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Evaluation of ghrelin and leptin in chronic obstructive pulmonary disease

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Abstract:

OBJECTIVE: Recent studies suggest an important role for ghrelin and leptin in pathogenesis of inflammatory respiratory diseases. Therefore, the present study aimed to investigate ghrelin and leptin levels in the circulation that might be associated with the development of obstruction.

METHODS: Stable chronic obstructive pulmonary disease (COPD) patients ($n = 119$) and matched healthy controls ($n = 27$) were recruited. The COPD patients were classified into four groups (A, B, C, and D) according to the Revised Global Initiative for Chronic Obstructive Lung Disease guidelines.

RESULTS: Compared to controls, significantly decreased leptin and ghrelin levels were observed in all COPD patient groups. Plasma ghrelin concentration was higher in Group A ($P < 0.001$), Group B ($P < 0.001$), and Group C ($P < 0.05$) when compared with the Group D. Plasma leptin concentration was significantly decreased in Group D patients when compared with Group A ($P < 0.001$) and Group B ($P < 0.001$). Ghrelin levels were positively correlated with forced expiratory volume in 1 s (FEV_1) ($r = 0.822$; $P < 0.001$), FEV_1/forced vital capacity (FVC) ($r = 0.431$; $P < 0.01$), and leptin ($r = 0.808$; $P < 0.001$) in Group D. Leptin showed positive correlation with FEV_1 ($r = 0.856$; $P < 0.001$) and FEV_1/FVC ($r = 0.376$; $P < 0.05$) in Group D. FEV_1 was positively correlated with ghrelin levels ($r = 0.639$; $P < 0.001$) and leptin levels ($r = 0.602$; $P < 0.001$) in Group C.

CONCLUSION: The data of the present study showed that the serum ghrelin and leptin levels are lower in patients with COPD. Since ghrelin and leptin correlate with FEV_1 in severe group of patients, they seem to be a potential biomarker candidate of prognosis in COPD. Decreased ghrelin and leptin levels might be associated with the development of obstruction.

Keywords:

Chronic obstructive pulmonary disease, forced expiratory volume in 1 s, forced expiratory volume in 1 s/forced vital capacity, ghrelin, leptin

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Introduction

Chronic obstructive pulmonary disease (COPD) is a disease characterized by persistant airway limitation of fully reversible airflow. Airflow limitation is usually progressive, associated with abnormal inflammatory responses in the lungs against harmful particulates and gases.[1] COPD, which has high prevalence and high morbidity and mortality, is an important health problem all over the world.[2] COPD is a disease with systemic effects accompanied by many diseases that occur in the middle and advanced age group who often smoke for a long time. Comorbidity describes one or more comorbid conditions whether or not directly related to COPD.

Ghrelin is a growth hormone (GH)-releasing hormone that is independent of the hypothalamus, which is termed the endogenous GH-related peptide, released from the gastric mucosa.[3,4] Plasma ghrelin

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level is indirectly proportional to body mass index (BMI). Ghrelin level is increased in negative energy equilibrium.[5] Ghrelin levels have been found to be altered in pulmonary diseases, such as COPD and pulmonary hypertension.[6] The role in pathophysiology of COPD is unclear because there are only a few studies in the literature.[3,6-14]

Leptin regulates energy homeostasis and informs the hypothalamus about fat tissue. Leptin is produced by differentiated adipocytes, but production from the stomach fundus, skeletal muscle, liver, and placenta has also been demonstrated. It has two forms in the blood, free and dependent on the protein. It is thought that the free form is responsible for the activity of leptin. It has been determined that most of the leptin in serum is in free form in obese individuals. The half-life of leptin in the circulation is about 30 min. Leptin is also a proinflammatory cytokine.[15] Several investigators have explored the association between serum leptin and COPD in humans, but these results are contradictory.[16-20]

The aim of the present study is to investigate ghrelin and leptin levels in the circulation that might be associated with the development of obstruction in patients with stable COPD.

