Original Article

Predictive Accuracy of the Mehran Score for Contrast Induced Nephropathy after Angiography

Contrast Induced Nephropathy after Angiography

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ABSTRACT

Objective: In a tertiary care hospital in Karachi, Pakistan, this research sought to determine how well the Mehran Risk Score predicted CIN in patients having coronary angiography.

Study Design: a prospective single-arm cohort study.

Place and Duration of Study: This study was conducted at the Department of Adult Cardiology, National Institute of Cardiovascular Disease, Karachi from September 16, 2019, and ending on March 15, 2020.

Methods: At the National Institute of Cardiovascular Disease (NICVD), a descriptive cross-sectional research was carried out. Informed permission was acquired before patients who met the inclusion criteria were enrolled. Serum creatinine levels were tested 48 and 72 hours before and after the surgery. For every patient, the Mehran Score was determined, and the CIN was noted.

Results: 230 individuals with a mean age of 57.56 ± 15.45 years and a mean Mehran Score of 4.84 ± 1.98 were included in the research. Of them, 64 (27.8%) had CIN, and 150 (65.2%) were men. The ROC analysis yielded an area under the curve (AUC) of 0.9296, and a threshold score of > 5.50 indicated strong prediction accuracy.

Conclusion: When patients with acute coronary syndrome undergo coronary angiography, the Mehran Risk Score provides useful differentiation between risk groups and accurately predicts the development of CIN. To further corroborate these results, bigger cohort studies are required in the future.

Key Words: Mehran Score, Contrast-Induced Nephropathy, Acute Coronary Syndrome, Acute Kidney Injury.

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INTRODUCTION

About 10% of instances of hospital-acquired acute kidney damage (AKI) are caused by contrast-induced nephropathy (CIN). Even while CIN often has a very benign course, it is linked to significant clinical outcomes, such as greater rates of in-hospital morbidity and death, longer hospital stays, and more expensive medical care[1]. The aforementioned considerations underscore the need of promptly identifying individuals who are at risk of CIN, especially those undergoing procedures such as percutaneous coronary intervention (PCI). There are a number of known risk factors for CIN, and the Mehran risk score—which was first developed in 2004—is now a commonly used instrument for predicting CIN in patients receiving PCI.

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Hypotension, the use of an intra-aortic balloon pump, congestive heart failure (CHF), advanced age, anemia, diabetes mellitus, contrast media volume, and estimated glomerular filtration rate (GFR) are some of the factors that make up this risk score. The Mehran score gives each of these parameters a weighted value, which enables doctors to predict a patient's risk of developing CIN and modify treatment strategies appropriately[2, 3].

The Mehran risk score's capacity to divide patients into groups according to their chance of developing CIN makes it significant. For instance, because of their heightened susceptibility to CIN, patients with hypotension necessitating inotropic support, CHF categorized as Class III or IV by the New York Heart Association, and those using intra-aortic balloon pumps are assigned higher risk ratings. Furthermore, patients who are old or have diabetes mellitus are regarded as high-risk groups because to their increased vulnerability to kidney injury from contrast media. Risk for CIN is mostly dependent on renal function, especially GFR. The kidneys' capacity to eliminate contrast media diminishes with decreasing GFR, raising the risk of nephropathy. The highest score in the GFR category is awarded to patients whose GFR is less than 20 mL/min/1.73 m², indicating the substantial risk associated with severe renal impairment. The possibility of CIN formation is also influenced by the

amount of contrast media used during PCI, with higher quantities carrying a higher risk[4, 5].

Depending on patient demographics, illness incidence, and healthcare systems, the score's predictive value may change. Five of the eight factors from the original Mehran score still had predictive significance in our local community, which is consistent with results from earlier studies that validated the score in other clinical contexts. The accuracy of the score, however, might be impacted by regional variations in patient characteristics, such as the frequency of comorbidities and access to treatment[6]. In addition to being a renal consequence, CIN is associated with worsening clinical outcomes, including elevated mortality and cardiovascular event rates. The use of preventative treatments, such as lowering the amount of contrast media, switching to an alternate contrast agent, or using hydration procedures, depends on the identification of individuals at risk for CIN before to PCI. By being proactive, we can lessen the effects of CIN and enhance patient outcomes[7, 8].

