Frequency of Contrast Induced Acute Kidney Injury in Patients Undergoing Cardiac Catheterization at Jinnah Hospital Lahore

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Abstract

Objective: To determine the frequency of contrast induced acute kidney injury in patients undergoing cardiac catheterization in Jinnah Hospital, Lahore.

Material & Methods: It was a cross sectional study conducted at the cardiology department of Jinnah Hospital. After taking ethical approval from Ethical Review Board (Ref No. ERB130/2/03-11-2022), the study was completed in six months i.e. from 04-11-2022 to 30-04-2023.Total of 217 patients of either sex who underwent cardiac catheterization were included in the study. CI-AKI was defined as increase of serum creatinine 0.5mg/dl or 25% increase from baseline creatinine within 48 hours after exposure to contrast material.

Results: Of total 217patients, 54.8% were male and 45.2% were female. 25 patients (11.5%) in study population developed CI-AKI . Risk of developing CI-AKI was clearly associated with old age, diabetes, hypertension, coronary artery disease and angioplasty.($p < 0.05$)

Conclusion: The conclusion of the study was that frequency of CI-AKI in subjects undergoing cardiac catheterization is 11.5% which is quite significant. Old age, history of diabetes mellitus, hypertension, ischemic heart disease and angioplasty were significantly related with higher risk of developing CI-AKI.

Keywords: Contrast induced AKI, Cardiac catheterization

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Introduction

Acute kidney injury (AKI) is defined as the increase in serum creatinine value more than 1.5 times the basal value or the decrease in glomerular filtration rate by more than 25% or the decrease in urine output below 0.5 mL/kg/h.[2] Acute kidney injury (AKI) is a frequently documented entity in admitted patients ranges form 18-70% with more frequent in critically ill patients.[3] Among multiple causes of AKI, administration of intravenous contrast is one of the leading causes of AKI and ranked third most cause of AKI in hospitalized patients[1].

IV contrast is used both for diagnostic and therapeutic purposes. Cardiac catheterization is one of the important procedures where intravenous contrast is used. The term 'contrast induced AKI (CI-AKI)' has been used to describe renal injury with contrast exposure.[4]

It is less common with contrast exposure in patients with normal renal functions as compared to patients already having underlying renal disease.[5]

CI-AKI is considered reversible form of AKI though it may be related to the adverse outcomes.[6]

Definition of the Contrast-induced nephropathy (CIN) is deterioration of renal parameters, measured as either a twenty five percent rise in serum creatinine (S/Cr) from baseline or a 0.5 mg/dL (44 µmol/L) rise in absolute Serum Creatinine , within forty-eight hours of administration of intravenous contrast.[7] CIN has strong correla-

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tion with a higher risk of mortality.[8]

There are multiple risk factors for developing CIN. Pre-existing renal insufficiency is the most important risk factor for CIN. Other important risk factors are advancing age, underlying liver disease, atherosclerosis, heart failure, anaemia and dehydration.[9]

The incidence of CIN ranges from 5 to 27% with less chances in patients with normal renal functions.[10] According to study by Rear et al , following coronary angiography or percutaneous coronary intervention, CIN is reported in upto 50% of high risk patients.[11]

