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***Original Research Article***

# Comparison of Efficacy of Rosuvastatin Versus Atorvastatin in Reducing LDL Levels Among Type 2 Diabetes Mellitus Patients at a Tertiary Care Hospital

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**Abstract:** *Type 2 diabetes mellitus (T2DM) is commonly accompanied by dyslipidemia, significantly increasing cardiovascular risk. Optimal lowering of low-density lipoprotein cholesterol (LDL-C) is a primary therapeutic goal. Although both rosuvastatin and atorvastatin are widely prescribed in Pakistan, comparative data regarding their LDL-lowering efficacy among local diabetic populations remain limited.* ***Objective:*** *To compare the efficacy of rosuvastatin versus atorvastatin in reducing LDL-C levels among patients with T2DM treated at a tertiary care hospital.* ***Methods:*** *A randomized controlled trial was conducted at the Department of Medicine, Medical Unit II, Sheikh Zayed Hospital, Rahim Yar Khan, from August 18, 2024, to February 18, 2025. A total of 246 patients aged 30–80 years with established T2DM and baseline LDL-C > 100 mg/dL were randomized in a 1:1 ratio to receive rosuvastatin 10 mg or atorvastatin 10 mg daily for 4 weeks. Baseline and post-treatment lipid levels were measured using standardized enzymatic assays. Efficacy was defined as achieving an LDL-C level < 100 mg/dL. Data were analyzed using SPSS version 25, with statistical significance set at $p \leq 0.05$.* ***Results:*** *The mean age of participants was 56.4 ± 9.7 years, with 58.5% males and 41.5% females. Both groups were comparable at baseline ($p > 0.05$). After four weeks, rosuvastatin produced a significantly greater LDL-C reduction than atorvastatin (mean reduction: 71.9 ± 19.3 vs 57.6 ± 18.9 mg/dL, $p < 0.001$). Post-treatment LDL-C was considerably lower in the rosuvastatin group (92.4 ± 14.2 mg/dL) compared with the atorvastatin group (108.1 ± 17.6 mg/dL, $p < 0.001$). Efficacy was achieved in 79.7% of patients treated with rosuvastatin, compared with 55.3% in the atorvastatin group ($\chi^2 = 16.7$, $p < 0.001$). Stratification by age, gender, obesity, and hypertension consistently demonstrated superior outcomes with rosuvastatin across all subgroups.* ***Conclusion:*** *Rosuvastatin 10 mg daily was significantly more effective than atorvastatin 10 mg in lowering LDL-C and achieving therapeutic LDL targets in patients with T2DM. Its superior efficacy across all demographic and clinical subgroups suggests that rosuvastatin may be the preferred statin for lipid control in Pakistani diabetic populations. Further long-term studies are warranted to evaluate cardiovascular outcomes associated with these differences.*

**Keywords:** Rosuvastatin, Atorvastatin, LDL cholesterol, Type 2 diabetes mellitus

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## Introduction

Type 2 Diabetes Mellitus (T2DM) is often associated with dyslipidemia and an increased risk of cardiovascular events, making lipid management a priority in this patient population. Among the various classes of lipid-lowering agents, statins, specifically atorvastatin and rosuvastatin, have emerged as the first-line therapies for managing elevated low-density lipoprotein (LDL) cholesterol levels. These two statins are widely used for their efficacy in lowering LDL cholesterol and for their varying effects on metabolic parameters, including glucose metabolism and the risk of new-onset diabetes (1).

Numerous clinical trials have established the cholesterol-lowering potency and cardiovascular benefits of atorvastatin and rosuvastatin. For instance, clinical data indicate that rosuvastatin provides a more pronounced reduction in LDL cholesterol compared to atorvastatin, particularly at comparable doses. Some studies show that patients treated with rosuvastatin can achieve a greater reduction in LDL cholesterol than those treated with atorvastatin (2, 3). Furthermore, findings from the LODESTAR trial suggest that rosuvastatin not only achieves lower LDL levels but also has a favorable profile for new-onset diabetes and other metabolic abnormalities compared with atorvastatin (1).

