Benign Prostat Hiperplazisi Tedavisinin Değerlendirmesinde Prostat Kapsüler Arter Rezistif İndeks Değerinin Etkinliği

Bekir TURGUT[1], Mustafa Bilal HAMARAT[2]

Öz

Benign prostat hipertrofisi olan hastalarda prostat kapsüler arter rezistif indeksin hastalığın şiddetini belirleme ve uygulanan α-bloker tedavi etkinliğini değerlendirmede parametrik bir ölçüt olup olamayacağını değerlendirmeyi amaçladık. Hastanemize başvuran ve tedavi olan alt üriner sistem semptomları olan hastaların tedavi, işlem, tetkik aşamasında hasta bulguları ve görüntüleri kayıt altına alındı. Daha sonra retrospektif olarak bu kayıtlar ve hastanemiz verileri incelendi. Çalışmaya 66 hasta dahil edildi. IPSS skoru yüksek olup tedavi önerilen 36 hastanın rezistif indeks ortalama değeri 0,68±0,09 , IPSS skoru düşük olan hastaların rezistif indeks ortalama değeri 0,65±0,05 dır. Bu iki değer arasındaki fark istatiksel olarak anlamlı bulunmuştur($p<0,05$). Alt üriner sistem semptomları olan ve tedavi verilen 36 tedavi öncesi rezistif indeks değeri ortalama 0,68±0,09 'dir. Tedavi sonrasında ortalama 0,64±0,07 değere gerilemiştir. Bu gerileme istatistiksel olarak anlamlı bulunmuştur ($p<0,05$). Aynı şekilde tedavi öncesi ortalama 20,38±4,03 olan IPSS değeri tedavi sonrasında ortalama 14,38±3,69 'e gerilemiş ve istatistiksel olarak anlamlı bulunmuştur ($p<0,05$). Prostat kapsüler arter rezistif indeks değeri benign prostat hipertrofisinin şiddetini saptama ve uygulanan alfa bloker tedavi etkinliğinin değerlendirilmesinde parametrik bir belirteç olduğunu düşünüyoruz.

Anahtar Kelimeler: Benign prostat hiperplazisi, transrektal renkli doppler ultrason, uluslararası prostat semptom skoru, prostatik kapsüler arter rezistif indeksi

Yayın Bilgisi

Gönderi Tarihi: 29.9.2018

Kabul Tarihi: 30.11.2018

Online Yayın Tarihi: 30.06.2019

DOI: 10.26453/otjhs.465637

Sorumlu Yazar

Bekir TURGUT

Radiology Department, Health Sciences University, Konya Education and Research Hospital, Hacı Şaban neighb. Yeni meram street. No:97 Meram / KONYA/TURKEY
Phone number: +905057076274
Email address:

drbekirturgut@gmail.com

Effectiveness of Prostatic Capsular Artery Resistive İndex in the Evaluation of Benign Prostatic Hyperplasia Treatment

Bekir TURGUT[1], Mustafa Bilal HAMARAT[2]

Abstract

We aimed to evaluate whether the prostatic capsular artery resistive index can be a parametric criterion in evaluating the efficacy of α-blocker treatment and the severity of the disease in patients with benign prostatic hyperplasia. The clinical and diagnostic investigation findings and the radiographic images were recorded during the treatment and during the application of procedures in the patients who presented to our hospital with lower urinary system symptoms. Then, these data and the information of the respective patients recorded in the hospital database were examined retrospectively. A total of 66 patients were included in the study. Of the patients, 36 with higher IPSS were recommended to be treated and had a mean resistive index of 0.68±0.09, and the patients with lower IPSS had a mean resistive index of 0.65±0.05. The difference between these two values was found to be statistically significant ($p<0.05$). In 36 patients who were treated for lower urinary system symptoms, the mean resistive index before the treatment was 0.68±0.09. After the treatment, the mean resistive index decreased to 0.64±0.07. This decrease was statistically significant ($p<0.05$). The mean IPSS was 20.38±4.03 before the treatment and it decreased to 14.38±3.69 after the treatment, showing a statistically significant difference, similarly ($p<0.05$). We are of the opinion that the resistive index of the posterior capsular artery of the prostate gland is a parametric indicator to determine the severity of the benign prostatic hyperplasia and to assess the efficacy of the treatment with alpha-blocker medications.

