



## FREQUENCY OF LEFT VENTRICULAR SYSTOLIC DYSFUNCTION IN PATIENTS WITH END STAGE RENAL DISEASE ON MAINTENANCE HAEMODIALYSIS

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### ABSTRACT

**INTRODUCTION:** Cardiovascular diseases are the most common cause of mortality in patient with end-stage renal disease. 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.

**MATERIALS & METHODS:** All 130 patients fulfilling the inclusion/exclusion criteria presenting to Haemodialysis Unit, Sheikh Zayed Hospital, Lahore were included in the study after informed consent. Two dimensional, M mode, Doppler and color Doppler echocardiography in the left lateral decubitus position, using 3.5 MHz transducer by the researcher was used. The left ventricular ejection fraction (EF) and fractional shortening (FS) was measured as indices of LV systolic function and the measurements were taken according to American society of echocardiography guideline.

**RESULTS:** Patients were 18 to 70 years of age, majority of the patients were between 41-50 years i.e. 30%(n=39), mean and SD was calculated as 39.43+4.21 years, 63 (48.46%) were male and 67 (51.54%) were females, frequency of left ventricular systolic dysfunction was seen in 7 (5.38%) patients with end stage renal disease maintenance haemodialysis.

**CONCLUSION:** The frequency of Left Ventricular systolic dysfunction is considerable among patients with end stage renal disease in first year of regular maintenance haemodialysis. Therefore, it is recommended that every patient who is diagnosed as ESRD or known patient of ESRD on maintenance haemodialysis, should be investigated for LV systolic dysfunction to prioritize them for early initiation of renal replacement therapy. It is also required that every setup should have their surveillance in order to know the frequency of the problem.

**KEY WORDS:** End stage renal disease, maintenance haemodialysis, frequency, Left Ventricular systolic dysfunction.

### Author's Contribution

HB: Conducted the study and wrote the article. QAS: Helped in conducting the study, did echocardiography and was consultant incharge of the patients and gave frequent advice, corrections and did the proof reading. AH: Re-arranged data and corrected article. SS: Consultant incharge of the patients and gave frequent advice, corrections and did the final proof reading. AM: Consultant incharge of the patients and gave frequent advice, corrections and did the proof reading also. QMT: Helped in re-arranging data and corrected article. ASM: Tables. WA: Tables and figures. MAR: Helped in analysis of data and typing.

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### INTRODUCTION

Patients on haemodialysis have a high risk for cardiovascular morbidity and mortality.<sup>1,2</sup> The incidence of congestive heart failure is 3-fold greater than that of acute coronary syndrome in haemodialysis (HD) patients.<sup>3</sup> Diagnosis of congestive heart failure (CHF) with concomitant renal failure presents a particular challenge. The incidence of patients with end-stage renal failure has increased progressively in the past decades.<sup>4</sup> Patients with end-stage renal disease have three key mechanical contributors to CHF including pressure overload, volume overload, and cardiomyopathy.<sup>5</sup>

Previous studies showed that the frequency of LV systolic dysfunction (LVSD) 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. Studies provided indirect evidence



that uremic serum had a net depressant effect on myocardial performance in chronically uremic rats *in vivo*.<sup>5</sup> 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. 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. This could be interpreted as preliminary evidence of dialysis-induced myocardial stunning, backed up by similar results from the study by Selby et al.<sup>6</sup>

In a study conducted by Ostovan MA and colleagues, left ventricular dysfunction in patients with haemodialysis was shown as 20.3%.<sup>5</sup>

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 common among ESRD patients, and the frequency of LV dysfunction is higher in patients requiring more haemodialysis sessions.<sup>5</sup> Periodic echocardiographic examination for earlier diagnosis and treatment of cardiac abnormalities is highly recommended, but it is not a routine practice in Pakistan.

