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Research Article

ANALYZING THE IMPACT OF STATINS USE IN TYPE 2 DIABETES MELLITUS PATIENTS AT A TERTIARY CARE HOSPITAL IN ANDHRA PRADESH

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ABSTRACT

Objectives: The objectives of the study were to analyze the impact of statins uses in Type-2 diabetes mellitus patients at a tertiary hospital.

Methods: It is a hospital-based prospective and observational study. The study was conducted in the General Medicine Department of Manipal Super Speciality Hospital, Vijayawada, Andhra Pradesh, India. Six months (August 2018–January 2019), 450 cases were collected from the general medicine department.

Results: A total of 450 patients data were collected, the results show that rosuvastatin at its list dose in this study (10 mg) was more effective at reducing fasting blood sugar (FBS), post-prandial blood sugar (PPBS), and hemoglobin A1C (HbA1c) levels than rosuvastatin combination. Moreover, significant increment of these levels (FBS, PPBS, and HbA1c) was observed with atorvastatin combination followed by atorvastatin (10 mg, 20 mg, and 40 mg) in both treatment group as well as a control group.

Conclusion: We concluded that there is a significant rise in blood glucose levels (both FBS and PPBS) and also HbA1c levels (glycated hemoglobin) due to the usage of statins for a longer duration. Statistical analysis was performed using the Pearson correlation coefficient method (SPSS 20. Version) and two-tailed analysis of variance. The results were represented as Z value (correlation coefficient) and p-value.

Keywords: Type 2 diabetes mellitus, New-onset diabetic statins, Fasting blood sugar, Post-prandial blood sugar, Glycated hemoglobin, Cardiovascular disease.

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INTRODUCTION

Diabetes is a bunch of metabolic diseases characterized by inappropriate hyperglycemia ensuing from defects in internal secretion, internal secretion action, or both. Symptoms of acute hyperglycemia embody kidney disease, polydipsia, polyphagia, weight loss, blurred vision, fatigue, headache, and poor wound healing. Chronic hyperglycemia will cause harm and probably failure of various organs, together with the eyes, heart, kidneys, blood vessels, and nerves [1]. Statins are medicines which are reduced lipid levels. Although steroid alcohol is essential for traditional cell and body to operate, high levels of steroid alcohol will result in cardiovascular complications. Many styles of statins exist such as statin drug, Baycol, Lescol, lovastatin, mevastatin, pitavastatin, rosuvastatin, and lipid-lowering medication [2]. Statins inhibit an accelerator known as reductase that controls steroid alcohol production within the liver. The medicines really act to exchange the hydroxy methylglutaryl-coenzyme A that exists within the liver, thereby speed down the steroid alcohol production method. These receptors relocate to the liver cell membranes and bind to passing low-density lipoprotein (LDL) and very LDL. Many people who begin statin treatment do so to lower their cholesterol level to <5 mmol/l, or by 25–30% [3]. The relationship between statins and diabetes, some experimental studies support the hypothesis that statins might cause polygenic disease by neutering aldohexose. Physiological condition through each impaired hypoglycemic agent secretion, and diminished hypoglycemic agent sensitivity. Moreover, inhibition of isoprenoid biogenesis by statins has been involved in the down-regulation of glucose transporter 4 (GLUT4) in adipocytes. GLUT4 mediates hypoglycemic agents stirred up the uptake of aldohexose in skeletal muscles and adipocyte. Statin drug and lipid-lowering medicine are shown to decrease the expression of GLUT4 in adipocytes which can end in impaired aldohexose tolerance. Adiponectin is a hypoglycemic agent sensitizing and anti-inflammatory protein free from adipocytes. Rosuvastatin and lipid-lowering medicine are shown to decrease plasma adiponectin levels and hypoglycemic agent sensitivity, whereas lipid-lowering cure raised each. Mitochondrial dysfunction in beta cells, skeletal muscles, and adipocytes have been coupled with the pathological process of polygenic disease. Since statins area unit far-famed to cause mitochondrial dysfunction in skeletal muscles, it is plausible that a similar mechanism is additionally accountable for their diabetogenic result. In addition, medication-induced myokymia and fatigue might impair exercise capability and worsen sarcopenia that is related to aldohexose intolerance and sort two polygenic diseases. Therefore, multiple mechanisms might result in impairment of glycemic control and risk of a non-obese diabetic with statins [4] link between diabetes and hypertension. When hypertension and diabetes co-exist, the effects of one disease tend to make the other worse. This makes for a deadly combination. Diabetes does three things that may increase blood pressure, decreasing the blood vessels' ability to stretch increasing the amount of fluid in the body. Changing the way the body manages insulin. Hypertension and diabetes generally co-exist because they share similar risk factors, including being overweight, following an unhealthy diet, and living an inactive lifestyle [5].

