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RESEARCH

Preoperative and postoperative urotensin II levels in obese patients undergoing laparoscopic sleeve gastrectomy

Obez hastalarda laparoskopik sleeve gastrektomi öncesi ve sonrası urotensin II düzeyleri

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Abstract

Purpose: This study aimed to compare Urotensin II (UII) levels in adipose tissue and serum between individuals with obesity and those with normal weight.
Materials and Methods: Blood samples were collected from individuals with severe obesity prior to laparoscopic sleeve gastrectomy (LSG), and adipose tissue samples were obtained during the procedure. Postoperatively, blood samples were analyzed from individuals whose body mass index (BMI) had normalized after LSG, along with adipose tissue samples from individuals with normal BMI. UII levels and biochemical parameters were measured in both groups.
Results: Six months post-LSG, serum UII levels in 60 obese patients significantly decreased compared to preoperative levels. Adipose tissue UII levels in the severely obese group were significantly higher than in the control group. Additionally, serum UII levels in individuals who achieved normal BMI after LSG were lower than their preoperative levels. ROC curve analysis identified cut-off values for LSG suitability: individuals with serum UII levels below 46.88 and tissue UII levels below 202.87 were deemed less suitable for LSG, while those above these thresholds were considered more suitable.
Conclusion: The observed differences in UII levels between individuals with normal BMI and those with obesity suggest that UII may play a significant role in the pathophysiology of obesity. These findings highlight its potential as a biomarker for assessing surgical suitability and understanding obesity-related mechanisms.
Keywords:. Obesity, urotensin II, sleeve gastrectomy

Öz

Amaç: Bu çalışma, obez bireyler ile normal kilolu bireyler arasında adipoz doku ve serumdaki Urotensin II (UII) düzeylerini karşılaştırmayı amaçlamaktadır.
Gereç ve Yöntem: Laparoskopik sleeve gastrektomi (LSG) öncesinde şiddetli obezitesi olan bireylerden kan örnekleri alındı ve cerrahi sırasında adipoz doku örnekleri toplandı. Ameliyat sonrasında vücut kitle indeksi (VKİ) normal sınırlara düşen bireylerden alınan kan örnekleri ile normal VKİ'ye sahip bireylerden alınan adipoz doku örnekleri analiz edildi. Her iki grupta UII düzeyleri ve biyokimyasal parametreler ölçüldü.
Bulgular: LSG sonrası altıncı ayda, 60 obez hastanın serum UII düzeyleri, ameliyat öncesine kıyasla anlamlı şekilde azaldı. Şiddetli obez grubun adipoz dokudaki UII düzeyleri, kontrol grubuna göre istatistiksel olarak anlamlı derecede yüksekti. Ayrıca, LSG sonrası normal VKİ'ye ulaşan bireylerin serum UII düzeylerinin ameliyat öncesine göre daha düşük olduğu gözlendi. ROC eğrisi analizi, LSG uygunluğu için eşik değerler belirledi: serum UII düzeyi 46.88'in altında ve doku UII düzeyi 202.87'nin altında olan bireyler LSG için daha az uygun bulunurken, bu eşik değerlerin üzerinde olanlar daha uygun kabul edildi.
Sonuç: Normal VKİ'ye sahip bireyler ile obez bireyler arasında gözlemlenen UII düzeylerindeki farklılıklar, UII'nin obezitenin patofizyolojisinde önemli bir rol oynayabileceğini düşündürmektedir. Bu bulgular, UII'nin cerrahi uygunluğunun değerlendirilmesinde ve obeziteyle ilişkili mekanizmaların anlaşılmasında potansiyel bir biyobelirteç olabileceğini ortaya koymaktadır.
Anahtar kelimeler: Obezite, ürotensin II, sleeve gastrektomi

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INTRODUCTION

Due to factors such as sedentary lifestyles, increasing affluence and easy access to processed foods, obesity is spreading rapidly around the world. There is growing interest in ways to prevent obesity, especially given its association with chronic diseases such as diabetes, hypertension and even mortality. Lifestyle changes are the first step in treating obesity. Medications, psychological counselling and surgery are some of the additional treatment options that should be considered if lifestyle changes are insufficient. Laparoscopic sleeve gastrectomy (LSG) is one of the preferred bariatric surgical procedures due to its superior ability to effectively achieve weight loss while reducing co-morbidities compared to other bariatric surgical procedures[1,2].