There is little information available on the Mehran score's predictive power for CIN in local populations, despite its widespread use. To guarantee that the score continues to be a trustworthy instrument for risk assessment, validation of the score is required due to regional variations in disease prevalence, patient anatomy, and healthcare systems. The prognostic value of the Mehran score may change in areas with differing rates of diabetes, cardiovascular disease, and renal impairment, highlighting the need of localized investigations. The purpose of this research is to assess the predictive power of the Mehran score for CIN in the local PCI community. We want to give data that helps direct clinical decision-making in our environment by evaluating its performance. Early identification of high-risk individuals is critical for avoiding complications and improving outcomes, given the substantial prognostic implications of CIN. This study adds to the continuing efforts to improve patient care and risk stratification tools, especially in communities where the incidence of risk variables may vary from those in the Mehran score's initial development cohort.

METHODS

This research was conducted as a prospective single-arm cohort study. The research was conducted at the National Institute of Cardiovascular Disease (NICVD) in Karachi, specifically at the Department of Adult Cardiology.After the summary was approved, the research was conducted over a six-month period, beginning on September 16, 2019, and ending on March 15, 2020.

Sample Size: Based on the results of Mehran et al., who found that the Mehran risk score could predict CIN with an area under the receiver operating characteristic (ROC) curve (AUC) of 0.67, the sample size was determined. The needed sample size for this research was determined to be 230 individuals receiving elective coronary angiography, with a margin of error of 5% and a 95% confidence range. Using Microsoft Excel, the Hajian-Tilaki technique was used to determine the sample size.

Sampling Technique: Non-probability consecutive sampling was used for patient recruitment.

Sample Selection: ACS patients, regardless of gender, between the ages of 18 and 85, who were having elective coronary angiography were the study's inclusion criteria. Patients having a past history of any cardiac-related surgery, patients who died during coronary angiography, and patients who refused to provide permission were among the exclusion criteria.

Data Collection: The College of Physicians and Surgeons Pakistan (CPSP) and the NICVD Ethical Review Committee gave their clearance before the research was started. Individuals who satisfied the inclusion criteria and had an ACS diagnosis were chosen from the NICVD Adult Cardiology Department. All participants were told of the study's goal and possible benefits, and the primary investigator acquired verbal informed permission. The following demographic information was gathered: gender, age, height, weight, and pertinent medical history, such as smoking and hyperlipidemia. The method for calculating body mass index (BMI) is BMI = (weight in kg) / (height in meters)². Based on operational criteria, patients were classified as obese or non-obese. An experienced staff nurse took 5 mL of each patient's blood, which was then submitted to the institutional laboratory for serum creatinine measurement before to the operation and again 48 and 72 hours later. Each patient's Mehran score was determined, and the patients were categorized using operational criteria. An interventional cardiologist with over five years of expertise conducted every coronary angiography operation. The incidence of contrast-induced nephropathy (CIN) was documented in accordance with the established standards. The lead investigator recorded data on a predesigned proforma (see Annexure A for details). Strict adherence to the inclusion and exclusion criteria was maintained, and stratification was employed where appropriate to reduce confounding factors and bias. Ensuring patient confidentiality included safeguarding all information and limiting access to authorized people exclusively.

Data Analysis: SPSS version 21 (IBM Corp., 2012, IBM SPSS Statistics for Windows, Version 21.0, Armonk, NY: IBM Corp.) was used for data input and analysis. To summarize the data, descriptive statistics were used. Means and standard deviations (mean ± SD) were computed for continuous variables such as age, weight, height, BMI, and Mehran score. Frequencies and percentages were provided for categorical factors such gender, smoking status, obesity, hyperlipidemia,

risk categories for the Mehran score, and the incidence of CIN. Stratification was used to take impact modifiers such gender, age group, smoking, hyperlipidemia, and obesity into consideration. The chi-square test was used after stratification to identify meaningful correlations. Using receiver operating characteristic (ROC) analysis, the predictive accuracy of the Mehran risk score for CIN was evaluated, and the area under the curve (AUC) was reported. A p-value of less than 0.05 on both sides was deemed statistically significant. Pie charts and bar graphs were used to display the data visually.

RESULTS

In order to assess the Mehran Score's predictive accuracy of CIN after PCI in the local community, 230 patients in total were included in the research. With a mean age of 57.56 ± 15.45 years, the patients' ages varied from 28 to 80 years. Table 1 displays the age confidence interval, which ranged from 55.55 to 59.57 years.

Table No. 1: Descriptive Statistics of Age

Statistic	Value	Std. Error	95% C.I (Lower Bound - Upper Bound)
Mean	57.56	1.019	55.55 - 59.57
Std. Deviation	15.457		
Minimum	28		
Maximum	85		

With a 95% confidence range of 69.27 to 71.93 kg, the patients' mean weight was 70.60 ± 10.23 kg. The average BMI was 27.10 ± 5.91 kg/m², and the average height was 162.89 ± 12.65 cm (Table 2). There were 80 female patients (34.8%) and 150 male patients (65.2%) in the patient population.

