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ORIGINAL ARTICLE

Frequency of Acute Kidney Injury in Patients Presenting with Acute Coronary Syndrome and its Relationship with in-Hospital Mortality

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ABSTRACT
Background: Acute Kidney Injury (AKI) is a significant concern in patients with Acute Coronary Syndromes (ACS), including both ST Elevation Myocardial Infarction (STEMI) and Non-ST Elevation Myocardial Infarction (NSTEMI), due to its association with increased in-hospital mortality. Despite its critical impact, existing data on AKI in ACS patients is limited and often lacks local context. This study addresses this gap by investigating the frequency of AKI in myocardial infarction patients and its relationship with in-hospital mortality, providing valuable insights for local healthcare practices and patient management strategies.
Objective: To determine frequency of AKI in patients with ACS and to compare in-hospital mortality in patients of ACS with versus without AKI.
Settings: Cardiology Department, Shaikh Zayed Hospital Lahore
Duration: **N**ine months w.e.f 01-Jan to 30-Sept, 2021
Methodology: The study encompassed one hundred seventy (170) patients with various forms of ACS, such as STEMI and non-NSTEMI. Demographic were noted after taking informed written consents. The patients underwent required lab tests and data was recorded. Two groups were assimilated as group A (non-AKI group) and group B (AKI group). In hospital mortality was noted and compared between the groups using SPSS version 21.
Results: In this study, AKI was found in 24.7% of patients with myocardial infarction. Group A, comprising 128 patients without AKI, had a mean age of 61.62 ± 10.19 years, while Group B, with 42 AKI patients, had a mean age of 62.18±9.94 years, with no significant age difference (p=0.651). Gender distribution showed 70.3% of Group A patients were male, versus 80.9% in Group B, though this difference was insignificant (p=0.210). BMI distribution was also similar across groups, with no significant difference (p=0.321). Hemoglobin levels were significantly lower in Group B (131.6 ± 25.04 g/L) compared to Group A (141.9 ± 18.41 g/L, p=0.001). Serum creatinine was notably higher in Group B (188.07 ± 85.94 μmol/L) compared to Group A (101.91 ± 30.84 μmol/L, p=0.001). Group B also had lower ejection fraction and reduced glomerular filtration rate. The in-hospital mortality rate was significantly high in Group B (26.1%) compared to Group A (4.7%), p<0.05.
Conclusion: In this study, patients with AKI had significantly higher in-hospital mortality compared to those without AKI. This disparity, coupled with lower hemoglobin levels, elevated serum creatinine, higher triglycerides, reduced ejection fraction, and diminished baseline glomerular filtration rate in Group B, underscores the severe impact of AKI on patient survival and highlights the critical need for proactive management of kidney function in myocardial infarction cases.
Keywords: Acute Kidney Injury, STEMI and non-STEMI, In-Hospital Mortality

INTRODUCTION
Acute Kidney Injury (AKI) is a severe and complex condition defined by an increase in serum creatinine of at least 0.3 mg/dL within 48 hours or a rise of 1.5 times the baseline over a week. Additionally, urine output is less than 0.5 mL/kg/hour for six consecutive hours. The range of severity can vary from a slight increase in serum creatinine levels to complete renal failure requiring dialysis.[1] Among the most severe manifestations of AKI is Cardiorenal Syndrome (CRS) type 1, which is marked by a rapid deterioration in heart function leading to or worsening kidney dysfunction. This condition typically arises from ACS and is associated with extended hospital stays and higher mortality rates.[2] Research shows that AKI occurs in about 20% of patients with ACS and is a significant indicator of adverse cardiovascular outcomes.[3,4]

In cases of STEMI and NSTEMI, AKI often results from systemic hypoperfusion, which leads to kidney ischemia. This impaired heart function hampers effective blood circulation, contributing to renal damage. Additionally, factors such as hyperglycemia, increased sympathetic nervous activity, neurohumoral activation, nephrotoxic medications, and hypovolemia further exacerbate AKI.[5,6] Key risk factors for developing AKI include diabetes mellitus, anemia, older age, dehydration, and pre-existing chronic kidney disease.[7,8]

