

Clinical profile and outcomes of patients receiving acute renal replacement therapy in the cardiac intensive care unit at a South African referral centre

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INTRODUCTION

The reported incidence of acute kidney injury (AKI) in patients managed in the cardiac intensive care units (CICU) is increasing.⁽¹⁻³⁾ This is partly because of the ageing patient population and patients with complex comorbidities treated in the CICU. At least 25% of patients admitted with cardiovascular disease will develop AKI depending on the AKI definition used, including up to 56.1% in patients with acute decompensated heart failure and up to 30% in patients with acute coronary syndromes (ACS).⁽⁴⁻⁶⁾ AKI complicating cardiovascular disease portends poor outcomes. For example, of the 118 465 patients admitted for acute decompensated heart failure evaluated in the ADHERE (Acute Decompensated Heart Failure National Registry) database, the 56.1% who developed moderate to severe acute renal impairment had a 4-fold increase in in-hospital mortality when compared to those with mild or no renal impairment.⁽⁷⁾ Furthermore, a recent systematic review suggested that approximately 3% of patients with ACS, acute decompensated heart failure and / or cardiogenic shock admit-

ABSTRACT

Background: At least a quarter of patients admitted to the cardiac intensive care unit (CICU) will develop acute kidney injury (AKI), and some of these patients receive renal replacement therapy (RRT). The clinical profiles and outcomes of CICU patients receiving RRT in resource constraint settings like South Africa are unknown.

Objectives: The objectives of this study were to determine the clinical profiles and outcomes of patients receiving RRT in the CICU in a South African tertiary centre.

Methods: In this retrospective study, we included consecutive patients admitted and receiving RRT at the Groote Schuur Hospital CICU from 1 January 2012 - 31 December 2016.

Results: During the study period, 3 247 patients were admitted to the CICU, and 46 (1.4%) received RRT. The RRT patients had a mean (SD) age of 52 (17) years, 56% were males, and 65% had a background history of systemic hypertension. Heart failure syndromes accounted for 60.9% of CICU admission in the RRT patient group, followed by acute coronary syndromes and arrhythmias, which accounted for 26.1% and 13.0%, respectively. The RRT patient population had in-hospital and 30-day mortality rates of 58.7% and 60.9%, respectively. Baseline use of angiotensin converting enzyme (ACE) inhibitor or angiotensin receptor blocker (ARB) was associated with a reduced 30-day mortality rate, hazards ratio (HR) 0.43; 95% confidence interval (95% CI) 0.20 - 0.93; $p=0.031$. In addition, heart failure was associated with an increased 30-day mortality rate, HR 2.52; 95% CI 1.10 - 5.78; $p=0.029$.

Conclusion: In this single-centre study from an upper middle-income country, a small proportion of CICU patients receive RRT. Heart failure syndrome is associated with most RRT patients admitted to the CICU. Patients receiving RRT in CICU have a high in-hospital and 30-day mortality. SA Heart® 2025;22:82-86

ted to the CICU received renal replacement therapy (RRT).⁽⁸⁾ In this group, the need for RRT conferred a 10-fold increase in the risk of death, and a prolonged length of CICU stay.⁽⁸⁾

In a study conducted by the International Society of Nephrology looking at the availability and accessibility of health ser-

vices for diagnosis, monitoring, and management of CKD, provision of renal replacement therapies (RRTs), distribution of the nephrologist workforce on a global scale, Qami and colleagues demonstrated limited access to trained nephrologists, dialysis services and renal transplantation in low- and middle-income countries.⁽⁹⁾ In centres where such advanced care is available, there are frequently critical resource-related constraints that limit the number of patients who can access care and require careful selection of patients who are likely to benefit most. The ongoing epidemiological transition and increase in diseases such as coronary artery disease, diabetes and hypertension have led to a rapid rise in the demand for CICUs and advanced renal care.⁽¹⁰⁾ Given the persistently high burden of communicable diseases in South Africa requiring health resources,⁽¹¹⁾ important decisions about appropriate resource allocation require a thorough understanding of both the burden of non-communicable diseases and their related outcomes. Specifically, in a South African public sector setting where patient demographics and cardiovascular risk factor profiles are different to that found in the Global North,⁽¹²⁾ the burden of AKI amongst patients admitted to hospitals with acute cardiac syndromes and their related outcomes would be important to inform appropriate resource allocation and patient care.

