INTRODUCTION

The majority of males over the age of 50 have lower urinary tract symptoms (LUTS) and benign prostatic hyperplasia (BPH). LUTS is generally caused by BPH. It decreases quality-of-life[1] and is prevalent among old men. Research has shown that the prostates of obese men are larger than the prostates of normal-weight men.[2-6] Recent studies determined a relationship between LUTS and obesity.[2,4,7,8] Hyperinsulinemia was the proposed pathophysiology,[9,11] which is caused by tissue insulin resistance that stimulates the autonomic nervous system. Hyperinsulinemia stimulates the sympathetic nervous system in particular.[12] Bladder outlet obstruction and LUTS are caused by the over functioning of the sympathetic nervous system.

MATERIALS AND METHODS

Two hundred and eleven patients who underwent a transrectal
ultrasound (TRUS)-guided prostate biopsy due to elevated prostate-specific antigen (PSA) levels or abnormal digital rectal examination findings were evaluated retrospectively between December 2008 and November 2009. The study was approved by the local research ethics committee.

A clinical evaluation, including the International Prostate Symptom Score (IPSS) questionnaire, PSA level, height and weight measurement, and TRUS findings was performed of each patient. Body mass index (BMI) was calculated by dividing the weight of the patient by his height in meters squared (kg/m²). The IPSS was used for the evaluation of LUTS. Patients were divided into four groups according to BMI: <18.5 (underweight), 18.5–23.0 (normal), 23.0–27.5 (overweight), and >27.5 (obese). According to the IPSS, LUTS is characterized as mild between 0 and 7, moderate between 8 and 19, and severe between 20 and 35.

Exclusion criteria included the use of 5 alpha reductase inhibitor or antiandrogen, which may affect the prostate volume. Furthermore, patients with bladder stones, the presence of neurogenic bladder dysfunction, previous prostate surgeries, recurrent urinary tract infections or a history of acute or chronic prostatitis in the last 3 months were excluded from the study.

Statistical analyses
Data analysis was performed using SPSS for Windows, version 11.5 (SPSS Inc., Chicago, IL, United States). Whether the distributions of continuous variables were normally distributed or not was determined using the Shapiro–Wilk test. Data are shown as mean ± standard deviation or median (min-max), where applicable. The median volume and IPSS differences among groups were compared using the Kruskal–Wallis test. When the P value from the Kruskal–Wallis test statistics was statistically significant, Conover’s nonparametric multiple comparison tests was used to identify, which group differed from the others. Categorical data were analyzed using Pearson’s Chi-squared test or Fisher’s exact test, where appropriate. Degrees of associations among prostate volume, IPSS, and BMI were evaluated using Spearman’s rank correlation test. P < 0.05 was considered as statistically significant.

RESULTS
The mean age of the patients was 68.0 ± 0.3 years, and the mean BMI was 28.0 ± 4.9 kg/m². Our patient population consisted of obese patients. The distribution of the 211 patients according to BMI was: Two underweight patients (0.9%), 46 normal-weight patients (21.8%), 36 overweight patients (17.1%), and 127 obese patients (60.2%). Analysis was performed by including the underweight two patients in the normal group. The mean BMI, prostate volume, and IPSS values of the groups are listed in Table 1.

Prostate volume values for the overweight and obese group according to BMI were significantly higher than the normal group (P < 0.001). In addition, prostate volumes in the obese group were statistically higher than in the overweight group (P = 0.002) [Table 2 and Figure 1].

The level of IPSS was significantly higher in overweight and obese patients than patients in the normal group (P < 0.001). Furthermore, IPSS levels were significantly higher in the obese group than the overweight group (P = 0.010) [Table 2 and Figure 1].

In addition, a higher proportion of patients with low levels of IPSS were in the normal group, as opposed to the overweight or obese groups (P < 0.001). Likewise, a lower proportion of individuals with high levels of IPSS was found in the normal group compared with the other groups (P = 0.011 and P < 0.001, respectively). Among the three groups, there was no statistically significant difference in terms of intermediate IPSS level (P = 0.225) [Table 2].

### Table 1: Demographical and clinical characteristics

| Variable                  | n=211 (%) |
|---------------------------|-----------|
| Age                       | 68.0±6.3  |
| Age range                 | 56-90     |
| BMI (kg/m²)               | 28.0±4.9  |
| BMI groups                |           |
| <18.5 kg/m²               | 2 (0.9)   |
| 18.5-23.0 kg/m²           | 46 (21.8) |
| 23.0-27.5 kg/m²           | 36 (17.1) |
| ≥27.5 kg/m²               | 127 (60.2)|
| Volume                    | 55 (18-137)|
| IPSS                      | 18 (3-30) |
| IPSS groups               |           |
| Mild                      | 18 (8.5)  |
| Moderate                  | 101 (47.9)|
| Severe                    | 92 (43.6) |

