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Mehran risk score for predicting contrast-induced nephropathy: relevance to Indian population

With the increasing use of contrast media for both diagnostic and interventional procedures, the development of procedure related contrast-induced nephropathy (CIN) is becoming a subject of concern. CIN is defined as greater than 25% or 0.5 mg/dL increase in serum creatinine from baseline within 48 hours after contrast administration.[1] The reported incidence varies depending on the definition used, the dose and type of contrast administered as well as the presence of risk factors like chronic renal insufficiency, diabetes mellitus, and contrast volume administered.[2] The cumulative risk of several variables on renal function is thus unknown.[3]

Mehran risk score,[3] is a simple risk score that could be readily used by clinicians to evaluate individual patient risk to develop CIN after percutaneous coronary interventions (PCI). The risk score for predicting CIN was calculated according to the following algorithm: hypotension (integer score 5), intra-aortic balloon pump support (integer score 5), congestive heart failure (integer score 5), age greater than 75 years (integer score 4), diabetes mellitus (integer score 3), estimated glomerular function rate (eGFR) less than 60 (integer score 2 to 6), pre-existing anaemia (integer score 3), and contrast media volume (integer score 1 for each 100 mL). The scores less than or equal to 5, 6-10, 11-16 and greater than or equal to 16 predicted a CIN risk of 7.5%, 14%, 26.1% and 57.3%, respectively. Keeping the utility of the above score, we prospectively applied the same to our patient population who underwent PCI in our study.

One hundred and twenty patients scheduled to undergo diagnostic coronary angiography and/or angioplasty in the Department of Cardiology with baseline serum creatinine less than or equal to 1.2 mg/dL, were recruited. Patients with pre-existing renal disease, hypotension, hyperthyroidism, hypothyroidism, those on glucocorticoid therapy, cardiogenic shock, or allergy to contrast media and patients not willing to participate in the study were excluded. Patients with normal renal function (≤1.2 mg/dL) were recommended liberal intake of oral fluid before the procedure and a record of the input and output was maintained to monitor fluid status. They received low-osmolal contrast agent, iohexol (320mg iodine/ml, Ominipaque®, Jaya Pharmaceutical, Hyderabad, India). Patients with elevated serum creatinine or chronic kidney disease (CKD) received 1 ml/kg/hour I.V. fluids starting 12 hours prior to and continued 12 hours after the procedure, along with N-acetyl cysteine 600 mg BD, 3 days before and after the procedure and received iso-osmolar contrast medium (IOCM) Iodixonol (VISIPAQUE, from Cipla India).

The baseline and clinical characteristics of the study subjects are shown in Table 1. The risk score in the study group was 4.2 ± 30 which is below 5 and corresponds to 7.5% risk of CIN. We observed CIN in 27 (22.5%) patients in our study. Further, the score in patients with

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Table 1: Baseline and clinical characteristics in patients with CIN and without CIN
Data are presented as are mean ± SD and number of patients (%)

Variables	CIN group (n=27)	Non-CIN group (n=93)	P value
Age (years)	52.81 ± 8.77	50.28 ± 8.88	0.194
Male, n (%)	26 (96.2)	91 (97.8)	0.652
BMI (kg/m^2)	23.79 ±3.55	23.81± 2.78	0.970
Diabetes mellitus, n (%)	15 (55.5)	45 (48.3)	0.846
Systolic blood pressure (mm Hg)	118.14 ±12.72	118.46± 12.81	0.911
Diastolic blood pressure (mm Hg)	76.29 ± 8.38	76.81± 7.87	0.798
Hypertension, n (%)	1 (3.70)	7 (7.52)	0.473
Smokers, n (%)	8 (29.6)	48 (51.6)	0.052
eGFR by CG equation, ml/min	97.60 ± 25.79	89.11 ± 26.66	0.153
Congestive heart failure, n (%)	4 (14.8)	16 (17.2)	0.771
LVEF (%)	51.70 ±11.46	51.45± 9.62	0.915
CAG / CAG + PCI, n (%)	12 (44.4)/ 15 (55.5)	37 (39.7)/56 (60.2)	0.667
Volume of contrast (ml)	62.8 ± 28.8	60.4 ± 24.1	0.732
Angiographic characteristic, n (%)			0.307
One vessel	9 (33.3)	43 (46.23)	
Two vessels	8 (29.62)	30 (32.25)	
Multi-vessels	6 (22.22)	9 (9.67)	
Drugs			
ACE inhibitor, n (%)	-	2 (2.15)	1.000
Diuretics, n (%)	10 (37.0)	2 (2.15)	1.000
β- blockers, n (%)	8 (29.6)	5 (5.37)	0.165
Aspirin, n (%)	23 (85.1)	85 (91.3)	0.464
Statins, n (%)	11 (40.7)	18 (19.3)	0.039
Mehran risk score	4.33± 0.60	4.10 ±0.39	0.620

BMI= body mass index, CIN= contrast-induced nephropathy, eGFR = estimated glomerular filtration rate, CG equation= Cockcroft & Gault equation, LVEF= left ventricular ejection fraction, CAG= coronary angiography, PCI= percutaneous coronary intervention, ACE = angiotensin-onverting enzyme.

diabetes mellitus who developed CIN (n = 15, 25%) was higher than patients without diabetes mellitus (n = 12, 20%) (6.2 ± 2.8 vs 1.9 ± 2.0; p<0.001) since presence of diabetes itself carries an integer score of 3. A risk score between 6-10 corresponds to a risk of CIN of 14% and the observed incidence in both the diabetic (25%) and nondiabetic subgroups is higher (20%) than that expected for their corresponding risk scores (14% and 7.5% respectively).