OBJECTIVES

The overarching aim of this study was to review the local practice of acute renal replacement therapy in a typical South African tertiary centre CICU regarding the burden, patient profiles, and patient outcomes.

METHODS

Study design and patient population

This was a retrospective folder review of all patients admitted to a 6-bed CICU at a large tertiary centre in Cape Town, South Africa, between 1 January 2012 - 31 December 2016.

After obtaining appropriate regulatory and ethics permissions, ward admission records, renal replacement records and the electronic health information system for public sector hospitals and health care centres in the Western Cape province of South Africa (CLINICOM) were searched for patient data, and related information on all the patients admitted to the CICU during the study period. A standardised data collection form was used to extract and analyse relevant data on those participants receiving RRT from the above hospital records. The study was carried out with the approval UCT Human Subjects Research Ethics Committee (HREC 690/2020).

The conventional indications for renal replacement therapy in acute renal failure are:

- volume overload
- intractable hyperkalaemia
- refractory metabolic acidosis, and / or
- uremic signs or symptoms of progressive azotaemia in the absence of uraemia.⁽¹³⁾

The consultant cardiologist referred patients in the cardiac CICU needing renal replacement therapy to the consultant nephrologist. RRT and the mode of RRT were at the discretion of the treating consultants.

Statistical Analysis

Normally distributed data are presented as means [standard deviation (SD)] and, when highly skewed, as medians [inter-quartile range (IQR)]; discrete variables are presented as numbers (percentages). Continuous data were compared using the t-test or Mann-Whitney test, and categorical data using the Chi-square test or the Fisher exact test. Cox proportional hazard regression models were constructed to identify factors associated with 30-day mortality. All tests were 2-sided, and a p-value <0.05 was considered significant. Collected data were entered and analysed using IBM SPSS Statistical Software.

RESULTS

During the 5-year study period, 3 247 patients were admitted to the CICU, and 46 (1.4%) patients received RRT for AKI. The patients receiving RRT in the CICU had a mean (SD) age of 52.6 (17.1) years, and 56.5% (26/46) were male. The baseline characteristics of RRT in CICU patients are presented in Table I.

Amongst the RRT cohort, the leading indication for CICU admission was acute or decompensated heart failure, 28/46 (60.9%), followed by acute coronary syndromes in 12/46 (26.1%) and unstable cardiac arrhythmias in 6/46 (13.0%) (Figure 1 to Figure 4).

After a median (IQR) of 10 (5; 17) days in the hospital, 27 patients demised, thus representing an in-hospital mortality rate of 58.7%. The 30-day mortality rate was 60.9%. On Cox regression analysis, the baseline use of angiotensin converting enzyme (ACE) inhibitors or angiotensin receptor blockers (ARB) was associated with a reduced probability of a 30-day mortality, hazards ratio (HR) of 0.43; 95% confidence interval [95% CI], (0.20 - 0.93); p=0.03. In contrast, admission to the CICU for heart failure was associated with a 2.5-fold increase in the probability of death in 30 days; HR=2.52; 95% CI (1.10 - 5.78), p=0.03 (Table II).

TABLE 1: Baseline characteristics of the patients who received renal replacement therapy at the GSH cardiac ICU.

