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Research Article

Effect of Orlistat Treatment on Visceral Adiposity Index (VAI) in Obese Patients

İhsan Solmaz[1*], Jehat Kılıç[1], Ömer Faruk Alakuş[1]

[1] University of Health Sciences, Gazi Yasargil Training and Research Hospital, Department of Internal Medicine, Diyarbakır, Türkiye

ihsan2157@gmail.com,
jehat_kilic@outlook.com,
omerfaruk01@gmail.com,
ror.org/03f2jcq85

* Corresponding Author

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Introduction: Obesity is a chronic disease characterized by excessive fat accumulation. This study aims to assess the impact of orlistat treatment on the visceral adiposity index and related parameters.

Material and Methods: This study involved 54 patients (18–65 years, BMI >25) from the internal medicine and obesity clinic. Ethical approval and informed consent were obtained. Patients receiving orlistat were monitored at 0, 3, and 6 months. Anthropometric measurements (BMI, weight, waist, and hip circumference) and biochemical markers (glucose, AST, ALT, GGT, TG, HDL) were recorded. VAI was calculated separately for males and females.

Results: Clinical and biochemical parameters of 54 patients (F: 52, M: 2) were analyzed. At baseline, mean body weight (103.87±13,01 kg), waist circumference (113.59±10.25 cm), and BMI (41.59±4.86) indicated obesity. Liver enzymes (AST: 20.13 U/L, ALT: 21.87 U/L, GGT: 24.76 U/L) were mostly normal, with slight GGT elevations. Lipid profile showed mean HDL (47.11 mmol/L) and triglycerides (154,89 mg/dL). Over 6 months, significant reductions were observed in weight (93.33±12,44 kg, $p<0.01$), BMI (37.47±4.61, $p<0.01$), and waist circumference (105.9±10.2 cm, $p<0.01$). ALT ($p<0.01$) and GGT ($p<0.001$) decreased significantly, while AST did not ($p=0.159$). HDL improved ($p<0.016$). VAI slightly decreased (4.42±2.76 to 4.01±2.84), but was not statistically significant ($p=0.224$). These results suggest weight loss benefits metabolic and liver health.

Conclusion: The study observed positive metabolic changes, including weight loss, reduced waist circumference, and decreased BMI. Although VAI showed a decreasing trend after orlistat treatment, the change was not statistically significant. These findings indicate the potential benefits of orlistat.

Keywords: Obesity, Orlistat, Visceral Adiposity Index

1. INTRODUCTION

Obesity is the excessive accumulation of fat that can impair health and pose a risk to body health. Obesity, a chronic disease with increasing prevalence worldwide, is one of the main causes of health problems in many countries.[1,2] Obesity can increase the risk of comorbidities such as Type 2 diabetes mellitus, hypertension and heart disease. Its incidence and prevalence are increasing day by day in our country.[3] Obesity is diagnosed by measuring the height and weight of individuals and calculating the body mass index (BMI). Body mass index BMI: Weight (kg)/height^2 (m^2) is an indicator of obesity and additional measurements such as waist and hip circumference can also help diagnose obesity.[4]

Orlistat is a weight-loss medication approved by the U.S. Food and Drug Administration (FDA) in 1999 and used in conjunction with a low-calorie diet to treat obesity. As a gastrointestinal lipase inhibitor, orlistat inhibits fat metabolism enzymes, preventing the breakdown of triacylglycerol into absorbable fatty acids and nitroglycerides, resulting in poor intestinal absorption. Orlistat can also directly remove unabsorbed triacylglycerol from the body, leading to lower calorie intake and weight loss.[5]

Recently, Visceral Adiposity Index (VAI) has been proven to be an indicator of fat distribution and function that indirectly indicates cardiometabolic risk. In addition, VAI has been suggested as a useful indicator for early detection

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of cardiometabolic risk before it develops into an obvious metabolic syndrome. It has been shown that VAI can be considered as a marker of adipose tissue dysfunction. However, some studies have found conflicting results in the same patient or population. It has been argued that the main reason for this situation may be the lack of knowledge about these applications and their application limits. Future prospective studies will better define the possible usefulness of VAI as a predictor of cardiometabolic risk.[6] First, a fat distribution model, MOAD (a parameter that correlates with visceral fat mass determined by MRI), was developed. It was based on this linear equation. MOAD was then adjusted for triglyceride and HDL cholesterol levels to determine the Visceral Adiposity Index (VAI).[6] High levels of Visceral Adiposity Index (VAI) have been linked to worsening blood sugar levels. Both men and women with elevated VAI have a greater risk of developing Type 2 Diabetes Mellitus (T2DM). However, when it comes to predicting T2DM, it is only women with high VAI who show an increased risk of developing the condition in the future.[7]

Our aim in this study was to determine whether VAI decreases as BMI decreases with orlistat treatment and to reveal the importance of VAI in visceral fat, which is very important for obesity and its complications.

