Tissue Doppler, Speckle Tracking and Strain Imaging

Myocardial work brings a new insight into left ventricule remodelling in cardiooncology patients

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Funding Acknowledgements: Type of funding sources: None.

Introduction: Serial echocardiographic assessment of 2D left ventricular ejection fraction (LVEF) and global longitudinal strain (GLS) is the gold standard screening method for cancer therapeutics-related cardiac dysfunction (CTRCD). Non-invasive left ventricular (LV) pressure-strain loop (PSL) provides a novel method of quantifying myocardial work (MW) with potential advantages, as it incorporates measurements of myocardial deformation and LV pressure.

Purpose: To evaluate the impact of cardiotoxic treatments in MW indices.

Methods: Prospective study of female breast cancer patients (P) submitted to therapy (TH) who underwent serial monitoring by 2D, 3D transthoracic echocardiography (TTE) and concomitant blood pressure assessment. P were evaluated at T0, T1 and T2 (before, ≥6 and ≥12 months after starting TH). PSL analysis allowed the calculation of the following indices: Global Work Index (GWI), Global Constructive Work (GCW), Global Work Waste (GWW) and Global Work Efficiency (GWE). CTRCD was defined as an absolute decrease in 2D LVEF > 10% to a value < 54% or a relative decrease in 2D GLS > 15%, according to literature.

Results: 122 patients (mean age 54.7 ± 12.0 years), mostly treated with anthracyclines (77.0%, cumulative dose 268.6 ± 71.8 mg/m2), anti-HER (75.4%) and radiotherapy (77.0%) were included. 2D and 3D LVEF were significantly reduced during TH, however remaining within the limits of normality (2D LVEF T0-T1 64.2 ± 7.6 vs 61.1 ± 8.2 %, p = 0.006 and 3D LVEF T0-T1 60.2 ± 6.7 vs 56.9 ± 6.3 %, p = 0.022). 2D GLS was also more impaired at T1 (-19.8 ± 2.7 % vs -18.5 ± 3.0 %, p = 0.003).

All MW indices were significantly reduced at T1 compared to baseline (GWI 1756.9 \pm 319.2 vs 1614.3 \pm 338.5mmHg%, p = 0.005; GCW 2105.6 \pm 352.0 vs 1970.5 \pm 376.2 mmHg%, p = 0.015; GWW 121.1 \pm 66.6 vs 161.1 \pm 84.1 mmHg%, p = 0.001; GWE 93.5 \pm 3.1 vs 91.1 \pm 4.5%, p = 0.001). Between T1 and T2 no statistical difference was found but a partial recovery of parameters was observed when comparing T2 to T0 (GWI (T2) 1650.6 \pm 357.5 mmHg%, p = 0.035; GCW (T2) 2013.3 \pm 379.3 mmHg%, p = 0.086; GWW (T2) 148.0 \pm 85.0 mmHg%, p = 0.02 and GWE (T2) 92.0 \pm 4.7%, p = 0.012).

During a mean follow-up of 14.9 ± 9.3 months, 36 patients (29.5%) developed CTRCD. P presenting CTRCD revealed a significant decrease in GWI and GWE at T1 comparing with women without CTRCD (GWI 1.8 ± 21.6 vs -14.2 ± 18.5 %, p = 0.004 and GWE -1.0 ± 3.0 vs -3.6 ± 3.9 %, p = 0.005). GWW had a substantially increase at T1 in P with cardiotoxicity (27.6 \pm 76.3% vs 64.1 ± 68.0 %, p = 0.051).

Conclusion: Left ventricular systolic function study with MW showed a reduction in cardiac performance with a peak at 6 months from the start of chemotherapy and partial recovery after term. Assessment of myocardial deformation parameters, namely MW, proved to be a useful tool for a better characterisation of cardiac remodelling, and could enhance patient selection for cardioprotective therapeutics.

Abstract Figure. TTE parameters

TTE Variable	то	т1	T2	p-value (T0 vs T1)	p-value (T1 vs T2)	p-value (T0 vs T2)
2D LAEDV (ml)	44.4±14.8	50.3±14.1	48.6±15.1	0.007	0.424	0.049
2D LVEDV (ml)	75.1±19.0	82.9±20.2	78.9±18.6	0.005	0.122	0.137
2D LVESV (ml)	27.0±10.0	32.5±12.2	30.5±11.2	0.001	0.204	0.019
2D LVEF (%)	64.2±7.6	61.1±8.2	61.6±8.0	0.006	0.656	0.016
2D GLS (%)	-19.8±2.7	-18.5±3.0	-18.7±3.1	0.003	0.686	0.012
3D LVEF (%)	60.2±6.7	56.9±6.3	58.7±5.5	0.022	0.166	0.271
3D LVEDV (ml)	81.8±18.5	91.4±18.8	84,2±18.8	0.017	0.079	0.545
3D LVESV (ml)	32.8±10.6	39.8±11.7	34.9±9.8	0.005	0.046	0.332
GWI	1756.9±319.2	1614.3±338.5	1650.6±357.5	0.005	0.465	0.035
GCW	2105.6±352.0	1970.5±376.2	2013.3±379.3	0.015	0.427	0.086
GWW	121.1±66.6	161.1±84.1	148.0±85.0	0.001	0.281	0.02
GWE	93.5±3.1	91.1±4.5	92.0±4.7	0.001	0.171	0.012