A cyclic peptide called urotensin 2 (UII) is known for its potent vasoactive effects. By binding to the UII receptor (UR), UII exerts its biological activity in various tissues and organs. High levels of UII in pathological conditions suggest that UII may manifest as a pathological agent or as a response to pathological conditions[3-5]. Plasma UII levels are also linked to metabolic syndrome (MS), hypertension, serum lipids, and body mass index (BMI)[6,7]. Although there is a clear link between UII and MS, it is still not clear whether the peptide contributes to the development of the disease or whether elevated plasma levels of UII are a result of the syndrome[8]. There are studies in the literature on UII levels in metabolic syndrome and diabetes. However, UII levels have not been investigated in obese and bariatric patients. The aim of this study was to measure and compare UII levels in adipose tissue and serum before and after LSG, which is often the preferred surgical treatment for obesity, in order to better understand the relationship between obesity and UII, which has not been reported in the literature.

LSG is the most commonly used method of bariatric surgery worldwide due to its advantages such as low risk of complications. Technically, the removal of gastric tissue and some adherent adipose tissue in LSG has made it possible to measure the tissues removed from the specimen. The other most commonly used method of bariatric surgery is the classic gastric bypass. However, this and similar procedures do not remove tissue from the patient. Therefore, if other methods are preferred, there is no way to measure tissue levels under non-invasive conditions. All patients whose obesity was treated surgically were selected from patients who underwent LSG because it is uncomplicated, is the most commonly used method, and offers the possibility of obtaining tissue under non-invasive conditions.

In this context, the aim of our study was to determine adipose tissue and serum UII levels in obese and non-obese individuals and to show how LSG, which is often the preferred surgical treatment for obesity, changes UII levels with short-term (6 months) weight loss. In doing so, we contributed to the literature by demonstrating the relationship between weight loss and UII.

MATERIALS AND METHODS

Study design and sample

The study included two groups of people, one that underwent LSG for people with severe obesity (male:25, female:35) and control group that underwent elective laparoscopic cholecystectomy for symptomatic cholelithiasis (male:10, female:20). G*Power program 3.1.9.7 was used to determine study population by taking α=0.05, power (1-β) =0.80 at a confidence level of 95% and the number of samples to be taken in each group was determined as 30. In LSG groups, the number of samples was determined as 60 considering the missing cases.

Mean age of people with obesity are 36.04±9.80 and mean age of people with control are 46.2±10.25. The study inclusion criteria were the following: BMI> 40 kg in the obesity group and BMI< 25 for the control group. BMI was the only standard to select the participant.

Procedure

The entire surgical procedure was performed by a single surgeon. The surgeries were performed and samples were collected by Dr. Kenan Binnetoğlu at Kafkas University Medical Faculty Research and Application Center. The institution has the status of obesity surgery application center. Participants were selected from indications according to the 2022 American Society for Metabolic and Bariatric Surgery (ASMBS) and International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO): Indications for Metabolic and Bariatric Surgery". Exclusion criteria; study group: Conditions preventing LSG surgery (endocrine disorders, inflammatory diseases, psychiatric disorders) Control group: Individuals with symptomatic cholelithiasis who were considered for surgery had a BMI >25, hypertension, hyperlipidemia, diabetes, sleep apnea syndrome, fatty liver disease, advanced joint degeneration, endocrine disorder, psychiatric disorder, chronic inflammatory disease, no acute cholecystitis attack, and pathology findings of chronic cholecystitis. In the year of the study, 83 bariatric surgeries were performed. however, 23 people could not be included in the study because they did not come to the postop 6th month control. Ethics approval all authors declare that the study was conducted in accordance with the Declaration of Helsinki. The study has been approved by the Ethics Committee of Kafkas University Faculty of Medicine (30/04/2019-06). All participants gave written informed consent before enrollment in the study. Measurements and statistical analysis of the collected samples were performed double blind. After each individual gave verbal consent for the study, an informed consent form was signed by the individuals who agreed to participate in the study.

LSG Procedures

The procedure was performed in the reverse Trendelenburg position with four trocar entries. A 10 mm optical trocar was inserted through an incision made in the upper left lateral aspect of the umbilicus, and the camera was inserted through this trocar. The greater curvature was released from the greater omentum up to the His angle with the help of ligasure or harmonic dissection. The 36 Fr calibration tube was placed in the stomach and extended to the pylorus. Based on the placed calibration tube, the resection was completed with the help of a 60 mm linear stapler from the antrum fundus junction upwards. The staple line was checked by administering methylene blue into the stomach. The resected stomach was taken out through the 12 mm trocar incision.

