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Original Research Article

Acute coronary syndrome in chronic kidney disease: clinical characteristics and stage-wise associations from a tertiary care centre in Western India

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ABSTRACT

Background: Cardiovascular disease is the leading cause of morbidity and mortality among patients with chronic kidney disease (CKD). Acute coronary syndrome (ACS) in CKD is often associated with atypical presentations, diagnostic challenges and adverse outcomes. Data from western India regarding the clinical profile of CKD patients presenting with ACS remain limited.
Methods: This ambispective observational study was conducted at Goa Medical College, Goa. Adult patients with CKD presenting with ACS between September 2019 and August 2025 were included. Demographic characteristics, comorbidities, clinical presentation, cardiac biomarkers, echocardiographic findings and ACS subtype were assessed. Associations between CKD stage and clinical variables were analysed using the Chi-square test and analysis of variance.
Results: A total of 220 patients were included. The mean age was 66.5±9.1 years and 53.2% were male. Hypertension (87.3%), diabetes mellitus (71.8%) and dyslipidemia (66.8%) were common. NSTEMI was the predominant ACS subtype (60%), followed by unstable angina (37.7%) and STEMI (2.3%). Nearly half of patients (45.9%) had atypical presentation. Advancing CKD stage was significantly associated with NSTEMI/STEMI presentation ($p<0.001$), higher troponin variability ($p=0.004$), dialysis dependence ($p=0.002$), higher Killip class ($p=0.002$) and lower left ventricular ejection fraction ($p<0.001$).
Conclusions: ACS in CKD is characterised by a high burden of cardiovascular risk factors, frequent atypical presentation and predominance of NSTEMI. Advanced CKD is associated with greater cardiac dysfunction and more severe ACS manifestations, highlighting the need for early cardiovascular evaluation and intervention in this population.

Keywords: Acute coronary syndrome, Cardiovascular disease, Chronic kidney disease, Left ventricular ejection fraction, NSTEMI, Troponin

INTRODUCTION

Chronic kidney disease (CKD) affects approximately 9-10% of the global population and represents a major public health challenge.[1] Cardiovascular disease is the leading cause of morbidity and mortality among patients with CKD and accounts for a substantial proportion of deaths in this population.[2] The risk of cardiovascular events increases progressively with declining renal function and is influenced by both traditional cardiovascular risk factors and CKD-specific mechanisms such as chronic inflammation, endothelial dysfunction, vascular calcification and oxidative stress.[3]

Acute coronary syndrome (ACS) encompasses unstable angina, non-ST elevation myocardial infarction (NSTEMI) and ST elevation myocardial infarction (STEMI). Patients with CKD frequently present with

atypical symptoms, baseline electrocardiographic abnormalities and chronically elevated cardiac biomarkers, thereby making diagnosis challenging. Moreover, outcomes following ACS are significantly worse among patients with advanced CKD and end-stage kidney disease.[4]

Although several international studies have evaluated the interaction between CKD and ACS, data from India remain limited, particularly from western India. Analysing the clinical characteristics and presenting patterns of ACS in CKD may facilitate earlier diagnosis and improve cardiovascular outcomes. Hence, this study was undertaken to evaluate the clinical profile of CKD patients presenting with ACS ta a tertiary care centre in Goa, India.

METHODS

Study design and setting

This ambispective observational study was conducted at Goa medical College, Goa and involved patients evaluated in the departments of nephrology, cardiology and general medicine. The study comprised a retrospective phase from September 2019 to August 2024 and a prospective phase from September 2024 to August 2025.

Study population

Adult patients (≥18 years) with chronic kidney disease presenting with a presumptive diagnosis of acute coronary syndrome (ACS) were included. CKD was defined according to the kidney disease: improving global outcomes (KDIGO) 2012 clinical practice guidelines.[5] Patients unwilling to participate were excluded.

Sample size

The sample size was calculated using the formula for estimation of proportions with a 95% confidence level. Based on the calculated minimum sample size, 220 patients were enrolled in the study.

Data collection

Demographic characteristics, socioeconomic status, cardiovascular risk factors, comorbidities, dialysis status, clinical presentation, laboratory parameters, electrocardiographic findings, echocardiographic parameters and treatment details were recorded using a structured proforma.

Hypertension was defined as systolic blood pressure ≥140 mm Hg and/or diastolic blood pressure ≥90 mm Hg. Diabetes mellitus was diagnosed by fasting plasma glucose ≥126 mg/dl, postprandial plasma glucose ≥200 mg/dl. Dyslipidemia was defined according to the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) 2024 guidelines.[6]

Estimated glomerular filtration rate (eGFR) was calculated using the CKD-EPI equation. Cardiac biomarkers including troponin I and creatine kinase-MB (CK-MB) were assessed. Electrocardiography, chest radiography and 2D- echocardiography were performed in all patients.

Acute myocardial infarction was diagnosed according to the Fourth Universal Definition of Myocardial Infarction, requiring a rise and/or fall in cardiac troponin with at least one value above the 99th percentile upper reference limit in the presence of clinical, electrocardiographic, imaging or angiographic evidence of myocardial ischemia.[7] Patients were classified as having unstable angina, non-ST elevation myocardial infarction (NSTEMI) or ST-elevation myocardial infarction (STEMI) using standard diagnostic criteria.

