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ORIGINAL ARTICLE

Comparative effectiveness of rosuvastatin and atorvastatin in preventing Contrast-Induced Nephropathy (CIN) in patients with Chronic Kidney Disease (CKD).

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ABSTRACT… Objective: To compare the efficacy of rosuvastatin and atorvastatin in preventing contrast-induced nephropathy (CIN) in patients with chronic kidney disease (CKD) undergoing percutaneous coronary intervention (PCI). **Study Design:** Randomized Controlled Trial. **Setting:** Department of Nephrology, Shaikh Zayed Hospital, Lahore. **Duration:** 26/10/2024 to 26/03/2025. **Methods:** A total of 150 patients with CKD Stage G3, G4, and G5 were randomly assigned to two equal groups (75 patients each) using an online randomizer. Group A received atorvastatin (80 mg at baseline and daily), and Group B received rosuvastatin (40 mg at baseline and daily). Both medications were administered for three days before PCI and continued for two days after PCI. **Results:** The study included 60 participants with an average age of 57.15 ± 5.56 years and a mean BMI of 27.69 ± 1.62 kg/m^2. Baseline creatinine levels were 2.53 ± 1.23 mg/dL, increasing to 2.94 ± 2.03 mg/dL post-procedure. CIN occurred in 13 (21.7%) of participants. Among CIN cases, 8 (61.5%) were in the atorvastatin group, while 5 (38.5%) were in the rosuvastatin group ($p = 0.347$). CIN was more frequent in CKD Stage 5 patients (84.6%), showing a significant association with CKD stage ($p < 0.001$). However, diabetes ($p = 0.387$), hypertension ($p = 0.276$), BMI ($p = 0.139$), and smoking ($p = 0.321$) did not show significant associations with CIN. **Conclusion:** CIN occurred in 21.7% of the study population, with CKD Stage 5 as the strongest predictor ($p < 0.001$). No statistically significant difference was observed between atorvastatin and rosuvastatin in preventing CIN ($p = 0.347$).

Key words: Atorvastatin, Contrast-Induced Nephropathy, Chronic Kidney Disease, Percutaneous Coronary Intervention, Rosuvastatin, Renal Function, Statin Therapy.

INTRODUCTION

Contrast-induced nephropathy (CIN) is characterized by an acute impairment of renal function following exposure to contrast media, primarily due to the vasospasm of renal vessels triggered by the contrast agent.[1,2] The incidence of contrast-induced nephropathy (CIN) in patients with chronic kidney disease (CKD) ranges from 20% to 20.6%, with a global prevalence of contrast-induced acute kidney injury (CI-AKI) at approximately 150,000 cases annually, contributing to prolonged hospital stays, increased morbidity and mortality, and higher healthcare costs.[3] Current treatment protocols for preventing CIN include adequate hydration, the use of low or iso-osmolar contrast agents, and prophylactic medications such as N-acetylcysteine.[4,5] Statins, routinely prescribed by cardiologists, have shown promise in preventing CIN due to their antithrombotic, antioxidative, and anti-inflammatory properties.[6,7] Despite these potential benefits, the effectiveness of statins in preventing contrast-induced acute kidney injury (CI-AKI) remains inconsistent across studies.

According to Firouzi et al., in a study involving 495 randomly selected patients undergoing PCI, the incidence of CIN was observed in 63 patients (21.4%). Among the patients, those treated with rosuvastatin showed CIN incidence as follows: Grade 0 (no CIN) in 125 (19.4%), Grade 1 (mild CIN: increase in serum creatinine by 25-50%) in 22 (14.6%), and Grade 2 (moderate CIN: increase

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in serum creatinine by more than 50%) in 4 (2.6%). In the atorvastatin group CIN incidence was Grade 0 (no CIN) in 107 (74.3%), Grade 1 (mild CIN: increase in serum creatinine by 25-50%) in 28 (19.4%), and Grade 2 (moderate CIN: increase in serum creatinine by more than 50%) in 9 (6.3%). The study concluded that atorvastatin and rosuvastatin have similar efficacy for the prevention of CIN.[8]

