



RESEARCH ARTICLE

CONTRAST INDUCED NEPHROPATHY IN ACUTE STEMI PATIENTS UNDERGOING PRIMARY PCI AND ITS CORRELATION WITH VOLUME OF CONTRAST AND DURATION OF SYMPTOMS

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ABSTRACT

Introduction: Contrast induced nephropathy (CIN) is one of the major complications of coronary intervention and has been correlated with mortality. CIN is responsible for approximately 11% of all iatrogenic renal insufficiency and is the third most common cause of hospital-acquired renal failure after decreased renal perfusion and nephrotoxic drugs. CIN is traditionally defined as an increase in serum creatinine of either 0.5 mg/dl or 25% from baseline within 72 h of exposure. The association of increase in serum creatinine with short- and long-term adverse clinical outcomes is well established.

Objectives: To find out occurrence of contrast induced nephropathy in patients undergoing primary PCI and its relation with duration of symptoms and contrast volume.

Materials and Methods: This was a hospital based prospective observational study conducted at a tertiary care hospital, including 140 patients undergoing primary PCI.

Results: Majority of patients were males (74.28%). Mean patient age was 53.32±11.97 years. Smoking (45.71%), hypertension (36.42%), diabetes mellitus (28.57%), and Dyslipidemia (22.85%) were the main risk factors. Most patients presented between 3 to 6 hours of index event (44.28%). Twenty nine patients (20.71%) developed CIN. The mean contrast volume used in CIN group was significantly higher than non CIN group.

Conclusion: Contrast induced nephropathy occurs frequently in patients undergoing primary PCI. There is no correlation between duration of symptoms at presentation and CIN. The volume of contrast used during procedure is a good predictor of development of CIN.

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INTRODUCTION

Contrast induced nephropathy (CIN) is one of the major complications of coronary intervention and has been postulated to be correlated with mortality (Rihal et al., 2002; McCullough et al., 1997). CIN is responsible for approximately 11% of all iatrogenic renal insufficiency and is the third most common cause of hospital-acquired renal failure after decreased renal perfusion and nephrotoxic drugs (Nash et al., 2002). CIN is traditionally defined as an increase in serum creatinine of either 0.5 mg/dl or 25% from baseline within 72 h of exposure (Gleeson and Bulughapitiya, 2004; Murphy et al., 2000). The association of the above-specified magnitude and time course of serum creatinine increase with short- and long-term adverse clinical outcomes is well established (Rihal et al., 2002; Levy et al., 1996; Lindsay et al., 2004). Patients undergoing percutaneous coronary interventions (PCIs) represent a high-risk subset of patients for CIN and they have a 15-fold higher

rate of major adverse cardiac events during hospitalization when they develop CIN as compared with patients without this complication (Rihal et al., 2002). Recent observations suggest that the risk of CIN and adverse cardiac events is even higher among patients undergoing primary PCI for acute myocardial infarction (AMI) (Weisz et al., 2008). In patients with AMI, several conditions may contribute to the development of renal dysfunction. Impaired systemic perfusion due to left ventricular dysfunction, a large volume of contrast medium, and the impossibility of starting renal prophylactic therapies before exposure to contrast medium are among the major factors that seem to be involved. Indeed, more complicated clinical courses and significantly higher in hospital mortality have been reported when contrast medium-induced nephropathy occurs after primary angioplasty, even in patients who present with normal renal function (Marenzi et al., 2004). Only a few studies have evaluated the clinical relevance of CIN in the setting of primary PCI. The present study is planned to evaluate the development of CIN in patients with ST elevation myocardial infarction undergoing primary PCI in our hospital

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and its relation with duration since the onset of symptoms and volume of contrast used during the procedure.

Aims and Objectives

1. To study the occurrence of contrast induced nephropathy in patients presenting with acute ST elevation myocardial infarction undergoing primary angioplasty.
2. To study effect of duration of symptoms on contrast induced nephropathy.
3. To study effect volume of contrast on contrast induced nephropathy

MATERIALS AND METHODS

Definition

CIN is defined as an increase in serum creatinine of either 0.5 mg/dl or 25% from baseline within 72 hours of contrast exposure.

