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FREQUENCY OF ACUTE KIDNEY INJURY IN PATIENTS WITH ACUTE CORONARY SYNDROME

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Abstract

Objective: To determine the frequency of acute kidney injury (AKI) in patients admitted with acute coronary syndrome (ACS) as AKI commonly complicates ACS and contributes to worse in-hospital outcomes. As frequency of AKI is variable among different populations and local data on the frequency and impact of AKI in ACS patients remains limited we conducted this study to address the paucity of data among Pakistani population.
Study Design: Cross-sectional study
Place and duration of the study: This study was done at cardiology ward of Aga Khan university hospital in Karachi over a six month period from 1 February 2025 to 16 June 2025.
Methodology: We included 230 patients admitted with ACS and evaluated them for the development of AKI using KDIGO criteria. We examined associations between AKI and key clinical variables, including age, gender, comorbid conditions, types of ACS and intervention with coronary angiography.
Results: AKI developed in 29.1% of patients during their hospital stay. Patients with AKI were more likely to have cardiovascular disease or chronic kidney disease. Patients who experienced ST elevation myocardial infarction and underwent coronary angiography had a higher frequency of AKI. In our data, we found no significant association between AKI and age, sex, diabetes or hypertension.
Conclusion: The incidence of AKI in Pakistani population was found to be 29.1% placing our findings within the international range and indicating a notably high burden of AKI in our cohort. AKI affects a considerable proportion of patients especially those with CVD, CKD, STEMI or those undergoing coronary angiography.

INTRODUCTION

Acute kidney injury (AKI), is an emerging entity including a wide spectrum of kidney injuries and not just renal failure requiring dialysis. AKI is manifested by a rapid decline of renal function ranging from minor rise in serum creatinine (sCr) to renal failure requiring renal replacement therapy. Diagnosis of AKI is based on sCr levels and monitoring of urine output.[1]

Acute coronary syndrome (ACS) is characterized by sudden disruption of cardiac blood supply causing cardiac ischemia which includes unstable angina (UA), non-ST elevation myocardial infarction (NSTEMI), or ST elevation myocardial infarction (STEMI). Each year, an estimated more than 7 million people are diagnosed with ACS worldwide. [2]

In patients with ACS, there is acute left ventricular (LV) systolic failure causing decreased cardiac output hence decreased systemic perfusion. This leads to decreased effective renal blood flow hence renal ischemia. This is considered to be the main mechanism causing AKI in ACS. After the resumption of coronary flow and improvement of LV function, renal blood flow is also restored but renal functions may not recover or take more time to recover. Other important factors in these patients include hemodynamic instability and contrast administration. Renal function is amenable even to a slight hypotension or hypovolemia. Contrast induced AKI is much more prevalent now and is listed as third most common cause of hospital induced AKI. [3]

When ACS is complicated by AKI, the risks of renal replacement therapy, prolonged hospitalization, cardiovascular complications and mortality is profoundly increased. The risk factors for AKI include hypovolemia, anemia, age, diabetes mellitus and chronic kidney disease. [4] Frequency of AKI in ACS ranges from 4.4% to 30% in different studies. [5-6]

Aim of our study is to find out the frequency of AKI in patients having ACS as it is associated with worse outcomes in terms of morbidity and mortality. The frequency is highly variable in different populations and there is only limited data available from our population. So our aim is to identify the local statistics about frequency of AKI in ACS. Also patients admitted in hospitals are exposed to multiple risk factors that may cause AKI. Some of those risk factors include hypovolemia, drugs, contrast and anemia. If physicians have an insight of how the frequency of AKI is increasing among these patients they may be more vigilant and can monitor these patients more thoroughly and can aim to minimize the controllable risk factors (like anemia, hypovolemia, nephrotoxic drugs, contrast) to improve health and kidney outcomes.