Serum and tissue collection

Blood samples of people with obesity collected before 12 h from LSG and then After 6 months LSG to compare preoperative and postoperative serum levels of UII and other biochemical parameters.

Adipose (omental) tissue around the gastric tissue was collected from the people with obesity in the study group. Adipose (omental) tissue around the gallbladder was collected from the people with cholelithiasis.

Routine biochemistry analyses

Biochemical tubes with gel (Vacuette, Greiner Bio-One GmbH) were used for biochemical and hormone analysis in serum, whereas tubes containing ethylenediaminetetraacetic acid were used for full blood count. The samples were immediately centrifuged at 4C at 4000 rpm for 15 minutes in the Biochemistry Laboratory of Kafkas University Health Research and Training Hospital to obtain serum. Whole blood samples were hemolyzed by tetradecyltrimethylammonium bromide using turbidimetric inhibition immunoassay on Cobas C501 (Roche Diagnostics) automated 159 biochemical analyzer.

Glucose, Amylase, lipase, Blood urea nitrogen (BUN), Urea, Uric acid, Creatine, Glomerular filtration rate (GFR), Aspartate aminotransferase (AST), Alanine aminotransferase (ALT), Gamma glutamyl transferase (GGT), Alcaline phosphatase (ALP), Direct bilirubin, Total bilirubin, Low density lipoprotein (LDL), Triglyceride (TG), High density lipoprotein (HDL), Cholesterol, Creatine kinase (CK), Total Protein, Iron, Albumin, Iron binding, C-reactive protein (CRP), Lactate dehydrogenase (LDH), Na, Ca, K, Mg, Cl, P, Fasting insulin, Glycated hemoglobin (HbA1c), Folate, Vitamin B12, Parathormone (PTH), Ferritine were measured in the people with obesity before surgery after 12 hours of fasting, and results were recorded.

Measurement of serum levels of UII

Additionally, to compare preoperative and postoperative serum levels of UII, blood samples were collected at 6 months postoperatively. Serum levels of UII were measured via Human UII ELISA Kit (Cloud-Clone, Product No: CEA362Hu, China) according to the manufacturer's recommendations. The intensity of color is measured spectrophotometrically at 450 nm in a microplate reader (Biotec). A standard curve is plotted that relates the intensity of the color (O.D.) to standards. The UT-II concentration of each sample is interpolated from this standard curve. Intra-assay precision (precision within an assay) was CV% < 10%. Inter-assay precision (precision between assays) was CV% < 12%. The detection range was 12.35 pg/ml-1000 pg/ml.

Measurement of UII levels in adipose tissue

Preparation of tissue homogenates the frozen adipose tissue was weighed and homogenized in ice-cold 0.01M phosphate-buffered saline (1/10 weight per volume; pH:7.4) using a tissue liyser II (Qiagen) at 20 Hz for 3 minutes at 4C. The homogenates were centrifuged at 5.000g for 45 minutes at 4C, and the supernatants were placed into sterile tubes and stored at -80 ^{o} C until analysis. Concentration of the total protein was determined according to the procedure described by Lowry et al [9].

The levels of UII in adipose tissue samples were determined using the Human UII ELISA Kit (Cloud-Clone, Product No: CEA362Hu, China) according to the manufacturer's directions. The intensity of color is measured spectrophotometrically at 450 nm in a microplate reader (Biotek). A standard curve is plotted that relates the intensity of the color (O.D.) to standards. The UT-II concentration of each sample is interpolated from this standard curve [10, 11]. Intra-assay precision (precision within an assay) was CV% < 10%. Inter-assay precision (precision between assays) was CV% < 12%. The detection range was 12.35 pg/ml-1000 pg/ml.

Statistical analysis

SPSS IBM 21.0 software was used for statistical analysis of the data. Normal distribution of the data was evaluated with the Kolmogrov Smirnov test. Since p>0.05, it was accepted that the data were normally distributed. Independent T test was used for pairwise comparison of the biochemical data (UII levels and others) in Table 1, Figure 1A-B and 2 compared to the control. Dependent (paired) T test was used to compare the preoperative and postoperative groups of biochemical data (UII levels and others) in Table 1 and Figure 1C. Pearson correlation test were used to determine correlation between the biochemical data (UII levels and others). p<0.05 indicates a correlation. If the PC value was >0, the correlation was considered positive, and if the PC value was <0, the correlation was considered negative. To determination UII cut-off value, we used roc curve analyses. Using the ROC curve, the cut-off value was plotted and it was associated with the Sensitivity and Specificity values of the test. Results were evaluated within the 95% confidence interval. p<0.05 was accepted as statistically significant.