Methods

The study has been approved by the Ethics Committee of the Acibadem University School of Medicine, Acibadem Atakent Hospital, Department of Chest Diseases, and written informed consent was obtained from each patient. A total of 119 stable COPD patients and 27 controls were included in the study. The patients were divided into four groups according to the combined Global Initiative for Chronic Obstructive Lung Disease (GOLD) stages (A, B, C, and D), according to the new revision of 11/2016 as defined by the GOLD committee.[21] A combined assessment system of COPD severity was used to classification of patients. Spirometry was done in all of the patients. When evaluated according to COPD phenotypes, approximately half of the patients had emphysema-type COPD; emphysema (47.9%), chronic bronchitis (30.8%), and mixt (22.3%).

Exclusion criteria were respiratory disorders other than COPD, pulmonary embolism, and left ventricular systolic or diastolic dysfunction, having comorbidities such as diabetes, chronic renal insufficiency, hyperthyroidism, hypothyroidism, hepatic dysfunction, having lower respiratory tract infection or COPD attack in the last 6 weeks, and presence of metabolic syndrome. Detailed anamnesis was taken from all participants, and physical examination was performed. All patients were clinically stable and between 33 and 80 years old. Exclusion criteria and characteristics of the control group were the same.

Spirometry tests were done in accordance with the criteria recommended by the European Respiratory Society using a computer-assisted spirometry (Vmax22D, SensorMedics, California, USA). Pulmonary function parameters including forced expiratory volume in 1 s (FEV_1), forced vital capacity (FVC), and FEV_1/FVC ratio were measured, and the absolute values and the percentage of expected values of these parameters were analyzed.

Biochemical analysis

All venous blood samples were obtained from all patients and controls in the morning after 12 h of fasting. After blood samples were obtained, we immediately centrifuged the samples and stored them at – 80°C until the assay was performed.

Measurement of plasma ghrelin (total) levels

Plasma ghrelin levels were measured by a commercially available competitive enzyme-linked immunoassay kit (Enzyme-Linked Immunosorbent Assay, Organon Teknika, Durham NC, USA). The coefficients of intra- and inter-assay variation were 4.8% (n = 15) and 5.9% (n = 15), respectively.

Measurement of plasma leptin levels

Plasma leptin levels were measured by a commercially available competitive enzyme-linked immunoassay kit (Leptin ELISA, DRG Instruments GmbH, Marburg, Germany). The coefficients of intra- and inter-assay variation were 4.4% (n = 15) and 5.6% (n = 15), respectively.

Routine biochemical parameters were measured by the autoanalyzer (Hitachi Modular System, Roche Diagnostic, USA). Serum C-reactive protein levels were measured by a nephelometric method (Immage 800 Beckman Coulter). Complete blood count parameters were obtained with automatic hematology analyzer (Siemens-Sysmex, Germany). Erythrocyte sedimentation rate was measured according to the Westergren method with an established normal range (0–20 mm/h).

Statistical analysis

Statistical analyses were performed using the SPSS 20.0 for Windows (SPSS Inc., Chicago, IL, USA). All data were expressed as mean ± standard deviation. Descriptive statistics were obtained and data were tested for normality using the Shapiro–Wilk test. Parametric tests for comparison of parameters with normal distribution were used while nonparametric tests for comparison of parameters with abnormal distribution were used. For this purpose, one-way ANOVA, unpaired Student's *t*-test, Kruskal–Wallis test, and Mann–Whitney U-test were used. Tukey's (for parametric analysis) and Dunn's tests (for nonparametric analysis) were used as *post hoc*

tests. Relationships between variables were assessed with Pearson's or Spearman's correlation coefficient. $P \leq 0.05$ was considered statistically significant.

Results

The demographic and functional characteristics of the patients and the control group are given in Table 1. Hematocrit, platelet, total cholesterol, low-density lipoprotein cholesterol, and triglyceride concentrations did not differ between the groups. However, high-density lipoprotein cholesterol levels were lower in patients when compared to the control group ($P < 0.05$). As expected, FEV_1 and FEV_1/FVC levels were lower in patients when compared to the control group ($P < 0.001$). On the other hand, plasma ghrelin and leptin levels were found lower in the patient groups ($P < 0.001$).