METHODOLOGY

This cross-sectional study was conducted in the cardiology ward of Aga Khan University Hospital, Karachi, over a period of six months from 1 February 2025 to 16 June 2025, following approval of the research synopsis by the College of Physicians and Surgeons Pakistan (CPSP) and ethical approval exemption by ethics review committee (ERC) of The Aga Khan University. The sample size had been determined using OpenEpi based on findings from a prior local retrospective study, which reported a 17.5% prevalence of acute kidney injury (AKI) in patients with acute coronary syndrome (ACS). At a 95% confidence level and with a 5% margin of error, a minimum of 230 participants were required.[6] A non-probability consecutive sampling technique was employed to recruit eligible patients. **Acute kidney injury**: AKI was defined as an increase in serum Creatinine by 0.3 mg/dl within 48 hours or increase in Serum Creatinine to 1.5 times baseline or more within the prior 7 days. [7]

Acute coronary syndrome:

Acute coronary syndrome (ACS) described the range of myocardial ischemic states that includes unstable angina (UA), non-ST elevation myocardial infarction (NSTEMI), or ST-elevation myocardial infarction (STEMI). UA was defined by the presence of ischemic symptoms without elevations in biomarkers (troponin I) and transient ECG changes. The term myocardial infarction (MI) was used when there was evidence of myocardial necrosis (raised troponin I) in the setting of acute myocardial ischemia. STEMI was differentiated from NSTEMI by the presence of persistent ECG findings of ST segment elevation. [8]

Patients of either gender between 18 and 90 years of age who were admitted with a diagnosis of acute coronary syndrome were included in the study. Individuals with a history of renal transplant, those already in stage V chronic kidney disease, or those receiving maintenance hemodialysis were excluded. Data was collected prospectively from all eligible ACS patients admitted during the study period. The diagnosis of ACS and AKI was based strictly on the predefined operational definitions. Information on age, gender, medical history, and comorbidities was recorded, along with findings from electrocardiograms (ECGs), cardiac biomarkers, and serum creatinine levels. Diabetes Mellitus (DM): Patients diagnosed DM based on American diabetes association's (ADA) definition that states: **Diabetes is diagnosed at an A1C of greater than or equal to 6.5%** (history and previous lab reports were also assessed) [9] Hypertension (HTN): Patients already diagnosed hypertensives as per WHO definition that states: HTN is diagnosed, as when it is measured on two different days, the systolic blood pressure readings on both days is ≥140 mmHg and/or the diastolic blood pressure readings on both days is ≥90 mmHg. [10] Chronic kidney disease (CKD): Documented history of CKD or presence of impaired kidney function manifesting as glomerular filtration rate of less than 60ml/min per 1.73m2 for atleast three months (history and previous lab reports were assessed). [11] Cardiovascular disease (CVD)**:** Documented history of CVD or presence of atherosclerosis with two major complications, myocardial infarction or ischemic stroke, heart failure (HF), cardiac valvulopathies or arrhythmias, rheumatic heart disease, congenital heart disease. (history, previous lab reports and imaging were assessed, where available). [12]

Creatinine levels were documented at baseline (on admission) and 48 hours post-admission to identify cases of AKI. All information was sourced from patients' electronic medical records or hospital files, ensuring that data collection was both accurate and timely. Confidentiality was strictly maintained; no personally identifiable information such as names or contact details, was used or disclosed in the study. To minimize bias and control confounding, strict adherence to the inclusion and exclusion criteria was maintained.

Data was analyzed using SPSS version 31. For quantitative variables such as age, creatinine, descriptive statistics were reported as mean and standard deviation for normally distributed data (confirmed using the Shapiro–Wilk test), or as median and interquartile range (IQR) for non-normal data. Categorical variables including gender, diabetes, hypertension, cardiovascular disease, and ACS subtype were presented as frequencies and percentages. To assess the impact of potential effect modifiers such as age, gender, and comorbidities, data was stratified accordingly. Post-stratification analysis using Chi-square or Fisher's exact test was performed, with a p-value ≤ 0.05 considered statistically significant.