Rationale of this study is that in spite of best of my search we could not find any local data of Pakistan regarding frequency of LV systolic dysfunction among patients with end stage renal disease on maintenance hemodialysis so this study will set baseline data and considered to be primary. By early detection of LV systolic dysfunction we can prioritize the patients for early renal transplant as this type of LV systolic dysfunction is reversible by renal transplant.<sup>7</sup>

#### OBJECTIVES

The objective of the study is to:

- Determine the frequency of Left Ventricular systolic dysfunction in patients with end stage renal disease on maintenance haemodialysis

#### OPERATIONAL DEFINITION:

1. LV Systolic Dysfunction:

- Left Ventricle of the heart functionally impaired with EF < 50% measured by Area-length method was considered as LV systolic dysfunction.

2. End Stage Renal Disease:

- Patients who need renal replacement therapy (renal transplant or maintenance haemodialysis).

#### MATERIAL & METHODS:

STUDY DESIGN:

- Cross sectional survey

SETTING:

- Department of Cardiology, Sheikh Zayed Hospital, Lahore

STUDY DURATION:

- Six months

SAMPLE SIZE:

- The calculated sample size was 130, with 7% margin of error, 95% confidence level taking expected percentage of LV systolic dysfunction patients i.e. 20.3%.

SAMPLING TECHNIQUE:

- Non probability, purposive sampling.

INCLUSION CRITERIA:

- Gender: Male and female both
- Age: 18 to 70yrs
- Patients of end stage renal disease on haemodialysis twice weekly for more than six months (were confirmed on history and record)

EXCLUSION CRITERIA:

- Patients with poor echo window (confirmed on echo)
- Known cases of ischemic heart disease. (confirmed on history and record)
- Known cases of cardio-myopathy prior to haemodialysis. (Confirmed on history and record)
- Known case of organic valvular heart disease (confirmed on history and record)

#### DATA COLLECTION:

All 130 patients fulfilling the inclusion/exclusion criteria presenting to Haemodialysis Unit, Sheikh Zayed Hospital, Lahore were included in the study after informed consent. The potential effect modifiers that might alter the results of the study were excluded as mentioned in the exclusion criteria. Two dimensional, M mode, Doppler and color Doppler echocardiography in the left lateral decubitus position, using 3.5 MHz transducer by the researcher was used. The left ventricular ejection fraction (EF) and fractional shortening (FS) was measured as indices of LV systolic function. This measurement was taken according to American society of echocardiography guideline.<sup>8</sup> Demographic data and frequency of LV dysfunctional in patients with end stage renal disease on haemodialysis were recorded on pre-designed questionnaire .

#### DATA ANALYSIS:

The collected data was entered and analyzed in computer software SPSS software (version 13.0). The quantitative data (age) was presented



as mean  $\pm$  SD. Frequency and percentages of LV systolic dysfunction in patients with end stage renal disease on maintenance haemodialysis and gender were calculated as qualitative data.

### RESULTS:

A total of 130 patients fulfilling the inclusion/exclusion criteria were enrolled to determine the frequency of Left Ventricular systolic dysfunction in patients with end stage renal disease on maintenance haemodialysis.

Age distribution of the patients was done, which showed that 30%(n=39) were between 41-50 years, 21.54%(n=28) were between 18-30 years, 25.38%(n=33) were between 31-40 years, 16.92%(n=22) were between 51-60 years and only 6.16%(n=8) were between 61-70 years, mean and SD was calculated as  $39.43 \pm 4.21$  years. (Table No. 1)

Gender distribution was done, which showed that 48.46% (n=63) were male and 51.54%

**Table 1: Age distribution of the patients (n=130)**

| Age(in years) | No. of patients  | %     |
|---------------|------------------|-------|
| 18-30         | 28               | 21.54 |
| 31-40         | 33               | 25.38 |
| 41-50         | 39               | 30.00 |
| 51-60         | 22               | 16.92 |
| 61-70         | 8                | 06.16 |
| Total         | 130              | 100   |
| Mean and sd   | $39.43 \pm 4.21$ |       |

**Table 2: Gender distribution of the patients (n=130)**

| Gender | No. of patients | %     |
|--------|-----------------|-------|
| Male   | 63              | 48.46 |
| Female | 67              | 51.54 |
| Total  | 130             | 100   |