METHODS

Approval of the protocol by the institutional ethics committee (IEC)

The protocol for the proposed study was submitted to the IEC of Nirmala College of Pharmacy, Mangalagiri, Guntur, Andhra Pradesh (AP), India. The protocol was approved by the IEC on 13 July 2018.

Research design

It is a hospital-based prospective and observational study. The study was conducted in the General Medicine Department of Manipal Super Specialty Hospital, Vijayawada, AP, India. Six months

(August 2018–January 2019), 450 cases were collected from the general medicine department.

Study criteria

Inclusion criteria

The following criteria were included in the study:

- Patients of both sex who are willing to participate.
- Patients having diabetes mellitus (DM) along with other diseases.
- Patients above 25 years.

Exclusion criteria

The following criteria were excluded from the study:

- Patients who are unable or unwilling to participate.
- Children, pregnant, and lactating women.

Source of Data

- Patient case sheets.
- Treatment chart.
- Laboratory reports (fasting blood sugar [FBS], post-prandial blood sugar [PPBS], hemoglobin A1C [HBA1C], and lipid profile).
- Other relevant data sources.

Statistical analysis

Statistical analysis was performed using the Pearson correlation coefficient method (SPSS 20. Version) and two-tailed analysis of variance (ANOVA). The results were represented as Z value (correlation coefficient) and p-value ($p<0.5$).

RESULTS

Table 1 and Fig. 1: This table shows the percentage of the diseased population in particular sex, of which 62.6% (n=94) were males and 37.3% (n=56) were females.

Table 2 and Fig. 2: This table shows the percentage of the diseased population in particular sex, of which 62.6% (n=94) were males and 37.3% (n=56) were females.

Table 3 and Fig. 3: This table shows the percentage of the diseased population in particular age groups of subjects above 10 years of age among the 300 patients in which 51–60 years age group of patients are high in number, that is, 31.3% (94).

Table 4 and Fig. 4: This table shows the percentage of the diseased population in particular age groups of subjects above 10 years of age among the 300 patients in which 51–60 years age group of patients are high in number, that is, 31.3% (94).

Table 5 and Fig. 5: The graph explains the percentage of the type of statin used. Monotherapy and combination therapy show in which the most commonly used atorvastatin combination therapy 58.36% (n=178)

Table 1: Gender-wise distribution of diabetes in the treatment group

Gender	Number (%)
Male	190 (63.3)
Female	110 (36.7)

Table 2: Gender-wise distribution of diabetes in the control group

Gender	Number (%)
Male	94 (62.6)
Female	56 (37.3)

Table 3: Age-wise distribution of diabetes in the treatment group

Age	Number (%)
11–20	2 (0.06)
21–30	2 (0.06)
31–40	35 (12)
41–50	91 (30.6)
51–60	94 (31.3)
61–70	54 (18.7)
71–80	17 (5.6)
81–90	5 (1.7)