RESULTS

Before LSG (PREOP), the study group's average BMI was 44.93; six months later LSG (POSTOP), it had dropped to 27.92, a statistically significant difference. The study's healthy participants, who made up the control group (C), had an average BMI of 21.96. Following a LSG, people with obesity were seen to approach healthy weight levels six months later.

It was found that the systolic blood pressure (SBP) of the PREOP group significantly increased when compared to the C group SBP and diastolic blood pressure (DBP) data were compared. In contrast to the PREOP and C groups, the SBP of the POSTOP group significantly dropped. When compared to the PREOP group, the POSTOP and C groups showed a significant decline in DBP data (Table 1).

Table 1. Blood pressure and BMI measurements

	Mean ±SD		Mean ±SD		p
	PREOP		**C**		
BMI	44.93	± 4.73*	21.96	± 1.13	**0.002**
SBP	124.11	± 13.28*	118.29	± 5.1	**0.028**
DBP	77.33	± 10.59*	74.24	± 2.41	**0.000**
	POSTOP		**C**		
BMI	27.92	± 3.26*	21.96	± 1.13	**0.000**
SBP	107.11	± 9.26*	118.29	± 5.1	**0.000**
DBP	66.6	± 8.57*	74.24	± 2.41	**0.000**
	PREOP		**POSTOP**		
BMI	44.93	± 4.73*	27.92	± 3.26*	**0.000**
SBP	124.11	±13.28*	107.11	± 9.26*	**0.000**
DBP	77.33	±10.59*	66.6	± 8.57*	**0.000**

p<0.05 is statistically significant. BMI: body mass index, SBP: systolic blood pressure, DBP: diastolic blood pressure, PREOP: Before LSG, POSTOP: six month later LSG, C: control

Uric acid, AST, GGT, Creatine, Direct bilirubin and total bilirubin levels were found to be low and statistically significantly lower and K levels significantly higher than in the PREOP group compared to the C group. The levels of glucose, BUN, urea, AST, ALT, GGT, ALP, LDH, and total bilirubin significantly decreased in the POSTOP group compared to the C group. The levels of GFR, total protein, ALT, and iron significantly increased in the POSTOP group compared to the C group. Postoperative glucose, urea, ALT, ALP, iron binding and LDH levels significantly decreased when compared to the PREOP group. On the other hand, there was a significant increase in GGT, Direct bilirubin, total bilirubin, total protein, and iron levels in POSTOP group compared to the PREOP group (Table 2).

Table 2. Risk factors of obesity and comparison biochemical parameters between the groups

