Contrast Induced Nephropathy
A study of 850 patients undergoing cardiac catheterization laboratory procedures

Priya SV*, K P Jayakumar **, V L Jayaprakash ***, Raju George****

Summary

Background: Contrast-induced nephropathy (CIN) represents an increasing healthcare burden and challenge especially in the scenario of increasing frequency of diagnostic imaging and interventional procedures. Frequency of CIN varies widely depending on the population. There is paucity of data regarding CIN in our population. The risk of CIN is elevated and is of clinical importance in patients with estimated glomerular filtration rate (GFR) <60 mL/mt.

Methods: Patients admitted to the Department of Cardiology, Medical College, Kottayam from March 2009 to Feb 2010 for undergoing angiographic studies or percutaneous interventions were taken up for the study. After detailed clinical evaluation, GFR was estimated by MDRD equation. Serum creatinine level was estimated on admission and 72hrs after the procedure. They were prospectively followed up for occurrence of CIN as per the standard definition. Patients were randomized into 2 groups – GFR > 60 ml/mt and GFR 30 – 60 ml/mt. Patients who developed CIN were followed up with serum creatinine measurement on the 5th day post procedure.

Results: Among 850 patients enrolled for the study, 15 patients were lost for follow-up. Of the rest 835 patients, 535(64%) were having GFR > 60 ml/mt and 300 (36%) having GFR of 30-60 ml/mt. The procedure was coronary angiography in 795(95%) patients and percutaneous coronary intervention (PCI) in 40 (5%) patients. CIN occurred in 5 patients (0.59 %). 3 of 300 patients in the group with GFR 30 – 60 ml/mt and 2 of 535 patients in the group with GFR > 60ml/mt had CIN (1% vs 0.4%) (p value 0.260 NS). Among the 500 hypertensives in the study population, 3 (0.6%) developed CIN. CIN was seen in 4 out of 635 diabetics (0.6%), where as it occurred in 1 out of 200 non diabetics (0.5%) (p value 0.589 NS). 4 among 100 patients with LV dysfunction and 1 out of 735 patients with normal LV function developed CIN (4% vs 0.13%) (p value 0.001).

Conclusions: Overall incidence of CIN is low in the study population. Even in the group with low GFR, incidence of CIN is low. Left ventricular dysfunction is the only risk factor predicting development of CIN.

Funding: Nil

Introduction

CIN defined as Increase in serum creatinine > 25% or > 0.5gm/dl above the baseline value after systemic administration of iodinated contrast. Serum creatinine rises after 48hours, peaks in 3-5 days and returns to normal in 21 days, in the absence of other causes of renal failure.

CIN develops in 1-3% with normal renal function, 4-11% with mild to moderate renal dysfunction and in 9-38% if mild to moderate renal dysfunction co-exists with Diabetes Mellitus, heart failure, volume depletion or...
recent contrast exposure. It rises to 50%, if Serum Creatinine is > 4 mg/dl especially in a diabetic. Need for dialysis has been reported in 0.5 - 2% of patients, with a 36% in-hospital mortality and 19% two year survival.

Pathogenesis is multifactorial. Contrast agents are small molecules with low protein binding and lipid solubility. Their renal tubular absorption is negligible and as a result they are concentrated 100 times in the kidney. Contrast agents cause increased sodium and water excretion, causing a decrease in GFR. This causes renal vasoconstriction, decreased tissue oxygenation, and production of oxygen free radicals. Cortical vasoconstriction due to endothelin & vasopressin release PGI-2 inhibition, and decreased nitric oxide production. Enhanced osmolar load to distal nephron leads to enhanced oxygen consumption, regional medullary hypoxia and constriction of medullary capillaries.

Contrast-induced nephropathy (CIN) poses an increasing healthcare burden in the scenario of increasing frequency of diagnostic imaging and interventional procedures. Frequency of CIN varies widely depending on the population. There is paucity of data regarding CIN in our population. The risk of CIN is elevated and is of clinical importance in patients with estimated glomerular filtration rate <60 mL/mt. Presence of multiple risk factors like diabetes mellitus, volume depletion, advanced age, preprocedural hemodynamic instability, use of nephrotoxic drugs, congestive heart failure and anemia can increase the incidence of CIN.