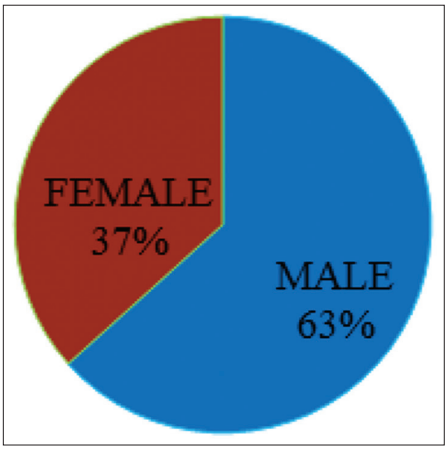

Fig. 1: Gender-wise distribution of diabetes in the treatment group

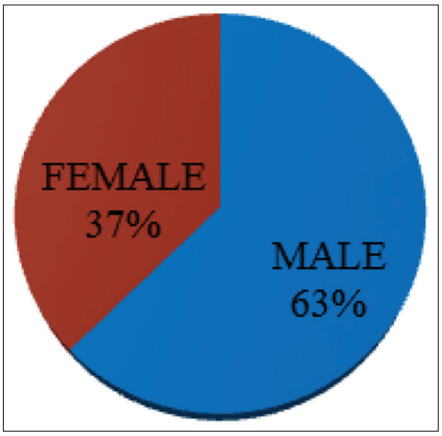

Fig. 2: Gender-wise distribution of diabetes in the control group

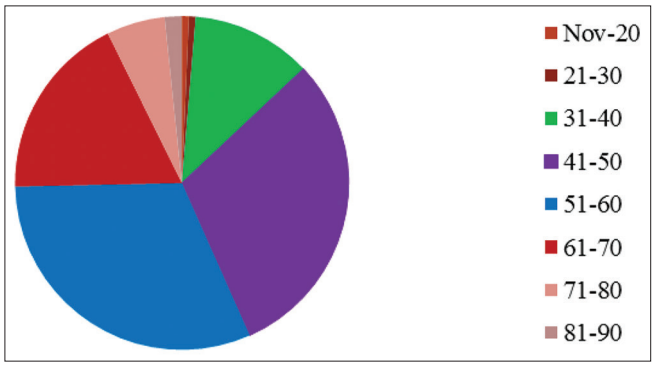

Fig. 3: Age-wise distribution of diabetes in the treatment group

followed by atorvastatin (monotherapy) 26.9% (n=82). Moreover, less widely used types are rosuvastatin combination therapy 4.59% (n=31) followed by rosuvastatin monotherapy 4.5% (n=14).

Table 6 and Fig. 6: The above table and graph explain about the percentage of the type of statin used. Both monotherapy and combination therapy shows in which the most commonly used kind of statin is atorvastatin combination therapy 54.6% (n=82) followed by atorvastatin.

Table 4: Age-wise distribution of diabetes in the control group

Age	Number (%)
11–20	2 (0.06)
21–30	2 (0.06)
31–40	35 (12)
41–50	91 (30.6)
51–60	94 (31.3)
61–70	54 (18.7)
71–80	17 (5.6)
81–90	5 (1.7)

Table 5: Types of statins used in the treatment group

Types of statins	Number (%)
Atorvastatin	82 (26.9)
Rosuvastatin	14 (4.59)
Atorvastatin+combination	178 (58.36)
Rosuvastatin+combination	31 (10.16)

Table 6: Types of statins used in treatment in the control group

Types of statins	Number (%)
Atorvastatin	29 (19.3)
Rosuvastatin	11 (7.3)
Atorvastatin+combination	82 (54.6)
Rosuvastatin+combination	28 (18.6)