2. MATERIAL AND METHODS

A total of 54 patients were included in our study. Informed voluntary consent forms were obtained from all patients. In our study, the patients' BMI, Height, Weight, Hip Circumference, Waist Circumference were measured and recorded in accordance with appropriate standards. Age, Gender, Visceral Adiposity Index (VAI) of the patients were calculated and recorded separately for male and female patients. Our study was initiated after receiving approval from our hospital's local Ethics Committee dated 17/01/2025 and numbered 321. The study was approved according to the guide of the Declaration of Helsinki and by the Institutional Review Board and Ethical Committe

Patients who visited our hospital's internal medicine and obesity clinic and were aged between 18 and 65 years, with a body mass index (BMI) greater than 25, received orlistat treatment. These patients were monitored over a period of 6 months, with follow-up assessments at 0, 3, and 6 months. During these follow-ups, we tracked their body weight, BMI, and waist circumference. Additionally, laboratory results for glucose, AST, ALT, GGT, triglycerides (TG), and HDL were also recorded. The patients' visceral adiposity index was calculated and monitored using a specific formula throughout the study.

2.1. Visceral Adiposity Index formulation

VAI (Male) = (Waist circumference (cm) / (39.68 + (1.88 x BMI)) x (Triglyceride (mmol/L)/1.03) x (1.31/ HDL (mmol/L))

VAI (Female): (Waist circumference (cm) / (36.58 + (1.89 x BMI)) x (Triglyceride (mmol/L)/0.81) x (1.52/ HDL (mmol/L)) formulated as follows.[8]

In our study, patients aged <18, >65 years, patients with comorbidities such as DM, HT, CRF, CAD other than obesity, patients with any psychiatric history, patients with malignancy and patients using regular medication were excluded from the study.

Statistics: The descriptive characteristics of the data are indicated by mean, standard deviation, median, quartiles, frequency and percentage. The Kolmogorov-Smirnov Test assessed the conformity of the data to normal distribution. In comparing continuous variables between more than two independent groups, if the data were normally distributed, One-Way Analysis of Variance was used, and if the data were not normally distributed, the Kruskal Wallis H Test was used. The variables were examined at a 95% confidence level, and a p-value of less than 0.05 was considered significant. The analysis of the data of the patients in the study was performed using the SPSS 27.0 version package program.

3. RESULTS

In this study, clinical and biochemical parameters of 54 patients (F: 52, M: 2) at the time of admission were evaluated. The mean body weight of the patients was 103.87±13.008 kg, with a minimum of 76 kg and a maximum of 142 kg. The mean waist circumference was 113.59±10.245

cm, varying between a minimum of 89 cm and a maximum of 137 cm. The mean body mass index (BMI) was calculated as 41.585±4.8563, and these values were within the limits of obesity. When liver enzymes were examined, the mean aspartate aminotransferase (AST) levels were determined as 20.13 U/L (11-44 U/L), and alanine aminotransferase (ALT) levels were determined as 21.87 U/L (8-56 U/L), and both enzymes were generally within normal limits. Gamma-glutamyl transferase (GGT) levels ranged between 24.76 U/L (10-86 U/L), and a slight increase was observed in some patients. When the lipid profile was examined, the mean HDL level of the patients was 47.11 mmol/L (28-78 mmol/L), and the mean triglyceride levels were calculated as 154.89 mg/dL (49-440 mg/dL). The mean glucose levels were 98.46±12.683 mg/dL, ranging from a low of 75 mg/dL to a high of 141 mg/dL. When evaluated in general, it was observed that the individuals in the study were at risk for obesity with high body weight, large waist circumference, and high BMI values. In addition, changes in lipid profile and liver enzymes suggest that these individuals should be evaluated for metabolic syndrome or non-alcoholic fatty liver disease (NAFLD).

Table 1.

Descriptive anaylsis of laboratory results

At the time of admission	N	Mean	Minimum	Maximum
Weight (Kg)	54	103.87 ±13.008	76	142
Waist Circumference (cm)	54	113.59± 10.245	89	137
BMI	54	41.585±4.8563	31.0	52.8
AST U/L	54	20.13(11-44)	11	44
ALT U/L	54	21.87(8-56)	8	56
GGT U/L	54	24.76(10-86)	10	86
HDL mmol/L	54	47.11(28-78)	28	78
Triglycerides mg/dL	54	154.89(49-440)	49	440
Glucose levels mg/dL	54	98.46±12.683	75	141

