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Diagnostic Role of Intravesical Prostatic Protrusion and Visual Prostate Symptom Score in Lower Urinary Tract Symptoms in Male

Erkek Alt Üriner Sistem Semptomlarında İntravezikal Prostat Protrüzyonun ve Görsel Prostat Semptom Skorunun Tanısal Rolü

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Abstract

Introduction In this study, it was aimed to evaluate non-invasive, effective and low-cost diagnostic methods of bladder filling and voiding abnormalities in male patients.

Materials and Methods: Patientswere admitted between March 2020 and August 2020. Visual Prostate Symptom Score (VPSS) and the International Prostate Symptom Score (IPSS) were completed by the patients. Patients' intravesical prostatic protrusion (IPP), prostate volume, and post voiding residual urine (PVR) were measured by suprapubic ultrasound. Bladder Outlet Obstruction Number (BOON)was used to calculate urethral resistance. Patients with a BOON value above -20 were considered obstructive.

Results: This study included 219 male patients aged 50 years and over. The number of patients with a BOON value over -20 were 34 (obstructed) and below -20 were 61 (non-obstructed). There was a significant difference between these two groups in terms of PSA, prostate volume, IPP, Qmax, PVR, IPSS, and VPSS. It was observed that IPSS and VPSS were correlated (r=0.786). Obstructive (r=0.779) and irritative symptoms (r=0.813) of IPSS and VPSS were also observed to be correlated.

Conclusion: VPSS was found to be equivalent to IPSS in the diagnosis of lower urinary tract symptoms. IPP is an important, practical and non-invasive method that correlates with IPSS, VPSS and BOON.

Keywords: Prostatic hyperplasia; lower urinary tract symptoms urological diagnostic techniques

Özet

Amaç: Bu çalışmada erkek hastalarda mesane dolum ve boşaltım bozukluklarının, non-invaziv, etkili ve düşük maliyetli tanı yöntemleri ile değerlendirilmesi amaçlanmıştır.

GereçveYöntem: Vizüel Prostat Semptom Skoru (VPSS) ve Uluslararası Prostat Semptom Skoru (IPSS) hastalar tarafından doldurduldu. Hastaların intra vezikal prostat çıkıntısı (IPP), prostat hacm ive işeme sonrası rezidüel idrarı (PVR) suprapubik ultrason ile ölçüldü. Üretral direnci hesaplamak için Mesane Çıkış Obstrüksiyonu Numarası (BOON) kullanıldı. BOON değeri -20' nin üzerindeolan hastalar obstrüktif kabul edildi.

Bulgular: Bu çalışmaya 50 yaşveüzeri 219 erkek hasta dahil edildi. BOON değeri -20'nin üzerinde olan hasta sayısı 34 (tıkanık) ve -20' nin altında olan hasta sayısı 61 (tıkanık değil) idi. Bu iki grup arasında PSA, prostathacmi, IPP, Qmax, PVR, IPSS ve VPSS açısındananlamlı fark vardı. IPSS ve VPSS' nin korele olduğu görüldü (r=0,786). IPSS ile VPSS' ninobstrüktif (r=0,779) ve irritatif semptomları (r=0,813) arasında da korelasyon olduğu görüldü.

Sonuç: Alt üriner sistem semptomlarının tanısında VPSS, IPSS'e eşdeğer bulundu. IPP; IPSS, VPSS ve BOON ile ilişkili olan önemli, pratik ve non-invaziv biryöntemdir.

Anahtar Kelimeler: Prostatik hiperplazi; alt üriner sistem semptomları; ürolojik tanısal teknikler.

