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Original Article

Incidence and Risk Factors of Contrast Induced Nephropathy in Patients Following Coronary Angiography

Mohammed Rashed Anwar[1], Abu Noim Md. Abdul Hai[2], Dilip Kumar Debnath[3], Md. Anwarul Hoque Faraji[4], KAM Mahbub Hasan[5]

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Abstract

Background: Contrast induced nephropathy (CIN) is a common complication after administration of contrast medium. As the third leading cause of hospital acquired acute kidney injury, CIN occurs in half of the patients undergoing coronary angiography (CAG). **Objective:** The purpose of the present study was to see the frequency of contrast induced nephropathy in patients after coronary angiography and its risk factors. **Methodology:** This comparative cross sectional study was performed at National Institute of Kidney Diseases and Urology, Dhaka and Department of Cardiology, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh from July, 2016 to December 2016 for a period of six (06) months. All patients 18 years and above who underwent coronary angiography with or without percutaneuous Transluminal coronary angioplasty with normal or impaired renal function, with or without Diabetes Mellitus or hypertension were included in the study. The patients were divided into two groups named as group A who did not develop CIN and group B developed CIN. Pre- and Post procedure serum creatinine was estimated at 48 hours after coronary angiogram. Independent characteristics associated with CIN were identified. **Results:** A total number of 250 patients were recruited for this study. Older age ≥70 years, diabetes mellitus were significant risk factor for CIN whereas hypertension was not statistically significant. Logistic regression analysis of risk factors were identified 05 (five) risk factors in this study which were baseline estimated GFR <60mi/min/1.73m^2 BSA, diabetes mellitus, contrast volume >100ml, PTCA and LVEF < 40%). Effect of drugs used in the development of CIN by logistic regression analysis. None of the drugs showed significant relationship on development of CIN. **Conclusion:** Older age, baseline estimated GFR <60mi/min/1.73m^2 BSA, diabetes mellitus, contrast volume >100ml, PTCA and LVEF < 40%) were significant risk factor to developed CIN. [*Journal of Science Foundation 2017;15(1):20-25*]

Keywords: Incidence; risk factors; contrast induced nephropathy; coronary angiography

Introduction

Contrast induced nephropathy (CIN) is a common complication after administration of contrast medium. As the third leading cause of hospital acquired acute kidney injury, CIN occurs in half of the patients undergoing coronary angiography (CAG) (Fan et al., 2016). Contrast induced nephropathy is a common

[1]Assistant Professor, Department of Nephrology, National Institute of Kidney Diseases & Urology, Dhaka, Bangladesh
[2]Registrar, Department of Nephrology, National Institute of Kidney Diseases & Urology, Dhaka, Bangladesh
[3]Assistant Professor, Department of Nephrology, National Institute of Kidney Diseases & Urology, Dhaka, Bangladesh
[4]Assistant Professor, Department of Nephrology, National Institute of Kidney Diseases & Urology, Dhaka, Bangladesh
[5]Medical Officer, Department of Cardiology, National Institute of Cardiovascular Diseases, Dhaka, Bangladesh

Correspondence: Dr. Mohammed Rashed Anwar, Assistant Professor, Department of Nephrology, National Institute of Kidney Diseases & Urology, Dhaka, Bangladesh; Email: rashedanwar.68@gmail.com; Cell no.: +8801711368756

form of acquired acute renal failure after coronary angiography and percutaneous coronary intervention (PCI) and this is associated with prolonged hospital stay and worse outcome (Ullah et al., 2016).

Contrast induced nephropathy (CIN) is a form of acute renal failure after coronary angiography and percutaneous coronary intervention (PCI) and leads to longer hospital stay and worse outcomes (Park et al., 2010). CIN is characterized by the onset of acute renal failure within 24 to 72 hours after iodinated contrast medium administration and is usually self limiting but some patients may need dialysis (Wood 2012). CIN is one of the most common factor responsible for hospital-acquired Acute Kidney Injury (AKI) and is responsible for more occurence of myocardial infarction, coronory interventions (Lindsay et al., 2003; McCullough 2008) and more in hospital complications like bleeding, blood transfusions, vasculcomplications, higher mortality and morbidity (Barrett 1994). It also leads to more cost and more use of resources (Subramanian et al., 2007). Multiple risk factors are involved in causing CIN. These are high blood pressure, diabetes, deranged renal functions, left ventricular failure, peripheral arterial disease, use of IABP, high contrast volume > 250 ml and emergency procedure (Mehran et al., 2004). This study is important as it will provide local data of CIN and will aware our interventionist to look for risk factors before procedure to avoid its occurrence and take prophylactic measures. The purpose of the present study was to see the frequency of contrast induced nephropathy in patients after coronary angiography and its risk factors.

