Safety and Efficacy Comparison of Atorvastatin Versus Rosuvastatin in Management of Lipid Profile in Patients Diagnosed with Type-2 Diabetes Mellitus and Obesity

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ABSTRACT:
The objective of the present study is to evaluate and compare the safety and efficacy comparison of the effect on Fasting Blood Sugar (FBS), Post Lunch Blood Sugar (PLBS), Hemoglobin A1c (HbA1c), Serum Creatinine, Lipid Profile [Low density Lipoprotein (LDL), Very Low-Density Lipoprotein (VLDL), High Density Lipoprotein (HDL), Triglycerides (TG), Total Cholesterol (TC)] of Atorvastatin (A) and Rosuvastatin (R) in Type 2 Diabetes Mellitus (T2DM) and Obese patients. It is a Prospective, Observational & multicentric comparative study conducted in Patients with T2DM and in patients with Obesity in Warangal, Telangana state. The Study Protocol, Data Collection Sheet were submitted. A total of 903 patients were screened for the study, out of 903 patients 610 patients are T2DM and 293 patients are Obese. Results obtained from the study in T2DM group patients indicate that Atorvastatin as well as Rosuvastatin has significant effect on reducing LDL levels (for A 160.82 ± 24.39 to 107.57 ± 18.67; for R 162.49 ± 29.37 to 85.51 ± 17.30), reducing TC levels (for A 213.48 ± 36.02 to 156.59 ± 30.90; for R 223.40 ± 34.65 to 141.69 ± 23.26), reducing TG levels (for A 182.91 ± 43.57 to 129.64 ± 29.13; for R 183.65 ± 52.44 to 115.48 ± 29.43) and elevating HDL levels (for A 35.70 ± 5.01 to 49.32 ± 5.38; for R 34.88 ± 4.91 to 48.59 ± 5.38) and in obese group patients indicate that has significant effect on reducing LDL levels (for A1 58.57 ± 21.29 to 123.66 ± 18.95; for R 160.02 ± 32.67 to 102.91 ± 22.20), reducing TC levels (for A 208.68 ± 32.84 to173.96 ± 32.59; For R 210.09 ± 33.79 to 156.17 ± 24.13), reducing TG levels (for A 174.88 ± 40.15 to 139.80 ± 33.23 ; for R 172.64 ± 37.40 to 117.63 ± 30.87), elevating HDL levels (for A 34.83 ± 3.79 to 45.99 ± 3.92; for R 35.54 ± 4.85 to 47.83 ± 6.34). In consideration of the Safety parameters, the most common adverse events in T2DM group patients are: Atorvastatin reported Myalgia, Rosuvastatin reported Headache in high number, whereas in Obese group patients Atorvastatin reported Myalgia, Abdominal bloating, Headache, Rosuvastatin reported Headache, Pain in high number. Conclusion: Thus, this study shows that Rosuvastatin should be prescribed over Atorvastatin in Type 2 Diabetes Mellitus patients and in obese patients in whom LDL, HDL, TG and TC levels are deviated from normal reference values.

KEYWORDS: Type-2 Diabetes Mellitus, Obesity, Atorvastatin, Rosuvastatin, Lipid profile.

INTRODUCTION

Diabetes Mellitus (DM) is a set of metabolic disorder or syndrome recognized as chronic hyperglycemia (presence of high blood sugar) occurs due to defects in insulin action, insulin secretion or both [1,2]. It is now prevalent across the world with multiple complications [3–5]. Dyslipidemia and hypertension are major modifiable risk factors for T2DM [6]. Lipid abnormalities in patients with diabetes, often termed "diabetic dyslipidemia", are typically characterized by high TC, high TG, low HDL-C and high LDL particles. Lipid abnormalities are common in people with T2DM and prediabetes [7, 8].

Obesity is defined as an accumulation of excess body fat (Adipose tissue) that is of sufficient Magnitude to impair health [9]. Obesity is a complex, multi-factorial disease that develops from the interaction between Genotype and the Environment [10]. Obesity rises very sharply throughout the world which reaches dangerous levels and is a factor for the emergence of serious diseases including hypertension, stroke, dyslipidemia, coronary artery disease and Type 2 Diabetes Mellitus [11]. Obesity is strongly associated with elevated plasma lipid levels and that actually 60-90% of cases of Type 2 DM now appear to be related to obesity [12]. High BMI (Body Mass Index) has a 2 times greater risk of developing T2DM compared to low BMI [13].

Abdominal obesity may cause fat cells to release pro-inflammatory chemicals. These chemicals can make the body less sensitive to the insulin it produces by disrupting the function of insulin responsive cells and their ability to respond to insulin [14, 15].

Obesity may trigger changes in body's metabolism that cause adipose tissue to release increased amounts of Fatty acids, Glycerol, Hormones, Pro-inflammatory cytokines and other factors that are involved in the development of insulin resistance. When insulin resistance is accompanied by dysfunction of pancreatic islet beta-cells it leads to failure to control blood glucose levels [16].

So, in the present study safety and efficacy comparison of atorvastatin and rosuvastatin were evaluated and compared on the basis of the effects on lipid profile in Type 2 Diabetic and Obese patients. Such study is hoped to be useful in choosing a statin out of plethora of statins available, suitable for lowering risk of atherosclerosis.

MATERIAL AND METHODS

Study design and Ethical conduct of research

It is a Prospective, Observational & Multi-centric Comparative study to be conducted in patients with T2DM and Obesity, performed over aperiodof6 months. 903 patients were included in this study based on the inclusion criteria of which 610 were T2DM and 293 were Obese. The project protocol was submitted to the Institutional Human Ethics Committee (IHEC) and was approved (Approval No.: IHEC/VCOP/PHARM.D/ NRCT/2021/010) before the initiation of the research work.

Selection criteria:

Inclusion Criteria includes patients diagnosed with T2DM, Obesity and are either on treatment with Atorvastatin or Rosuvastatin, patients with age ≥ 18Years, Elevated Lipid profile, patients having values of HbA1c ≥ 6% and the Exclusion Criteria includes patients diagnosed with T1DM, patients with Gestational Diabetes Mellitus, patients with age < 18 Years, pregnant women and

lactating women.

Study assessment

Patient's demographic data and medical history were recorded at trial visit. The patient received the drugs and returned for follow up on the last day. Laboratory tests of FBS, PLBS, HbA1c, Serum creatinine, Lipid profile were recorded at the beginning and at end of treatment. The effectiveness of Atorvastatin and Rosuvastatin was assessed by measuring changes in Lipid profile levels after treatment. The end point was change in lipid profile levels such as Total cholesterol, High Density Lipoprotein, Low Density Lipoprotein, Triglycerides. All the patients included in the study were also assessed for Myalgia, Abdominal bloating, Headache, Pain, Pharyngitis, Stroke, Acute Kidney Injury (AKI), Rhabdomyolysis.

Statistical analysis

All the parameters were expressed as Mean ± Standard Deviation (SD). Data analysis was performed using MS Excel and GraphPad prism 9.3.1 version. ANOVA (Analysis of Variance) One Way Method followed by Tukey's multiple comparisons test was performed to assess the significant difference between the safety and efficacy parameters of the drugs Atorvastatin and Rosuvastatin of T2DM group and Obese group patients. P value <0.0001 was considered to be significant.

RESULTS

Out of 1012 patients, 903 patients were selected for this study based on inclusion criteria from Ajara Hospital, Sri Bhadrakali Diabetic Clinic, MGM Hospital, Sathyam's Clinic, Samraksha Super Speciality Hospital, Medlife Super Speciality Hospital.

Sample distribution in T2DM:

Out of 903 patients, 610 patients are Type2 Diabetic and 293 patients are Obese. Out of 610 Type 2 Diabetic patients, 302 patients received Atorvastatin (A) and 308 patients received Rosuvastatin (R).

Sample distribution in obesity:

Out of 293 obese patients, 138 patients received Atorvastatin (A) and 155 patients received Rosuvastatin (R).

Gender distribution in T2DM:

The study included a population of 610 patients, out of 302 patients in A group 160 (26%) were male, 142 (23%) were female and in R group out of 308 patients, 159 (26%) were male, 149(25%) were female as shown in Figure 1.

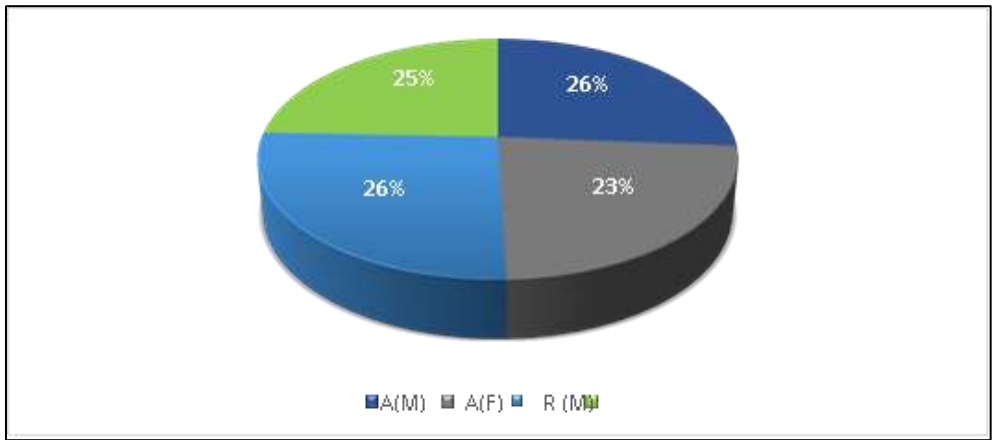

Fig1: Gender distribution of the T2DM sample.

GENDER DISTRIBUTION IN OBESITY:

The study included a population of 293 patients, out of 138 patients in A group 73 (25%) were male, 65 (22%) were female and in R group out of 155 patients, 85 (29%) were male, 70 (24%) were female as shown in Figure 2.

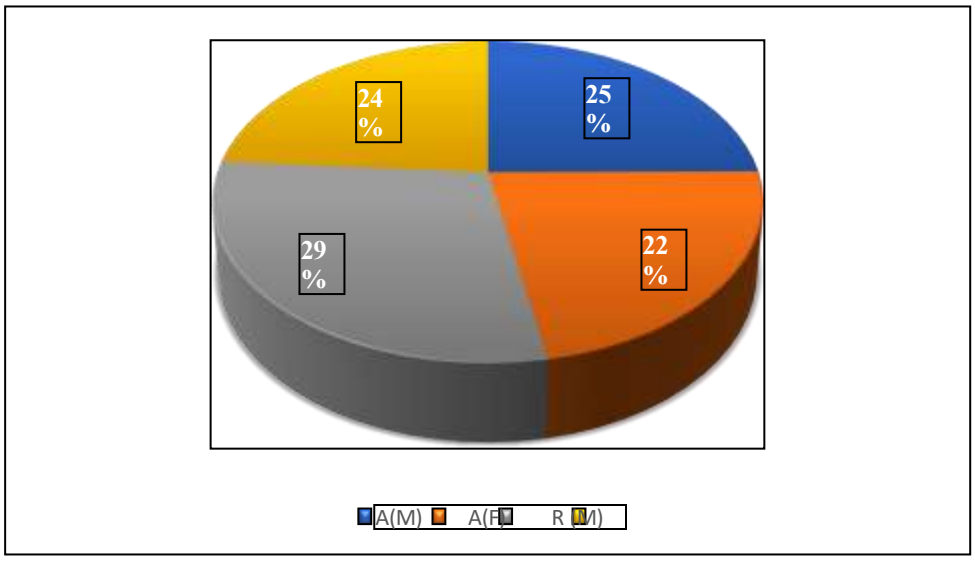

Fig2: Gender distribution of the Obesity sample.

AGE DISTRIBUTION IN T2DM:

Table 1 and Figure 3 explain age distribution of A group and R group patients included in the study. In A group 302 patients were included and in R group 308 patients were included:

A GROUP:

Out of 302 Patients maximum number of patients was found in age between 51-60years (33.11%) and minimum number of patients was found in age between 21-30, 81-90 years (0%) patients respectively.

R GROUP:

Out of 308 Patients maximum number of patients was found in age between 61-70 years (31.16%) and minimum number of patients were found in age between 11-20 years (0%) patients respectively.