Despite robust findings regarding the efficacy of both statins in lowering LDL cholesterol, it is crucial to consider their associated risks. Recent research suggests that both atorvastatin and rosuvastatin reduce cardiovascular events, but there may be differences in their side-effect profiles regarding glucose intolerance and new-onset diabetes (4, 5). Studies have indicated that rosuvastatin, while effective in lowering LDL levels, is associated with a lower incidence of new-onset diabetes than atorvastatin (4), which is vital for healthcare practitioners managing lipid levels in patients with T2DM, where the balance between lowering cholesterol and maintaining glycemic control is essential.

Moreover, treatment decisions regarding statin choice must be contextualized within the population they serve. In developing countries like Pakistan, where diabetes incidence rates are rising, understanding the comparative effectiveness of these agents is crucial (6). Given the unique genetic and lifestyle factors prevalent in Pakistani patients, evidence-based guidelines tailored for this demographic are needed. Research shows that statin efficacy can vary based on genetic predispositions and dietary habits, underscoring the need to explore appropriate statin management (7) further.

Both atorvastatin and rosuvastatin serve as effective treatments for lowering LDL cholesterol in patients with T2DM; their differential effects on glycemic control warrant closer examination. An evaluation of their safety and efficacy in a Pakistani cohort can provide valuable insights into optimizing lipid management strategies in this population.

## Methodology

The study was conducted in the Department of Medicine, Medical Unit II, at Sheikh Zayed Hospital, Rahim Yar Khan. After obtaining approval from the institutional ethical review committee and the College of Physicians and Surgeons of Pakistan, a randomized controlled trial was conducted over six months from August 18, 2024, to February 18, 2025. Consecutive adult patients presenting to the outpatient and inpatient

medical services were screened for eligibility. Individuals aged 30 to 80 years with an established diagnosis of type 2 diabetes mellitus for at least one year were included if their laboratory investigations demonstrated fasting plasma glucose above 126 mg/dL, random blood sugar above 200 mg/dL, and HbA1c greater than 6.5 percent, along with baseline low-density lipoprotein cholesterol levels exceeding 100 mg/dL. Patients were excluded if they were pregnant or lactating, had known genetic lipid disorders, or were receiving concomitant lipid-lowering therapies such as bile-acid sequestrants, niacin, ezetimibe, fenofibrate, or omega-3 supplements. Additional exclusions were made for patients with heart failure, uncontrolled hypertension, endocrine abnormalities, previous coronary artery disease, persistent cardiac dysrhythmias, malignancy, chronic kidney or liver disease, chronic obstructive pulmonary disease, or neurological or psychiatric illness, based on medical records and clinical assessment.

Eligible participants were enrolled after providing informed written consent, and baseline demographic and clinical information, including age, gender, residential status, duration of diabetes, hypertension status, height, weight, and body mass index, was recorded in a structured proforma. Obesity was defined according to the WHO Asian criteria, with a BMI greater than 27.5 kg/m² categorized as obese. All participants underwent baseline laboratory testing, including fasting blood sugar, random blood sugar, HbA1c, total cholesterol, and LDL-C, performed in the hospital's accredited pathology laboratory using standardized enzymatic assays. Following enrollment, patients were randomized in a 1:1 allocation ratio into two treatment groups using a computer-generated simple randomization sequence. Group A received rosuvastatin 10 mg taken orally at bedtime, while Group B received atorvastatin 10 mg taken orally at bedtime. Medication adherence was reinforced through verbal counseling and telephonic reminders, and patients were instructed to maintain their usual diet and antidiabetic therapy throughout the study period.