RESULTS

A total of 230 patients with acute coronary syndrome were enrolled in the study. Most participants (n =190 ,82.6%) were aged between 51 and 90 years, while 40 (17.4%) were between 18 and 50 years. Mean age of our population was 63.5±12 years, while the mean age for developing AKI was 67±13.8 years. Male participants outnumbered females, accounting for 71% of the study population. Among all patients, 68.7% had hypertension, 53.5% had diabetes mellitus, and 34.8% had a history of cardiovascular disease. Chronic kidney disease (CKD) was present in 13.9% of patients. Only 16% of the patients had no prior known co morbidities. Overall, 67 patients (29.1%) developed acute kidney injury (AKI) during hospitalization.

Table 1: Distribution of baseline characteristics among the study participants.

Variables	n (%)
Age 18 to 50 years 51 to 90 years	 40 (17.4) 190 (82.6)
Gender Male Female	 165 (71.7) 65 (28.3)
Diabetes Mellitus Yes No	 123 (53.5) 107 (46.5)
Hypertension Yes No	 158 (68.7) 72 (31.3)
Chronic kidney disease Yes No	 32 (13.9) 198 (86.1)
Cardiovascular disease Yes No	 80 (34.8) 150 (65.2)
Acute kidney injury Yes No	 67 (29.1) 163 (70.9)
Total	230 (100)

We observed a statistically significant association between cardiovascular disease and the occurrence of AKI ($p = 0.04$). 37.5% of patients who had history of CVD developed AKI as compared to 24.7% with no prior history of CVD. Undoubtedly, patients with CKD had a higher frequency of AKI (59.4%) compared to patients without chronic kidney disease, among whom only 24.2% developed AKI. Patients with STEMI also showed a significant association ($p = 0.015$), with 39.2% of patients developing AKI versus combined incidence of 23.8% among patients with UA and NSTEMI. As expected, patients who underwent coronary angiography had higher incidence of AKI and this association was statistically significant ($p <0.001$).

We found no significant relationship between AKI and age ($p = 0.31$) gender ($p = 0.11$), diabetes ($p = 0.35$) or hypertension ($p = 0.75$). Although a higher proportion of male patients developed AKI (32.1%) compared to females (21.5%), the difference was not statistically meaningful. Likewise, patients aged between 51 to 90 years had a higher rate of AKI (30.5%) compared to younger individuals (22.5%) and the frequency of AKI in patients with diabetes was also greater (31.7%) compared to patients without diabetes (22.7%) but these differences were statistically insignificant.

Table 2: Distribution of patient characteristics according to the Acute kidney injury groups.

Variables	Acute kidney injury Yes n (%)	Acute kidney injury No n (%)	P value
Age 18 to 50 years 51 to 90 years	 9 (22.5) 58 (30.5)	 31 (77.5) 132 (69.5)	 0.31

Gender Male Female	 53 (32.1) 14 (21.5)	 112 (67.9) 51 (78.4)	 0.11
Diabetes Mellitus Yes No	 39 (68.3) 28 (73.8)	 84 (31.7) 79 (26.1)	 0.35
Hypertension Yes No	 45 (28.5) 22 (30.5)	 113 (71.5) 50 (69.5)	0.75
Chronic kidney disease Yes No	 19 (59.4) 48 (24.2)	 13 (40.6) 150 (75.8)	 0.001
Cardiovascular disease Yes No	 30 (37.5) 37 (24.7)	 50 (62.5) 113 (75.3)	 0.04
Unstable angina Yes No	 7 (17.9) 60 (31.4)	 32 (82.1) 131 (68.6)	 0.09
Non ST elevation myocardial infarction Yes No	 28 (41.8) 39 (58.2)	 83 (50.9) 80 (49.1)	 0.2
ST elevation myocardial infarction Yes No	 31 (39.2) 36 (23.8)	 48 (60.8) 115 (76.2)	 0.015
Coronary angiography Yes No	 41 (22.4) 26 (55.3)	 142 (77.5) 21 (44.7)	 0.001

These findings suggest that existing cardiovascular disease, presence of CKD, STEMI and intervention with coronary angiography are important risk factors for developing AKI in patients with acute coronary syndrome.

