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Speckle Tracking Ultrasound: Role in Cerebrovascular Imaging

Pooja Sethi Zia Ur Rahman, MD Ghulam Murtaza, MD Aitzaz Bin Sultan Rai, MD

Cardiology Fellow
East Tennessee State University, Johnson City, TN.
Resident Internal Medicine
East Tennessee State University, Johnson City, TN.

Speckle tracking ultrasound is an emerging modality. It involves tracking of ultrasound derived speckles formed by constructive and destructive interference of ultrasound waves(1). Tracking algorithms track a set (kernel) of speckles frame by frame throughout the cardiac cycle. In this way, deformation measures like strain and strain rate are calculated. Speckle tracking ultrasound has emerging applications in the field of cerebrovascular imaging.This technique has various applications as detailedas below.

Laser speckle imaging during neurosurgical procedures help measures intra-operative cortical blood flow.Monitoring of the cerebral microcirculation is crucial, because tissue viability and clinical outcome depend on restoration of blood flow to an ischemic region in a timely manner. Traditionally,intraoperative visualization of vessel perfusion is routinely accomplished by indocyanine green (ICG) video angiography and off-line transit-time calculations to predict cortical blood flow.(2). However laser speckle imaging provides a more accurate and direct measurement of the same.

Multiexposure speckle imaging(MESI) afterbrain injury is an upcoming technique being studied in mouse models. This technique provides a quantitative measure of adequately measuring post occlusion cortical blood flow. The MESI flow measurements and volume fractions are shown to have high co-relation within areas of recovering vasculature in peri-infarct area(3). Thistechnique will aid in guiding recovery post thrombolytic therapy and other pharmacotherapy in patients with cerebrovascular arterial occlusion due to trauma or stroke.

Swillens et al (4) compared Speckle Tracking with Crossed Beam Vector Doppler in imaging of blood flow across carotid bifurcation and found Speckle Tracking a better imaging technique for the detailed study of blood flow in carotid arteries.2 D Speckle Tracking was used to assess vascular stiffness in people with cardiac risk factors and it was found to be a reliable and reproduciblemethod to study carotid artery mechanics in patients with intermediate cardiac risk factors for further risk stratification of these patients for future cardiovascular complications (5).

Lee et al found Speckle Tracking as a good imaging technique to follow patients with rheumatoid arthritis by measuring elastic properties of the carotid arteries to determine the long term vascular complications of rheumatoid arthritis in the form of carotid artery stiffness which directly correlated with prolonged disease activity in rheumatoid arthritis patients.(6). When used in healthy subjects, 2 D Speckle Tracking was found to be an accurate, fast and reliable method to assess carotid artery stenosis. (7). New Framework (Genlik wavelet based noise reduction) of Speckle tracking have been used successfully as an accurate and reproducible method to diagnose periventricular leukomalacia in premature neonates (8).

Speckle tracking ultrasonography was used by Roberts et al (9) in the study of 28 neurosurgery operations to quantify cortical surface motion. A mean displacement of 1 cm was noted which correlated directly with the duration and invasiveness of the surgery while no correlation was found between the amount of shift with the type of surgery, use of osmotic agent and the size, position or orientation of the cranial opening.

Speckle tracking in brain imaging is an upcoming field. More studies and experience is needed in the field before we can see its wider and broader spread use in clinical practice.

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