

## PREVALENCE OF CONTRAST INDUCED ACUTE KIDNEY INJURY IN PATIENTS UNDERGOING PRIMARY PCI AFTER ACUTE MYOCARDIAL INFARCTION

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### ABSTRACT

**Objective:** To determine the prevalence of contrast-induced acute kidney injury after primary percutaneous coronary intervention among patients of acute myocardial infarction.

**Study Design:** Descriptive cross-sectional study.

**Place and Duration of Study:** Department of Interventional Cardiology, Armed Forces Institute of Cardiology & National Institute of Heart Diseases (AFIC/NIHD) Rawalpindi, from Jan 2021 to Mar 2021.

**Methodology:** Five Hundred patients between 30-80 years of age, diagnosed with Acute Myocardial Infarction were planned to undergo primary percutaneous coronary intervention (PCI) at cardiac catheterization lab. Blood sample was taken before and after 24 and 72 hours of primary percutaneous coronary intervention. Acute kidney injury was labeled when serum creatinine rise  $\geq 25\%$  after 72 hours of primary percutaneous coronary intervention as compared to the baseline. Statistical Package for Social Sciences version 20 was used to enter and analyze the collected data. Frequency (%) were estimated for variables like gender, diabetes, hypertension and acute kidney injury. Mean and standard deviation were estimated for variables like age and body mass index.

**Results:** Out of 500 patients enrolled in the study, 402 (80.4%) were males and 98 (19.6%) were females. The mean age of patients was  $64.34 \pm 8.68$  years. In our study, 313 (62.6%) were diabetic, 287 (57.4%) had hypertension, 88 (17.6%) had history of smoking, while 51 (10.2%) were ex-smokers. The mean serum creatinine level at baseline was  $0.86 \pm 0.13$  mg/dl which was increased to  $0.95 \pm 0.18$  mg/dl after 72 hours. The mean change in serum creatinine level was  $0.08 \pm 0.07$  mg/dl. There was  $9.16 \pm 7.1\%$  rise in the serum creatinine level from baseline ( $p < 0.05$ ). There were 26 (5.20%) patients who had got acute kidney injury while 474 (94.80%) patients had normal kidney functions.

**Conclusion:** The prevalence of contrast-induced acute kidney injury (CK-AKI) was very low in our population due to contrast medium used for primary percutaneous coronary intervention after acute myocardial infarction.

**Keywords:** Acute myocardial infarction, Acute kidney injury, Contrast induced nephropathy, Primary percutaneous coronary intervention, Serum creatinine.

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### INTRODUCTION

Primary percutaneous coronary intervention (PCI) is a very effective treatment strategy, which is applied to restore the patency of the atherosclerotic coronary arteries and protecting the ischemic myocardium. This treatment strategy can be helpful in preventing the left ventricular dysfunction and improve the chances of survival of the patients who develop acute myocardial infarction<sup>1</sup>. Patients usually undergo primary PCI after acute myocardial infarction by using contrast medium. It has been observed that patients are at risk of developing Contrast-induced acute kidney injury who undergo primary PCI as compared to those who undergo elective PCI. Numerous risk factors are associated with Contrast-induced acute kidney injury after primary PCI, like nature and volume of the used contrast media, lack of pre and post procedural hydration of the patient, hemodynamic instability,

reduced left ventricular ejection fraction (LVEF)<sup>2</sup>.

Contrast-induced acute kidney injury is a serious and most common complication of primary PCI. It is the third leading cause of prolonged hospital stay after primary PCI<sup>3</sup>. The occurrence of Contrast-induced acute kidney injury is associated with the prolonged hospital stay and increases the rate of morbidity and mortality during hospital stay and long term renal dysfunction<sup>4,5</sup>. Thus; the precise prediction of the risk of acute kidney injury after primary PCI at the time of admission of patients for acute myocardial infarction is precarious for both; efforts for its prevention and informed decision-making like informing about invasive procedure. The prevalence of Contrast-induced acute kidney injury may vary as described in literature. This may be due to presence of pre-existing risk factors like level of serum creatinine before undergoing percutaneous coronary intervention, age, type-I or II diabetes, chronic hypertension, congestive heart failure, hemoglobin level, body mass index and gender<sup>6</sup>.

