



STUDY ON INCIDENCE AND RISK FACTORS OF CONTRAST INDUCED NEPHROPATHY IN PATIENTS UNDERGOING CARDIAC CATHETERIZATION STUDIES

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ABSTRACT Contrast induced nephropathy (CIN) is a significant problem in clinical practice with the increasing use of contrast media in diagnostic and interventional procedures. In our hospital (Osmania General Hospital, Hyderabad), we conducted a study of the incidence and risk factors of contrast - induced nephropathy among the patients undergoing cardiac catheterisation studies, based on the increase in post - procedural serum creatinine from the baseline. In the results of the present study, 28% of the patients presented with CIN. Incidence of CIN is increasing with age, 58.9% patients of CIN are in between 51-60 years age ($p < 0.05$). There was no statistically significant difference observed between CIN and No CIN patients based on gender ($p > 0.05$). There was no statistically significant difference observed in presence of HTN and DM between CIN and No CIN patients ($p > 0.05$). It is observed that 12.5% patients with CIN had significantly higher baseline Creatinine compared to 4.2 % in no CIN group ($p < 0.05$). 30.4% of patients in CIN group had LVEF $< 40\%$ which was significant higher than when compared to 8.3% in no CIN group ($p < 0.05$).

KEYWORDS : Contrast induced nephropathy, Cardiac Catheterization, Serum Creatinine, left ventricular ejection fraction.

INTRODUCTION

Nephropathy induced by contrast media is a significant yet underestimated problem in clinical practice. With the increasing use of contrast media in diagnostic and interventional procedures over the last 30 years, this form of nephropathy has become the third leading cause of hospital-acquired acute renal failure, accounting for 12% of all cases^{1,2}

The incidence of CIN has been calculated to be $>2\%$ in the general population but in high-risk patients, i.e., diabetic patients, subjects with history of congestive heart failure, chronic renal impairment, and older age, the incidence has been considered to be $>20\%$ to 30% ^{1,3}

The risk of contrast-medium nephropathy continues to be considerable, despite the use of newer and less nephrotoxic contrast agents in high-risk patients in recent years^{2,4}.

Recently suggested definition by Harjai, et al. categorized, contrast nephropathy as grade 0 (serum creatinine increase $<25\%$ above baseline and <0.5 mg/dL above baseline), grade 1 (serum creatinine increase $\geq 25\%$ above baseline and <0.5 mg/dL above baseline), or grade 2 (serum creatinine increase ≥ 0.5 mg/dL above baseline)⁵

Aims and Objectives of the study

To assess the incidence of contrast induced nephropathy, defined as a raise in post-procedural creatinine by $>25\%$ over the baseline, in patients undergoing cardiac catheterization studies.

To identify the common and important risk factors of contrast induced nephropathy in patients undergoing cardiac catheterization studies

Material and Methods

STUDY POPULATION

200 consecutive patients who are undergoing coronary angiography are undertaken in the Department of Cardiology, Osmania General Hospital / Osmania Medical College Hyderabad. All procedures were elective, no emergency procedure was included in the study.

Laboratory investigations were performed on all the patients included in the study, Haemoglobin (Hb), estimation, Random Blood Sugar (RBS), Lipid Profile, Serum Creatinine, before and after angiogram are done.

Contrast induced nephropathy was defined as an increase in post-procedural creatinine by more than 25% from the baseline. All patients who had an increase in post-procedural creatinine by more than 25%

over baseline were diagnosed to have Contrast Induced Nephropathy. Serum creatinine values were followed up in the patients before coronary angiogram was performed and at 24 and 48 hours after the procedure, and peak serum creatinine levels were considered for calculation of increase from baseline.

Patients were identified as hypertensives if already diagnosed and on treatment or newly detected with a Blood pressure of 140/90 or more as defined by JNC7⁶.

Height and weight of all patients was documented and Body Mass Index calculated using the formula
BMI = (weight in kg) / (Height in meters)

Statistical analysis

Statistical analysis was carried out for 200 subjects after categorizing each variable.

Baseline data were collected from all patients. Age, sex, presence of hypertension, diabetes, BMI, serum creatinine, creatinine clearance, type and amount of contrast medium, number of coronary vessels diseased, presence of dyslipidemia and left ventricular ejection fraction were analyzed with respect to development of CIN.

Results are presented as mean \pm SD or a percentage of the total. The significance of difference in means between two groups was calculated by means of Student's t test and the significance of difference in proportions were compared with Pearson's χ^2 (chi-square) test. Statistical significance was taken to be significant when P value is >0.011 to 0.05.

Statistical analysis was carried out using standard formulae SPSS (Statistical package for Social Sciences) for Windows Dos

Results

Table : 1 : BASELINE CHARACTERISTICS OF STUDY POPULATION

Age	Frequency	Percent
≤ 50	79	39.5
51 - 60	68	34.0
> 60	53	26.5
Gender		
Male	160	80.0
female	40	20.0
HTN	90	45.0

DM	78	39.0
BMI < 25	154	77.0
BMI ≥ 25	46	23.0

In the present study it was observed that 39.5% patients were in the age group of ≤50, followed by 34.5% patients in the age group pf 51 – 60 yrs and 26.5% in the age group > 60 yrs. The mean age of the study population was 53.34 ± 9.4 yrs.

