ORIGINAL ARTICLE

PREVALENCE OF CARDIORENAL SYNDROME IN PATIENTS ADMITTED FOR ACUTE DECOMPENSATED HEART FAILURE AND ITS CORRELATION WITH IN-HOSPITAL OUTCOMES

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Background: Cardiorenal syndrome is the prevalent form of the syndrome in Pakistan. Despite the rising importance of CRS, more information is needed to understand comorbidities and hospital outcomes. This research study explores the prevalence, and In-hospital outcomes of patients admitted for Acute Decompensated Heart Failure at the tertiary care hospital of Islamabad at the age of above 18. **Methods:** This cohort study was conducted at the tertiary care hospital in Islamabad from January to June 2024. Data were collected from 200 known ADHF patients who visited the CCU (OPD) and ward through a structured questionnaire. The data were analyzed using SPSS version 25. **Result:** The majority of the sample was diagnosed with Type 1 Cardiorenal Syndrome, which accounted for 30% of the total. Cardiorenal Syndrome Types 3 and 5 had a prevalence of 20% each among the patients, while Types 2 and 4 had a prevalence of 15% each. This suggests that Type 1 was more prevalent, but the other types were equally distributed. The mortality rate in the Hospital was highest for Type 5 CRS at 15% and Type 3 CRS at 13%. During this period, Type 2 CRS exhibited the lowest mortality rate. Type 3 CRS had the most extended average hospitalization duration. **Conclusion:** It was concluded in our study that cardiorenal syndrome is the prevalent form among admitted patients with ADHF, and the government needs to increase awareness about health and health-related risk factors related to the communities.

Keywords: Prevalence; Cardiorenal syndrome; In-hospital; Tertiary care

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INTRODUCTION

Cardio-renal syndrome (CRS) encompasses a range of illnesses that affect both the heart and kidneys. In this syndrome, malfunction in one organ, whether acute or chronic, can lead to dysfunction in the other organ, whether it is also acute or chronic.[1] In 2008, the Acute Disease Quality Initiative (ADQI) introduced the current conceptual description of CRS, which categorizes it into five subtypes: Type 1 CRS, also known as acute cardiorenal syndrome, is defined by the sudden deterioration of cardiac function that results in acute kidney injury (AKI).[2] Approximately 25% of patients admitted for acute decompensated heart failure (ADHF) experience Type 1 CRS.[3] CRS type 2 is distinguished by persistent irregularities in the functioning of the heart, which result in injury or failure of the kidneys. Type 3 CRS is distinguished by an acute deterioration of kidney function that results in cardiac disease. Chronic Reno cardiac illness, commonly known as Type 4 CRS, is identified by cardiovascular complications in individuals with CKD at any stage. CRS type 5 is a newly identified clinical illness; comprehensive epidemiological information must still be included. Type 5 cardiorenal syndrome refers to the simultaneous occurrence of cardiac and renal impairment. This typically happens in cases of sepsis, where both the heart and kidneys are affected due to a shared underlying pathogenic origin.[2]

Cardiorenal syndrome (CRS) frequently arises during the management of acute decompensated heart failure (ADHF) and is linked to unfavourable clinical prognosis.[4] Approximately 14–34% of patients diagnosed with acute decompensated heart failure (ADHF) experience the development of worsening renal function (WRF). The wide range of values can be mainly attributed to differences in the threshold values for changes in renal function, the duration of observation, the population being studied, and the severity of the initial renal function. Furthermore, the admission creatinine measurements, considered "baseline creatinine" values, may not accurately represent the baseline in patients who previously experienced some decline in their renal function before admission. While the majority of

studies have indicated that WRF (Worsening Renal Function) in Acute Decompensated Heart Failure (ADHF) typically begins soon after admission to the Hospital, WRF can develop in the short- and medium-term following hospitalization.[5]

