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# CONTRAST INDUCED NEPHROPATHY IN PATIENTS UNDERGOING CARDIAC CATHETERIZATION PROCEDURES- A SINGLE CENTRE STUDY

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## Abstract

*Non-Iodinated contrast media are commonly used for diagnostic and therapeutic applications. More than 1.2 million cardiac catheterizations are performed worldwide each year. Contrast Induced Nephropathy (CIN) is a serious consequence of several radiographic procedures that expose patients to contrast media.*

***Objective:*** *To evaluate the frequency of Contrast Induced Nephropathy in patients undergoing cardiac catheterization procedures.*

***Design****: Observational Study*

***Place and Duration of Study:*** *This observational study was carried out in the department of Nephrology in collaboration with the Department of Cardiology, Liaquat University Hospital, Hyderabad (October, 2023 to April, 2024).*

***Methods:*** *A total of 100 patients of either gender of aged between 20 to 70 years with stable ischemic heart disease undergoing cardiac catheterization were included. Patients with chronic kidney disease, renal congenital abnormalities, single kidney either congenitally or having previous nephrectomy, candidates of renal transplant or on dialysis patients were excluded. Contrast Induced Nephropathy (CIN) was defined as a relative 25% increase in serum creatinine from baseline or a 0.5 mg/dl (44µmol/l) increase in the absolute value within 72 hours of contrast administration. Statistical analysis was performed using SPSS version 26. Mean ± SD was calculated for quantitative data, whereas qualitative data was illustrated in the form of frequencies and percentages. Chi-square/fisher exact test was applied to know the factors associated with CIN. P-value ≤ 0.05 was considered as significant.*

***Results:*** *Mean age of the patients was 57.20 ± 9.91 years and 53% were men. Obesity, hypertension, diabetes and smoking were present in 10 (10%), 53*

*(53%), 40 (40%) and 9 (9%) respectively. The frequency of CIN was 16 (16%) within 72 hours of post procedure.*

***Conclusion:*** *Patients having cardiac catheterization procedures (Angiography and PCI) have 16% occurrence of CIN, which is linked to heart failure and obesity. To lessen the clinical burden of CIN after primary PCI, early risk assessment and proactive preventive measures are necessary in clinical practice.*

## INTRODUCTION

Non-Iodinated contrast chemicals are commonly used for analytical and therapeutic applications. Greater than 1.2 million cardiac catheterizations are performed worldwide each year [1].These procedures are more commonly used in South Asian countries like Pakistan, where cardiovascular disease is more prevalent [2].The ongoing development of coronary procedures, along with an ageing population and growing procedural complexity, has caused an amplified prevalence of kidney damage induced by introduction to contrast agents, an illness defined as CIN [3].

It is a serious consequence of several radiographic procedures that expose individuals to contrast media. The most prominent of these techniques is PCI [4]. This is a major source of disease and death, as well as it contributes to higher expenses in high-risk individuals undergoing PCI. It is hypothesized to originate from uninterrupted cytotoxicity and hemodynamic challenge of renal tissue. [5].

It is identified as a rise in serum creatinine by ≥0.5 mg/dL or ≥25% from baseline in 72 hours after contrast delivery, once other causes of kidney injury like infections, dehydration, drugs are ruled out. It has been discovered that post PCI contrast-induced nephropathy ranges from 2 to 25% over the world [6]. According to latest researches, the occurrence of CIN after primary PCI ranges between 10.4% and 23.2% [7]. Diabetics, elderly, and individuals having renal disease have significantly greater incidences than the general population [8].

There are numerous risk issues for CIN. They can be classified into patient-related and procedure-related risk factors. There are five types of patient-related risk factors: creatinine clearance, diabetes, Congestive Heart Failure (CHF),Hypertension (HTN), and peripheral vascular disease, procedure-related risk factors include utilization of an intra-aortic balloon pump, a contrast volume of >260ml, and an emergency or elective procedure [9,10].

