ORIGINAL ARTICLE

Changes in echocardiographic parameters after hemodialysis session in a North African pediatric population with end-stage renal disease and without known heart disease

Modifications des paramètres échocardiographiques après une séance d'hémodialyse chez une population pédiatrique nord-africaine avec insuffisance rénale terminale et sans cardiopathie connue

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Abstract

Introduction: Children undergoing long-term hemodialysis (HD) face a reduction in life expectancy mostly due to cardiovascular mortality. Effects of HD on cardiac function have not been fully elucidated in pediatric population.

Aim: This study aimed to assess HD session impact on cardiac function in pediatric patients using conventional and strain echocardiography.

Methods: We performed a prospective, comparative study of echocardiographic parameters before and after single HD session in a chronic HD pediatric population. We enrolled between the 1st and 30th September 2023, all consecutive patients with end-stage renal disease (ESRD) aged up to 18 years old on maintenance HD three times weekly for at least three months. All patients underwent conventional and left ventricular (LV) longitudinal strain echocardiography in a window of 30-60 minutes before and after HD.

Results: 23 patients, 14.8 ± 2.1 years old and 47.8% male, were enrolled. Reductions in body weight and blood pressure were observed after HD, whereas heart rate increased. Significant decrease in LV and left atrial diameters and volumes after HD session were observed. Mitral peak E velocity, as well as average E/e' were significantly lower after HD. Although LV ejection fraction was unchanged, global longitudinal strain for LV was significantly reduced after dialysis (-17.3 ± 3.0% vs. -14.9 ± 2.4%, p=4.10-8).

Conclusion: Patent deterioration in LV systolic function following HD was identified by speckle tracking echocardiography (STE). STE has the potential to unmask early myocardial dysfunction even when there is no evident alteration in conventional systolic function parameters in children with ESRD.

Key words: 2D strain, echocardiography, pediatrics, end stage renal disease

Résumé

Introduction : L'espérance de vie chez les enfants hémodialysés chroniques est réduite principalement en raison de la mortalité cardio-vasculaire. Les effets de l'hémodialyse (HD) chronique sur la fonction cardiaque n'ont pas été entièrement élucidés dans la population pédiatrique.

Objectif: Cette étude vise à évaluer l'impact de la séance d'HD sur la fonction cardiaque chez les patients pédiatriques en utilisant l'échocardiographie conventionnelle et de Strain.

Méthodes: Il s'agissait d'une étude prospective et comparative des paramètres échocardiographiques avant et après une séance d'HD chez des enfants hémodialysés chroniques. Du 1er au 30 septembre 2023, nous avons colligé tous les patients consécutifs atteints d'insuffisance rénale terminale (IRT), âgés de moins de 18 ans et hémodialysés trois fois par semaine depuis au moins trois mois. Tous les patients ont bénéficié d'une échocardiographie conventionnelle et de Strain ventriculaire gauche (VG) 30 à 60 minutes avant et après HD.

Résultats: 23 patients, âgés de 14,8 ± 2,1 ans, 47,8 % de sexe masculin, ont été recrutés. Des réductions du poids corporel et de la pression artérielle ont été observées après HD, tandis que la fréquence cardiaque a augmenté. Une diminution significative des diamètres et des volumes VG et de l'oreillette gauche a été observée après la séance d'HD. L'onde E mitrale, ainsi que la moyenne E/e' étaient significativement plus bas après HD. Bien que la fraction d'éjection VG était inchangée, le Strain longitudinal global VG était significativement réduit après HD (-17,3±3,0% vs -14,9±2,4%, p=4,10-8).

Conclusion: Une dysfonction systolique VG patente après HD a été identifiée par l'échocardiographie de Strain malgré l'absence d'altération évidente des paramètres conventionnels de la fonction systolique chez des enfants atteints d'IRT et hémodialysés au long cours.