Acute decompensated heart failure is a prevalent cardiac condition in Pakistan for hospitalization, with various precipitants significantly impacting the severity of decompensation, especially in resource-poor settings.[6] Individuals suffering from heart disease often require hospitalization as a result of acute decompensated heart failure (ADHF), which can be associated with either preserved or diminished left ventricular systolic function.[7] The study conducted by Zaidi *et al*.[8] focused on cardiorenal syndrome type 1 in children admitted to the Hospital with acute heart failure. In addition, Naqvi[9] examined a case series involving individuals who experienced Acute Kidney Injury (AKI) and Cardiorenal Syndrome (CRS). The aim was to record multiple factors contributing to CRS and the subsequent prognosis in this group of patients. The aetiologies of CRS encompassed acute myocardial infarction with ST elevation, congestive heart failure, infective endocarditis, and dilated cardiomyopathy. Moreover, the main factors that increase the likelihood of kidney damage in the context of heart failure or cardiac dysfunction include high blood pressure, diabetes, and substantial underlying atherosclerotic vascular disease. A considerable percentage of diabetic patients eventually develop clinically severe nephropathy, and diabetes is a known risk factor for cardiovascular disease (CVD).[10]

Limited published literature exists on cardiorenal syndrome in Pakistan. This study is conducted to fill the literature and knowledge gap for future studies. This research aimed to determine the prevalence of cardiorenal syndrome in hospitalized patients with acute decompensated heart failure.

MATERIAL AND METHODS

The sample was comprised of N=200 patients with ADHF. Acute decompensated heart failure (ADHF) is the sudden worsening of chronic heart failure symptoms, often requiring immediate medical care. It is marked by symptoms like severe shortness of breath, fluid buildup, and fatigue due to the heart's reduced ability to pump blood effectively. Patients who were above the age range of 18 were included in this study, which was conducted over the span of 6 months (January–June 2024). The existing criteria served as the foundation for the definitions of ADHF. Patients with active infections, those who had undergone heart surgery for emergency coronary revascularization, or those with a history of end-stage renal illness necessitating renal replacement treatment were not included in our analysis.

This study was carried out at the tertiary care Hospital in Islamabad, using a retrospective cohort design. This facility is located in the metropolitan area. This tertiary care and sees a mix of patients from wealthy and lower and middle-class backgrounds.

The study was undertaken following approval from the Hospital's ethical and research council. This study covered all patients who were admitted for acute decompensated heart failure. After stabilizing and treating these patients, formally informed consent was obtained from them. Data was collected through the Hospital's computerized information system. Standard clinical, physiological, and demographic data were gathered. Age, sex, body mass index, weight (kg), height (cm), and duration of hospital stay were among the demographic data. Primary diagnoses and other comorbidities were included in the clinical data.

The data was recorded and analyzed using SPSS version 25.0. The mean and standard deviation (SD) were computed for numerical variables such as age and BMI. Categorical characteristics such as gender, professions, hypertension, chronic kidney disease, diabetes mellitus, ischemic heart disease, NYHA Class 1–11, NHYA Class III-IV, and ADHF were analyzed to determine frequencies. ADHF was examined by stratifying data based on age and gender. The findings were displayed in the form of tables and charts.

RESULTS

The study involved 200 patients admitted for Acute Decompensated Heart Failure (ADHF). The majority of these patients were diagnosed with Type 1 Cardiorenal Syndrome, accounting for 30% of the sample. Types 3 and 5 of Cardiorenal Syndrome each affected 20% of the patients. In comparison, Types 2 and 4 affected 15% of the patients, indicating a higher prevalence of Type 1 and an equal distribution of the other types.

The gender distribution showed a predominance of males, with 130 patients (65%) compared to 70 females (35%). Regarding age groups, the most affected were those aged 40–50 years, comprising 45% of the total sample. The second largest group was patients under 40 years old, representing 35% of the cohort. The age group over 50 years old was the least represented, making up only 20% of the study population.

Table 2 showed the comorbidities based on types of cardiorenal syndrome in 200 patients. It classifies 110 individuals with diabetes, with Type 1 accounting for the largest number (40), followed by Type 5 (30). There are 140 cases of hypertension, with

Type 1 accounting for the largest number, followed by Type 2, and Type 5. Seventy patients have chronic kidney disease (CKD), with Type 1 accounting for the majority of cases. There are 120 individuals with ischaemic heart disease (IHD), with the highest number of type 1, type 5 and type 2. New York Heart Association (NYHA) functional classes are used to categorise patients according to the degree of their heart failure. There are 70 cases in Class I–II, with the majority falling into Type 1 (20) and Type 5 (15). There are 130 people in Class III–IV, with Type 1 (45) and Type 5 (40) having the greatest groupings. This distribution shows how common certain comorbidities are and how severe heart failure is in distinct patient groups.