Materials and Methods

The study was conducted at the cardiology department of Jinnah Hospital, Lahore. The duration of the study was 6 months after synopsis approval i.e., 04-11-2022 to 30-04-2023. A sample size of 217 was determined taking expected frequency of CI-AKI at 10% with confidence level of 95% and 5 % margin of error. Non-probability consecutive sampling. Indoor patients undergoing cardiac catheterization (Angiography and percutaneous coronary intervention). Both male and female gender. Patients between 18 to 65 years of age were included. Patients of ESRD currently on dialysis. Patients already having underlying renal disease. Patients underwent open heart surgery within 3 days after coronary angiography were included. After the synopsis approval, patients admitted to the cardiology ward of Jinnah Hospital Lahore who met the inclusion criteria were evaluated. Informed consent was obtained. Fifty millilitres of low-osmolal contrast 'Ultravist' with an osmolality of 600 mosm/kg was used intra-arterially for cardiac catheterization. Five millilitres of venous blood were drawn for the measurement of serum creatinine, at the baseline and 48 hours after the catheterization. All the laboratory investigations were performed in the pathology laboratory of Allama Iqbal Medical College, Lahore. Data collection was carried out by the investigator himself via a questionnaire. Contrast induced AKI was recorded as per operational definition and it was managed as per hospital protocol. In order to analyze data, the software SPSS 22.0. was utilized. Categorical variables like gender, diabetes, hypertension and ischemic heart disease were described as percentage and frequency. Whereas the quantitative variables e.g. age was reported as mean ± standard deviation. However, the outcome variables i.e. CI-AKI was stratified by age, gender, diabetes mellitus (BSR >200mg/dl), hypertension (BP >140/90mmHg), ischemic heart disease, procedure (angiography/ angioplasty) and analyzed. Chi- square test was employed taking p-value ≤ 0.05 as significant to know the difference by age, gender and with respect to outcome variable.

Results

217 patients were included in our study population.21 (9.4%) had age 30-40 years,54(24.9%) had age 41-50 years,98(45.2%) had age 51-60 years and 44 patients (20.3%) had age 61-65 years. Among 217, majority 119 patients (54.8%) were male and 98 patients(45.2%) were female(Table 1).Regarding associated comorbidities, 138 patients(63.6%) had diabetes, 141 patients (65%) had hypertension while 72 patients (33.2%) had prior history of ischemic heart disease (Table 2).172 patients (79.3%) had undergone angiography while 45 patients (20.7%) had angioplasty. 25 patients (11.5%) in study population developed CI-AKI while 192 patients (88.5%) did not had CI-AKI (Table 3). When we cross tabulated age of patient with CI-AKI, it showed significant result (p value <0.001) implying the significant

Table 1: *Cross tabulation of CI-AKI with age groups and Gender*

	Contrast Induced AKI		p-value
Age of Patient	Yes	No	
30-40 year (n=21)	1 (4.76%)	20 (95.24%)	<0 .001
41-50 year (n=54)	0 (0%)	54 (100%)	
51-60 year (n=98)	1 (1.02%)	97 (98.98%)	
61-65 year (n=44)	23 (52.3%)	21 (47.7%)	
Total (n=217)	25 (11.5%)	192 (88.5%)	
Gender			
Male (n=119)	13(10.92%)	106(89.08%)	0.762
Female (n=98)	12 (12.24%)	86(87.76%)	
Total (n=217)	25 (11.5%)	192(88.5%)	

Table 2: *Cross tabulation of CI-AKI against comorbidites*

	Contrast Induced AKI		p-value
Diabetes Mellitus	**Yes**	**No**	
Yes (n=138)	22 (15.94%)	116 (84.06%)	**0.007**
No (n=79)	3 (11.5%)	76 (88.5%)	
Total (n=217)	25(11.5%)	192(88.5%)	
Hypertension			
Yes (n=141)	23(16.31%)	118(83.69%)	**.003**
No (n=76)	2 (2.63%)	74 (97.37%)	
Total (n=217)	25(11.5%)	192(88.5%)	
IHD			
Yes (n=72)	18 (25%)	54(75%)	**<.001**
No (n=145)	7 (4.82%)	138 (95.18%)	
Total (n=217)	25(11.5%)	192(88.5%)	

association of old age with risk of CI-AKI. While gender difference was not statistically significant (Table 1). On cross tabulation of diabetes, hypertension and ischemic heart disease with CI-AKI, all three comorbidities were statistically significant.

Table 3: *Cross tabulation of Cardiac catheterization procedure with Contrast induced AKI*

Cardiac	Contrast Induced AKI		Total	p value
Catheterization	**Yes**	**No**		
Procedure				
Angiography	13	159	172	**<.001**
	8.17%	91.83%	100%	
Angioplasty	12	33	45	
	26.66%	73.34%	100%	
Total	25	192	217	
	11.5%	88.5%	100%	

Discussion

Acute renal injury due to contrast is common in patients undergoing cardiac catheterization. It is a commonly reported issue in literature however local data is scarce.