Introduction

Lower urinary tract symptoms (LUTS) usually occur in older men and are mainly caused by enlargement in prostate gland volume due to hormonal changes. This enlargement is known to contribute to bladder outlet obstruction (BOO). Benign Prostatic Enlargement (BPE) increases with age. It is found in 50% of men up to the age of 60 years and in 80% of men up to the age of 80 years (1,2). Prostate enlargement is associated with particularly obstructive symptoms of LUTS. The gold standard diagnosis of BOO is pressure-flow studies. However, its widespread use is limited since it is an invasive procedure, requires specific equipment and experienced personnel and is a worrying method for the patient. Today, the search for non-invasive techniques for the diagnosis of BOO

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continues, including methods such as peak flow of uroflowmetry, prostate volume, intravesical prostatic protrusion (IPP), bladder wall thickness, bladder weight estimated by ultrasonography (USG) and penile cuff test (3,4). The international prostate symptom score (IPSS) has been translated into many languages worldwide as a proven tool in the diagnosis and follow-up of LUTS and its use is strongly recommended in guidelines (5). There are some problems such as false results since patient groups with low education level or advanced age tend to have difficulty understanding IPSS questions or require support from healthcare professionals when answering them (6). This need for support also puts an extra workload on healthcare professionals. Visual Prostate Symptom Score (VPSS) has been developed as an alternative to IPSS to overcome these problems (7). Urinary system USG is widely used for LUTS. It is possible to measure IPP, as well as prostate volume and post voiding residual urine (PVR) using urinary system USG and studies show that IPP provides useful information for LUTS (8). It is claimed that IPP causes urinary obstruction and increases LUTS by a "ball-valve" mechanism in which the middle and lateral lobes of the prostate prevent the bladder neck from opening while the patient is urinating (9). Bladder Outlet Obstruction Number (BOON) is a formula with non-invasive parameters and is suggested to be used in the diagnosis of BOO in patients with BPE (10). BOON also has been comparatively studied with Bladder Outlet Obstruction Index (BOOI) (11). The development of non-invasive, effective and cost-effective diagnostic methods for male patients with bladder filling and voiding abnormalities has been recommended by the International Continence Society (ICS) (12). In this study, it was aimed to determine the use of VPSS instead of IPSS when necessary, the importance of IPP in the evaluation of LUTS and the correlations of IPP with VPSS and BOON-based IPSS in the diagnosis of obstruction.

Materials and Methods

Male and patients over 50 years of age were included in this prospective study. After the urological examination of the patients, their consent to participate in the scientific study was obtained. The prostate volume and IPP of the patients were determined. Ultrasonography was performed by a single radiologist. Patients with previous urological surgery, history of urological malignancy, systemic disease (diabetes mellitus, multiple sclerosis, etc.) or trauma that may cause LUTS, pharmacotherapy for LUTS, use of diuretic antihypertensive, PSA>4 ng/dl, history of pelvic radiotherapy or visual problems that prevent the completion of the VPSS test were excluded.

IPSS: IPSS is a screening tool consisting of 7 items that question quality of life and urinary symptoms and is filled by the patients themselves. Each question is scored from 0 to 5. Storage (items 2, 4 and 7) and voiding (items 1, 3, 5 and 6) symptoms are questioned. LUTS is classified as mild (0-7), moderate (8-19) or severe (20-35) according to the final score.

VPSS: VPSS enables patients to evaluate the severity of their complaints on visual scales. It consists of 4scale visuals measuringpollakuria, nocturia, urine flow rate and quality of life (13).

IPP: IPP is the measurement of the length between the bladder neck and the top of the median lobe on the midsagittal axis by suprapubic USG duringat a bladder volume of 100 cc and above. Since it is equivalent to rectal USG when measuring prostate at a bladder volume of above 100 cc (14), suprapubic USG was used for parameters such as prostate volume, IPP and PVR. The patients were divided into three groups according to their IPP results (<5mm, 5-10mm, >10mm). Uroflowmetry and PVR values were also measured.