Keywords: Benign prostatic hyperplasia, transrectal colour doppler ultrasound, international prostate symptom score, prostatıc capsular artery resistive index

Article Info

Received:29.09.2018

Accepted: 30.11.2018

Online Published: 30.06.219

DOI: 10.26453/otjhs.465637

Corresponding Author

Bekir TURGUT

Radiology Department, Health Sciences University, Konya Education and Research Hospital, Hacı Şaban neighb. Yeni meram street. No:97 Meram / KONYA/TURKEY
Phone number: +905057076274
Email address:

drbekirturgut@gmail.com

[1]Radiology Department, Health Sciences University, Konya Education and Research Hospital, Konya/Turkey
[2]Urology Department, Health Sciences University, Konya Education and Research Hospital, Konya/Turkey

INTRODUCTION

Benign prostatic hyperplasia (BPH) is the most common cause of bladder outlet obstruction.[1] European Association of Urology has proposed several methods, including ultrasound imaging, to examine the urinary system. To diagnose a bladder outlet obstruction, several recently introduced imaging indices are made use of as non-invasive methods, including the resistive index of the capsular artery, prosthetic urethral angle, intraprostatic protrusion, and the thickness of the wall of the detrusor muscle.

Grey-scale transrectal ultrasound (TRUS) is the most commonly used method to examine the prostate gland. Transrectal colour Doppler ultrasound (TRDUS) is used to demonstrate the vascular anatomy of the prostate gland as a real-time and reproducible examination technique.[2] The resistive index is associated with both the vascular resistance and the flow, therefore, the increases in the intraprostatic pressure may be reflected in the Doppler signals received from the blood vessels of the prostate.

The resistive index (RI) is considered to be a new parameter to estimate the intraprostatic pressure by using transrectal colour Doppler ultrasound (TRDUS) in benign prostatic hyperplasia (BPH). Of the spectral analysis criteria, it is suggested that RI can be used as a new parameter to demonstrate the severity and degree of BPH.[3] Recent studies have shown that RI values obtained with TRDUS are correlated with the prostate symptom scores and the size of the prostate gland. The RI of the blood flow in the prostate is suggested to be used as a non-invasive diagnostic method to evaluate BPH in patients with prostatic capsular artery resistive index.[4]

In our study, we evaluated the correlation of the prostate capsular artery RI, measured by means of TRDUS, with age, IPSS, and the prostate volume. We also examined the changes in these parameters in the patients after the treatment with α-blocker medications for the lower urinary system symptoms (LUSS) as recommended by the urology outpatient clinic.

We aimed to investigate whether the capsular artery RI could be used as a dynamic parameter in assessing the severity of benign prostatic hyperplasia and in measuring the efficacy of treatment.

MATERIAL AND METHOD

The study was conducted after receiving the approval from the institutional ethics committee. All procedures performed in this

study were in accordance with the ethical standards of the institutional and/or national research committee and the 1964 Helsinki declaration and its later amendments or comparable ethical standards. A total of 66 patients were included in the study. The findings and radiologic images of the patients were recorded during the treatment, application of the procedures, and during diagnostic investigations. Then, these data and the information of the respective patients recorded in the hospital database were examined retrospectively.

The patients were excluded from the study if they received medical treatment for benign prostatic hyperplasia, if there was a contraindication for treatment with α-blocker medications, if they had a history of a previous prostatic surgery or if the patients had the following diseases including a renal failure, prostate cancer, urinary bladder tumours, urinary bladder stones, neurogenic bladder or urinary infections. The patients were also excluded if cystic or solid lesions were identified in the transrectal colour Doppler ultrasound examination.

LUSS were assessed with the international prostate symptom score (IPSS) form and prostate-specific antigen (PSA) was tested. All transrectal examinations with colour Doppler ultrasound were performed with the Siemens Acuson X150 EC9-4 transducer device in our clinic. The prostate glands, urinary bladders, and seminal vesicles of all patients were examined. First, the size and the volume of the gland were computed in three planes. The gland diameter and depth were measured from the widest transverse section and the length was measured from the longitudinal section. The gland volume was automatically provided by the device and the results were recorded. The Doppler examination was carried out using a colour Doppler method. The colour box was positioned to cover the whole prostate gland as much as possible during the examination. Gain settings were performed for the colour Doppler and lower wall filters were used. The gain was increased until observing a scattering in the background. Pulse repetition frequency (PRF) was maintained in the range from 400 to 500 Hz and the angle was maintained at 60 degrees. Spectral sampling was performed from an artery in the subcapsular region. The imaging continued until the occurrence of three wave-forms similar to each other. Maximum systolic velocity, end-diastolic velocity, and RI were measured by means of the software in the device using the emergent wave-forms.

The patients with lower urinary system symptoms were seen at follow-up visits at the end of one-month treatment with Alfuzosin 10 mg tb 1x1 as recommended at the urology outpatient clinic. During the follow-up visits,

capsular artery RI was measured using the same technique and the patients were assessed with IPSS for the second time.

