



## Original Article

# Echocardiographic Patterns in Severe Chronic Kidney Disease with Type 4 Cardiorenal Syndrome Patients

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### Abstract

Changes in cardiac structure and function detected by echocardiography are common in patients with type 4 cardiorenal syndrome and have been recognized as key outcome predictors. This study aimed to evaluate echocardiographic patterns in severe chronic kidney disease (CKD) in type 4 cardiorenal syndrome patients. This was a descriptive type of cross-sectional study. The study was carried out in the Cardiology and Nephrology Department of Bangabandhu Sheikh Mujib Medical University, Dhaka. After exclusion total of 44 patients having severe CKD (GFR <30 ml/min/1.73 m<sup>2</sup>) with type 4 cardiorenal syndrome were included in this study. All patients underwent echocardiography.

Most of the patients with type 4 cardiorenal syndrome were in the 6<sup>th</sup> decade (Mean age was 58.9±5.9 (SD) in severe CKD with male predominant. Ischemic heart disease (65.9%), arrhythmia (13.63%), and heart failure (22.72%) were significantly noted in severe CKD in type 4 cardiorenal syndrome patients. Mean systolic blood pressure was 178.2±18.7 mmHg & mean diastolic blood was 97.7±5.9 mmHg among the study subjects.

Left ventricular hypertrophy (54.6%), systolic dysfunction (27.3%), pericardial effusion (36.4%), valvular calcification (63.6%), and diastolic dysfunction (54.5%) were most common findings in severe CKD with type 4 cardiorenal syndrome.

The study recommended that a careful analysis of echocardiographic findings in patients with type 4 cardiorenal syndrome may discover the signs of cardiovascular changes. Thus appropriate measures can be taken. From this current study, it is evident that most of the patients with type 4 CRS with severe CKD developed left ventricular hypertrophy, so periodic 24-hour ambulatory blood pressure monitoring may be advised to address the unusual rise of blood pressure and treat it properly.

**Keywords:** Echocardiography, Type 4 cardiorenal syndrome, Chronic kidney disease.

TAJ 2022; 35: No-1: 11-16

## Introduction

The term cardiorenal syndrome (CRS) has been introduced recently in an attempt to emphasize the tight interaction between the cardiovascular and renal systems in acute or chronic disease settings

treatment.<sup>1</sup> The definition encompasses different syndromes, all involving the heart and the kidney, “whereby acute or chronic dysfunction of one organ may induce an acute or chronic dysfunction of the other”.<sup>2</sup>

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According to the site of the initial injury and the acute or chronic nature of the process, five distinct syndromes (types) are defined. Type 4 cardiorenal syndrome is a primary chronic kidney disease (CKD) that contributes to cardiac dysfunction, which may be manifested by coronary disease, heart failure, or arrhythmia.<sup>3</sup> Patients with CKD have an increased risk of both atherosclerotic cardiovascular disease and heart failure, and cardiovascular disease is responsible for up to 50% of deaths in patients with renal failure.<sup>4</sup>

Assessment and quantification of right ventricular function often are difficult and challenging.<sup>5</sup> Diagnosis of right ventricular myocardial infarction (RVMI) is based on electrocardiographic (ECG) ST-segment elevation in lead V<sub>4R</sub> in an inferior myocardial infarction setting. The Echocardiographic diagnosis of RVMI is straightforward if right ventricular (RV) dilation and regional wall motion abnormality are present. These changes are not evident in many RVMI patients. Also, the assessment of RV volume and function is cumbersome due to the complex geometry and inaccessible location of the RV.<sup>6</sup>

Changes in cardiac structure and function detected by echocardiography are common in patients with CKD and have been recognized as key outcome predictors. Left ventricular hypertrophy (LVH) is the most frequent echocardiographic finding<sup>5</sup>. It is associated with a clearly unfavorable prognosis. More than 2/3 of the patients undergoing dialysis with LVH die of congestive heart failure or sudden death<sup>6</sup>, which is why it is one of the main targets of therapeutic intervention, together with coronary artery disease. Other echocardiographic abnormalities in CKD patients, especially in End-Stage Renal Disease (ESRD), are left ventricular systolic and diastolic dysfunction, pericardial effusion, and calcific/sclerotic valves. By using Doppler flow studies, valvular incompetence (MR, AR) is detected in a number of patients. A Canadian study that followed a cohort of 432 patients starting hemodialysis therapy showed that only 16% had a normal Doppler echocardiogram.<sup>7</sup>

