

Incidence of Contrast-Induced Nephropathy in Patients Undergoing Angiography in a Tertiary Hospital: a Prospective Study

Jangbhadur Singh, Neeraj Dhar, Pritpal Singh, SK Bali*

Abstract

The current study was done to determine the incidence of CIN in patients of coronary angiography and angioplasty in Government Medical College, a tertiary care institution of Jammu province in Jammu and Kashmir State. Two hundred and fifty-four eligible patients scheduled for coronary angiography and angioplasty were enrolled from the outdoor/indoor departments of cardiology and medicine, Government Medical College, Jammu. Renal function was measured at baseline and 48 hours after the intervention, and CIN was defined by an increase in creatinine of >0.5 mg/dL or 25% of the initial value. The results were reported as percentages for the categorical variables. 95% CI were calculated, wherever required. Incidence of CIN following cardiac procedures in the study was observed in 11.02% subjects. In subjects with no risk factor ($n=130$), incidence of CIN was 2.31%, in diabetes/no renal insufficiency subjects ($n=68$), incidence was 5.88%, while it was much higher in subjects with renal insufficiency/no diabetes 31.03% and in subjects with both diabetes and renal insufficiency 44.44%. Among 43 subjects with age >70 years, 4.65% developed CIN. Mortality was recorded in 1.33% subjects without CIN and in 17.86% subjects with CIN. Although the incidence of CIN is low in general population without risk factors, it occurs frequently in patients with underlying diabetes mellitus or renal dysfunction or when both are present especially among elderly. A careful risk-benefit analysis must always be performed prior to the administration of contrast media to patient at risk of CIN.

Key Words

Nephropathy, Contrast Media, Angiography, Angioplasty

Introduction

Contrast-induced nephropathy (CIN) refers to an abrupt deterioration in renal function temporally associated with iodinated contrast media administration, with no alternative clinical explanation (1). It is generally defined as an increase in serum creatinine concentration of 0.5 mg/dL (44 mmol/L) or 25% above baseline within 48 hours after contrast administration (2). The first 24 hour post-exposure appear to be crucial in the development of CIN. The serum creatinine increase usually peaks

between days 3 and 5 of contrast media use, with levels returning to baseline within 1-3 weeks (3). Radiographic contrast media are responsible for 11% of cases of hospital-acquired renal insufficiency, the third most common cause of renal failure after impaired renal perfusion and the use of nephrotoxic medications. Among all procedures utilizing contrast media for diagnostic or therapeutic purposes, coronary angiography and percutaneous coronary interventions (PCI) are associated

From the Deptt. of Medicine and *Nephrology SSH, Govt. Medical College, Jammu.(J&K), India

Correspondence to : Dr. Jangbhadur Singh, Lecturer, Department of G Medicine, Govt. Medical College, Jammu. (J&K), India

with the highest rates of CIN (4). Risk factors synergistic in their ability to predispose to the development of CIN include advanced age, preexisting renal dysfunction, diabetes mellitus, systolic hypertension, hypotension, congestive heart failure, and use of nephrotoxic drugs. Procedure- and contrast medium-related risk factors include high total doses of contrast media and their high osmolality, high ionic content, and high viscosity as well as intra-arterial administration of contrast media and <2 days between the use of contrast media and the accomplishment of emergency procedures (5,6). In patients without risk factors, the incidence may be as low as 2%. With risk factor like diabetes the number rises to 9%, with incidences being as high as 90% in diabetics with chronic kidney disease (CKD). Therefore, the number and the type of preexisting risk factors directly influence the incidence of renal insufficiency. It is also procedure dependant, with 14.5% overall in patients undergoing coronary interventions compared to 1.6-2.3% for diagnostic intervention, as reported in literature (7).

The underlying mechanism of nephrotoxicity is likely to involve the following pathogenic factors: increased vasoconstrictive forces, decreased local prostaglandin and nitric oxide mediated vasodilation, direct toxic effect on renal tubular cells with damage caused by oxygen free radicals, increase oxygen consumption and increased intra-tubular pressure secondary to contrast culminating in renal medulla ischemia. These intrinsic causes act in concert with harmful extrinsic pre-renal causes such as dehydration and decreased effective intravascular volume to increase the risk of nephrotoxicity (1).

Although the treatment of established CIN is limited to supportive care and dialysis, the renal injury resulting from iodinated contrast exposure is potentially preventable (8). Multiple interventions have been investigated for their capacity to prevent CIN. The initial steps in reducing the risk of kidney injury are looking for risk factors and reviewing the indications for the administration of contrast medium. Most risk factors can be detected by history taking and physical examination. Factors such as dehydration can be at least partially corrected before

exposure to the contrast medium (9). The present one-year prospective, observational study was undertaken to determine the incidence of CIN in patients of coronary angiography and angioplasty in Government Medical College, a tertiary care institution of Jammu province in Jammu and Kashmir State.

Materials and Methods

Two hundred and fifty-four eligible patients scheduled for coronary angiography and angioplasty were enrolled from the outdoor/indoor departments of cardiology and medicine, Government Medical College, Jammu during this prospective, observational one-year study. Patients included in this study were more than 19 years of age, of either gender. Patients having diabetes mellitus type-1 or type-2 on insulin or OHD, patients with renal insufficiency i.e. serum creatinine concentration >1.5 mg/dL, patients of acute coronary syndrome and patients having multivessel disease were also included in the study. All the patients enrolled received 50-60 ml of iohexol non-ionic radiopaque contrast media. Renal function was measured at baseline and 48 hours after the intervention, and CIN was defined by an increase in creatinine of >0.5 mg/dl or 25% of the initial value. The study protocol was approved by the institutional ethical committee and written informed consent was obtained from all the patients.