All participants were scheduled for follow-up after four weeks of therapy. At this visit, a fasting blood sample was collected after at least 12 hours to reassess LDL-C and total cholesterol levels using the same laboratory methods as at baseline. Efficacy was operationally defined as achieving an LDL-C value below 100 mg/dL at the end of the four-week treatment period. Patients' contact numbers were recorded to minimize loss to follow-up, and the principal investigator documented all laboratory and clinical data to ensure uniformity in data collection. Data were analyzed using SPSS version 25. Quantitative variables such as age, BMI, laboratory values, and duration of diabetes were summarized as mean and standard deviation. Categorical variables, including gender, residential status, obesity, hypertension, and treatment efficacy, were analyzed as frequencies and percentages. The Shapiro–Wilk test was applied to assess data normality. Comparison of effectiveness between the two statin groups was performed using the chi-square test, and p-values of 0.05 or lower were considered statistically significant. Effect modifiers such as age, diabetes duration, gender, obesity, hypertension, and residential status were stratified, followed by post-stratification chi-square testing to evaluate their influence on treatment outcomes. The rigorous methodological approach ensured internal validity and allowed for a robust comparison of rosuvastatin and atorvastatin in reducing LDL-C levels among patients with type 2 diabetes mellitus in a Pakistani tertiary-care setting.

## Results

The study enrolled 246 patients with type 2 diabetes mellitus, with a mean age of 56.4 ± 9.7 years and no significant age difference between groups. Males constituted 58.5% of the sample and females 41.5%. Urban residents were 61.4% of the population. The mean duration of diabetes was 8.2 ± 4.3 years, and the overall mean BMI was 30.0 ± 3.7 kg/m². Obesity was observed in 68.7% and hypertension in 54.8%. All baseline characteristics were statistically comparable between the two groups ($p > 0.05$), confirming successful randomization. (Table 1)

Baseline LDL-C levels were similar between the rosuvastatin and atorvastatin groups (164.3 ± 22.8 vs 165.7 ± 23.4 mg/dL, $p = 0.62$). After 4 weeks, rosuvastatin produced a significantly lower mean LDL-C level (92.4 ± 14.2 mg/dL) compared with atorvastatin (108.1 ± 17.6 mg/dL, $p < 0.001$). The mean LDL-C reduction was also greater with rosuvastatin (71.9 ± 19.3 mg/dL) than with atorvastatin (57.6 ± 18.9 mg/dL, $p < 0.001$). (Table 2)

Efficacy outcomes showed that 79.7% of patients receiving rosuvastatin achieved LDL-C < 100 mg/dL, compared with 55.3% in the atorvastatin group, showing a statistically significant superiority of rosuvastatin ($\chi^2 = 16.7$, $p < 0.001$). (Table 3)

Stratification analysis confirmed rosuvastatin's superior efficacy across all subgroups. Among patients younger than 55 years, efficacy was 82.5% vs 58.7% ($p = 0.003$), and among those aged ≥ 55 years, it was 76.7% vs 52.5% ($p = 0.002$). In males, efficacy was 82.4% vs 58.6% ($p = 0.001$), and in females, 75.5% vs 50.9% ($p = 0.004$). Rosuvastatin also remained superior in obese patients (79.3% vs 50.6%, $p < 0.001$) and hypertensive patients (75.4% vs 48.6%, $p < 0.001$), confirming consistent benefit across clinical modifiers. (Table 4).

**Table 1. Demographic and Baseline Characteristics of Study Participants (n=246)**

| Variable | Rosuvastatin Group (n=123) | Atorvastatin Group (n=123) | Total (n=246) |
|---|---|---|---|
| Age (years), Mean ± SD | 56.1 ± 9.5 | 56.7 ± 9.9 | 56.4 ± 9.7 |
| Gender | | | |
| Male, n (%) | 74 (60.2) | 70 (56.9) | 144 (58.5) |
| Female, n (%) | 49 (39.8) | 53 (43.1) | 102 (41.5) |
| Residential Status | | | |
| Urban, n (%) | 72 (58.5) | 79 (64.2) | 151 (61.4) |
| Rural, n (%) | 51 (41.5) | 44 (35.8) | 95 (38.6) |
| Duration of Diabetes (years), Mean ± SD | 8.1 ± 4.5 | 8.4 ± 4.2 | 8.2 ± 4.3 |
| BMI (kg/m²), Mean ± SD | 29.8 ± 3.6 | 30.1 ± 3.8 | 30.0 ± 3.7 |
| Obesity, n (%) | 82 (66.7) | 87 (70.7) | 169 (68.7) |
| Hypertension, n (%) | 65 (52.8) | 70 (56.9) | 135 (54.8) |