Mots clés: 2D strain, échocardiographie, pédiatrie, insuffisance rénale terminale

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Introduction

Even with the progress made in dialysis techniques, children with end-stage renal disease (ESRD) who require ongoing dialysis treatment still face reduced life expectancy compared to general population (1). Cardiovascular complications frequently occur in children with ESRD, and as much as 30% of fatalities in pediatric hemodialysis (HD) patients result from cardiovascular events (2,3). The fluctuation in body weight and volume status during HD sessions can negatively impact myocardial functions (4,5). Consequently, there is growing evidence, from studies in adults and children, that suggests HD may be a causative factor for recurrent subclinical myocardial injuries, even in the absence of apparent cardiac disease (6,7). Most of the echography research has investigated alterations in ventricular systolic and diastolic functions following HD by employing conventional echocardiographic parameters derived from tissue Doppler imaging with the drawback of its angle dependency (8,9). Limited research has examined the immediate effects of HD on cardiac functions using Strain echocardiography in pediatric population (10–13). To the best of our knowledge, no report has investigated the cardiac changes resulted from HD using STE in a Tunisian pediatric population.

Aim

This study aimed to assess the impact of HD session on cardiac functions in ESRD pediatric patients on chronic HD and without known heart disease, using conventional echocardiography including two-dimensional (2D), M-mode and Doppler echocardiography, as well as left ventricular (LV) 2D Strain echocardiography.

Methods

We performed a prospective comparative study of echocardiographic parameters before and after single HD session in a chronic HD pediatric population. The primary objective of the study was to investigate the acute effect of HD on cardiac function using 2D conventional and LV Strain echocardiography in ESRD pediatric patients on maintenance HD.

Between the 1st and 30th September 2023, all consecutive pediatric patients up to 18 years old with ESRD on chronic maintenance HD receiving three sessions/week for at least 3 months and without known heart disease followed in pediatric nephrology department of a tertiary university hospital, were included. All children's parent informed consent were obtained before their inclusion in the study. We did not include patients undergoing acute HD and patients with acute symptomatic instability before or after dialysis as well as those with significant pericardial effusion, encephalopathies, pulmonary edema and sepsis. Patients with poor quality of views that could affect speckle tracking interpretation and those with concomitant congenital heart disease, arrhythmia, or significant cardiac valve disorders were excluded from the study.

The primary endpoint was to compare 2D conventional and LV strain echocardiographic parameters 30-60 minutes before and 30-60 minutes after the HD session.

Each patient underwent a detailed assessment of his age, gender, history, duration of HD and the etiology of his ESRD. Measurement of height was taken and indexed to the Z score. Essential baseline laboratory tests of serum creatinine, calcium, phosphorus, parathyroid hormone, ferritin, and hemoglobin levels were noted. Clinical assessments were performed both before and after each session, encompassing measurements such as body weight, systolic and diastolic blood pressure (BP), and heart rate. In addition, the quantification of ultrafiltrate volume was noted.

All patients underwent echocardiography using a General Electric Vivid E9 ultrasound echocardiogram equipped with M5Sc transducer. Acquisition was performed 30-60 minutes before and 30-60 minutes after the dialysis session, involving a comprehensive analysis of 2D standard and LV strain echocardiographic parameters.

All pre and post HD echocardiographies were performed by the same experienced echocardiographer.

Standard Echocardiography

Parasternal long-axis view was used for the M-Mode measurements: Interventricular septal and LV posterior wall thicknesses in systole and diastole, LV end-diastolic (LVEDD) and end-systolic (LVESD) diameters, anteroposterior left atrial (LA) diameter, and LV mass index (LVMI). LV hypertrophy (LVH) was defined as post HD LVMI more than 88.9 g/m2 by indexation by BSA (14). LV systolic function was estimated using ejection fraction assessed using biplane Simpson's method from apical four and two-chamber views (15). The same method was also used to determine LV end-diastolic and end-systolic volumes, in addition to LA end-systolic volume.

Doppler measurements for cardiac valves were performed, including aortic and tricuspid peak velocities. Peak early (E) and late (A) diastolic velocities on the Pulsed Doppler of the mitral valve and early diastolic peak velocities (e') of the septal and lateral mitral annulus were evaluated by pulse wave Doppler and tissue Doppler imaging.

Inferior vena cava (IVC) diameter was measured from the subcostal view within 2cm of IVC junction with the right atrium in the maximum IVC diameter during passive expiration and in the minimum IVC diameter during passive inspiration (4,15).

