



THE MEHRAN RISK SCORING SYSTEM FOR PREDICTING CONTRAST INDUCED NEPHROPATHY FOLLOWING PERCUTANEOUS CORONARY INTERVENTION: STRONGER POSITIVE CORRELATION IN THE INDIAN SCENARIO

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ABSTRACT

Objective: To study the applicability and predictability of the Mehran risk score (MRS) in the prediction of Contrast Induced Nephropathy (CIN) in the Indian population.

Methods: This was a prospective observational study where high risk patients with estimated glomerular filtration rate (eGFR) between 30 -60 ml/mt under going elective percutaneous coronary intervention (PCI) were evaluated prospectively for the development of CIN. The high risk patients who developed CIN were then analysed for the presence of specific risk factors. All patients were assigned a baseline MRS and were categorised into the 4 risk groups based on the MRS.

Results: One hundred high risk patients underwent PCI during the study period. When the patients were analysed based on the MRS it was seen that with increasing MRS > 5, the observed incidence of CIN was substantially higher compared to the predicted risk for each category.

Conclusions: MRS is a useful in predicting the development of CIN in patients undergoing PCI. The incidence of CIN in high risk patients undergoing PCI is substantial. In an Indian population, higher MRS relegates these high risk patients to significantly higher risk of CIN compared to western population in which MRS was originally developed.

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INTRODUCTION

Contrast induced nephropathy (CIN) is the Achilles heel of interventional cardiology. It carries significant morbidity and mortality. Despite significant advances in the field of percutaneous coronary interventions, interventionists have been unable to tackle this serious complication. CIN is currently the third most common cause of hospital acquired acute renal failure accounting for 10 % of all cases (Nash *et al.* 2002). The European Society of Urogenital Radiology (ESUR) defined CIN as an increase in serum creatinine concentration of 0.5 mg/dL (44mol/L) or 25% above baseline within 48 hours after contrast administration (Thomsen *et al.*). Preventive strategies for contrast induced nephropathy include pre-procedural hydration with isotonic saline, usage of iso-osmolar non-ionic contrast media, pre-medicating with N-acetyl cysteine, and withdrawal of nephrotoxic drugs

(Trivedi, *et al.*, Cigarroa *et al.*, Tepel *et al.*). Despite the best of precautions, around 20-30 % of patients with underlying risk factors for CIN undergoing PCI go on to develop contrast induced nephropathy (Mehran *et al.*).

The well validated Mehran risk score (MRS) has been formulated and validated for the western population. The current study was conducted to see the extend of correlation of Mehran risk score to risk of developing CIN in the Indian population compared to the European population in the original Mehran study.

MATERIALS AND METHODS

Study design

This was a prospective observational study conducted at a Government teaching hospital in Trivandrum, Kerala state, India for a period of 15 months from January 2015.

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Inclusion criteria

The study population included adult patients aged above 18 years with coronary artery disease (CAD) at high risk of CIN who were admitted for elective PCI. All patients had reduced eGFR: 30-60 mL/ min /1.73 m² 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 followed up for the development of CIN.

Exclusion criteria

Exclusion criteria included patients undergoing routine hemodialysis or peritoneal dialysis, ST elevation myocardial infarction (STEMI) and patients with cardiogenic shock.

Standard protocol for prevention of CIN

All patients received standard prophylactic measures for prevention of CIN namely , continuous intravenous saline infusion (0.9%) 12 hours before to 24 hours after PCI (1 mL per kilogram of body weight per hour), oral N-acetylcysteine 600 mg twice orally, the day before and on the day of PCI and withdrawal of nephrotoxic drugs.

Definitions

CIN : CIN is defined as an increase in serum creatinine concentration of 0.5 mg/dL (44mol/L) or 25% above baseline within 48 hours after contrast administration
Anemia: Anemia was defined by the WHO definition of hemoglobin of less than 13g/dl in adult males or less than 12g/dl in adult females.

Maximum permissible dye volume: The upper limit of dye 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.

Periprocedural Hypotension: Periprocedural hypotension is defined as systolic blood pressure less than 80 mm Hg persisting for more than one hour requiring inotropic support or Intra aortic balloon pump {IABP}.

Statistical Analysis

Continuous variables were expressed as minimum, maximum, mean, standard deviation (SD), and qualitative data were presented as percentages and frequencies.

RESULTS

Baseline characteristics

Table 1 Baseline characteristics of the patients

	Number (percentage)
Male Sex	83 (83)
Anemia	52 (52)
Diabetes Mellitus	57 (57)
Systemic Hypertension	64 (64)
Dyslipidemia	27 (27)
Smoking	64 (64)
Peripheral arterial disease	26 (26)
Anemia	52 (52)

One hundred high risk patients 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 and hypertension was 57% and 64%. The mean dye usage per patient was 206.4 +/-58.3 ml. The higher dye usage in our study was attributed to the higher number of multivessel PCI and CTO {Chronic total occlusion} interventions in our study.