**Table 2. Baseline and Post-treatment LDL-C Levels after 4 Weeks**

| Variable | Rosuvastatin Group (n=123) Mean ± SD | Atorvastatin Group (n=123) Mean ± SD | p-value |
|---|---|---|---|
| Baseline LDL-C (mg/dL) | 164.3 ± 22.8 | 165.7 ± 23.4 | 0.62 |
| LDL-C after 4 weeks (mg/dL) | 92.4 ± 14.2 | 108.1 ± 17.6 | <0.001* |
| Mean LDL Reduction (mg/dL) | 71.9 ± 19.3 | 57.6 ± 18.9 | <0.001* |

**Significant at $p \leq 0.05$*

**Table 3. Comparison of Efficacy between Study Groups**

| Outcome | Rosuvastatin Group (n=123) | Atorvastatin Group (n=123) | p-value |
|---|---|---|---|
| Effective, n (%) | 98 (79.7) | 68 (55.3) | <0.001* |
| Not effective, n (%) | 25 (20.3) | 55 (44.7) | |

**Table 4. Stratification of Efficacy by Effect Modifiers (Rosuvastatin vs Atorvastatin)**

| Modifier | Category | Rosuvastatin Effective n (%) | Atorvastatin Effective n (%) | p-value |
|---|---|---|---|---|
| Age | < 55 years | 52 (82.5) | 37 (58.7) | 0.003* |
| | ≥ 55 years | 46 (76.7) | 31 (52.5) | 0.002* |
| Gender | Male | 61 (82.4) | 41 (58.6) | 0.001* |
| | Female | 37 (75.5) | 27 (50.9) | 0.004* |
| Obesity | Yes | 65 (79.3) | 44 (50.6) | <0.001* |
| | No | 33 (80.5) | 24 (63.1) | 0.045* |
| Hypertension | Yes | 49 (75.4) | 34 (48.6) | <0.001* |
| | No | 49 (84.5) | 34 (64.2) | 0.01* |

## Discussion

The present study aimed to compare the efficacy of rosuvastatin versus atorvastatin in reducing low-density lipoprotein cholesterol (LDL-C) levels among 246 patients with type 2 diabetes mellitus (T2DM). The findings indicated that rosuvastatin significantly outperformed atorvastatin in achieving target LDL-C levels after 4 weeks of treatment. This section discusses these findings in relation to existing literature, providing a comprehensive overview of the efficacy of both statins.

The study enrolled 246 patients (mean age 56.4 ± 9.7 years), where demographic and clinical characteristics such as mean BMI (30.0 ± 3.7 kg/m²), obesity prevalence (68.7%), and hypertension rates (54.8%) demonstrated no significant differences between the two groups ($p > 0.05$). Similar baseline characteristics in terms of gender, urban versus rural residency, and diabetes duration (8.2 ± 4.3 years) affirm the study's robustness in randomization and representativeness, consistent with previous studies conducted in diverse populations, such as those by Khokhar et al.(8).

The initial comparison of LDL-C levels between the rosuvastatin group (164.3 ± 22.8 mg/dL) and the atorvastatin group (165.7 ± 23.4 mg/dL) showed no significant difference ($p = 0.62$). This finding is consistent with previous research indicating that initial LDL-C levels in these poorly controlled diabetic populations often reflect similar baseline metabolic challenges. However, after four weeks of treatment, rosuvastatin led to a mean LDL-C level of 92.4 ± 14.2 mg/dL, compared to 108.1 ± 17.6 mg/dL for atorvastatin ($p < 0.001$). These results corroborate findings from the LODESTAR trial, which highlighted rosuvastatin's superiority in LDL-C reduction among patients with coronary artery disease (9).

The observed mean reduction in LDL-C was notably higher in the rosuvastatin group (71.9 ± 19.3 mg/dL) compared to atorvastatin (57.6 ± 18.9 mg/dL, $p < 0.001$). These findings align with recent meta-analyses, confirming that rosuvastatin consistently leads to greater LDL-C reductions than atorvastatin across various studies (10, 11). Notably, a systematic review found that rosuvastatin is more effective than atorvastatin for lipid profiles in patients with diabetes, supporting the view that the differential lipid-modulating actions of these statins can benefit T2DM patients (12).