Table1: Age distribution of T2DM.

CHARACTERISTICS	A GROUP(n=302)		R GROUP(n=308)	
Age(years): MEAN±SD	57.93 ± 10.76		58.72 ± 11.40	
	Number of participants	Percentage	Number of participants	Percentage
11-20	1	0.33%	0	0%
21-30	0	0%	2	0.64%
31-40	17	5.62%	15	4.87%
41-50	62	20.52%	64	20.77%
51-60	100	33.11%	87	28.24%
61-70	85	28.14%	96	31.16%
71-80	37	12.25%	39	12.66%
81-90	0	0%	5	1.62%

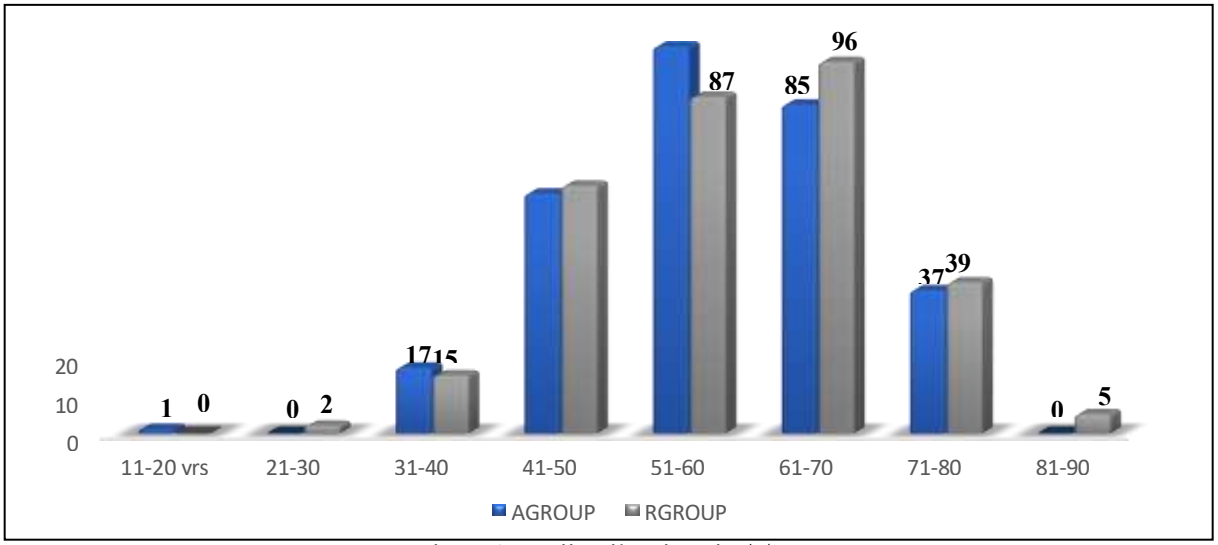

Fig3: Age distribution in T2DM.

AGE DISTRIBUTION IN OBESITY:

Table 2 and Figure 4 explain age distribution of A group and R group patients included in the

study. In A group 138 patients were included and in R group 155 patients were included:
A GROUP:
Out of 138 Patients maximum number of patients was found in age between 61-70 years (38.40%) and minimum number of patients were found in age between 81-90 years (0.72%) patients respectively.
R GROUP:
Out of 155 Patients maximum numbers of patients were found in age between 51-60 years (29.67%) and minimum number of patients were found in age between 81-90 years (1.29%) patients respectively.

Table2: Age distribution of Obesity.

CHARACTERISTICS	A GROUP(n=138)		R GROUP(n=155)	
Age(years): MEAN± SD	59.40 ± 10.20		55.78 ± 10.69	
	Number of participants	Percentage	Number of participants	Percentage
31-40	6	4.34%	13	8.38%
41-50	22	15.9%	41	26.45%
51-60	39	28.26%	46	29.67%
61-70	53	38.40%	41	26.45%
71-80	17	12.31%	12	7.74%
81-90	1	0.72%	2	1.29%

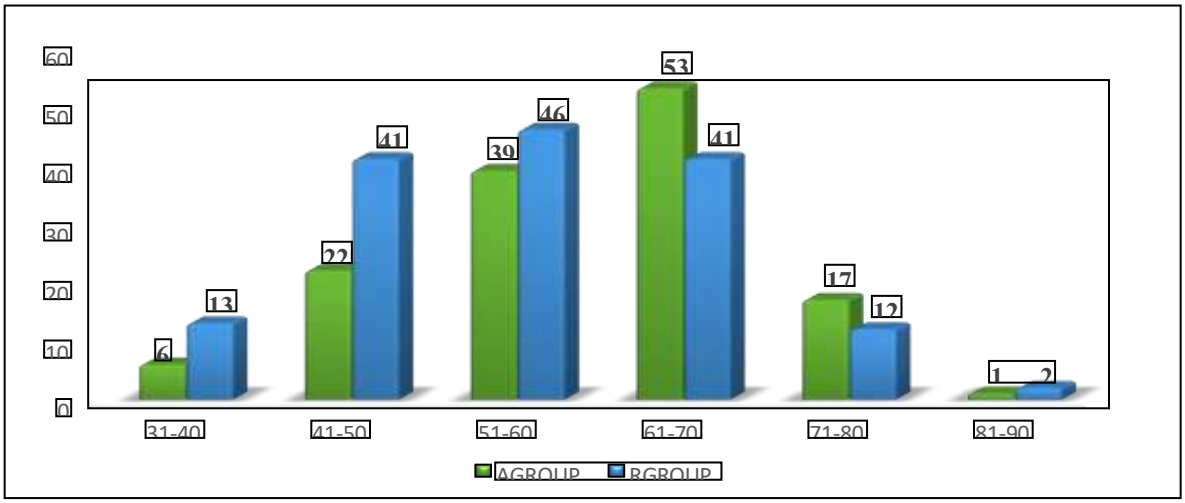

Fig4: Age distribution in Obesity.

BMI DISTRIBUTION IN T2DM:

Table 3 and Figure 5 explain the BMI distribution in T2DM, 302 patients received Atorvastatin and 308 patients received Rosuvastatin. The BMI groups and their percentage distribution of A group and R group are:

A GROUP:

The percentage of participants in each of 3 BMI groups of A group (16-20, 20.1-25, 25.1-30) was 0.98%, 22.62% and 25.90%.

R GROUP:

The percentage of participants in each of 3 BMI groups of R group (16-20, 20.1-25, 25.1-30) was 0.98%, 21.47% and 28.03%.

Table 3: BMI distribution of T2DM.

CHARACTERISTICS	A GROUP(n=302)		R GROUP(n=308)	
BMI: MEAN ± SD	24.90 ± 2.01		24.99 ± 2.04	
	Number of participants	Percentage	Number of participants	Percentage
16-20	6	0.98%	6	0.98%
20.1-25	138	22.62%	131	21.47%
25.1-30	158	25.90%	171	28.03%

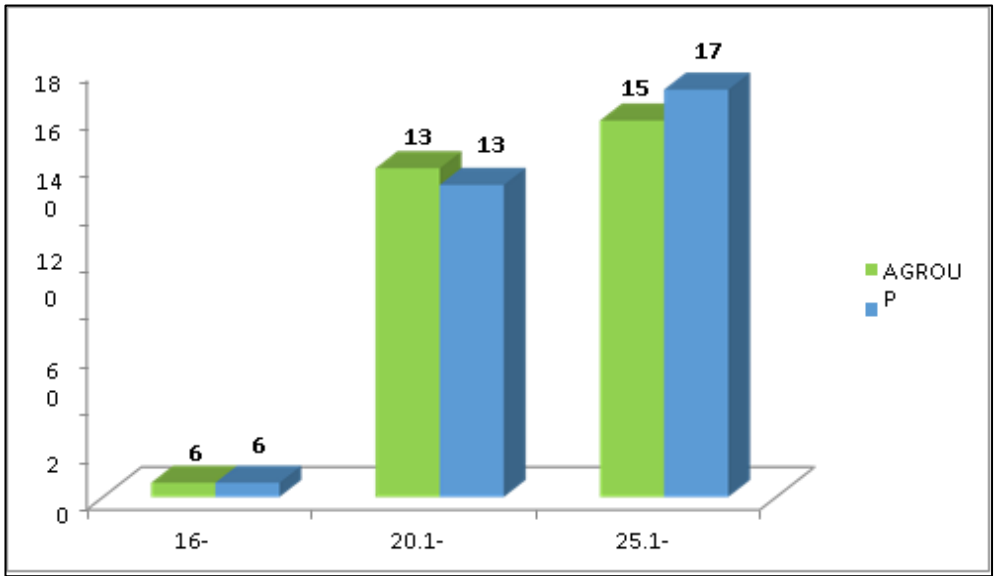

Fig 5: BMI distribution in T2DM.

BMI DISTRIBUTION IN OBESITY:

Table 4 and Figure 6 explain the BMI distribution in Obesity, 138 patients received Atorvastatin and 155 patients received Rosuvastatin. The BMI groups and their percentage distribution of A group and R group are:

A GROUP:

The percentage of participants in each of 4 BMI groups of A group (30, 30.1-35, 35.1-36, 36.1-40) was 1.02%, 39.93%, 6.14%, 0%.

R GROUP:

The percentage of participants in each of 4 BMI groups of R group (30, 30.1-35, 35.1-36,36.1-40) was 3.07%, 45.39%, 3.75%, 0.68%.

Table 4: BMI distribution of Obesity.

CHARACTERISTICS	AGROUP(n=138)		R GROUP(n=155)	
BMI:MEAN±SD	32.11 ± 2.05		31.96 ± 2.17	
	Number of participants	Percentage	Number of participants	Percentage
30	3	1.02%	9	3.07%
30.1-35	117	39.93%	133	45.39%
35.1-40	18	6.14%	11	3.75%
40.1-45	0	0%	2	0.68%

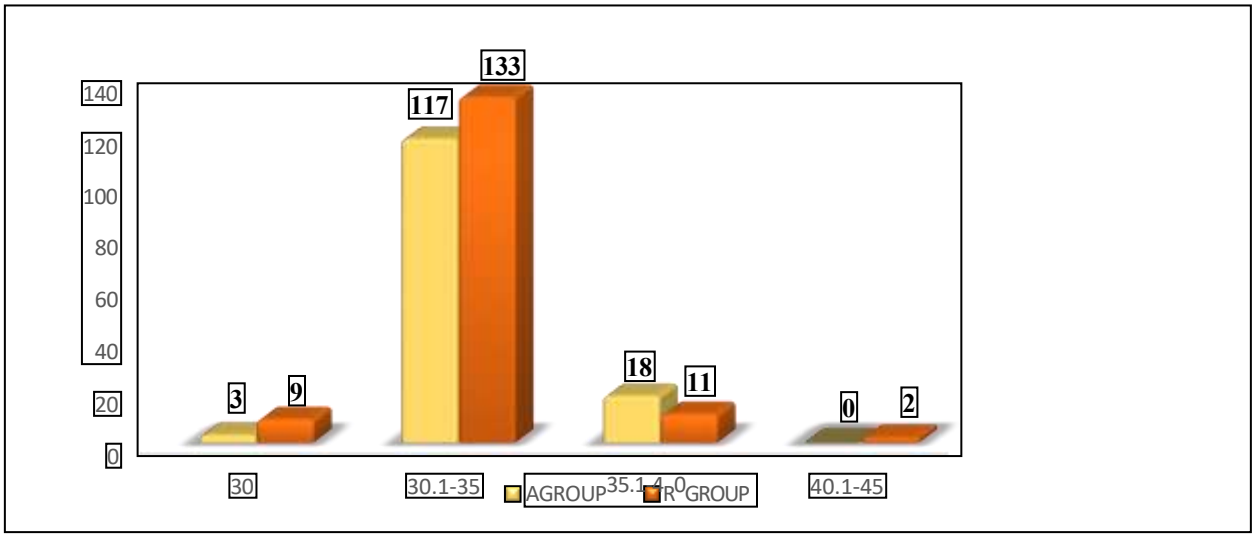

Fig6: BMI distribution in Obesity.