	Mean ±SD						*p*		
Variable	**PREOP**		**POSTOP**		**C**		**PREOP/ POSTOP**	**C/PREOP**	**C/OSTOP**
Glucose	111.51	±44.86	93.97	±11.68	105.13	±22.54	**0.022**	0.339	0.003
Amylase	55.2	±21.98	55.24	±22.79	68.05	±41.20	0.745	0.061	0.063
Lipase	36.09	±25.84	31.35	±18.26	31.35	±32.87	0.175	0.437	0.999
BUN	11.79	±4.72	11.93	±3.56	26.17	±36.75	0.595	0.100	0.018
Urea	28.89	±7.71	23.52	±7.05	30.61	±10.94	**0.008**	0.377	0.000
Uric acid	5.37	±0.93	4.78	±1.30	4.23	±1.52	0.453	0.001	0.232
Creatine	0.74	±0.16	2.82	±10.81	0.84	±0.20	0.209	0.011	0.162
GFR	104.5	±19.85	106.46	±14.53	95.36	±20.20	0.568	0.069	0.006
AST	19.11	±5.53	19.44	±10.6	31.06	±36.87	0.548	0.033	0.043
ALT	26.2	±12.85	19.08	±15.28	37.69	±52.11	**0.005**	0.151	0.022
GGT	27	±22.82	16.74	±7.56	46.63	±51.12	**0.000**	0.020	0.000
ALP	82.7	±21.73	67.56	±19.21	82.28	±30.88	**0.006**	0.938	0.007
DB	0.18	±0.09	0.53	±1.11	0.23	±0.12	**0.049**	0.043	0.076
TB	0.514	±0.26	1.33	±1.74	0.67 +	±0.40	**0.004**	0.017	0.006
LDL	101.3	±34.14	102.02	±38.16	102.04	±36.62	0.361	0.943	0.998
TG	144.22	±114.49	110	±41.18	96.69	±55.86	0.116	0.034	0.258
HDL	45.13	±13.63	47.74	±11.27	48.34	±10.32	0.526	0.337	0.821
Cholesterol	178.65	±45.60	163.86	±42.53	164.59	±35.03	0.128	0.214	0.941
CK	211.22	±134.02	85.27	±92.90	241.8	±351.43	0.209	0.728	0.158
TP	11.32	±14.84	32.23	±29.32	13.01	±18.59	**0.002**	0.647	0.001
Iron	60.76	±28.77	85.394	±49.60	51.82	±30.94	**0.000**	0.215	0.001
Albumin	5.63	±6.75	10.85	±13.95	7.9	±11.33	0.078	0.277	0.429
IB	288.69	±69.31	257.02	±84.77	289.11	±78.32	**0.032**	0.982	0.120
CRP	1.46	±3.01	3.06	±4.05	2.88	±5.77	0.054	0.135	0.860
LDH	198.93	±49.11	152	±55.61	195.02	±36.55	**0.010**	0.686	0.001
Na	140.04	±2.36	139.98	±3.70	137.11	±13.05	0.969	0.140	0.165
Ca	9.4	±0.41	9.3	±0.73	10.58	±10.02	0.383	0.432	0.405
K	4.53	±0.34	4.29 +	±0.44	4.24	±0.47	0.052	0.001	0.618
Mg	2.06	±0.15	2.01	±0.32	1.97	±0.25	0.421	0.050	0.482
Cl	104.38	±2.83	104.61	±2.18	104.62	±2.65	0.248	0.704	0.981
P	3.33	±0.83	3.48	±0.74	3.46	±1.06	0.508	0.528	0.917
Hba1c	6.4	±1.27	5.28	±0.43			**0.000**		
Folate	7.17	±3.85	5.77	±1.62			0.106		
B12	375.52	±222.78	255.11	±169.87			0.069		
PTH	53.69	±20.78	62.2	±30.71			0.689		
Ferritine	72.21	±74.24	62.67	±51.89			0.586		

$p<0.05$ is statistically significant. BUN: Blood urea nitrogen, GFR: Glomerular filtration rate, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase, GGT: Gamma glutamyl transferase, ALP: Alcaline phosphatase, DB: Direct bilirubin, TB: Total bilirubin, HDL: High density lipoprotein, TG: Triglyceride, LDL: Low density lipoprotein, CK: Creatine kinase, TP: Total Protein, IB: Iron binding, CRP: C-reactive protein, LDH: Lactate dehydrogenase, HbA1c: Glycated hemoglobin, B12: Vitamin B12, PTH: Parathormone, PREOP: Before LSG, POSTOP: six month later LSG, C: control

When serum UII levels were measured, it was discovered that the levels in the PREOP and POSTOP groups were statistically significantly higher than those in Group C. The UII levels of the POSTOP group decline when compared to the PREOP, however, this decreasing is statistically significant (Figure 1). This suggests that there is a strong link between obesity and UII. Investigated were the differences in tissue UII levels between Group C and the PREOP group. It has been noted that in Group C, tissue UII levels have increased in lockstep with serum UII levels. The statistical analysis performed revealed that this increase is statistically significant (Figure 2).