Variable	No = 46
Age, mean (SD) years	52.6 (17.1)
Female, No (%)	20 (43.5)
Hypertension, No (%)	30 (65.2)
Diabetes mellitus, No (%)	18 (39.1)
Dyslipidaemia, No (%)	16 (34.8)
Atrial fibrillation, No (%)	9 (19.5)
Peripheral vascular disease, No (%)	5 (10.9)
Current smoking history, No (%)	15 (32.6)
History of ischaemic heart disease	12 (26.1)
Chronic kidney disease	11 (23.9)
ACE inhibitor / ARB, No (%)	24 (52.2)
Beta blocker, No (%)	14 (30.4)
Loop diuretic, No (%)	16 (34.8)
Thiazide diuretic, No (%)	10 (21.7)
Spironolactone, No (%)	4 (8.7)
Statin, No (%)	20 (43.5)
Sulfonylurea, No (%)	8 (17.4)
Metformin, No (%)	14 (30.4)
Insulin, No (%)	6 (13.0)
Warfarin, No (%)	6 (13.0)

CICU: Cardiac Intensive Care Unit, RRT: Renal Replacement Therapy,
PVD: Peripheral Vascular Disease, IHD: Ischaemic Heart Disease,
ACE: Angiotensin Converting Enzyme, ARB: Angiotensin Receptor Blocker,
ACS: Acute Coronary Syndrome, SD: Standard Deviation, IQR: Interquartile Range.

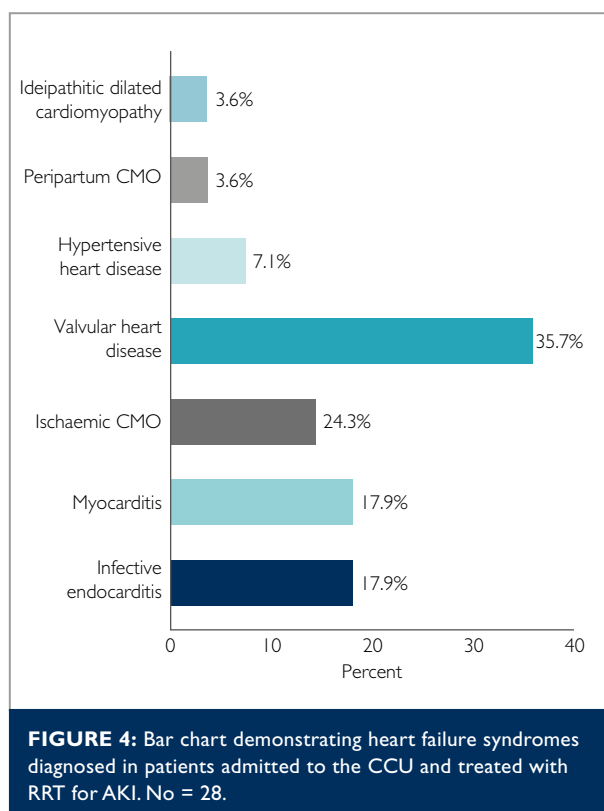
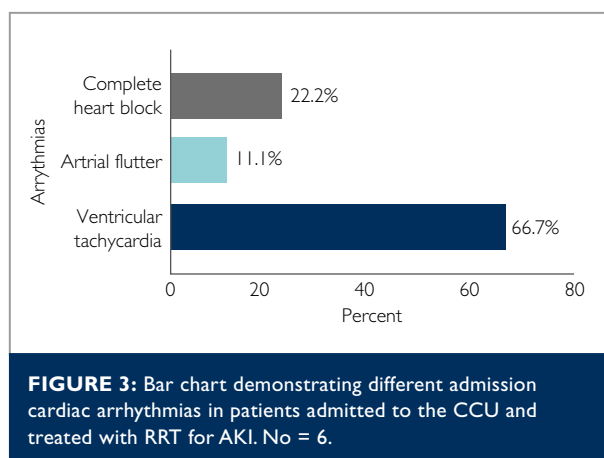
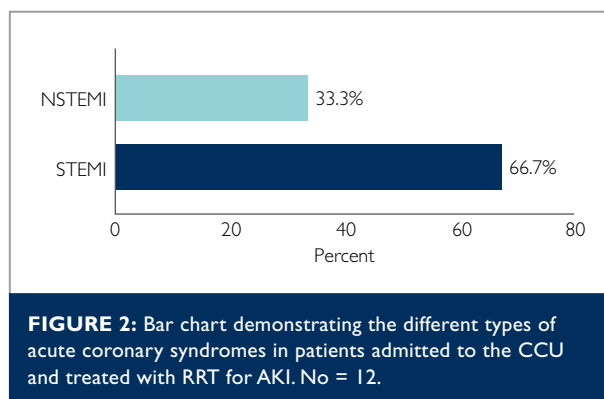
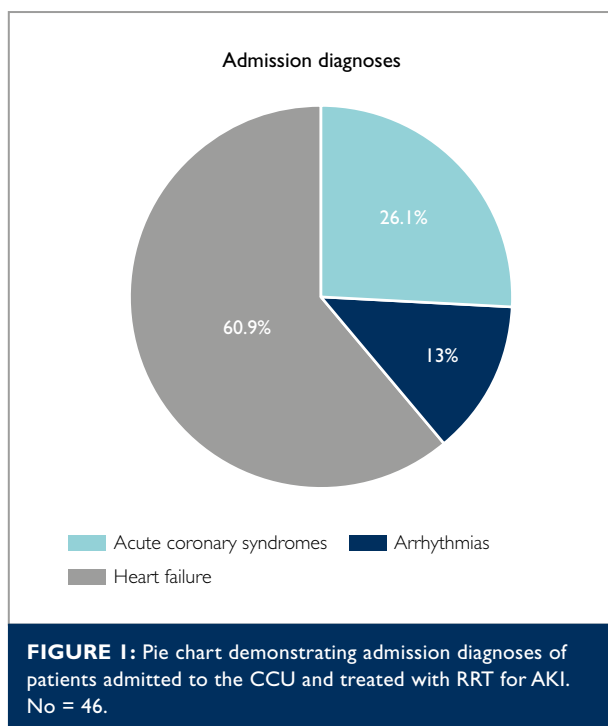