Incidence of CIN in our study is much higher than that expected in patients with normal baseline renal function and for the corresponding Mehran risk score.[3] The incidence of CIN depends on the type of contrast medium administered. Low-osmolal, non-ionic contrast media have been shown to be more nephrotoxic compared to iso-osmolal contrast medium.[4] Iohexol, used in the present study has been shown to be associated with increased incidence of CIN.[5] The type of prophylaxis administered prior to the procedure also influences the outcome. Table 2 gives a summary of Indian studies on the effect of prophylactic measures on the development of CIN. Patients with normal baseline renal function receiving N-acetyl-cysteine,[6] allopurinol,[6] theophylline[7] or dopamine[8] have been shown to have a lesser incidence of CIN (Table 2). Hydration was performed with 1 mL/ kg/h of half-normal saline for 4 - 12 h before PCI and 18 -24 h after PCI in the study by Mehran et al,[3] as against unrestricted use of oral fluids in the present study. This shows that preventive strategies being followed in patients with normal baseline renal function should be given importance as is being done for those with impaired renal function. The use of statins was significantly (p = 0.039) more in the CIN

Table 2: Summary of Indian studies on the effect of prophylactic measures on the development of contrast-induced nephropathy

Study	Number of subjects (n), groups	Type of contrast, volume	Baseline serum creatinine mg/dL	Prophylaxis used	Mehran risk score	Incidence of CIN
Kumar A et al [6]	500, Divided into two groups based on the type of contrast medium administered. 1. Group I : Iohexol 2. Group II: Iodinaxol	Iohexol(low-osmolar, non-ionic, monomeric)/Iodinaxol (iso- osmolar, non-ionic, dimer)	0.9-1.3	Each group further divided into three sets based on the type of prophylaxis given: Group 1- saline hydration (SH, 1ml/kg/hr), Group 2: N-acetylcysteine(SH+NAC ,600 mg bd) Group 3: Allopurinol (SH+ALLP, 300 mg/day) 12 hours before and after administration of radio contrast agent	1.Group I : 10(4-12) 2.Group II: 10(3-13)	Group I (Iohexol group) SH group: 14/40=40% SH+NAC group: 8/40=20% SH+ALLP group: Group II (Iodinaxc group) SH group: 15/50=30% SH+NAC group: 10/50=20% SH+ALLP group:
Kapoor A et al[7]	70, Diabetic Divided into two groups based on prophylactic measures used	High osmolar, Group1: 77.8 ± 9.6ml Group 2: 80.2 ± 8.6ml	Group 1: 1.19 ± 0.23 Group 2: 1.16 ± 0.18	Group I (n=35) underwent routine CAG, and Group II (n=35) received oral theophylline 200 mg b.d. 24 h before and for 48 h after CAG		Group 1:31% Group 2: 0
Kapoor A et al[8]	40, Diabetic Divided into two groups based on prophylactic measures used	Urograffin: 70%, 120-180 ml	Group I: 1.50 ± 0.32 Group II: 1.52 ± 0.68	Group I(n=20): dopamine (5 µg/kg/min) starting 30 min before cardiac catheterization and continued for 6 h thereafter. Group II (n=20): did not receive dopamine		Group I = 0 Group II = 10/20=50%
Present study	120, Divided into two groups based on the presence or absence of diabetes	Low-osmolal agent; iohexol	0.98 ± 0.21	All patients received oral hydration	1. Group I : 6.02 ± 2.24 2. Group II: 2.30 ± 2.35	27/120 = 22.5%

group compared to the non-CIN group. Contrary to our finding, literature states that statins have a beneficial effect on reducing CIN incidence in patients with baseline renal impairement.[9] Similarly, another study[10] showed that statin pretreatment significantly decreased the risk of CIN in CAD patients undergoing PCI. However, a study[11] which classified patients based on Mehran score for risk development of CIN and analysed the effect of statins observed a higher incidence of CIN in patients on statins as compared with patients not on statins. However, this difference was not observed after propensity-based adjustment for reciept of statins. Hence, this needs further probing.

In a study from India,[6] the Mehran risk score[3] of the patients ranged from 3-10 and observed incidence was 40% in the group that received iohexol as the contrast medium and normal saline hydration prior to the procedure. The baseline renal function in their subjects was also normal (serum creatinine 0.9-1.3mg/dL). Similarly, our study shows that the incidence of CIN is higher than that predicted by Mehran risk score.[3] Also, the risk score did not differ between the CIN and non-CIN groups implying that it is unable to predict CIN in our population. Hence, there is a need to further validate this widely acceptable risk scoring system in a larger number of patient population for its application to assess the risk of CIN in Indian population. Also, a new risk scoring system which is easy to implement in clinical practice needs to be developed especially for those with normal baseline renal function who are often neglected assuming them to be at low risk.

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