Left ventricular systolic dysfunction is a powerfully unfavorable prognostic indicator for individuals undergoing hemodialysis<sup>8</sup> and those submitted to renal transplant.<sup>9</sup> Echocardiography should be performed early in the course of CKD and may be valuable in the monitoring of therapy of these patients.<sup>10</sup> Echocardiographic evaluation plays a pivotal role in establishing the diagnosis of cardiomyopathy as well as in stratifying risk and defining the impact of interventions. There is increasing evidence of the pivotal role of echocardiography in the improvement of the quality of global clinical evaluation of advanced CKD patients. Current literature and clinical practice have emphasized the usefulness of the method for the diagnosis of clinical and subclinical cardiac dysfunction, the prediction of cardiovascular risk, and the orientation and follow-up of treatment strategies (Rewrite). The purpose of this study was to find out the echocardiographic patterns in different grades of CKD patients with type 4 cardiorenal syndrome.

## Materials and Methods

This was a descriptive type of cross-sectional study. The study was carried out in the Cardiology and Nephrology Department of Bangabandhu Sheikh Mujib Medical University, Dhaka. After exclusion total of 44 patients having severe CKD (GFR <30 ml/min/1.73 m<sup>2</sup>) with type 4 cardiorenal syndrome were included in this study.

Inclusion criteria:

1. Patients with type 4 cardiorenal syndrome
2. Age greater than 18 years, irrespective of sex

Exclusion criteria:

1. Patients with liver disease, history of essential hypertension, untreated hypothyroidism, and cor pulmonale were excluded from the study. Clinical data, including clinical history and treatment history, was recorded. Clinical features, relevant physical examination, and baseline laboratory investigations were done. All patients underwent echocardiography.

## Results

A total of 44 patients were enrolled in this study. The mean age was  $58.9 \pm 5.9$  SD (Table I). Among the study subjects, 32 (72.7%) were male, and 8 (27.3%) were females. The male: female ratio was 4:1 (Figure I). After comparing presenting symptoms of the study patients, it was observed that chest pain 30 (68.2%), breathlessness 28 (63.6%), and edema 32 (72.7%) were more significant among the study subjects (Figure II). Mean systolic blood pressure was  $178.2 \pm 18.7$  mmHg & mean diastolic blood was  $97.7 \pm 5.9$  mmHg among the study subjects (Table II). Among the study patients, ischemic heart disease 29 (65.9%), arrhythmia 6 (13.63%), and heart failure 10 (22.72%) were noted (Table III).

**Table I: Distribution of the study patients by age (n=44)**

Age (in years)	Study patients (n=44)	
	N	(%)
31 - 40	0	0.0
41 - 50	4	9.1
51 - 60	26	59.1
61 - 70	14	31.8
> 80	0	0.0
<b>Mean±SD</b>	<b>58.9±5.9</b>	
<b>Range (min-max)</b>	<b>50-70</b>	

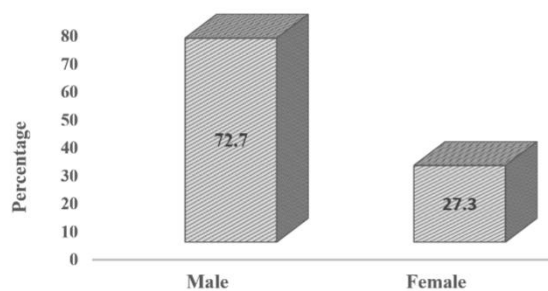


Figure I: Bar diagram showing sex distribution of the patients (n=44)

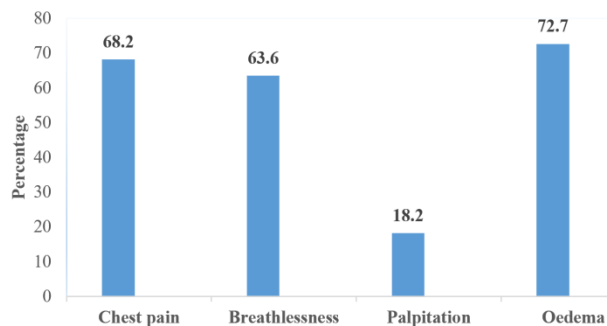


Figure II: Bar diagram showing presenting symptoms of the patients (n=44)

