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Original Article

Predictors of contrast induced nephropathy and the applicability of the Mehran risk score in high risk patients undergoing coronary angioplasty—A study from a tertiary care centre in South India

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ABSTRACT

Objective: To study the incidence and predictors of Contrast induced nephropathy {CIN} in high risk patients undergoing coronary angioplasty. To study the applicability of the Mehran Risk Score {MRS} in the prediction of CIN in our population.

Methods: This was a prospective observational study where patients with an estimated glomerular filtration rate {eGFR} between 30 and 60 ml/mt undergoing elective percutaneous coronary intervention {PCI} over a period of 15 months were evaluated prospectively for the development of CIN. The patients who developed CIN were then analysed for the presence of specific risk factors. The patients were categorised into the 4 risk groups based on the MRS.

Results: 100 high risk patients underwent PCI during the study period. The incidence of CIN was 29%. On multivariate analysis, the presence of anaemia {p = 0.007}, increased contrast volume usage (as defined by >5* B.Wt/S.cr) {p = 0.012} and usage of loop diuretics {p = 0.033} were independently found to confer a significant risk of CIN. In patients belonging to the high Mehran risk group {MRS10- 15} and very high risk group {MRS >15} the risk of CIN was 3 fold {OR: 3.055, 95% CI: 1.18–7.94, p = 0.022} and 24 fold {OR: 24, 95% CI: 2.53–228.28, p = 0.006} higher respectively when compared to intermediate and low risk patients {MRS <10}.

Conclusion: The incidence of CIN in high risk patients undergoing PCI is substantially higher in our population compared to similar studies in the west. The MRS risk prediction is pertinent even in an Indian population.

1. Introduction

Contrast induced nephropathy CIN is the Achilles heel of interventional cardiology. It carries significant morbidity and mortality. Despite burgeoning advances in the field of cardiac catheterisation, and overall improvements in the hardware, scientists have been unable to tackle this serious complication. CIN is the acute worsening of renal function after parenteral administration of contrast media once other causes of deteriorating renal function have been excluded. CIN is currently the third most common cause of hospital acquired acute renal failure accounting for 10% of all cases.[1] The European Society of Urogenital Radiology {ESUR} defined CIN as an increase in the serum creatinine concentration of 0.5 mg/dL (44 mol/L) or 25% above the baseline within 48 h after contrast administration.[2] Preventive strategies for contrast induced nephropathy traditionally include pre- procedural hydration with isotonic saline, the usage of isoosmolar non-ionic contrast media, pre-medicating with *N*-acetyl cysteine, and the withdrawal of nephrotoxic drugs.[3,4,5,8,9] Despite the best of precautions, around 20–30% of patients with underlying risk factors for CIN undergoing PCI go on to develop CIN.[6–8]

Abbreviations: CIN, contrast induced nephropathy; PCI, percutaneous coronary intervention; eGFR, estimated glomerular filtration rate; MRS, Mehran risk score; ESUR, European Society of Urogenital Radiology; CKD, chronic kidney disease; CAD, coronary artery disease; CTO, chronic total occlusion; CVP, central venous pressure; MDRD, modification of diet in renal disease.

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The current study was conducted with the intention to identify the incidence of CIN in patients with chronic kidney disease {CKD} stage III as defined by an eGFR of between 30 and 60 ml/mt and to analyse the risk factors for CIN. We also aimed to identify if the MRS could be used to accurately predict the incidence of CIN in patients belonging to the respective risk groups in an Indian population. It should be noted that the well validated MRS was formulated in a western population where the incidence of CIN was found to be 13.1%.[9] The population in the Indian subcontinent has higher atherogenic burden with a higher incidence of risk factors for CIN.

2. Materials and methods

2.1. Study design

This was a prospective observational study conducted at the Department of Cardiology, Government Medical College Trivandrum for a period of 15 months from January 2015.

2.2. Study protocol

2.2.1. Inclusion criteria

The study population included adult patients above the age of 18 years with coronary artery disease {CAD} who were admitted for elective PCI in the Dept of Cardiology, Medical College Trivandrum. All patients had impaired renal function as suggested by a reduced eGFR of: 30–60 ml/ min/1.73 m^2 calculated by the Cockcroft- Gault formula. None of the patients included had end-stage renal failure with the need for haemodialysis. These patients were prospectively evaluated for the development of CIN. To reinforce the baseline risk of the study population it was decided to include only those patients in whom the contrast usage was more than 100 ml.