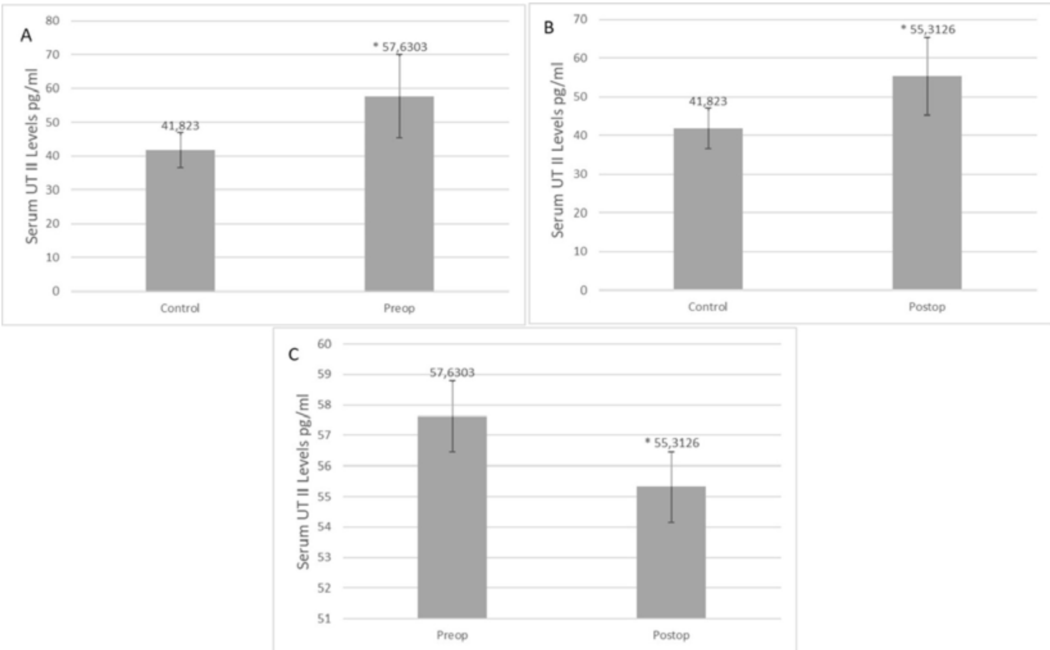


Figure 1. A) Control and Preop Serum Urotensin II levels. B) Control and Postop Serum Urotensin II levels. C) Preop and Postop Serum Urotensin II levels

*p<0.05 is statistically significant.

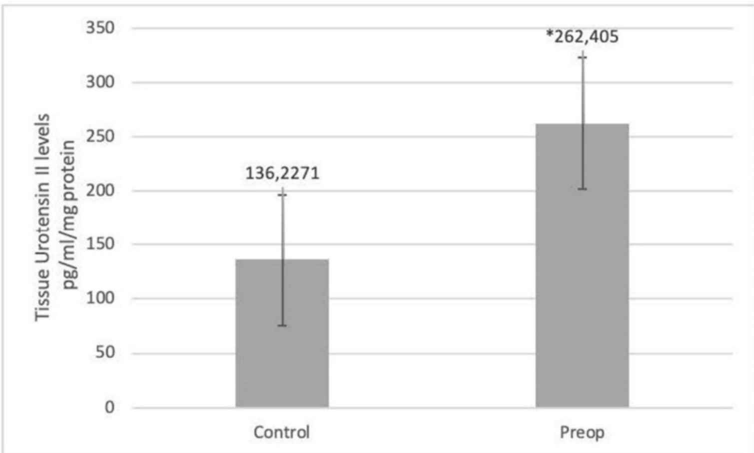


Figure 2. Tissue Urotensin II levels.

*compared to control, p<0.05 is statistically significant.

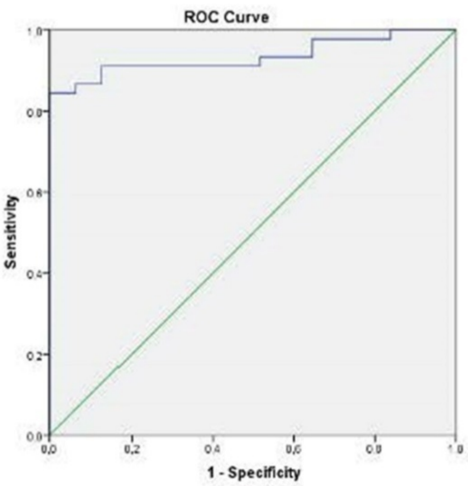
Cut off, and ROC analysis were performed to find out if tissue and serum UII levels can be used as a selection criterion for people having LSG. Individuals with serum UII levels below 46.88 were found to be unsuitable for LSG, whereas those with values above this cut off were found to be more suitable (p<0.05; sensitivity: 0.911; specificity: 0.871). With a value above 202.87, tissue UII levels were deemed suitable for surgery (p<0.05, sensitivity: 0.889, specificity: 0.919) (Table 3, Figure 3).

The correlation between serum and tissue UII levels and biochemical parameters was examined using the Pearson correlation (PC) test. The test results showed a significant positive correlation between serum and tissue UII levels (PC: 0.589, p<0.05). A positive correlation was also seen (PC: 0.659 and 0.708, respectively, p<0.05) when serum and tissue UII levels were compared to BMI. Serum UII levels and serum creatinine, AST and GGT levels were found to be negatively correlated (PC: -0.189, -0.182, -0.284, respectively), while serum UII levels and serum GFR and Na levels were found to be positively correlated (PC: 0.254 and 0.221, respectively, p<0.05). In contrast, the positive correlations seen with uric acid, sodium, and potassium levels (PC: 0.308, 0.318 and 0.240, respectively, p<0.05) with the tissue UII levels and negative correlations were seen in GGT and total bilirubin levels with the tissue UII levels (PC: -0.222 and -0.212, resprectively, p<0.05).