Study population

This was hospital based prospective observational study conducted at PGIMER and DR RML hospital, New Delhi to assess the incidence of contrast induced nephropathy in patients presenting with acute ST elevation myocardial infarction undergoing primary PCI and its relation with duration of symptoms and volume of contrast used during procedure. 140 patients with acute ST elevation myocardial infarction presenting in emergency department and eligible for Primary PCI were considered for this study.

Inclusion criteria

- Patients with acute ST Segment elevation myocardial infarction eligible for primary PCI.
- Patients giving informed consent for primary PCI.

Exclusion criteria

- Patients not giving consent.
- Patients in cardiogenic shock.
- Patients with baseline creatinine clearance less than 60ml/min/1.73 m² BSA.

Study design

Primary PCI was performed with the standard technique as per the protocol of department. A non ionic low osmolarity contrast material was used in all patients. The volume of contrast material was calculated. Duration of symptoms was noted. Baseline serum creatinine was measured. Then serial serum creatinine were measured at 24, 48, 72 hours. Creatinine Clearance was estimated by Cockcroft-Gault equation. Equation = $[[140-\text{age}(\text{yr})]*\text{weight}(\text{kg})]/[72*\text{serumCr}(\text{mg/dL})]$ (multiply by 0.85 for women). This study conforms to widely accepted ethical principles guiding human research and also this study was approved by institutional ethics committee.

Statistical analysis

Statistical analysis was done using statistical software package SPSS 21.0. The difference between the mean values was compared using t test. Nominal data was compared using chi squared test. Multiple logistic regression analysis was done for determination of factors responsible for CIN. ROC curve was plotted to determine the cut off value of contrast volume.

RESULTS AND OBSERVATION

The study recruited a total of 140 patients after considering inclusion and exclusion criteria. These patients were subjected to necessary examination and investigations. Table 1 shows baseline characteristics of patients. Table 2 shows logistic regression analysis of variables responsible for CIN. Most of the patients in this study were males (74.28%).

Table 1. Comparison between two groups

Parameter	Contrast induced nephropathy (No. of subjects)		p-value
	Yes (29)	No (111)	
Age (years)	56.8±13.1	52.4±11.5	0.074
Gender (M:F)	21:8	83:28	0.814
Hypertensive subjects (%)	44.8%	34.2%	0.386
Dyslipidemic subjects (%)	20.6%	23.4%	1.000
Diabetic subjects (%)	44.8%	24.3%	0.038
Smokers (%)	55.1%	43.2%	0.298
Alcoholics (%)	31%	23.4%	0.471
Subjects with previous MI (%)	3.4%	2.7%	1.000
Hb (gm%)	12.7±1.8	12.8±1.7	0.607
Contrast Volume	156.0±11.2	127.9±10.6	<0.001***
Baseline creatinine (mg %)	0.7±0.1	0.8±0.1	0.029*
MAX. Creatinine in 72 hours (mg %)	1.3±0.4	0.9±0.1	<0.001***

Table 2. Logistic regression analysis of factors for determination of factors responsible for CIN

	Variables in the Equation						95% C.I. for EXP(B)	
	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Baseline creatinine (mg %)	-20.893	7.318	8.151	1	0.004	0.000	0.000	0.001
MAX. Creatinine in 72 hours (mg %)	10.489	3.353	9.789	1	0.002	35928.966	50.324	25651417.933
Diabetes mellitus	1.560	1.540	1.026	1	0.311	4.757	0.233	97.285
Contrast volume	0.277	0.102	7.413	1	0.006	1.320	1.081	1.612
Constant	-36.178	13.630	7.045	1	0.008	0.000		