Clinical and laboratory findings of the groups according to GOLD stage are shown in Table 2. Plasma ghrelin and leptin did not differ significantly between Group A and Group B ($P > 0.05$). Plasma ghrelin concentration was higher in Group A (41.52 ± 10.07 pg/mL, $P < 0.001$), Group B (40.33 ± 10.16 pg/mL, $P < 0.001$), and Group C (30.73 ± 8.28 pg/mL, $P < 0.05$) when compared with the Group D (23.33 ± 6.61 pg/mL) [Figure 1]. In addition, plasma leptin concentration was significantly decreased in Group D patients (1.53 ± 0.64 ng/mL) when compared with Group A (2.48 ± 0.54 ng/mL, $P < 0.001$) and Group B (2.32 ± 0.34, $P < 0.001$). No significant difference was found for leptin levels between the Group C and Group D ($P > 0.05$) [Figure 2].

Total protein levels were positively correlated with FEV_1 ($r = 0.285$, $P < 0.01$) and FEV_1/FVC ($r = 0.361$, $P < 0.001$) in all patients. Ghrelin and leptin levels were weak positively correlated with BMI ($r = 0.193$; $P < 0.05$; $r = 0.208$; $P < 0.05$, respectively). Ghrelin levels were positively correlated with FEV_1 ($r = 0.699$; $P < 0.001$), FEV_1/FVC ($r = 0.554$; $P < 0.001$), and leptin ($r = 0.646$; $P < 0.001$) in all patients. Leptin showed positive correlation with FEV_1 ($r = 0.670$; $P < 0.001$) and FEV_1/FVC ($r = 0.522$; $P < 0.001$) in all patients [Table 3].

Ghrelin levels were positively correlated with FEV_1 ($r = 0.822$, $P < 0.001$), FEV_1/FVC ($r = 0.431$, $P < 0.01$), and leptin ($r = 0.808$, $P < 0.001$) in Group D. Leptin showed

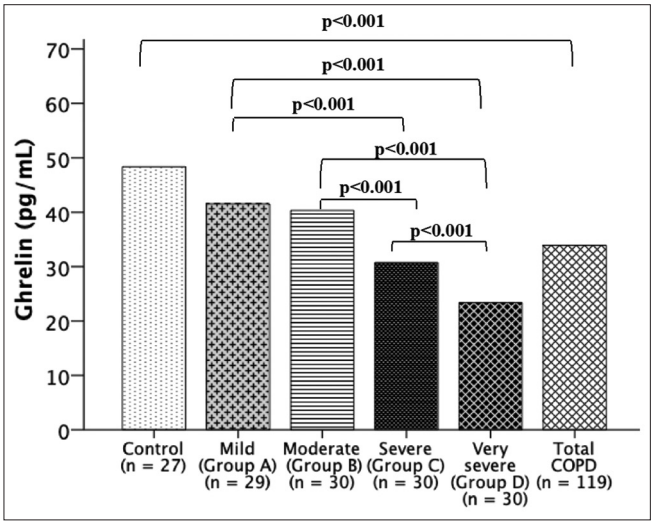

Figure 1: Ghrelin levels in all groups

Table 1: Demographic, clinical, and laboratory findings of the groups

	Control (*n*=27)	Total COPD (*n*=119)	*P*
Age (year)	45.59±7.78	63.75±12.58	<0.001
Female/male	9/18	30/89	0.098
BMI (kg/m²)	23.68 (22.46-24.11)	25.97 (23.12-30.42)	<0.001
FEV_1 (%)	101.00 (96.00-106.00)	49.00 (30.00-74.00)	<0.001
FEV_1/FVC (%)	83.00 (80.00-86.00)	63.00 (47.00-69.00)	<0.001
WBC (×10³/μL)	6.99 (5.95-8.030)	8.01 (6.71-10.31)	<0.001
Hb (g %)	15.26±1.40	13.15±2.01	0.002
Hematocrit (%)	45.83±4.22	40,82±5,57	<0.001
Platelet (×10³/μL)	239.00 (213.00-284.00)	244.00 (203.00-289.00)	0.914
Total cholesterol (mg/dL)	193.78±25.44	201.43±43.60	0.621
LDL-C (mg/dL)	133.07±24.54	133.11±67.00	0.127
HDL-C (mg/dL)	47.00 (40.90-52.70)	43.90 (39.00-52.00)	0.045
Triglyceride (mg/dL)	113.00 (95.00-177.00)	112.00 (89.00-164.00)	0.809
Total protein (g/dL)	8.16±0.26	7.27±0.59	<0.001
Albumin (g/dL)	4.12±0.21	3.54±0.47	<0.001
ESR (mm/h)	8.00 (4.00-10.00)	18.00 (13.00-25.00)	<0.001
CRP (mg/L)	0.30 (0.13-0.41)	0.44 (0.20-0.79)	<0.001
Ghrelin (pg/mL)	48.37±11.07	33.92±11.47	<0.001
Leptin (ng/mL)	2.80±0.55	2.04±0.63	<0.001