The table provides a summary of in-hospital outcomes for each of the five patient categories, including in-hospital mortality, average length of stay, and 30-day readmission rates. Type 5 patients had the greatest in-hospital mortality rate (15%). The typical length of stay varies by patient category; Type 3 patients spend the longest, on average, for 15 days. Additionally, the 30-day readmission rate is highest for Type 3 patients (38%), followed by Type 5 patients (35%). This data reflects differences in in-hospital outcomes as well as differences in mortality, length of hospital stay, and readmission risk among the different patient categories.

Table-1: Demographic distribution based on types (N = 200)

Category	Total Patients (N)	Type 1 (N)	Type 2 (N)	Type 3 (N)	Type 4 (N)	Type 5 (N)
Total ADHF Patients	200	60	30	40	30	40
Gender						
Male	130	40	20	30	15	25
Female	70	20	10	10	15	15
Age Group						
< 40	70	15	10	10	20	15
40-50	90	30	15	20	5	20
> 50	40	15	5	10	5	5

Table-2: Comorbidities based on types of cardiorenal syndrome (N=200)

Comorbidities	Total Patients (N)	Type 1 (N)	Type 2 (N)	Type 3 (N)	Type 4 (N)	Type 5 (N)
Diabetes	110	40	25	5	10	30
Hypertension	140	50	40	8	6	36
Chronic Kidney Disease (CKD)	70	20	13	15	7	15
Ischemic Heart Disease (IHD)	120	40	25	10	15	30
Severity of Heart Failure						
NYHA Class I-II	70	20	16	9	10	15
NYHA Class III-IV	130	45	30	8	7	40

Table-3: In hospital outcomes based on types of cardiorenal syndrome (N=200)

In Hospital Outcomes	Type 1 (N)	Type 2 (N)	Type 3 (N)	Type 4 (N)	Type 5 (N)
In-Hospital Mortality (%)	10%	8%	13%	11%	15%
Average Length of Stay (days)	14	8	15	8	12
30-Day Readmission Rate (%)	30%	25%	38%	26%	35%

DISCUSSION

This study aimed to determine the prevalence of various forms of Cardiorenal Syndromes (CRS) in Acute Decompensated Heart Failure (ADHF) patients and co-morbid diseases, severity of heart failure, and post-hospitalization outcomes. This study described the frequency and features of Cardiorenal Syndrome (CRS) among 200 admitted patients with Acute Decompensated Heart Failure (ADHF). According to the data, among all types of CRS, Type 1 affects 30% of participants. As Ronco *et al*.[11] Ronco & Lullo (12**),** and Zarbock *et al*.[13] state, Type 1 CRS is an acute cardiorenal syndrome that is most common. Types 3 and 5 affected twenty percent of subjects, whereas fifteen percent were affected by Types 2 and 4. The Distribution of CRS amongst ADHF patients is highly nonuniform, with Type 1 being more prevalent, although other types are also discernible.

There were more men than women, 65% and 35%, respectively, in terms of gender and age distribution of the participants. A relation between heart failure prevalence rate vis-a-vis sex disparity has been reported elsewhere.[14] The most harshly hit age group was participants in their forties and fifties, which constituted 45%. After that, 35% were for those under 40. Another twenty percent comprised individuals aged fifty or above. Thus, it is essential to raise awareness and implement early intervention measures to address the higher incidence of heart failure and CRS among those below the age of fifty years. These results might help halt the progression of cardiovascular insufficiency and CRS.

Different types of CRS have distinct patterns of coexisting diseases, with diabetes being the most common in Type 1 CRS (40 patients) and Type 5 CRS (30 persons), suggesting a strong link between these comorbidities.[15] In a study by Prothasis *et al*.[16] Type 1 CRS was highest among the 140 participants affected by hypertension at 50 individuals, followed by Type 2 at 40 people. Liu *et al*.[17] found that CKD had subtypes: Type 3, Type 1 (20 patients), and Type 5, but there were only patients within each subtype comprising fifteen individuals. Silva & Diógenes[18] observed IHD in fifty cases of Type 1 CRS, while thirty cases out of them had Type 5 CRS. The complex interaction between cardiac and renal dysfunction is highlighted by this condition, which underscores the necessity to employ balanced care approaches targeted towards both heart failure and its most commonly associated ailments.

