EARLY EFFECTS OF ANTHRACYCLINE CONTAINING CHEMOTHERAPY ON LEFT VENTRICULAR STRAIN AND STRAIN RATES USING 2D SPECKLE TRACKING ECHOCARDIOGRAPHY

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Introduction

Anthracyclines (ANT) are a widely used group of drugs, but their use is limited by their cardiotoxic effects. Detection of early effects of ANT and prediction of future occurrence of cardiotoxicity have been always endeavored. Left ventricular ejection fraction (LVEF) is the most widely used parameter to monitor cardiotoxicity, but reduction of LVEF occurs relatively late. Speckle tracking echocardiography is a relatively new modality to detect subclinical myocardial affection following ANT administration. Assessment of subclinical chemotherapy related cardiac dysfunction could allow early introduction of medical therapies, reduction of ANT doses, finding new alternatives and close follow-up which eventually prevents further deterioration of cardiac function and development of heart failure.

Aim of the work

The aim of the study was to detect early effects of ANT-containing chemotherapy using two-dimensional speckle tracking echocardiography (2D STE).

Patients and Methods

The study was conducted on 100 patients receiving ANT-containing chemotherapy for the first time. Exclusion criteria were preexisting heart disease (ischemic heart disease, complete bundle branch block, more than mild valvular heart disease, arrhythmias, heart failure, prosthetic valves and pacemakers), concomitant use of cardiotoxic drugs as trastuzumab in patients with breast cancer, previous cardiotoxic chemotherapy administration and previous or concomitant radiotherapy. All the patients were subjected to complete history taking, a standard resting 12 lead ECG (performed before and after completion of chemotherapy), laboratory markers [serum urea, creatinine, complete blood count (CBC) were obtained at baseline and after completion of chemotherapy and marker of myocardial injury (baseline and follow-up high sensitivity cardiac troponin I (hs-cTnI) were assessed within one week after the last cycle of chemotherapy)] and echocardiographic assessment including conventional echocardiography, 2D STE and 3D left ventricular ejection fraction.

Results

Table (1):Distribution of the studied cases according to cancer type, chemotherapy regimen and troponin I level

		Patients (n = 100)
Cancer type	Acute myeloid leukemia	6(6%)
	Breast cancer	85(85%)
	Hodgkin's lymphoma	6(6%)
	Non-Hodgkin's lymphoma	3(3%)
Chemotherapy Regimen		
Type	ABVD	6(6%)
	AC	77(77%)
	DC	6(6%)
	RCHOP	3(3%)
	TAC	8(8%)
Cumulative dose of anthracyclines (mg)		439.0 ± 55.66
Length of treatment cycles (weeks)		12.50 ± 4.08
Troponin I Level (Post-Therapy)		
Troponin I (ng/mL)		0.24 ± 0.37
Negative		78(78%)
Positive		22(22%)

Data are presented as mean ± SD and frequency (%). ABVD: doxorubicin (Adriamycin), bleomycin, vinblastine, dacarbazine. R-CHOP: rituximab, Cyclophosphamide, Doxorubicin Hydrochloride, Vincristine Sulfate (Oncovin), Prednisone. AC: doxorubicin (Adriamycin), cyclophosphamide. DC: Daunorubicin, Cytarabine. TAC: docetaxel (Taxotere), doxorubicin (Adriamycin), cyclophosphamide.

Table (2) :Comparison between pre-therapy and post-therapy according to systolic and diastolic dimensions of the left ventricle, LVEF, diastolic function parameters, longitudinal strain, circumferential Strain (n = 100).

		Pre-therapy	Post-therapy	P value
Systolic and diastolic dimensions of the left ventricle				
Diastolic	2D (mm)	48.85 ± 5.34	50.90 ± 4.87	0.001*
	3D (ml)	70.30 ± 16.03	69.07 ± 13.07	0.315
Systolic	2D (mm)	30.48 ± 3.85	32.49 ± 3.31	<0.001*
	3D (ml)	27.64 ± 6.71	29.69 ± 6.05	<0.001*
LVEF	2D	65.15 ± 4.39	62.35 ± 3.40	<0.001*
	3D	62.81 ± 4.15	60.90 ± 3.47	<0.001*
Δ LVEF	2D	-2.80 ± 4.39		<0.001*
	3D	-1.91 ± 3.32		<0.001*
Diastolic Function Parameters				
E/A		1.08 ± 0.25	0.97 ± 0.34	0.003*
E' septal (Cm/s)		11.35 ± 2.35	9.92 ± 3.20	<0.001*
E' lateral (cm/s)		13.33 ± 1.85	12.08 ± 2.31	<0.001*
Average E/e'		11.78 ± 1.67	12.59 ± 2.01	<0.001*
longitudinal strain				
Global %		-18.15 ± 1.58	-16.12 ± 1.93	<0.001*
Δ GLS		-2.03 ± 1.97		
Circumferential Strain				
Global %		-21.78 ± 3.61	-19.74 ± 2.81	<0.001*
Δ GCS		-2.28 ± 2.81		

Data are presented as mean ± SD, p: p value for comparing between, *: Statistically significant at p ≤ 0.05. 2D: Bidimensional. 3D: Three dimensional. LVEF: Left ventricular ejection fraction, GCS: Global circumferential strain. GLS: Global longitudinal strain.

Conclusion

ANT treatment induces early deterioration of LV global longitudinal and circumferential strain. Early change in the GLS and GCS seem to be a good predictor of the development of chemotherapy-induced cardiotoxicity.

Newer modalities for detection of subclinical ANT cardiotoxicity as 3D STE and CMR can be incorporated into future studies to support occurrence of early changes by 2D STE.