Methodology

This comparative cross sectional was carried out at National Institute of Kidney Diseases and Urology, Sher-e-Bangla Nagar, Dhaka and Department of Cardiology, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh. All patients 18 years and above who underwent coronary angiography with or without percutaneuous Transluminal coronary Angioplasty with normal or impaired renal function, with or without Diabetes Mellitus or hypertension were included in the study. Age below 18 years, patients with preexisting end stage renal disease requiring dialysis, history of contrast allergy, patients who developed shock after the procedure, patients underwent other contrast exposure within one week from the index procedure were excluded in this study. Demographic profile, clinical examination and relevant investigation reports and procedural factors of all patients were recorded in pre-designed data collection sheet. The anti-ischaemic, anti-hypertensive, lipid lowering, platelet inhibitors, and oral hypoglycemic agents except metformin if taking were continued. Low osmolar, non ionic radiocontrast agent iopamidol (Lopamir 370) were used for all patients. Base line serum creatinine was estimated before procedure. Post procedure serum creatinine was estimated at 48 hours after coronary angiogram. For estimation of serum creatinine 2 samples of venous blood (one pre-procedure, 1 post-procedure) of 3 cc each were collected and were sent immediately to laboratory. Sample analyzed by automated clinical chemistry analyzer (ABX Pentra 400 of HORIBA ABX, France). Estimated GFR (eGFR) was calculated from MDRD formula both pre and 48 hour post procedure. Study population was divided into two groups named as group A in which patients with diabetes mellitus and/or impaired renal function (estimated GFR<60ml/min/1.73m^2, MDRD prediction equation) and group B in which patients with absence of diabetes mellitus (estimated GFR ≥60ml/min/1.73m^2). Contrast induced nephropathy (CIN) was defined as increase in serum creatinine of ≥25% from baseline value and/ or an absolute increase of ≥0.5 mg/dl in serum creatinine from baseline. Incidence of CIN in these groups was compared. The relationship between the incidence of CIN with renal impairment, diabetes mellitus, contrast volume, hypertension, dyslipidemia left ventricular ejection fraction <40% were analyzed. Statistical analysis was conducted using SPSS 23.0 for windows software. Categorical data were expressed as frequency and percentages. Parametric data were expressed in mean±SD. Parametric data were evaluated by independent sample "t" test; categorical data were evaluated by Chi-square test as needed. Multivariable logistic regression was applied including all the potential confounding variables. Levels of significance for all analytical tests were set at 0.05 and p value <0.05 is considered significant.

Results

A total number of 250 patients were recruited for this study. The mean (±SD) age of patients who developed CIN was significantly higher (P<0.05) compared to patients who did not develop CIN (58.17±9.20 and 52.32±10.88 years). Sex distribution did not show significant variation between patients who did not develop CIN and who developed CIN, respectively 184 (81.1%) and 22 (95.7%) males; and 43 (18.9%) and 1 (4.3%) females).

Table 1: Comparison of patients who did or did not develop CIN

Parameters	Didn't Develop CIN (n=227)	Developed CIN (n=23)	P value
Age (years)	52.32±10.88	58.17±9.20	0.013*
Sex			0.080^{ns}
Male	184 (81.1)	22 (95.7)	
Female	43 (18.9)	1 (4.3)	
Baseline serum Creatinine concentration (µmol/L)	92.32±16.94	134.73±29.01	0.0001***
Total volume of Contrast media (ml)	64.53±26.03	114.13±38.34	0.0001***
Diabetes mellitus			0.0001***
Present	70 (30.8)	16 (69.6)	
Absent	157 (69.2)	7 (30.4)	
PTCA procedure			0.0001***
Yes	17 (7.5)	9 (39.1)	
No	210 (92.5)	14 (60.9)	
ACEI/ARB used			0.073^{ns}
Yes	94 (41.4)	14 (60.9)	
No	133 (58.6)	9 (39.1)	
HMG-CoA reductase used			0.066^{ns}
Yes	75 (33.0)	12 (52.2)	
No	152 (67.0)	11 (47.8)	
Antiplatelet used			0.066^{ns}
Yes	144 (63.4)	19 (82.6)	
No	83 (36.6)	4 (17.4)	
Beta-blocker used			0.063^{ns}
Yes	66 (29.1)	11 (47.8)	
No	161 (70.9)	12 (52.2)	

