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# THE EFFECT OF ACUTE KIDNEY INJURY IN ELDERLY PATIENTS UNDERGOING PERCUTANEOUS CORONARY INTERVENTION

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**Abstract:** *This study aims to determine the frequency of acute kidney injury (AKI) in patients who undergo percutaneous coronary intervention (PCI) and its impact on elderly patients. To achieve this, 80 patients admitted to Ayub Teaching Hospital from March 2019 to August 2020 for PCI were studied for AKI after the procedure. The primary endpoint was mortality from all causes, while the secondary was mortality due to major cardiovascular events. The results showed that out of the 80 patients, 29 developed AKI, with a higher incidence observed in the older age group. These patients reported a higher rate of congestive heart failure, increased C-reactive proteins, and an increased rate of major adverse cardiovascular events, which was 39.43%. Furthermore, all-cause mortality was higher in patients suffering from AKI. In conclusion, this study highlights that one-fourth of elderly patients undergoing PCI face a higher risk of AKI. Further research is required to mitigate the mortality and morbidity associated with AKI in this vulnerable group.*

**Keywords:** Percutaneous Coronary Intervention, Acute Kidney Injury, Elderly People

## Introduction

Coronary artery disease has become one of the most common causes of morbidity and mortality worldwide, and older people are most commonly affected by diaspora (Cury et al., 2022). With technological advancement, surgical interventions are becoming more and more modernized. In the present era, PCI is considered the first line of treatment for coronary artery disease, especially in older people (Wang et al., 2022). PCI reduces morbidity and mortality caused by coronary artery disease, as it improves tissue reperfusion and timely averts the progression of ischemic injury (Valgimigli et al., 2021). However, this procedure is associated with certain post-operative complications (Abtan et al., 2021). There are many complications, but acute kidney injury is one of the few that can occur immediately after percutaneous coronary intervention (Mehran et al., 2021).

With increasing age, the risk of complications after PCI increases due to the advanced stage of the disease and the increased vulnerability of the patients (Ono et al., 2021). However, the statistical data relevant to this issue in older people is deficient because this populace is not in focus in different trials and research (Wei et al., 2021). Enrolling this age group in such programs is also not very promising. The onset of AKI is mostly observed immediately after PCI, with the most reported time of emergence being 3-4 days after the intervention, especially in older people (Valle et al., 2017). It has been associated with high post-operative mortality and morbidity and a significant disease burden on health infrastructure by increasing financial demands (He et al., 2021). The pathophysiology of the disease is also very diverse.

The most common issues that give birth to acute kidney injury after percutaneous coronary interventions include ischemic injury and nephrotoxic insult, which fuel the fire (Lin et al., 2019). The emergence of acute kidney injury after percutaneous coronary intervention is most common in people suffering from co-morbidities like diabetes mellitus, chronic hypertension, and asthma (Mosenye et al., 2023). On the other hand, the presentation of the disease is getting more diverse in older people, with their decreased ability to tolerate the impacts of AKI given birth to the need for more intensive measures directed toward the prevention and management of the disease (Guo et al., 2023). In Pakistan, data relevant to the prevalence, incidence, and impacts of acute coronary injury after percutaneous coronary intervention is very limited (Ammar et al., 2022). A few researches have been conducted to determine the prevalence and predict the risk of nephropathy after percutaneous coronary intervention in older people (Kumar et al., 2022). However, all these studies have limited scope, and there is wide room for further inquiry and investigation on this topic. The focus of this study is to find out the impacts of acute kidney injury in elderly patients after percutaneous coronary intervention.

## Methodology

This study was observational at Ayub Teaching Hospital in Abbottabad from March 2019 to August 2020. Out of 114 patients aged over 65 years, only those with available data on pre-operative baseline creatinine levels and post-operative peak creatinine levels were included. Patients with a history of chronic kidney disease, genetic kidney

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disorder, long-term steroid use, drug use, autoimmune disorder, obstructive nephropathy, or acute kidney injury after surgery were excluded. The study included 80 patients who received standard pre-operative and post-operative care and were treated according to recommended guidelines. Elective and early percutaneous coronary intervention procedures followed international best practices, and preventive measures were taken during the perioperative periods. Isotonic fluids were administered 12 hours before the procedure and continued 24 hours after the operation.

All patients gave informed consent, and their demographic data, including age, gender, baseline change in creatinine levels, history of contrast media-based investigation, and need for hemodialysis, were collected. The study population was divided into two groups. Group A included patients who developed acute kidney injury after percutaneous coronary intervention, while group B consisted of people who did not develop this injury. The presenting signs and symptoms of group A patients were noted to assess the severity of the complication. The medications given on discharge were also studied to assess the morbidity arising from the complications after acute kidney injury post-percutaneous coronary intervention.