Two-dimensional speckle tracking Echocardiography

2D grayscale images were recorded for analysis of changes before and after HD using a frame rate between 55 and 90 frames per second. At least 3 consecutive cardiac cycles were recorded. Echocardiographic images were sent to a single software station (EchoPAC Clinical Workstation Software, GE Vingmed Ultrasound) and strain analyses were performed offline.

For LV global longitudinal strain (GLS) assessment, three LV apical views (apical 3-, 2- and 4-chamber views) were acquired. The strain of the selected tissue was evaluated by identifying three points, one point on each side of the mitral valve annulus and one point at the apex. Then, the software automatically tracked the speckle patterns from the endocardial boundary outward toward the epicardium, which could be manually adjusted whenever needed. Finally, the software automatically generated LV strain profiles. The segmental longitudinal strains were demonstrated automatically in bull's eye with 17 segments model.

Statistical analysis

All the statistical analyses were carried out using SPSS software (IBM SPSS Statistics, version 26).
The numeric variables were depicted through mean ± Standard Deviation or median (interquartile range), whereas categorical variables were represented as frequencies and percentages. We evaluated the comparisons between pre- and post-dialysis variables by employing either a paired sample t-test or Wilcoxon test. To assess the relationship between percentage of change in GLS and clinical and biological parameters, linear Pearson or Spearman correlation coefficients were employed. A p value < 0.05 was considered as statistically significant.

Results

During the study period, 23 children with ESRD (mean age 14.8 ± 2.1 years; 47.8% male) were enrolled. The flow chart of the study is represented in Figure 1.

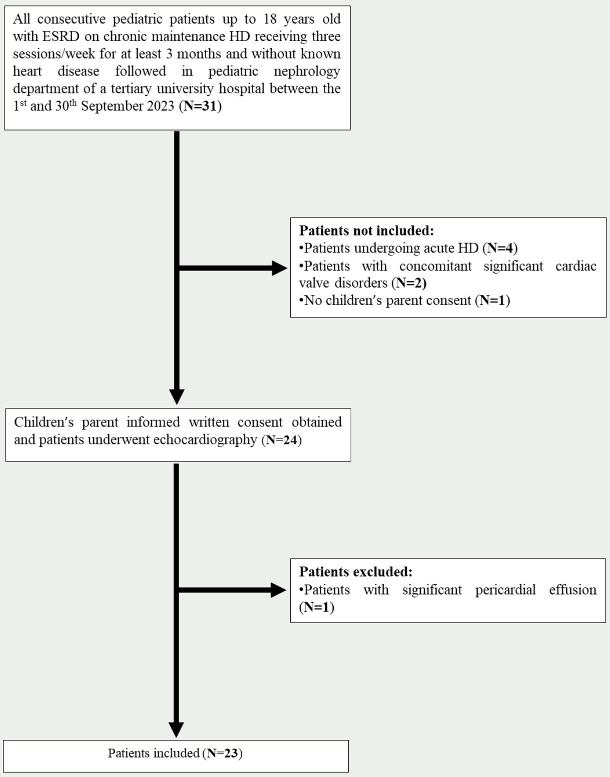

Figure 1. Flow chart of the study.

Median duration of routine HD was of 48 (24-60) months. Mean height was 139.7 ± 9.2 cm. Demographic and baseline laboratory data of the study population are shown in Table 1.

Table 1. Demographic and baseline laboratory data of the study population.

Parameters	Statistics
Age (years)	14.8 ± 2.1
Gender (male)	11 (47.8%)
Height (cm)	139.7 ± 9.2
Height Z score	–4 [(–4) - (–3)]
Duration of hemodialysis (months)	48 (24 - 60)
Ultrafiltration volume (L)	1.84 ± 0.8
Left ventricular hypertrophy	14 (60.9%)
Serum creatinine (µmol/l)	850.4 ± 249.8
Hemoglobine (g/dl)	7.98 ± 1.7
Serum total calcium (mmol/l)	2.1 ± 0.44
Serum phosphorus (mmol/l)	1.95 ± 0.27
Parathroid hormone (pg/ml)	867.5 ± 750,9
Serum ferritin (ng/ml)	257,65 ± 147,7

Data are represented as mean ± standard deviation, median (interquartile range), frequency (percentage) as appropriate.