**Table 3: Frequency of left ventricular systolic dysfunction in patients with ESRD on haemodialysis (n=130)**

| LV systolic dysfunction | No. of patients | %     |
|-------------------------|-----------------|-------|
| Yes                     | 7               | 5.38  |
| No                      | 123             | 94.62 |
| Total                   | 130             | 100   |

**Table 4: Stratification for frequency of left ventricular systolic dysfunction with regards to age (n=7)**

| Age (in years) | No. of patients | LV Systolic Dysfunction (n=7) |      |
|----------------|-----------------|-------------------------------|------|
|                |                 | No. of patients               | %    |
| 18-30          | 28              | 2                             | 7.14 |
| 31-40          | 33              | 3                             | 9.09 |
| 41-50          | 39              | 1                             | 4.76 |
| 51-60          | 22              | 1                             | 2.94 |
| 61-70          | 8               | 0                             | 0    |
| Total          | 130             | 7                             | 5.38 |

**Table 5: Stratification of ejection fraction of systolic dysfunction in patients on haemodialysis (n=7)**

| Ejection fraction (%) | No. of patients (n=7) | Gender   |            |
|-----------------------|-----------------------|----------|------------|
|                       |                       | Male (%) | Female (%) |
| 40-50%                | 5(71.43%)             | 3(60%)   | 2(40%)     |
| 30-40%                | 2(28.57%)             | 2(100%)  | 0          |
| <30%                  | 0                     | 00       | 00         |
| Total                 | 7                     | 5        | 2          |

**Table 6: Stratification for duration of dialysis in patients with LV systolic dysfunction (n=130)**

| Duration of dialysis (in years) | No. of patients | LV systolic Dysfunction (n=7) |       |
|---------------------------------|-----------------|-------------------------------|-------|
|                                 |                 | No. of patients               | %     |
| 0.5-1                           | 31              | 4                             | 12.90 |
| 1-2                             | 39              | 2                             | 5.13  |
| 2-5                             | 48              | 1                             | 2.08  |
| 5-10                            | 12              | 0                             | 0     |
| Total                           | 130             | 7                             | 5.38  |

(n=67) were females.(Table No. 2)

Among 130 patients with end stage renal disease on maintenance haemodialysis, frequency of left ventricular systolic dysfunction observed was 5.38% (n=7) while 94.62%(n=123) had no LV systolic dysfunction. (Table No. 3)

Stratification for age in patients with LV systolic dysfunction was recorded which showed 7.14%(n=2) out of 28 cases between 18-30 years, 9.09%(n=3) out of 33 cases were between 31-40 years, 4.76%(n=1) out of 39 cases were between 41-50 years, 2.94%(n=1) out of 22 cases were between 51-60 years of age while no patient between 61-70 years out of 8 cases were recorded. (Table No. 4)

Frequency of ejection fraction of systolic dysfunction in patients on haemodialysis was recorded in Table No. 5, where 5(71.43%) patients were having EF of 40-50% , while 30-40%EF was recorded in 2 cases (28.57%), while no patient with <30% EF was recorded.

Stratification for duration of dialysis in patients with LV systolic dysfunction was done. There was



systolic dysfunction in 4 (12.90%) out of 31 with 0.5-1 years duration of regular dialysis, 2 (5.13%) out of 39 cases with 1-2 years duration had systolic dysfunction, only 1 (2.08%) out of 48 with 2-5 years duration had systolic dysfunction while no patient with 5-10 years duration of regular dialysis had systolic dysfunction. (Table No. 6)

## DISCUSSION:

Cardiovascular diseases are the most common cause of mortality in patient with end-stage renal disease.<sup>1</sup> 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. Congestive heart failure is found in about 25% of cases of chronic kidney disease.<sup>9</sup>

The frequency of LV systolic dysfunction (LVSD) was higher in patients requiring more haemodialysis sessions per week which might be due to the toxic effect of haemodialysis membrane on myocardial function, or myocardial hibernation.