Mean±SD are shown for parameters with normal distribution, median values (25%-75% percentiles) are shown for parameters that do not show normal distribution. BMI: Body mass index, FEV_1: Forced expiratory volume in 1 s, FVC: Forced vital capacity, LDL-C: Low-density lipoprotein cholesterol, HDL-C: High-density lipoprotein cholesterol, ESR: Erythrocyte sedimentation rate, CRP: C-reactive protein, WBC: White blood cell, Hb: Hemoglobin, SD: Standard deviation, COPD: Chronic obstructive pulmonary disease

Table 2: Clinical and laboratory findings of the groups according to Global Initiative for Chronic Obstructive Lung Disease stage

	Mild (Group A) (*n*=29)	Moderate (Group B) (*n*=30)	Severe (Group C) (*n*=30)	Very severe (Group D) (*n*=30)	*P*			
Age (years)	58.86±13.87	59.37±9.54	66.70±11.97	69.90±11.73	Between groups			0.001
					-	A	B	C
					B	0.998	-	0.084
					C	0.059	0.084	-
					D	0.003	0.004	0.723
Female/male	9/20	10/20	5/25	6/24	Between groups			0.514
BMI (kg/m^2)	25.45 (23.08-27.49)	29.27 (26.09-33.33)	29.69 (26.18-34.37)	21.43 (19.50-24.03)	Between groups			<0.001
					-	A	B	C
					B	0.001	-	0.869
					C	0.008	0.869	-
					D	0.013	<0.001	<0.001
FEV_1 (%)	88.00 (83.50-97.00)	68.00 (66.00-69.25)	48.00 (46.00-49.00)	28.00 (26.00-29.00)	Between groups			<0.001
					-	A	B	C
					B	<0.001	-	<0.001
					C	<0.001	<0.001	-
					D	<0.001	<0.001	<0.001
FEV_1/FVC (%)	70.00 (68.00-70.00)	69.00 (62.75-69.25)	61.50 (56.50-66.00)	44.00 (41.75-47.00)	Between groups			<0.001
					-	A	B	C
					B	0.441	-	0.004
					C	<0.001	0.004	-
					D	<0.001	<0.001	<0.001
WBC (×10^3/μL)	8.67 (7.22-10.58)	7.34 (6.47-8.20)	7.58 (6.52-9.69)	9.88 (7.53-11.82)	Between groups			0.006
					-	A	B	C
					B	0.140	-	0.694
					C	0.702	0.694	-
					D	0.599	0.004	0.094
Hb (g %)	13.81±1.86	13.22±2.30	12.77±1.79	12.81±2.00	Between groups			0.163
Hematocrit (%)	42.32±4.98	40.36±5.86	39.65±5.24	41.01±6.13	Between groups			0.307
Platelet (×10^3/μL)	258.00 (221.00-293.50)	243.50 (201.00-278.50)	242.50 (212.50-316.75)	215.50 (153.75-278.50)	Between groups			0.448
Total cholesterol (mg/dL)	213.79±36.70	218.07±48.68	197.30±40.60	176.97±37.52	Between groups			0.001
					-	A	B	C
					B	0.978	-	0.212
					C	0.418	0.212	-
					D	0.005	0.001	0.229
LDL-C (mg/dL)	136.48±32.65	128.00±32.27	122.63±36.76	100.85±28.46	Between groups			<0.001
					-	A	B	C
					B	0.751	-	0.920
					C	0.367	0.920	-
					D	<0.001	0.009	0.053
HDL-C (mg/dL)	44.00 (35.55-52.00)	45.45 (40.20-53.67)	46.50 (39.75-54.60)	42.05 (39.00-47.02)	Between groups			0.064
Triglyceride (mg/dL)	132.00 (100.00-180.50)	121.50 (91.00-188.25)	108.00 (86.50-138.25)	100.50 (83.75-135.25)	Between groups			0.564
Total protein (g/dL)	7.52±0.39	7.26±0.63	7.30±0.47	6.99±0.71	Between groups			0.006
					-	A	B	C
					B	0.324	-	0.995
					C	0.458	0.995	-
					D	0.003	0.239	0.151
Albumin (g/dL)	3.70±0.31	3.65±0.43	3.42±0.47	3.41±0.55	Between groups			0.248
ESR (mm/h)	18.00 (7.00-23.00)	18.00 (11.00-25.75)	18.00 (13.00-29.25)	18.50 (16.75-26.25)	Between groups			0.930
CRP (mg/L)	0.42 (0.18-0.90)	0.29 (0.15-0.86)	0.52 (0.21-1.21)	0.50 (0.30-0.70)	Between groups			0.682

