

# Effect of Atorvastatin and Rosuvastatin on the Glycemic Control in Patients with Type II Diabetes Mellitus: A Comparative, Randomized, Double-Blind Study

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## Abstract

**Objectives:** To compare the effects of atorvastatin and rosuvastatin in type II diabetes mellitus (T2DM) patients with dyslipidemia. **Materials and Methods:** Eighty patients with history of T2DM of more than 3 months duration, glycated hemoglobin <7%, dyslipidemia, and normal electrocardiogram were included in the randomized double-blind trial. The patients received either tablet atorvastatin 20 mg or rosuvastatin 10 mg once a day along with metformin and glimepiride twice daily orally. Patients were evaluated by the change in estimated average glucose (eAG), lipid profile, and incidence of adverse drug reactions (ADRs). **Results:** Rise in fasting blood sugar (FBS), postprandial blood sugar, and eAG were significant in the atorvastatin group as compared to the rosuvastatin group where there was a significant increase only in FBS levels. Changes in lipid parameters and incidence of ADR were similar in both the groups. **Conclusion:** Rosuvastatin can be preferred to atorvastatin in T2DM with dyslipidemia due to less variation in the blood sugar parameters, effective control over lipid profile, pleiotropic effects, and less microsomal interactions.

**Keywords:** Diabetes dyslipidemia, microsomal interactions of statin, pleiotropic effects of statins, statin in diabetes

## INTRODUCTION

Diabetes mellitus (DM) is a leading metabolic disorder with prevalence of 425 million worldwide and 72.946 million in India.<sup>[1]</sup> Type 2 DM (T2DM) results due to either insulin deficiency/hyperinsulinemia or normal insulin level with insulin receptor resistance leading to higher value of blood glucose-related measurements such as random blood sugar (RBS), fasting blood sugar (FBS), postprandial blood sugar (PPBS), and glycated hemoglobin (HbA1c).<sup>[2]</sup>

Low-density lipoprotein-cholesterol (LDL-C) is the most important determinant of the onset of cardiovascular disease in these patients.<sup>[3]</sup> The risk of cardiovascular adverse events is 2–4 times higher in diabetics than in other population. Atherosclerosis-related events account for approximately 65%–75% of all deaths in diabetic patients.<sup>[4]</sup> As per the American College of Cardiology (ACC) Lipid guidelines 2018 and European Society of Cardiology lipid management guidelines update 2019, diabetes is the independent risk factor for development of atherosclerotic vascular disease.<sup>[5,6]</sup>

Hence, in patients with diabetes, the management and control of both hyperglycemia and dyslipidemia is critical.

Statins are the most preferred agents for controlling lipid levels in the diabetics.<sup>[7]</sup> Patients above 40 years of age with LDL-C levels >70 mg/dL should be treated with moderate intensity statins irrespective of their atherosclerotic cardiovascular disease risk as per the recommendations of ACC Lipid guidelines (2018).<sup>[8]</sup>

Atorvastatin and rosuvastatin are the easily available and commonly used statins due to their higher cholesterol-lowering

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**DOI:**  
10.4103/jpp.jpp\_8\_21

**How to cite this article:** Mahatme MS, Bargade MB, Hiware SK, Motlag MM. Effect of atorvastatin and rosuvastatin on the glycemic control in patients with type II diabetes mellitus: A Comparative, randomized, double-blind study. J Pharmacol Pharmacother 2021;12:54-60.

**Received:** 22-01-2021

**Revised:** 15-05-2021

**Accepted:** 22-05-2021

**Web Publication:** 17-09-2021

effect.<sup>[9]</sup> Available data has demonstrated that the diabetogenic risk with statins increases with the higher dose.<sup>[10]</sup> This evidence has resulted in adding DM risk warning on the labels of all statins.<sup>[11]</sup> Despite increased risk of DM, the resultant reduction in cardiovascular morbidity goes in favor of statins use in patients with T2DM irrespective of dysglycemic effects.<sup>[12]</sup> Our in-depth search failed to retrieve studies evaluating the effect of atorvastatin, rosuvastatin, or atorvastatin compared with rosuvastatin in T2DM with dyslipidemia. Moreover, there is a paucity of data regarding the use of statins in Indian diabetic patients.