BMI: Body mass index, IPSS: International Prostate Symptom Score

### Table 2: Prostate volume and IPSS findings in terms of BMI

| Variables                  | Normal (n=48) | Overweight (n=36) | Obese (n=127) | P     |
|----------------------------|---------------|-------------------|---------------|-------|
| Volume                     |               |                   |               |       |
| PSA                       | 30 (18-113)a | 50 (30-90)b       | 70 (18-137)c | <0.001|
| IPSS                      | 8 (6-30)      | 16.5 (6-28)       | 20 (3-30)     | <0.001|
| IPSS groups (%)           |               |                   |               |       |
| Mild                      | 16 (33.3)a   | 1 (2.8)b          | 1 (0.8)c      | <0.001|
| Moderate                  | 25 (52.1)    | 21 (58.3)         | 55 (43.3)     | 0.225 |
| Severe                    | 7 (14.6)a    | 14 (38.9)b        | 71 (55.9)c    | <0.001|

*aThe difference between the normal and overweight groups was found to be statistically significant (P<0.05). The difference between the normal and obese groups was found to be statistically significant (P<0.001). The difference between the overweight and obese groups was found to be statistically significant (P<0.01). BMI: Body mass index, IPSS: International Prostate Symptom Score*
We examined the relationships among prostate volume, IPSS, and BMI. In a univariate analysis using Spearman's rank correlation test coefficient, BMI was positively correlated with prostate volume ($r = 0.630$ and $P < 0.001$) and IPSS ($r = 0.604$ and $P < 0.001$) [Figure 2].

**DISCUSSION**

We analyzed the relationship among obesity, prostate volume, and IPSS in prostate biopsy patients. Obese patients were found to have higher prostate volumes and IPSS values than normal individuals. There was a statistically significant difference between the prostate volumes and IPSS values of obese patients and patients in other BMI groups. We found a positive correlation between BMI and IPSS and BMI and prostate volume.

A restrictive aspect of our work may be that the population included in our work does not consist of asymptomatic people and that these individuals may not reflect the common characteristics of general society. The patients included in our work consisted of individuals who were selected on the basis of a prostate biopsy.

Kim et al. analyzed the relationship between prostate volume and metabolic and anthropometric parameters. The researchers found that there was a correlation between prostate volume and body weight and height; however, multivariable linear regression analysis revealed no statistically significant correlation between BMI and prostate volume. A study carried out with 465 men in a health promotion center reported a positive correlation between prostate volume and central obesity based on waist circumference and BMI, not based on overall obesity. On the other hand, a study carried out in the United States with men who had undergone a radical prostatectomy showed that there was a positive relationship between BMI and prostate volume in the patients under the age of 63. Another study carried out on men who had had benign biopsies reported that there was a direct relationship between BMI and prostate volume.

Obesity can increase sympathetic nervous systems activity, which affects prostatic enlargement and urinary obstructive symptoms. Kristal et al. analyzed a number of modifiable life-style factors that affect symptomatic BPH in 5,600 men who participated in the prostate cancer prevention trial. The patients were included in a placebo group of the trial and were followed for 7 years. The authors found that symptomatic BPH (IPSS > 14) significantly increased with obesity. For this reason, Kristal et al. suggested that there was a relationship between higher LUTS prevalence and adulthood obesity. Rohrmann et al. analyzed the relationship between LUTS and obesity in the National Health and Nutrition Examination Survey III. They found that there was a positive relationship between increased BMI and prevalence of LUTS.

Obesity increases estrogen levels by CYP19 (aromatase) conversion of androgens in adipose tissue. Obese men have a larger prostate volume and lower testosterone concentrations. Obesity lowers free and total testosterone and serum globulin-binding protein levels, but also increases estrogen levels, both free and total estradiol concentrations. Higher estrogen levels and lower testosterone levels can affect prostate cell growth. The ratio of estrogen to androgen and sympathetic nervous activity are known to affect BPH development and LUTS severity. Abdominal obesity increases with both of the conditions discussed above. Obese men are at an increased risk for BPH. The link to the quality of venous drainage to BPH is another pathway that explains this risk.

Gat et al. reported that an impairment of the testicular venous drainage system in an erect posture causes BPH.
researchers reported that the one-way valves in the vertically oriented internal spermatic veins were destroyed (varicocele) in BPH patients, causing 6 times higher hydrostatic pressure than normal in the venous drainage of the male reproductive system. In addition, a large abdominal mass above the testicular venous system can negatively affect the prostate in obese men.

Recent studies of the pathophysiology of BPH reported that newly identified risk factors, including diet and obesity, can affect the development of BPH. These risk factors are in addition to conventional risk factors such as age, family history, and androgen activity.  

CONCLUSIONS

Patients with a high BMI may be at risk for an increased prostate volume and IPSS. Therefore, losing weight may result in a smaller prostate volume in the geriatric period, so that LUTS will be less pronounced and quality of life will be improved.

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