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Every year, in United States, >30 million iodinated contrast material - enhanced imaging scans are acquired, making the iodinated contrast medium as one of the most recommended agent in current medical clinical practice. In these imaging modalities, iodinated contrast medium is infused to enhance the conspicuity of the tissue and so improve the diagnostic accuracy of the modality. In a struggle to lessen the occurrence of Contrast-induced acute kidney injury, the "American College of Radiology, Canadian Association of Radiologists, and European Society of Urogenital Radiology" published guidelines for the administration of intravenous contrast medium, depending on the pre-existing level of serum creatinine<sup>7,8</sup>.

A literature has been widely reviewed and published on the risk factors and clinical effects of coronary procedures on the acute kidney injury<sup>9,10</sup>. However, no information is available for tertiary care hospitals and National Post graduate Institutes in Pakistan. This research aims to assess the contrast induced acute kidney injury frequency and clinical predictors in the unselected group of patients of acute myocardial infarction, candidates of primary PCI.

### **METHODOLOGY**

This descriptive cross-sectional study was conducted at department of Interventional Cardiology, Armed Forces Institute of Cardiology and National Institute of Heart Diseases (AFIC/NIHD) Rawalpindi, from January 2021 to March 2021. By using the Non probability, consecutive sampling technique and by using the 95% confidence level, 3% margin of error and 10-15% frequency of contrast induced acute kidney injury; the sample size was estimated to be 500 cases<sup>11,13</sup>. Five Hundred patients of both genders between 30-80 years of age, presented with acute myocardial infarction at emergency and Primary PCI was decided to be done in all enrolled patients after their informed consents. Acute myocardial infarction was considered when 2 of following 3 criteria met: typical or a typical chest pain lasting for >20 minutes duration, Cardiac enzymes elevation > reference range set by pathology lab and development of new ST-T-wave changes or new Q waves on electrocardiography (ECG). Patients with chronic kidney disease, renal congenital abnormalities, single kidney either congenitally or having previous nephrectomy, candidates of renal transplant or on dialysis, previous history of Urinary system surgery were excluded. Patients who were not hospitalized initially for acute myocardial infarction or

transferred from other hospitals after >24 hours were also excluded from the study.

After getting the approval of research study from the hospital ethical board review committee, 500 patients presenting in the emergency of cardiology department fulfilling the inclusion criteria were included in the study after explaining the primary PCI procedure in detail and fully informed written consents. Serum creatinine level, factors related to procedure and risk factors that may lead to acute kidney injury were taken through medical records. Blood samples were taken at baseline before undergoing primary PCI. Then primary PCI was performed under local anesthesia through radial or femoral artery approach by the competent Interventional Cardiologist's team of AFIC/NIHD according to International clinical practice. Type of contrast agent and volume of contrast, angioplasty technique, and supportive pharmacologic therapies were left to the discretion of the interventional cardiologist. Successful lesion dilatation after PCI was defined as "achievement of <10% residual diameter stenosis, including at least a 95% improvement, by visual estimate." Procedural success was defined as "successful treatment of 1 or more lesions without in-hospital death, Q-wave myocardial infarction, or emergency bypass surgery". Then blood samples were obtained again to assess serum creatinine level after 24 hours and 72 hours. Acute kidney injury was labeled as defined as EUSR guidelines "an increase of 25% in serum creatinine level from baseline with in and after 72 hours from contrast media administration"<sup>14</sup>. Statistical Package for Social Sciences (SPSS) version 20 was used to enter and analyze the collected data. Frequency (%) were estimated for variables like gender, diabetes, hypertension and acute kidney injury. Mean and standard deviation were estimated for variables like age and BMI.

