Research Article

Impact of Hemodialysis on Echocardiographic Indices of Left Ventricular Function: Comparative Study Before and After Dialysis

Abdelali Hadi[1*], Altit L[2], Oughazzou I[1], Elkarimi S[1], Benzaroual D[1], Fadili.W[2], Laouad I[2] and Elhattaoui M[1]

[1]Department of Cardiology, University Center Mohammed VI Marrakech, Morocco

[2]Department of Nephrology Dialysis Transplantation,University Hospital Of Mohamed VI, Morocco

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Corresponding author:
Abdelali Hadi, Department of Cardiology, University Center Mohammed VI Marrakech, Morocco, Tel: +212641524330; Email: abdelalizate@hotmail.fr

ABSTRACT

Objectives: Hemodialysis in patients with renal insufficiency may affect cardiac function due to acute changes in blood volume, blood pressure, electrolytes and sympathico-vagal balance. The purpose of this study is to describe and analyze the impact of the hemodialysis on echocardiographic indices of left ventricular function.

Patients and methods: This is a prospective descriptive and analytical study including chronic hemodialysis patients carried out for 4 hours/three times per week and having a seniority of hemodialysis greater than 9 months.

Results: 40 patients were collected including 18 male (45% of cases). Mean age was 41.05 ± 18.8 years with mean hemodialysis duration of 6.9 ± 6.17 years. Hemodialysis led to reduction in LV end-diastolic volume ($p = 0.001$), LV end-systolic volume ($p = 0.004$), LV end-diastolic diameter ($p = 0.000$), LV end-systolic diameter ($p = 0.002$), the aortic time-velocity integral ($p = 0.0001$), the left atrial area ($p < 0.0001$), the early diastolic velocity peak of the mitral flow E ($p = 0.002$). In tissue doppler, the early diastolic velocity measured on the septal side of the mitral annulus significantly decreased ($p = 0.01$). The Tei index and the LVEF did not show any significant change after dialysis.

Conclusion: Doppler indices of left ventricular function are preload dependent. Assessment of LV function should not be performed on the hemodialysis day shortly before dialysis, but preferably 2h after dialysis. At that moment, the patient is closest to a relatively normovolaemic state.

INTRODUCTION

Hemodialysis treatment in patients with chronic kidney failure may affect systolic and diastolic heart function because of several acute changes including electrolyte disturbances that contribute to the change in cardiovascular hemodynamics [1]. The cardiac abnormalities may result from a variety of mechanisms including uremia, fluid retention, chronic volume overload, pressure overload, renal anemia, high flow arteriovenous shunting, and hyperparathyroidism. Some studies report a deterioration of left ventricular function [2-4] while others find an improvement in it [5] which makes its data contradictory. In order to evaluate the immediate effect of a decrease in preload by hemodialysis on the left ventricular systolic and diastolic function we conducted

a study comparing the echocardiographic parameters of left ventricular function before and after hemodialysis.

PATIENTS AND METHODS

This is a prospective descriptive and analytical study including 40 chronic hemodialysis patients which are carried out for 4 hours; three times per week and having seniority in hemodialysis greater than 9 months. Once selected and after having informed them about the nature of the study and their informed consent is obtained, we performed a transthoracic echocardiography examination 2 hours before and 2 hours after a hemodialysis session by the same operator. We collected all the data of the diastolic and systolic left ventricular function: in M.Mode and 2D mode (LV End-Diastolic Diameter (LVED-D) and left Ventricular End-Systolic Diameter (LVES-D), LV End-Diastolic Volume (LVED-V) and LV End-Systolic Volume (LVES-V), segmental kinetic abnormalities and LV biplane Fraction Ejection (LVFE)); in pulsed Doppler mode (the peak of the E and A wave's, the ratio E / A, Deceleration time of E wave DT , IVRT and the VTI of the aortic flow) and tissue Doppler imaging (the peak of the E ' and A' wave, the S ' wave of the left ventricle). All data were analyzed using an SPSS version 17 computer system and reported on average ± standard deviation. The difference before and after hemodialysis is considered significant if the P value <0.05.

RESULTS

Forty patients, (18 male) were collected in this study and evaluated. Mean age was 41.05 ± 18.8 years with mean hemodialysis duration of 6.9 ± 6.17 years. Initial nephropathy was diabetic in 12.5% of cases, hypertensive in 12.5%, focal hyalinosis in 2.5%, lithiasic 5% and indeterminate in 60% of cases. The main cardiovascular risk factor was hypertension in 45 % (18patients). Ten of them had received tritherapy (angiotensin-converting enzyme inhibitor ACEI+calcium channel inhibitor CCB + Betablocker BB), six bitherapy (ACEI+ CCB) and two monotherapy (CCB). The average duration of hemodialysis was 4 hours and the average reduction of weight was 3+/-1.2Kg. (Table 1 and 2) summarizes their clinical characteristics.

Table 1: Clinical Characteristics of Patients: Cardiovascular Risk Factors and History.