There was a male predominance observed in the study with 80 % males compared to 20 % females the male : female ratio was 4:1 45% patients had history of Hypertension and 39% patient shad history of diabetes. 77 % patients had BMI < 25 and 23 % patient s had BMI ≥ 25 kg/m2

Table 2 : Incidence of CIN

	Frequency	Percent
CIN	56	28.0
No CIN	144	72.0
Total	200	100.0

In the present study it was observed that 28 % patients presented with CIN

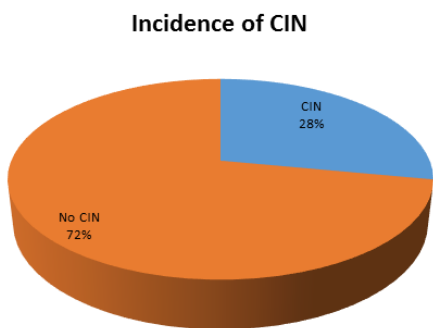


Table 3 : Distribution of patients based on age

Age Grp in yrs	CIN		No CIN	
	No.	%	No.	%
≤ 50	7	12.5	72	50.0
51 - 60	33	58.9	35	24.3
> 60	16	28.6	37	25.7
Total	56	100.0	144	100.0
chi square	28.7		p value	<0.001

In the present study it was observed that significantly higher no of CIN patients , 58.9% were in the age group of 51 – 60 and 28.6 % in age group > 60 yrs compared to 24.3% in the age group of 51 – 60 yrs and 25.7% in the age group of > 60 yrs in no CIN. 12.5% patients were in the age of ≤ 50 yrs in CIN patients which was significantly lower than 50 % patients in no CIN group. (P<0.05).

In the present study there was no statistically significant difference observed between CIN and No CIN patients based on gender p>0.05

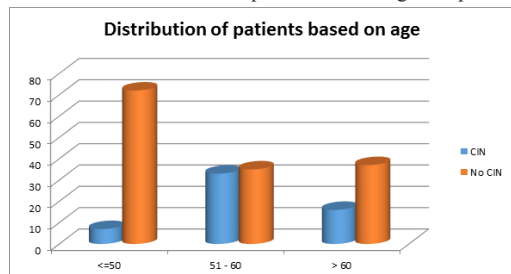


Table 4: Distribution based on gender

Gender	CIN		No CIN	
	No.	%	No.	%
Male	41	73.2	119	82.6
Female	15	26.8	25	17.4
Total	56	100.0	144	100.0
chi square	2.23		p value	0.135

Table 5: Distribution based on other baseline charecteristics

	CIN		No CIN		Chi square	P value
	No.	%	No.	%		

HTN	25	44.6	65	45.1	0.004	0.95
DM	23	41.1	55	38.2	0.14	0.708

In the present study In the present study there was no statistically significant difference observed in presence of HTN and DM between CIN and No CIN patients p>0.05

Table 6: Base Line Serum Creatinine

Creatinine	CIN		No CIN	
	No.	%	No.	%
< 1.5 mg/dl	49	87.5	138	95.8
≥ 1.5 mg/dl	7	12.5	6	4.2
Total	56	100.0	144	100.0
chi square	4.607		p value	0.032

In the present study it was observed that 12.5% patients with CIN had significantly higher baseline Creatinine compared to 4.2 % in no CIN group p<0.05.

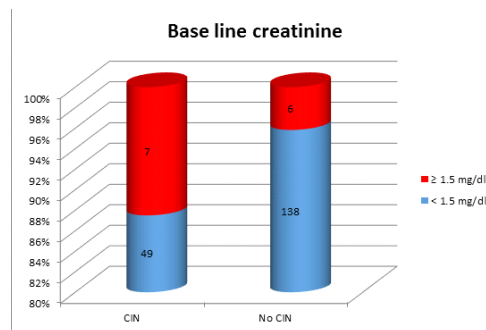


Table 7: comparison between Left ventricular Ejection Fraction and CIN

LVEF	CIN		No CIN	
	No.	%	No.	%
< 40 %	17	30.4	12	8.3
≥ 40 %	39	69.6	132	91.7
Total	56	100.0	144	100.0
chi square	15.7		p value	0.001

In the present study it was observed that 30.4% patients in CIN group had LVEF < 40 % which was significantly higher than when compared to 8.3 % in No CIN group p<0.05.

