



Nephrology

COMPARATIVE STUDY OF AKI SEVERITY AND RECOVERY IN PATIENTS UNDERGOING PCI AND CABG

Dr. Satyanarayana Garre*	MD, DNB (Nephrology), Consultant Nephrologist, Apollo Hospitals, Hyderabad, Telangana, India. *Corresponding Author
Dr. Mohammed Sajid Abdul Samad	MD, Senior Resident, Department of Nephrology, Apollo Hospitals, Hyderabad, Telangana, India.
Dr. Soamshekar Mudigonda	MD, DM (Nephrology), Senior Consultant Nephrologist, Apollo Hospitals, Hyderabad, Telangana, India.

ABSTRACT **Background:** After the cardiac procedures in the patients like Coronary Artery Bypass Grafting(CABG) or Percutaneous Coronary Intervention(PCI), etc. the most common and severe complication that can occur is Acute Kidney Injury(AKI). This research aimed to evaluate the severity and recovery from AKI following these interventions and to recognize clinical predictors related to this condition. **Method:** A total of 46 patients were recruited between January 2023 and May 2024. Information regarding demographics, comorbid like conditions, medication use, and important clinical factors was gathered. The function of kidney was monitored through the serum creatinine levels and the estimated glomerular filtration rate (eGFR) at the time of admission, as well as on Day 3 and Day 7 following the procedures. Chi-square tests were conducted to examine the relationship between the clinical variables and the occurrence of AKI. **Results:** Age, gender, diabetes, hypertension, and the use of ACE inhibitors/ARBs/ARNIs did not show a statistically significant link to the development of AKI. Conversely, hypotension($p=0.01$), sepsis($p=0.02$), antibiotic treatment($p=0.01$), and the volume of contrast used($p=0.001$) were notably correlated with AKI. Presence of oliguria and the requirement for renal replacement therapy(RRT) were seen in 10.9% of patients and were significantly linked to AKI($p=0.02$). eGFR showed a more considerable decline on Day 3 for CABG patients compared to those who underwent PCI, indicating a higher risk of AKI among the CABG cohort. **Conclusion:** Patients undergoing CABG exhibited more pronounced early renal dysfunction than those who had PCI, underscoring the necessity for vigilant renal observation. In patients with chronic kidney disease(CKD) or compromised hemodynamics it can be seen. These results advocate for more focused preventive measures in the cardiac patients to control the complication of AKI.

KEYWORDS : Contrast-induced nephropathy; Renal replacement therapy; Hemodynamic instability; Postoperative complications; Cardiovascular comorbidities; Risk stratification

INTRODUCTION:

Acute Kidney Injury(AKI) leads in the decline in the function of the kidney, it can be identified by the rise in levels of serum creatine or even by oliguria. In the older patients or patients suffering from severe kidney diseases undergoing the treatments; Coronary Artery Bypass Grafting(CABG) or Percutaneous Coronary Intervention(PCI) are more prone to AKI.

AKI following in CABG is notably higher than that following in PCI. This increased risk associated with CABG can be attributed to several factors, including prolonged aortic cross-clamp time, the utilization of cardiopulmonary bypass, and alterations in hemodynamic status, all of which lead to renal ischemia-reperfusion injury. The factors contributing to AKI in these patients involve oxidative stress, inflammation, nephrotoxicity from contrast media, and ischemia-reperfusion injury, especially in CKD patients, who often exhibit impaired renal autoregulation and endothelial function. Various conditions that heighten the trouble of AKI in this population include older age, diabetes, hypertension, heart failure, peripheral vascular disease, anemia, exposure to contrast agents, and the degree of pre-existing renal dysfunction. CIN: Contrast-induced nephropathy is a major contributor to AKI during coronary procedures, stemming from the detrimental effects of iodinated contrast agents(CM). Patients with CKD and diabetes are particularly susceptible to CIN.