Surprisingly, AKI has bene overlooked in the context of ACS. While these resources address rarer complications like Dressler's syndrome or papillary muscle rupture, AKI, a condition with an incidence rate as high as 30% receives comparatively little attention. This lack of focus is significant given the high prevalence and serious consequences of AKI.[9,10]

Furthermore, many patients who experience AKI do not receive follow-up care after their hospital discharge, underscoring the need for more research into the early identification of those at high risk of renal impairment. Such research is crucial for improving patient outcomes. In particular, there is a lack of studies investigating the incidence of AKI among patients with ACS in Pakistan, where the population characteristics may differ from those in developed nations. This highlights the necessity of conducting research tailored to the Pakistani context to better understand and address AKI among these patients.[11,12]

Mezhonov et al. (2021) found in-hospital mortality was significantly less in patients without AKI than with AKI (4.7% vs. 20.0%; p-value=0.001).[13] Similarly, Moriyama et al. reported significantly less mortality in ACS patients without AKI than with AKI (3.0% vs. 25.0%; p<0.001).[14] However, there is no local study. Therefore, this study aimed to investigate the prevalence of AKI among ACS patients in Pakistan to compare in hospital mortality in such patients from non AKI patients. By addressing this research gap, the study will provide critical insights that could enhance patient management and outcomes in this specific demographic.

METHODOLOGY
The study encompassed one hundred fifty (170)[14] patients with ACS, such as STEMI and non-NSTEMI. Exclusions were made for individuals with known cancers, liver disorders, autoimmune conditions, or infections. Additionally, patients with kidney

transplantation, chronic kidney disease, or dialysis were excluded. Demographic were noted after taking informed written consents. The patients underwent required lab tests and data was recorded. Renal function was evaluated within 30 minutes of presentation and after 72 hours of admission. AKI was identified by a rise in serum creatinine levels from baseline of at least 0.5 mg/dL. Two groups were assimilated as group A (non-AKI group) and group B (AKI group). In hospital mortality was noted and compared between the groups. Data analysis was conducted using SPSS version 21. Numerical data are shown as mean ± standard deviation, whereas categorical data are expressed as frequency and percentage. The chi-square test was used to compare the rates of in-hospital mortality, with a p-value of ≤0.05 indicating statistical significance.

RESULTS

In this study, frequency of AKI was 24.7%, group A (n=128), consisting of patients without AKI, had a mean age of 61.62 ± 10.19 years. Group B (n=42), comprising patients with AKI, had a mean age of 62.18 ± 9.94 years, with a p-value of 0.651 indicating no significant difference between the two groups in terms of age. Regarding gender distribution, 70.3% of Group A patients were male, compared to 80.9% in Group B; however, this difference was insignificant (p=0.134). In terms of body mass index (BMI), 23.4% of Group A patients were classified as normal weight, 53.1% as overweight, and 23.4% as obese. In Group B, 28.5% were normal weight, 50.0% were overweight, and 21.5% were obese, with no significant difference observed between the groups (p=0.175). Lastly, 70.8% of patients in Group A were diagnosed with STEMI, while 29.2% had non-STEMI. In Group B, 70.3% were diagnosed with STEMI and 29.7% with non-STEMI, with a p-value of 0.558 showing no significant difference in diagnosis between the groups. Data is given in table 1.0.

In this study, Group A had a hemoglobin level of 141.9 ± 18.41 g/L, significantly higher than the 131.6 ± 25.04 g/L observed in Group B (n=37) with AKI (p=0.001). Total cholesterol levels were 4.77 ± 1.29 mmol/L in Group A and 4.49 ± 1.42 mmol/L in Group B, with no significant difference (p=0.154). Serum creatinine levels at admission were markedly elevated in Group B (188.07 ± 85.94 µmol/L) compared to Group A (101.91 ± 30.84 µmol/L), with a p-value of 0.001 indicating a significant difference. Triglyceride levels were higher in Group B (1.81 ± 0.67 mmol/L) compared to Group A (1.47 ± 0.64 mmol/L), with a p-value of 0.038. In-hospital ejection fraction (EF) was lower in Group B (46.99 ± 7.33%) than in Group A (51.44 ± 7.02%), with a p-value of 0.001. Additionally, the baseline glomerular filtration rate (GFR) was significantly reduced in Group B (40.21 ± 22.16 mL/minute/1.73 m²) compared to Group A (63.02 ± 21.87 mL/minute/1.73 m²), with a p-value of 0.001. Data is given in Table 2.