SAFETY PARAMETERS:

The safety parameters assessed were Myalgia, Headache, Rhabdomyolysis, Abdominal bloating, Pharyngitis, Pain, Acute Kidney Injury (AKI) and Stroke in patients treated with Atorvastatin and Rosuvastatin of T2 DM and Obesity. The results were appropriately represented in a bar graph diagram as shown in Table 5, Figure 7 and Table 6, Figure 8.

Table 5: Safety parameters of Atorvastatin.

ATORVASTATIN SAFETY PARAMETERS	T2DM(n=302)	OBESITY (n=138)
Myalgia	155	116
Rhabdomyolysis	3	5
Headache	68	92
Abdominal bloating	84	102
AKI	11	27
Stroke	29	47

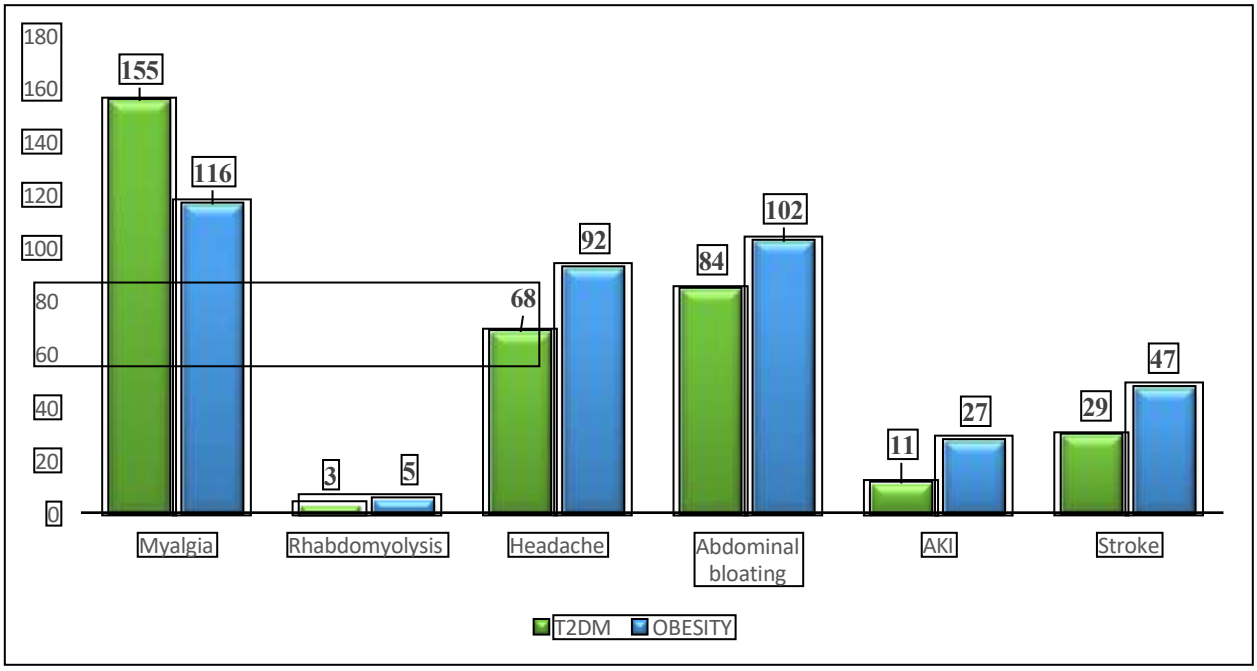

Fig7: Safety parameters of Atorvastatin.

Table 6: Safety parameters of Rosuvastatin.

ROSUVASTATIN SAFETY PARAMETERS	T2DM(n=308)	OBESITY(n=155)
Headache	118	128
Myalgia	44	68
Rhabdomyolysis	5	8
Pharyngitis	52	74
Pain	78	104
AKI	20	47
Stroke	16	21

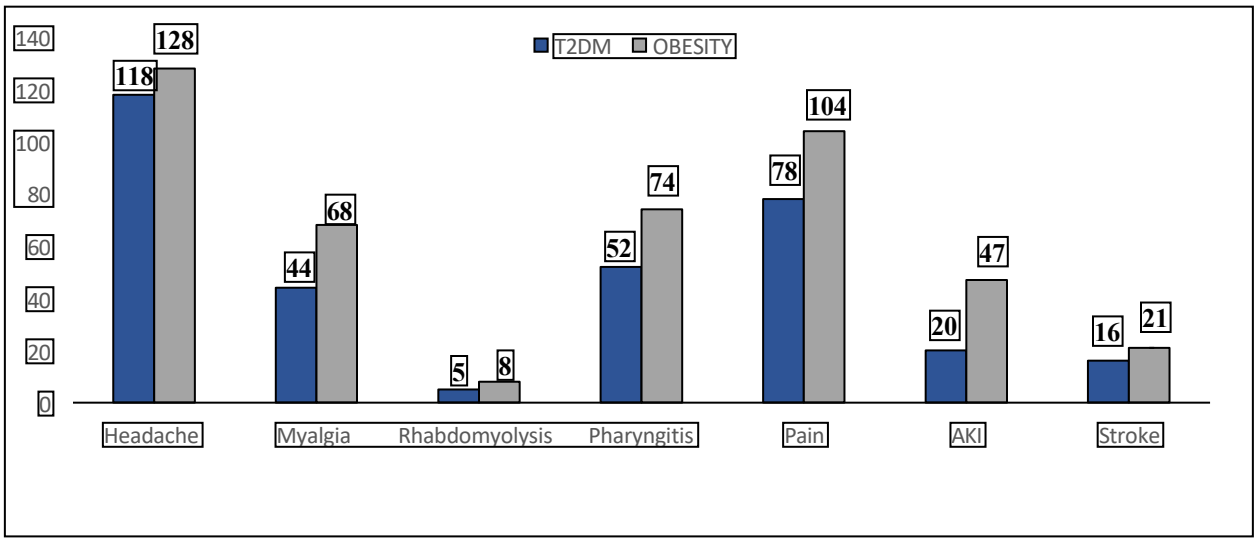

Fig 8: Safety parameters of Rosuvastatin.

EFFICACY PARAMETERS IN T2DM

1. EFFECT ON FASTING BLOOD SUGAR (FBS) LEVELS

Table 7 represents the comparison of 3 visits of T2DM patients of A group and R group which is graphically illustrated in Figure 9.

There was a significant change between visit-1 & visit-2; visit-1 & visit-3 of Atorvastatin with P-values <0.0001****, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3 of Rosuvastatin with P-values <0.0001****, <0.0001**** respectively.

Table7: FBS changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE
VISIT 1	171.18 ± 60.82		157.91 ± 54.66	
VISIT 2	146.42 ± 43.88	<0.0001****	133.75 ± 41.98	<0.0001****
VISIT 3	118.62 ± 34.81	<0.0001****	108.93 ± 40.07	<0.0001****

Results obtained had shown that there is a significant decrease in the FBS levels of Rosuvastatin and Atorvastatin.

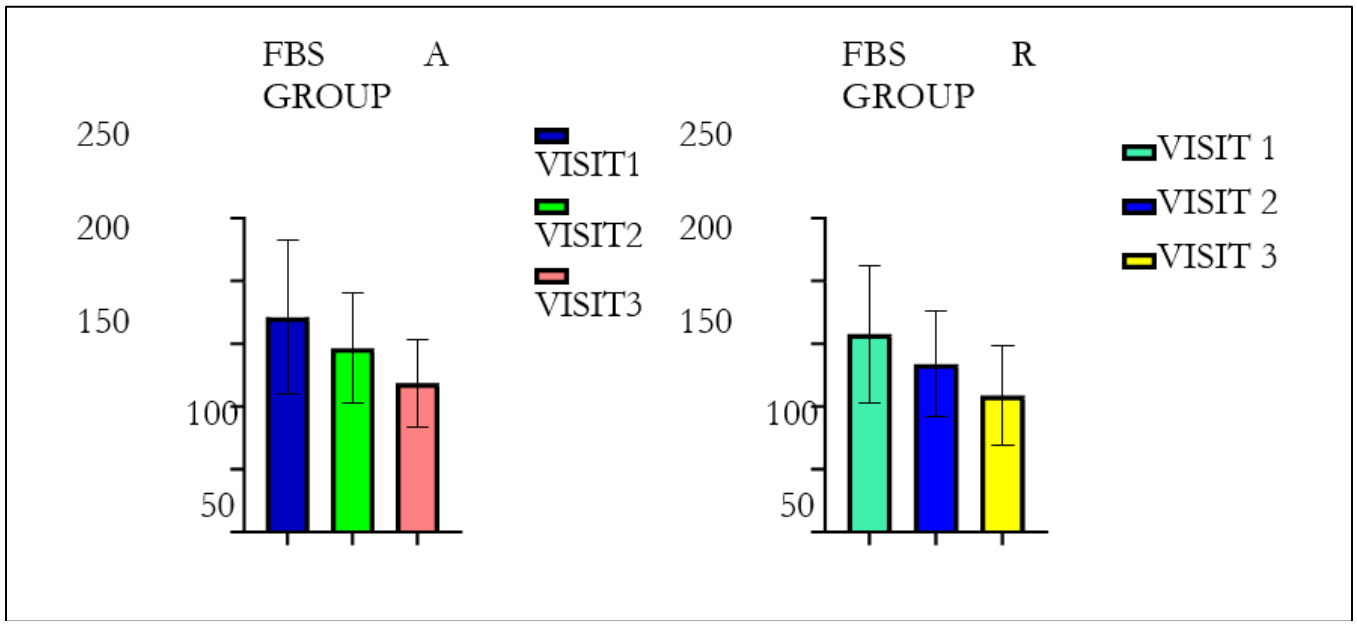

Fig 9: FBS changes in T2DM patients.

From the graph it is evident that there is a significant reduction in Rosuvastatin and Atorvastatin in the later treatment period i.e., visit 2 & 3.

2. EFFECT ON POSTLUNCH BLOOD SUGAR (PLBS) LEVELS

Table 8 represents the comparison of 3 visits of T2DM patients of A group and R group which is graphically illustrated in Figure 10.

There was a significant change between visit-1 & visit-2; visit-1& visit-3 of Atorvastatin with P-values <0.0001****, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3 of Rosuvastatin with P-values <0.0001****, <0.0001**** respectively.

Table 8: PLBS changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE

VISIT 1	246.31 ± 82.28		232.31 ± 74.23	
VISIT 2	208.32 ± 63.77	<0.0001****	199.15 ± 60.66	<0.0001****
VISIT 3	163.10 ± 43.89	<0.0001****	160.51 ± 54.55	<0.0001****

Results obtained had shown that there is a significant decrease in the PLBS levels of Rosuvastatin and Atorvastatin.

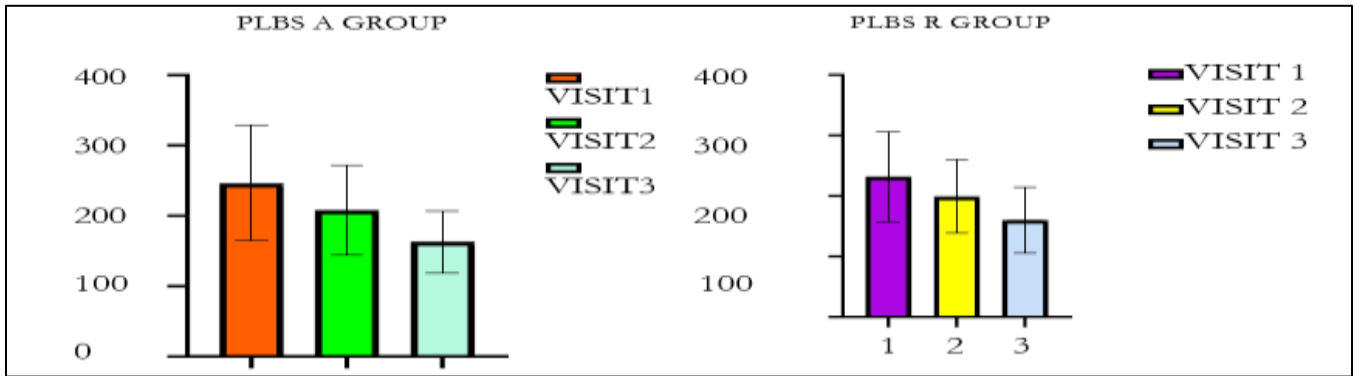

Fig 10: PLBS changes in T2DM patients.