Mean±SD are shown for parameters with normal distribution, median values (25%-75% percentiles) are shown for parameters that do not show normal distribution. BMI: Body mass index, FEV_1: Forced expiratory volume in 1 s, FVC: Forced vital capacity, LDL-C: Low-density lipoprotein cholesterol, HDL-C: High-density lipoprotein cholesterol, ESR: Erythrocyte sedimentation rate, CRP: C-reactive protein, SD: Standard deviation

Table 3: Correlations of parameters in all groups

	BMI	FEV_1	FEV_1/FVC	CRP	ESR	Albumin	Total protein	Ghrelin	Leptin
BMI									
r		0.191*	0.355**			0.238**	0.239**	0.193*	0.208*
P		0.038	<0.001			0.009	0.009	0.035	0.022
FEV1									
r	0.191*		0.739**				0.285**	0.699**	0.670**
P	0.038		<0.001				<0.001	<0.001	<0.001
FEV_1/FVC									
r	0.355**	0.739**					0.361**	0.554**	0.522**
P	<0.001	<0.001					<0.001	<0.001	<0.001
CRP									
r					0.489**				
P					<0.001				
ESR									
r				0.489**					
P				<0.001					
Albumin									
r	0.238**						0.184*		
P	0.009						0.045		
Total protein									
r	0.239**	0.285**	0.361**			0.184*			
P	0.009	0.002	<0.001			0.045			
Ghrelin									
r	0.193*	0.699**	0.554**						0.646**
P	0.035	<0.001	<0.001						<0.001
Leptin									
r	0.208*	0.670**	0.522**					0.646**	
P	0.023	<0.001	<0.001					<0.001	

BMI: Body mass index, FEV_1: Forced expiratory volume in 1 s, FVC: Forced vital capacity, ESR: Erythrocyte sedimentation rate, CRP: C-reactive protein

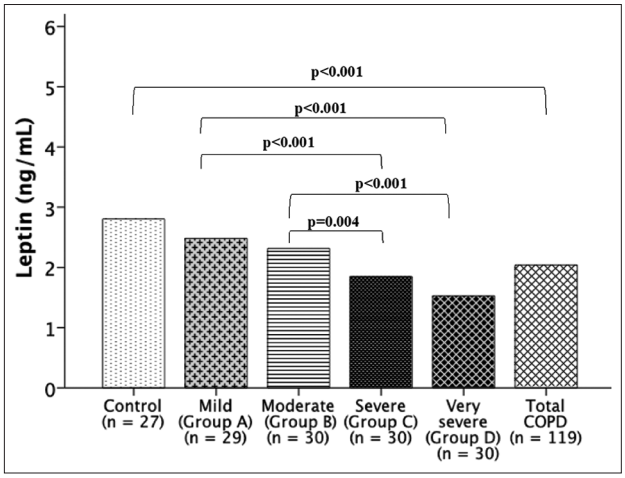

Figure 2: Leptin levels in all groups

positive correlation with FEV_1 (r = 0.856, P < 0.001) and FEV_1/FVC (r = 0.376, P < 0.05) in Group D. FEV_1 was positively correlated with ghrelin levels (r = 0.639; P < 0.001) and leptin levels (r = 0.602, P < 0.001) in Group C.