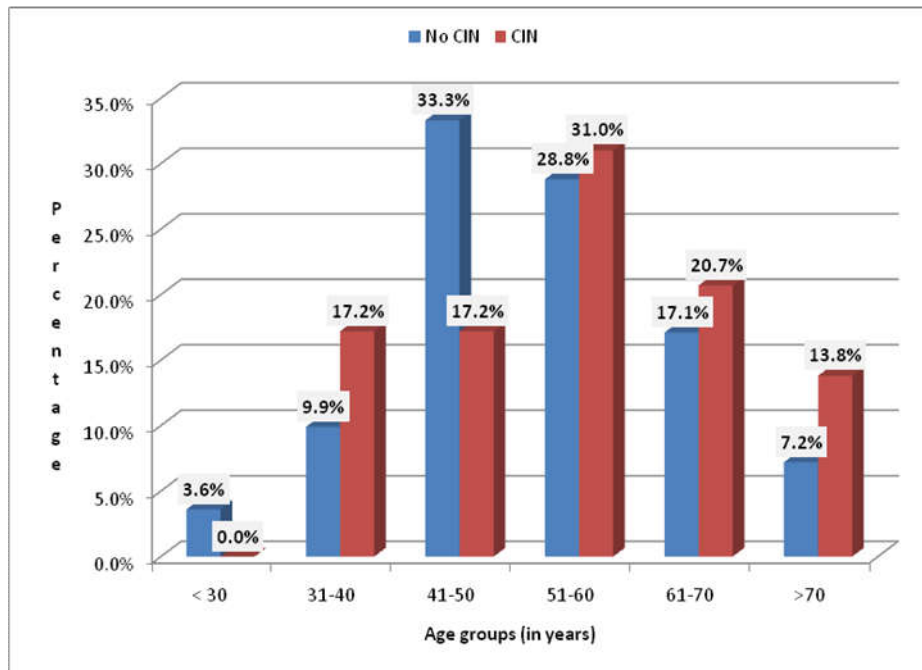


Figure 1. Distribution among age groups

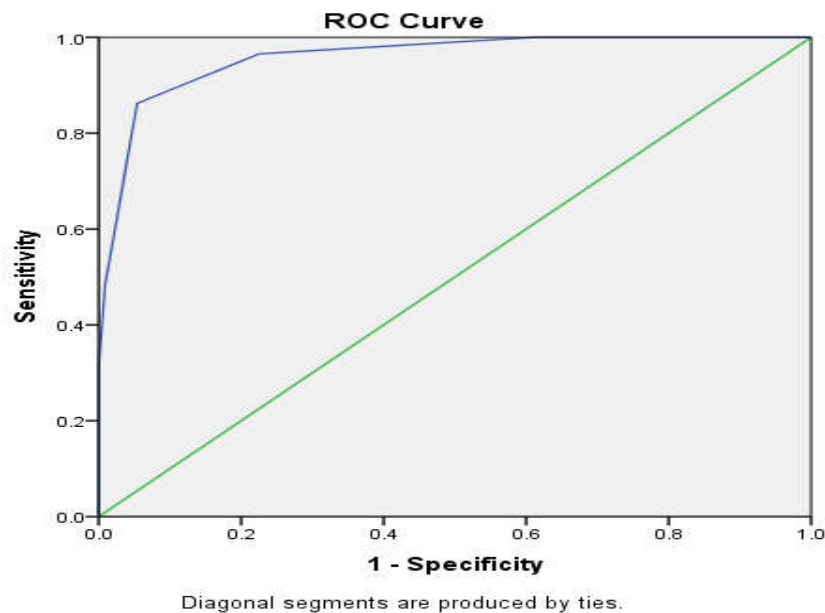


Figure 2. ROC curve for determination of cut off value of contrast volume causing CIN

Mean age of the patients was 53.32 ± 11.97 years. Figure 1 shows distribution among different age groups. Smoking (45.71%), hypertension (36.42%), diabetes mellitus (28.57%), and Dyslipidemia (22.85%) were the main risk factors. 35 patients (25 %) had history of consumption of alcohol. Majority of patients had presented between 3 to 6 hours of index event (44.28%). Fifty percent patients had AWMI, 44.28% had IWMI and 5.72% had combined IWMI and RVMI. Most of patients were in killip class I when presented (87.8%). Most of patients had ejection fraction more than forty percent (57.14%) 74 patients (52.85%) had single vessel disease followed by double vessel disease (27.85%) and triple vessel disease (19.28%) on angiography. The contrast volume

used during angioplasty procedure ranged from 100 ml to 170 ml with mean volume 135.75 ± 15.67 ml. Most of the patients were treated with drug eluting stents (52.85 %) followed by bare metal stents (13.37%). POBA was done in 3 patients. In this study out of 140 patients twenty nine patients developed CIN. In the CIN group 21 were males and 8 were females. In the non CIN group 83 were males and 28 were females. Fisher's exact test reveals Diabetes mellitus is a risk factor for contrast induced nephropathy. Subjects with DM have 1.2 times more risk of having CIN. (RR=1.24; CI=0.98-1.5) (P-value =0.038*). Other associated risk factors like hypertension, dyslipidemia, smoking, alcoholism and previous history of MI did not found to be associated with increased risk

of CIN. However logistic regression analysis shows DM is not an independent risk factor after adjusting for other risk factors. The contrast used was non ionic. In the non CIN group the volume used ranged from 100 to 160 ml. Mean value was 127.93 ml. In the CIN group the volume used ranged from 130 to 170 ml. Mean value was 156.03 ml. Figure 2 shows ROC for determination of contrast volume cut off responsible for CIN.