From the graph it is evident that there is a significant reduction in Rosuvastatin and Atorvastatin in the later treatment period i.e., visit 2 & 3.

3. EFFECT ON HbA1c LEVELS

Table 9 represents the comparison of 3 visits of T2DM patients of A group and R group which is graphically illustrated in Figure 11.

There was a significant change between visit-1& visit-2; visit-1 & visit-3 of Atorvastatin with P-values <0.0001****, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3ofRosuvastatin with P-values <0.0001****, <0.0001**** respectively.

Table 9: HbA1c changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE
VISIT 1	8.15 ± 1.65		8.24 ± 1.70	
VISIT 2	7.40 ± 1.21	<0.0001****	7.56 ± 1.36	<0.0001****
VISIT 3	6.60 ± 0.87	<0.0001****	6.82 ± 1.22	<0.0001****

Results obtained had shown that there is a significant decrease in the HbA1c levels of Rosuvastatin and Atorvastatin.

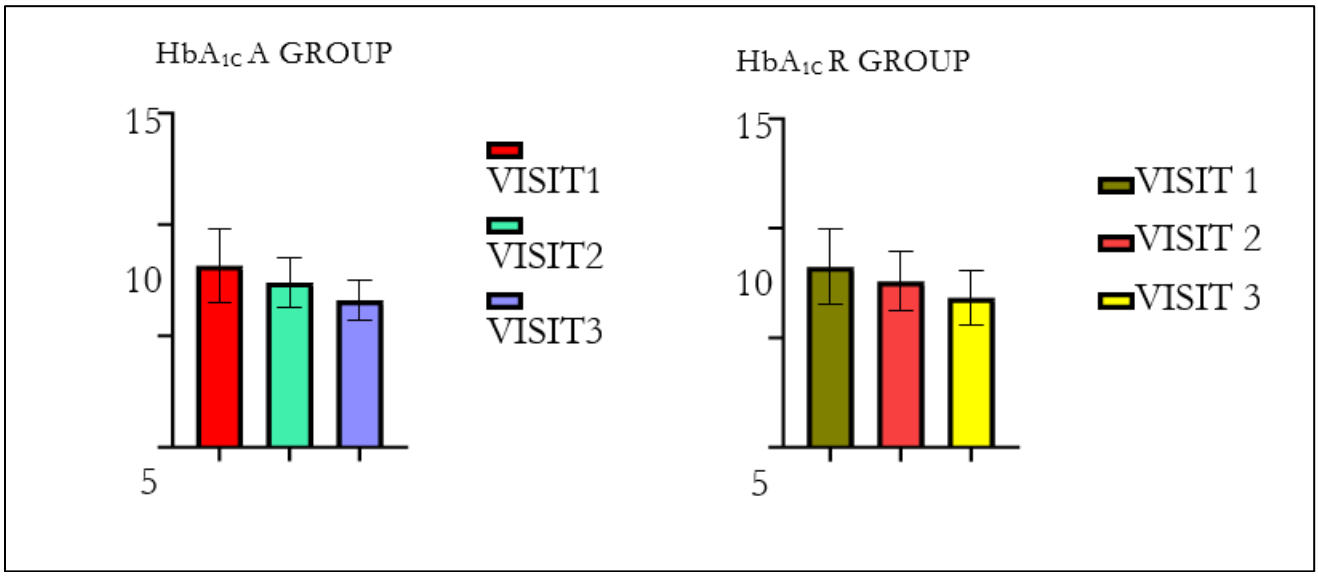

Fig 11: HbA1c changes in T2DM patients.

From the graph it is evident that there is a significant reduction in Rosuvastatin and Atorvastatin in the later treatment period i.e., visit 2 & 3.

4. EFFECT ON SERUM CREATININE LEVELS

Table 10 represents the comparison of 3 visits of T2DM patients of A group and R group which is graphically illustrated in Figure 12.

There was a significant change between visit-1&visit-2; visit-1&visit-3of Atorvastatin with P-values <0.0001****, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3 of Rosuvastatin with P-values <0.0001****, <0.0001**** respectively.

Table10: Serum creatinine changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE
VISIT 1	1.31 ± 0.45		1.09 ± 0.21	
VISIT 2	1.10 ± 0.28	<0.0001****	0.96 ± 0.16	<0.0001****
VISIT 3	0.86 ± 0.15	<0.0001****	0.80 ± 0.14	<0.0001****

Results obtained had shown that there is a significant decrease in the Serum creatinine levels of Rosuvastatin and Atorvastatin

5. EFFECT ON LDL LEVELS

Table 11 represents the comparison of 3visits of T2DM patients of A group and R group which is graphically illustrated in Figure 13.

There was a significant change between visit-1 & visit-2; visit-1 & visit-3 of Atorvastatin with P-values <0.0001****, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3 of Rosuvastatin with P-values <0.0001****, <0.0001**** respectively.

Table 11: LDL changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE
VISIT 1	160.82 ± 24.39		162.49 ± 29.37	
VISIT 2	133.90 ± 20.27	<0.0001****	127 ± 20	<0.0001****
VISIT 3	107.57 ± 18.67	<0.0001****	85.51 ± 17.30	<0.0001****

Results obtained had shown that there is a significant decrease in the LDL levels of Rosuvastatin than that of Atorvastatin.

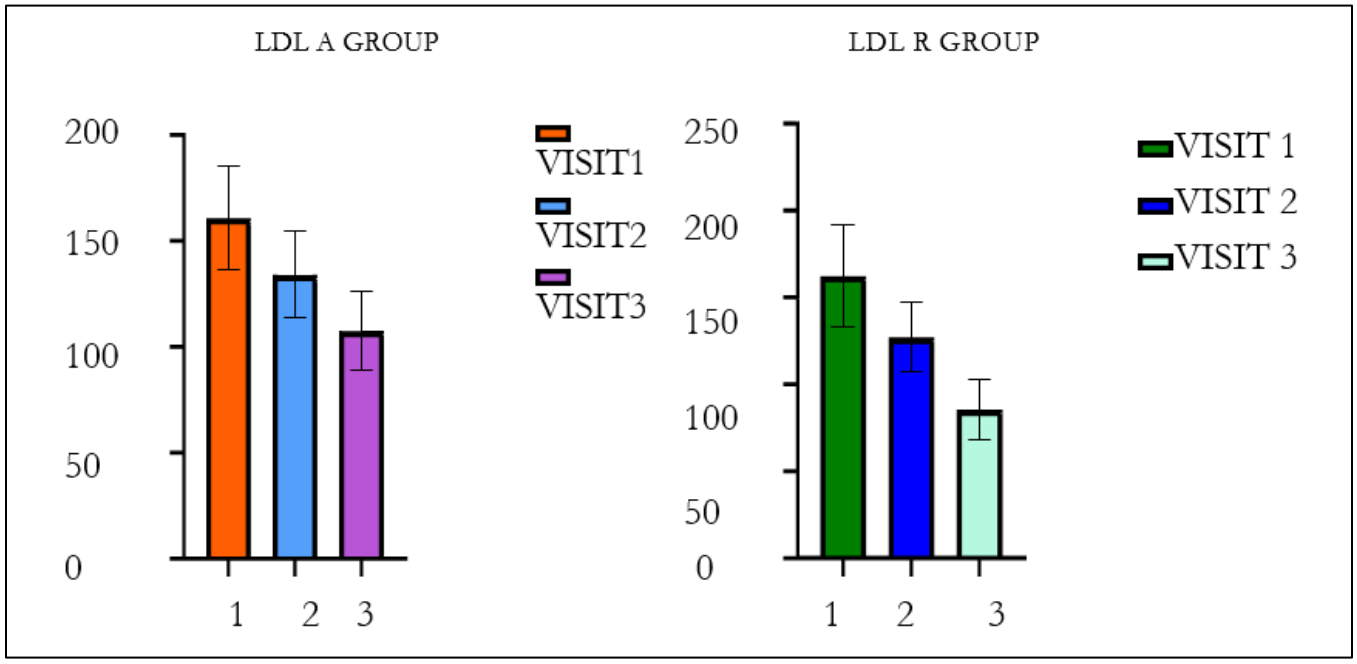

Fig 13: LDL changes in T2DM patients.

From the graph it is evident that there is a significant reduction in Rosuvastatin thanAtorvastatin in the later treatment period i.e., visit 2 & 3.

6. EFFECT ON VLDL LEVELS

Table 12 represents the comparison of 3 visits of T2DM patients of A group and R group which is graphically illustrated in Figure 14.

There was a significant change between visit- 1 & visit-2; visit-1& visit-3 of Atorvastatin with P-values <0.0001****, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3of Rosuvastatin with P-values <0.0001****, <0.0001**** respectively.

Table 12: VLDL changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE

VISIT 1	33.78 ± 5.29		34.81 ± 5.95	
VISIT 2	27.83 ± 4.35	<0.0001****	28.90 ± 5.55	<0.0001****
VISIT 3	22.13 ± 3.92	<0.0001****	22.94 ± 5.28	<0.0001****

Results obtained had shown that there is a significant decrease in the VLDL levels of Rosuvastatin than that of Atorvastatin.

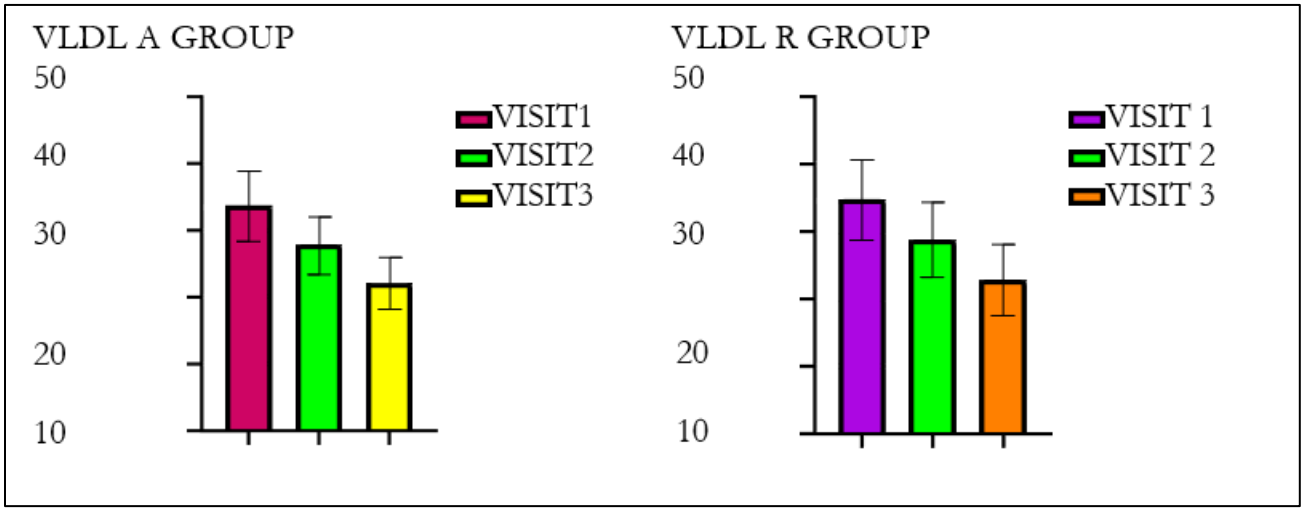

Fig 14: VLDL changes in T2DM patients.

From the graph it is evident that there is a significant reduction in Rosuvastatin thanAtorvastatin in the later treatment period i.e., visit 2 & 3.

7. EFFECT ON HDL LEVELS

Table 13 represents the comparison of 3 visits of T2DM patients of A group and R group which is graphically illustrated in Figure 15.

There was a significant change between visit-1 & visit-2; visit-1&visit-3 of Atorvastatin with P-values <0.0001****, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3 of Rosuvastatin with P-values <0.0001****, <0.0001**** respectively.

Table 13: HDL changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE
VISIT 1	35.70 ± 5.01		34.88 ± 4.91	
VISIT 2	42.85 ± 5.33	<0.0001****	41.48 ± 5.01	<0.0001****
VISIT 3	49.32 ± 5.38	<0.0001****	48.59 ± 5.38	<0.0001****

Results obtained had shown that there is a significant increase in the HDL levels of Rosuvastatin than that of Atorvastatin.

