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Behavior of 2D and 3D derived ejection fraction and strain in patients with Hodgkin and non-Hodgkin lymphoma undergoing anthracycline-based chemotherapy, a prospective study

Authors:
LF Nhola¹, T Daramola¹, S Barros-Gomes¹, JS Rico-Mesa¹, MC Arciniegas¹, EA Oehler¹, J Herrmann¹, CG Scott¹, PA Pellikka¹, JR Cerhan¹, CA Thompson¹, HR Villarraga¹, ¹Mayo Clinic - Rochester - United States of America.

Topic(s):
Cardio-Oncology

Citation:
Department of Cardiovascular Medicine-Mayo Clinic Rochester MN

Background: Anthracyclines are one of the most effective chemotherapeutic agents but can lead to a decline in cardiac function. Two-dimensional (2D) speckle tracking echocardiography derived strain can predict cancer therapeutics-related cardiac dysfunction (CTRCD). However, little is known about the role of three-dimensional (3D) strain imaging in this setting.

Purpose: To evaluate different methods of Left Ventricular Ejection Fraction (LVEF) and strain, and to identify the best strain parameter for the prediction of CTRCD in this group of patients during treatment with anthracycline based chemotherapy.

Methods: Patients with Hodgkin’s or non-Hodgkin’s lymphoma receiving anthracycline based chemotherapy were enrolled. 2D- and 3D echocardiography was performed at 3 time points: baseline, at the completion of chemotherapy and at 1 year. 2D- and 3D LVEF (2D Modified Quinones, M-mode, 2D Biplane, 3D Philips, 3D GE and 3D TomTec), peak systolic left and right ventricular longitudinal, radial and circumferential strain and strain rate were measured. CTRCD was defined as a decrease in LVEF >10% to an absolute value of <53%. Lin’s Concordance Correlation Coefficient (CCC) was calculated to compare LVEF. ANOVA, uni and multivariate analysis was performed.

Results: A total of 130 patients (79 males, mean age 57±16 years) were enrolled; 104 non-Hodgkin.3D Philips and GE (CCC 0.88 [0.84, 0.92]), 3D Philips and biplane (CCC 0.84 [0.79, 0.89]), 3D Philips and Modified Quinones (CCC 0.86 [0.82, 0.91]) as well as 3D Philips and M-mode (CCC 0.77 [0.70, 0.85]) showed strong correlation for LVEF. 15 patients (12%) developed CTRCD. Mean cumulative anthracycline dose was 263±65 mg/m². 2D and 3D global longitudinal and circumferential peak systolic strain, 2D global longitudinal systolic and early diastolic strain rate, 2D global early diastolic strain rate, 2D right ventricular longitudinal peak systolic strain and systolic strain rate, 2D global radial peak systolic strain and systolic strain rate measured at the completion of chemotherapy were independent predictors of the development of CTRCD at 1 year post-chemotherapy. The strongest predictors of CTRCD were 3D global longitudinal and circumferential strain either individually (area under the curve, 0.90 and 0.95 respectively) or combined (area under the curve, 0.95) at the completion of chemotherapy; a cutoff value of <-18% in 3D global longitudinal strain had a sensitivity of 82% and specificity of 99%, while for 3D global circumferential peak systolic strain of <-24% had a sensitivity of 82% and specificity of 95%. Conclusions: To our knowledge this is the first prospective trial that shows that 3D EF correlates well with other EF methods and 3D strain predicts cardiac toxicity in this group of patients with a very good sensitivity and specificity.