Hence, the present study was planned to compare the effects of atorvastatin 20 mg and rosuvastatin 10 mg on the glycemic control in T2DM patients with dyslipidemia in Central India.

## MATERIALS AND METHODS

### Trial design

A prospective, randomized, double-blind, parallel, comparative clinical trial was conducted in 80 patients of T2DM with dyslipidemia.

### Participants

Patients above the age of 18 years, willing to comply with the study procedures by signing a written informed consent, having history of T2DM for more than 3 months, maintained on metformin and glimepiride, baseline HbA1c <7%, triglycerides (TGs) levels <240 mg/dL, LDL-C <160 mg/dL and normal electrocardiogram were included.

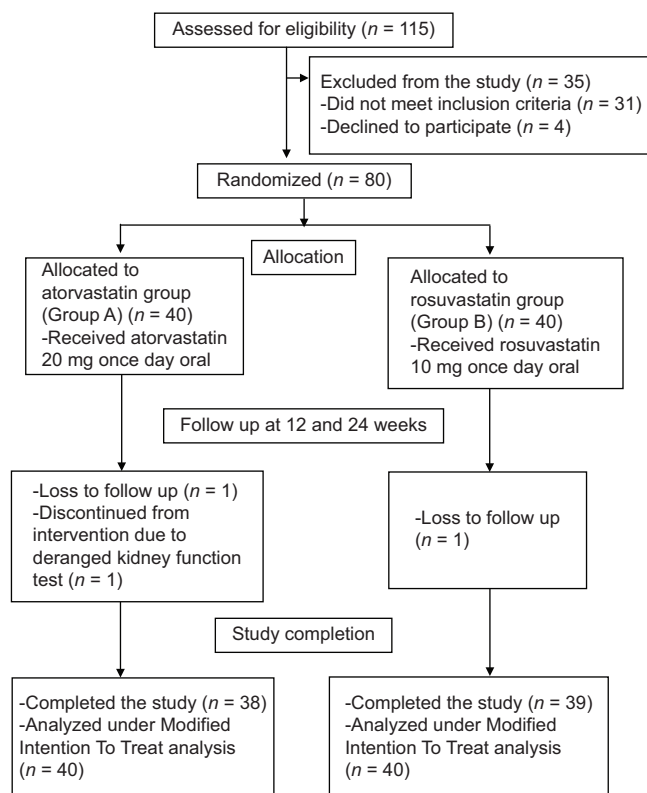
Patients on other medicines which might alter glucose tolerance, lipid or statins metabolism, with overt cardiovascular disease, renal, hepatic disease, peripheral vascular disease, thyroid disease, clinical or laboratory evidence of any inflammatory or infectious condition, history of allergies, intolerance to study drugs, pregnant/lactating/females of childbearing age and not practicing any contraceptive methods were excluded from the study.

The study was commenced after approval by Institutional Ethics Committee (No. IGGMC/ENT/IEC/04-06/2015). After screening, those satisfying the inclusion criteria were briefed about the nature, purpose, procedure, and follow-ups of the study. Patient information sheet was provided to all the participants.

This study was carried out over a period of 18 months (July 2015–December 2016) in the Medicine Out-Patient Department of the tertiary care teaching institute.

### Interventions

The enrolled patients were randomized into two groups i.e., Group A ( $n = 40$ ) and Group B ( $n = 40$ ). Each patient received either tablet atorvastatin 20 mg or tablet rosuvastatin 10 mg once a day in the form of study drugs filled in nontransparent capsule shells identical in shape, size, color and packing. The patients were asked to take the study drug orally at bedtime (once daily), while metformin and glimepiride twice daily. Patients were



**Flowchart 1:** Flow diagram of the progress of the study through the different phases

given a new supply of drug at the end of every 2 weeks and they were instructed to bring any unused drugs and containers to follow-up appointments to check the compliance.