**Results**

In this study, 80 patients were selected. The analysis of their demographics revealed that 48 patients were male while 32 were female. The average age of males was 67.23 (±4.37), and that of females was 68.29 (±3.17) (Table 1). The baseline serum creatinine levels were 0.7 mg/dl (±0.52) for males, while the average baseline serum creatinine levels for the overall population were 0.6 mg/dl (±0.41). Of the 80 patients, 54 were exposed to radiocontrast media within 48 hours before the percutaneous coronary intervention, out of which 33 were male and 21 were female (Figure 1).

After the procedure, 29 patients developed Acute Kidney Injury (AKI), of which 10 were women. Five affected patients, including one female patient, had to undergo hemodialysis. The percent change in creatinine levels from baseline was 10.3 (4.7-23.5%) among patients with low baseline creatinine levels (≤median of 1.13 mg/dL), 19 developed AKI, compared to 10 in those with high levels (>median, P= 0.53). Patients who developed AKI were older (>69years, P= 0.03) and more frequently presented with congestive heart failure (P< 0.001), left ventricular systolic dysfunction (P= 0.03), and non-ST segment elevation myocardial infarction (P= 0.04), as shown in Table 3. C-reactive protein levels were higher in patients with AKI than those without (P= 0.01). The rates of AKI were 35.8% and 26.2% in patients with and without exposure (≥300 mL) of contrast media used (P= 0.14). The medication at discharge did not differ between the two groups except for the lower use of renin-angiotensin system blockers in patients with AKI (Table 3).

During the follow-up, major adverse cardiovascular events occurred in 39.43% and 21.4% of patients with and without AKI, respectively (P= 0.01). AKI was associated with increased rates of MACE (HR 1.78, 95%CI 1.25-2.52, P= 0.001), and the relations remained unchanged after multivariable adjustments (adjusted HR 1.75, 95%CI 1.15-2.67, P= 0.01). The all-cause mortality was not affected by the presence and absence of acute kidney disease, as the interaction between these variables was not significant (interaction P= 0.61) and MACE (interaction P= 0.16) (Table 4).

When comparing patients with (n= 29) and without (n= 51) AKI, defined as≥0.3 mg/dL or≥50% increase in creatinine levels from baseline, patients with AKI had higher rates of all-cause mortality (25.7% vs 7.2%, P< 0.001) and MACE (41.3% vs 26.4%, P= 0.004). The presence of a≥0.3 mg/dL or≥50% increase in creatinine levels emerged as an independent predictor of all-cause mortality (HR 4.45, 95%CI 2.59-7.65, P< 0.005) (Table 5).

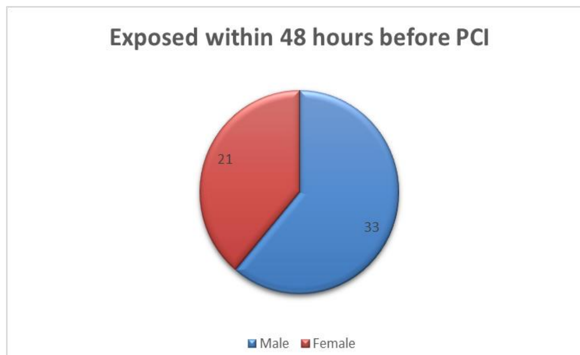


**Figure 1: Exposure to Radio Contrast Media**

**Table 1: Demographics and Baseline Characteristics**

| **Total Patients** (n=80) | **Male (n=48)** | **Female (n=32)** |
|---|---|---|
| Age (years) | 67.23 (±4.37) | 68.29 (±3.17) |
| Serum Creatinine (mg/dL) | 0.7 (±0.52) | 0.6 (±0.41) |

**Table 2: Factors Associated with AKI**

| **Factor** | **AKI Patients (>0.3 mg/dL or >50% increase)** |
|---|---|
| Low Baseline Creatinine (≤median 1.13 mg/dL) vs. High Baseline Creatinine (>median) | 19 vs. 10 (P= 0.53) |
| Age (>69 years vs. ≤69 years) | P= 0.03 |
| Congestive Heart Failure | P< 0.001 |
| Left Ventricular Systolic Dysfunction | P= 0.03 |
| Non-ST Segment Elevation Myocardial Infarction | P= 0.04 |
| C-reactive Protein Levels | P= 0.01 |
| Contrast Media Exposure (≥300 mL) | P= 0.14 |
| Use of Renin-Angiotensin System Blockers | Lower in AKI Patients |

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**Table 3: Outcomes and Associations with AKI**

| Outcome | AKI Patients (n=29) | Non-AKI Patients (n=51) | P-value |
|---|---|---|---|
| Major Adverse Cardiovascular Events (MACE) | 39.43% | 21.4% | P= 0.01 |
| All-Cause Mortality | Not affected | Not affected | Interaction P= 0.61 |
| **MACE** | Not affected | Not affected | Interaction P= 0.16 |