2.2.2. Exclusion criteria

Patients undergoing routine hemodialysis or peritoneal dialysis, patients admitted with ST elevation myocardial infarction {STEMI} and patients with cardiogenic shock were excluded from the study.

All patients received standard prophylactic measures for prevention of CIN namely, continuous intravenous saline infusion (0.9%) 12 h before to 24 h after PCI (1 ml per kilogram of body weight per hour), oral *N*-acetylcysteine 600 mg twice orally on the day before and on the day of PCI and withdrawal of nephrotoxic drugs. In all patients Iodixanol, a non ionic isoosmolar contrast was used.[10] In heart failure patients the rate of saline infusion was lowered to 0.5 ml per kilogram of body weight per hour to prevent over hydration. The loop diuretics were not withheld in these patients.

2.3. Definitions

CIN: CIN was defined as an increase in serum creatinine concentration of 0.5 mg/dL (44 mol/L) or 25% above baseline within 48 h after contrast administration.[2]

Anaemia: The WHO definition of anaemia was used namely: haemoglobin of less than 13 g/dl in adult males or less than 12 g/dl in adult females.

2.4. Maximum permissible contrast volume

The upper limit of contrast usage for the prevention of CIN in PCI has been validated by Cigarroa et al. and is given by the formula: 5 times the body weight in kilogram divided by the serum creatinine in mg/dl.[11]

Table 1
Baseline characteristics of the patients.

Variable	Percentage/Mean
Mean Age,y	61.76 ± 9.1
Male Sex n, {%}	83{83}
Mean LVEF,%	54.5
Anemia n,{%}	52{52}
Diabetes Mellitus n, {%}	57{57}
Systemic Hypertension n, {%}	64{64}
Heart failure n, {%}	18{18}
Peripheral artery disease n, {%}	26{26}
Dyslipidemia n, {%}	27{27}
Smoker n, {%}	64{64}
eGFR, ml/min	46.47 ± 8.9
Volume of Contrast used, ml	206.4 ± 58.3
Mehran Risk score	10.43 ± 3.5

The maximum permissible contrast volume for a given patient in relation to the creatinine clearance has also been validated in numerous studies.[12–16] The largest among them is the study conducted by Gurm et al., who enunciated that when the ratio of contrast volume to the creatinine clearance exceeded 3, the risk of CIN is dramatically increased.[17]

2.5. Periprocedural hypotension

Periprocedral hypotension was defined as a systolic blood pressure of less than 80 mm Hg persisting for more than one hour, requiring inotropic support or an Intra-aortic balloon pump {IABP}.

2.6. Statistical analysis

Continuous variables were expressed as minimum, maximum, mean, standard deviation (SD), and qualitative data were presented as percentages and frequencies. Continuous variables were analysed by a Student's *t*-test and categorical variables by the Chi square test when appropriate. The statistical analyses were performed with SPSS software {version 17.0}. Multivariable logistic regression analysis was used to identify the independent risk factors associated with CIN. The results of this model were presented as an Odds Ratio (OR) and a 95% confidence intervals (95% CI) for OR. A 2-sided probability value of 0.05 was considered to indicate statistical significance throughout the analysis.

3. Results

3.1. Baseline characteristics

During the study period of 15 months, 100 high risk patients with CKD stage III underwent elective PCI and were prospectively evaluated for the development of CIN. The baseline characteristics of the patients are shown below in Table 1. The mean age of the patients was 61.76 ± 9.1 years and the majority were males. The prevalence of diabetes mellitus and systemic hypertension was 57% and 64% respectively. The mean contrast usage per patient was 206.4 ± 58.3 ml. The higher contrast usage in our study was

Table 2
Table showing the split up of patients based on the Mehran Risk Score.

MRS score	Risk Category	Patients		Predicted risk of cin from Mehran et al.
		N	%	
≤5	Low	3	3	7.5%
6–10	Intermediate	55	55	14%
11–15	High	36	36	26%
>15	Very High	6	6	57.3%
Total		100	100	

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