Studies concerning acute kidney injury(AKI) in individuals undertaking coronary artery bypass grafting(CABG) and percutaneous coronary interventions(PCI) highlight significant consequences, including increased mortality rates, prolonged intensive care unit stays, and the need for mechanical circulatory support. et al., study demonstrated that the occurrence of AKI in patients undergoing CABG is significantly greater (67%) compared to those undergoing PCI(31%) among 730 patients with severe CKD. Research conducted by Tsai et al. and Hooda et al. demonstrates a strong correlation between AKI and higher in-hospital mortality, with a striking 7.8-fold increase in risk noted among patients undergoing PCI. The findings of Schweitzer et al. underscore the effectiveness of mechanical circulatory support devices like Impella in reducing the incidence of AKI during high-risk PCI, and other research suggests that prompt intervention is crucial for decreasing mortality in patients

with AKI.

To summarize, acute kidney injury(AKI), especially contrast induced nephropathy, remains a significant complication following (CABG) and (PCI). The improvement of patient outcomes hinges on effective preventive measures, comprehensive risk assessments, and timely interventions. Strategies such as selecting safer contrast agents, optimizing hydration methods, and detecting renal problems early are crucial for reducing kidney damage and enhancing survival rates, particularly among high-risk groups. Quickly identifying risk factors and implementing immediate interventions will be vital for lessening long-term renal harm and improving overall patient outcomes.

AIM AND OBJECTIVES

The primary objective is to assess the occurrence and severity of AKI following coronary revascularization procedures (PCI compared to CABG) in patients who have pre-existing CKD. Furthermore, the study seeks to investigate the effects of early versus late initiation of hemodialysis in Stage 3 AKI and to evaluate recovery outcomes, which include complete recovery (restoration of eGFR to baseline), partial recovery, dependence on dialysis, and mortality in relation to the type of coronary revascularization performed.

MATERIALS AND METHODS**RESULTS:****Age Distribution And Study Outcomes:****Comorbid Conditions And Study Outcomes:**

Diabetes mellitus(DM) was existed in 56.5% of the participants, while hypertension(HTN) affected 65.2% of the group. The statistical analysis showed that neither DM($p=0.10$) nor HTN($p=0.46$) was significantly related to AKI, indicating that these comorbidities had minimal impact on the occurrence of AKI in this study population.

Clinical Factors and AKI:

Use of Renin-Angiotensin System(RAS) Inhibitors:

Renal Function and AKI:

Clinical Parameters and AKI Risk:

Hematological Parameters:

Gender And Procedure Type:

There is no significant variance in gender distribution between the CABG and PCI groups ($p=0.001$). Regarding the type of procedure, the findings indicated no substantial correlation between gender and eGFR distribution among the groups, suggesting that both genders were adequately represented in the CABG and PCI groups.

eGFR and Procedure Type:

The assessment of renal function via eGFR showed no considerable differences between the CABG and PCI groups upon admission ($p=0.03$). However, by Day 3 post-procedure, there was a significant shift in eGFR distribution, especially within the 15-29 mL/min/1.73m² range, with a higher proportion of CABG patients (26.1%) compared to PCI patients (19.6%) in this category ($p=0.01$). On Day 7, the eGFR distribution across both groups became comparable, with no statistically significant differences observed ($p=0.06$).

Diabetes And Hypertension In Relation To eGFR:

The presence of diabetes and hypertension did not show a significant correlation with changes in eGFR throughout the study ($p=0.1$ for diabetes and $p=0.7$ for hypertension). The analysis revealed that these comorbidities did not meaningfully affect the alterations in renal function measured by eGFR during the study period.

DISCUSSION

The findings offered several important insights that improve the understanding of how these factors influence AKI outcomes in this population.