TABLE II: Hazards ratios and 95% confidence intervals for 30-day mortality in patients admitted to CICU and receiving RRT.

Variable	Hazard Ratio	95% CI lower	95% CI upper	P-value
Age in years	1.01	0.98	1.03	0.685
Hypertension	0.65	0.30	1.385	0.262
Diabetes Mellitus	0.62	0.28	1.36	0.232
Atrial fibrillation	1.02	0.35	2.93	0.975
Atrial Flutter	0.64	0.09	4.70	0.659
Dyslipidaemia	1.11	0.51	2.40	0.796
PVD	0.85	0.26	2.81	0.784
Chronic Kidney injury	0.47	0.18	1.24	0.125
IHD	1.17	0.50	2.74	0.727
Metformin	0.56	0.23	1.37	0.204
Sulfonylurea	0.44	0.13	1.47	0.181
Insulin	0.74	0.22	2.46	0.624
ACE inhibitors/ ARB	0.43	0.20	0.93	0.031
Beta blockers	1.94	0.89	4.22	0.095
Atenolol	1.82	0.74	4.52	0.195
Carvedilol	1.15	0.40	3.32	0.795
Spironolactone	0.57	0.13	2.40	0.441
Statins	0.10	0.31	1.45	0.308
Furosemide	0.58	0.27	1.23	0.153
Warfarin	1.15	0.40	3.32	0.798
Hydrochlorothiazide	0.32	0.01	1.06	0.063
Aspirin	0.47	0.21	1.05	0.067
ACS	1.45	0.24	8.72	0.687
Cardiogenic shock	0.85	0.36	1.95	0.702
Heart failure	2.52	1.10	5.78	0.029

CICU: Cardiac Intensive Care Unit, RRT: Renal Replacement Therapy, PVD: Peripheral Vascular Disease, IHD: Ischaemic Heart Disease, ACE: Angiotensin Converting Enzyme, ARB: Angiotensin Receptor Blocker, ACS: Acute Coronary Syndrome.