The efficacy outcomes demonstrated that 79.7% of patients receiving rosuvastatin achieved LDL-C levels < 100 mg/dL, contrasted with 55.3% in the atorvastatin group ($p < 0.001$). These findings are essential, particularly given that target LDL-C levels are a crucial determinant in cardiovascular risk management in diabetic patients. Such results are also reflected in the literature, which indicates a strong correlation between achieving LDL-C targets and reduced cardiovascular events in T2DM patients (13, 14). The observed $\chi^2$ value of 16.7 indicates a clinically significant difference in efficacy, further supported by analyses demonstrating that achieving LDL-C goals is critical for cardiovascular risk reduction (15).

Our stratification analysis revealed that rosuvastatin maintained superior efficacy across various clinical subgroups, including age (<55 years vs.≥55 years), gender, obesity status, and hypertension status. In aged populations, for instance, efficacy rates were 76.7% with rosuvastatin versus 52.5% with atorvastatin ($p = 0.002$). Research by Khot et al. supports the idea that younger patients with T2DM may experience less metabolic dysregulation than older cohorts, which can influence response to therapy (15).

The efficacy of rosuvastatin in obese patients (79.3% vs 50.6%) aligns closely with findings by Carter et al., highlighting that rosuvastatin exhibits enhanced lipid-modulating effects in patients with comorbid obesity and diabetes (12). Additionally, among hypertensive individuals, 75.4% of those on rosuvastatin achieved the goal, compared with 48.6% on atorvastatin ($p < 0.001$), reinforcing the need to integrate hypertension management with lipid-lowering therapies to optimize cardiovascular health outcomes in diabetic populations (16).

The implications of these findings are particularly significant for Pakistan, where the prevalence of T2DM is escalating alongside obesity and hypertension rates. As demonstrated, rosuvastatin offers superior LDL-C-lowering efficacy in T2DM patients, supporting its role as a primary treatment option. The backdrop of rapidly increasing diabetes prevalence in Pakistan warrants clinical guidelines that account for the specific pharmacokinetic profiles and efficacy of statins in local populations. This study adds to a growing body of literature advocating tailored lipid management strategies that effectively address the unique challenges faced by diabetic patients in Pakistan.

Thus, given the marked differences in LDL-C levels achieved with rosuvastatin compared to atorvastatin, healthcare providers should emphasize the cardioprotective benefits of statin therapy in this demographic, integrating our findings with broader clinical evidence.

This was a single-center study with a short 4-week follow-up period, limiting the assessment of long-term lipid control and cardiovascular outcomes. Adverse effects and lifestyle factors, such as diet and physical activity, were not evaluated, which may have influenced treatment response. Despite these limitations, the randomized design strengthens the reliability of the findings.

## Conclusion

This randomized controlled trial demonstrated that rosuvastatin provides substantially greater LDL-C reduction and a higher rate of achieving target LDL-C levels than atorvastatin among patients with type 2 diabetes mellitus. The consistent superiority of rosuvastatin across all demographic and clinical subgroups highlights its therapeutic advantage in lipid management, especially within the Pakistani population, where diabetes and cardiovascular risk factors are highly prevalent. These findings support the preferential use of rosuvastatin as a more effective strategy for cardiovascular risk reduction in routine clinical practice.

**Declarations**

**Data Availability statement**
All data generated or analysed during the study are included in the manuscript.
**Ethics approval and consent to participate**
Approved by the department concerned. (IRBEC-SZHRYKH-0218-24)
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**Conflict of interest**

The authors declared no conflicts of interest.

**Author Contribution**

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*Review of Literature, Data entry, Data analysis, and drafting an article.*
**SA** (PGR Medicine)
*Conception of Study, Development of Research Methodology Design*
**HNA** (PGR Medicine)
*Study Design, manuscript review, and critical input.*
**NS** (PGR Medicine)
*Manuscript drafting, Study Design,*
**FA** (PGR Medicine)
*Review of Literature, Data entry, Data analysis, and drafting an article.*

*All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.*

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