Ethical considerations

The study was approved by the institutional ethics committee of Goa Medical College, Goa. Written informed consent was obtained from all prospectively enrolled participants. Confidentiality of patient information was maintained throughout the study.

Statistical analysis

Data was entered into Microsoft Excel and analysed using IBM SPSS Statistics version 22.0. Continuous variables were expressed as mean±standard deviation, while categorical variables were presented as frequencies and percentages. Associations between categorical variables were assessed using the Chi-square test. A two sided p value <0.05 was considered statistically significant.

RESULTS

A total of 220 patients with chronic kidney disease (CKD) presenting with acute coronary syndrome (ACS) were included in the study. The mean age was 66.5±9.1 years (range 45 84 years), and 117 (53.2%) were males. CKD stages were almost equally represented, with 33.2% each in CKD stages 3 and 4, and 33.6% in CKD stage 5.

Table 1: Baseline demographic and clinical characteristics of CKD patients with ACS (n=220).

Variables	Values
Age (years), mean±SD	66.52±9.07
Male sex, N (%)	117 (53.2)
eGFR (ml/min/1.73m^2), mean±SD	24.99±15.75
Serum creatinine (mg/dl), mean±SD	5.06±3.25
Troponin I (first), mean±SD	10.12±13.18
Troponin I (second), mean±SD	2.43±2.47
CK-MB (first), mean±SD	46.50±43.04
CK-MB (second), mean±SD	13.87±11.87
LVEF (%), mean±SD	46.38±13.59

The mean estimated glomerular filtration rate (eGFR) was 24.99±15.75 ml/minute/1.73 m^2, while the mean serum creatinine was 5.06±3.25 mg/dl. The mean left ventricular ejection fraction (LVEF) was 46.4±13.6% (Table 1).

Table 2: Clinical characteristics and cardiovascular risk factors.

Variables	N (%)
Hypertension	192 (87.3)
Diabetes mellitus	158 (71.8)
Dyslipidemia	147 (66.8)
On dialysis	93 (42.3)
Chest pain	147 (66.8)
Typical presentation	119 (54.1)
Atypical presentation	101 (45.9)

Hypertension was the most common comorbidity, present in 192 (87.3%) patients, followed by diabetes mellitus in 158 (71.8%) and dyslipidemia in 147 (66.8%). Nearly half of the patients (42.3%) were receiving maintenance dialysis. Chest pain was reported by 66.8% of patients, whereas 45.9% presented with atypical symptoms. Dyspnea was observed in more than half of the study population, with moderate-to-severe dyspnea present in 29.1% of patients (Table 2).

Table 3: Distribution of ACS type and clinical severity.

Variable	N (%)
Unstable angina	83 (37.7)
NSTEMI	132 (60.0)
STEMI	5 (2.3)
Troponin rise >20%	136 (61.8)
Troponin rise <20%	84 (38.2)
Killip I	104 (47.3)
Killip II	52 (23.6)
Killip III	37 (16.8)
Killip IV	27 (12.3)

NSTEMI was the predominant ACS subtype, occurring in 132 (60.0%) patients, followed by unstable angina in 83 (37.7%) and STEMI in 5 (2.3%) patients. A troponin rise greater than 20% was observed in 61.8% of patients. Electrocardiographically, 95.5% demonstrated ST-segment depression with T-wave inversion. Killip class I was the most common presentation (47.3%), although nearly one-third of patients presented with Killip class III or IV heart failure (Table 3).

Advanced CKD was significantly associated with more severe cardiovascular manifestations. NSTEMI and STEMI were increasingly frequent with advancing CKD stage, while unstable angina predominated in CKD stage 3 (p<0.001). Similarly, a troponin rise >20% was significantly more common in CKD stage 5 (p=0.004), and dialysis dependence was strongly associated with advanced CKD (p=0.002) (Tables 4 and 5).

Table 4: Association between CKD stage and ACS subtype.

CKD Stage	UA N (%)	NSTEMI N (%)	STEMI N (%)
Stage 3 (n=73)	54 (74.0)	19 (26.0)	0
Stage 4 (n=73)	24 (32.9)	49 (67.1)	0
Stage 5 (n=74)	5 (6.8)	64 (86.5)	5 (6.8)

Chi-square =77.87, p<0.001.

Table 5: Association between CKD stage and troponin dynamics.

CKD stage	Troponin change <20%	Troponin change >20%
Stage 3	54	19
Stage 4	24	49
Stage 5	6	68

Chi-square =68.84, p=0.004.

Higher CKD stages were also associated with worse heart failure severity, with CKD stage 5 accounting for 62.2% of Killip class III and 74.1% of Killip class IV presentations (p=0.002). (Table 6) A progressive decline in left ventricular systolic function was observed with worsening renal function. Mean LVEF decreased from 61.3% in CKD stage 3 to 48.0% in stage 4 and 30.2% in stage 5. This difference was highly significant on ANOVA analysis (F=843.3, p<0.001), indicating a strong association between advancing CKD stage and impairment of cardiac systolic function (Table 7).