Under all aseptic precautions, 10 ml venous blood was withdrawn at 0, 12, and 24 weeks and analyzed for blood parameters like RBS, FBS, PPBS, HbA1c, lipid profile, kidney function test (KFT), liver function test (LFT), and complete blood count. HbA1c is the standard marker of DM control over the last 3 months.<sup>[13]</sup> HbA1c was estimated using Bio-Rad D-10 Variant-II High-Performance Liquid Chromatography model.<sup>[14]</sup> But estimated average glucose (eAG) was preferred to HbA1c, as the difference in HbA1c change is very small which makes it difficult to analyze. The eAG was calculated from HbA1c using the following formula:<sup>[15]</sup>

$$\text{eAG} = (28.7 \times \text{HbA1c} - 46.7)$$

## Outcomes

### Primary end point

To compare change in eAG with atorvastatin and rosuvastatin in T2DM patients with dyslipidemia.

### Secondary end points

To assess effect of atorvastatin and rosuvastatin on blood sugar profile, lipid profile, and any adverse drug reactions (ADR).

## Sample size calculation

Sample size was calculated by using power and sample size calculator software version 3.1.2. By considering power of 80%, significance level of 0.05, standard deviation of 0.3, and expected difference of 0.2 between two groups from the previous study, the required sample size was calculated to be 36 patients in each group. Thus, taking into consideration the dropouts, 40 patients were recruited in each group.

## Randomization and study drug allocation

Block randomization was used for the random allocation of patients with block sizes of four to ensure a uniform allocation ratio (1:1). A computerized random number table was used for random treatment allocation sequence.

## Blinding

Both the patients and the investigator were unaware of treatment administered. The codes of random allocation sequence were opened only after the completion of the study.

## Statistical analysis

Modified intention-to-treat analysis was used for all the statistical analyses. Inter-group comparison of baseline nonparametric data was done by Chi-square test. Inter-group comparison of parametric data was done by unpaired-*t*-test. Intra-group increment of parametric data was compared using repeated measures ANOVA followed by Bonferroni *post hoc* test at 0, 12, and 24 weeks. ADRs in the two groups were compared by Fisher's exact test. The probability value of <0.05 was considered as statistically significant. The data were analyzed using SPSS for Windows Software version 20.0 (SPSS Inc., Chicago, IL, USA) with the help of statistician.

## RESULTS

This study was carried out over a period of 18 months (July 2015–December 2016) for 24 weeks with follow-up at 0, 12, and 24 weeks. Among 115 patients screened 80 were included in the study. One patient in each group was lost to follow-up. One patient in the atorvastatin group was excluded from the study at 12 weeks due to deranged kidney function test (KFT). Thus, a total of 77 patients (38 in atorvastatin and 39 in the rosuvastatin group) completed the study as depicted in flowchart 1.

Baseline demographic and clinical parameters were comparable in both the groups [Tables 1 and 2] which maintain the homogeneity of the two groups.

## Efficacy analysis

Atorvastatin showed significant change in RBS, FBS, PPBS, and eAG values at 24 weeks as compared to baseline in intra-group analysis. However, in the rosuvastatin group, there was a significant change only in FBS ( $P = 0.008$ ) at 24 weeks [Table 3]. On inter-group analysis, the atorvastatin group showed significant change in FBS, PPBS, and eAG

**Table 1: Baseline demographic parameters**

| Parameter            | Atorvastatin<br>(n=40) | Rosuvastatin<br>(n=40) | P*                 |
|----------------------|------------------------|------------------------|--------------------|
| Age (years), mean±SD | 55.75±7.27             | 57.55±6.27             | 0.239 <sup>a</sup> |
| Sex (male:female)    | 21:19                  | 20:20                  | 0.823 <sup>b</sup> |
| Height (cm), mean±SD | 162±4.64               | 161.75±6.03            | 0.836 <sup>a</sup> |
| Weight (kg), mean±SD | 63.90±6.22             | 62.35±5.95             | 0.258 <sup>a</sup> |
| Diet (veg:mix)       | 11:29                  | 7:33                   | 0.285 <sup>b</sup> |

\* $P < 0.05$  significant, Compared using <sup>a</sup>Unpaired *t*-test, <sup>b</sup>Chi-square test. SD=Standard deviation