The most frequent cause of ESRD was neurogenic bladder 5 (21.7%) followed by nephrotic syndrome 3 (13.0%), nephronophthisis type 1, and posterior urethral valve in 2 patients (8.7%) each. Etiologies of ESRD are summarized in Figure 2.

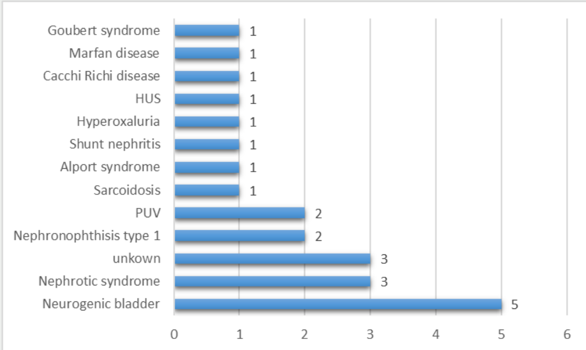

Figure 2. Etiologies of end-stage renal disease in the study population.
HUS= hemolytic uremic syndrome; **PUV** = posterior urethral valve.

There was a significant decline in body weight after HD (p=0.00002), with a mean reduction of 1.68 ± 0.74 kg (4.8 ± 1.6% decrease in body weight). Furthermore, there was a notable decrease in both systolic and diastolic BP after the HD session, whereas the heart rate of the study population exhibited a significant increase. The patients' clinical characteristics are presented in Table 2.
A total of 46 echocardiography images were recorded in the 23 patients' population. The conventional 2D and M-mode echocardiography showed a significant reduction in all LA parameters including diameter, volume, and area after HD session, while right atrial area did not change. Moreover, end-diastolic, and end-systolic LV diameters and volumes after HD significantly decreased compared to pre-HD values, while LV wall thicknesses were unchanged. It is to be noted that 60.9% were considered to have LVH based on data calculated

after the HD session. Reductions of these load dependent parameters were not concomitant with an improvement in LVEF which has not significantly changed when comparing before and after HD session measurements (Table 2).

Table 2. Patients' clinical characteristics and conventional 2D, M-mode and Doppler echocardiographic parameters before and after hemodialysis in study population.

	Before HD	After HD	P value
Patients' clinical characteristics			
Weight (kg)	35.1 ± 10.0	33.5 ± 9.6	0.000027
Systolic blood pressure (mmHg)	122.6±12.1	102.2±11.3	0.00002
Diastolic blood pressure (mmHg)	70.0±12.8	60.9±15.6	0.003
Heart rate (beats/min)	78.9±6.8	106.9±11.7	0.00002
Conventional 2D and M-mode echocardiographic parameters			
IVST (mm)	9.7 ± 2.0	9.5 ± 2.4	0.4
LV PWT (mm)	10.4 ± 2.2	10.2 ± 2.0	0.4
LV EDD (mm)	41.6 ± 4.7	39.1 ± 4.6	0.002
indexed LV EDD (mm/m^2 BSA)	37.6 ± 4.4	35.2 ± 4.0	0.0003
LV ESD (mm)	28.1 ± 2.9	26.8 ± 3.0	0.01
indexed LV ESD (mm/m^2 BSA)	25.1 ± 3.8	23.8 ± 3.1	0.01
LV EDV (ml)	92.6 ± 29.6	81.6 ± 27.7	0.0004
Indexed LV EDV (ml/m^2 BSA)	79.5 ± 27.9	72.4 ± 21.2	0.001
LV ESV (ml)	39.5 ± 14.8	30.6 ± 11.2	0.00007
Indexed LV ESV (ml/m^2 BSA)	32.0 ± 11.4	27.5 ± 8.9	0.0004
LV EF, Simpson biplane (%)	61.1 ± 5.1	62.2 ± 4.3	0.2
LA diameter (mm)	33.5 ± 4.6	31.6 ± 4.9	0.0001
LA area (cm^2)	17.5±4.3	14.7±3.2	0.00006
Indexed LA volume (ml/m^2 BSA)	45.2 ± 16.5	31.2 ± 10.6	0 .00003
RA area (cm^2)	11.5 ± 2.6	11.0 ± 2.2	0.3
IVC ID (mm)	13.2 ± 3.6	11.4 ± 4.0	0.02
IVC ED (mm)	10.0 ± 4.1	5.7 ± 2.2	0.00007
IVC compliance (%)	26.1	95.7	0.00003
Doppler echocardiographic parameters			
Mitral peak E velocity (cm/s)	127.6 ± 25.7	107.4 ± 21.4	0.00006
Mitral peak A velocity (cm/s)	78.6 ± 25.1	90.2 ± 21.6	0.03
Mitral E/A ratio	1.75 ± 0.7	1.2 ± 0.2	0.001
e' Septal velocity (cm/s)	10.2 ± 2.4	10.1 ± 1.7	0.7
e' Lateral velocity (cm/s)	13.3 ± 3.4	13.2 ± 3.3	0.8
E/ e' Septal ratio	13.1 ± 4.4	10.1 ± 1.8	0.0002
E/ e' Lateral ratio	10.0 ± 2.5	8.5 ± 2.4	0.005
E/ e' average ratio	11.0 ± 2.7	8.8 ± 2.1	0.0002
Aortic valve velocity (m/s)	1.7 ± 0.6	1.6 ± 0.3	0.004
Aortic VTI (cm)	30.4 ± 7.2	29.0 ± 4.8	0.2
Sub aortic VTI (cm)	25.1 ± 7.5	23.4 ± 6.0	0.2
Tricuspid valve velocity (m/s)	2.6 ± 0.6	2.3 ± 0.6	0.0001
SPAP (mmHg)	34.3 ± 12.2	28.6 ± 9.8	0.0003