According to Golshani et al., among 206 patients who underwent primary PCI, the incidence of CIN was 14.6% (18 patients) in the atorvastatin group and 7.2% (6 patients) in the rosuvastatin group.[9]

According to Liu et al., the study compared the preventive effects of rosuvastatin and atorvastatin on contrast-induced nephropathy (CIN) in patients with chronic kidney disease (CKD) undergoing percutaneous coronary intervention (PCI). CIN was observed in 58 (5.4%) patients, with a similar incidence in those pretreated with rosuvastatin or atorvastatin (5.9% vs. 5.2%).[10]

The rationale of the current study is to address the conflicting results observed in previous research regarding the efficacy of rosuvastatin and atorvastatin in preventing contrast-induced nephropathy (CIN) in patients with chronic kidney disease (CKD). Despite the widespread use of statins for their potential nephroprotective effects, there remains a significant gap in the literature, particularly concerning patients with advanced CKD stages (G3, G4, and G5) and within the Pakistani population. Limited comparative studies have been conducted in this specific demographic, and the existing studies present inconsistent findings on the relative benefits of rosuvastatin versus atorvastatin. This study aims to provide clearer evidence on the efficacy of these statins in preventing CIN, thereby informing clinical practice and potentially improving patient outcomes. The findings of this study will be crucial for healthcare providers in making evidence-based decisions and could lead to the development of more effective preventive strategies for CIN in high-risk CKD patients, ultimately reducing the incidence of CIN, hospital stays, morbidity, mortality, and healthcare costs.

OBJECTIVE

To compare the efficacy of rosuvastatin and atorvastatin in preventing contrast-induced nephropathy (CIN) in patients with chronic kidney disease (CKD).

METHODS

This randomized controlled trial was conducted in the Department of Nephrology, Shaikh Zayed Hospital, Lahore from 26 September 2024 to 26 March 2025 after approval from ethics committee (Ref. No. 02-TERC/NHRC-SZH/Int-Sc/691 Dated: 23-09-24). The study included 150 patients with Chronic Kidney Disease (CKD) Stages G3, G4, and G5, diagnosed using the CKD-EPI Creatinine Equation (2021). Patients undergoing Percutaneous Coronary Intervention (PCI) were enrolled and randomly assigned into two equal groups (75 patients each) using an online randomizer. Group A received atorvastatin (80 mg at baseline and daily), and Group B received rosuvastatin (40 mg at baseline and daily). Both medications were administered for three days before PCI and continued for two days after PCI.

Contrast-Induced Nephropathy (CIN) was defined as an absolute increase in serum creatinine (SCr) of $\geq$0.5 mg/dL or a relative increase of $\geq$25% from baseline within 48 hours after contrast medium (CM) exposure. The primary endpoint was the incidence of CIN in both groups, and the statin associated with a lower CIN incidence was considered more effective.

Patients aged 20 to 70 years, of either gender, with CKD for at least three months, and undergoing PCI were included. Patients were excluded if they had a history of chronic statin therapy (>14 days), heart failure, pregnancy, contrast medium allergy, or hepatic insufficiency. Those treated with nephroprotective (e.g., N-acetylcysteine, theophylline) or nephrotoxic (e.g., steroids, NSAIDs, aminoglycosides, amphotericin B) drugs or those who had undergone renal transplantation or dialysis were also excluded.

After obtaining approval from the hospital ethical committee and CPSP, informed consent was secured from all patients. Demographic

details, including age, gender, BMI, CKD stage and duration, smoking history, and comorbidities (diabetes mellitus, hypertension, and other conditions), were recorded. Baseline serum creatinine was measured before statin administration, and patients underwent contrast imaging during PCI. Serum creatinine levels were reassessed 48 hours post-PCI to determine CIN occurrence. Data were collected using a predefined proforma.