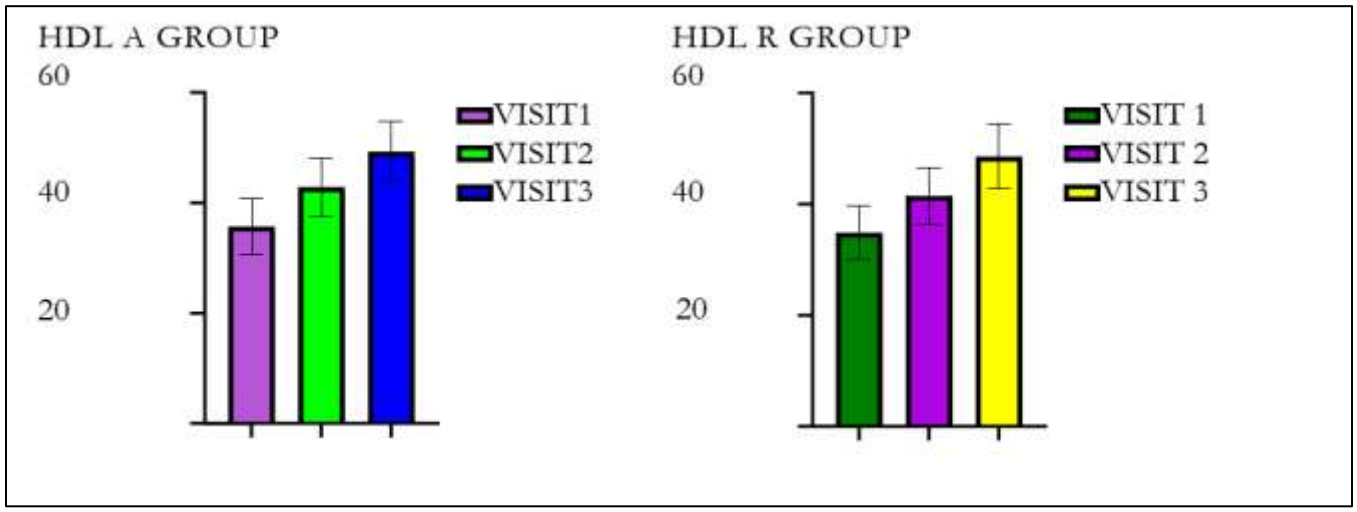

Fig 15: HDL changes in T2DM patients.

From the graph it is evident that there is a significant increase in Rosuvastatin than Atorvastatinin the later treatment period i.e., visit 2 & 3.

8. EFFECT ON TC LEVELS

Table 14 represents the comparison of 3 visits of T2DM patients of A group and R group which is graphically illustrated in Figure 16.

There was a significant change between visit-1 & visit-2; visit-1 & visit-3 of Atorvastatin with P-values <0.0001****, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3 of Rosuvastatin with P-values <0.0001****, <0.0001**** respectively.

Table 14: TC changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE
VISIT 1	213.48 ± 36.02		223.40 ± 34.65	
VISIT 2	184.44 ± 32.31	<0.0001****	179.04 ± 27.54	<0.0001****
VISIT 3	156.59 ± 30.90	<0.0001****	141.69 ± 23.26	<0.0001****

Results obtained had shown that there is a significant decrease in the TC levels of Rosuvastatin than that of Atorvastatin.

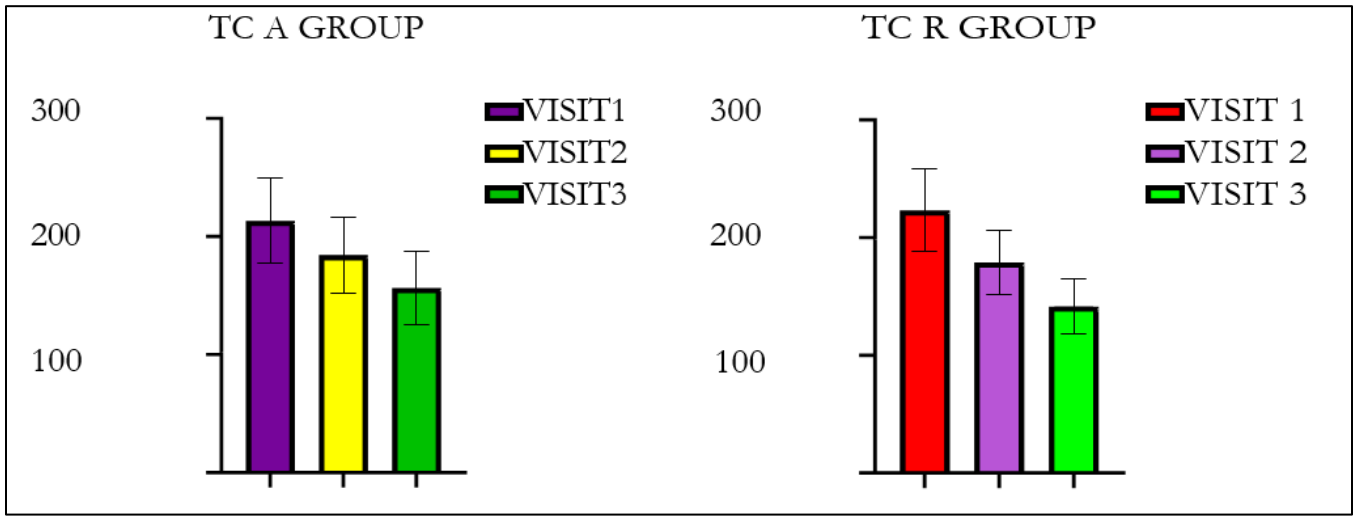

Fig 16: TC changes in T2DM patients.

From the graph it is evident that there is a significant reduction in Rosuvastatin than Atorvastatin in the later treatment period i.e., visit 2 & 3.

9. EFFECT ON TG LEVELS

Table 15 represents the compariso n of 3 visits of T2DM patients of A group and R group which is graphically illustrated in Figure 17.

There was a significant change between visit-1 & visit-2; visit-1 & visit-3 of Atorvastatin with P-values <0.0001****, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3 of Rosuvastatin with P-values <0.0001****, <0.0001**** respectively.

Table15: TG changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE
VISIT 1	182.91 ± 43.57		183.65 ± 52.44	
VISIT 2	157.97 ± 37.66	<0.0001****	150.27 ± 40.10	<0.0001****
VISIT 3	129.64 ± 29.13	<0.0001****	115.48 ± 29.43	<0.0001****

Results obtained had shown that there is a significant decrease in the TG levels of Rosuvastatin than that of Atorvastatin.

EFFICACY PARAMETERS IN OBESITY

1. EFFECT ON FASTING BLOOD SUGAR (FBS) LEVELS

Table 16 represents the comparison of 3 visits of Obese patients of A group and R group which is graphically illustrated in Figure 18.

There was a significant change between visit-1 & visit-2; visit-1&visit-3 of Atorvastatin with P-values 0.007**, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3 of Rosuvastatin with P-values 0.0043**, <0.0001**** respectively.

Table 16: FBS changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE
VISIT 1	159.65 ± 51.64		140.09 ± 44.65	
VISIT 2	143.02 ± 43.45	0.007**	126.19 ± 39.74	0.0043**
VISIT 3	128.62 ± 41.92	<0.0001****	99.41 ± 28.99	<0.0001****

Results obtained had shown that there is a significant decrease in the FBS levels of Rosuvastatin and Atorvastatin.

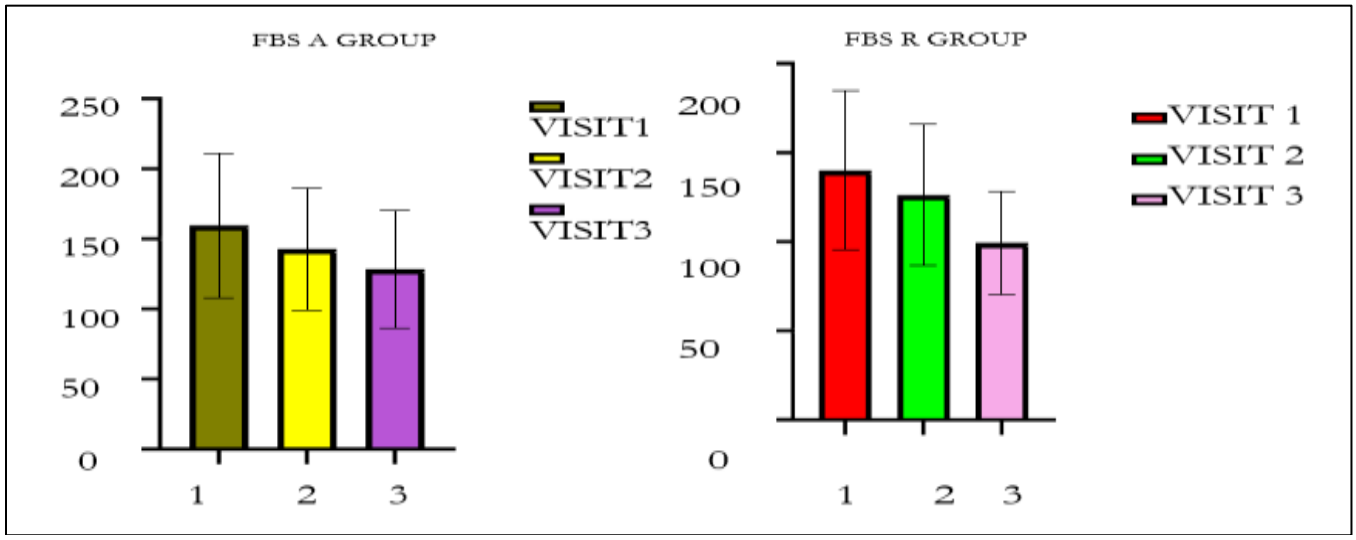

Fig18: FBS changes in obese patients.

From the graph it is evident that there is a significant reduction in Rosuvastatin and Atorvastatin in the later treatment period i.e., visit 2 & 3.

2. EFFECT ON POST LUNCH BLOOD SUGAR (PLBS) LEVELS

Table 17 represents the comparison of 3 visits of Obese patients of A group and R group which is graphically illustrated in Figure 19.

There was a significant change between visit-1 & visit-2; visit-1&visit-3 of Atorvastatin with P-values 0.1855^{ns}, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3 of Rosuvastatin with P-values 0.0021**, <0.0001**** respectively.

Table17: PLBS changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE
VISIT 1	242.25 ± 83.07		230.04 ± 83.05	
VISIT 2	226.55 ± 73.61	0.1855^{ns}	201.65 ± 68.12	0.0021**

VISIT 3	202.24 ± 64.80	<0.0001****	175.56 ± 67.91	<0.0001****

Results obtained had shown that there is a significant decrease in the PLBS levels of Rosuvastatin and Atorvastatin.