EDD: end-diastolic diameter; **EF**: ejection fraction; **ESD**: end-systolic diameter; **HD**: hemodialysis; **IVC ID**: inferior vena cava inspiratory diameter; **IVC ED**: inferior vena cava expiratory diameter; **IVST**: Interventricular septum thickness; **LA**: left atrial; **LV**: left ventricular; **PW**: posterior wall thickness; **RA**: right atrial; **SPAP**: systolic pulmonary arterial pressure; **VTI**: velocity time integral.

Pulsed Doppler echocardiography of the mitral valve showed a significant decrease of the E/A ratio (1.75± 0.7 to 1.2±0.2, p=0.001), which resulted from a significant decrease of mitral peak E wave velocity and to a lesser extent A wave. E/e' ratio was also lower after HD. Furthermore, tricuspid flow velocity was significantly reduced, leading to a significant improvement in estimated systolic pulmonary arterial pressure. The conventional 2D, M-mode and Doppler echocardiographic parameters before and after HD are detailed in Table 2.

The mean GLS significantly worsened in children after HD when compared to mean GLS before HD session (-17.3 ± 3.0% before HD vs. -14.9 ± 2.4% after HD, $p=4.10^{-8}$). The mean reduction of GLS was 2.4±1.4%. The 2D longitudinal strain measurements of the LV are represented in table 3.

Table 3. 2D longitudinal strain measurements of the left ventricle before and after hemodialysis session.

	Before HD	After HD	P value
Global longitudinal strain			
GLS (%)	-17.3 ± 3.0	-14.9 ± 2.4	4.10^{-8}
Segmental longitudinal strain			
Basal segmental longitudinal strain			
Basal anterior	-15.2 ± 5.9	-13.0 ± 4.3	0.06
Basal anteroseptal	-14.9 ± 4.0	-12.0 ± 3.8	0.0002
Basal inferoseptal	-15.7 ± 4.2	-13.5 ± 3.9	0.02
Basal inferior	-18.1 ± 4.97	-15.5 ± 3.4	0.001
Basal inferolateral	-17.7 ± 4.9	-14.6 ± 4.4	0.01
Basal anterolateral	-16.2 ± 5.7	-14.3 ± 4.4	0.03
Mid segmental longitudinal strain			
Mid anterior	-18.5 ± 4.8	-15.3 ± 4.9	0.0003
Mid anteroseptal	-18.8 ± 3.8	-16.3 ± 3.8	0.01
Mid inferoseptal	-18.7 ± 2.6	-16.1 ± 2.3	0.0002
Mid inferior	-16.8 ± 4.5	-13.2 ± 3.3	0.003
Mid inferolateral	-16.2 ± 3.1	-13.1 ± 2.9	0.00003
Mid anterolateral	-16.1 ± 5.6	-14.3 ± 4.4	0.09
Apical segmental longitudinal strain			
Apical anterior	-18.8 ± 5.2	-16.3 ± 4.9	0.07
Apical septal	-21.3 ± 3.7	-17.2 ± 4.0	0.0002
Apical inferior	-18.8 ± 3.7	-15.9 ± 4.4	0.004
Apical lateral	-18.6 ± 5.2	-16.4 ± 6.3	0.04
Apex	-19.5 ± 4.2	-17.0 ± 1.0	0.01