CI-AKI is correlated with higher risk of hospitalization, higher morbidity and conversion to chronic kidney disease in high-risk population undergoing the procedure. CI-AKI also has poor prognosis in long term in high-risk population. Thus, the study was performed to find the incidence of CI-AKI in local population and elaborate the association between various risk factors and risk of CI-AKI. Out of total 217 patients, 25 patients (11.5%) in study population developed CI-AKI while 192 patients (88.5%) did not develop CI-AKI. This shows that the frequency of CI-AKI is high in those undergoing cardiac catheterization. The findings of our study are compatible with study conducted at cardiology department Hyatabad Medical Complex of Peshawar in 2014. In this study, 177 admitted patients underwent cardiac catheterization and CI-AKI was observed in 18 patients (10% of study population)[12]. Similarly, in a meta-analysis (Aug 2019) of 12 studies including 6342 patients who underwent cardiac catheterization after STEMI showed that overall incidence of CI-AKI was about 13%[13]. In our study, there was significant association between age of patients and CI-AKI with overall p value<.001. Out of total 21 patients in the age group between 30-40 years, only 1 patient (5%) developed CI-AKI while 23 patients out of 44(52%) developed CI-AK in the age group 61-65 years. A study done by Moos SI et al in 2013 showed increased risk of CI-AKI in patients aged > 65 years (odds raio:1.95)[14].

Our study determined that frequency of CI-AKI was 10% in males while 12% for females but it was not statistically significant (p = 0.762). A study by Sidhu RB et al in 2008 including 13127 patients showed that there was no difference among different gender in young patients but it was noted that frequency of CI-AKI was higher for females compared with males in the age group 65-79 years old with p<.00115.

Statistically significant association was noted between diabetes mellitus and risk of CI-AKI in our population. In the diabetes group frequency of CI-AKI was 15.9% vs 3.9 % in non-diabetic group (p=0.007). These results were similar to an Iranian study (2010) which demonstrated that risk of contrast induced nephropathy was greater in diabetics when compared to non-diabetic patient (p<0.05)16. Similarly, there was statistically significant association noted between hypertension and CI-AKI. In our study CI-AKI occurred in 19% hypertensive patient's vs 2% normotensive patients (p = 0.003). Our study also found statistically significant association between ischemic heart disease and risk of CI-AKI. It showed that the incidence of CI-AKI was 25% in those with history of IHD vs 4.82% in those with no IHD (p = <0.001). It has been found in Our data that there is statistically significant difference occurs in the incidence of CI-AKI in those undergoing angiography vs angioplasty (7% vs 26% respectively) with p value<0.001. A study by Marenzi G et al in 218 patients with anterior wall MI undergoing angioplasty showed incidence of CI-AKI at 19%[17].

There are limitations to our current study which include single centre study and sample size which was not much larger than the previous studies. Our study did not include patients who were >65 years and <30 years of age. The large sample size and inclusion of all age groups will make data more reliable and accurate. There was also no follow up of the patients who had AKI after contrast so we cannot comment on long term consequences of CI-AKI. Despite all these limitations, our study had many strengths as well. It highlighted a very important clinical entity on which very limited local data is available. Our study can provide important insights into future studies conducted on CI-AKI

Conclusion

It is concluded that there is very much high frequency (11.5%) of CI-AKI observed in patients undergoing cardiac catheterization. Significant association of CI-

AKI occurs with old age, history of diabetes mellitus, hypertension, coronary artery disease and angioplasty.

