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SHORT COMMUNICATION

Spectrum of echocardiographic abnormalities in end-stage renal disease patients undergoing hemodialysis

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Abstract

Background: Cardiovascular disease is the most common cause of mortality in patients with end-stage renal disease. Determining the spectrum of echocardiographic abnormalities in these patients can help the prevention of mortality in this group of chronically ill patients.

Methods: 123 adult patients with chronic renal failure who underwent hemodialysis and echocardiography during February till November 2006 were enrolled. Complete 2-D, M-mode, Doppler and color Doppler study were performed by a single operator for each patient and the abnormalities were recorded.

Results: The mean age was 38.3±13 and 61.5 % were female. The mean cardiac dimensions were right ventricular diastolic dimension: 1.89±0.05 cm, inter-ventricular septal dimension: 1.3±1.23 cm, enddiastolic dimension: 6.1±0.6 cm, endsystolic dimention: 3.84±2.5 cm, ejection fraction: 59.2±11 %, left ventricular mass: 238±90 gr. The prevalence of LV systolic dysfunction (EF < 50 %) was 20.3%, valvular regurgitation ≥ mild, mitral regurgitation: 52.8%, aortic regurgitation: 24.4%, and tricuspid regurgitation: 35.8%. Valvular calcification was seen in 14.5% of the patients but no significant stenosis was noted. The prevalence of pulmonary hypertension (SPAP>30 mm Hg) was 14.7% and that of pericardial effusion (≥ mild) was 14.7%. Cardiac ejection fraction was lower in patients requiring more hemodialysis sessions (p value <0.036).

Conclusion: Echocardiographic abnormalities are very common in patients suffering from end-stage renal disease (ESRD), so periodic echocardiographic examination for diagnosis and treatment of cardiac abnormalities is highly recommended.

Keywords: Echocardiography; End-stage renal disease; Hemodialysis

Introduction

Cardiovascular disease is the most common cause of mortality in patient with end-stage renal disease.[1] Diagnosis of congestive heart failure (CHF) with concomitant renal failure presents a particular challenge. Patients with end-stage renal disease have three key mechanical contributors to CHF including pressure overload, volume overload, and cardiomyopathy. Approximately 20% of patients undergoing hemodialysis have a diagnosis of CHF.[2,3] It is unclear whether this is due to impaired systolic or diastolic dysfunction. Mitral annular classification cardiac volume overload, hypertension, and uremic toxins,[1] all affect valve function status in patients with chronic renal failure. Pulmonary hypertension and pericardial effusion are other common abnormalities in patients suffering from end stage renal disease. Determining the spectrum of echocardiographic abnormalities in these patients can change our vision in prevention of mortality in this group of chronically ill patients.

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Materials and Methods

123 adult patients with chronic renal failure undergoing dialysis and echocardiographic study during January till November 2006 were enrolled. The

patients with poor echo window were excluded from the study. Informed consent was taken from all the subjects participating in the study. All the patients underwent two dimensional, M mode, Doppler and color Doppler echocardiography by ATL 3500 HDI Echo machine in the left lateral decubitus position, using 3.5 MHz transducer by a consultant physician experienced in echocardiography, in Motahary Clinic affiliated to Shiraz University of Medical Sciences. The left ventricular ejection fraction (EF) and fractional shortening (FS) were measured as indices of LV systolic function. EF was determined using area length method. LV mass was measured by echo machine in M-mode, short axis view of the left ventricle, and the LV mass index was calculated as LV mass/body surface area. Demographic data, cardiac risk factors, type, frequency and onset of dialysis were also recorded. All the data were analyzed by SPSS software, version 13.

Results

The mean age of the patients was 38.3±13 years and 61.5% of the patients were female. The prevalence of various cardiac risk factors was 8.1% (diabetes mellitus), 49.6% (hypertension), and 14.6% (current smoking). Relation between frequency of hemodialysis and LV systolic function in patient's with EF<50% was 2.36 (P value=0.03) and in patient's with EF>50% was 1.95 (p value=0.03).

The mean cardiac dimensions were: RV diastolic dimension 1.89±0.05 cm, interventricular septal dimension 1.3±1.23 cm , the left ventricular end-diastolic dimension 6.1±0.6 cm, the left ventricular end-systolic dimension 3.84±2.5 cm , cardiac ejection fraction 59.2±11, LV mass 238±90 gram, and LV mass index 10.5±4.39 gram/m^2 (Table 1).