In this study, the rate of in-hospital mortality was significantly higher in Group B (n=42), with 26.1% of patients experiencing mortality compared to just 4.7% in Group A (n=128), yielding a p-value of less than 0.05. Data is given in Table 3.0.

Table 1.0: Baseline Characteristics of Study Sample

	Group A n=128 (Non-AKI)	Group B n=42 (AKI)	p-value
Age (years)	61.62±10.19	62.18±9.94	0.651
Gender			
• Male	90 (70.3%)	34 (80.9%)	0.210
• Female	38 (29.7%)	8 (19.1%)	
BMI			
• Normal	30 (23.4%)	12 (28.5%)	0.321
• Overweight	68 (53.1%)	21 (50.0%)	
• Obese	30 (23.4%)	9 (21.5%)	
Diagnosis			
• STEMI	90 (70.3%)	31 (73.1%)	0.558
• Non-STEMI	38 (29.7%)	11 (26.9%)	

Independent sample t test & Chi Square test, p-value≤0.05 was taken as significant.

Table 2.0: Comparison of Lab Findings between the Groups

Variable	Group A	Group B	P-value
Hemoglobin (g/L)	141.9±18.41	131.6±25.04	0.001
Total cholesterol (mmol/L)	4.77±1.29	4.49±1.42	0.154
Serum creatinine (µmol/L) at Admission	101.91±30.84	188.07±85.94	0.001
Triglycerides (mmol/L)	1.47±0.64	1.81±0.67	0.038
In-hospital EF (%)	51.44±7.02	46.99±7.33	0.001
Baseline GFR (mL/minute/1.73 m^2)	63.02±21.87	40.21±22.16	0.001

Independent sample t test, p-value≤0.05 was taken as significant.

Table 3.0: Frequency of In-hospital Mortality and Comparison between the groups

Variable	Group A (n=128)	Group B (n=42)	p-value
In-hospital Mortality			
• Yes	6 (4.7%)	11 (26.1%)	<0.05
• No	124 (95.3%)	31 (73.8%)	

Chi-Square test, observed difference was significant with p-vaule≤0.05.

DISCUSSION

The frequency of AKI in patients with Acute STEMI and NSTEMI is a critical concern, given its impact on in-hospital mortality.[15,16] Despite existing literature highlighting the association between AKI and increased mortality, there remains controversy over the extent and consistency of this relationship.[13,14] This study aims to clarify these discrepancies by examining AKI rates and their influence on survival outcomes, addressing the need for clearer guidelines and targeted management strategies.

This study compared patients with and without AKI to explore its impact on in-hospital mortality. Group A (n=128), without AKI, had a mean age of 61.62 ± 10.19 years, while Group B (n=42), with AKI, had a mean age of 62.18 ± 9.94 years, with no significant age difference (p=0.651) with frequency of AKI to be 24.7%. Overall frequency of AKI in this study was 24.7%. Marbach et al.[17] reported an AKI frequency of 21.5% among Canadian patients, while Chen et al.[18] observed a rate of 19.9% in China. Mezhonov et al.[13] found a frequency of 20.5% in Russian patients. These findings reflect a consistent global prevalence of AKI across diverse populations.

Notably, Group B had significantly lower hemoglobin (131.6 ± 25.04 g/L vs. 141.9 ± 18.41 g/L, p=0.001), higher serum creatinine (188.07 ± 85.94 µmol/L vs. 101.91 ± 30.84 µmol/L, p=0.001), elevated triglycerides (1.81 ± 0.67 mmol/L vs. 1.47 ± 0.64 mmol/L, p=0.038), lower ejection fraction (46.99 ± 7.33% vs. 51.44 ± 7.02%, p=0.001), and reduced glomerular filtration rate (40.21 ± 22.16 mL/minute/1.73 m² vs. 63.02 ± 21.87 mL/minute/1.73 m², p=0.001).