### **RESULTS**

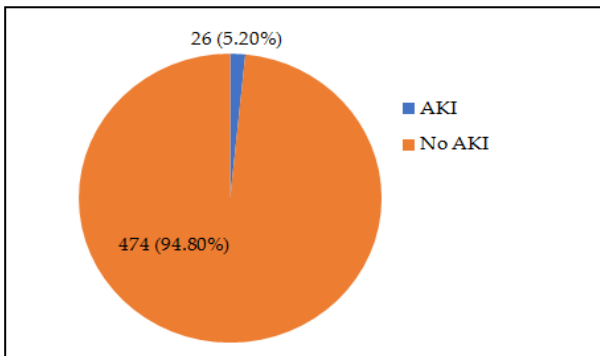
The mean age of all the patients was  $64.34 \pm 8.68$  years. Out of 500 cases, 402 (80.4%) were males and 98 (19.6%) females. The male to female ratio in our study was 4.1:1. The mean BMI was  $31.98 \pm 5.39$  kg/m<sup>2</sup>. In our study, 313 (62.6%) were diabetic, 287 (57.4%) had hypertension, 88 (17.6%) had history of smoking, while 51 (10.2%) were ex-smokers. There was no patient who had history of previous heart failure before myocardial infarction, previous PCI/CABG was done in 102 (20.4%) patients and no patients had history of pre-procedural shock in our study population. The mean time from symptoms to PCI was  $3.54 \pm 1.38$  hours. The

mean duration of procedure was  $26.93 \pm 4.56$  min table-I.

**Table-I : Baseline characteristics of patients.**

	Mean $\pm$ SD, n (%)
n	500
Age (years)	64.34 $\pm$ 8.68
<b>Gender</b>	
Male	402 (80.4%)
Females	98 (19.6%)
BMI (kg/m <sup>2</sup> )	31.98 $\pm$ 5.39
Diabetes	313 (62.6%)
Hypertension	287 (57.4%)
Current smokers	88 (17.6%)
Ex-smoker	51 (10.2%)
History of heart failure	-
Previous PCI / CABG	102 (20.4%)
Pre-procedural shock	-
Time from symptoms to PCI	3.54 $\pm$ 1.38
Duration of procedure	26.93 $\pm$ 4.56

Before PCI, the mean serum creatinine level was  $0.86 \pm 0.13$  mg/dl which was increased to  $0.95 \pm 0.18$  mg/dl. The mean change in the serum creatinine level was  $0.08 \pm 0.07$  mg/dl within 72 hours of primary PCI. There was  $9.16 \pm 7.1\%$  rise in the serum creatinine level as compared to the baseline ( $p < 0.05$ ) table-II. There were 26 (5.20%) patients, who developed the acute kidney injury while 474 (94.80%) patients had normal kidney function figure.



**Figure-1: Distribution of acute kidney injury.**

We stratified data for different effect modifiers. The acute kidney injury was significantly higher in patients aged 66-85 years (12.2%). The acute kidney injury was significantly more in males (6.5%) while no female developed acute kidney injury. The contrast induced acute kidney injury was noticed in 8.3% diabetic patients and in 9.1% patient who had hypertension. While among smokers no acute kidney injury develop, however 3.6% non-smokers and 25.5% ex-

smokers developed acute kidney injury. Among patients who had previous PCI, 12.7% developed acute kidney injury table-III.