VPSS-IPSS: Patients were asked to fill out IPSS and VPSS forms on their own. Total scores from items 1, 3, 5 and 6 of IPSS were collected and accepted as the "IPSS (voiding)" group. Total scores from items 2, 4 and 7 of IPSS were collected and accepted as the "IPSS (storage)" group. Likewise, the third pictogram of VPSS for voiding symptoms was accepted as the "VPSS (voiding)" group and the sum of the 1st and 2nd pictogram values for storage symptoms was accepted as "VPSS (storage)".Bladder Outlet Obstruction Number (BOON) was used to detect obstruction by the following equiation: BOON = Volumeprostate (cc) - 3 x Qmax(Voiding)(ml / sec) - 0.2 x Voiding Volume (ml)If the value was above -20, the patients were considered obstructed. Patients were divided into two groups with and without obstruction and compared in terms of PSA, prostate volume, IPP, Qmax, PVR, IPSS and VPSS. The power of IPP, IPSS and VPSS in predicting these patients was examined with the ROC curve.

Ethical Approval: Patients who applied to the urology outpatient clinic between March 2020 and August 2020 were included after obtaining approval from the Cumhuriyet University Scientific Research Ethics Committee date:17.07.2019, number: 2019-07/09).

Table 1: Descriptivestatistics

	Mean ± SD (min-max)
Age	62.6 ± 7.5 (46-82)
PSA (ng/ml)	1.99 ± 1.1 (0.19-4.37)
PV (cc)	57.4 ± 27.3 (20-200)
Q_{max}(ml/sn)	15.6 ± 6.9 (5.9-38.7)
Q_{mean}(ml/sn)	6.1 ± 3.6 (1.5-21)
MVV (ml)	237.2 ± 117.3 (83-477)
PVR (ml)	105 ± 90.3 (0-461)
IPSS	14.5 ± 5.7 (3-29)
VPSS	9.5 ± 2.3 (2-17)
IPSS (voiding) (1+3+5+6)	8.9 ± 3.9 (1-19)
VPSS (voiding) (3)	2.6 ± 1.1 (1-5)
IPSS (storage) (2+4+7)	5.5 ± 2.7 (1-14)
VPSS (storage) (1+2)	6.0 ± 2.1 (3-11)
IPP (mm)	12.7 ± 4.9 (0- 33)

SD:standard deviation, **Min:** minimum, **Max:** maximum, **IPSS:** International Prostate Symptom Score, **VPSS:** Visual Prostate Symptom Score, **PV:** Prostate Volume, **Q_{max}:** Maximum flow rate, **Q_{mean}:** Mean flow rate, **MVV:** Maximal voiding volume, **PVR:** Post voiding residual urine, **IPSS (voiding):** Total score of questions 1, 3, 5 and 6 (voiding symptom), **IPSS (storage):** Total score of questions 2, 4, and 7 (storage phase), **VPSS (voiding):** 3rd pictogram score (voiding symptom), **VPSS (storage):** Total score of pictograms 1 and 2 (storage phase), **IPP:** Intravesical prostatic protrusion

Statistical analysis: Data from the study were evaluated using SPSS 23.0 software.Conformity to normality was tested by the Shapiro-Wilk test. Non-parametric test was used because the data were not normally distributed. Mann Whitney U test was used to compare two independent groups.Correlation analysis was performed in order to understand the co-movement between the variables. Spearman correlation analysis was used due to the absence of parametric variables. In the study, ROC analysis was performed with focal variables in order to predict the obstruction. The Kruskal-Wallis test was performed to calculate the differences of IPP groups (<5mm, 5-10mm, and >10mm) according to other parameters.Post-Hoc (Bonferroni) test was used to determine the differences between the three groups. The error level was set as 0.05.