Conflict of Interest *None*

Funding Source *None*

References

1. Haq MF, Yip CS, Arora P. The conundrum of contrast-induced acute kidney injury. Journal of Thoracic Disease. 2020 Apr;12(4):1721.
2. Er RE, Okyay GU, Erten Y. Comparison between RIFLE, AKIN, and KDIGO: acute kidney injury definition criteria for prediction of in-hospital mortality in critically ill patients. Iranian Journal of Kidney Diseases. 2020 Sep 1;14(5):365.
3. Yan P, Duan XJ, Liu Y, Wu X, Zhang NY, Yuan F, Tang H, Liu Q, Deng YH, Wang HS, Wang M. Acute kidney disease in hospitalized acute kidney injury patients. PeerJ. 2021 May 24;9:e11400.
4. Chen H, You Z, Zhang S, He C, He H, Luo M, Lin X, Zhang L, Lin K, Guo Y. Predictive value of preprocedural albuminuria for contrast-induced nephropathy non-recovery in patients undergoing percutaneous coronary intervention. International Urology and Nephrology. 2021 Dec 1:1-8.
5. Abdalla MA, Ahmed KO, Yousef BA. Incidence and risk factors of contrast-induced acute kidney injury in Sudanese patients undergoing coronary angiography: a descriptive prospective study. Cureus. 2022 Feb 3; 14(2)
6. Wang Y, Liu K, Xie X, Song B. Contrast-associated acute kidney injury: An update of risk factors, risk factor scores, and preventive measures. Clinical Imaging. 2021 Jan 1;69:354-62.
7. Cho E, Ko GJ. The pathophysiology and the management of Radiocontrast-Induced nephropathy. Diagnostics. 2022 Jan 12;12(1):180..
8. Safadi S, Hommos MS, Enders FT, Lieske JC, Kashani KB. Risk factors for acute kidney injury in hospitalized non–critically ill patients: A population-based study. InMayo Clinic Proceedings 2020 Mar 1 (Vol. 95, No. 3, pp. 459-467). Elsevier.
9. Zhang F, Lu Z, Wang F. Advances in the pathogenesis and prevention of contrast-induced nephropathy. Life sciences. 2020 Oct 15;259:118379.
10. Shams E, Mayrovitz HN. Contrast-induced nephropathy: a review of mechanisms and risks. Cureus. 2021 May 4;13(5).
11. Rear R, Bell RM, Hausenloy DJ. Contrast-induced nephropathy following angiography and cardiac interventions. Heart. 2016 Apr 15;102(8):638-48
12. Ullah I, Israr M, Ali U, Iqbal MA, Ahmad F, Awan ZA. Frequency of contrast induced nephropathy in patients undergoing percutaneous coronary intervention. Pakistan Heart Journal. 2016 Oct 9;48(3).
13. He H, Chen XR, Chen YQ, Niu TS, Liao YM. Prevalence and predictors of contrast-induced nephropathy (CIN) in patients with ST-segment elevation myocardial infarction (STEMI) undergoing percutaneous coronary intervention (PCI): a meta-analysis. Journal of interventional cardiology. 2019 Aug 25;2019.
14. Moos SI, van Vemde DN, Stoker J, Bipat S. Contrast-induced nephropathy in patients undergoing intravenous (IV) contrast enhanced computed tomography (CECT) and the relationship with risk factors: a meta-analysis. European journal of radiology. 2013 Sep 1;82(9): e387-99.
15. Sidhu RB, Brown JR, Robb JF, Jayne JE, Friedman BJ, Hettleman BD, Kaplan AV, Niles NW, Thompson CA, Dartmouth Dynamic Registry Investigators. Interaction of gender and age on post cardiac catheterization contrast-induced acute kidney injury. The American journal of cardiology. 2008 Dec 1;102(11):1482-6.
16. Pakfetrat M, Nikoo MH, Malekmakan L, Tabande M, Roozbeh J, GANBAR ALI RJ, Khajehdehi P. Comparison of risk factors for contrast- induced acute kidney injury between patients with and without diabetes. Hemodialysis International. 2010 Oct;14(4):387-92.
17. Marenzi G, Lauri G, Assanelli E, Campodonico J, De Metrio M, Marana I, Grazi M, Veglia F, Bartorelli AL. Contrast-induced nephropathy inpatients undergoing primary angioplasty for acute myocardial infarction. Journal of the American College of Cardiology. 2004 Nov 2;44(9):1780-5.

Authors Contribution

MUA, AN: Conceptualization of Project
MAS, MMB: Data Collection
MUA, FUS: Literature Search
AN, MK: Statistical Analysis
MAS, MMB: Drafting, Revision
MUA, AN: Writing of Manuscript