Discussion

In the present study, plasma ghrelin and leptin levels were found lower in the patient groups. Plasma ghrelin and leptin concentration was lowest in Group D (very severe group) when compared with the other group. Furthermore, ghrelin levels were positively correlated with FEV_1, FEV_1/FVC, and leptin in Group D. Leptin showed positive correlation with FEV_1 and FEV_1/FVC in Group D. FEV_1 was positively correlated with ghrelin levels and leptin levels in Group C. The present study suggests that decreased ghrelin and leptin levels might be associated with development of airway obstruction.

The causes of cachexia in COPD are multifactorial including tissue hypoxia, aging, physical exercise, increased resting metabolic rate, chronic inflammatory processes, and certain drugs, resulting in net catabolism. Leptin and ghrelin seem to be the big players in regulating appetite, which consequently influences the body weight/fat. The current study aimed to investigate markers of appetite as ghrelin and leptin in the circulation that might be associated with development of cachexia and hypoxia. Ghrelin and leptin levels were positively correlated with BMI in all patients but not subgroups. Our results identify ghrelin as an early marker of cachexia that is significantly decreased in the circulation even in COPD. Serum leptin levels appear to be decreased with disease progress. These changes were manifested in the clinical signs of disease exacerbation.

Peng *et al*.[10] showed that plasma leptin levels were decreased, while plasma total ghrelin and active ghrelin levels were elevated in underweight patients with COPD and the levels were associated with nutritional parameters. The plasma levels of leptin and ghrelin may be a compensatory mechanism in malnutritional status of COPD. After adjustment for nutritional parameters, leptin levels were elevated in COPD patients. Their result suggests that leptin may play a role in systemic inflammation of COPD. The results of ghrelin and leptin in COPD patients are controversial. Ying *et al*.[11] conducted that plasma tumor necrosis factor- α (TNF-α), interleukin-6 (IL-6), and ghrelin levels were found to be statistically higher in COPD patients compared to the control group. Furthermore, TNF-α, IL-6, and ghrelin levels were found to be statistically significantly higher in patients with low-overweight COPD compared with those with normal-overweight COPD according to BMI. It was found that the anabolic and catabolic imbalance in patients with cachexic COPD may increase the level of plasma ghrelin for compensation, may also be associated with abnormal pulmonary functions. Itoh *et al*.[3] demonstrated that the COPD patients were divided into two according to BMI, and the relationship between plasma ghrelin, TNF-α, and IL-6 and body composition was examined in 16 patients. Serum ghrelin, TNF-α, and IL-6 levels were found to be significantly higher in patients with COPD compared to the control group and in patients with low-weight COPD compared to normal-weight COPD, and there was negative correlation between ghrelin level and BMI, while proinflammatory cytokines showed a positive correlation between them. Again, in this study, it was shown that plasma ghrelin levels were positively correlated between residual volume (RV) and RV/total lung capacity. At the end of this study, it has been concluded that the cachexia of the increased level of grease in patients with cachectic COPD may be related to the grade and impaired pulmonary functions. In contrast to these studies, in which patients with COPD, especially those with increased weight gain, plasma leaning levels were increased. Luo *et al*.[13] showed a statistically significant decrease in serum ghrelin levels and a significantly higher TNF-α level in the COPD group compared with the control group. There were also a positive correlation between ghrelin levels and BMI in the COPD group and a negative correlation between ghrelin levels and TNF-α, and it was stated that low ghrelin levels may be due to the suppressive effect of elevated inflammatory mediators in COPD. In the study conducted by Deveci *et al*.[14] similar to the study of Luo *et al*.,[13] serum ghrelin levels in patients with COPD were statistically significantly lower than the control group, while levels of TNF-α and IL-6 were found to be statistically significant. At the end of the study, it has been thought that increased serum active ghrelin levels may contribute to increased weight gain in COPD as well as increased proinflammatory cytokines.[22] Uzum *et al*.[8] were investigated the relationship between pulmonary functions and inflammatory and metabolic parameters in low-weight COPD patients and they showed that the anti-inflammatory effect of adiponectin and ghrelin is more evident in severe–very severe COPD patients. In the study of Imazu *et al*.,[23] ghrelin has been shown to have anti-inflammatory activities in mice with pulmonary fibrosis. However, Kamiide *et al*.[24] found that ghrelin did not inhibit the alveolar infiltration of neutrophils but the ghrelin inhibited the loss of body weight, food efficiency and skeletal muscle strength, respiratory dysfunction, and the development of emphysema in rats with COPD. In the study of Piehl-Aulin *et al*.,[12] serum leptin levels were trending up instead of mild and moderate COPD, whereas TNF levels in COPD patients did not change when compared with the control group. In addition, all other hormones examined showed generally normal levels of serum levels in COPD patients without male-to-female variation, when each group was compared to the corresponding control population. Unlike other studies, Sueblinvong and Liangpunsakul[16] showed that there were no differences in the level of serum leptin among COPD patients with different severity in both genders.