Table 2: Descriptive Statistics of Weight, Height, and BMI

Statistic	Weight (kg)	Height (cm)	BMI (kg/m²)
Mean	70.60 ± 10.23	162.89 ± 12.65	27.10 ± 5.91
95% C.I	69.27 - 71.93	161.24 - 164.53	26.33 - 27.87
Minimum	51	142.24	15.8
Maximum	90	182.88	44.5

64 patients (27.8%) in the study group had CIN after PCI, while 166 patients (72.2%) did not. Figure 1 illustrates the patient distribution according to Mehran Risk Score categories: 150 patients (65.2%) were categorized as low risk, 76 patients (34.0%) as moderate risk, and only 4 patients (1.7%) as high risk.
Patients with higher Mehran Scores had a greater incidence of CIN. Three individuals (75%) out of the high-risk group and 47 (61.8%) out of the moderate-risk group had CIN. On the other hand, only 14 people (9.3%) in the low-risk group had CIN. The area under the curve (AUC) of 0.9296 was obtained from the receiver operating characteristic (ROC) curve, which was used to evaluate the discriminating strength of the Mehran Score and is shown in Table 3. > 5.50 was shown to be the ideal cut-off value for predicting CIN, with a sensitivity of 90.63% and a specificity of 87.95%. This yields a probability ratio of 7.522, indicating that the Mehran Score for CIN has a good prediction accuracy in this local population.

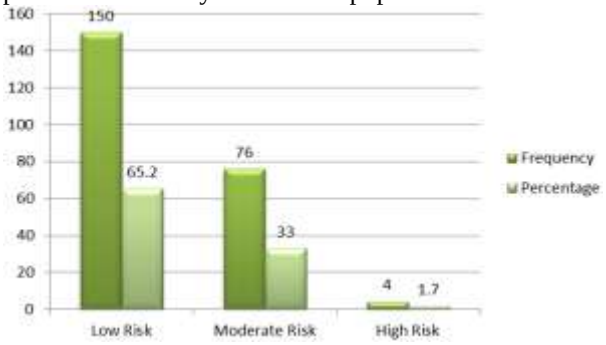

Figure No. 1: Distribution of Mehran Risk Score Categories

Table No. 3: ROC Analysis of Mehran Score for Predicting CIN

Statistic	Value
AUC	0.9296
Standard Error	0.02129
95% C.I	0.8851 - 0.9686
P-value	< 0.0001

The research also looked at age, gender, smoking status, BMI, and hyperlipidemia as possible risk factors for CIN development. Older individuals had a considerably greater incidence of CIN. 50 patients (21.7%) in the over-50 age group had CIN, compared to only 14 individuals (6.1%) in the 25–50 age group. Table 4 summarizes the statistical significance of this difference ($p < 0.0001$).

Table No. 4: Association Between Age and CIN Development

Age Group (Years)	CIN Present (%)	CIN Absent (%)	P-value
25 – 50	14 (6.1%)	85 (37.0%)	< 0.0001
> 50	50 (21.7%)	81 (35.2%)	

Table No 5: Association Between Gender and CIN Development

Gender	CIN Present (%)	CIN Absent (%)	P-value
Male	43 (18.7%)	107 (46.5%)	0.697
Female	21 (9.1%)	59 (25.7%)	

According to the research, there is no discernible gender difference in the incidence of CIN. Table 5 demonstrates that there was no statistically significant connection ($p = 0.697$) between the number of men

who acquired CIN (18.7%) and the number of females (9.1%).

There was no statistically significant correlation seen between smoking status and the onset of CIN. Table 6 shows that of the 130 patients who did not smoke, 35 (15.2%) got CIN (p = 0.728), while 29 (12.6%) of the 100 smokers had CIN.

Table No. 6: Association Between Smoking Status and CIN Development

Smoking Status	CIN Present (%)	CIN Absent (%)	P-value
Smoker	29 (12.6%)	71 (30.9%)	0.728
Non-Smoker	35 (15.2%)	95 (41.3%)	

The incidence of CIN and BMI were shown to be statistically significantly correlated (p = 0.010). Patients who were obese had the greatest incidence of CIN (12.2%), followed by those who were overweight (7.8%) and those who were normal weight (7.8%). Figure 2 illustrates that no incidences of CIN were recorded among individuals who were

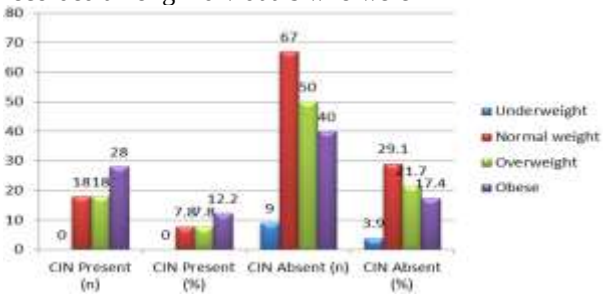

Figure No. 2: Association Between BMI and CIN Development

Table 7 summarizes the research findings. Patients with hyperlipidemia had a greater risk of CIN (16.1%) than those without hyperlipidemia (11.7%), although this difference was not statistically significant (p = 0.326).