Table 3. Serum and Tissue Urotensin II Cutt-of value of Patients

	AUC(%95CI)	Cut off	*p*	Sensitivity	Specificity
Serum UII	0.934 (0.877-0.991)	46.88	**0**	0.911	0.871
Tissue UII	0.951 (0.914-0.988)	202.87	**0**	0.889	0.919

AUC: area under the curve for a ROC curve, CI: confidence interval



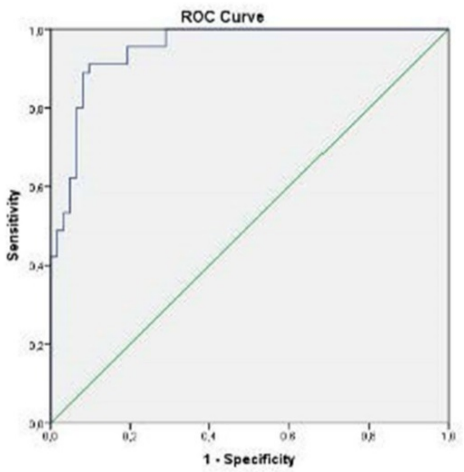


Figure 3. ROC Analysis results to determination cutt-of value.

DISCUSSION

When the BMI is over 35 and there are chronic comorbidities such as diabetes or hypertension, or when the BMI is over 40 for the treatment of clinically severe obesity, bariatric surgery, also known as LSG, may be performed. LSG is a surgical procedure that is often performed because of its benefits, which include reducing comorbidities, providing effective weight loss, not requiring anastomosis, not causing mesenteric defects, maintaining continuity of the pylorus and digestive system, reducing ghrelin production, and not altering the absorption of food, minerals, vitamins, and medications[12,13].

The release of proinflammatory cytokines and adipokines is one of the symptoms of obesity, which is also known as a chronic inflammatory condition [14–16]. In adipocytes, it has been demonstrated to cause a localized increase in insulin resistance (IR)[15,17]. The development and progression of cardiometabolic risk factors associated with obesity in MS are significantly influenced by IR. Studies suggest that obesity may exacerbate the pathological role of inflammation in IR and MS. On the other hand, it has been suggested that obesity may have an effect on inflammation[18–21].

There is weak evidence for a direct link between UII and obesity or dyslipidaemia. However, UII may play a role in the development of MS or its components, such as hypertension, IR, hyperglycaemia and inflammation. UII is thought to affect digestive function and contribute to inflammation. UII and angiotensin II may interact synergistically, particularly in conditions characterised by endothelial dysfunction, such as MS[7].

Elevated plasma UII levels have been observed in diabetic patients, whether proteinuric or not [22]. The increase is not influenced by fasting plasma glucose or glycated haemoglobin levels, suggesting that UII release or production is not solely dependent on hyperglycaemia. There was no correlation between glucose levels and serum UII levels in the PREOP, POSTOP and C groups of our study when glucose and UII levels were measured. In the PREOP group, glucose levels were higher, but in the POSTOP group they were even lower than in the C group. In addition, there was a statistically significant decrease in serum UII levels between the PREOP and POSTOP groups. High HbA1c levels found in a study of obese children [23]. In our study, the HbA1c levels of the POSTOP group also decreased and eventually reached levels comparable to those of the C group.

Studies in experimental animals have shown that expression of UII is present in epididymal fat but not in abdominal or perirenal fat. It is thought that UII may contribute to abdominal obesity, which is thought to be a critical factor in the development of MS, if similar effects on lipid metabolism and feeding behaviour are seen in humans. Plasma UII levels and body weight have been shown to correlate positively in studies of the Chinese population[22].

Obese mice were used to examine the effects of UR blockade on various aspects of MS in a study to ascertain the role of UII in the pathogenesis of the condition. Compared to wild-type mice, obese mice treated with the UR antagonist SB657510 experienced less weight gain and significant reductions in blood pressure, hyperlipidemia, and glucose levels [24]. According to the results of a study done on kids with obesity, those who had a family history of high blood pressure had serum UII levels that were significantly higher than those in the control group [23]. In our study, weight loss was associated with a parallel decrease in blood pressure and serum UII levels. These results support the idea that the UII system may be critical in the fight against obesity and MS when UII system activity is reduced.

