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Research Article

INCIDENCE OF CONTRAST INDUCED NEPHROPATHY IN PATIENTS UNDERGOING CORONARY ANGIOGRAPHY IN A DEFENCE SERVICE HOSPITAL

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A B S T R A C T

Background: Coronary angiography and percutaneous intervention (PCI) is an indispensable diagnostic and therapeutic procedure in cases of acute myocardial infarction (Acute MI). However it possesses a potential complication of renal failure due to contrast induced nephropathy (CIN). Occurrence of CIN prolongs the hospital stay and may even lead to death. A prospective study was conducted in a defence service hospital to assess the incidence of CIN in patients undergoing coronary angioplasty. **Methods:** Consecutive 407 patients who had undergone elective coronary angiography and percutaneous coronary intervention between 01 Dec 2011 to 31 Jan 2013 at tertiary level defence service hospital in Mumbai, India were included in the study. Written informed consent was taken from all the included patients. Patients less than 18 years of age were not included in the study. Pregnant and patients with preexisting renal disease were also excluded. Baseline renal function tests were conducted, followed by repetition of tests at 24 hours and 72 hours. **Results:** Contrast induced nephropathy was detected in 4.18 % of the patients. Patients with preexisting co morbidities specially diabetes, hypertension and old age showed higher risk of contrast induced nephropathy. **Conclusion:** The preexisting diseases predispose the patient to higher risk of contrast induced nephropathy. Modifiable risk factors should be addressed adequately to reduce incidence of renal impairment due to interventional procedures.

INTRODUCTION

Contrast induced Nephropathy (CIN) is an important complication due to exposure of the patient to iodinated contrast media used in diagnostic and interventional procedures such as coronary angiography. The incidence ranges from 5-50% in such patients.(1). CIN is associated with a longer hospital stay, complicated clinical course and increased risk of death (2). The most commonly used definition of contrast induced nephropathy is a rise in serum creatinine of 0.5 mg/dl or 25% increase from base line, assessed at 72 hours the procedure (3-6). CIN generally begins as sudden decline in renal function occurring after exposure to intravenous radiographic agents that is not within 12-24 hours after contrast medium injection and is commonly mild and transient returns to base line in 3-5 days (7-9).

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Dialysis is required in about 9% of population who developed contrast induced acute kidney injury (13), and in these cases higher mortality has been reported (2). Although the risk of acute kidney injury associated with radiological procedures is low in the general population (2%) (14), it may be very high in selected subsets (10,11), especially after cardiac procedures (1,16). It can be as high as 50%for patients with multiple risk factors (12).

Amongst other co morbidities, preexisting chronic kidney disease represents the most important risk factors for CIN (16), especially when associated with diabetes mellitus, older age, female, anemia, heart failure and peripheral vascular disease are also reported as risk factors that increase likelihood of contrast induced nephropathy (11, 16-18). It is known that factors related to procedures can play role in the incidence of contrast induced nephropathy (19-22). Prevention and early detection of CIN are of utmost clinical relevance. In view of above the study done to access prevalence of contrast induced nephropathy was done in patients who undergone coronary

angiography at our tertiary care hospital. In addition, knowledge of pathogenesis and the relevant risk factors of CIN is also expanding, and this progress contributes significantly to our planning of strategies to prevent this. Through understanding of the epidemiology, pathophysiology, clinical manifestations, diagnosis, prevention strategy and management of CIN is of critical importance for both primary care physicians and interventional cardiologists. Contrast induced nephropathy is the most commonly defined as acute renal failure cccurring within 48 hr of exposure to intravascular radiographic contrast material which is not attributable to other causes (23).

Ideally, the impairment of renal function should be measured by serial creatinine clearance, but this step is neither practical nor cost effective. Most of the literatures describes the use of isolated measurements of serum creatinine levels, even though this parameter may be less sensitive at reflecting early changes in renal function and may be slower to reach maximal sensitivity than creatinine clearance. Serum creatinine levels may prove to be more sensitive, however in cases of preexisting renal impairment, in which tubular secretion of creatinine can lead to overestimation of glomerular filtration rate (GFR). A range of values between 25% and 50% (an increase in absolute values of 0.5-1.0 mg/dl) increase in serum creatinine levels from base line has been suggested to define contrast induced nephropathy (24). Hence contrast induced nephropathy is most commonly defined as "A 25% increase in serum creatinine concentration from the base line value, or an absolute increase in serum creatinine concentration from base line value, or an absolute increase of at least 0.5 mg/dl, which appears within 48-72 hours after the administration of radiographic contrast media, and is maintained for 2-5 days."