Statistical analysis done by Chi-square test/Unpaired Student's `t' test; Pius-minus values are mean±SD for continuous variables; Values = Number (percent) for other variables; ns = Not significant; * = Significant at P<0.05; *** = Significant at P<0.001

Mean (±SD) baseline serum creatinine concentration was significantly higher (P<0.001) in patients who developed CIN compared to who did not develop CIN (134.73±29.01 and 92.32±16.94 µmol/L). Mean (±SD) baseline eGFR was significantly lower (P<0.001) in patients who developed CIN compared who did not develop CIN (52.22±13.21 and 79.02±17.67ml/min/1.73 m^2).

Table 2: Logistic Regression Analysis of Risk Factors for Contrast Induced Nephropathy (CIN)

Variables	Total	Incidence of CIN	OR (95% CI)	P value
Age≥70 years	20	2(10.0%)	0.204(0.026-1.842)	0.157^{ns}
eGFR <60 ml/min/1.73m^2	57	19(33.3%)	422.8435(29.520-6056.851)	0.0001*
Diabetes Mellitus	86	16(18.6%)	1.8002(0.354-9.162)	0.048*
Hypertension	105	16(15.2%)	16.0179(2.940-87.2790)	0.054^{ns}
Dyslipidemia	60	12(20.0%)	9.2237(1.6935-50.2372)	0.056^{ns}
LVEF% <40	13	2(15.4%)	13.9431(1.2641-153.793)	0.032*
Contrast Volume >100ml	31	16(51.6%)	0.0009(0.0000-0.018)	0.0001*
PTCA	26	9(34.6%)	0.0064(0.0003-0.145)	0.002*

OR = Odds ratio, CI = Confidence interval; Statistical analysis done by Logistic regression; Ns = Not significant; * = Significant at P<0.05

Mean (±SD) total volume of contrast media used was significantly higher in patients who developed CIN Compared to who did not develop CIN (114.13±38.34ml and 64.53±26.03ml). Significantly higher (P<0.001) number of patients who developed CIN had diabetes mellitus (69.6%) compared to patients variation (P<0.001); out of 23 patients who developed CIN, 9 (39.1%) underwent PTCA, and out of 227 patients who did not develop CIN, only 7.5% underwent PTCA. None of the drugs (ACEI/ARB, HMG-CoA reductase, anti-platelet and beta-blocker) used in this study showed significant variation in the development of CIN (Table 1). Older age ≥70 years, diabetes mellitus were significant risk factor for CIN where as hypertension are not statistically significant. Logistic regression analysis of risk factors identified 05 (five) risk factors in this study. Those were baseline estimated GFR <60mi/min/1.73m^2 BSA, diabetes mellitus, contrast volume >100ml, PTCA and LVEF < 40%) (Table 2).

Table 3: Logistic Regression Analysis of Effect of Drugs on Development of Contrast Induced Nephropathy (CIN)

Drugs	**Patients (No)**	**Number of Patients with CIN**	**Incidence of CIN (%)**	**OR**	**95% CI**	**p value**
ACEI/ARB	108	14	13.0	2.0348	0.8894-4.6551	0.093^{ns}
HMG-CoA Reductase	87	12	13.8	1.0631	0.4221-2.6774	0.897^{ns}
Antiplatel Agent	163	19	11.7	1.2496	0.8447-5.99.09	0.105^{ns}
Beta-Blocker	77	11	14.3	1.0721	0.4316-2.6631	0.881^{ns}

OR = Odds ratio, CI = Confidence interval; Statistical analysis done by Logistic regression; ns = Not significant

Effect of drugs used in the development of CIN by logistic regression analysis. None of the drugs showed significant relationship on development of CIN (Table 3).

Discussion

Contrast induced nephropathy (CIN) is a common hospital acquired acute kidney injury. The incidence of CIN can be much higher if the patients have underlying conditions such as chronic kidney disease (CKD), diabetes, or old age. Published studies on this condition have dramatically increased in current years. No study has been taken place until now in Bangladesh. Comparison of patients who did or did not developed CIN shows those who developed CIN were relatively aged 58.17±9.20 years vs 52.32±10.88 years who did not developed CIN (P=0.013). No statistical significant sex difference was observed. In study of Evola et al (2012) observed that average age was 65.32 ± 12.02 years in no-CIN group and 68.94±11.31 years in CIN group. Male was found 337 (69.3%) patients in no-CIN group and 69 (65.7%) in CIN group. Age was statistical significant but sex was not statistical significant (p>0.05) between two group.

