

Vendor Specific Ultrasound Grayscale Ranges for Identifying Carotid Plaque Composition

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Background: Atherosclerotic plaque composition is important for identifying vulnerable lesions. Pixel distribution analysis (PDA) uses ultrasound grayscale pixel ranges to identify the tissue composition of plaque. However, current PDA ranges were established in 2002 and require reevaluation using modern systems. The purpose of this study was to define PDA ranges for major plaque tissue components using current ultrasound technology and compare them between vendors (General Electric (GE) and Philips Healthcare).

Methods: Healthy adult participants (n=20) with no cardiovascular history underwent B-mode ultrasound of representative body parts associated with tissue-like components of plaque: carotid artery lumen (blood), abdomen (fat), bicep (muscle), iliotibial band (fibrous), and humerus bone (calcium). Two ultrasound systems were used (GE Vivid E9 and Philips iU22). The lumen of a blood vessel was included in all frames for image normalization to blood (grayscale median 0), and the upper limit was set to 190 (representing adventitia). DICOM images were uploaded to a semi-automated software called IntelliPlaqueTM for PDA analysis. A region of interest was selected on each image and used to determine the GSM of each tissue.

Results: The greyscale median (PDA ranges) for blood, fat, muscle, fibrous, and calcium respectively were 0 (0-0.3), 11 (8-19), 32 (19-46), 64 (46-80), and 134 (127-140) for GE, and 0 (0), 18 (9-26), 39 (30-50), 66 (61-83), and 220 (203-223) for Philips (Figure). These ranges were similar to previously established PDA

ranges (0-4, 8-26, 41-76, 112-196, 211-255). The GSM for calcium had a significantly lower GSM on the GE system than the Philips system ($p < 0.0001$).

Conclusions: Updated ultrasound PDA ranges were established for two vendors and compared to historical ranges. System variability exists for the identification of calcium plaque tissue component. The use of updated and machine-specific PDA ranges may increase the accuracy in identifying unstable plaque prone to rupture and causing cardiovascular events.

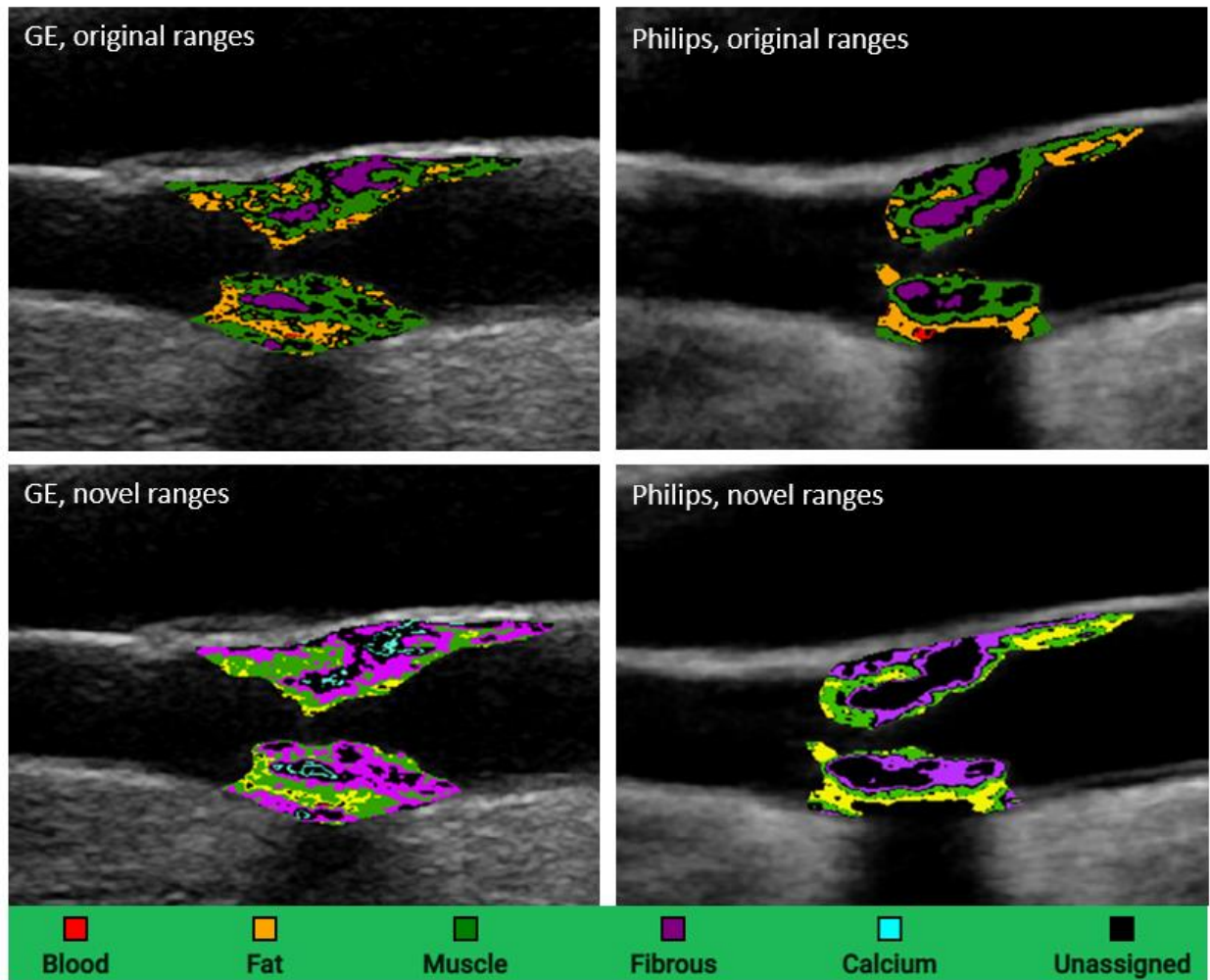


Figure. Analysis of a representative carotid bulb.