In the current study, ghrelin levels were positively correlated with BMI, FEV_1, FEV_1/FVC, and leptin in all patients. Leptin showed positive correlation with BMI, FEV_1, and FEV_1/FVC in all patients. Ghrelin levels were positively correlated with FEV_1, FEV_1/FVC, and leptin in Group D. Leptin showed positive correlation with FEV_1 and FEV_1/FVC in Group D. FEV_1 was positively correlated with ghrelin levels and leptin levels in Group C. Our results showed that ghrelin and leptin seem to be the big players in regulating airway obstruction, which consequently influences pulmonary function tests (PFTs). Cingözler *et al*.[25] showed that decreased serum ghrelin and leptin levels were associated with weight loss. However, no relation could be identified between hyperinflation and hormonal markers. It is accentuated that abnormal ghrelin activity might cause overweight or low weight.

The studies in Japan[3,26,27] have suggested that plasma ghrelin levels are elevated in patients with low bodyweight COPD and that levels are related to abnormal pulmonary functions and cachetic status. Even in recent years, new pharmacologic agents that regulate the somatotropic axis in patients with COPD have begun to be tried. In patients with COPD, 3 weeks of treatment with ghrelin has been shown to improve appetite, GH levels, and peripheral and respiratory muscle strength, improve 6-min walking distance, and reduce norepinephrine levels. In some studies, it has been reported that plasma ghrelin levels are increased

in cases with cachectic lung cancer and congestive heart failure and that ghrelin is positive with TNF-α and has a negative correlation with BMI.[27,28] Wu *et al*.[29] have demonstrated that ghrelin administration improved pulmonary blood flow, decreased proinflammatory cytokines, and reduced acute lung injury. Guven *et al*.'study[30] has demonstrated that acute lung injury initiated proinflammatory responses and ghrelin administration showed an anti-inflammatory effect in lung contusion. Thus, particularly ghrelin replacement therapy may improve the symptoms of patients with COPD.

Conclusion

The data of the present study showed that the serum ghrelin and leptin levels are lower in patients with COPD. Since decreases in plasma ghrelin and leptin levels correlated with the PFTs in severe group of patients, they seem to be a potential biomarker candidate of prognosis in COPD. Decreased ghrelin and leptin levels might be associated with development of airway obstruction. New studies are needed to determine the effect of ghrelin levels and leptin levels on cachexia and respiratory function in COPD patients. Understanding the mechanisms of weight loss in COPD will help prevent weight loss in these patients and will benefit from a variety of new treatment approaches that will improve the quality of life.

Ethics committee approval

The study has been approved by the Ethics Committee of the Acibadem University School of Medicine, Acibadem Atakent Hospital, and Department of Chest Diseases.

Informed consent

Written informed consent was obtained from patients who participated in this study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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