Table 2 Mehran Risk Score and development of CIN

MRS score	Incidence of CIN in present study
≤5	3%
6-10	55%
11-15	36%
>15	6%

Development of CIN

Out of the 100 high risk patients who were prospectively evaluated for the development of CIN, 29 patients developed CIN (29%). This is shown in the figure 1 below.

INCIDENCE OF CIN



Figure 1 Incidence of CIN

Mehran risk score and development of CIN

The patients were analysed for the risk of CIN based on the MRS. The mean MRS of the study population was 10.43 +/-3.5. The split up of the patients based on the MRS is shown in Table 2. It was observed that majority of the patients (55%, n=55) belonged to the intermediate MRS (6-10). Further 42 patients (42%) had a high MRS of more than 10. This reiterates the high baseline risk of CIN of the patient population

Actual incidence of CIN in various Mehran risk score bands compared to predicted risk of developing CIN

Analysing the MRS and predicted risk of CIN in our cohort of CIN patients, it was seen that no patient with a MRS < 5 developed CIN but with higher MRS scores the risk of CIN was significantly higher than the expected risk. For instance with a MRS > 11 the predicted risk of CIN is 26% but it was seen to be 39.4% in our population. Similarly the predicted risk of CIN in the highest risk group with MRS >15 was 57.3% but the observed incidence of CIN in this group in our study was 83.3%. See table 3 and figure 2.

Table 3 Actual incidence of CIN in various Mehran risk score bands compared to predicted risk of developing CIN

MRS score	Incidence of CIN in present study	Predicted risk of CIN based on Mehran score
≤5	3%	7-5%
6-10	55%	14%
11-15	36%	26%
>15	6%	57.3%

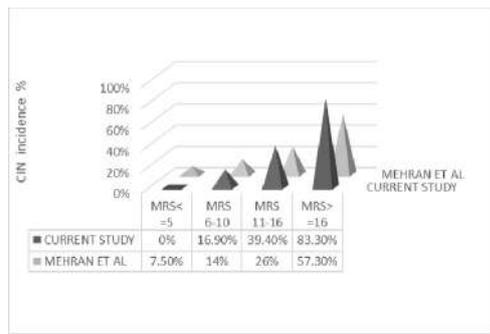


Figure 2 Figure showing Observed risk of CIN versus expected risk of CIN based on MRS

DISCUSSION

Although studies show the incidence of CIN in the general population to be around 2%, in high-risk patients with chronic renal impairment, diabetes mellitus, congestive heart failure, and older age, the incidence of CIN is significantly higher in common practise (Tepel M *et al.*). CIN is a lurking danger in every high risk patient undergoing PCI and the current study highlights this very fact. The incidence of CIN in our study population was 29 % which indicates the high risk nature of the patients.

Previous studies show that patient demographics like older patients, anaemia, presence of diabetes mellitus, low ejection fraction and procedural characteristics like intra procedure hypotension , increased dye volume confer a significant risk of CIN (Mehran *et al.*, Victor *et al.*, Evola *et al.*). Iodinated radio contrast causes renal vasospasm by tilting the balance in favour of the vasoconstrictors in the renal medulla. The vasospasm is fuelled by the increased production of endothelin and adenosine. There is direct renal tubular damage causing decreased nitric oxide and prostaglandin synthesis. The vasospasm triggers ischaemic reperfusion injury in the metabolically active renal medulla (Sendeshi *et al.*, Persson *et al.*). The second important risk factor which significantly predicted the risk of CIN was anaemia. Ionic media increases the affinity of haemoglobin to oxygen molecules, this impairs the delivery of oxygen to the metabolically active renal medulla. The hypoxic renal injury is aggravated in the presence of anaemia

There are numerous risk scores for the prediction of CIN in patients undergoing interventions with radiocontrast media (Silver *et al.*). Of these the score promulgated by Mehran *et al* has been well validated in external populations, is provided with an electronic online calculator and distinctly categorises the patients into 4 risk categories (Mehran *et al.*). The MRS offers not just the risk of CIN but also outlines the risk of haemodialysis specific to each category.

Strikingly in our study it was seen that with increasing MRS, the observed risk of CIN was significantly higher than the expected risk based on MRS.

The Mehran risk score though formulated and tested in the western population, the current study vehemently reinforces the fact that in the Indian population, a patient with a MRS of more than >5 has a substantially higher risk of CIN than the expected risk

CONCLUSION

A high Mehran risk score indicates a high probability of developing CIN in India. Whenever a patients MRS is found to be > 5 , extreme vigilance needs to be practiced and measures for the prevention of CIN should be reinforced .

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