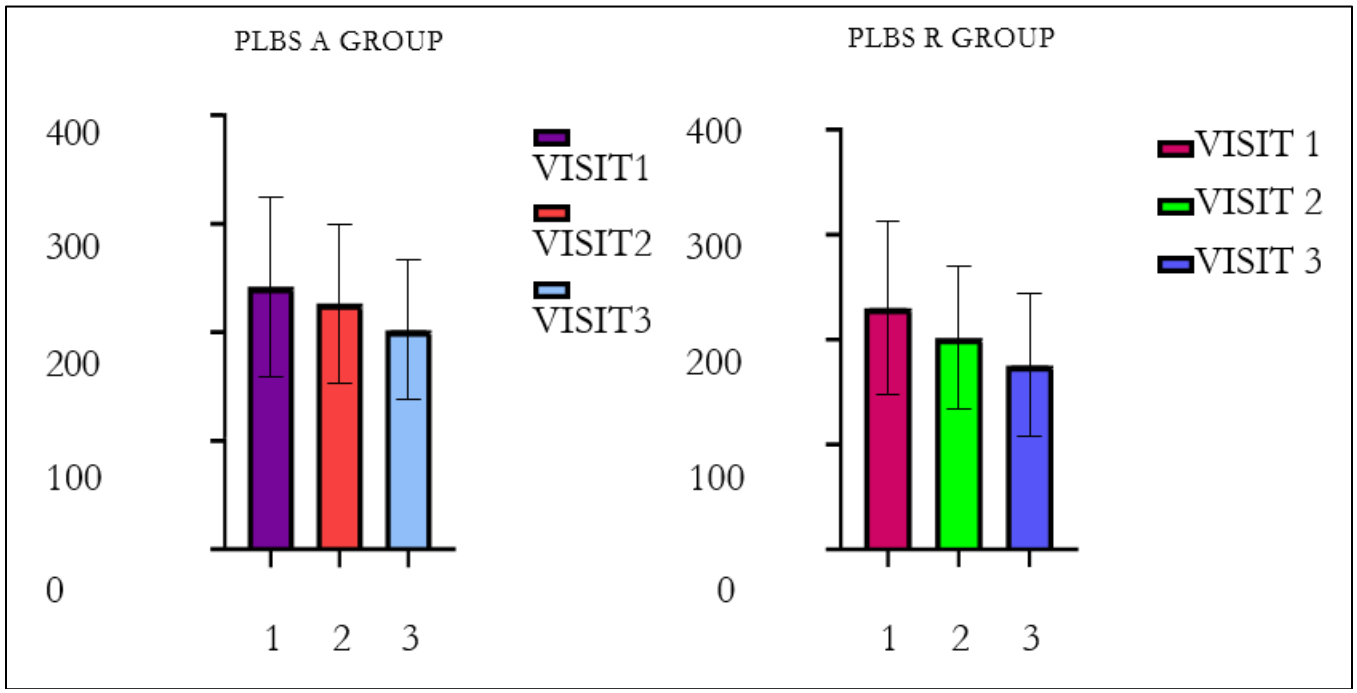

Fig19: PLBS changes in obese patients.

From the graph it is evident that there is a significant reduction in Rosuvastatin and Atorvastatin in the later treatment period i.e., visit 2 & 3.

3. EFFECT ON HbA1c LEVELS

Table 18 represents the comparison of 3 visits of Obese patients of A group and R group which is graphically illustrated in Figure 20.

There was a significant change between visit-1 & visit-2; visit-1 & visit-3 of Atorvastatin withP-values 0.4509^{ns}, 0.0011** and visit-1 & visit-2; visit-1 & visit-3 of Rosuvastatin with P-values 0.2042 ^{ns}, <0.0001**** respectively.

Table18: HbA1c changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE
VISIT 1	8.04 ± 1.84		8.12 ± 1.78	
VISIT 2	7.81 ± 1.58	0.4509^{ns}	7.81 ± 1.54	0.2042^{ns}
VISIT 3	7.34 ± 1.35	0.0011**	7.08 ± 1.53	<0.0001****

Results obtained had shown that there is a significant decrease in the HbA1c levels of Rosuvastatin and Atorvastatin.

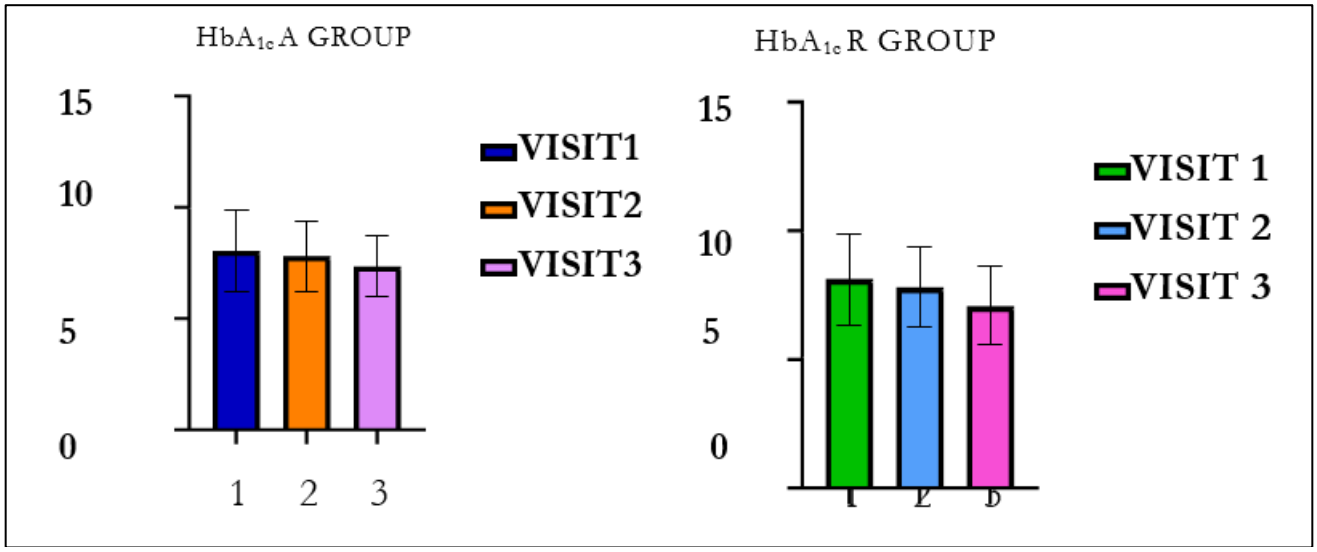

Fig 20: HbA1c changes in obese patients.

From the graph it is evident that there is a significant reduction in Rosuvastatin and Atorvastatin in the later treatment period i.e., visit 2 & 3.

4. EFFECT ON SERUM CREATININE LEVELS

Table 19 represents the comparison of 3 visits of Obese patients of A group and R group which is graphically illustrated in Figure 21.

There was a significant change between visit-1 & visit-2; visit-1 & visit-3 of Atorvastatin with P-values 0.0078**, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3 of Rosuvastatin with P-values 0.0003***, <0.0001**** respectively.

Table19: Serum creatinine changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	PVALUE
VISIT 1	1.14 ± 0.21		1.03 ± 0.18	
VISIT 2	1.06 ± 0.19	0.0078**	0.95 ± 0.17	0.0003***
VISIT 3	0.94 ± 0.19	<0.0001****	0.83 ± 0.17	<0.0001****

Results obtained had shown that there is a significant decrease in the LDL levels of Rosuvastatin and Atorvastatin.

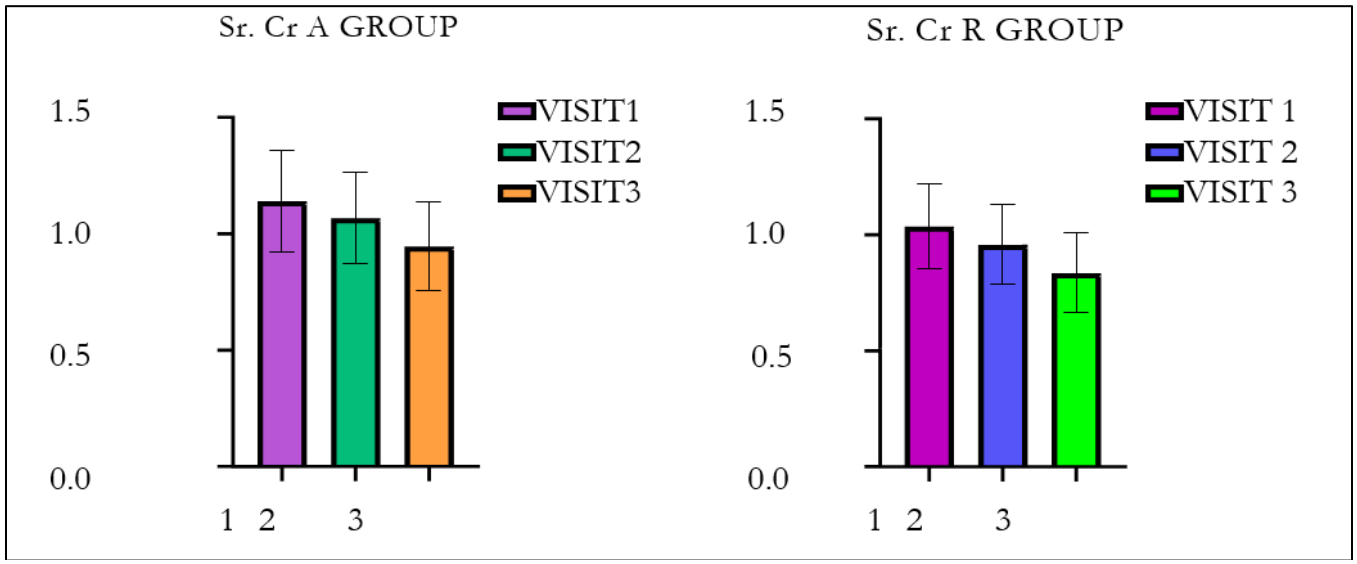

Fig21: Serum creatinine changes in obese patients.

From the graph it is evident that there is a significant reduction in Rosuvastatin and Atorvastatin in the later treatment period i.e., visit 2 & 3.

5. EFFECT ON LDL LEVELS

Table 20 represents the comparison of 3 visits of Obese patients of A group and R group which is graphically illustrated in Figure 22.

There was a significant change between visit-1 & visit-2; visit-1&visit-3 of Atorvastatin with P-values <0.0001****, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3 of Rosuvastatin with P-values <0.0001****, <0.0001**** respectively.

Table 20: LDL changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE
VISIT 1	158.57 ± 21.29		160.02 ± 32.67	
VISIT 2	142.11 ± 20.74	<0.0001****	136.91 ± 22.87	<0.0001****
VISIT 3	123.66 ± 18.95	<0.0001****	102.91 ± 22.20	<0.0001****

Results obtained had shown that there is a significant decrease in the LDL levels of Rosuvastatin than that of Atorvastatin.

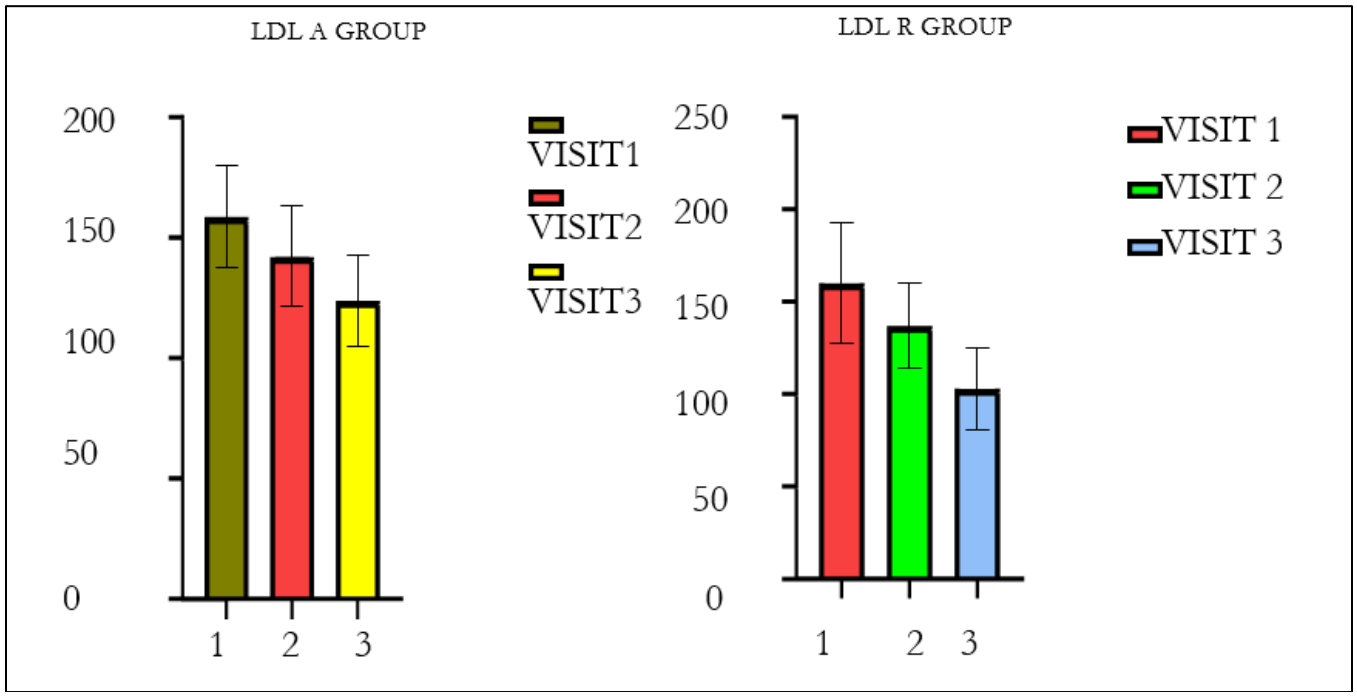

Fig 22: LDL changes in obese patients.