A remarkable increase in the severity of heart failure was noted as 130 study participants were classified as NYHA Class III-IV. The New York Heart Association (NYHA) Classes I-II [20 patients] and Classes III-IV [45 patients] represent incidences and grades of Type 1 CRS, respectively. This is indicated by 40 patients from 5 CRS being placed in the category of NYHA Class III-IV, which suggests that severe heart failure is common in this condition. Consequently, the statement asserts a need for prompt identification and intervention against HF to prevent it from progressing into severe CKD.[19,20]

Regarding CRS type within the hospital setting, a significant difference was observed in patient prognosis. In Type 5 CRS, this rate was higher at 15% compared to Type 3 CRS (13%). The death rate linked with Type 2 CRS is less than other types of syndromes described above. Different death rates are associated with various types of cardiorenal syndrome due to different pathophysiological processes and different levels of organ dysfunction caused by them.[21,22]

Those with Type 3 CRS stayed an average of 15 days, and those with Type 2 or 4 CRS just eight days. The degree of kidney failure linked to Type 3 CRS necessitates intense and continuous medical therapy that cannot be adequately handled in a shorter amount of time, which is why patients with this condition require longer hospital stays. For Type 3 CRS, the 30-day readmission rate was the highest at 38%. Type 2 CRS was next highest at 25%. A readmission rate of 35% was seen among people with Type 5 CRS. The high readmission rates for Type 3 and Type 5 CRS underscore the symptoms' recurrent, intractable nature. Therefore, comprehensive treatment programs are significant.[22] Chronic renal insufficiency (CRS) is present in patients with acute decompensated heart failure (ADHF), and it is associated with worse outcomes following hospitalization; these subjects require specialized care. Immediate consultation with other specialties, such as cardiologists and nephrologists, is crucial to ensure adequate treatment of this portion. Three strategies should be emphasized to increase patient results: early diagnosis of kidney function impairment, combat the burden by taking outstanding comorbidities, and thinking about specific care plans.

CONCLUSION

The study concentrated on the significant differences in incidence, severity, and comorbidities in various CRS types among ADHF patients. CRS Type 1 (day of surgery type) has a poorer prognosis but expresses less frequently, Chronic cardiorenal syndrome, or CRS Type 2, on the other hand, is linked to chronic heart failure that progressively impairs kidney function over time. In contrast to the abrupt deterioration observed in CRS Type 1, patients with CRS Type 2 typically have more stable and controllable symptoms, which may account for the comparatively improved short-term prognosis. Nevertheless, patients with CRS Type 2 have substantial long-term difficulties in spite of this seeming stability. Over time, these individuals are at a higher risk of death and frequent hospitalisations due to the chronic progression of both renal and heart disease. Higher death and readmission rates result from this. The findings underline the importance of creating protocols for each phenotypically distinct CRS to improve patient outcomes and reduce hospital readmissions.

AUTHORS' CONTRIBUTION

Conceptualization NY. Data curation: FK, MHI Formal analysis: WA, MFK, MFK Investigation: NY Methodology: FK, WA Validation: NY, MFK, WA Writing –original draft: MHI, MFK, MFK. Writing – review & editing: NY, MHI

REFERENCES

1. House AA, Anand I, Bellomo R, Cruz D, Bobek I, Anker SD, *et al*. Definition and classification of Cardio-Renal Syndromes: workgroup statements from the 7th ADQI Consensus Conference. Nephrol Dial Transplant 2010;25(5):1416–20.
2. Bargshaw SM, Cruz DM, Aspromonte N, Daliento L, Ronco F, Sheinfeld G, *et al*. Epidemiology of cardio–renal syndromes: workgroup statements from the 7th ADQI Consensus Conference. Nephrol Dial Transplant 2010;25(5):1406–16.
3. Dar O, Cowie MR. Acute heart failure in the intensive care unit: epidemiology. Crit Care Med 2008;36(1):S3–8.
4. Aronson D. Cardiorenal syndrome in acute decompensated heart failure. Expert Rev Cardiovasc Ther 2012;10(2):177–89.
5. Blair JE, Pang PS, Schrier RW, Metra M, Traver B, Cook T, *et al*. Changes in renal function during hospitalization and soon after discharge in patients admitted for worsening heart failure in the placebo group of the EVEREST trial. Eur Heart J 2011;32(20):2563–72.
6. Zahoor S, Arshad MS, Riaz A, Farhan M. Precipitants of acute decompensated heart failure and their correlation with the