Table No. 7: Association between Hyperlipidemia and CIN Development

Hyperlipi-demia	CIN Present (%)	CIN Absent (%)	P-value
Present	37 (16.1%)	84 (36.5%)	0.326
Absent	27 (11.7%)	82 (35.7%)	

DISCUSSION

The current investigation sought to assess the Mehran Score's prediction power for CIN in a community receiving PCI. With an AUC of 0.9296, our findings show that the Mehran Score has good discriminating power. This demonstrates the score's usefulness in clinical settings for estimating the risk of CIN, particularly in high-risk groups like the elderly and those with high body mass index. These results are in line with other research that showed the Mehran Score to be a reliable predictor of CIN, especially in individuals with related comorbid illnesses. But by concentrating on a local community with distinct risk factors and illness patterns, our research contributes to the body of literature by highlighting regional differences in health profiles.

It is clear from comparing our findings to earlier research that the prediction accuracy of the Mehran Score is consistent across a range of demographics [9]. The AUC ranged from 0.72 to 0.89 in previous research, indicating different degrees of prediction accuracy based on demographic variables including ethnicity, illness prevalence, and therapeutic practices[10]. The Mehran Score may perform even better in our particular environment, according to our study's higher AUC, which may be caused by variations in risk factor profiles, such as greater rates of diabetes and chronic renal disease in the local community.

This study indicated that the cut-off value for predicting CIN was > 5.50, which deviates somewhat from earlier values published in other studies [11]. Our findings are consistent with research that have shown a cut-off point between 5 and 6, indicating that even small changes in thresholds may have a substantial effect on sensitivity and specificity. This result highlights the need of local validation for risk prediction methods, as population-specific risk variables may require adjusting standard scores. The results of the stratified analysis demonstrated a strong correlation between the incidence of CIN and advanced age and higher BMI. This result is in line with other research that found obesity and age to be important predictors of CIN. Higher BMI patients were more likely to develop CIN, consistent with previous research linking obesity to altered renal hemodynamics that heighten the risk of CIN. Given that older patients often have lower renal reserves and more concomitant illnesses, age has also been extensively documented as a risk factor for CIN.

In our investigation, however, smoking status, gender, and hyperlipidemia did not substantially correlate with CIN. This is different from other previous research that indicated smoking's role in endothelial dysfunction as a major risk factor for CIN[12]. Our population's unique features or the comparatively small sample size might be to blame for the results' lack of statistical significance. Furthermore, hyperlipidemia did not significantly affect our population, despite being linked to CIN in several studies. our might be due to different lipid management strategies in our area[13].

Limitations and Future Directions: There are certain restrictions on this research, even with the encouraging outcomes. Firstly, the limited sample size might potentially restrict the applicability of our results to larger demographics. Secondly, the research was carried out in a solitary facility, perhaps failing to include the variations in CIN risk across diverse healthcare environments. Finally, the assessment of the long-term effects of CIN on renal function was not conducted because to the absence of long-term follow-up. To verify these results in a variety of demographics, future research should concentrate on multi-center studies with bigger sample numbers. Furthermore, investigating the long-term effects of CIN and including other biomarkers may improve the prediction

power of current risk ratings. In populations with distinct risk profiles, the creation of region-specific models for CIN prediction may further enhance therapeutic results.

CONCLUSION

It has been shown that the Mehran Risk Score is a useful tool for anticipating CIN in patients having coronary angiography who have ACS. Based on their risk classifications, this research shows that the Mehran Score can accurately distinguish between patient subgroups that are low, medium, high, and extremely high risk. All things considered, our results show that the Mehran Risk Score has a strong predictive value for the development of CIN. However, further research with bigger sample numbers and a wider variety of factors across more Pakistani centers is necessary to validate these findings even more. The comprehension and use of the Mehran Score in a variety of patient groups will be improved by such studies.

Author's Contribution:

Concept & Design of Study:	Sumaiya Muhammad Iqbal Memon
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Final Approval of version:	By all above authors

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