**Table 2: Baseline clinical characteristics**

| Parameter                | Atorvastatin<br>(n=40) | Rosuvastatin<br>(n=40) | P*     |
|--------------------------|------------------------|------------------------|--------|
| SBP (mm of Hg)           | 117.35±11.81           | 117.4±11.54            | 0.984  |
| DBP (mm of Hg)           | 76.50±6.16             | 76.30±6.07             | 0.884  |
| Hb (g %)                 | 11.83±0.60             | 11.89±0.74             | 0.691  |
| TLC                      | 7665.0±1956.26         | 7410±1808.78           | 0.546  |
| RBS (mg/dL)              | 136.18±15.95           | 134.15±15.90           | 0.570  |
| FBS (mg/dL)              | 111.63±11.39           | 111.85±8.61            | 0.922  |
| PPBS (mg/dL)             | 157.15±12.20           | 159.78±12.70           | 0.347  |
| HbA1c (%)                | 6.43±0.30              | 6.43±0.30              | >0.999 |
| eAG (mg/dL)              | 137.84±8.50            | 137.84±8.50            | >0.999 |
| TC (mg/dL)               | 198.88±17.59           | 202.45±16.72           | 0.355  |
| TG (mg/dL)               | 180.18±15.13           | 181.50±16.83           | 0.713  |
| VLDL-C (mg/dL)           | 35.95±3.15             | 36.23±3.58             | 0.711  |
| HDL-C (mg/dL)            | 39.95±4.57             | 40.05±4.44             | 0.921  |
| LDL-C (mg/dL)            | 122.89±13.48           | 126.10±13.01           | 0.379  |
| AST (IU/L)               | 21.9±8.3               | 23.75±8.69             | 0.333  |
| ALT (IU/L)               | 19.75±6.43             | 20.98±8.05             | 0.452  |
| ALP (U/L)                | 76.15±12.65            | 73.7±12.41             | 0.384  |
| Serum bilirubin (mg/dL)  | 0.64±0.22              | 0.63±0.19              | 0.828  |
| Serum albumin (mg/dL)    | 4.30±0.54              | 4.22±0.53              | 0.505  |
| Total protein (gm/dL)    | 7.69±0.41              | 7.64±0.44              | 0.600  |
| Blood urea (mg/dL)       | 21.30±4.65             | 20.38±4.07             | 0.349  |
| Serum creatinine (mg/dL) | 0.83±0.24              | 0.78±0.22              | 0.334  |

\* $P < 0.05$  significant, compared using unpaired *t*-test. Values expressed as mean±SD. SBP=Systolic blood pressure, DBP=Diastolic blood pressure, Hb=Hemoglobin, TLC=Total leucocyte count, RBS=Random blood sugar, FBS=Fasting blood sugar, PPBS=Postprandial blood sugar, HbA1c=Glycated hemoglobin, eAG=Estimated average glucose, TC=Total cholesterol, TG=Triglycerides, VLDL-C=Very low density lipoproteins cholesterol, HDL-C=High density lipoproteins cholesterol, LDL-C=Low density lipoproteins cholesterol, AST=Aspartate aminotransferase, ALT=Alanine aminotransferase, ALP=Alkaline phosphatase, SD=Standard deviation

at the end of the treatment as compared to the rosuvastatin group [Table 4].

Lipid parameters, i.e., total cholesterol (TC), TG, very-low-density lipoproteins cholesterol (VLDL-C), high-density lipoproteins cholesterol (HDL-C), LDL-C declined significantly at 24 weeks in both the groups. However, comparatively rosuvastatin group had a significant decline in VLDL-C only, while there was no significant change in TC, TG, HDL-C, and LDL-C [Table 5].

## Safety analysis

There was no statistically significant difference ( $P > 0.05$ ) in the incidence of ADRs between the two groups [Table 6].