ROC curve analysis suggests that contrast volume of 135 ml is a critical volume. It can predict the CIN with 96% sensitivity and 78% of specificity. AUC is 95.8% which suggests this cutoff value of contrast volume to be an excellent CIN predictor. ($p < 0.001$)

DISCUSSION

In this study, 140 patients with acute myocardial infarction were enrolled who underwent primary percutaneous coronary intervention (PPCI). Baseline serum creatinine and maximum increase in serum creatinine within 72 hours were the main variables. These variables were evaluated for duration of symptoms and contrast volume used during the procedure of primary angioplasty. In our study twenty nine patients (20.71%) developed contrast induced nephropathy after primary angioplasty. The mean age of patients with CIN was 56.8 ± 13.1 years. Out of 29 patients twenty one (72.41%) patients were males and eight (27.59%) were females. The reported incidence of contrast-induced CIN varies widely across the literature, depending on the patient population and the baseline risk factors. Moreover, as with any clinical event, the incidence also varies depending on the criteria by which it is defined. The incidence of CIN in our study correlates well with Giancarlo Marenzi *et al.* (2004) study where CIN occurred in 19 % patients undergoing primary angioplasty. They had defined CIN as rise in creatinine by > 0.5 mg/dl. The incidence of CIN would have been more, if they had included a rise of serum creatinine by more than 25% from the baseline in the inclusion criteria. The mean age of CIN patients in their study was 67 ± 12 years. Ninety percent of CIN patients were males. In a study by Akihito Tanaka *et al.* (2011) the incidence of CIN in patients undergoing primary angioplasty was 9.2%. Patients were randomly assigned to two groups (NAC group, placebo group). CIN was defined as an increase in the serum creatinine concentration of 25 percent or more from baseline value within the 72-hour period after primary angioplasty. The incidence of CIN in the NAC group tended to be lower than in the placebo group (NAC; 2/38: 5.3% vs. placebo; 5/38: 13.2%, $p = 0.21$). In a study by Giancarlo Marenzi *et al.* (2010) studied 780 patients undergoing primary angioplasty. 113 patients (14.5 %) patients developed CIN in their study. Contrast-induced nephropathy was defined as an increase in serum creatinine $\geq 25\%$ from baseline in the first 72 hours. After contrast exposure, isotonic (0.9%) saline was given intravenously at a rate of 1 mL / (kg per hour) (0.5 mL/[kg per hour] in case of left ventricular ejection fraction [LVEF] $< 40\%$ or heart failure) for 12 hours. This might be the explanation for lesser incidence of CIN their study compared our study.

Conclusion

Contrast induced nephropathy occurs frequently in patients undergoing primary percutaneous intervention for acute STEMI. Its incidence is more compared to patients undergoing

elective percutaneous intervention. There is no correlation between duration of symptoms at presentation and CIN. The amount of contrast used during procedure is a good predictor of CIN. Patients with diabetes mellitus are at higher risk of developing CIN. However it is not an independent risk factor for developing CIN in our study.

Limitations

- Our study included small population, admitted to a single centre. Our findings should be confirmed in a large multicentre trial.
- We had excluded the patients with cardiogenic shock.
- Long term follow up assessment of MACE is advisable

Abbreviations

ACS	Acute coronary syndrome
AMI	Acute myocardial infarction
BMS	Bare metal stent
CIN	Contrast induced nephropathy
CKD	Chronic kidney disease
DES	Drug eluting stents
HB	Hemoglobin
IWMI	Inferior wall myocardial infarction
LAD	Left anterior descending artery
LCX	Left circumflex artery
NAC	N Acetyl cysteine
PCI	Percutaneous coronary intervention
POBA	Plain old balloon angioplasty
RCA	Right coronary artery
RVMI	Right ventricular myocardial infarction
STEMI	ST elevation myocardial infarction
Scr	Serum creatinine

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