We planned this study as we could not find any local data in Pakistan regarding frequency of LV systolic dysfunction among patients with end stage renal disease on maintenance haemodialysis. So the results may set baseline data. The additional benefit of the study is that it will create awareness for early detection of LV systolic dysfunction which will further helpful for prioritizing the patients for early renal transplant as this type of LV systolic dysfunction is reversible by renal transplant.<sup>7</sup>

The results of the study revealed that left ventricular systolic dysfunction in patients with end stage renal disease maintaining haemodialysis was prevalent in 5.38%(n=7). Further investigations determined that its frequency was not higher in elderly age but in younger patients i.e. 7.14 % (n=2) between 18-30 years and 9.09 % (n=3) between 31-40 years as compared to 4.76 % (n=1) between 41-50 years and 2.94 % (n=1) between 51-60 years of age. It was also observed that among majority of younger patients with LV systolic dysfunction, underlying cause of ESRD was chronic glomerulonephritis and they were having high serum creatinine level, low albumin level, low haemoglobin level and Low serum calcium level.

LV dysfunction in ESRD patients occurs due to hemodialysis-induced repetitive myocardial injury<sup>10</sup>. A study conducted by Ostovan MA and colleagues, recorded the frequency of left ventricular dysfunction in patients on haemodialysis as 20.3%<sup>5</sup>

while we observed 12.9% for 0.5 -1 year duration of haemodialysis. This difference may be explained by our exclusion of known cases of ischemic heart disease, valvular heart disease and cardiomyopathy. They did not mention about duration of haemodialysis of selected patients, as they suggested that The frequency of LV systolic dysfunction was higher in patients requiring more haemodialysis sessions per week. In contrast we observed that frequency of LV systolic dysfunction declined with increase in duration of haemodialysis.

Another study by Kale et al<sup>11</sup> evaluated 161 patients for left ventricular disease manifesting after 4 to 12 weeks of initiating haemodialysis and revealed that systolic dysfunction is prevalent in 14.9%, LV hypertrophy in 54.7% and LV dilatation in 26.1% patients. The difference between Kale et al and the present study is that they included patients within 4 to 12 weeks of initiating haemodialysis while we include patients with 0.5 years to 10 years duration of haemodialysis. But the outcome of frequency of LV systolic dysfunction is almost similar for the initial period as we recorded 12.9% of the patients during first year of haemodialysis.

This study does not reflect the frequency of LV systolic dysfunction only but it encompass the potential effects of haemodialysis on LV systolic dysfunction of these patients as it shows the gradual decline from 12.9% of the patients during first year of haemodialysis to 5.33% of the cases between 1-2 years duration of haemodialysis, 2.08% of cases between 2-5 years duration of haemodialysis and no case between 5-10 years duration of haemodialysis which suggest that duration of haemodialysis had no direct harmful effects on myocardium but it improves LV systolic dysfunction.

In this study we included only 130 patients of ESRD on maintenance haemodialysis, among these patients to determine the accurate frequency of LV systolic dysfunction we need larger sample size. We excluded significant number of patients with ESRD on maintenance haemodialysis who were suffering from IHD, valvular heart disease and cardiomyopathies. As these diseases are potential causes of LV systolic dysfunction. We may get different results by including these patients in study. This is the first study conducted in Pakistan to evaluate the frequency of LV systolic dysfunction among patients of ESRD on maintenance haemodialysis and we do not have any previous local study as baseline data to compare the results in local population.

We postulate that periodic echocardiographic



examination for earlier diagnosis and treatment of cardiac abnormalities is highly recommended. However, the results of the study should be considered as primary and further trials should be done to confirm the findings in our population.

### CONCLUSION:

The frequency of Left Ventricular systolic dysfunction is considerable among patients with end

stage renal disease in the first year of regular maintenance haemodialysis. Therefore, it is recommended that every patient who is diagnosed as ESRD or known patient of ESRD on maintenance haemodialysis, should be investigated for LV systolic dysfunction to prioritize them for early initiation of renal replacement therapy. It is also required that every setup should have their surveillance in order to know the frequency of the problem.

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