Results

This study included 219 male patients aged 50 years and over with LUTS applied to the outpatient clinic. Of these patients, 67 were excluded from the study for having undergone urological surgery, 36 for having high PSA or prostate malignancy, 16 for having systemic diseases that could cause LUTS and 5 for not wanting to participate. The mean age of the remaining 95 patients was 62.6±7.5 (46-82), mean PSA value was 1.99±1.1 (0.19-4.00), mean IPSS value was 14.5±5.7 (3 -29), was the mean VPSS value. Value 9.5±2.3 (2-17), mean flow rate (Qmean) 6.1±3.6 (1.5-21), mean Qmaxof 15.6±6.9 ml/s (5.9 - 38.7), mean prostate volume 57.4±27.3 (20-200) cc, mean PVR 105±90.3 ml (0-461) and mean IPP 12.7±4.9 (0-33) mm. (Table 1) The BOON value of 34 patients was above -20 (obstructed) and the BOON value of 61 patients was below -20 (not obstructed). Patients were divided into two groups with and without obstruction and significant differences were observed in terms of PSA, prostate volume, IPP, Qmax, PVR, IPSS and VPSS (p=0.004, <0.001, 0.009, <0.001, 0.009, <0.001, <0.001, respectively) .(Table 1) It was observed that IPSS and VPSS were correlated (r=0.786). There were also positive correlations of IPSS with prostate volume (r=0.298), PVR (r=0.334) and VPSS (r=0.319). There was a correlation between obstructive (r=0.779) and irritative symptoms (r=0.813,

Table 2: IPSS, VPSS, Q_{max}, Q_{mean}correlation test

	Spearmancorrelation (95%CI)	**p**
IPSS & VPSS	0.786	0.001
IPSS & PV	0.298	0.002
VPSS & PV	0.319	0.001
IPSS &Q_{max}	-0.283	0.003
VPSS &Q_{max}	-0.235	0.005
IPSS &Q_{mean}	-0.386	0.000
VPSS &Q_{mean}	-0.299	0.001
IPSS & PVR	0.334	0.000
VPSS & PVR	0.335	0.000
IPSS (voiding) & VPSS (voiding)	0.779	0.000
IPSS (storage) & VPSS (storage)	0.813	0.000
IPSS (voiding) &Q_{max}	-0.266	0.005
VPSS (voiding) &Q_{max}	-0.430	0.000
IPSS (voiding) &Q_{mean}	-0.376	0.000
VPSS (voiding) &Q_{mean}	-0.452	0.000

IPSS: International Prostate Symptom Score, **VPSS:**Visual ProstateSymptom Score, **PV:**Prostate Volume, **Q_{max}:**Maximum flow rate, **Q_{mean}:**Mean flow rate, **PVR:** Post voiding residual urine, **IPSS (voiding):**Total score of questions 1, 3, 5 and 6 (voiding symptom), **IPSS (storage):**Total score of questions 2, 4, and 7 (storage phase), **VPSS (voiding):**3rd pictogram score (voiding symptom), **VPSS (storage):**Total score of pictograms 1 and 2 (storage phase), **IPP:**Intravesical prostatic protrusion

Table 3: Correlation of IPP andotherparameters

		BOON	**VPSS**	**IPSS**	**PV**	**Q_{max}**	**PSA**	**PVR**
IPP	Correlation (r)	0.351	0.122	0.109	0.287	-0.242	0.268	0.201
	p	0.001	0.244	0.297	0.005	0.019	0.009	0.054

IPP: Intravesical prostatic protrusion, **BOON:**Bladder Outlet Obstruction Number, **IPSS:**International ProstateSymptom Score, **VPSS:**Visual Prostate Symptom Score, **PV:**Prostate Volume, **Q_{max}:**Maximum flow rate, **PVR:**Post voiding residual urine

p=0.000) of IPSS and VPSS.(Table 2)The power of IPSS and VPSS in predicting patients considered obstructed due to BPE (BOON>-20) was found to be significant (p=0.001). The area under the curve (AUC) was higher in IPSS than in VPSS (0.811 and 0.798). A significant positive correlation was found between IPP value and BOON, prostate volume and PSA (r=0.351, 0.287, 0.268, p=0.001, 0.005, 0.009, respectively).(Table 3). In the correlation curves of IPP and BOON values (Figure 1), it was seen that the cut-off value for IPP was 12 mm (65% sensitivity, 80% specificity). In the Post-Hoc (Bonferroni) analysis of the three groups according to IPP values, considering BOON as the dependent variable, there was no significant difference between the groups 1 and 2. However, group 3had a significant difference with groups 1 and 2 (p=0.002, 0.018, respectively). It was observed that the predictive power of prostate volume and IPP values in obstructed patients (BOON>-20) was significant (p=0.000). The (AUC) was greater in prostate volume than in IPP (0.805 and 0.760).