Statistical analyses of the data were performed using 'SPSS for Windows 17.0'. The Pearson correlation coefficient was used to determine the degree of correlation of RI with age, IPSS, and the volume of the prostate gland. The mean RI values were calculated for the patients with low IPSS and for the patients with high IPSS who were given treatment. One-way analysis of variance for independent samples was used to determine whether the difference between the two means was significant. The mean values of RI and IPSS scores were calculated in the patients with LUSS who were given treatment. The student t-test (Paired-Samples T-Test) was used to determine whether the difference between the mean scores was significant. The results were evaluated in a confidence interval of 95% and at a significance level of $p<0.05$.

RESULTS

The mean age of the 66 patients was 58.78±7.14 (37-75). The mean IPSS of the patients was 14.84±7.38 (3-27) and the mean PSA value was 1.48±1 (0.27-3.99) ng /ml. Using RDUS, the mean prostatic volume was found to be 39.87±15.83 (20-99) cm3 and the mean RI was 0.67±0.08 (0.44-0.82) (Table 1).

There was a moderately positive correlation between the resistive index and age ($r=0.42$; $p=0.04$). A weak positive correlation was observed between the volume of the prostate and the resistive index ($r=0.27$; $p>0.05$). A favourable positive correlation was found between the prostate volume and age ($r=0.58$, $p<0.05$). A moderately positive correlation was found between the prostate volume and IPSS ($r=0.35$; $p<0.05$).

Patients were categorized into three groups according to IPSS as follows: Mild symptom (0-7), moderate symptom (8-19), and severe symptom (20-35) groups. Of the patients, 36 with higher IPSS were recommended to be treated and had a mean resistive index of 0.68±0.09 (0.44-0.82), and the patients with lower IPSS had a mean resistive index of 0.65±0.05 (0.56-0.76). The difference between these two values was found to be statistically significant ($p<0.05$).

In 36 patients who were treated for lower urinary system symptoms, the mean resistive index before the treatment was 0.68±0.09 (0.44-0.82). After the treatment, the mean resistive index decreased to 0.64±0.07 (0.48-0.76). This decrease was statistically significant ($p=0.04$). The mean IPSS was 20.38±4.03 (14-27) before the treatment and it decreased to 14.38±3.69 (9-27) after the treatment, showing a statistically significant difference, similarly ($p=0.01$) (Table2).

DISCUSSION

Recent studies have found out that magnetic resonance imaging (MRI) have been proven to be an effective method to evaluate the pathologies of the prostate gland.[5] The limitation of the magnetic resonance imaging technique is the difficulty to identify the prostate tissue in older patients. The parameters elicited by MRI may be helpful in differentiating prostate cancer from prostatitis and BPH, however, MRI is not a routine procedure for the diagnosis and follow-up of BPH.[6] On the other hand, the transrectal colour Doppler ultrasound remains to be a currently used method as it is less costly, easy to apply, and has a higher diagnostic value.

Resistive Index is calculated by the following formula, (peak systolic flow velocity - end-diastolic flow velocity)/peak systolic flow velocity. Generally, higher resistive and pulsatility indices indicate that the resistance is high in the distal vascular bed and the lower values indicate a lower resistance. There was not a significant difference between the transitional zone resistive index and the peripheral zone resistive index.[7] We performed the measurements only in the peripheral zone based on this information.

Studies have shown that the resistive index levels (0.72±0.06) in patients with BPH are higher than the resistive index levels (0.64±0.04) in patients with a normal prostate volume. The cut-off value of the intraprostatic resistive index is recognized to be 0.70 for the diagnosis of BPH. Of the spectral analysis criteria, it is suggested that RI can be used as a new parameter to demonstrate the severity and degree of BPH.[3] It has been observed that there is a significant correlation between the transitional zone RI and the volume of the prostate (r=0.653; p=0.001). When the prostate volume reached values over 80 ml and the resistive index increased to values over 0.725, it has been noted that there is a positive correlation between the resistive index and the prostate volume based on the results elicited by regression analysis.[8] Another study found out that RI of the urethral artery and the right and left capsular arteries were significantly correlated with the degree of obstruction, the severity of symptoms, and the volume of the prostate (P=0.001).[9] In our study conducted on 66 patients, the mean value of the prostate volume was 39.60±16.22(10-99) and it was found out that there was a mild positive correlation between the capsular artery resistive index and the volume of the prostate (r=0.27; p=0.04).