The present study is designed to assess occurrence of CIN in patients going through cardiac catheterization procedures. Majority of these studies were done at international, local data about its significance is insufficient. Paucity of information in this regard exists in our part of the world which has different geographical setup, climate, dietary habit, lifestyle and economical soundness as compared to western world. Furthermore, studies conducted in the past had analyzed retrospective data which may led to biasness. Based on these insights, the study was designed. Due to scarcity of data work in this subject would contribute to early identification of risk of CIN and prevention in the future.

### Methodology:

This prospective cross-sectional study was carried out in a span of six months from October 2023 to April 2024 at the Department of Nephrology in collaboration with the Department of Cardiology, Liaquat University Hospital, Hyderabad. Approval from the ethical review committee of the hospital was sought prior conducting the study. After taking written informed consent, a total of 100 participants of age ranging from 20 to 70 years with stable ischemic heart disease, underwent cardiac catheterization were included in the study via non-probability sampling technique. Patients with established CKD, renal congenital abnormalities, solitary kidney either congenital or having prior nephrectomy, candidates of renal transplant or on dialysis patients were excluded. OPEN EPI calculator was used to calculate the sample size by taking the prevalence of CIN i.e.10.4% [7], margin of error = 6%, confidence interval = 95%, then calculated sample was 100.

A written consent was taken from all the patients and a detailed history was taken. Complete systemic examination, including renal and cardiovascular systems, was performed along with a general physical examination. Patient baseline characteristics were

measured including age, gender, height, weight, RBS, Blood pressure, serum creatinine.

Oral anti-glycemic medications (metformin) were discontinued before and after two days of cardiac catheterization in diabetic patients. Previous medical records were reviewed, particularly the renal profile. Blood samples were collected for random blood sugar and HbA1C levels, as well as renal function tests. Angiography or PCI was carried out in accordance with the standardized procedural protocols. Serum creatinine levels were measured both before and after contrast. All the data was collected on the pre designed proforma and frequency of CIN was calculated in patients undergoing cardiac catheterization. CIN was defined as a relative 25% rise in serum creatinine within 24-72 hours of contrast shot.

Statistical analysis was performed using SPSS version 26, with data recorded in Excel. Mean ± SD was calculated for quantitative data, whereas qualitative data was illustrated in the form of frequencies and percentages. Chi-square/fisher exact test was applied to know the factors associated with CIN. P-value ≤ 0.05 was considered as significant.

**Results:**

An outline of characteristics is presented in Table I, 53% of the 100 individuals that were examined were males. The patients' average age (SD) was 57.20 ± 9.91 years. The most frequent cardiovascular risk factor, accounting for 53% of the total patients was Hypertension, 11% of the participants had a prior history of HF. Prior to the procedure almost all the patients had normal renal functions.

**Table # I: Baseline Data of the Patients**

| Baseline Data | Statistics |
|---|---|
| Age (mean ± SD) | 57.20± 9.91 years |
| **Gender** | |
| • Male | 53 (53%) |
| • Female | 47(47%) |
| **Procedures** | |
| • Angiogram | 59 (59%) |
| • PCI | 15 (15%) |
| • Both | 26 (26%) |
| **Risk factors** | |
| • Obese | 10 (10%) |
| • Known hypertension | 53 (53%) |
| • Known Diabetics | 40 (40%) |
| • Alcoholic | 0 (0%) |
| • Smokers | 9 (9%) |
| • History of HF | 11 (11%) |
| • Previous angiography procedure | 9 (9%) |
| | 34 (34%) |



The occurrence of CIN at 72-hours post procedure was found 16% in patients undergoing cardiac catheterization procedures, **as shown in table # II**.

**Table# II: Frequency of Contrast Induced Nephropathy in patients undergoing cardiac catheterization procedures (n=100)**

| Contrast Induced Nephropathy | n (%) |
|---|---|
| Yes | 16 (16%) |
| No | 84 (84%) |

Chi-square/fisher exact test was applied to know the factors associated with CIN and factors found to be associated with CIN ($p<0.05$) were obesity, hypertension and history of heart failure, **as shown in table # III**.