**Table 4: AKI as a Predictor of Outcomes**

| Outcome | Patients with AKI (n=29) | Patients without AKI (n=51) | Hazard Ratio (HR) |
|---|---|---|---|
| All-Cause Mortality | 25.7% | 7.2% | HR 4.45, 95%CI 2.59-7.65, P< 0.005 |
| MACE | 41.3% | 26.4% | - |

**Discussion**

This study has revealed that after percutaneous coronary intervention, almost three-fourths of elderly patients are at high risk of developing acute kidney injury. This procedure's complication can result in a very high risk of morbidity and mortality (Wang et al., 2022). The incidence of the disease can vary depending on the type of cohort and the criteria used to define acute kidney injury. However, elderly patients are relatively more susceptible to acute kidney injury after percutaneous coronary intervention, and this incidence rate is high even in patients with relatively low pre-operative serum creatinine levels (Miura et al., 2017).
Different guidelines are available to define acute kidney injury, and various criteria have defined the scope of acute kidney injury over the years. However, few criteria gained more acceptance than others, including RIFLE criteria (risk, injury, failure, loss of function, and end-stage kidney disease), the AKIN criteria (the acute kidney injury network), and the KIDGO classification. These criteria define acute kidney injury utilizing serum creatinine levels, urine output, and other measurements, which are mostly unavailable in all cases (Davenport et al., 2020). This study has defined its results based on serum creatinine levels measured 72 hours before the percutaneous coronary intervention and 72 hours after the percutaneous coronary intervention so that the relation of acute kidney injury with this procedure can be established. This study has also revealed that radio-contrast media exposure increases the likelihood of acute kidney injury (Chen et al., 2021).
There is only a rudimentary understanding of the pathophysiological mechanisms behind the emergence of AKI. Congestive heart failure, advanced age, diabetes mellitus, chronic renal illness, and other risk factors have all been identified in the past. Other reasons can include direct nephrotoxicity and the vasoconstrictive effects of contrast agents that result in medullary ischemia (Li et al., 2020). AKI is also more likely to occur in people with acute coronary syndromes who need rapid coronary revascularization and those with hemodynamic instability and left ventricular dysfunction. Because a very small percentage of patients in this study underwent PCI for stable coronary artery disease, it was impossible to make comparisons based on the presence or absence of acute coronary syndromes (Cai et al., 2020). Congestive heart failure, high levels of C-reactive protein, and advanced age (>65 years) emerged as independent predictors of AKI in our large, senior patient sample. These results are corroborated by earlier research showing a link between elevated C-reactive protein levels and the likelihood of AKI after PCI (McCarthy et al., 2014).
Further research is required to understand the relationship between activated inflammation and AKI in coronary revascularization, especially given that AKI puts people at risk for infections and that prior research has revealed that contrast agents may modify complement activation. Even though patients who used more contrast media had numerically greater incidences of AKI, trends in this patient population did not achieve statistical significance. The relatively small number of registered patients may partially account for this (Mach et al., 2020). Furthermore, we cannot completely rule out the possibility that the effect of the contrast volume was somewhat counterbalanced by co-morbidities or other factors that were not considered in this older high-risk patient population.
Patients who acquired AKI had longer hospital stays, which indicates the significant strain on the healthcare system and the related morbidity in these patients. In-hospital consequences like death, cardiac resuscitation, and concurrent infections were more common in patients. Future research is required, though, to precisely examine the nature and effects of bleeding events in older patients undergoing PCI according to renal function using known bleeding classifications (Noh et al .,2021). Deaths from all causes and MACE rates were substantially correlated with AKI, whether rising baseline morbidity is to blame for the increased rate of unfavorable cardiovascular events linked to AKI.
Whether there is a direct causal link between AKI and upcoming adverse occurrences or whether it may be explained by a gradual loss in kidney function over time. The concept of combined cardiac and renal dysfunction may be reinforced given that tAKI's unfavorable prognosis extended beyond increased heart failure hospitalization rates. Preventive hydration with isotonic saline and a reduction, in contrast, media, are two treatments for preventing AKI that are advised by guidelines. The use of N-acetyl cysteine and sodium bicarbonate, or the administration of statins or ascorbic acid, have been the main strategies used to further lower the incidence of AKI. These efforts have had mixed success. Our results confirm the clinical need for new approaches to lower the incidence of AKI in high-risk patients undergoing PCI.

**Conclusion**

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According to this study, AKI is a common finding in elderly patients (>65 years old) having PCI and is linked to a higher risk of unfavorable cardiovascular events. These results emphasize the need to include AKI in the risk assessment of PCI patients and enhance treatment approaches aimed at preventing AKI beyond appropriate fluid management and contrast volume reduction, especially in high-risk patient subsets.

**Declarations**

**Data Availability statement**
All data generated or analyzed during the study are included in the manuscript.
**Ethics approval and consent to participate**
Approved by the department concerned.
**Consent for publication**
Approved
**Funding**
Not applicable

**Conflict of interest**

The authors declared the absence of a conflict of interest.

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