In-hospital mortality was significantly higher in Group B (26.1%) compared to Group A (4.7%, p<0.05). Our findings align with those of Mezhonov et al.[13] who reported a markedly higher in-hospital mortality rate in Russian acute STEMI patients with AKI compared to those without (20.0% vs. 4.7%, p=0.001). Similarly, Moriyama et al. found a significant disparity in Japan, with in-hospital mortality rates of 25.0% for AKI patients versus 3.0% for non-AKI patients (p<0.001). Shacham et al.[19] also observed a notable difference in Israel, where AKI patients had a 13.4% mortality rate compared to 2.4% for those without AKI (p=0.001). In Denmark, El-Ahmadi et al.[20] reported a comparable difference with 13.5% mortality in AKI patients versus 4.5% in those without (p=0.001). These studies collectively underscore the strong association between AKI and increased in-hospital mortality across different populations.

CONCLUSION

In this study, patients with AKI experienced significantly higher in-hospital mortality (26.1%) compared to those without AKI, who had a mortality rate of just 4.7%. This disparity, coupled with lower hemoglobin levels, elevated serum creatinine, higher triglycerides, reduced ejection fraction, and diminished baseline glomerular filtration rate in Group B, underscores the severe impact of AKI on patient survival and highlights the critical need for proactive management of kidney function in myocardial infarction cases.

Limitations & Recommendations

This study's strengths lie in its comprehensive data on the significant impact of AKI on in-hospital mortality among myocardial infarction patients, aligning with similar findings globally and enhancing the generalizability of its results. However, the study's observational design limits causal inferences, and its single-center focus may affect the broader applicability of its findings. Future research should aim to validate these results through longitudinal and multi-center studies, explore effective AKI management strategies, and investigate potential interventions to improve patient outcomes in high-risk populations.