## Discussion

Although the present study was double blind, it was limited by small sample size and short duration. However, the value of its results cannot be ignored. In future, similar studies with large sample size and longer follow-up periods may yield more meaningful data.

| Table 3: Change in blood sugar parameters during the study |                     |       |                     |       |
|------------------------------------------------------------|---------------------|-------|---------------------|-------|
| Weeks of treatment                                         | Atorvastatin (n=40) |       | Rosuvastatin (n=40) |       |
|                                                            | Absolute change     | P*    | Absolute change     | P*    |
| RBS (weeks)                                                |                     |       |                     |       |
| 0 and 12                                                   | 7.20±15.84          | 0.072 | 3.62±13.65          | 1.000 |
| 12 and 24                                                  | 6.16±15.20          | 0.184 | 4.00±11.07          | 0.607 |
| 0 and 24                                                   | 13.37±18.39         | 0.000 | 7.62±14.87          | 0.084 |
| FBS (weeks)                                                |                     |       |                     |       |
| 0 and 12                                                   | 8.25±8.58           | 0.003 | 2.26±8.48           | 0.705 |
| 12 and 24                                                  | 10.05±7.47          | 0.000 | 3.38±7.37           | 0.202 |
| 0 and 24                                                   | 18.37±9.66          | 0.000 | 5.64±6.60           | 0.008 |
| PPBS (weeks)                                               |                     |       |                     |       |
| 0 and 12                                                   | 9.48±7.39           | 0.001 | 4.23±11.11          | 0.483 |
| 12 and 24                                                  | 10.53±8.52          | 0.000 | 0.95±8.91           | 1.000 |
| 0 and 24                                                   | 19.97±8.76          | 0.000 | 5.18±12.75          | 0.246 |
| eAG (weeks)                                                |                     |       |                     |       |
| 0 and 12                                                   | 3.52±1.38           | 0.213 | 1.84±1.92           | 0.901 |
| 12 and 24                                                  | 4.98±1.85           | 0.023 | 1.91±1.66           | 0.927 |
| 0 and 24                                                   | 8.53±2.06           | 0.000 | 3.75±2.10           | 0.122 |

\* $P < 0.05$  significant, compared using Bonferroni *post hoc* test. Values expressed as mean±SD. RBS=Random blood sugar, FBS=Fasting blood sugar, PPBS=Postprandial blood sugar, SD=Standard deviation, eAG=Estimated average glucose

Statins are the recommended first-line therapy in dyslipidemia, with benefits extended to diabetic patients with dyslipidemia.<sup>[6]</sup> Atorvastatin and rosuvastatin are preferred due to their higher cholesterol-lowering effect and long half-life which make them suitable for once-daily dosing.<sup>[16]</sup> Metformin is the first-line drug in T2DM. It can be combined with sulfonylureas, meglitinides, thiazolidinediones, and other second-line drugs.<sup>[13]</sup>

A significant increment in all blood sugar parameters in the atorvastatin group was observed, while in the rosuvastatin group, a significant increment was observed only in FBS. As per the available literature, atorvastatin is associated with a greater risk of new-onset diabetes.<sup>[17]</sup> Findings similar to our study have been reported by other studies where atorvastatin was used along with anti-diabetic drugs for the period ranging from 12 weeks to 4 years.<sup>[18-20]</sup> However, for rosuvastatin, some studies have reported findings that are different from our study.<sup>[10,20-22]</sup> This variation may be due to diversity in inclusion and exclusion criteria, duration and the doses of the study drugs.

The inter-group analysis could not be compared with other studies due to the paucity of data in literature. Liew *et al.* analyzed the effect of atorvastatin and rosuvastatin in hypertensive patients with and without diabetes and found a significant increase in HbA1c.<sup>[21]</sup> Similarly, Park *et al.* demonstrated a significant increase in HbA1c and no increase in FBS in the rosuvastatin group.<sup>[22]</sup> Another study by Culver *et al.* found a higher incidence of T2DM in the statin group as compared to the nonstatin group.<sup>[17]</sup> The Cholesterol-lowering effects of rosuvastatin compared with atorvastatin in patients with type 2 diabetes (CORALL) trial reported significant increase in HbA1c and no significant rise in FBS with both high dose or low dose of rosuvastatin and significant increase in FBS with low dose of atorvastatin.<sup>[20]</sup> This variation in results of all studies might be due to differences in study population, duration, clinical conditions, doses of study drugs.