Table 1 The currently available definition of contrast-induced nephropathy

Serum markers	Time frame	
	Within 24 hours after procedure	Within 48-72 hours after procedure
Serum creatinine	Increase of 0.5 mg/dL	Increase of 0.5 mg/dL
Serum creatinine	Increase of 25% from baseline	Increase of 25% from baseline

There are many risk factors which has been associated with increased risk of CIN in patients. These risk factors are predominantly divided into modifiable and non modifiable risk factors. Table 2 shows the various risk factors associated with the development of CIN.

Table 2 Risk Factors for contrast induced nephropathy (CIN)

Non modifiable	Modifiable
Age	
Diabetes mellitus	
Preexisting renal failure	Volume depletion
Congestive heart failure	Anemia, PCI related blood loss
Hemodynamic instability	Nephrotoxic drug use
Nephrotic syndrome	Low serum albumin

Proceedure-related factors	
IABP	Volume of contrast media
Emergent/primary PCI	Multiple administration of Contrast media within 72 hours
Intra arterial CM administration	Osmolarity and iconicity and ionicity of CM

CM:contrast Media, IABP: Intra-aortic balloon pump; PCI: percutaneous coronary intervention

Type of contrast media and the total volume of contrast used has effect on CIN. Iodinated contrast media are structurally composed of carbon based skeleton and iodine atoms, which render the molecule radiopaque. Non ionic contrast media are less likely to result in CIN. Evidences have pointed out that arterial injection of contrast medium carries higher risk of CIN than intravenous use (25,26). However, no mechanism has been provided to explain this phenomenon**.**

Congestive heart failure, anterior MI, Cardiogenic shock, use of intra aortic Balloon pump have all been associated with increased risk of CIN after PCI (27).

Diabetes mellitus has been established as an independent factor for patients developing CIN. Advanced age is another risk factor that enhances the probability of CIN. Age higher than 75 can associate with 1.5-5 folds is elevated risk, while every one year increment carries a 2%increased risk (29).

Several measures have been recommended to prevent CIN. These include hydration, N-acetylcysteine (NAC), dopamine and fenoldopam, theophylline, diuretics, atrial natriuretic peptide (ANP), calcium channel blockers, endothelin antagonist, infusion of sodium bicarbonate and prophylactic hemodialysis.

Aim

To study the incidence of contrast induced nephropathy in patients undergoing Coronary angiography in a tertiary level defence service hospital

MATERIAL AND METHODS

Clearance was obtained from the hospital ethics committee. This prospective study was conducted on consecutive 407 patients who had undergone elective coronary angiography between 01 Dec 2011 to 31 Jan 2013 at tertiary level defence service hospital in Mumbai, India. A separate informed consent for the study was taken from all the included patients. All the patients less than 18 years of age were not included in the study. Pregnant and patients with preexisting renal disease were excluded. All the patients underwent clinical evaluation and laboratory investigations including baseline serum creatinine and urea levels. The patients underwent coronary angioplasty and PCI using non ionic iodinated contrast media. Serum urea and creatinine levels were investigated at 24 hrs and at 72 hrs after the procedure. Patients who were detected to have more that 0.5mg% increase or more than 50 % increase in baseline creatinine values at 72 hrs post procedure were considered to be having CIN. Statistical analysis was carried out for these patients using statistical package for social sciences (SPSS) version 10.0

RESULTS AND DISCUSSION

The total number of patients who developed CIN was 17(4.18%). The age ranged from 19 to 76 years. The mean of the study population (n=407) was 52.4 years+/- 12.1 years. 6.38 % patients were older than 70 years. 82 % were older than 45 years. 80.09 % were males and rest were females. Figure 1 shows the gender distribution of the study population. 4.42% patients had cardiac failure with left ventricular ejection fraction of less than 45% (LVEF <45%). Diabetes mellitus was present in 47.68% of the patients. 53.59 % patients had systemic hypertension Table 3 shows presence of various co morbidities in the study population.

