Original Research Article

Contrast-Induced Nephropathy: Myth or Reality? Single center experience in patients undergoing planned percutaneous coronary intervention

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Abstract

Background: The definition of Contrast-induced nephropathy (CIN) is the impairment of renal function and is measured either as increase in serum creatinine (SCr) by 25% from baseline or 0.5 mg/dL increase in absolute value, within 48-72 hours of intravenous contrast administration. The objectives were to establish the incidence of CIN and to define the clinical and periprocedural risk factors leading to CIN in patients receiving contrast media.**Methods:** In a retrospective, observational, descriptive study, patients who were admitted to the hospital for therapeutic Percutaneous Coronary Inervention (PCI) between June 2020 to December 2020, the serum creatinine and glomerular filtration rate (GFR) prior to angiography and 72 hours post procedure were measured. **Results:** 202 patients were included in the study, of which 4.45 % developed CIN. **Discussion:** In our study,the incidence was found to be lower than the literature review. The present study investigated renal function in the chronic phase in patients with ischemic heart disease undergoing planned PCI. The progression of renal dysfunction in patients who develop CIN is thought to result from glomerular overfiltration in the residual nephrons and the release of neurohormones that reduce renal blood flow.

Keywords: CIN, Serum Creatinine, Percutaneous Coronary Intervention

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Introduction

The definition of Contrast-induced nephropathy (CIN) is the impairment of renal function and is measured either as an increase in serum creatinine (SCr) by 25% from baseline or 0.5 mg/dL increase in absolute value, within 48-72 hours of intravenous contrast administration [1-3]. CIN is one of the important cause of acute kidney injury (AKI) in the patients who are hospitalized and has been reported as the third most common cause of kidney injury in patients who undergo interventional radiologic procedures [4]. However, the incidence of CIN is less than 2% [5] although, in patients with chronic kidney disease (CKD) the incidence is more than 12%, as well as in patients who developed acute coronary syndrome (ACS) and underwent a percutaneous coronary intervention (PCI) [6] Even more, it is also associated with excess mortality and longer hospital stay [7,8]CIN was first observed in a patient with multiple myeloma receiving IVP. In 2004, Gleeson et.al reported CIN as third main cause of hospital-acquired acute kidney injury after surgery and hypotension, which is responsible for 12% of all cases of acute kidney injury in the hospital. CIN is temporary process, and kidney functions return to the baseline within 7-14 days of contrast administration [9].

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Residual renal impairment is seen in less than one-third of the patients , less than 1% of patients require renal replacement therapy , and there is slightly higher incidence of underlying AKI in patients raising the mortality up to 17%, when compared with patients who don't develop AKI has just a mortality rate of 3.9% . The primary risk factors for CIN include Preexisting renal impairment and diabetes mellitus [10-12].There is no well established documentation regarding importance of CIN in PCI. The main aim of the present study was to estimate the incidence, study the clinical presentation, and prognostic inferences of CIN in patients going for PCI with newer contrast medium and maintaining optimum hydration to prevent contrast induced AKI.

Methods

Study design

This is an observational, retrospective and descriptive study conducted at Dhiraj hospital SBKSMIRC, Vadodara, India, a tertiary care center from June 2020 to December 2020 in patients admitted for therapeutic planned PCI. Total of 202 patients who met inclusion and exclusion criteria undergoing planned angioplasty were enrolled.

Inclusion criteria

1. Age more than 18 years
2. Patients admitted with NSTEMI undergoing planned PCI

Exclusion criteria

1. Patients who has advance chronic kidney disease (GFR < 30 ml/min)
2. Patients with AKI other than Contrast induced AKI.
3. Patients with cardiogenic shock.

4. Patients who did not possess serum creatinine levels at the day of angiography procedure (day 0) and 3 days after the procedure.
5. Pregnant Female.
6. Contrast medium allergy; use of contrast within the prior 7 days.

After complete examination with detailed history, complete hemogram, serum creatinine, serum electrolytes, and eGFR were measured on admission. After contrast medium exposure creatinine and electrolytes were monitored on day 3 and 30. The eGFR was calculated by Modification of Diet in Renal Disease study (MDRD) Estimated GFR (mL/min per 1.73 m^2) = 1.86 × (Serum Creatinine) −1.154 × (age) −0.203(× 0.742 for women).Physiologic (0.45%) saline was given intravenously at a rate of 1 ml/kg/hour for 12 hours before and after the procedure. Based on our institute's clinical protocols and international experience guidelines, Supportive pharmacologic therapies or mechanical support were left to the interventionists and cardiologists of the coronary intensive care unit,. On admission an echocardiographic evaluation was performed for all patients.Planned PCI was performed based on standard clinical practice by a 24-hour, on-call, interventional team, using the femoral and radial approach and 6French guiding catheters, using iso-osmolar contrast medium (IODIXANOL – VISIPAQUE) with an ideal contrast dose of 5ml/kg for all patients. The indications to use aspirin,clopidogrel,β-adrenergic blocking agents, statins, angiotensin-converting enzyme inhibitors, intra-aortic balloon pump (IABP) or inotropic drugs, was left to the interventional cardiologists. Patients received a bolus of 5,000 U heparin in the intensive coronary care unit, followed by a bolus of 5,000 U heparin just before the angiography . Identified lesions were predilated using conventional angioplasty balloons followed by stent implantation. Total of 202 patients undergoing planned angioplasty were enrolled. All the findings were noted down and appropriate statistical analytics were used and important correlate on and conclusions were drawn.