| Table 4: Intergroup and intragroup comparison of changes in blood sugar parameters |              |              |              |      |
|------------------------------------------------------------------------------------|--------------|--------------|--------------|------|
| (n=40)                                                                             | At baseline  | At 12 weeks  | At 24 weeks  | P#   |
| Random blood glucose                                                               |              |              |              |      |
| Rosuvastatin                                                                       | 134.15±15.9  | 137.05±12.04 | 141.05±13.02 | 0.08 |
| Atorvastatin                                                                       | 136.18±15.95 | 143.38±12    | 149.39±13.97 | 0.0  |
| P*                                                                                 | 0.57         | 0.28         | 0.13         |      |
| Fasting blood glucose                                                              |              |              |              |      |
| Rosuvastatin                                                                       | 111.85±8.61  | 114.03±8.06  | 117.41±7.57  | 0    |
| Atorvastatin                                                                       | 111.63±11.39 | 119.88±9.45  | 130.18±11.97 | 0    |
| P*                                                                                 | 0.92         | 0            | 0            |      |
| Postprandial blood glucose                                                         |              |              |              |      |
| Rosuvastatin                                                                       | 159.78±12.7  | 163.62±13.45 | 164.62±13.45 | 0.17 |
| Atorvastatin                                                                       | 157.15±12.2  | 166.63±11.29 | 177.5±10.18  | 0    |
| P*                                                                                 | 0.34         | 0.01         | 0            |      |
| Estimated average glucose                                                          |              |              |              |      |
| Rosuvastatin                                                                       | 137.84±8.5   | 139.78±8.18  | 141.69±8.10  | 0.11 |
| Atorvastatin                                                                       | 137.84±8.5   | 141.36±8.79  | 146.65±8.85  | 0    |
| P*                                                                                 | 0            | 0            | 0            |      |

P value significant <0.05. \*P value calculated for difference in absolute changes between the group using unpaired t-test, #P value calculated for within group changes using repeated measures ANOVA test



| Table 5: Change in lipid profile at 12 weeks and 24 weeks in the two groups |                     |              |              |       |                     |              |              |       |                          |
|-----------------------------------------------------------------------------|---------------------|--------------|--------------|-------|---------------------|--------------|--------------|-------|--------------------------|
| Parameter                                                                   | Atorvastatin (n=40) |              |              |       | Rosuvastatin (n=40) |              |              |       | Intergroup comparison P# |
|                                                                             | At baseline         | At 12 weeks  | At 24 weeks  | P*    | At baseline         | At 12 weeks  | At 24 weeks  | P*    |                          |
| TC (mg/dL)                                                                  | 198.88±17.59        | 190.90±15.80 | 184.08±14.83 | 0.000 | 202.45±16.72        | 196±15.19    | 185.13±13.77 | 0.000 | 0.057                    |
| TG (mg/dL)                                                                  | 180.18±15.13        | 172.38±14.59 | 168.13±13.56 | 0.001 | 181.50±16.83        | 176.44±16.16 | 167.67±16.23 | 0.001 | 0.239                    |
| VLDL-C (mg/dL)                                                              | 35.95±3.15          | 34.65±2.97   | 33.68±2.76   | 0.003 | 36.23±3.58          | 35.21±3.34   | 33.82±3.36   | 0.008 | 0.025                    |
| HDL-C (mg/dL)                                                               | 39.95±4.57          | 42.20±4.55   | 44.55±4.42   | 0.000 | 40.05±4.44          | 41.69±4.51   | 43.85±4.43   | 0.001 | 0.170                    |
| LDL-C (mg/dL)                                                               | 124.43±13.48        | 113.25±13.80 | 106.79±12.26 | 0.000 | 127.05±13.01        | 119.28±13.05 | 107.28±12.55 | 0.000 | 0.340                    |

\*P<0.05 significant, compared using repeated measures ANOVA test, #P<0.05 significant, compared using unpaired t-test. Values expressed as mean±SD. TC=Total cholesterol, TG=Triglycerides, VLDL-C=Very low density lipoproteins cholesterol, HDL-C=High density lipoproteins cholesterol, LDL-C=Low density lipoproteins cholesterol, SD=Standard deviation