**Table II: Distribution of the study patients by blood pressure (n=44)**

Blood pressure	Study patients (n=44)	
	N	(%)
<b>Systolic BP (mmHg)</b>		
<140	0	0.0
≥140	44	100.0
Mean±SD	<b>178.2±18.7</b>	
Range (min-max)	<b>150-210</b>	
<b>Diastolic BP (mmHg)</b>		
<90	8	18.2
≥90	36	81.8
Mean±SD	<b>97.7±5.9</b>	
Range (min-max)	<b>90-110</b>	

**Table III: Distribution of the study patients by ischemic heart disease, arrhythmia, and heart failure (n=44)**

	Study patients (n=44)	
	N	(%)
Ischemic heart disease	29	65.9
Arrhythmia	6	13.63
Heart failure	10	22.72

All patients underwent echocardiography. The mean ejection fraction was found to be 52.8±9.2 percent in study patients. Left ventricular hypertrophy, systolic dysfunction, pericardial effusion, valvular calcification, and diastolic dysfunction were the most common finding in severe CKD with type 4 cardiorenal syndrome (Table IV).

**Table IV: Echocardiographic assessment of the study patients (n=44)**

Echocardiographic findings	Study patients (n=44)	
	N	(%)
Systolic dysfunction	12	27.3
Diastolic dysfunction	24	54.5
Pericardial effusion	16	36.4
Valvular calcification	28	63.6
LVH and systolic dysfunction	8	18.2
LVH and Diastolic dysfunction	16	36.4

## Discussion

This was a descriptive type of cross-sectional study. The study findings were discussed and compared with previously published relevant studies.

The mean age was  $58.9 \pm 5.9$  SD (Table I). Among the study subjects, 32 (72.7%) were male, and 8 (27.3%) were females. The male: female ratio was 4:1. After comparing presenting symptoms of the study patients, it was observed that chest pain 30 (68.2%), breathlessness 28 (63.6%), and edema 32 (72.7%) were more significant among the study subjects.

Mean systolic blood pressure was  $178.2 \pm 18.7$  mmHg & mean diastolic blood was  $97.7 \pm 5.9$  mmHg among the study subjects (Table II). Similarly, Nitin et al. found that the mean systolic blood pressure was  $158. \pm 12.06$  mmHg and mean diastolic blood pressure was  $101.13 \pm 7.9$  mmHg in severe CKD patients.<sup>11</sup> In another study, Agarwal et al. observed systolic blood pressure of  $163.5 \pm 9.6$  mmHg and mean diastolic blood pressure was  $100.0 \pm 5.7$  mmHg in severe CKD patients.<sup>12</sup> The above findings are consistent with the current study.

All patients underwent echocardiography. Among the study patients, ischemic heart disease 29 (65.9%), arrhythmia 6 (13.63%), and heart failure 10 (22.72%) were noted (Table III).

The mean ejection fraction was found to be  $52.8 \pm 9.2$  percent in study patients. Debnath et al. study observed that the mean ejection fraction in patients with severe CKD patients showed a downward trend (mean LVEF < 50%)<sup>13</sup>. Dangri et al. and Raj et al., the mean ejection fraction in patients with severe CKD patients, was < 49%<sup>14-15</sup>. Left ventricular hypertrophy, systolic dysfunction, pericardial effusion, valvular calcification, and diastolic dysfunction were the most common finding in severe CKD with type 4 cardiorenal syndrome (Table IV). Similar findings were also observed by Nitin et al., which are comparable with the current study.<sup>11</sup>

## Limitations of the study:

There were some limitations of this study.

- I. The study population was taken from a single center, so the results of the study may not reflect the exact picture of this population.
- II. The present study was conducted for a short period, but for appropriate results, a long time follow-up is necessary.

## Conclusion

A careful analysis of echocardiographic findings in patients with type 4 cardiorenal syndrome may discover the signs of cardiovascular changes. Thus appropriate measures can be taken. From this current study, it is evident that most of the patients with type 4 CRS with severe CKD developed left ventricular hypertrophy, so periodic 24-hour ambulatory blood pressure monitoring may be advised to address the unusual rise of blood pressure and treat it properly.

**Conflict of interest:** None declared

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