Aim

To study incidence of CIN in patients undergoing cardiac catheterization laboratory procedures and to assess the influence of risk factors, prophylactic treatment protocols, and type of dye on development of CIN.

Methods

Patients admitted to the Department of Cardiology, Medical College, Kottayam from March 2009 to Feb 2010 for undergoing angiographic studies or percutaneous interventions were taken up for the study. After detailed clinical evaluation, Glomerular Filtration Rate (GFR) was estimated by MDRD equation. Serum creatinine level was estimated 24 hours before and 72hrs after the procedure. Patients were prospectively followed up for occurrence of CIN as per the standard definition. Patients with GFR < 30 ml/hr were

Results - GFR groups

<table>
<thead>
<tr>
<th>GFR 30-60ml/mt</th>
<th>GFR &gt;60 ml/mt</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/535</td>
<td>3/300</td>
</tr>
<tr>
<td>(0.4%)</td>
<td>(1%)</td>
</tr>
</tbody>
</table>

P 0.26 NS
Patients who developed CIN were followed up with serum creatinine measurement on 5th day post procedure.

**Statistical analysis**

Variables were analysed by chi-square analysis and Student t test.

**Results**

Among 850 patients enrolled for the study, 15 patients were lost for follow-up. Among the remaining 835 patients, 535 (64%) were having GFR > 60 ml/mt and 300 (36%), GFR of 30-60 ml/mt (Fig.1).

The procedure was coronary angiography in 795 (95%) and percutaneous coronary intervention (PCI) in 40 (5%) patients. CIN occurred in 5 patients (0.59%).

3 of 300 patients in the group with GFR 30 – 60 ml/mt and 2 of 535 patients in the group with GFR>60ml/mt developed CIN. (1% vs 0.4%) (p value 0.26 NS) (Fig.2).

1 out of 250 patients in the age group < 40 years (0.4%), 3 out of 400 patients in the age group 40 – 50 years (0.75%) and 1 out of 185 patients in the age group > 50 years (0.54%) developed CIN. (p value 0.096NS) (Fig.3).

Among the 500 hypertensives in the study population, 3 (0.6%) developed CIN. This was statistically not significant.(p 0.165 NS). CIN was seen in 4 out of 635 diabetics (0.6%), and it occurred in 1 out of 200 non diabetics (0.5%) (Fig.4).

Among those randomized to NAC, 1.1% developed CIN compared to 0.8% randomized to placebo (p value 0.769 NS). The dye used was low osmolar in all patients except in 10 patients in whom non osmolar dye was used. Low osmolar dye did not as such increase the incidence of CIN in the study population.

4 of the 100 patients with LV dysfunction and 1 out of 735 patients with normal LV function developed CIN. (4% vs 0.13%). This was found to be statistically significant (p value 0.001) (Fig.5).

4 out of 795 patients undergoing CAG and 1 out of 40 patients

**Discussion**

Previous studies have shown that incidence of CIN ranged from 3% - 18%, and 0.3% - 7% of these patients needed dialysis. This is in contrast to our study, where the incidence is only 0.59% and none
of the patients needed dialysis. In previous studies Diabetes mellitus, Age, Hypertension and LV dysfunction were predictors of CIN, whereas in our study only risk factor predicting development of CIN was LV dysfunction. This is probably related to use of diuretics and inadequate hydration.

Conclusions

Overall incidence of CIN is low in the study population. Even in the group with low GFR (30 – 60 ml/mt), incidence of CIN is low and is not significantly different from the group with GFR >60ml/mt. Risk factors like age, hyper tension, and diabetes mellitus are not predictive of development of CIN. Presence of LV dysfunction is a risk factor for development of CIN. Prophylactic treatment with NAC had no influence on occurrence of CIN.

References