severity of decompensation in a resource poor country. J Islamabad Med Dent Coll 2017;6(4):219–23.
7. DeFrances CJ, Lucas CA, Buie VC, Golosinskiy A. 2006 national hospital discharge survey. Natl Health Stat Report 2008;5:1–20.
8. Zaidi M, Rehman AJ, Haque A, Akhtar S, Maheshwar PK. Frequency of cardiorenal syndrome type-I in hospitalized children with acute heart failure in a tertiary-care hospital. J Coll Physicians Surg Pak 2014;24(8):577–80.
9. Naqvi R. Thrombotic Microangiopathy and acute kidney injury with malaria: One-year experience at SIUT. Pak J Kidney Dis 2024;8(2):23–6.
10. Usman MS, Khan MS, Butler J. The interplay between diabetes, cardiovascular disease, and kidney disease. In: Chronic Kidney Disease and Type 2 Diabetes. Arlington (VA): American Diabetes Association; 2021.
11. Ronco C, McCullough P, Anker SD, Anand I, Aspromonte N, Bagshaw SM, *et al*. Cardio-renal syndromes: report from the consensus conference of the acute dialysis quality initiative. Eur Heart J 2010;31(6):703–11.
12. Ronco C, Di Lullo L. Cardiorenal syndrome in western countries: epidemiology, diagnosis and management approaches. Kidney Dis (Basel) 2017;2(4):151–63.
13. Zarbock A, Küllmar M, Ostermann M, Lucchese G, Baig K, Cennamo A, *et al*. Prevention of cardiac surgery–associated acute kidney injury by implementing the KDIGO guidelines in high-risk patients identified by biomarkers: The PrevAKI-multicenter randomized controlled trial. Anesth Analg 2021;133(2):292–302.
14. Syed M. Hyponatremia in acute decompensated heart failure as a predictor of acute cardiorenal syndrome Type-1. Indian J Cardiovasc Dis Women 2023;8(2):121–5.
15. Maisons V, Halimi JM, Fauchier G, de Fréminville JB, Goin N, Gueguen J, *et al*. Type 2 diabetes and cardiorenal syndromes. A nationwide French hospital cohort study. Diabetes Metab 2023;49(3):101441.
16. Prothasis M, Varma A, Gaidhane S, Kumar S, Khatib N, Zahiruddin QS, *et al*. Prevalence, types, risk factors, and outcomes of cardiorenal syndrome in a rural population of central India: A cross-sectional study. J Family Med Prim Care 2020;9(8):4127–33.
17. Liu M, Li XC, Lu L, Cao Y, Sun RR, Chen S, *et al*. Cardiovascular disease and its relationship with chronic kidney disease. Eur Rev Med Pharmacol Sci 2014;18(19):2918–26.
18. Kumar A, Shandil R, Gupta D, Ganju N, Shandil A, Shandil A. Clinical profile and outcome of patients with cardiorenal syndrome type 1: a cross sectional observational study. Eur J Cardiovasc Med 2023;13(4):258.
19. Nakayama M. Nonuremic indication for peritoneal dialysis for refractory heart failure in cardiorenal syndrome type II: review and perspective. Perit Dial Int 2013;33(1):8–14.
20. Gigante A, Liberatori M, Gasperini ML, Sardo L, Di Mario F, Dorelli B, *et al*. Prevalence and clinical features of patients with the cardiorenal syndrome admitted to an internal medicine ward. Cardiorenal Med 2014;4(2):88–94.
21. Pimienta González R, Couto Comba P, Rodríguez Esteban M, Alemán Sánchez JJ, Hernández Afonso J, Rodríguez Pérez MD, *et al*. Incidence, mortality and positive predictive value of type 1 cardiorenal syndrome in acute coronary syndrome. PLoS One 2016;11(12):e0167166.
22. Dreznik Y, Hoffman A, Hamburger T, Ben-Yaacov A, Dux Y, Jacoby H, *et al*. Hospital readmission rates and risk factors for readmission following cytoreductive surgery (CRS) and hyperthermic intraperitoneal chemotherapy (HIPEC) for peritoneal surface malignancies. Surgeon 2018;16(5):278–82.

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