Table 6: Association between CKD stage and Killip classification.

CKD stage	Killip I	Killip II	Killip III	Killip IV
Stage 3	64	5	3	1
Stage 4	28	28	11	6
Stage 5	12	19	23	20

Chi-square =94.32, p=0.002.

Table 7: Left ventricular ejection fraction across CKD stages.

CKD stage	Mean LVEF (%) ±SD
Stage 3	61.25±3.86
Stage 4	47.96±4.36
Stage 5	30.15±5.44

ANOVA F=843.26, p<0.001.

DISCUSSION

Cardiovascular disease is the leading cause of morbidity and mortality among patients with chronic kidney disease (CKD) and Acute coronary syndrome (ACS) represents a

serious manifestation of the same. In the present study, the mean age of patients was 66.5±9.1 years, with a slight male predominance (53.2%). These findings are consistent with previous studies demonstrating that the burden of ACS increases with advancing age and is more common among males. Go et al. reported a progressive increase in cardiovascular events with worsening renal function, particularly among elderly CKD patients.[2] Similarly, Charytan et al observed a high prevalence of ischemic heart disease among older individuals with advanced CKD.[8]

Hypertension (87.3%), diabetes mellitus (71.8%) and dyslipidemia (66.8%) were the most prevalent comorbidities in our cohort. These finding are comparable to those reported by Sarnak et al and Majmundar et al, who identified traditional cardiovascular risk factors as major contributors to adverse cardiovascular outcomes in CKD.[3,9-12] The coexistence of these risk factors, along with CKD-specific mechanisms such as chronic inflammation, endothelial dysfunction, oxidative stress and vascular calcification substantially increases cardiovascular risk in this population.[9-11]

NSTEMI was the predominant ACS subtype in our study and accounted for 60% cases, while STEMI was relatively uncommon. Similar observations have been reported by Majmundar et al. and Herzog et al, who demonstrated that NSTEMI is the most frequent ACS presentation in patients with CKD.[12,13] This may be attributed to diffuse coronary artery disease, microvascular dysfunction and chronically elevated cardiac biomarkers frequently seen in CKD.

An important finding in our study was the high prevalence of atypical presentations, observed in 45.9% patients and is consistent with previous studies which presented often without classical ischemic chest pain. Herzog et al reported that dyspnoea, fatigue, nausea and generalised weakness are common presenting symptoms among CKD patients with ACS.[13] Such atypical manifestations may contribute to delayed diagnosis and treatment, emphasising the need for a high index of clinical suspicion when evaluating CKD patients presenting with nonspecific symptoms.

Our study also observed a significant association between advancing CKD stage and ACS subtype, with NSTEMI and STEMI occurring more frequently in patients with advanced CKD. Moreover, worsening of CKD stage was associated with increased troponin variability. Interpretation of cardiac biomarkers in CKD remains challenging due to chronic elevations in troponin even in the absence of acute myocardial injury. However, many studies have shown that serial changes in troponin levels are more useful than isolated measurements for diagnosis of ACS in CKD patients.[14,15] This is also supported by our study findings. Another important observation was the significant decline in left ventricular ejection fraction (LVEF) with advancing CKD stage. Stage 5 CKD patients had markedly lower LVEF as compared with stage 3 CKD. Similar findings have been reported by Foley et al and Sarnak et al, who demonstrated that progressive renal function decline was associated with structural and functional cardiac abnormalities, including left ventricular hypertrophy, systolic dysfunction and heart failure.[3,16] Heart failure prevalence and severity also increase significantly with advancing CKD stages.[17]

Dialysis dependence was significantly associated with more severe cardiovascular manifestations, which is consistent with many studies. Factors such as chronic volume overload, accelerated atherosclerosis, vascular calcification, anaemia and persistent inflammation may contribute to this increased risk.[18,19]

Recent studies have asserted the bidirectional interaction between CKD and cardiovascular disease and the need for integrated cardiorenal management strategies.[20] Our study highlights the association between CKD and ACS, while emphasising on early recognition of ACS, appropriate interpretation of cardiac biomarkers and aggressive management of cardiovascular risk factors, which may help improve outcomes in this population.

This study has certain limitations. Being a single-centre study conducted at a tertiary care referral hospital, the findings may not be generalizable to all CKD populations. The ambispective design includes retrospective data collection which may be subject to information bias. Long-term cardiovascular outcomes and mortality after hospitalisation were not evaluated. Coronary angiographic findings were not available for all patients.

CONCLUSION

Acute coronary syndrome in patients with chronic kidney disease is characterised by a high association with traditional cardiovascular risk factors, frequent atypical presentations and predominance of NSTEMI. Advancing CKD stage is associated with greater troponin variability, dialysis dependence, higher Killip class and significant impairment of left ventricular systolic function. Early identification of ACS in CKD patients and close interdepartmental collaboration are essential for optimisation of diagnosis, treatment and outcomes in these patients.

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