Ethical considerations

There are no ethical problems associated with this study as there is no active intervention needed for this. There is no harm to humans. The confidentiality of the identity and personal deatils of patients was maintained.

Statistical Analysis

Median and standard deviation were used for Continuous variables, and percentage was used for qualitative variables. Student's t test and categorical variables with $\chi 2$ test used for analysis of Continuous variables. Logistic regression of the variables was used for Multivariate analysis and results were determined with odds ratio with a confidence interval of 95% and given a significant result when $p < 0.05$. (using software Epiinfo)

Results

During June 2020 to December 2020 period, total 225 therapeutic planned PCIs were performed. Thus, 202 successive patients (153 males and 49 females with a mean age of 57.2 years) met inclusion and exclusion criteria. Among these 202 patients 135 (66.83 %) had single vessel disease, 56 (27.72 %) had double vessel disease & 11 (5.44 %) had triple vessel disease. Among these 202 patients, 37 (18.31 %) had hypertension, 39 (19.30 %) had type II diabetes mellitus and 5 (2.47 %) had Hypothyroidism. Average contrast used is 203 ml in each patient. On hospital admission, before the procedure 90 (44.55 %) of 202 patients had Serum Creatinine level more than 1.1 mg/dl and 11 (5.44 %) of 202 patients had serum creatinine level more than 1.5 mg/dl Of these 202 patients, 9 (4.45 %) developed CIN (AKI Stage I) and 193 (96.5 % did not). On Follow up after 30 days, 3 patients had SCr level (more than 1.1 mg/dl); all of them recovered from CIN on 3 month follow up.

The patients developed CIN were older mean age (57 years), more often male (7 males), baseline mean Serum creatinine value was 1.28 mg/dl. 9 patients developed CIN, among them 2 patients had diabetic mellitus type II, 3 had hypertension.

The left anterior descending artery culprit lesion was more frequently seen in the CIN group. There was no significant difference in contrast volume between the 2 groups. After contrast medium exposure, no patient required hemodialysis. The requirement for permanent hemodialysis was not found in any of the patients.

Table 1: Demographical analysis

	CIN Present (9)		No CIN (193)	
	Number (n)	**Percentage (%)**	**Number (n)**	**Percentage (%)**
Male	7	77%	146	75%
Age(mean) years	57		58.4	
DM-II	2	22.22%	37	19.17%
HTN	3	33.33%	34	17.61%
Quantity of media (mean) (ml)	200 ml		206 ml	
Single vessel disease	4	44.44%	131	67.87%
Double vessel disease	1	11.11%	55	28.49%
Triple vessel disease	4	44.44%	7	3.62%
eGFR 30-45	2	40%	3	60%
eGFR 45-60	5	14.70%	29	83.30%
eGFR>60	2	1.22%	161	98.78%
Death	0		0	
RRT	0		0	

Table 2: Multivariate analysis

	Odds ratio	**Risk ratio**	**P value**
Diabetes Mellitus	1.2	1.15	0.39
Hypertension	2.33	1.89	0.13
Single Vessel Disease	0.37	0.65	0.08
Double Vessel Disease	0.31	0.38	0.14
Triple Vessel Disease	21.25	12.25	0.0002

Discussion

The major finding of this study was that the incidence of CIN was 4.45% which is a major finding of this study which is lower than reported in similar studies such as that of Rihal et al [10] documented that it is a common complication, even in patients with normal renal function.

In this study we had a low incidence of AKI and it is important that most patients in this study were at high risk, There are so many other causes of AKI besides the use of contrast media that could influence the decrease in renal function, like atheroembolism, drug toxicity or hemodynamic changes; can make it harder to differentiate the true cause of AKI, as Newhouse reported [13]. In the study population, the use of nephroprotective measures showed no statistically significant difference between both groups.The present study documented renal function in chronic phase in patients with ACS who are going for planned PCI. Gomerular overfiltration in the residual nephrons and the release of neurohormones that reduce renal blood flow were thought to be the causes of progression of renal dysfunction in patients who develop CIN.Moreover, together with the progression of cardiac dysfunction and decreased cardiac output in heart failure, renal failure can also progress. In the present study, patients who had CIN were associated with low cardiac output, like in case of anterior acute myocardial infarction and high peak creatine kinase levels. An evaluation of Serum Creatinine in both the acute and chronic phases is important in patients who develop CIN.

The weaknesses of this study was that we should emphasize that it is a retrospective study, with a small sample, single-center, with no influenced therapeutic measures, the underlying cause for renal failure was not fully investigated. This study is relevant in our medical practice because it is a rare entity described leading to high morbidity and increases in-hospital expenses. Currently patients undergoing PCI are increasing due to ischemic heart disease, so it is necessary to stratify patients at high risk to carry out early preventive measures.

Conclusion

Though CIN was found in the studies population but the incidence was lower than that mentioned in the literature. The early detection of risk factors and stratification is necessary to prevent contrast induced nephropathy in patients undergoing percutaneous coronary intervention.

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