GLS: global longitudinal strain; **HD**: hemodialysis.

Figure 3 shows an example of a change in LV global and segmental longitudinal strain before and after hemodialysis in one of the study participants.

It is notable that detailed analysis of segmental longitudinal strain revealed significant worsening in almost all segments except 3 among 17 bull's eye myocardial LV segments (Segment 1 "basal anterior", segment 12 "mid anterolateral" and segment 13 "apical anterior").

In univariate analysis, serum calcium levels were negatively correlated to GLS changes (r=-0.5; p=0.02). No correlation was found between the changes of body weight, ultrafiltration volume, systolic BP, diastolic BP, heart rate, IVC diameters and GLS changes.

No correlation was studied between HD session duration and GLS changes.

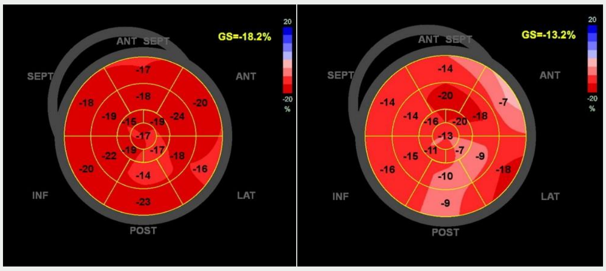

Figure 3. Bull's eye plot showing an example of a change in left ventricular global and segmental longitudinal strain before and after hemodialysis in one of the study participants.

Discussion

The main findings of this echocardiographic study among pediatric patients in ESRD were:

- Structural and load dependent echocardiographic parameters namely LV and LA diameters and volumes, average E/e' ratio, Tricuspid valve peak velocity and IVC diameters were significantly improved.
- LV longitudinal strain worsening as assessed by mean GLS, identifying latent post HD LV systolic function impairment while conventional systolic function assessed by LVEF was unchanged.

HD can be a significant stressful condition on cardiac functions, particularly among children who are sensitive to abrupt fluctuations in blood volume, BP, electrolytes, and sympathovagal imbalance. Despite the theoretical expectation that HD should enhance myocardial function by addressing volume overload and eliminating toxins, it is important to note that cardiovascular mortality remains elevated among patients undergoing HD when compared to the general population (16).

In our study population, weight and BP were significantly reduced in post-HD, besides the heart rate was higher, as described in other pediatric studies (4,17,18).

A significant worsening in post-dialysis GLS was demonstrated in this study as compared to the pre-dialysis GLS, while LVEF was unchanged. These results were in accordance with findings of Hothi et al (19) and Rakha et al. (12) who reported that 2D STE could reveal noteworthy reductions in global and segmental strain following HD in pediatric patients with ESRD. These changes were detected despite the absence of significant alterations in systolic function on conventional echocardiography. This provides further supporting evidence for the adverse impact of HD on myocardial function, especially among pediatric patients (12).

Use of LVEF as an indicator of systolic function in ESRD is suboptimal due to fluctuating load conditions and impact of uremic metabolites during dialysis. In line with the 'Starling effect', LV function is contingent upon load, where higher preload leads to enhanced LV function, while lower preload has the opposite effect (20). GLS serves as a highly sensitive indicator of systolic function, and it has emerged as a more precise predictor of cardiovascular mortality in adult with kidney failure when compared to LVEF (21).