VAI: Visceral Adiposity Index, BMI: Body Mass Index, AST: Aspartate Transaminase, ALT: Alanin Transaminase, GGT: Gama Glutamil Transaminase, HDL: High-Density Lipoprotein

This table 2 shows the statistical significance of the changes in certain metabolic and biochemical parameters of the patients at 0, 3 and 6 months. The mean body weight was 103.88±13.01 kg at the beginning of the study (0 month), decreased to 96.5±12.40 kg at 3 months and 93.33±12.44 kg at 6 months ($p<0.01$), indicating a statistically significant weight loss. Similarly, body mass index (BMI) also showed a significant decrease from 41.59±4.86 to 38.76±4.63 and 37.47±4.61 ($p<0.01$). Waist circumference measurements also decreased over time, from 113.6±10.2 cm at month 0 to 105.9±10.2 cm at month 6 ($p<0.01$). VAI (Visceral Adiposity Index) showed a slight decrease over time (4.42±2.76 at baseline, 4.16±2.73 at 3 months, and 4.01±2.84 at 6 months); however, this change was not statistically significant ($p=0.224$).

Table 2.

Repeated measures of laboratory results

	0. Month	3. Month	6. Month	P value
VAI	4.42 ±2.76	4.16 ±2.73	4.01 ±2.84	0.224
Body Weight	103.88 ± 13.01	96.5 ±12.40	93.33 ±12.44	<0.01
BMI	41.59 ±4.86	38.76 ±4.63	37.47 ±4.61	<0.01
Waist Circumference	113.6 ±10.2	108.2±9.8	105.9±10.2	<0.01
AST	20.1±7.1	19.9±6.6	18.4±4.6	0.159
ALT	21.9±9.6	20.4±11.7	17.0±5.7	<0.01
GGT	24.8±12.5	23.0±13.3	21.2±14.2	<0.001
HDL	47.1±11.2	48.1±10.8	50.3±11.9	<0.016
TG	154.8±	147.1±	145.0±	0.309

VAI: Visceral Adiposity Index, BMI: Body Mass Index, AST: Aspartate Transaminase, ALT: Alanin Transaminase, GGT: Gama Glutamil Transaminase, HDL: High-Density Lipoprotein

Liver enzyme aspartate aminotransferase (AST) levels decreased from 20.1±7.1 U/L at month 0 to 18.4±4.6 U/L at month 6; however, this change was not found to be statistically significant (p=0.159). Alanine aminotransferase (ALT) levels showed a significant decrease from 21.9±9.6 to 17.0±5.7 (p<0.01). Similarly, gamma-glutamyl transferase (GGT) levels decreased from 24.8±12.5 to 21.2±14.2 and this change was considered statistically significant (p<0.001). HDL levels showed a positive change, increasing from 47.1±11.2 mmol/L at the beginning to 50.3±11.9 mmol/L at the 6th month (p<0.016).

4. DISCUSSION

Orlistat primarily acts as a pancreatic lipase inhibitor, also inhibiting gastric lipase. By blocking pancreatic lipase, it prevents the breakdown of triglycerides and the absorption of fatty acids.[9] Multicenter studies have demonstrated that orlistat, a pharmaceutical agent designed to aid in weight management, exhibits significant positive effects on weight loss and the treatment of obesity. These comprehensive research initiatives, conducted across multiple healthcare facilities, have consistently shown that orlistat works by inhibiting the absorption of dietary fats in the gastrointestinal tract, thereby promoting a decrease in overall body weight. Participants in these studies have reported not only reductions in body mass index (BMI) but also improvements in various health markers related to obesity, such as cholesterol levels and blood pressure. As a result, orlistat has emerged as a valuable option in the multifaceted approach to addressing obesity and its associated health risks.[10] In our study, we examined the effects of orlistat on the visceral adiposity index, weight, body mass index, and laboratory values in patients undergoing orlistat treatment.

Orlistat treatment has been predominantly associated with favorable outcomes concerning key health indicators, including body mass index (BMI), lipid profiles, and waist circumference. However, it has shown no significant impact on the visceral adiposity index, which is a measure of fat accumulation around abdominal organs. In a noteworthy study conducted by Al-Kuraishy et al., involving a cohort of 99 patients, the administration of orlistat yielded beneficial effects on weight reduction, waist circumference, and total cholesterol levels among participants. Surprisingly, the findings indicated that the treatment did not result in a statistically significant change in body mass index. Conversely, our research findings present a different perspective. In our investigation, we observed that a 6-month regimen of orlistat not only facilitated substantial weight loss but also led to a significant reduction in waist circumference and body mass index. The statistical analysis revealed highly significant results (p<0.01 for all three parameters), underscoring the effectiveness of orlistat in promoting weight management and improving overall health metrics in our study

population. This highlights the potential of orlistat as a valuable therapeutic option for individuals struggling with obesity and related health concerns.[11]