DISCUSSION

Our data showed a 29.1% frequency of acute kidney injury (AKI) among patients who were admitted with acute coronary syndrome (ACS). This figure lies within the reported global range.[13-20] Although, variability across studies remains considerable. Cardiovascular disease, STEMI, coronary angiography and chronic kidney disease (CKD) emerged as important risk factors in our sample data set. These associations are consistent with the growing recognition that AKI in ACS arises from a combination of cardiovascular stress, renal vulnerability, and systemic comorbidities.[13-24]

Our findings align closely with the study by Neves et al.,[13] who had reported high rates of AKI and noted increased risks in patients with renal diseases and cardiovascular diseases. However, their study showed no significant association between AKI and performance of coronary angiography and angioplasty whereas our population manifested significant association with the above. Similarly, Buargub and Elmokhtar[14] documented a 41.7% AKI incidence among ACS patients in a coronary care setting. This is the highest frequency found in the given studies. This discrepancy may stem from differences in patient acuity, clinical setting, and criteria used for AKI classification.

Chetan's study from India [15] also supports our observation that CKD strongly predicts AKI in the setting of ACS. Most of the patients with CKD in our sample had AKI, reflecting the central role of baseline renal function in determining clinical outcomes. [15]

Safi and colleagues [16] similarly reported pronounced male predominance (85.7%) and a high incidence of diabetes (62.8%) among patients with AKI—findings that are well-aligned with our results.

Malik et al. [17] highlighted transient hypotension during cardiac catheterization as a risk factor for AKI. They reported a 26.3% AKI rate in this specific population. [17] We did not isolate hypotensive episodes in our sample data. However, patients who developed AKI generally had lower systolic and diastolic pressures, suggesting compromised perfusion likely contributed to renal dysfunction.

Ali et al. [18] focused on patients with ST-elevation myocardial infarction (STEMI) and reported a 28% AKI frequency. Their study also demonstrated a clear link between AKI and in-hospital mortality. Our sample included a broader ACS spectrum. However, upon stratifying ACS patients by subtype, we identified a statistically significant association between AKI and STEMI—suggesting that those presenting with STEMI are at markedly higher risk of developing acute kidney injury compared to other subtypes.

Recent biomarker-based studies add further insight into AKI risk. Liang et al. [19] identified long- and very long-chain ceramides as independent predictors of AKI in ACS. However, Yu et al. [20] demonstrated that poor nutritional status, as measured by the NRS-2002 score, predicted both AKI and in-hospital mortality. We did not assess metabolic or nutritional indices. However, the broader evidence supports the view that patient frailty plays a substantial role in AKI development and progression. [19-20]

Jentzer et al., [21] studying critically ill patients in cardiac ICUs, reported even higher AKI rates, again reinforcing the idea that clinical context strongly influences AKI risk.

On the preventive side, the PRATO-ACS trial by Leoncini et al. [22] found that high-dose rosuvastatin reduced the incidence of contrast-induced nephropathy in ACS patients undergoing percutaneous coronary intervention. We did not assess preventive strategies in our sample data. However, this evidence points to a modifiable risk window that may benefit high-risk groups like ours.

Pan et al. [23] linked elevated serum anion gap to AKI following coronary artery bypass grafting in ACS patients, suggesting that acid-base status may offer an early clue to impending renal injury. This finding opens potential avenues for risk stratification and early intervention that warrant exploration in future research.

LIMITATIONS

We conducted this study at a single tertiary care hospital with a small sample size. This may limit how broadly the results apply to other settings. We also did not follow patients beyond discharge. Hence, we were unable to evaluate the long-term impact of AKI on renal function or survival.

CONCLUSION

This study shows that acute kidney injury develops frequently in patients hospitalized with acute coronary syndrome. This is particularly so among those with existing kidney disease, cardiovascular disease, ST elevation myocardial infarction and patients undergoing coronary angiography. These findings raise important questions regarding longer-term consequences of AKI—namely progression to permanent kidney failure requiring dialysis, prolonged hospitalization, and increased mortality. Future research should explore these outcomes more extensively

ETHICAL APPROVAL

Ethical approval was exempted by the Ethics Review Committee of Aga Khan university hospital, as the study involved routine-care data extraction from electronic medical records and had no physical interaction with participants.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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