Data were entered and analyzed using SPSS version 27.0. Numerical variables (age, height, weight, BMI, CKD duration, and creatinine levels) were expressed as mean ± standard deviation (SD). Categorical variables (gender, CKD stage, smoking, diabetes mellitus, hypertension, and CIN development) were presented as frequencies and percentages. The Chi-square test was used to compare CIN occurrence between groups, with a p-value ≤0.05 considered statistically significant. Data were stratified based on age, gender, BMI, CKD stage, and comorbidities, and post-stratification Chi-square tests were applied.

RESULTS

The study included 60 participants with an average age of 57.15 ± 5.56 years. The average BMI was 27.69 ± 1.62 kg/m^2. The baseline creatinine level was 2.53 ± 1.23 mg/dL, and the post-procedure creatinine level increased to 2.94 ± 2.03 mg/dL.

According to table 1, 34 (56.7%) had DM, while 26 (43.3%) did not. Hypertension (HTN) was highly prevalent, with 56 (93.3%) of participants having HTN, while only 4 (6.7%) did not. Regarding smoking status, 22 (36.7%) were smokers, and 38 (63.3%) were non-smokers. CKD) stages were distributed as follows: 31 (51.7%) were in stage 3, 18 (30.0%) in stage 4, and 11 (18.3%) in stage 5. Contrast-Induced Nephropathy (CIN) occurred in 13 (21.7%) of participants, while 47 (78.3%) did not develop CIN.

According to table 2, in the Atorvastatin group, 8 (61.5%) developed CIN, compared to 5 (38.5%) in the Rosuvastatin group. Among those without CIN, 22 (46.8%) were in the Atorvastatin group, while 25 (53.2%) were in the Rosuvastatin group. The difference between the two groups was not statistically significant (p = 0.347).

Clinicodemographic Variables	Category	n (%)
Diabetes Mellitus	Yes	34 (56.7%)
	No	26 (43.3%)
Hypertension	Yes	56 (93.3%)
	No	4 (6.7%)
Smoking	Yes	22 (36.7%)
	No	38 (63.3%)
CKD Stage	Stage 3	31 (51.7%)
	Stage 4	18 (30.0%)
	Stage 5	11 (18.3%)
Contrast Induced Nephropathy	Yes	13 (21.7%)
	No	47 (78.3%)

Table-I. Descriptive statistics of clinicodemographic variables

CIN Status	Atorvastatin Group (N, %)	Rosuvastatin Group (N, %)	Total (N, %)	P-Value
Yes	8 (61.5%)	5 (38.5%)	13 (21.7%)	0.347
No	22 (46.8%)	25 (53.2%)	47 (78.3%)	
Total	30 (50.0%)	30 (50.0%)	60 (100.0%)	

Table-II. Comparison of CIN between Atorvastatin and Rosuvastatin Group

Among CIN cases, 4 (30.8%) were in the 40-50 years age group, 8 (61.5%) were in the 51-60 years group, and 1 (7.7%) was 60 years or older. The difference was not statistically significant (p = 0.081). All 13 (100.0%) CIN cases were in the overweight category, while none of the obese participants developed CIN. The association was not significant (p = 0.139). CIN was more common in patients with advanced CKD. No CIN cases were observed in Stage 3, while 2 (15.4%) of Stage 4 patients and 11 (84.6%) of Stage 5 patients developed CIN. This association was highly significant (p < 0.001). Among participants with CIN, 6 (46.2%) had diabetes, while 7 (53.8%) did not. The association between DM and CIN was not statistically significant (p = 0.387). All 13 (100.0%) CIN cases had hypertension, but 43 (91.5%) of non-CIN participants also had

hypertension. The difference was not significant (p = 0.276). Among CIN cases, 5 (38.5%) were smokers, while 8 (61.5%) were non-smokers. The association between smoking and CIN was not statistically significant (p = 0.321).