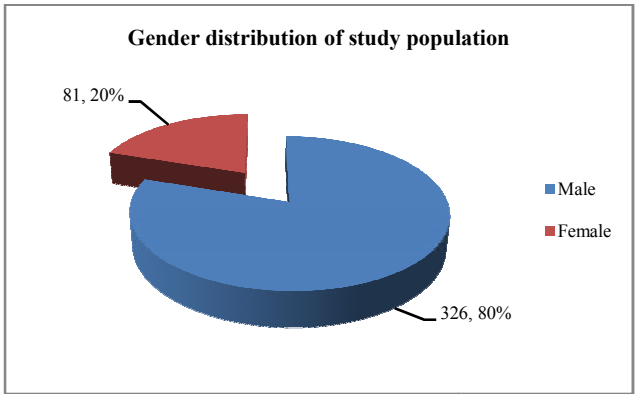

Figure 1 showing the gender distribution of the study population

Table 3 summarizes the results as correlated with various co morbidities.

Factors	Total numbers	Percentage	CIN detected	CIN not detected
Age > 70 years	26	6.38%	14 (53.84%)	12 (46.16%)
Hypertension	127	53.59%	10 (7.87%)	117 (92.13%)
Diabetes	113	47.68%	17 (15.04%)	96 (84.96%)
LVEF< 45%	18	4.42%	11 (6.11%)	7 (93.89%)
Presence of myocardical infarction	41	10.07%	5 (12.19%)	36 (87.81%)
Contrast volume > 200mL	20	4.91%	2 (10%)	18 (90%)

The patients with preexisting comorbities like old age, hypertension and diabetes had higher incidence of CIN as compared to other subgroups. Patients with age more than 70 years had 53.84% incidence of nephropathy and it was the most significant single factor which can be implicated. 17 of the 113 patients with diabetes developed CIN (15.04%) which was another significant co morbidity in the study population. Percentage of CIN in patients with hypertension and myocardial infarction was 7.87% and 12.19% respectively. 6..11 % of the patients with cardiac failure developed CIN. High volumes of contrast (more than 200mL) lead to CIN in 10 % of the patients.

DISCUSSION

CIN is an unwanted and potentially lethal complication of angiography and PCI in patients with MI. Also it is quite common event that requires prompt diagnosis and follow up of CIN patients. Prevention can be aimed at modifiable risk factors and usage of non ionic contrast media. The rates of CIN in patients of PCI have been reported in the range of 10-50 % with increased risk to certain subset of patients. Prevention and early detection of CIN are of utmost clinical significance. Several authors have published in depth review articles: most notably Katzberg RW (23), who performed a thorough review of contrast agents and their potential effects, and Tublin *et al*(24). Who published a review in 1998 of current concepts relating to contrast nephropathy. In our study the incidence of CIN associated with coronary angiography and PCI was 4.18 % which is much lower as compared to studies conducted by Hossein *et al* (30) and Nash *et al* (1). This is likely effect of low sample size.

Whereas the incidence of CIN after angiography generally is transient, persistent renal impairment requiring long term dialysis or chronic renal failure is less (31) Predisposing risk factors play a significant role in incidence of CIN. These factors medullary renal functions and hence lead to renal impairment. Pre existing risk factors like diabetes mellitus, hypertension, old age, hypotension, cardiac failure and usage of nephrotoxic drugs play an important role in development of CIN. The dosage, osmolarity and route of administration of contrast media has also shown to be a key factor in development of CIN, however our study didn't focus on the type of contrast media as non ionic isoosmalar contrast media was used for all the patients, which has shown to have low incidence of CIN (32,33). The risk factors for CIN are largely classified into modifiable (dehydration, anemia, type of contrast media, hypovolemia, hypoalbuminemia, and intake of renotoxic medication) and non modifiable (age, gender, predisposing illnesses, medical history, hypersentivity to contrast, preexisting renal impairment. In a study by Roghi *et al*. (34) CIN has increased association with low LVEF, hypertension and diabetes similar to results observed in the present study.

The volume of contrast media more than hundred milliliter had less incidence of CIN. These results were comparable to the study by McCullough *et al* (35). Kane *et al*. (36) demonstrated increased incidence of CIN with increased volume of contrast media.

A limitation of the study was predominant male population as the service hospitals are primarily visited by serving personnel and less commonly by dependant family members. The results may turn out to be different in studies with larger sample sizes. It is recommended to conduct studies with larger sample size.

CONCLUSION

CIN is a relatively common and potentially morbid complication of coronary angiography and PCI. Prevention can aimed at culminating modifiable risk factors. Prior hydration and introduction of nephroprotective drugs can reduce incidence of CIN. Prompt detection and adequate management can help in reducing long term morbidity. The benefits of coronary angiography and PCI for high risk patients should be weighed against the potential benefit for such patients.

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Conflicts of Interest

The authors have none to declare

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