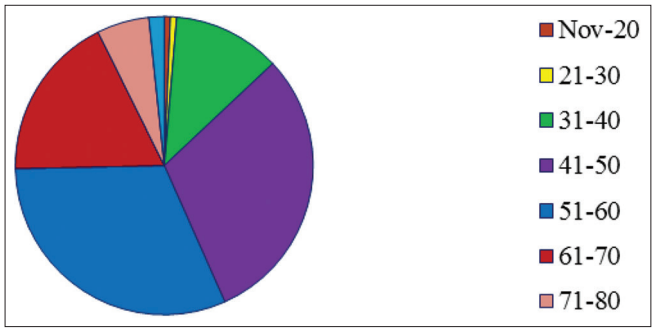

Fig. 4: Age-wise distribution of diabetes in the control group

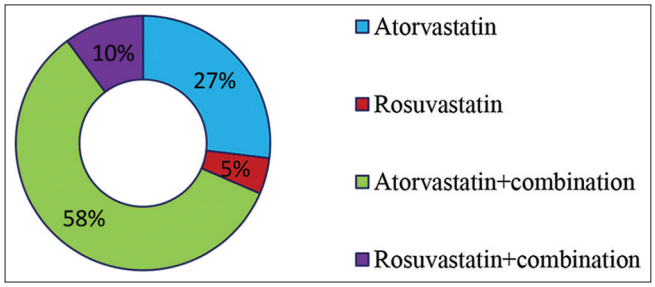

Fig. 5: Types of statins used in the treatment group

Table 7 and Fig. 7: It explains the percentage of fasting blood glucose levels, of which rosuvastatin monotherapy showed a remarkable decrease in FBS levels (−17.9%) followed by rosuvastatin combination therapy (−2.9%).

Table 8 and Fig. 8: It explains the percentage of post-prandial blood glucose levels, of which rosuvastatin monotherapy showed a remarkable decrease in FBS levels (−28.9%) followed by rosuvastatin combination therapy (−8.4%).

Table 9 and Fig. 9: It explains the percentage of HbA1c levels, of which rosuvastatin monotherapy showed a remarkable decrease

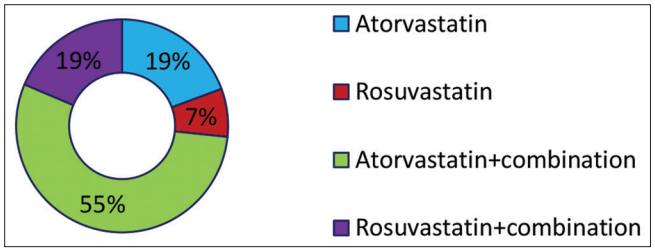

Fig. 6: Types of statins used in treatment in the control group

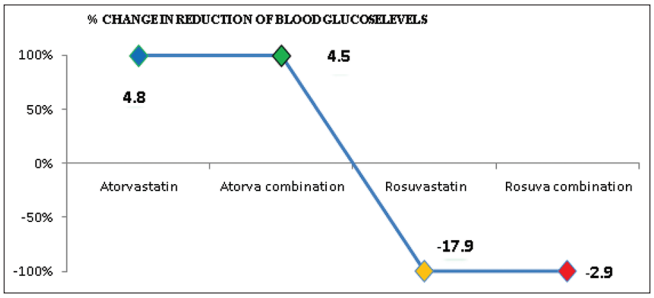

Fig. 7: Glucose levels (fasting blood sugar) of the treatment group

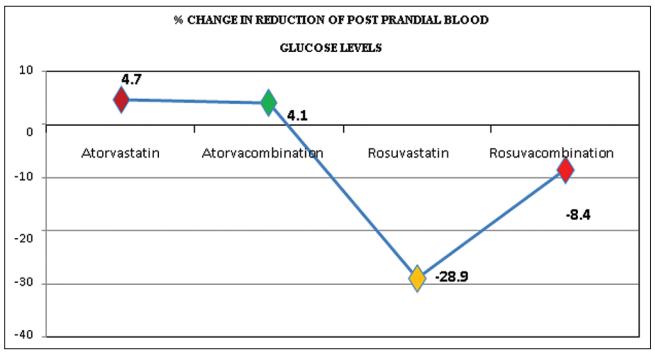

Fig. 8: Glucose levels (post-prandial blood sugar) of the treatment group

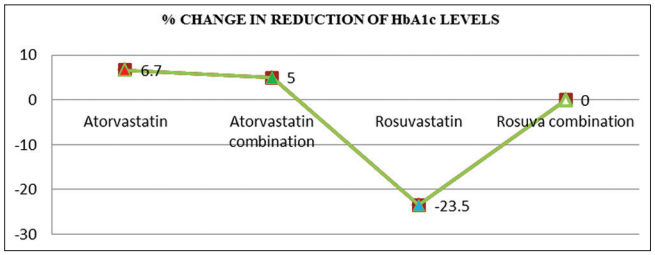

Fig. 9: Hemoglobin A1C levels of the treatment group

in HbA1c levels (−23.5%) followed by rosuvastatin combination therapy (−1%).