**Table# III: Factors of Association with CIN among patients undergoing cardiac catheterization procedures**

| Characteristics | CIN | | P-value |
|---|---|---|---|
| | Yes (n=16) | No (n=84) | |
| Age < 65 years | 11 | 63 | |
| Age≥ 65 years | 05 | 21 | 0.756** |
| **Gender** | | | |
| • Male | 12 | 41 | 0.062* |
| • Female | 04 | 43 | |
| **Obese** | | | |
| Yes | 10 | 00 | <0.001* |
| No | 06 | 84 | |
| **Known hypertension** | | | |
| Yes | 16 | 37 | <0.001* |
| No | 00 | 47 | |
| **Known Diabetics** | | | |
| Yes | 09 | 31 | 0.171** |
| No | 07 | 53 | |
| **History of HF** | | | |
| Yes | 09 | 02 | <0.001* |
| No | 07 | 82 | |

*** Fisher exact test**
**** Chi-square test**

**Discussion:**

This study shows that the incidence of CIN among patients following coronary angiography and percutaneous coronary intervention is 16%.The extent of CIN detected in this research is smaller than that stated by the Nigerian study amongst individuals undergoing radio-contrast treatments (35.9%)[11].However, our findings are higher than those reported in South Africa and Kenya [12,13].Some differences between this research and preceding ones maybe described by variations in the characteristics of patients and procedures performed. Our results, however, are in line the frequency stated by Chillo P et al who found that incidence of CIN was 19% within 72 hours post procedure [2]. Evidence of the independent relationship between the development of CIN and a past history of heart failure has been reported in both industrialized and developing nations [14,15]. Our research supports this finding and provides more proof that individuals with heart failure have more risk of developing CIN than those individuals without heart failure. Poor pre-renal perfusion has been proposed as mechanism of CIN in HF. This leads to low preload and renal vasoconstriction, which negatively affect medullary oxygenation. When contrast media are present, this increases nephrotoxicity and consequently, CIN [16]. Kidney damage is associated with obesity. Obesity has been linked in the past to the development of CIN in patients undergoing coronary angiography procedures [17,18] or receiving any kind of contrast [19]. Obesity-related abnormal kidney function is mediated by increased CNS activity, RAAS stimulation, & somatic pressure on kidneys by fat in and around them [21]. Notably, obesity was not linked to CIN in the Nigerian investigation [11] & was not considered hazard in South African research [11].Therefore, further researchers in the area should validate our findings.

As obesity was not included in current study, it does

not account for extended patient outcomes with CIN, which limits research.

Age and DM, were found to be unrelated to the progress of CIN in this analysis. This stands in contrast to previous studies [7, 9,]. Since the univariate analysis only revealed trends, it's plausible that our research population lacked the power to identify these changes. A small number of CIN investigations have noted these absence of correlations. Consequently, the details of these observations should be examined in larger regional investigations. One of the study's advantages is that it is earliest to document occurrence of CIN & its associated hazards. The study's prospective design gives realistic image of what happens to individuals who get contrast medium within 3 days after coronary angiography procedures at our setup.

Study limitations

This study's primary weakness is its small sample size, which is apparent in the number of patients who had CIN. Analyzing such a limited number of CIN predictors can lead to incorrect inferences. The consequences come from a single medical facility, and not all "post-PCI nephropathy" is CIN as nephropathy can also result from pre-renal causes and cholesterol emboli .Kidney biopsies were not performed so precise cause of AKI could not be identified. Furthermore, we cannot rule out the possibility of selection bias and the possibility that other features may have added, at least in part, to renal impairment and influenced clinical outcomes of our participants because it is impossible to settle casualty or rule out unmeasured confounding as contributor to observed association.

**Conclusion:**

Contrast-Induced nephropathy (CIN) occurs in approximately 16% of patients undergoing cardiac catheterization. To mitigate the clinical burden associated with CIN, early risk stratification and implementation of proactive preventive strategies are essential in routine clinical practice.

**Authors Contribution:**

**SM: Study design+ manuscript writing+ Data collection**
**PM: Study concept+ manuscript drafting + Final approval**
**SR: Data Analysis+ collection + manuscript writing+**
**NM: Data interpretation + Manuscript writing**
**KS: Data Interpretation + Collection**
**JS: Data collection+analysis**

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