From the graph it is evident that there is a significant reduction in Rosuvastatin than Atorvastatin in the later treatment period i.e., visit 2 & 3.

6. EFFECT ON VLDL LEVELS

Table 21 represents the comparison of 3 visits of obese patients of A group and R group which is graphically illustrated in Figure 23.

There was a significant change between visit-1 & visit-2; visit-1 & visit-3 of Atorvastatin with P-values <0.0001****, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3 of Rosuvastatin with P-values <0.0001****, <0.0001**** respectively.

Table 21: VLDL changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE
VISIT 1	32.86 ± 3.78		35.32 ± 5.51	
VISIT 2	29.79 ± 3.43	<0.0001****	31.03 ± 5.44	<0.0001****
VISIT 3	25.88 ± 3.40	<0.0001****	26.12 ± 5.30	<0.0001****

Results obtained had shown that there is a significant decrease in the VLDL levels of Rosuvastatin than that of Atorvastatin.

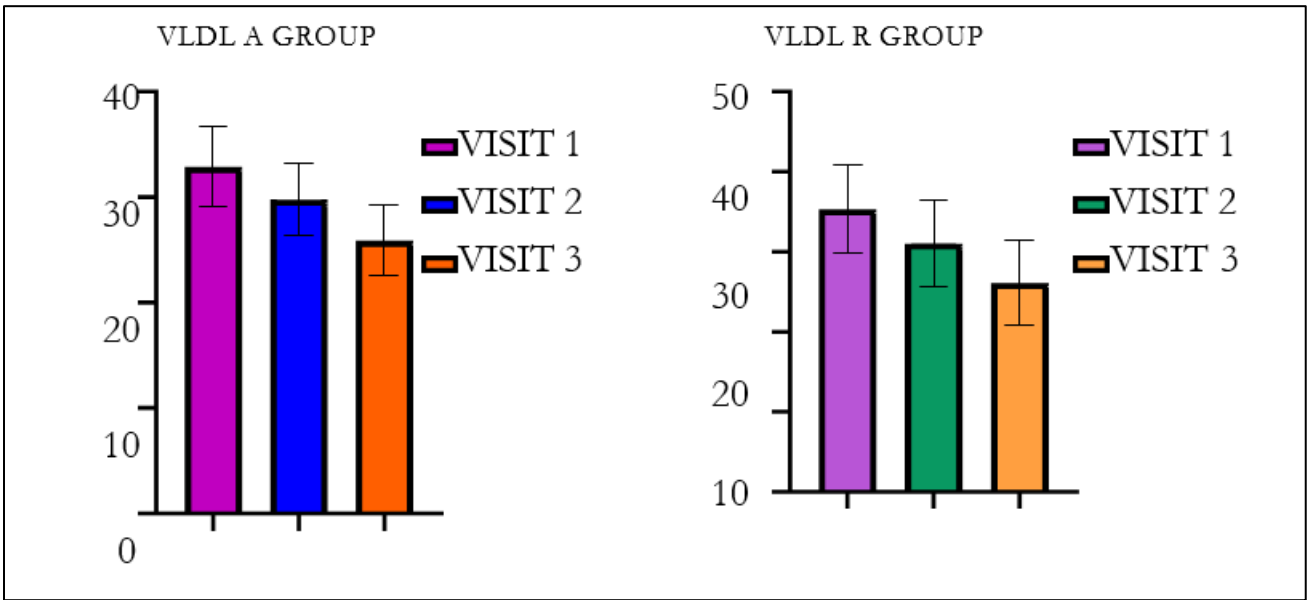

Fig23: VLDL changes in obese patients.

From the graph it is evident that there is a significant reduction in Rosuvastatin thanAtorvastatin in the later treatment period i.e., visit 2 & 3.

7. EFFECT ON HDL LEVELS

Table 22 represents the comparison of 3 visits of Obese patients of A group and R group which is graphically illustrated in Figure 24.

There was a significant change between visit-1 & visit-2; visit-1 & visit-3 of Atorvastatin with P-values <0.0001****, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3ofRosuvastatin with P-values <0.0001****, <0.0001**** respectively.

Table22: HDL changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE
VISIT 1	34.83 ± 3.79		35.54 ± 4.85	
VISIT 2	40.66 ± 3.88	<0.0001****	41.21 ± 5.14	<0.0001****
VISIT 3	45.99 ± 3.92	<0.0001****	47.83 ± 6.34	<0.0001****

Results obtained had shown that there is a significant increase in the HDL levels of Rosuvastatin than that of Atorvastatin.

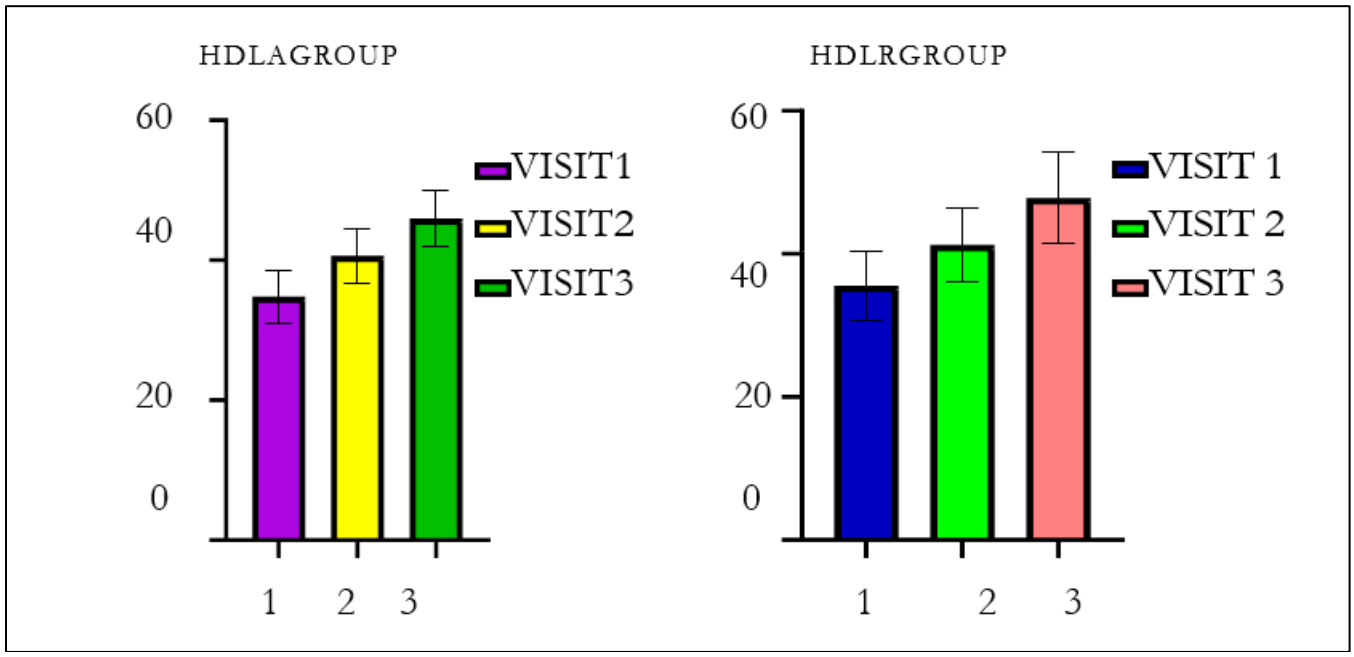

Fig24: HDL changes in obese patients.

From the graph it is evident that there is a significant increase in Rosuvastatin than Atorvastatin in the later treatment period i.e., visit 2 & 3.

18. EFFECT ON TC LEVELS

Table 23 represents the comparison of 3 visits of Obese patients of A group and R group which is graphically illustrated in Figure 25.

There was a significant change between visit-1 & visit-2; visit-1&visit-3 of Atorvastatin with P-values <0.0001****, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3of Rosuvastatin with P-values <0.0001****, <0.0001**** respectively.

Table23: TC changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE
VISIT 1	208.68 ± 32.84		210.09 ± 33.79	
VISIT 2	191.05 ± 32.82	<0.0001****	180.80 ± 29.23	<0.0001****
VISIT 3	173.96 ± 32.59	<0.0001****	156.17 ± 24.13	<0.0001****

Results obtained had shown that there is a significant decrease in the TC levels of Rosuvastatin than that of Atorvastatin.

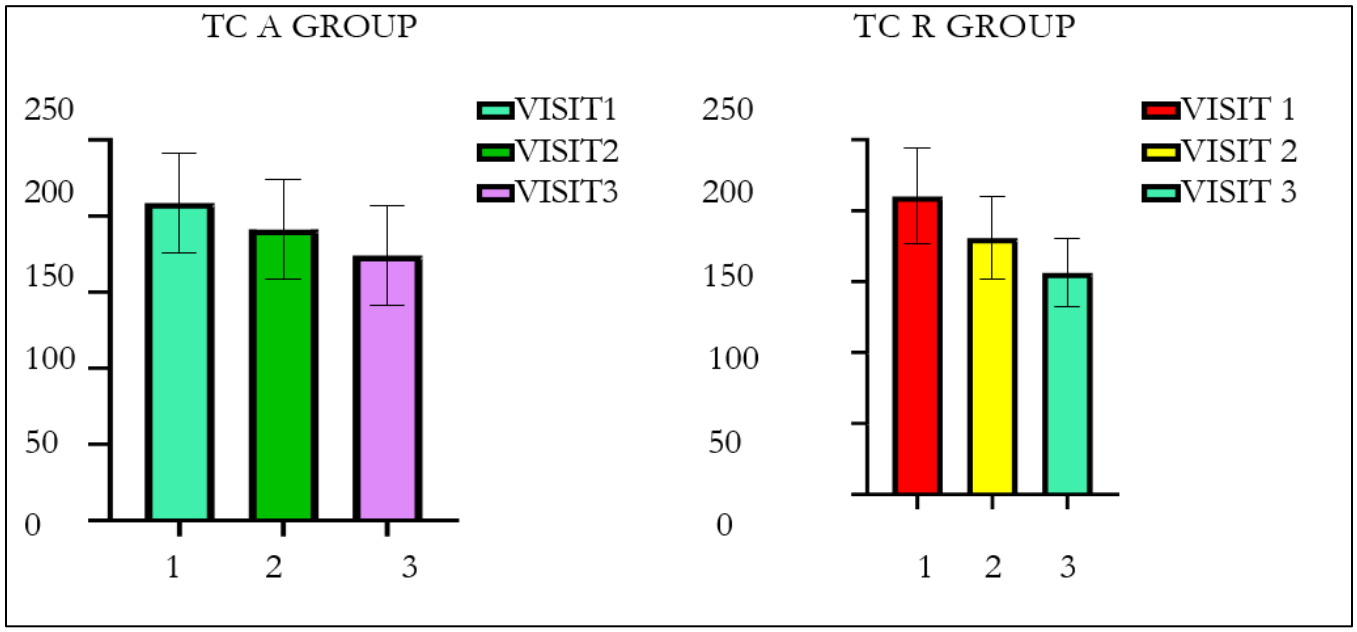

Fig25: TC changes in obese patients.

From the graph it is evident that there is a significant reduction in Rosuvastatin than Atorvastatin in the later treatment period i.e., visit 2 & 3.

9. EFFECT ON TG LEVELS

Table 24 represents the comparison of 3 visits of Obese patients of A group and R group which is graphically illustrated in Figure 26.

There was a significant change between visit-1 & visit-2; visit-1 & visit-3 of Atorvastatin with P-values 0.0010**, <0.0001**** and visit-1 & visit-2; visit-1 & visit-3 of Rosuvastatin with P-values <0.0001****, <0.0001**** respectively.