Table 6: Occurrence of adverse drug reactions

| ADR                           | Atorvastatin (n=40) | Rosuvastatin (n=40) | P*     |
|-------------------------------|---------------------|---------------------|--------|
| Nausea                        | 3                   | 2                   | >0.999 |
| Loose stools                  | 1                   | 2                   | >0.999 |
| Deranged kidney function test | 1                   | 0                   | >0.999 |
| Anorexia                      | 2                   | 3                   | >0.999 |
| Headache                      | 3                   | 2                   | >0.999 |
| Myalgia                       | 4                   | 5                   | >0.999 |
| Body ache                     | 4                   | 4                   | >0.999 |
| Backache                      | 2                   | 3                   | >0.999 |

\*P<0.05 significant, compared using two-tailed Fisher exact test.  
ADR=Adverse drug reaction

The fall in TC, TG, VLDL, and LDL-C and rise in HDL-C were significant in both the groups. Similar findings have been reported in various studies with both the statins.<sup>[18,21,23-25]</sup> collaborative atorvastatin diabetes study (CARDS) study and other studies<sup>[3,26]</sup> support our findings by reporting fall in LDL-C, TG, TC, and VLDL-C and rise in HDL-C levels with the use of atorvastatin. Some studies as by Lamendola *et al.*,<sup>[27]</sup> Kim *et al.*,<sup>[28]</sup> found fall in LDL-C, TG, and TC and rise in HDL-C with the use of rosuvastatin. The results were same as ours in the rosuvastatin group.

At 12–24 weeks, as compared to atorvastatin, rosuvastatin resulted in a significantly greater fall in TC, TG and VLDL-C. Moreover, the fall in VLDL-C was significantly greater even at 24 weeks. Due to the paucity of data, the results of comparison of atorvastatin with rosuvastatin in diabetic patients on metformin and glimepiride could not be compared. Park *et al.* reported a significant fall in TC and LDL-C levels with rosuvastatin as compared to atorvastatin in dyslipidemic patients with metabolic syndrome.<sup>[21]</sup> This may be attributed to different geographical conditions, study population, and the clinical conditions in which the drugs are used.

In both the study groups, there was no significant change in LFT and KFT parameters. Occurrence of ADR was not significant in both the groups, and they were mild. There were no unexpected safety concerns in both the treatment groups supporting the findings of the previous studies.<sup>[3,21,29]</sup>

The treatment of diabetes with dyslipidemics not only reduces the level of lipids but also the incidence of complications of diabetes which are mainly due to atherosclerosis.<sup>[5,6]</sup> However, the safety of statin is also important in T2DM patients with dyslipidemia as the diabetogenic risk associated with statins increases with higher dose.<sup>[10]</sup> We found that rosuvastatin did not have much effect on the blood sugar parameters making it safe to be used in the diabetic patients. The pharmacokinetic property of the statins affects the mechanism of insulin resistance or enhanced glycemic control. Rosuvastatin, being water soluble, has high

specificity for the hepatocytes and is not easily taken up by beta cells of pancreas and adipocytes. Therefore, it shows less unfavorable effects on blood glucose with significant control of lipid profile. Atorvastatin being lipid-soluble enters extrahepatic cells easily and thus inhibits isoprenoid and ubiquinone synthesis. The decreased production of ubiquinone results in the delayed adenosine triphosphate production in the pancreatic beta-cells which thereby impair insulin release.<sup>[30]</sup> Thus this results in enhanced insulin resistance and increased blood glucose level with the use of atorvastatin as compared to rosuvastatin. Moreover, less microsomal enzyme interaction due to less dependence on CYP450 enzymes and pleiotropic effects favors the use of rosuvastatin as compared to atorvastatin in diabetic patients with dyslipidemia.<sup>[16]</sup>

## CONCLUSION

Rosuvastatin is preferred to atorvastatin in T2DM patients with dyslipidemia due to less variation in the blood sugar parameters, effective control over lipid profile, less microsomal interactions, and pleiotropic effects.

## Acknowledgment

We acknowledge the support of Dr. Shailesh Pitale (MBBS, MD, DM), Dr. Chaitanya Patil, and Dr. Vikas Sharma for their support and valuable suggestions.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

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