In present study revealed that patients who developed CIN, their baseline eGFR (52.22±13.21 ml/min/1.73m^2) was significantly low than who did not (79.02±17.67 ml/min/1.73m^2), (p = 0.0001). Patients who developed CIN, their baseline serum significantly high than who did not, 134.73±29.01pmol/L vs 92.32±16.94 pmol/L, (p=0.0001) similar observation was found Sharma et al. they showed the baseline mean serum creatinine of patients without CIN and who developed CIN were 0.926±0.317 mg/dL and 1.29 ± 0.460 mg/dL respectively. e-GFR was 89.24±27.3 ml/min in patient without CIN and 62.44± 25.08 ml/min patients with CIN. Shukla et al (2016) study observed 88 (39.6%) patients was found eGFR (<60 ml/min/1.73m^2) in non CIN group and 27(87.1%) in CIN group. The difference was statistically significant (p<0.05) between two group. IN current study showed patients got significantly larger volume of radio contrast 114.13±38.34 ml who developed CIN vs 64.53±26.03 ml compared who did not (p = 0.0001). Diabetic patients were found vulnerable to develop CIN (p=0.0001). When PTCA was done found statistically significant for the development of CIN (p = 0.0001). Evola et al (2012) study observed Hundred fifty (30.9%) patients had diabetic in no-CIN group and 44 (42.0%) in CIN group. The difference was statistical significant (p<0.05) between two group. Many studies have found Diabetes Mellitus (DM) as an independent risk factor for CIN (Rihal et al., 2002; Dangas et al., 2005). Sharma et al (2014) study reported the incidence of CIN in diabetic patients was higher than non-diabetic population and it was statistically significant (12.5% in diabetes Vs. 6.97% in no-diabetic patients, p=0.01).

In present study showed older age ≥70 years, diabetes mellitus were significant risk factor for CIN where as hypertension are not statistically significant. Compare to other studies hypertension not showed statistically significant risk factor in this study. Age and hypertension were not associated with CIN (Gruberg et al., 2000). However Mehran et al (2004) identified older age, hypertension and anemia as additional risk factors for CIN. Dyslipidaemia appeared not to be statistically significant impact on development of CIN in this study. Andrade et al (1998) and Yang et al (2004) found no significant relationship between CIN and hypercholesterolaermia). In this study we detect significant association of CIN with LVEF <40%, (p =0.032). Gruberg et al (2000) and Schillinger et al (2001) shown that a reduced left ventricular ejection fraction (≤49%) and advanced congestive heart failure (NYHA class III or IV) are in dependent risk factor for CIN. Dangas et al (2005) showed that a LVEF <40% is an independent predictor of CIN. Seventy one (32%) patients was found LVEF <40% in non CIN group and 12(38.7%) in CIN group. The difference was not statistically significant (p>0.05) between two group.

Logistic regression analysis of risk factors identified 05 (five) risk factors in this study. Those were, baseline estimated GFR <60mi/min/1.73m^2 BSA, diabetes mellitus, contrast volume >100ml, PTCA and LVEF <40%). Shukla et al (2016) study reported seventy one (32%) patients was found LVEF <40% in non CIN group and 12(38.7%) in CIN group. The difference was not statistically significant (p>0.05) between two group. Logistic regression analysis of risk factors identified 05 (five) risk factors in this study. Those were, baseline estimated GFR <60mi/min/1.73m^2 BSA, diabetes mellitus, contrast volume >100ml, PTCA and LVEF < 40%). Age ≥70 years, hypertension, dyslipidaemia were not significantly related to the development of CIN. Haller et al (1997) found no statistical correlation between age and CIN. Lautine et al (1991) found age and sex were not important risk factor.

Sharma et al (2014) observed that Variables included in the first step of the multivariate analysis were age, sex, BMI, systolic blood pressure, diastolic blood pressure, arterial hypertension, hypercholesterolemia, LVEF, presence of coronary artery disease, presence of diabetes mellitus, STEMI, unstable angina, PCI, baseline e-GFR, amount of contrast agent administered, serum sodium, serum potassium, glucose level, hemoglobin level and ACE inhibitor medication.

Conclusion

Older age, baseline estimated GFR <60mi/min/1.73m^2 BSA, diabetes mellitus, contrast volume >100ml, PTCA and LVEF < 40%) were significant risk factor to developed CIN.

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