Children undergoing conventional HD often experience temporary global or regional reductions in systolic myocardial function, a phenomenon known as myocardial stunning. This can be attributed to intradialytic hypotension, leading to diminished coronary perfusion and alterations in volume status (19). Repeated myocardial stunning is considered cumulative and may cause chronic injury, contributing in some circumstances to chronic systolic dysfunction and highly risk for cardiovascular events and mortality (22).

In ESRD, combination of volume overload in one hand, and myocardial ischemia induced by HD on the other hand can lead to mechanical dyssynchrony due to imbalances in the stretching and shortening of myocardial fibers. This, in turn, can result in an abnormal STE pattern, potentially impacting systolic function (23).

Moreover, many studies have indicated that among HD patients, the initially reversible segmental LV dysfunction may evolve into permanent segmental systolic dysfunction from a year of initiating dialysis in adult patients. This progression can lead to an overall decline in global LV function and compromised hemodynamics during subsequent dialysis session (21,22).

Many definitions of LVH in pediatric population are proposed (14,24). In this study, LVH was defined as post HD LVMI more than 88.9 g/m^2 by indexation to BSA (14). In children with ESRD, myocardial changes like LV mass increase is commonly seen as an initial adaptive response to increased cardiac workload and pressure/volume overload. LVH can be linked to cellular growth triggered by FGF23. The progress of this hypertrophy can be maladaptive and lead to higher cardiac workload demands (25). Concentric LVH is mostly developed due to the hypertrophic response in the mid-myocardial layers, which are mostly circumferentially oriented. This can compensate for the longitudinal function reduction and can explain the maintained LVEF (11).

It is of note that contradictory results of our study were reported by Amoozgar et al. who did not encounter GLS changes following dialysis in a pediatric cohort and this study showed preload independency of STE in children (13).

Our study showed also that HD induced significant changes in LV diastolic parameters, with significant decrease in peak E of the mitral inflow and E/A ratio. Regarding Tissue Doppler and combined parameters, a significant improvement in the E/e' ratio was noted. This was in relation with significant decrease in peak E velocity of the mitral inflow while e' Septal and lateral velocities were unchanged. Likewise, indexed left atrial volume and tricuspid valve velocity were significantly improved. Previous studies in pediatric HD patients (12,13,26,27) demonstrated the same findings in these load dependent parameters.

Another observation in this study was the negative correlation between serum total calcium levels and percentage of change of GLS. Calcium plays a crucial role in myocardial excitation-contraction coupling. Since the calcium stored within the sarcoplasmic reticulum is insufficient to initiate contraction, the influx of extracellular calcium is predominantly responsible for initiating and regulating cardiac contraction (28). Hypocalcemia has been demonstrated to impact cardiac function, leading to reduced cardiac contractility, as evidenced by a decrease in LV work (29).

In this study, we did not find a correlation between ultrafiltration volume and GLS changes. This finding is in agreement with some others studies who proved that the changes in the regional wall motion are not correlated to changes in ultrafiltration volume (30).

Study Limitations

This study has several limitations. First, a single-center pediatric outpatient dialysis unit with small sample size of patients may present a limitation for the validation of efficiency of the methods and data. Second, we did not assess global circumferential and radial strain for myocardial deformation, studied in other studies on pediatric population with ESRD. Finally, there is a requirement for a follow-up study design to ascertain the point at which myocardial function reversibility occurs following a single session.

The evaluation of right ventricle speckle tracking was not included in our current study, and this aspect should be explored in future pediatric research.

Conclusion

A deterioration in LV longitudinal systolic function following HD was identifiable through 2D STE, despite the lack of significant changes in systolic function measured using conventional echocardiography. STE has the potential to uncover early myocardial dysfunction even when there is no evident systolic dysfunction in children with ESRD. This study serves as supplementary evidence of the compromise in both global and segmental myocardial function after a HD session in pediatric patients with ESRD.

Abbreviations:
2D: two-dimensional
ESRD: end-stage renal disease
GLS: global longitudinal strain
HD: hemodialysis
LA: left atrial
LV: left ventricular
LVEDD: left ventricular end-diastolic diameter
LVEF: left ventricular ejection fraction
LVMI: left ventricular mass index
LVESD: left ventricular end-systolic diameter
LVH: left ventricular hypertrophy
STE: speckle tracking echocardiography

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