Table 10 and Fig. 10: This table shows the percentage of fasting blood glucose levels, of which rosuvastatin monotherapy showed a remarkable decrease in FBS levels (−22.2%) followed by rosuvastatin combination therapy (−3.8%).

Table 11 and Fig. 11: It explains the percentage of post-prandial blood glucose levels, of which rosuvastatin monotherapy showed a remarkable decrease in FBS levels (−21.6%) followed by rosuvastatin combination therapy (−3.8%).

Table 12 and Fig. 12: It explains the percentage of HbA1c levels, of which rosuvastatin monotherapy showed a remarkable decrease

Table 7: Glucose levels (FBS) of the treatment group

Name of the statin	Mean baseline blood glucose level (mg/dl)	Mean follow-up blood glucose levels (mg/dl)	Percentage (%) change in the reduction of blood glucose levels
Atorvastatin	145	152	4.8
Atorvastatin combination	153	160	4.5
Rosuvastatin	83	68	−17.9
Rosuva combination	170	165	−2.9

FBS: Fasting blood sugar

Table 8: Glucose levels (PPBS) of the treatment group

Name of the statin	Mean baseline post-prandial blood glucose levels (mg/dl)	Mean follow-up post-prandial blood glucose levels (mg/dl)	Percentage (%) change in reduction of post-prandial blood glucose levels
Atorvastatin	209	219	4.7
Atorvastatin combination	218	227	4.1
Rosuvastatin	145	103	−28.9
Rosuva combination	237	217	−8.4

PPBS: Post-prandial blood sugar

Table 9: HbA1c levels of the treatment group

Name of the statin	Mean baseline HbA1c levels (mg/dl)	Mean follow-up HbA1c levels (mg/dl)	Percentage (%) change in reduction of HbA1c levels
	7.4	7.9	6.7
Atorvastatin combination	8.0	8.4	5
Rosuvastatin	6.8	5.2	−23.5
Rosuva combination	8.1	8.1	0

HbA1cl: Hemoglobin A1C

Table 10:FBS levels of the control group

Name of the statin	Mean baseline blood glucose levels (mg/dl)	Mean follow-up blood glucose levels (mg/dl)	Percentage (%) change in reduction of blood glucose levels
Atorvastatin	115	142	23.4
Atorvastatin combination	129	145	12.4
Rosuvastatin	90	70	−22.2
Rosuva combination	129	124	−3.8

FBS: Fasting blood sugar

Table 11: PPBS levels of the control group

Name of the statin	Mean baseline post-prandial blood glucose levels (mg/dl)	Mean follow-up post-prandial blood glucose levels (mg/dl)	Percentage (%) change in the reduction of post-prandial blood glucose levels
Atorvastatin	178	195	9.5
Atorvastatin combination	202	213	5.4
Rosuvastatin	111	87	−21.6
Rosuva combination	183	176	−3.8

Table 12: HbA1c levels of the control group

Name of the statin	Mean baseline HbA1c levels (mg/dl)	Mean follow-up HbA1c levels (mg/dl)	Percentage (%) change in reduction of HbA1c levels
Atorvastatin	7.2	8	11.1
Atorvastatin combination	7.6	8.5	11.8
Rosuvastatin	5.6	5	−10.7
Rosuva combination	6.5	6.3	−3

in HbA1c levels (−10.7%) followed by rosuvastatin combination therapy (−3%).

Table 13 and Fig. 13: It explains the percentage of triglyceride (TG) levels, of which rosuvastatin combination therapy showed a significant decline in TG levels (−23.8%) followed by atorvastatin monotherapy (−18%).

Table 14 and Fig. 14: It explains the percentage of HDL levels of which rosuvastatin monotherapy showed a notifiable increment in HDL levels (23.8%) followed by rosuvastatin combination therapy (2.5%).

Table 15 and Fig. 15: It explains the percentage of LDL levels, of which rosuvastatin combination therapy showed a remarkable decrease in LDL levels (−14.7%) followed by rosuvastatin monotherapy (9.2%).