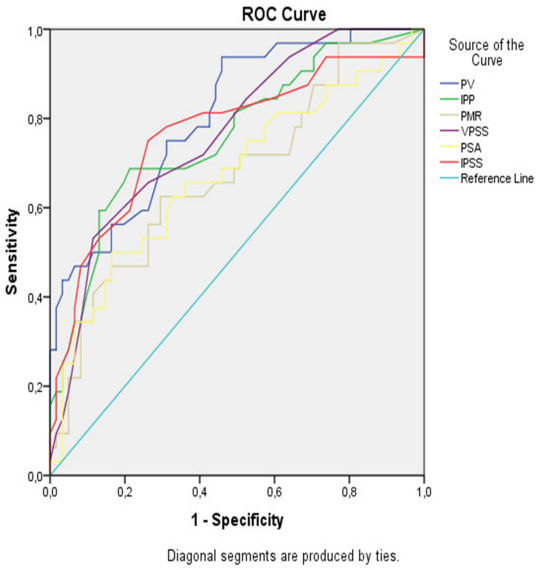

Figure 1. Correlation curves to the BOON value

Discussion

IPSS is currently a widely used scale for the grading, treatment and follow-up of LUTS patients worldwide. However, IPSS also has some disadvantages. First, it requires literacy and has more questions than VPSS and patients are expected to fill in the form in busy outpatient clinic conditions. Here, it was found that both voiding and storage symptom scores of IPSS and VPSS were correlated with each other and the results were similar and consistent with the results of previous studies on the subject (Table 4) (15-18). This correlation was more pronounced in storage symptoms. This may stem from the fact that the pictograms in VPSS are visually larger and more understandable. VPSS was found to be nearly equivalent to IPSS and considered a possible alternative. It was observed that the time to fill the VPSS pictogram in outpatient clinic conditions was shorter and patients needed less assistance from healthcare workers. VPSS can be used safely and practically instead of IPSS in outpatient clinics in elderly or illiterate patients. Another low-cost and non-invasive method used to evaluate LUTS is IPP. In this study, prostate volume and IPP values were found to have a significant predictive power for obstructed patients (BOON>-20). The reason for the higher AUC in prostate volume was evaluated as the presence of prostate volume in the BOON formulation and its direct effect on the result. However, it should be accepted that IPP is also an important parameter in predicting obstruction with its undeniably higher AUC and significant p-value. IPP was negatively correlated with Q_{max} and positively correlated with the other parameters and this correlation rate was higher at the BOON value. It has been observed that IPP provides information about the severity of obstruction.Likewise, IPP is associated with prostate volume, Q_{max}, PVR, IPSS and VPSS (Table 5). Malde S. et al. carried out a review on 42 studies using different diagnostic techniques for the detection of BOO and reported that uroflowmetry with a Q_{max}<10 ml/sec had a sensitivity of 68% and a specificity of 70% in the diagnosis of BOO. It has been reported that IPP>10 mm has similar diagnostic accuracy with a sensitivity of 68% and a specificity of 75%(19-21). Similar results were obtained in the current study with the 12 mm cut-off value of IPP (65% sensitivity, 80% specificity). Reis et al. reported an IPP threshold of was 5 mm with a sensitivity of 95% and a specificity of 50%. The cut-off value for IPP was 12 mm with a sensitivity of 65% and a specificity of 80%. The area under the ROC curve was similar (0.758-0.760).