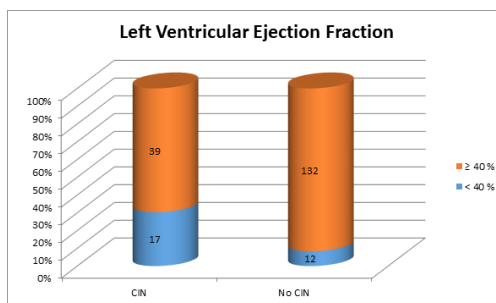


Table 8: comparison between Dyslipidemia and CIN

Dyslipidemia	CIN		No CIN	
	No.	%	No.	%
Present	14	25	25	17.4
Absent	42	75	119	82.6
Total	56	100.0	144	100.0
chi square	1.49		p value	0.221

There was no statistically significant relation observed between Dyslipidemia and CIN p>0.05.

Table 9: comparison between No. of Vessels involved and CIN

No. of Vessels	CIN		No CIN	
	No.	%	No.	%
1	22	39.3	54	37.5
> 1	34	60.7	90	62.5
Total	56	100.0	144	100.0
chi square	0.192		p value	0.909

There was no statistically significant relation observed between no. of vessels involved and CIN $p > 0.05$

Discussion

Our study has attempted to assess the incidence of contrast induced nephropathy in patients undergoing cardiac catheterization studies in our hospital and to identify the major risk factors for developing CIN in this population.

The major findings of this study are that the incidence of contrast nephropathy is as high as 28% among the population undergoing cardiac catheterization studies at our Institute.

McCullough PA et al also reported an increase in serum creatinine by 25% in 14.5% of patients who underwent coronary angiography (95 percent confidence interval, 12.9 to 16.1 percent)⁷. In our study 12.5% patients with CIN had significantly higher baseline creatinine compare to 4.2% in no CIN group ($p < 0.05$).

In our study 41.1% of the patients with CIN had diabetes mellitus. 25% of the CIN patients had dyslipidemia. The rates of contrast induced nephropathy reported in various studies that included patients with pre-existing renal dysfunction or diabetes mellitus in whom a standard hydration protocol was not administered is between 12% and 26%^{8,11}.

Hypertension was reported to an independent predictor of CIN in the study conducted by Iakovou I et al. In our study 44.6% of the CIN patients have hypertension⁹.

Studies have shown that reduced left ventricular ejection fraction ($\leq 49\%$), advanced congestive heart failure (New York Heart Association class III or IV), or any history of congestive heart failure are independent risk factors for CN and contribute even greater risk in patients with diabetes or renal disease. In our study 30.4% of patients with CIN group had left ventricular ejection fraction $< 40\%$, which was significantly higher than when compare to 8.3% in no CIN group ($P < 0.05$)¹⁰.

Most studies performed internationally have found that the risk of CIN increases with increasing age and age > 75 years was a significant risk factor for development of CIN. The study by Mehran et al in 2004 puts the incidence at as high as 21.8% among those aged > 75 years¹². In our study shows that CIN does increase with increasing age, with the population between 51-60 years having an incidence as high as 58.9%. Age has been found to be a statistically significant factor ($p < 0.05$) in development of CIN.

Mehran et al reported an incidence of 19.2% in diabetics¹². 13.2% patients with hypercholesterolemia has been shown to be a significant risk factor for CIN incidence rates among diabetics have been reported to be between 5%- 30% in various studies.

Rudnick et al¹³ found no differences in the incidence of nephropathy between patients receiving iohexol (low-osmolar; 780 mOsm per kilogram of water) and patients receiving diatrizoate (high-osmolar; 1870 mOsm per kilogram of water) among low-risk patients (patients without diabetes who had a base-line serum creatinine concentration of less than 1.5 mg per deciliter [133 μ mol per liter]). Among patients with diabetes, the incidence was reduced from 47.7 to 33.3 percent. Overall, patients receiving high-osmolar contrast medium were 3.3 times as likely to have nephropathy induced by contrast medium as those receiving low-osmolar contrast medium¹³.

A study of more than 7000 patients by Rihal CS et al showed that each 100 mL of contrast medium administered correlates with a hazard ratio for CIN of 1.12. Rihal et al in a study observed 22.4% incidence of CIN among patients with baseline serum creatinine of between 2-2.9mg/dl, and 30.6% among those with baseline value of > 3.0 mg/dl¹⁴

This study has shown that risk factors for CIN are an elevated baseline creatinine, a low creatinine clearance, left ventricular ejection fraction $< 40\%$, the type and amount of contrast medium used, and the presence of multivessel CAD. Identification of these risk factors before subjecting the patient to angiogram gives us an opportunity to use prophylactic measures to prevent CIN and also anticipate CIN in high risk patients..

CONCLUSION

There is a significant risk of contrast induced nephropathy in patients undergoing cardiac catheterization studies especially **among the elderly**, and among those with pre-existing renal failure and the patients with left ventricular dysfunction.

- There were no patients in this study who developed renal failure needing Haemodialysis.
- Risk of CIN can be predicted before the procedure based on risk factors and suitable precautions can be taken including use of low or iso-osmolar contrast media, minimizing the amount of contrast medium used.

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