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REFERENCES

1. Wang WH, Hong YC, Chen HM, Chen D, Wei KC, Lai PC. Risk factors and outcome of acute kidney injury following acute myocardial infarction-a case series study from 2009 to 2019. J Clin Med. 2022;11(20):6083. doi: 10.3390/jcm11206083
2. Rigattieri S, Cristiano E, Tempestini F, Pittorino L, Cesario V, Casenghi M, et al. Acute kidney injury in patients with acute myocardial infarction undergoing percutaneous coronary intervention: the role of vascular access site. J Clin Med. 2024;13(8):2367-71. doi: 10.3390/jcm13082367.
3. Goriki Y, Tanaka A, Nishihira K, Kuriyama N, Shibata Y, Node K. A novel prediction model of acute kidney injury based on combined blood variables in STEMI. JACC Asia. 2021;1(3):372-81. doi: 10.1016/j.jacasi.2021.07.013
4. Sinkovič A, Masnik K, Mihevc M. Predictors of acute kidney injury (AKI) in high-risk ST-elevation myocardial infarction (STEMI) patients: A single-center retrospective observational study. Bosn J Basic Med Sci. 2019;19(1):101-10. doi: 10.17305/bjbms.2018.3797
5. Kaladee A, Phinyo P, Chantadansuwan T, Patumanond J, Siribumrungwong B. Clinical scoring for prediction of acute kidney injury in patients with acute ST-segment elevation myocardial infarction after emergency primary percutaneous coronary intervention. J Clin Med. 2021;10(15):3402-9. doi: 10.3390/jcm10153402
6. Frydman S, Freund O, Banai A, Zornitzki L, Banai S, Shacham Y. Relation of gender to the occurrence of AKI in STEMI patients. J Clin Med. 2022;11(21):6565-72. doi: 10.3390/jcm11216565
7. Kosaki R, Wakabayashi K, Sato S, Tanaka H, Ogura K, Oishi Y, et al. Onset time and prognostic value of acute kidney injury in patients with acute myocardial infarction. IJC Heart Vasc. 2021;35(2):100826. doi: 10.1016/j.ijcha.2021.100826
8. Maksimczuk J, Galas A, Krzesiński P. What promotes acute kidney injury in patients with myocardial infarction and multivessel coronary artery disease-contrast media, hydration status or something else?. Nutrients. 2022;15(1):21-9. doi: 10.3390/nu15010021
9. Sun YB, Tao Y, Yang M. Assessing the influence of acute kidney injury on the mortality in patients with acute myocardial infarction: a clinical trail. Renal Fail. 2018;40(1):75-84. doi: 10.1080/0886022X.2017.1419969
10. Mitsis A, Gragnano F. Myocardial Infarction with and without ST-segment Elevation: a contemporary reappraisal of similarities and differences. Curr Cardiol Rev. 2021;17(4):e2304. doi: 10.2174/1573403X16999201210195702
11. Zaky H, Tabatabai S, Zarger PA, Al Hashmi JM. A case report of severe dehydration associated with acute kidney injury causing acute st-segment elevation myocardial infarction. Cureus. 2022;14(5):e25226. doi: 10.7759/cureus.25226
12. Isaac T, Gilani S, Kleiman NS. When prevention is truly better than cure: contrast-associated acute kidney injury in percutaneous coronary intervention. Methodist DeBakey Cardiovasc J. 2022;18(4):73-8. doi: 10.14797/mdcvj.1136
13. Mezhonov EM, Vialkina IA, Vakulchik KA, Shalaev SV. Acute kidney injury in patients with ST-segment elevation acute myocardial infarction: predictors and outcomes. Saudi J Kidney Dis Transplant. 2021;32(2):318-27. doi: 10.4103/1319-2442.335442
14. Moriyama N, Ishihara M, Noguchi T, Nakanishi M, Arakawa T, Asaumi Y, et al. Early development of acute kidney injury is an independent predictor of in-hospital mortality in patients with acute myocardial infarction. J Cardiol. 2017;69(1):79-83. doi: 10.1016/j.jjcc.2016.01.001
15. Jiang MY. Impact of acute kidney injury and baseline renal impairment on prognosis among patients undergoing percutaneous coronary intervention. Acta Cardiologica Sinica. 2020;36(3):223-32. doi: 10.6515/ACS.202005_36(3).20190920A
16. Puti E, Rasyid H, Tandean P, Sanusi H, Kasim H, Bakri S, et al. High uric acid level increases the risk of acute kidney injury in acute coronary syndrome patients. Caspian J Intern Med. 2021;12(3):323-6. doi: 10.22088/cjim.12.3.323
17. Marbach JA, Wells G, Di Santo P, So D, Chong AY, Russo J, et al. Acute kidney injury after radial or femoral artery access in ST-segment elevation myocardial infarction: AKI-SAFARI. Am Heart J. 2021;234:12-22. doi:10.1016/j.ahj.2020.12.019
18. Chen L, Wang X, Wang Q, Ding D, Jiang W, Ruan Z, et al. Predictivevalue of two different definitions of contrast-associated acute kidney injury for long-term major adverse kidney events in patients with STsegment elevation myocardial infarction undergoing primary percutaneous coronary intervention. Cardiol J. 2022;10(4):53-61. doi: 10.5603/CJ.a2022.0034
19. Shacham Y, Gal-Oz A, Ben-Shoshan J, Keren G, Arbel Y. Prognostic implications of acute renal impairment among ST elevation myocardial infarction patients with preserved left ventricular function. Cardiorenal Med. 2016;6(2):143-9. doi: 10.1159/000443621
20. El-Ahmadi A, Abassi MS, Andersson HB, EngstrømT, Clemmensen P, Helqvist S, et al. Acute kidney injury–a frequent and serious complication after primary percutaneous coronary intervention in patients with ST-segment elevation myocardial infarction. PLoS ONE 2019;14(12):e0226625. doi.org/10.1371/journal.pone.0229346.