Table 4: Comparison of the correlation of IPSS and VPSS values with different studies

Variables	This Study	I.B.O.W. Putra et al.[15]	Afriansyah et al.[16]	Park et al.[17]	Taneja et al.[18]
IPSS &VPSS	0.786 (0.001)	0.57 (<0.001)	0.67 (<0.001)	0.63 (<0.001)	0.72 (<0.001)
IPSS(voiding) & VPSS(voiding)	0.779 (0.000)	0.51 (<0.001)	0.50 (<0.001)	0.50 (<0.001)	No Data
IPSS(storage) & VPSS (storage)	0.813 (0.000)	0.57 (<0.001)	0.73 (<0.001)	0.69 (<0.001)	No Data

Results are expressed: r (p-value); r: Spearman's correlation coefficient

Table 5: Studies investigating the relationship between IPP and BOO

Studies	n	Study Design	Mean Prostate Volume (ml)	Measurement Parameter	IPP Classification	IPP's prediction of obstruction (AUC) and (Confidence Interval)	Main Results
ThisStudy	95	Prospective	57.4	BOON	<5 mm 5-10 mm >10 mm	0.760 (0.65-0.86)	BOON correlationwith IPP: r = 0.351, p = 0.001 IPP cut-off at 12 mm: 65% sensitivity 80% specificity, LHR: 3.85
Shin et al. (2013)[21]	239	Retrospective	No Data	BOOI	No Data	0.759 (0.65-0.86)	BOOI correlationwith IPP: r = 0.551, p < 0.0001
Aganovic et al. (2012)[11]	110	Prospective	47.3	BOON	<5 mm 5-10 mm >10 mm	0,708 (0.61-0.79)	BOON correlationwith IPP: r = 0.481, p < 0.0001
Huang et al. (2012)[22]	365	Retrospective	43.0	BOOI	<10 mm 10-20 mm >20 mm	No Data	BOOI correlationwith IPP: r = 0.469, p = 0.042
Lee et al. (2010)[23]	72	Retrospective	70.5	BOOI	< 5mm 5-10 mm >10 mm	No Data	BOOI correlationwith IPP: r = 0.608, p < 0.0001
Reis et al. (2007)[24]	42	Prospective	45	BOOI	< 5mm 5-10 mm >10 mm	0.758 (0.60-0.87)	IPP cut-off at 5 mm: 95% sensitivity 50% specificity
Franco et al. (2010)[25]	100	Prospective	40	BOOI	< 5mm 5-10 mm >10 mm	0.835 (0.75-0.91)	BOOI correlationwith IPP: R = 0.491, p = 0.001 IPP cut-off at 12 mm: 65% sensitivity 77% specificity

The authorsused a lower IPP cut-off value compared to this study, although with lower specificity. In conclusion, further studies with larger samples are needed to determine the correct IPP threshold value. Shin et al. conducted a retrospective research using BOOI to determine BOO and found an area under the ROC curve of 0.759 and a correlation between IPP and BOOI (r=0.551)(21).In this study, BOON was found to have a similar area under the ROC curve (0.760), but the correlation of IPP and BOON was lower (r=0.351). This may have been due to the lower cut-off value of IPP. Aganovic et al. found BOON to have an area under the ROC curve of 0.708 and the correlation between IPP and BOON was r=0.481 (11). Here, the power of BOON in BOO detection was found to be higher (0.760). This may be due to different USG experiences. The correlation between IPP and BOON was found to be lower in studies compared to the correlation between IPP and BOOI, which may be associated with the weakness of the BOON parameter (11,21,23). Studies have been made with various BOON cut-off values. In the study of Zhang et al., when the BOON cut-off value decreased, the sensitivity increased and the specificity decreased. When BOON -20 was taken, the sensitivity was 42.4% and the specificity was 88.2%, the sensitivity was 66.1% and the specificity was 82.4% when BOON -30 was taken (26). Most articles accept -20 as cut-off value for BOON. The limitations of the present study were the use of BOON instead of BOOI, as the latter is the gold standard for BOO and the exclusion of elderly patients with hearing loss due to difficulties in cooperation while filling the IPSS and VPSS.This may also be related to the correlation between IPP and BOON is lower than BOOI users.