**Table-II: Change in serum creatinine level before and after procedure.**

	Before PCI	After PCI	Change	Percentage Change
n	500	500	500	500
Serum creatinine	0.86 $\pm$ 0.13	0.95 $\pm$ 0.18	0.08 $\pm$ 0.07	9.16 $\pm$ 7.1

Paired sample t-test = 26.562, p-value < 0.0001

**Table-III: Comparison of acute kidney injury according to effect modifiers.**

	n	Acute Kidney Injury		p-value
		Yes	No	
		26	474	
Age (years)	45-65	-	287 (100%)	0.000
	66-85	26 (12.2%)	187 (87.8%)	
Gender	Male	26 (6.5%)	376 (93.5%)	0.010
	Female	-	98 (100%)	
Diabetes	Yes	26 (8.3%)	287 (91.7%)	0.000
	No	-	187 (100%)	
Hypertension	Yes	26 (9.1%)	261 (90.9%)	0.000
	No	-	213 (100%)	
Smoking	Yes	-	88 (100%)	0.000
	No	13 (3.6%)	348 (96.4%)	
	Ex-smoker	13 (25.5%)	38 (74.5%)	
Previous PCI / CABG	Yes	13 (12.7%)	89 (87.3%)	0.001
	No	13 (3.3%)	385 (96.7%)	

**DISCUSSION**

Contrast-induced acute kidney injury constitute around 12% of cases of acute renal injury that develop in the hospital during stay after administration of contrast medium<sup>13</sup>. The prevalence of acute renal injury ranges from 0-24% based on the risk factors of the patient<sup>15</sup>. It is usually an acute renal failure in temporary and reversible form. However, a longer hospitalization, increased morbidity and mortality plus increased financial costs are involved with acute kidney injury<sup>16</sup>. Acute kidney injury is described as the abrupt rise of serum creatinine level of >25% from the baseline level within 48 hours after all causes of nephropathy have been excluded, like nephrotoxins, low blood pressure, urinary tract blockage, or atheromatous emboli. It's usually self-limiting, with serum creatinine concentration peaking in 3-5 days and back to normal in 7-10 days<sup>17-18</sup>.

Patients with mild to moderate chronic renal insufficiency have 9-40% chance of developing diabetes, whereas people with severe chronic renal insufficiency have a 50-90% chance of developing diabetes<sup>19</sup>. Over-

all, 9.33% of patients may develop acute kidney injury due to infusion of contrast medium, which is described as 25% rise in serum creatinine level as compared to the level before PCI, with an occurrence of 0.88%<sup>20</sup>. Another study found that after PCI, 21.5% of type-II diabetic patients developed acute kidney injury<sup>21</sup>. However, one survey found that after PCI, 40.4% of diabetic patients had acute kidney damage<sup>22</sup>.

After renal hypo-perfusion (42%) and postoperative renal damage, it is the third most frequent cause (18%). Acute kidney damage after PCI has a confirmed incidence of 0-24%, based on the frequency of related risk factors, with a higher prevalence that reported after primary PCI in emergency setting<sup>23,24</sup>. In our study, there were 26 (5.20%) patients who developed acute kidney injury while 474 (94.80%) patients had normal kidney function. One meta-analysis of forty studies showed that contrast enhanced computed tomography caused 6 percent acute kidney damage<sup>25</sup>.

Acute kidney failure is uncommon in people with normal renal function (0-5%)<sup>14</sup>. Moreover, despite the use of lowosmolar contrast media and proper hydration, an occurrence of around 50% was identified in cases having diabetic nephropathy, undergoing primary PCI or coronary angiography in one study. It's worth noting that up to 15% of them need renal dialysis. Acute kidney injuries are strongly related to the longer stay in the hospital, greater morbidity and mortality, as well as a higher cost. Acute kidney disease affects 8-16% of patients above the age of 60, according to different studies. Age of 75 years or more has also been found to be an additional risk factor for acute kidney failure in patients of acute myocardial infarction, who undergo percutaneous coronary intervention. In our study we also observed that the acute kidney injury developed in 12.2% patients, who were aged >65 years.

## CONCLUSION

The frequency of contrast-induced acute kidney injury was very low in our population after primary PCI for acute myocardial infarction. Hence the conducted study gives the conclusive evidence for local population. But still there is a need to improve protocols for primary PCI after acute myocardial infarction to nullify the incidence of contrast-induced acute kidney injury in local population and improve our clinical medical practice.

## CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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