Table 16 and Fig. 16: It explains the percentage of TG levels, of which rosuvastatin combination therapy showed a remarkable decrease in TG levels (−22.3%) followed by rosuvastatin monotherapy (−13.1%).

Table 17 and Fig. 17: It explains the percentage of HDL levels, of which rosuvastatin monotherapy showed a remarkable increase in HDL levels (38.8%) followed by rosuvastatin combination therapy (17.1%).

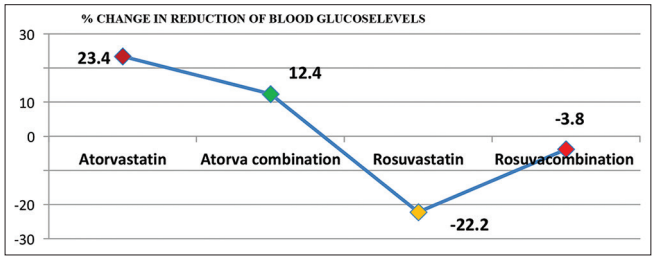

Fig. 10: Fasting blood sugar levels of the control group

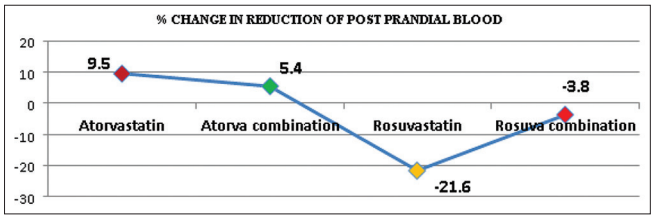

Fig. 11: Post-prandial blood sugar levels of the control group

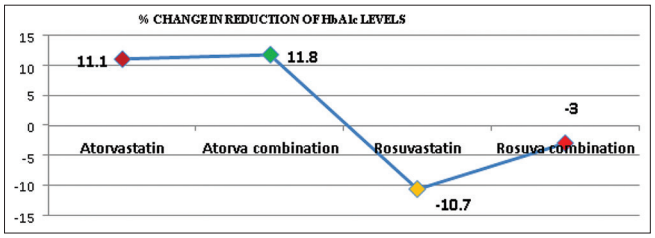

Fig. 12: Hemoglobin A1C levels of the control group

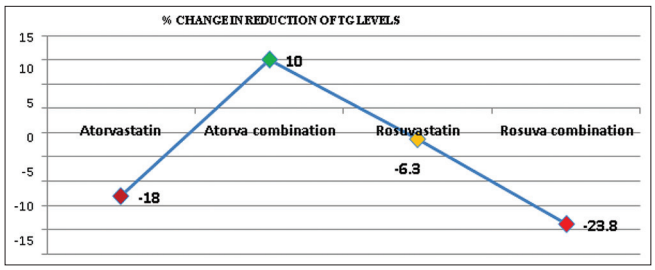

Fig. 13: Triglyceride levels of the treatment group

Table 18 and Fig. 18: It explains the percentage of LDL levels, of which rosuvastatin monotherapy showed a remarkable decrease in LDL levels (−41.3%) followed by rosuvastatin combination therapy (−5.4%).

Comparison of different parameters in control versus treatment groups using multivariate analysis

Variables	Control vs. treatment	
	Z value	p-value
Atorvastatin	0.407	0.423*
Atorva-combination	0.790	0.062**
Rosuva statin	0.765	0.076**
Rosuva combination	0.850	0.032**