In studies involving orlistat, it has been shown to have positive effects on liver enzymes, steatosis, and steatohepatitis. For example, a double-blind study conducted by Zelber-Sagi and colleagues on patients with non-alcoholic fatty liver disease revealed that orlistat use led to significant improvements in liver enzymes and steatosis. The study reported approximately a two-fold decrease in ALT (alanine aminotransferase) levels, which was statistically significant when compared to the control group. Additionally, a significant reduction in liver steatosis was also observed in those taking orlistat compared to the control group.[12]

In our comprehensive study, we observed a noteworthy reduction in alanine aminotransferase (ALT) enzyme levels among patients following a six-month treatment regimen with orlistat. This decline was not only significant in magnitude but also statistically validated, with a p-value of less than 0.01, indicating a strong correlation between orlistat use and improved liver enzyme function. Conversely, while aspartate aminotransferase (AST) levels also exhibited a downward trend, this change did not reach statistical significance, as evidenced by a p-value of 0.159. This distinction is particularly important, as it suggests that the reduction in AST may not be directly attributable to the intervention or may require longer observation to establish a clear trend. Furthermore, we noted a tendency for the liver fatty indexes of the patients to improve during the six-month follow-up period, which was accompanied by a statistically significant decrease ($p<0.01$). This finding underscores the potential effectiveness of orlistat in addressing liver fat accumulation over time. It's critical to highlight that ALT and AST are key enzymes that serve as markers for liver health, with ALT being recognized in many studies as more specific to liver conditions compared to AST. The significant decrease in ALT levels observed in our study can be interpreted as an encouraging sign, suggesting that while AST levels showed no notable change, the specific targeting of liver function by ALT supports the premise that orlistat positively impacts liver health. This understanding reinforces the notion that improvements in ALT levels can be indicative of liver recovery and function, especially in the absence of significant changes in AST.[13]

Visceral adipose tissue exhibits a significant correlation with intra-abdominal adipose tissue and is associated with metabolic and cardiovascular diseases. Increased visceral adipose tissue emerges as an important and independent prognostic metabolic marker for dyslipidemia, type 2 diabetes mellitus (DM), and cardiovascular diseases.[14] Recent studies have suggested that the visceral adiposity index serves as an effective metabolic indicator for assessing adipose tissue distribution and function, which indirectly reflects cardiometabolic risks.[15] In a study conducted by Smith et al. involving 123 patients alongside a control group, a statistically significant reduction in visceral adipose tissue was observed in the Orlistat treatment group compared to the control group.[15] In our comprehensive research study, we closely examined the visceral adiposity index (VAI) of a diverse group of patients over an extensive 24-week period. This involved conducting detailed assessments at 12-week intervals, which allowed us to systematically track fluctuations and trends in visceral fat levels. Throughout the duration of the study, we noted a consistent and gradual decline in the visceral adiposity index (4.42 ±2.76, 4.16 ±2.73, 4.01 ±2.84), suggesting a potential improvement in the patients' fat distribution and overall metabolic health. However, it is crucial to highlight that this reduction, while observable, did not reach statistical significance (p:0.224).

One of the notable limitations of this study lies in its retrospective design, which inherently carries the risk of bias when analyzing past data. Additionally, the small sample size of patients included in this study may limit the generalizability of the findings and obscure the true effects of the intervention under investigation. Another limitation of our study is the absence of a well-defined control group, which prevents direct comparisons between individuals

with and without the condition under investigation. This limitation may reduce the generalizability of our findings and limit our ability to establish causal relationships between the studied variables. This limitation reduces the robustness of the conclusions drawn from the study and highlights the need for further research with more comprehensive designs.

5. CONCLUSION

As a result, the study observed positive changes such as weight loss, narrowing of waist circumference and decrease in BMI, as well as improvements in liver enzymes and increases in HDL levels. In particular, decreases in ALT and GGT indicate improvements in liver health, while increases in HDL may contribute to a decrease in cardiovascular risk. The Visceral adiposity index tended to decrease after orlistat treatment, but this was not statistically significant. These findings indicate that healthy lifestyle changes, and orlistat treatment may be effective in improving patients' metabolic health.

Article Information Form

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Authors' Contribution

Our article's study design, article content review was done by Ihsan Solmaz.

The draft of the article was done by Ihsan Solmaz and Jehat Kilic.

Data collection and technical support were done by Omer Faruk Alakus.

Data analysis and literature review were done by Jehat Kilic.

The Declaration of Conflict of Interest/ Common Interest

No conflict of interest or common interest has been declared by authors.

Artificial Intelligence Statement

No artificial intelligence tools were used while writing this article.

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