another approach to obtain information about vascular stiffness was ultrasound-based measurement of regional mechanical properties of arterial wall.[4)] This method includes the measurement of changes in the dimension of an artery generated by each pulse pressure. From the pressure and diameter measurement, variables regarding vascular stiffness such as distensibility, compliance, elastic modulus index and beta stiffness index can be calculated.

More recently, technical advance in speckle tracking method, which originally used for the measurement of ventricular deformation, was applied to the evaluation of vascular stiffness. Automated analysis of vascular wall mechanics using speckle tracking became available not only to obtain longitudinal and radial displacement but also calculate circumferential strain, which is theoretically equal to the radial change if the circumference of a vessel is circle because radius is linear to the circumference in a circle.

In this issue of journal of cardiovascular ultrasound, they evaluated examine the additional value of multi-directional functional mechanics of the carotid artery in relation to cardiovascular risk in the manuscript entitled as "the value of elastic modulus index as a novel surrogate marker for cardiovascular risk stratification by dimensional speckle-tracking carotid ultrasonography".[5)] The main message was that assessment of the mechanical property of carotid artery using specialized software was feasible and that radial and longitudinal strain, CIMT as well as elastic modulus index could be obtained. Most importantly, mechanical vascular property assessed as elastic modulus index along with CIMT were independently associated with high risk profile for cardiovascular disease expressed as Framingham risk score. This means that carotid artery evaluation using ultrasound could evaluate not only morphologic change from atherosclerotic process but also functional mechanical property of vascular stiffness and could provide prognostic information of the subject.

Elastic modulus index, which is reversal of distensibility is calculated as $\Delta P / (\Delta D/D)$.[6)] If the artery is circle, $\Delta D/D$ is equal to the radial strain and circumferential strain. As corrected radial or circumferential strain is calculated as strain/ΔP or $(\Delta D/D) / \Delta P$, the elastic modulus index is exactly a reversal of the corrected strain. The finding of independent association

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of elastic modulus index with cardiovascular risk profile is important considering recent increased interest in circumferential mechanics at carotid artery.[6]

There are several limitations on the study as the author had admitted. As it was retrospective analysis and cross-sectional association study, it needs to be reproducible in the prospective cohort of large population with wide range of population. Furthermore they did not include circumferential strain measurement in the study, which is most promising and reproducible method theoretically. Most importantly this kind of approach is not yet fully established and several algorithms are commercially available. So there should be more works to confirm reproducibility, to find normal reference values according to age and sex, as well as to standardization of measurement method. However, message of the current study that mechanic property of carotid artery are related with cardiovascular in relatively large population is straight forward and further evaluations using this kind of multidimensional approach of both morphological and functional change in the prediction of cardiovascular event are needed especially using circumferential vascular speckle tracking.

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