Study limitations: The limitation of our study is the use of the BOON parameter to determine the presence or absence of obstruction. Although this system, in which pressure-flow study is not used, constitutes the limitation of the study, it has been accepted in the literature due to its non-invasiveness.

Conclusion

In conclusion, VPSS was found to be equivalent to IPSS in LUTS . Given that elderly and illiterate patients have particular difficulty in filling the IPSS form, leading to loss of time in the polyclinic, VPSS could be used as an alternative to IPSS. IPP is a significant, practical and non-invasive method that correlates with IPSS, VPSS and BOON in demonstrating obstruction. Urodynamic tests remain the gold standard for the diagnosis of LUTS, although non-invasive scoring systems should be used in daily practice in outpatient clinics. Non-invasive tests can be used safely in the detection of BOO. However, further studies are needed due to the data limitations and inconsistency experienced in studies on this subject.

Ethical approval: Ethics committee approval of our study was received from Cumhuriyet University Scientific Research Ethics Committee, dated 7/2019 and numbered 2019-07/09. Ethical consent signatures were obtained from the patients participating in the study.
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References

1. Egan KB. The Epidemiology of Benign Prostatic Hyperplasia Associated with Lower Urinary Tract Symptoms: Prevalence and Incident Rates. UrolClin North Am 2016;43:289-97.
2. Vuichoud C, Loughlin KR. Benign prostatic hyperplasia: epidemiology, economics and evaluation. *Can J Urol* 2015;22 Suppl 1:1-6.
3. Swavely NR, Speich JE, Stothers L, Klausner AP. New Diagnostics for Male Lower Urinary Tract Symptoms. Curr Bladder Dysfunct Rep 2019;14:90-97.
4. Oelke M. International Consultation on Incontinence-Research Society (ICI-RS) report on non-invasive urodynamics: the need of standardization of ultrasound bladder and detrusor wall thickness measurements to quantify bladder wall hypertrophy. *Neurourol Urodyn* 2010;29(4):634-639.
5. McVary KT, Roehrborn CG, AvinsAL, Michael JB, Reginald CB, Robert FD, et al. Update on AUA guideline on the management of benign prostatic hyperplasia. J Urol 2011;18:1793-1803.
6. Johnson TV, Abbasi A, Ehrlich SS,Kleris RS, Schoenberg ED, Owen-Smith Ashli, et al. Patient misunderstanding of the individual questions of the American urological association symptom score. J Urol 2008;179:2291-2294.
7. Van der Walt CL, Heyns CF, GroeneveldAE,EdlinRS, van VuurenSPJ Prospective comparison of a new visual prostate symptom score versus the international prostate symptom score in men with lower urinary tract symptoms. Urology 2011 ;78:17-20.
8. Tan YG, Teo JS, Kuo TLC, et al. A Systemic Review and Meta-analysis of Transabdominal Intravesical Prostatic Protrusion Assessment in Determining Bladder Outlet Obstruction and Unsuccessful Trial Without Catheter. *Eur Urol Focus* 2022;8(4):1003-1014.
9. Keqin Z, Zhishun X, Jing Z, Haixin W, Dongqing Z, Benkang S: Clinical significance of intravesical prostatic protrusion in patients with benign prostatic enlargement. Urology 2007 ;70:1096-9.
10. Van Venrooij GE, Eckhardt MD, Boon TA. Noninvasive assessment of prostatic obstruction in elderly men with lower urinary tract symptoms associated with benign prostatic hyperplasia. Urology 2004 ;63:476-80.
11. Aganovic D, Prcic A, Hadziosmanovic O, Hasanbegovic M. Does the combination of intravesical prostatic protrusion and bladder outlet obstruction number increase test accuracy according to benign prostatic obstruction at the individual level? Acta Inform Med 2012; 20: 160-166
12. Abrams P, Cardoza L, Wagg A, Wein A. Incontınence 6th Edition 2017 Volume 6.'Inıtıal Assessment Of Urınary Incontınence In Adult Male And Female Patıents'
13. Descazeaud A, Coloby P, Davin JL, De La Taille A, Karsenty G, Kouri G et al. Validation of visual prostate symptom score, VPSS, in the evaluation of lower urinary tract symptoms associated with benign prostatic hyperplasia (550 patients). Prog Urol 2017 ;27:176-183.
14. Topazio, L., Perugia, C., De Nunzio, C. *et al.* Intravescical prostatic protrusion is a predictor