A review of several studies reveals a set of diverse theories about the correlation between the age and the capsular artery resistive index. A recent study, comparing the maximum flow velocities in the capsular arteries between the

patients under 60 years of age and in the patients over 60 years, has found out that there has not been a significant correlation of these parameters with age neither in the group of patients with malignancies nor in the group of patients with benign disorders.[2] One study found a weak correlation between the age and the capsular artery resistive index.[10] Another study has argued that there is a significant and strong correlation between the age and the resistive index.[8] However, this correlation was not found to be significant in our study. Patients were not included in our study if they had chronic systemic diseases leading to increased levels of vascular resistance. The different results in terms of significance might have been caused by the exclusion of those patients. Those studies, where the patients with chronic systemic diseases were excluded, reported results similar to those of our study.[10] Although the prostate size increases with age, the significant increase in the resistive index may also be affected by atherosclerosis. In the light of these findings, it may be suggested that the resistive index of the capsular arteries may be a useful parameter for patients without chronic systemic diseases.

Atherosclerosis may also lead to an increased vascular resistance as it develops due to the chronic disorders such as hypertension and diabetes developing in increased ages. In our study, we determined a moderately positive correlation between the resistive index and age ($r=0.42$; $p<0.05$). None of the patients included in our study had any chronic systemic diseases (diabetes mellitus, hypertension or coronary artery disease). The difference between our study and the others is the inclusion of the patients with prostate cancer and chronic systemic diseases (diabetes mellitus, hypertension, coronary artery disease) in the other studies.

The increased levels of prostatic RI may be caused by the increased intraprostatic pressure caused the hyperplasia in the patients with BPH. This suggests that the RI is positively correlated with IPSS which is consistent with the earlier findings.[11] Furthermore, the resistive indices of the capillary arteries have been suggested to be used as parameters for the diagnosis of the bladder outlet obstruction.[12]

The cut-off value of the intraprostatic resistive index is reported to be 0.70 in the diagnosis of BPH.[3] However, the resistive index levels were lower than the cut-off value in the patients with higher IPSS in our study. However, some studies have reported similar results to the results of our study. In studies conducted on patients with lower urinary system symptoms, the resistive index value may be lower or higher than the cut-off value of 0.70. Therefore, the cut-off value should be reviewed for the diagnosis of BPH.

If the resistive index is used to assess the efficacy of alpha-blocker treatment in BPH, it may be beneficial to compare the pre-treatment and post-treatment levels of the resistive index. Our study is one of the several studies to the best of our knowledge conducted in this field and that further studies are required on this issue. Further studies will allow the use of the resistive levels as adjunctive parametric diagnostic tests along with IPSS in evaluating the severity of benign prostatic hyperplasia.

Our study has some limitations. Our results are derived from a relatively small sample size. In addition, although the data were recorded appropriately, the study had a retrospective design. However, the results led to the conclusion that the resistive index could be used as a parametric diagnostic test in evaluating the patients with LUSS despite these limitations. In addition, our study provided valuable results with statistical significance in evaluating the efficacy of the treatment. Further studies conducted on a higher number of patients will allow clarifying the beneficial value of the resistive index in making the diagnosis of BPH and in evaluating the efficacy of the treatment.

In conclusion, we recommend the use of the prostate capsular artery resistive index, measured by means of TRDUS, as an indicator of lower urinary system obstructions independent of the prostate volume. In addition, the levels of capsular artery RI provide effective results in evaluating the efficacy of alpha-blocker treatment in patients with lower urinary system symptoms.

Abbreviations: Benign prostatic hyperplasia (BPH), transrectal ultrasound (TRUS), Transrectal colour Doppler ultrasound (TRDUS), resistive index (RI), lower urinary system symptoms (LUSS), international prostate symptom score (IPSS), prostate-specific antigen (PSA), magnetic resonance imaging (MRI)

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Table 1. Baseline Values of The Patients Included In The Study.

	Study group (n = 66)	**Patients with LUSS (n=36)**	**Patients without LUSS* (n=30)**
Age	58.78±7.14 (37-75)	_	-
RI**	0.67±0.08 (0.44-0.82)	0.68±0.09 (0.44-0.82)	0.65±0.05 (0.56-0.76)
IPSS***	14.84±7.38 (3-27)	20.38±4.03 (14-27)	8.73±5.31 (3-17)
Prostate Volume	39.60±16.22 (10-99)	_	-

*lower urinary system symptoms
** resistive index
*** international prostate symptom score

Table 2. The resistive index and IPSS before and after the treatment

	Pre-treatment	**Post-treatment**	**p-value**
Resistive Index	0.68±0.09 (0.44-0.82)	0.64±0.07 (0.48-0.76)	0.004
IPSS* **	20.38±4.03 (14-27)	14.38±3.69 (9-27)	0.0001

*** international prostate symptom score