*: Significant, **: Highly significant

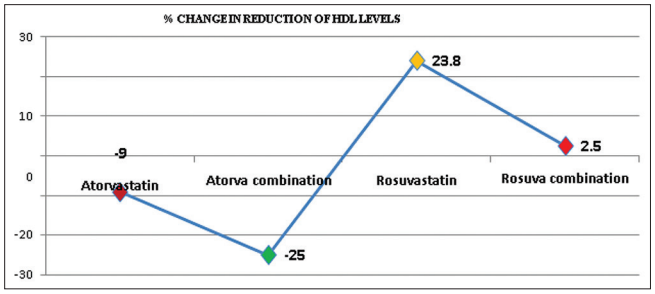

Fig. 14: High-density lipoproteins levels of the treatment group

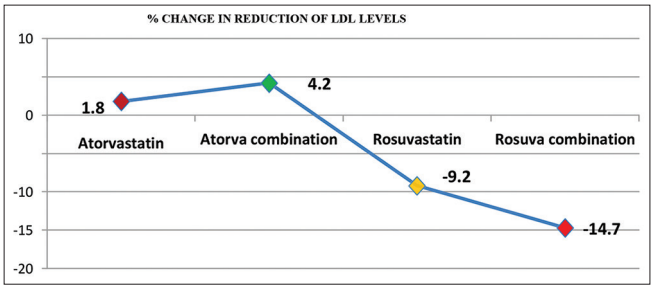

Fig. 15: Low-density lipoprotein levels of the treatment group

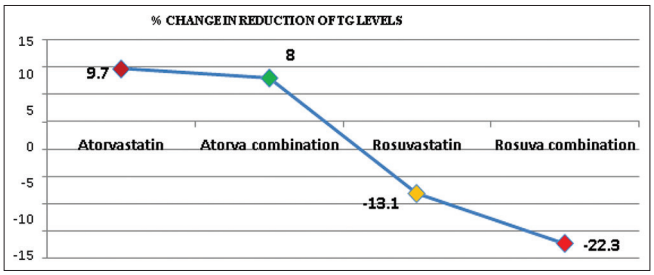

Fig. 16: Triglyceride levels of the control group

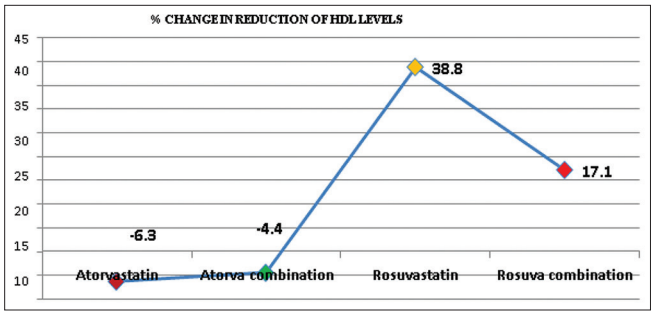

Fig. 17: High-density lipoproteins levels of the control group

Table 13: Triglyceride levels of the treatment group

Name of the statin	Mean baseline TG levels (mg/dl)	Mean follow-up TG levels (mg/dl)	Percentage (%) change in reduction of TG levels
Atorvastatin	234	190	−18
Atorvastatin combination	210	231	10
Rosuvastatin	79	74	−6.3
Rosuva combination	231	176	−23.8

TG: Triglyceride

Table 14: HDL levels of the treatment group

Name of the statin	Mean baseline HDL levels (mg/dl)	Mean follow-up HDL levels (mg/dl)	Percentage (%) change in the reduction of HDL levels
Atorvastatin	44	40	−9
Atorvastatin combination	39	29	−25
Rosuvastatin	21	26	23.8
Rosuva combination	40	41	2.5

HDL: High-density lipoproteins

Table 15: LDL levels of the treatment group

Name of the statin	Mean baseline LDL levels (mg/dl)	Mean follow-up LDL levels (mg/dl)	Percentage (%) change in the reduction of LDL levels
Atorvastatin	107	109	1.8
Atorvastatin combination	95	99	4.2
Rosuvastatin	40	37	−9.2
Rosuva combination	88	75	−14.7

LDL: Low-density lipoprotein

Table 16: TG levels of the control group

Name of the statin	Mean baseline TG levels (mg/dl)	Mean follow-up TG levels (mg/dl)	Percentage (%) change in the reduction of TG levels
Atorvastatin	225	247	9.7
Atorvastatin combination	236	255	8
Rosuvastatin	122	106	−13.1
Rosuva combination	192	149	−22.3

TG: Triglyceride

Table 17: HDL levels of the control group

Name of the statin	Mean baseline HDL levels (mg/dl)	Mean follow-up HDL levels (mg/dl)	Percentage (%) change in the reduction of HDL levels
Atorvastatin	47	44	−6.3
Atorvastatin combination	45	43	−4.4
Rosuvastatin	18	25	38.8
Rosuva combination	35	41	17.1