Age and AKI:

The examination of age distribution indicated that a significant portion of participants (58.7%) were older than 60 years, with the remainder (41.3%) falling between the ages of 40 and 60. However, the statistical analysis did not reveal a meaningful connection between age and AKI outcomes ($p=0.7$). This finding suggests that within the age groups analyzed, age alone may not play a pivotal role in influencing AKI severity or recovery among the cohort studied.

Impact of Comorbidities(Diabetes and Hypertension)

Hypertension (HTN) and diabetes mellitus (DM) were prevalent among the study participants, affecting 65.2% and 56.5%, respectively. The statistical evaluation did not demonstrate significant associations between HTN and DM and AKI outcomes ($p=0.46$ for HTN and $p=0.10$ for DM).

Hypotension, Sepsis, and Antibiotic Usage

The study identified significant correlations between two clinical conditions—hypotension and sepsis—and AKI outcomes ($p=0.01$ for hypotension, $p=0.02$ for sepsis). Hypotension can lead to reduced renal perfusion, which may result in AKI. Similarly, sepsis, a well-known contributor to prerenal AKI, may have exacerbated renal damage in this group. The substantial statistical association between antibiotic usage and AKI ($p=0.01$) is noteworthy. Consequently, administering antibiotics to patients with compromised renal function could have influenced the onset of AKI, highlighting the importance of careful prescribing and diligent monitoring.

Renin-Angiotensin System (RAS) Inhibitors and AKI

The research indicated that a moderate percentage of patients were given RAS inhibitors, including (ARB=23.9%), (ACEI=21.8%), and (ARNI=6.5%). Although these medications have been connected with an increase in risk of AKI—mostly in the patients who are volume-depleted or have bilateral renal artery stenosis—the statistical evaluation did not find a significant connection between the use of RAS inhibitors and the occurrence of AKI ($p=0.1$).

Oliguria and Renal Replacement Therapy (RRT)**Procedural Factors: Volume of Contrast and Renal Function**

The analysis showed a significant relationship between the volume of contrast used during coronary artery bypass grafting (CABG) and percutaneous coronary intervention (PCI) procedures and the development of AKI ($p=0.001$). This finding emphasizes the importance of minimizing contrast volume and applying strategies such as adequate hydration and alternative imaging techniques to reduce the CIN risk.

eGFR Assessment and Recovery

SUMMARY AND CONCLUSIONS:

This comparative research emphasizes that the occurrence and severity of acute kidney injury (AKI) following cardiac procedures varies between PCI and CABG, peculiarly in patients with pre-existing chronic kidney disease (CKD). While demographic variables such as age, gender, and comorbid conditions like diabetes and hypertension did not significantly impact AKI outcomes, clinical factors such as hypotension, sepsis, and antibiotic use were strongly linked to AKI development. Notably, patients undergoing CABG exhibited a more significant reduction in eGFR, particularly on Day 3 post-procedure, compared to those undergoing PCI, indicating a greater AKI risk in the CABG cohort during the initial postoperative phase. The presence of oliguria and the requirement for renal replacement therapy were also significantly related to AKI, emphasizing their importance as early signs of renal dysfunction.

The results highlight the critical need for careful monitoring of renal function, especially in patients at high risk undergoing CABG, to facilitate prompt interventions and enhance outcomes. This research offers important perspectives on the risk assessment of AKI in relation to PCI and CABG, and it encourages further studies focused on improving strategies for renal protection during the perioperative period.

Study Limitations

While this research offers important insights into the factors impacting AKI outcomes in patients undergoing PCI and CABG, some limitations should be considered. The size of the sample is relatively small, which may restrict the statistical power to detect correlations, particularly for specific variables such as medication use or comorbid conditions. Additionally, the observational nature of the study means that while correlations were identified, establishing causation remains uncertain. Lastly, the inclusion of clinical factors like antibiotic exposure and sepsis reflects the complexity involved in AKI development, indicating that further research is warranted to investigate the multifactorial aspects of this complication.

Conflicts of Interest:

Authors declared no conflicts of interest.

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