The UII gene is significantly associated with the amount of saturated fatty acids in skeletal muscle, while the UR gene has significant effects on the levels of saturated and monounsaturated fatty acids. This study provides the first evidence that the UII and UR genes control fat accumulation and fatty acid metabolism in skeletal muscle, highlighting their potential pathological role in type 2 diabetes mellitus and in people with obesity[25]. In our study, both serum UII levels and adipose tissue levels were found to be elevated PREOP. Adipose tissue and serum UII levels in group C, whose BMI was within the normal range, showed comparable parallelism. As a result, adipose tissue UII levels decrease with weight loss. The literature is supported by our results.

A different study that compared vitamin B12 levels in patients who had undergone LSG found that post-operatively low B12 levels were more typical in women [26]. POSTOP vitamin B12 levels decreased in our study, but deficiency has not yet materialized. After surgery, inconsistency in the general biochemical profile was seen in earlier studies, particularly in the levels of albumin, uric acid, creatinine, AST, and ALT, and it has been hypothesized that this inconsistency is more pronounced in men[27]. Uric acid levels decreased in a study where biochemical evaluations were carried out a year after LSG[28]. Similar results were found in our study, where uric acid levels decreased and statistically significant differences were found six months after surgery.

Another study found that people with obesity who underwent LSG had normal serum calcium and albumin levels one year after surgery[29]. However, our study found that although there was no statistically significant difference, albumin levels were higher six months after surgery compared with the C group. Some researchers claim that there were no significant changes in serum glucose, albumin, BUN, creatinine or GFR levels six months after LSG[30]. However, in our study, there were statistically significant variations in glucose and urea levels between the preoperative and postoperative groups.

Studies have shown that LSG has regulatory effects on lipid markers [31]. While some studies have claimed that there was a significant increase in serum HDL and cholesterol levels after LSG, other studies have claimed that there was no such significant increase[32]. Even studies have suggested that men and women have different total cholesterol and HDL cholesterol levels [33]. Given the importance of this issue, it is recognised that further research is needed to define the relationship between gender and post-LSG comorbidities.

It has been suggested that serum UII levels correlate positively with SBP, DBP and uric acid and negatively with creatinine, BUN and nitric oxide when correlation analyses are performed with UII levels[34, 35]. However, the results of our study were consistent with previous research, with negative correlations between serum UII levels and creatinine, AST and GGT. In addition, tissue UII levels showed negative correlations with GGT and total bilirubin levels, while showing positive correlations with uric acid, sodium and potassium levels. Furthermore, our study showed that tissue and serum UII levels increased with increasing BMI, adding important new data to the literature.

In conclusion, recent research raises the possibility that UII may play a protective role in inflammation, endothelial dysfunction and cardiovascular side effects. Further studies using UT receptor antagonists or a prospective study design are needed to better understand the functional role of UII. The relationship between weight loss and UII should be investigated in multicentre studies with larger numbers of participants.

The main limitation of our study is that our study population was single-center and consisted of a small number of patients. Multicenter studies with homogeneous gender distribution should be designed and studies that can reach large numbers should be conducted.

Another limitation of our study is that BMI was accepted as the main indicator. In addition to BMI, muscle mass, fat distribution and metabolic health status of patients should be evaluated by designing invasive studies. On the other hand, another limitation of our study is that the parameters influencing UII levels were not determined by collecting information on the lifestyle, diet and physical activity of the individuals included in the study. Our study evaluated the short-term results of LSG, a method used in the surgical treatment of obesity. this affects our study results. it is possible that although there is a decrease between PREOP and POSP UII levels at the end of 6 months, the levels are likely to converge at a level that does not create statistical significance at the end of 1 year. another important limitation of our study is that the patients were not followed up for a long period (1 year). Studies in which patients are followed up for a longer period of time will allow both a more accurate assessment of the efficacy of LSG and an analysis of metabolic functions in a more regular state.

LSG is a prominent and widely used bariatric procedure in the treatment of obesity. The decrease in UII levels in individuals with normal BMI after LSG surgery and the difference in UII between individuals with normal BMI and obese individuals indicate that UII plays an important role in obesity. In addition, another important statistical finding of our study is that tissue and serum UII levels can be a selection criterion for LSG surgery, just like BMI.

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