of alpha blockers response: results from an observational study. *BMC Urol* 18, 6 (2018).
15. Putra IBOW, Hamid ARAH, Rasyid N, Mochtar CA, Umbas R. Comparison of Visual Prostate Symptom Score with the International Prostate Symptom Score and uroflowmetry parameters in assessing men with lower urinary tract symptoms in Dr. CiptoMangunkusumo National General Hospital, Indonesia. Prostate Int 2019 ;7:91-95.
16. Afriansyah A, Gani YI, Nusali H. Comparison between visual prostate symptom score and international prostate symptom score in males older than 40 years in rural Indonesia. Prostate Int 2014 ;2:176-81.
17. Park YW, Lee JH. Correlation between the visual prostate symptom score and international prostate symptom score in patients with lower urinary tract symptoms. IntNeurourol J 2014 ;18:37-41.
18. Taneja Y, Ram P, Kumar S, Raj K, Singh CK, Dhaked SK et al. Comparison of Visual Prostate Symptom Score and International Prostate Symptom Score in the evaluation of men with benign prostatic hyperplasia: A prospective study from an Indian population. Prostate Int 2017 ;5:158-161.
19. Malde S, Nambiar AK, Umbach R, et al. Systematic Review of the Performance of Noninvasive Tests in Diagnosing Bladder Outlet Obstruction in Men with Lower Urinary Tract Symptoms. *Eur Urol* 2017;71(3):391-402.
20. Swavely NR, Speich JE, Stothers L, Klausner AP. New Diagnostics for Male Lower Urinary Tract Symptoms. Curr Bladder Dysfunct Rep 2019;14:90-97.
21. Shin SH, Kim JW, Kim JW, Oh MM, Moon du G. Defining the degree of intravesical prostatic protrusion in association with bladder outlet obstruction. Korean J Urol 2013;54:369-372.
22. Huang T, Qi J, Yu Y, Xu D, Jiao Y, Kang J, et al. Transitional zone index and intravesical prostatic protrusion in benign prostatic hyperplasia patients: correlations according to treatment received and other clinical data. Korean J Urol 2012;53(4):253-257.
23. Lee SW, Cho JM, Kang JY, Yoo TK. Clinical and urodynamic significance of morphological differences in intravesical prostatic protrusion. Korean J Urol 2010;51:694-699.
24. Reis LO, Barreiro GC, Baracat J, Prudente A, D'Ancona CA. Intravesical protrusion of the prostate as a predictive method of bladder outlet obstruction. IntBraz J Urol 2008;34:627-33
25. Franco G, De Nunzio C, Leonardo C, Tubaro A, Ciccariello M, De Dominicis C, et al. Ultrasound assessment of intravesical prostatic protrusion and detrusor wall thickness--new standards for noninvasive bladder outlet obstruction diagnosis? J Urol 2010;183:2270-4.
26. Zhang P, Wu ZJ, Yang Y, Zhang XD. Applying bladder outlet obstruction number to predict bladder outlet obstruction of benign prostatic hyperplasia. Chinese Journal Of Surgery2008;46:1156-9.