Hemodialysis: effects of preload reduction on novel echocardiographic parameters of left ventricular function

Milani M.[1]; Cerrito L.[1]; Casadei F.[1]; Tonti G.[2]; De Chiara B.[1]; Musca F.[1]; Santambrogio G.[1]; Spano" F.[1]; Belli O.[1]; Gervasi F.[3]; Brunati C.[3]; Giannattasio C.[1]; Moreo A.[1]

[1]Niguarda Ca Granda Hospital, Cardiology IV, Milan, Italy
[2]G. d Annunzio University, Institute of Cardiology, Chieti, Italy
[3]Niguarda Ca Granda Hospital, Dialysis and Renal Transplantation, Milan, Italy

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Background: Echocardiography has been widely used to study cardiac function in patients with end-stage renal disease on hemodialysis (HD), but cardiac function assessment by measuring cardiac dimensions and their rate of change is load dependent, therefore it is influenced by volume depletion. Effects of acute volume reduction on left (LV) and right ventricular (RV) function are still not well understood. Some studies investigated myocardial mechanics after dialysis using speckle tracking echocardiography (STE) but their relative load-dependency makes STE indices unable to account for changes in pre- and afterload. Myocardial work (MW) incorporates both deformation and load into its analysis and is an emerging tool to study LV myocardial function. There are no data about the effects of hemodialysis on LV MW.

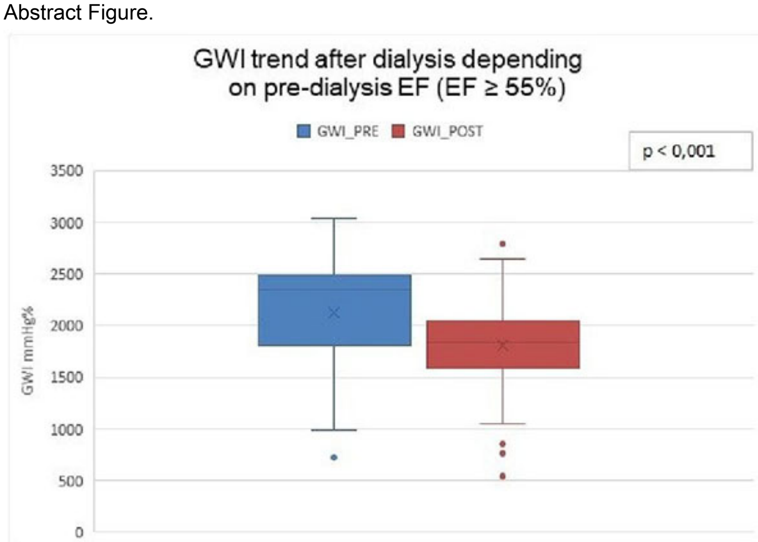
Purpose: This study aimed to evaluate acute changes of novel echocardiographic indices of both LV and RV function after a HD session.

Methods: Patients with end-stage renal disease undergoing HD were prospectively enrolled. A transthoracic echo, including STE calculation of LV global longitudinal strain (GLS) and free wall RV strain, was performed before and after hemodialysis. Parameters of MW such as global work index (GWI), global constructive work (GCW), global work efficiency (GWE) and global wasted work (GWW) were quantified using a commercially available software package.

Results: 27 patients were enrolled, mean baseline parameters were: LV end-diastolic volume 136 ± 38 mL, LV ejection fraction (LVEF) 56.9 ± 7.5%, LV GLS -17.1 ± 4.1%, RV free wall strain -26.9 ± 5.6%, GWI 2117 ± 602 mmHg%, GCW 2299 ± 633 mmHg%, GWW 137 ± 88 mmHg, GWE 93 ± 3.6%, systolic arterial pressure 145 ± 26 mmHg and diastolic pressure 80 ± 16mmHg. After hemodialysis we observed a significative reduction in LV GLS ($p = 0.04$), RV strain ($p = 0.002$), GWI ($p = 0.002$, Figure I) and GCW ($p = 0.004$). No significative changes in LVEF and blood pressure were observed. Comparing patients using a LVEF cut-off of 55% (19 patients with LVEF≥55%, 8 patients <55%) we observed a significative reduction of LV GLS ($p = 0.004$), GWI ($p < 0.001$), GCW ($p < 0.001$) only in patients with LVEF ≥55% while RV strain and LV volume showed a reduction in both groups. We observed no significative differences in extracted volumes between the groups (2.6 vs 2.1 liters,$p = 0.3$). Patients with normal LVEF showed a significative negative variation (D) of LVEF (-1 vs 3%), GWI (-551 vs 38 mmHg%) and GCW (-522 vs 11 mmHg%). Correlations were found between DGWI and extracted volume ($r= 0.46$, $p = 0.01$), basal GWI and both DLVEF ($r= 0.39$, $p = 0.04$) and DLV GLS ($r= 0,42$, $p = 0.02$), basal LV GLS and DLVEF ($r= 0.5$, $p < 0.01$).

Conclusions: Our preliminary data show that, immediately after the HD session, there is a reduction in biventricular STE-derived systolic parameters. Patients with normal LV systolic function are more sensitive to acute volume changes and entity of volume depletion seems to be correlated with MW reduction.

Abstract Figure.



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