Characteristics	N=40 cases
Age (years)	41,05 ± 18,8
Gender M/F	18/22
HT	45%
DM	12.5%
Smoking	5%
Dyslipidemia	45%
Diabetic nephropathy	12.5%
Indeterminate nephropathy	60%

M/F=Male/Femele HT= systemic hypertension

DM=Diabetes Mellitus

Table 2: Clinical parameters modifications after hemodialysis.

	Before hemodialysis	After hemodialysis	P value
Systolic BP(mmHg)	132± 20	121±16.25	0 ,0001
Diastolic BP(mmHg)	88±11.54	81±10.4	0.0001
Heart rate(ppm)	90±10.5	89.5±9	0.42
Body Weight(Kg)	68±18	65±20	<0.0001
Hemoglobin (g/dl)	10.3±1.8	11.5±1.4	0.02

The average thickness of the interventricular septum was 12.92± 2.66mm and that of posterior wall was 12.07±2.2mm.Hemodialysis led to significant reduction in the LV end-diastolic volume (p = 0.001), LV end-systolic volume (p = 0.004), LV end-diastolic diameter (p = 0.0001), LV end-systolic diameter (p = 0.002), LA surface (p <0.0001) (Table 3), the aortic time-velocity integral (p = 0.0001) and the early diastolic velocity peak of the E mitral flow (p = 0.002) (Table 4). In tissue doppler imaging, the early diastolic velocity measured at the septal annulus of the mitral valve decreases significantly (p = 0.012) (Table 3). The Tei index and the LVEF did not show any significant change after dialysis.

Table 3: M mode and 2D mode echocardiography.

	Before hemodialysis	After hemodialysis	P value
LVED-D (mm)	46.03±7.04	44.8±6.06	0.0001
LVES-D (mm)	30.7± 5.3	29.08±5.31	0 .002
LVED-V (ml)	98.45± 25.6	75.12± 23.14	0.001
LVES-V (ml)	50.12±14.1	45.32± 15	0.004
Left atrium area (cm2)	19.88±5,72	16.48±5,29	0.0001
Right atrium area (cm2)	13.48±3.48	10,9±3.28	0 .0001
EF (%)	58.38±8.33	60.08±6.77	0.082

Table 4: Pulsed and tissue Doppler mode Echocardiography.

	Before hemodialysis	After hemodialysis	P value
E (cm/s)	94.38± 30,4	84±19	0.002
A (cm/s)	79.5±21.74	82.88± 23.34	0.005
E' (cm/s)	13.15± 4.04	12.33± 3.38	0.01
DT	160.15± 43.86	152.98±45.06	0.003
I VRT	77.63± 13.25	70.08 ± 16.04	0.009
VTI Aortic (cm)	28± 5	24± 4	0.0001
Tei index	0.34±0.11	0.38±0.22	0.3

DISCUSSION

Echocardiography is the gold standard for the evaluation of left ventricular function in patients with chronic kidney failure. The study of the transmitral flow velocity, DT, IVRT and the ratio E / A coupled to the peaks of the tissue Doppler transmitral flow velocities makes it possible to evaluate the left ventricular function before and after hemodialysis. Several studies report the improvement of the parameters of the left ventricular function essentially diastolic after reduction of the preload. Galetta and al [2], Hung and al [3] and Drighil and al [4] have shown that hemodialysis performed in adults with kidney failure led to significant decrement in the end-systolic and end-diastolic diameters and volumes of LV without any change in the fraction ejection. Koga and al [6] Hung and al [3] have shown that hemodialysis engender a significant decrease in the early peak of transmitral flow velocity (E wave), and decrease in the E / A ratio, a prolongation of the IVRT, without any changes significant of the A wave and the DT while we have shown a significant reduction of the E wave, the DT and IVRT and an increase of the wave A in our study, especially among patients having lost more than two kg in body weight and among which the blood pressure has decreased significantly reflecting that these parameters are dependent to the blood volume. These same authors demonstrated a significant increase in the Tei index (0.42 ± 0.16 versus 0.51 ± 0.16, p <0.0001) contrary to our study, in those patients when the preload decreased the IVCT/ET ratio showed a reduction while the IVRT/ET ratio increased, leaving the index unchanged. Dincer and al [7] and Galletta and al [2] reported a significant decrease in velocities derived from tissue doppler diastolic function as in our one. On the other hand Hayashi and al [5] and Bauer and al [8] did not find any significant modification of these parameters. Amoozgar and al [9] demonstrated that diastolic and systolic LV velocities decreased after hemodialysis. The discrepancy between these different studies may be related to changes in heart rate, the existence of underlying heart disease and the degree of variation in preload and afterload. The change of heart rate, can influence the measures of E' and A' velocities, but in our study there is no significant change in heart rate after HD.

CONCLUSION

Conventional Doppler echocardiography is a noninvasive method useful for cardiac morphological and functional study in patients with kidney failure. This method coupled to tissue Doppler provides additional information on the left ventricular systolic and diastolic function. The majority of the parameters of left ventricular function are preload-dependent, that's why it is important that when echocardiographic LV function assessment is reported in dialysis patients, the time relation to the dialysis process is specified. Assessment of LV function should not be performed on the haemodialysis day shortly before dialysis, but preferably 2h after dialysis. At that moment, the patient is closest to a relatively normovolaemic state.

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