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Regional analysis of 3D-derived speckle tracking for the assessment of myocardial deformation in breast cancer patients submitted to anthracycline chemotherapy

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Introduction: Serial echocardiographic assessment of left ventricular ejection fraction (LVEF) and 2D left ventricular global longitudinal strain (GLS) is the gold standard in screening for cancer therapeutics-related cardiac dysfunction (CTRCD). Myocardial deformation assessed with 3D speckle tracking is not currently used in this setting, because of the lack of standardization and cut-off values, in spite of a potential for a greater reliability.

Methods: Prospective study of female breast cancer patients submitted to anthracycline chemotherapy with or without adjuvant immunotherapy and/or radiotherapy who underwent serial monitoring by 2D and 3D transthoracic echocardiography (ETT). Standard ETT measures and 3D-derived volumetric measures were assessed. Speckle tracking was used to estimate 2D-derived GLS – average and 18 segments – and 3D-derived GLS, global circumferential strain (GCS), global area strain (GAS) and global radial strain (GRS) – average and 17 segments. CTRCD was defined as an absolute decrease in 2D or 3D LVEF > 10% to a value < 54% or a relative decrease in 2D GLS > 15%. Variables were compared using the t-student paired test and the Wilcoxon sign-rank test, when appropriate.

Results: 106 patients (mean age 54.6 ± 12.9 years, 33.0% immunotherapy, 16.5% radiotherapy, baseline LVEF 64.5 % ± 8.5%, baseline 2D GLS -21.0 ± 2.8) were included. During a mean follow-up of 16.5 ± 9.6 months, an average of 3.9 echocardiographic examinations were performed per patient and 28 patients (26.4%) developed CTRCD. Overall, 3D regional longitudinal strain was determined in 88.9% of the segments analyzed, with lower success rates in the inferobasal (75.0%), the posterobasal (77.7%) and the laterobasal (82.4%) walls. When comparing variables before and during treatment, there was a significant difference in 2D-derived LVEF (64.5 vs. 57.6 p < 0.001), 3D-derived LVEF (60.1 vs. 55.7 p 0.002), 2D-derived GLS (-20.6 vs. -18.2 p < 0.001), 3D-derived GLS (-13.8 vs. -12.9 p 0.035), 3D-derived GRS (31.9 vs. 33.4 p 0.024), but not in GCS (-14.5 vs. -13.2 p 0.656) and GAS (-21.5 vs. -22.1 p 0.640). Figure 1 shows the segmental analysis of 2D and 3D strain parameters. In 2D GLS, 11 out of 18 segments showed decreased contractility during follow-up (mainly anterior septum and anterior, lateral and inferior walls). In 3D-derived strain parameters, only 3 out 17 for GLS, 2 out of 17 for GCS, 1 out 17 for GRS and none for GAS showed decreased contractility during follow-up.

Conclusion: In this population, there was worsening of 3D GLS and GRS, besides conventional values, such as LVEF and 2D GLS, during anthracycline-based cancer treatment. 3D-derived myocardial deformation parameters show promise in the setting of CTRCD, since 2D and 3D regional strain parameters might shed light onto the mechanisms of CTRCD, such that subendocardial myocardial fibers seem to be more affected than medial and subepicardial fibers.
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