DISCUSSION

The main findings of this study are:

- Over the 5 years under review, the proportion of CICU admissions receiving acute RRT for AKI was small, at 1.42 %.
- RRT in our CICU was commonly received by patients with heart failure syndromes.
- CICU patients treated with RRT have a high in-hospital and 30-day mortality.
- Heart failure was associated with an increased probability of 30-day mortality, and baseline use of ACE-inhibitors or ARB were protective.

AKI is common in hospitalised patients. A recent large meta-analysis reported that at least 22% of hospitalised patients will develop AKI.⁽¹⁴⁾ However, there is limited data on the prevalence, management, and outcomes of AKI in patients admit-

ted to the CICU in low- and middle-income countries, particularly in Africa. AKI is particularly common in critically ill patients admitted to the intensive care unit. For example, in a large retrospective study from the Mayo Clinic, 51% of CICU patients developed AKI.⁽¹⁵⁾ AKI in the CICU is associated with an increased risk of in-hospital mortality.^(3,6) Further, there is a graded increase in mortality with worsening severity of AKI.^(15,16) In a recent retrospective study from the Mayo Clinic reviewing 9 311 CICU patients over 9 years, AKI developed in 50.8% of the CICU admissions.⁽¹⁵⁾ The rate of RRT in the Mayo Clinic study was 14.7%, compared to only 1.4% in our study. Further, the Mayo Clinic cohort was older, with a mean age of 67.5 years and had many more comorbidities, including prior malignancies, lung disease and obesity.⁽¹⁵⁾ These differences between our study and the Mayo Clinic study are partly due to the restricted access to RRT in our setting, therefore the selection of younger patients with fewer comorbidities.⁽⁹⁾ The leading admission

diagnosis amongst those requiring RRT in the Mayo Clinic study was heart failure (45 %), followed by acute coronary syndromes (44.1%) and shock (13%).⁽¹⁵⁾ Heart failure and acute coronary syndromes were the 2 main cardiac conditions amongst those needing acute RRT in our study cohort, but the proportions differed.

We report an in-hospital rate and 30-day mortality rate of 58.7% and 60.9%, respectively, consistent with those from larger studies from high-income countries.^(3,15,17-19) This highlights the complex adverse relationship between the sick heart and the kidneys and vice-versa, the cardio-renal syndrome.⁽²⁰⁾ In contrast to our findings, where decompensated heart failure was the main predictor of mortality, Van Diepen and colleagues identified shock, cardiac arrest, significant liver disease, and older age as predictors of in-hospital mortality in their CICU patients needing acute RRT.⁽¹⁹⁾

The significant limitations of this study are its small size, single-centre, retrospective nature of its design and the lack of a comparative group, particularly the group of patients with AKI who are not referred or offered RRT. Further, the data is incomplete; the specific indications for offering RRT were not explicitly clear in the patient files. However, in light of our study findings, a larger, prospective study to confirm the high mortality rate and better evaluate predictors of a poor outcome may be helpful to assist clinicians in similar settings with local evidence-based decision-making.

In conclusion, we set out to determine the clinical profile and outcomes of patients receiving RRT in the CICU at a South African referral centre. We found that acute renal replacement therapy was used sparingly in a relatively young population, most of whom had decompensated heart failure with cardio-renal syndrome. The in-hospital and 30-day mortality was high. These findings highlight the need for more aggressive programmes to screen for cardiovascular risk factors and primary prevention interventions to reduce the burden of the need for both CICU admissions and acute kidney injury needing renal replacement therapy.

Conflict of interest: none declared.

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