Variable	CIN Yes (N, %)	CIN No (N, %)	Total (N, %)	P-Value
Age Categories				
40-50 years	4 (30.8%)	5 (10.6%)	9 (15.0%)	0.081
51-60 years	8 (61.5%)	27 (57.4%)	35 (58.3%)	
60+ years	1 (7.7%)	15 (31.9%)	16 (26.7%)	
BMI Categories				
Over weight	13 (100.0%)	40 (85.1%)	53 (88.3%)	0.139
Obese	0 (0.0%)	7 (14.9%)	7 (11.7%)	
CKD Stage				
Stage 3	0 (0.0%)	31 (66.0%)	31 (51.7%)	<0.001
Stage 4	2 (15.4%)	16 (34.0%)	18 (30.0%)	
Stage 5	11 (84.6%)	0 (0.0%)	11 (18.3%)	
Diabetes Mellitus				
Yes	6 (46.2%)	28 (59.6%)	34 (56.7%)	0.387
No	7 (53.8%)	19 (40.4%)	26 (43.3%)	
Hypertension				
Yes	13 (100.0%)	43 (91.5%)	56 (93.3%)	0.276
No	0 (0.0%)	4 (8.5%)	4 (6.7%)	
Smoking				
Yes	5 (38.5%)	17 (36.2%)	22 (36.7%)	0.321
No	8 (61.5%)	30 (63.8%)	38 (63.3%)	

Table-III. Cross-tabulations between CIN and Independent Variables

DISCUSSION

The findings of this study indicate that 21.7% of participants developed Contrast-Induced Nephropathy (CIN), with a higher occurrence in patients with advanced CKD (Stage 5, 84.6%). Diabetes mellitus (DM) and hypertension (HTN) were highly prevalent in the study population, but their association with CIN was not statistically significant. There was no significant difference in CIN incidence between the Atorvastatin (61.5%) and Rosuvastatin (38.5%) groups (p = 0.347).

The observed CIN incidence aligns with findings from Rahman et al., who reported a similar prevalence in high-risk populations.[11] Their study also emphasized CKD as a major risk factor for CIN, supporting the current study's finding of a significant association between CKD Stage and CIN (p < 0.001). However, Shanker et al. (2024) and Modi et al. (2025) reported a higher overall CIN incidence, which may be due to differences in patient selection criteria and contrast exposure.[12,13]

The lack of a significant association between diabetes and CIN (p = 0.387) is consistent with findings from Liu Y et al. (2014) who suggested that diabetes alone is not a strong predictor of CIN when renal function is considered.[10] Conversely, Anwar et al. (2017) and Heyman et al. (2013) found that diabetic patients had a higher CIN risk, particularly in those with poor glycemic control, indicating that other metabolic factors may influence susceptibility.[14,15]

Hypertension was prevalent in 93.3% of participants, yet it was not significantly associated with CIN (p = 0.276). This result supports Chillo et al. (2021) who suggested that HTN alone is not a strong predictor of CIN when renal function and other factors are considered.[16] However, Modi et al. (2025) found a significant association, proposing that long-term HTN may contribute to microvascular damage, increasing CIN risk over time.[13]

Regarding BMI, all CIN cases were observed in overweight individuals (100%), but the association was not significant (p = 0.139). This finding is in agreement with Jaipaul et al. (2010) who reported that BMI alone does not predict CIN risk.[17] However, Kabeer et al. (2020) found a positive correlation, suggesting that obesity-related metabolic disturbances could increase CIN susceptibility.[18]

The comparison of Atorvastatin and Rosuvastatin showed no significant difference in CIN occurrence ($p = 0.347$), which aligns with Firouzi et al. (2018) who reported that statin type does not significantly affect CIN prevention.[18] However, Zhang et al. (2018) found that Rosuvastatin was associated with a lower CIN risk, possibly due to its stronger lipid-lowering and anti-inflammatory properties.[19]

CONCLUSION

CIN occurred in 21.7% of the study population, with CKD Stage 5 as the strongest predictor ($p < 0.001$). No statistically significant difference was observed between atorvastatin and rosuvastatin in preventing CIN ($p = 0.347$).

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Muhammad Fiaz:** Research planning, data collection, analysis.
2	**Mateen Akram:** Data collection, initiate hypothesis.
3	**Khurshid Ahmed Butt:** Proof reading, analysis.
4	**Saira Aziz:** Revision, review.