All the patients were subjected to a detailed history and clinical examination. Laboratory investigations included CBC, serum creatinine before and 48 hours after radiocontrast administration, lipid profile, X-ray chest, ECG, USG abdomen for kidney, blood sugar fasting and postprandial, and urine routine. The results were reported as percentages for the categorical variables. 95% CI were calculated, wherever required.

Results

Out of 254 patients enrolled, 152 (59.84%) were male and 102 (40.16%) were female subjects with male to female ratio of 1.49:1. Age and genderwise distribution of patients is given in *Table 1*.

Baseline serum creatinine was less than 1.2 mg/dL in 201 (79.13%) subjects, between 1.2 and 2 mg/dL in 38

Table 1. Age and Genderwise Distribution of Patients

Age group (in years)	Male		Female	
	Number	Percentage	Number	Percentage
19-29	6	3.95	3	2.94
30-39	7	4.61	4	3.92
40-49	17	11.18	14	13.73
50-59	51	33.55	33	32.35
60-69	49	32.24	27	26.47
≥70	22	14.47	21	20.59
Total	152	100.00	102	100.00

Table 2. Incidence of CIN in the Study

Description of Patients	Number	Percentage	95% CI
No CIN	226	88.98	-
CIN	28	11.02	7.18 to 14.86

Table 3. Incidence of CIN with Respect to Risk Factors in the Study

Description of Patients	Number	Percentage	95% CI
Normal (no risk factor) (n=130)	3	2.31	-0.27 to 4.87
Diabetes/No renal insufficiency (n=68)	4	5.88	0.26 to 11.34
Renal insufficiency/No diabetes (n=29)	9	31.03	14.17 to 47.83
Renal insufficiency/Diabetes (n=27)	12	44.44	25.67 to 63.13

(14.97%) subjects and more than 2 mg/dL in 15 (5.90%) subjects. A total of 130 (49.02%) subjects were observed to be free of any risk factors which may predispose them to the development of CIN, 68 (26.47%) subjects had diabetes but no renal insufficiency, 29 (12.75%) subjects had renal insufficiency but no diabetes and 27 (11.76%) subjects had both diabetes and renal insufficiency.

Diagnostic coronary angiography was observed in 178 (70.08%) subjects, while percutaneous coronary intervention (PCI) was reported in 76 (29.92%) subjects.

Incidence of CIN found in this study is given in Table 2. In the present study, out of 43 subjects with age >70 years, 2 developed CIN with an incidence of 4.65%. Out of 226 subjects who did not had CIN, 3 (1.33%) died, while among 28 subjects with CIN, 5 (17.86%) died, during the course of the study.

Discussion

CIN is significant but underestimated cause of iatrogenic acute renal failure. Incidence rate may vary from 0 to 90% depending on the presence of risk factors, most notably chronic renal insufficiency, diabetes mellitus, age >70 years and high contrast volume administered

(1). In the present study, the incidence of CIN related to angiography or angioplasty was observed to be 11.02%. Among subjects with no risk factor, incidence of CIN was 2.31%, while in subjects with diabetes and no renal insufficiency it was 5.88%. The incidence of CIN in renal insufficiency with no diabetes group was 31.03% and in subjects with both diabetes and renal insufficiency present it was 44.44%.

Parfrey reported that the overall incidence of CIN after cardiac procedures in the general population lies between 1 and 6% (10). Nough et al. observed 12.8% incidence of CIN after angiography or angioplasty in their study which is similar to the present study (11). Mehran and Nikolsky opined that incidence rate of CIN might rise up to 20% or more in selected patient subsets, especially in patients with underlying cardiovascular disease (1).

Nikolsky *et al.* studied the incidence of CIN in 1,575 diabetic patients who underwent PCI and found CIN in 15% of patients without CKD versus 27% of those with CKD (12). Wang et al. studied 114 diabetic patients who had undergone elective PCI and reported the incidence

of CIN to be 18.4% (13). Zhao *et al.* found patients with diabetics and renal insufficiency had higher incidence of CIN at 15.5% and 22.5% respectively (14).

In the present study, mortality rate for patients developing CIN was 16.7% and for those without CIN was 1.2%. Rihal *et al.* observed that of the 7586 patients undergoing PCI, 254 patients (3.3%) experience CIN and the in-hospital mortality rate for these patients was 22% compared with a rate of 1.4% for the patients who did not develop CIN (15). Nikolsky *et al.* carried a study on 1826 consecutive patients undergoing coronary intervention. The in-hospital mortality rate for the patients who developed CIN but who did not require dialysis was significantly greater than the patients who did not develop CIN (7.1 vs 1.1%). For patients requiring dialysis the in-hospital mortality rate was 35.7% (3).

Conclusion

Among all procedures utilizing contrast media (CM) for diagnostic or therapeutic purposes, coronary angiography and percutaneous coronary intervention (PCI) are associated with the highest rates of CIN. Although the incidence of CIN is low in general population without risk factors, it occurs frequently in patients with underlying diabetes mellitus or renal dysfunction or when both are present especially among elderly. A careful risk-benefit analysis must always be performed prior to the administration of CM to patient at risk of CIN.

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