HDL: High-density lipoproteins

Table 18: LDL levels of the control group

Name of the statin	Mean baseline LDL levels (mg/dl)	Mean follow-up LDL levels (mg/dl)	Percentage (%) change in the reduction of LDL levels
	116	120	3.4
Atorvastatin-combination	96	98	2
Rosuvastatin	58	34	−41.3
Rosuva combination	92	87	−5.4

LDL: Low-density lipoprotein

Multivariate analysis has been performed using SPSS version 20. Pearson correlation coefficient between different parameters in control and treated groups was calculated as Z value at the level of significance ($Z<1$) and also two-tailed ANOVA performed to calculate p-value at the level of significance ($p<0.5$).

DISCUSSION

Despite the importance of the impact of statin therapy for achieving therapeutic goals, there are limited reports on the effect of statin therapy and its associated factors. Education in cholesterol ratio was

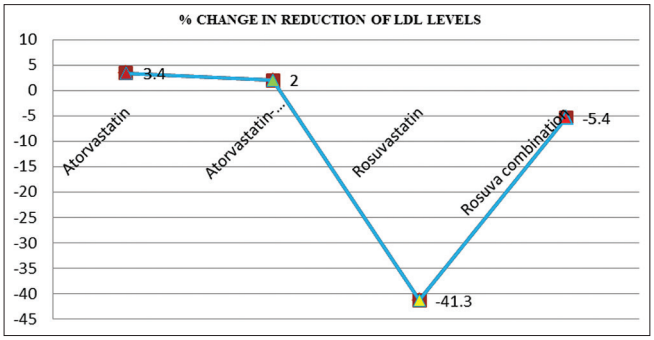

Fig. 18: Low-density lipoprotein levels of the control group

shown to be associated with adherence to treatment and following diet and exercises. Through the questionnaires, the data about a patient's adherence to statins were assessed. Our results revealed that according to the inquiries and obtained data from the case records, three fourth of patients with diabetes were adherent to statins therapy. We conducted a prospective observational study in patients with Type-2 diabetes under treatment with statins. We have collected 450 cases among which 300 cases are patients with DM under statins treatment (considered as a treatment group), 150 cases are patients without DM under statins treatment (considered as a control group). We observed rosuvastatin (10 mg and 20 mg) was found to be the most effective statin at reducing FBS, PPBS, and HbA1c levels when compared with rosuvastatin combination, and remarkable increment of these levels was observed with atorvastatin combination followed by atorvastatin (10 mg, 20 mg, and 40 mg). In other words, rosuvastatin at its lowest dose in this study (10 mg) was more effective at reducing FBS, PPBS, and HbA1c levels than rosuvastatin combination and significant increment of these levels was observed with atorvastatin combination followed by atorvastatin (10 mg, 20 mg, and 40 mg) in both treatment group as well as a control group. On applying statistics (SPSS version 20. Pearson correlation coefficient), we found that our study was significant.

CONCLUSION

From this study, we concluded that there is a significant rise in blood glucose levels (both FBS and PPBS) and also HbA1c levels (glycated hemoglobin) due to the usage of statins for a longer duration. Among the various types of statins, the most commonly used statins are atorvastatin monotherapy, atorvastatin combination therapy followed by rosuvastatin. Rosuvastatin combination therapy and particular raise are seen more frequently with atorvastatin combination therapy and atorvastatin monotherapy and less commonly seen with rosuvastatin combination therapy and rosuvastatin monotherapy.

Finally, we conclude that statins use showing a remarkable increase in blood glucose levels (both FBS and PPBS) and also HbA1c levels (glycated hemoglobin). The need for drug utilization evaluation is necessary to improve the quality of life by avoiding unnecessary usage of statins to prevent serious adverse effects. The pharmacist is the key person for better management of therapy based on the stage and condition of the patient. On applying statistics (SPSS version 20. Pearson correlation coefficient), we found that our study was significant.

CONFLICTS INTEREST

In this study would not interest any conflicts.

AUTHORS' CONTRIBUTIONS

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