Table 1: Major Echocardiographic dimension in ESRD patients.

RV diastolic dimension	**1.89±0 .05 mm**
Diastolic interventricular septal dimension	1.3±1.23 mm
LV end diastolic dimension	6.1±0.6 mm
LV end systolic dimension	3.84±2.5 mm
Ejection fraction	59±11 mm
LV mass	238±90 gram
LV mass index (LV mass/BMI)	10.5±4.39

The prevalence of LV systolic dysfunction (EF<50% measured by Area–length method) was 20.3%. Mitral regurgitation equal or more than mild was seen in 52.8%, aortic regurgitation (≥ mild) in 24.4%, and tricuspid regurgitation (≥mild) in 35.8%.

Valvular calcification was seen in 4.5% but no hemodynamically significant stenosis was noted. Significant pulmonary hypertension measured as systolic pulmonary artery pressure of more than 30 mm Hg (using TR gradient) was seen in 14.7% of the patients. Pericardial effusion (≥mild) was seen in 14.7% of cases. Cardiac ejection fraction was significantly lower in patients requiring more weekly hemodialysis sessions (P value <0.036) (Table 2).

Table 2: Frequency of valvular abnormalities in 123 patient's with ESRD.

Valvular Dysfunction	**%**
MR>1+	52.8
AR>1+	24.4
TR>1+	35.8
PI>1+	45
Valvular calcification	4.5
Valvular stenosis	0

Discussion

Echocardiographic abnormalities are very common in patients with ESRD. Valvular abnormalities due to uremic toxins, calcification, higher blood pressure, volume overloading and coronary artery disease are seen frequently in many ESRD patients.[2] In this study, the most frequent valvular abnormality was mitral regurgitation which was also seen in another study done by Pearson et al.[4]. Other valvular regurgitations were also frequently seen. Valvular calcification like mitral annular calcification and aortic valve calcification was seen in 4.5% of our patients. Its lower incidence compared with that in similar studies may be due to lower mean age of our patients.[4] The frequency of pericardial effusion (mild or more) was 14.7%, which is similar to that of other reported series, e.g. the study done by Kleiman et al. in which 11% of their reported cases had pericardial effusion.[5] Pulmonary hypertension was seen in 14.7% of our cases, similar to 15-20% prevalence reported by other studies.[6,7] Diminished pulmonary vasodilatory response could result from anatomical or functional changes. A study in dogs with experimental ESRD showed pulmonary calcification, increased pulmonary

vascular resistance, and right ventricular hypertrophy only in dogs with intact parathyroid glands.[8,9] The authors concluded that pulmonary involvement was secondary to increased parathyroid hormone activity. Endothelin-1, a potent pulmonary vasoconstrictor shown to be involved in primary and secondary pulmonary hypertension, is increased in patients with chronic renal failure.[9-11] The frequency of LV systolic dysfunction was higher in patients requiring more hemodialysis sessions per week which might be due to the toxic effect of hemodialysis membrane on myocardial function, or myocardial hibernation. Scheuer et al. provided indirect evidence that uremic serum had a net depressant effect on myocardial performance in chronically uremic rats in vivo.[12] An increasing body of evidence suggests that subclinical myocardial ischemia develops during hemodialysis. Transient myocardial ischemia may lead to LV systolic dysfunction that can persist despite the return of normal perfusion. This is known as myocardial stunning.[13] Repeated episodes of ischemia and stunning may be cumulative and lead to the phenomenon of myocardial hibernation that in turn contributes to the chronic heart failure in patients with ischemic heart disease.[14] This could be interpreted as preliminary evidence of dialysis-induced myocardial stunning, backed up by similar results from the study by Selby et al.[15] Therefore, the occurrence of subclinical ischemia in response to dialysis with sustained but reversible abnormalities in regional function could potentially contribute to the genesis of uremic cardiac failure. Echocardiographic abnormalities are very common among ESRD patients, and the frequency of LV dysfunction is higher in patients requiring more hemodialysis sessions. So, periodic echocardiographic examination for earlier diagnosis and treatment of cardiac abnormalities is highly recommended.

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