Table24: TG changes in the treatment period

TREATMENT PERIOD	ATORVASTATIN		ROSUVASTATIN	
	MEAN± SD	P VALUE	MEAN± SD	P VALUE
VISIT 1	174.88 ± 40.15		172.64 ± 37.40	
VISIT 2	158.57 ± 39.11	0.0010**	147.62 ± 32.78	<0.0001****
VISIT 3	139.80 ± 33.23	<0.0001****	117.63 ± 30.87	<0.0001****

Results obtained had shown that there is a significant decrease in the TG levels of Rosuvastatin than that of Atorvastatin.

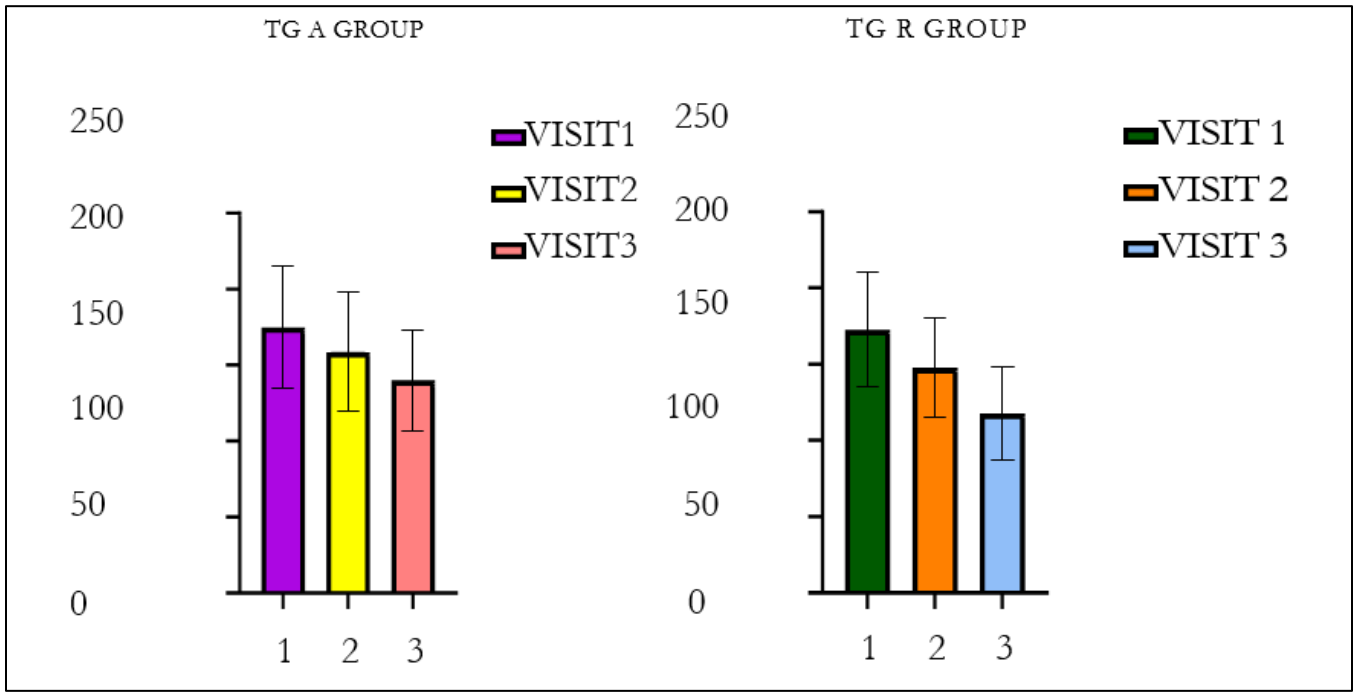

Fig26: TG changes in obese patients.

From the graph it is evident that there is a significant reduction in Rosuvastatin than Atorvastatin in the later treatment period i.e., visit 2 & 3.

DISCUSSION

In the present study, the study subjects were grouped into Type 2 Diabetes group and obese group patients. The efficacy parameters assessed were FBS, PLBS, HbA1c, Serum creatinine levels and Lipid profile. The present study shows that both Atorvastatin and Rosuvastatin have significant effect on reducing LDL, TC, TG levels and elevating HDL levels in both T2DM group and Obese group patients.

In T2DM patients, Atorvastatin reduced LDL levels from 160.82 ± 24.39 to 107.57 ± 18.67 whereas Rosuvastatin reduced LDL from 162.49±29.37 to 85.51±17.30. Similarly, Atorvastatin reduced TC from 213.48±36.02 to 156.59±30.90 and Rosuvastatin reduced TC from 223.40±34.65 to 141.69 ± 23.26; Atorvastatin reduced TG from 182.91 ± 43.57 to 129.64 ± 29.13 and Rosuvastatin reduced TG from 183.65 ± 52.44 to115.48 ± 29.43 and Atorvastatin elevated HDL from 35.70±5.01 to 49.32±5.38 and Rosuvastatin elevated HDL from 34.88±4.91 to 48.59±5.38.

These present findings were comparable with the work done by Strandberg et al., 2004, a randomized, open label comparison of the effects of Rosuvastatin 10mg/dl and Atorvastatin 10mg/dl in high-risk adults: a discovery study [17].

These present findings were comparable with the work done by Rudip et al., 2003, to compare the drugs: Atorvastatin (10mg) and Rosuvastatin (5mg) in patients with Dyslipidemia [18].

In Obese patients, Atorvastatin reduced LDL levels from 158.57±21.29 to 123.66±18.95 whereas Rosuvastatin reduced LDL from 160.02±32.67 to 102.91±22.20. Similarly, Atorvastatin reduced TC from 208.68±32.84 to 173.96±32.59 and Rosuvastatin reduced TC from 210.09±33.79 to 156.17±24.13; Atorvastatin reduced TG from 174.88±40.15 to 139.80±33.23 and Rosuvastatin

reduced TG from 172.64±37.40 to 117.63±30.87 and Atorvastatin elevated HDL from34.83±3.79 to 45.99 ±3.92 and Rosuvastatin elevated HDLfrom35.54± 4.85to 47.83± 6.34.

These present findings were comparable with the work done by Sindhu et al., 2011, effects on high sensitivity C-reactive protein (hs-CRP) levels and lipid profile of Atorvastatin and Rosuvastatin in Obese Type 2 Diabetes Mellitus (T2DM) patients [12].

TYPE2 DM	ATORVASTATIN			ROSUVASTATIN		
BIOCHEMICAL PARAMETERS	BASE LINE MEAN± SD	AFTER TREATMENT MEAN± SD	%CHANGE ± SD	BASE LINE MEAN± SD	AFTER TREATMENT MEAN± SD	%CHANGE ± SD
LDL-C	160.82 ± 24.39	107.57 ± 18.67	53.25 ± 5.72	162.49 ± 29.37	85.51 ± 17.30	76.98 ± 12.07
VLDL-C	33.78 ± 5.29	22.13 ± 3.92	11.65 ± 1.37	34.81 ± 5.95	22.90 ± 5.55	11.86 ± 0.4
HDL-C	35.70 ± 5.01	49.32 ± 5.38	-13.61±-0.37	34.88 ± 4.91	48.59 ± 5.38.	-13.71±-0.97
TC	213.48 ± 36.02	156.59 ± 30.90	56.88 ± 5.12	223.40 ± 34.65	141.69 ±23.26	81.71 ± 11.39
TG	182.91 ± 43.57	129.64 ± 29.13	53.27 ± 14.44	183.65 ± 52.44	115.48 ± 29.43	68.18 ± 23.01

OBESITY	ATORVASTATIN			ROSUVASTATIN		
BIOCHEMICAL PARAMETERS	BASE LINE MEAN± SD	AFTER TREATMENT MEAN± SD	%CHANGE ± SD	BASE LINE MEAN± SD	AFTER TREATMENT MEAN± SD	%CHANGE ± SD
LDL-C	158.57 ± 21.29	123.66 ± 18.95	34.91 ± 2.34	160.02 ± 32.67	102.91 ± 22.20	57.10 ± 10.47
VLDL-C	32.86 ± 3.78	25.88 ± 3.40	6.98 ± 0.38	35.32 ± 5.51	26.12 ± 5.30	9.2 ± 0.21

HDL-C	34.83 ± 3.79	45.99 ± 3.92	-11.16±-0.13	35.54 ± 4.85	47.83 ± 6.34	-12.29±-1.49
TC	208.68 ± 32.84	173.96 ± 32.59	34.72 ± 0.25	210.09 ± 33.79	156.17 ± 24.13	53.92 ± 9.66
TG	174.88 ± 40.15	139.80 ± 33.23	35.08 ± 6.92	172.64 ± 37.40	117.63 ± 30.87	55.01 ± 6.53

LDL-C:LowDensityLipoproteinCholesterol,VLDL-C:VeryLow-DensityLipoproteinCholesterol,HDL-C:HighDensityLipoprotein Cholesterol, TC- Total Cholesterol, TG- Triglycerides.

In the current study safety parameters of (A, R) in T2DM group and obese group Patients are as follows:There were few adverse events developed during the study course but not life threatening and severe.

During the treatment of Atorvastatin in T2DM group patients out of 302 subjects, 155 developed Myalgia, 84 developed Abdominal bloating, 68 developed Headache, 29 developed Stroke, 11 developed AKI, 3 developed Rhabdomyolysis.

During the treatment of Atorvastatin in Obese group patients out of 138 subjects, 116 developed Myalgia, 102 developed Abdominal bloating, 92 developed Headache, 47 developed Stroke, 27 developed AKI, 5 developed Rhabdomyolysis.

The present findings were comparable with the study done by Michaeletal.,2006 on Comparison of the efficacy and safety of Rosuvastatin 10 mg and Atorvastatin 20 mg in high-risk patients with hypercholesterolemia – Prospective study to evaluate the Use of Low doses of the Statins Atorvastatin and Rosuvastatin (PULSAR) [19].

During thetreatment of Rosuvastatin in T2DMgroup patients out of 308 subjects, 118 developed Headache, 78 developed Pain, 52 developed Pharyngitis, 44 developed Myalgia, 20 developed AKI, 16 developed Stroke, 5 developed Rhabdomyolysis.

During the treatment of Rosuvastatin in Obese group patients out of 155 subjects, 128 developed Headache, 104 developed Pain, 74 developed Pharyngitis, 68 developed Myalgia, 47 developed AKI, 21 developed Stroke, 8 developed Rhabdomyolysis.

The present study was comparable with the study done by Carswelletal., 2002 conducted a study on Rosuvastatin its Pharmacokinetic, Pharmacodynamic profile, Therapeutic Trials and Tolerability [20].

CONCLUSION

The obtained data suggests that Statins significantly reduced the LDL, VLDL, TC, TG levels and elevated the HDL levels in T2DM group and Obesity group patients. Both Atorvastatin and Rosuvastatin drugs shown good efficacy in maintaining Lipid profile in both T2DM group patients and Obese group patients, within the comparison, Rosuvastatin is slightly efficacious compared to Atorvastatin in LDL, whereas in HDL Rosuvastatin is slightly efficacious compared to

Atorvastatin. Similarly in other parameters TC also shown the same results that Rosuvastatin is slightly efficacious compared to Atorvastatin and TG also shown the same results that

Rosuvastatin is slightly efficacious compared to Atorvastatin. However, further studies are needed to establish its long-time efficacy and to determine whether it has specific advantages over approved HMG-Co A reductase Inhibitors.

Safety parameters, the most common adverse events in T2DM group patients are: Atorvastatin reported Myalgia, Rosuvastatin reported Headache in high number, whereas in Obese group patients Atorvastatin reported Myalgia, Abdominal bloating, Headache, Rosuvastatin reported Headache, Pain in high number. The results had shown some abnormalities but further evaluation is required to assess whether the drug alone or in combination with other medication had produced such events in the patients.

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Competing Interests

The Authors declare that they have no competing interests.

Authors Contribution

B. Harshitha and B. Bhargavi, May be considered as first authors and worked in the Hospitals in collection of data, Counselling the Diabetic patients, etc., Dr. B. SivaSubrahmanyam was helpful as Clinical guide in selection of Patients, making them understand about the research work and treatment, E.Venkateshwarlu dragged the results by applying suitable statistical designs and B.S. Sharavana bhava discussed and conceived the idea of doing this research work and prepared the Project proposal.

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