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CLINICAL RESEARCH / KLİNİK ARAŞTIRMA

Is Bladder Outlet Obstruction Diagnosis with Uroflow Parameters Without Urodynamics?

Üroflow Parametreleri ile Mesane Çıkış Obstrüksiyonu Tanısı, Ürodinami Olmadan mı?

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Abstract

Objective: We have tried to define bladder outlet obstruction without urodynamics, by examining the uroflowmetry parameter (time to start voiding after the command, time between start voiding and maximum flow, maximum urinary flow, mean urinary flow, voiding time, voiding volume, postvoid residual urine volume).

Methods: In our study, group 1 patients who were diagnosed with bladder outlet obstruction and received surgical or medical treatment, and group 2 patients with an underactive bladder, which was the cause of surgical treatment failure, were compared in terms of uroflow parameters.

Results: Ninety-nine patients in group 1, 105 patients in groups 2. Mean and maximum flow value are similer between the two groups (p=0.091 p=0.387 repectively) however, total voiding time, time to reach the maximum urinary flow rate and voided volume showed statistically significant difference between the two groups (p<0.001). Bladder outlate ostrction patients can be diagnosed with at least 95% sensitivity and 88% specificity.

Conclusion: Bladder outlet obstruction can be diagnosed without urodynamics by uroflowmetry parameters.

Keywords: Uroflowmetry parameters, urodynamics, bladder outlet obstruction

Öz

Amaç: Üroflowmetri parametrelerini (işeme komut sonrası işemeye başlama zamanı, işemeye başlama ile maksimum akım arasındaki süre, maksimum idrar akımı, ortalama idrar akımı, işeme zamanı, işeme hacmi, işeme sonrası kalan idrar hacmi) inceleyerek ürodinami olmaksızın mesane çıkım obstrüksiyonunu tanımlamaya çalıştık.

Yöntem: Çalışmamızda mesane çıkım obstrüksiyonu tanısı ile cerrahi veya medikal tedavi uygulanan grup 1 hastalar ile cerrahi tedavi başarısızlığına neden olan mesanesi az çalışan grup 2 hastalar üroflow parametreleri açısından karşılaştırıldı.

Bulgular: Grup 1'de 99 hasta, grup 2'de 105 hasta iki grup arasında ortalama ve maksimum akım değerleri birbirine benzer (sırasıyla p=0,091 p=0,387), ancak toplam işeme süresi, maksimum idrar akım hızına ulaşma süresi ve işeme hacmi, iki grup arasında istatistiksel olarak anlamlı farklılık gösterdi (p<0,001). Bu parametreler ile mesane çıkım tıkanıklığı tanılı hastalara en az %95 duyarlılık ve %88 özgüllük ile teşhis konulabilir.

Sonuç: Mesane çıkım obstrüksiyonu ürodinami olmadan üroflovmetri parametreleri ile teşhis edilebilir.

Anahtar Kelimeler: Üroflow parametreleri, ürodinami, mesane çıkım tıkanıklığı

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Introduction

Bladder outlet obstruction, in other words benign prostatic hypertrophy, is a common disease affecting men over 40 years age, on the other hand underactive bladder means prolonged voiding at low pressure, without any obstruction from urodynamic view. This has been named by several terms and a symptom complex including prolonged voiding time with or without a feeling of complete bladder emptying, difficulty in initiating voiding, diminished sense of bladder filling and a slow voiding[1]. Bladder outlet obstriction and underactive bladder are similer clinic semptoms, which also leads to lower urinary tract (LUT) symptoms. This similarity causes the failure of surgical treatment, which makes necessary an invasive procedure urodynamics[2].

Underactive bladder is generally seen in patients over age 75 but bladder outlet obstruction is seen in younger relatively[3], a study reported higher frequencies for underactive bladder in men (40.2%) than in women (12%) over age 80[4].

There are studies reporting symptom recovery after prostate surgery in these patients. Some others claimed that only slight clinical recovery would be seen[5].

In this study, we tried to prove that the surgical decision in bladder outlet obstruction can be made with uroflow parameters without the need for an invasive method, urodynamics.

Materials and Methods

The data of a total of 350 patients who complaints of LUTs between 2015 and 2017 were examineted retrospectively. Female gender, transurethral intervention history disease that may affect the dynamics of the urinary system (multiple sclerosis medulla spinalis disease, diabetes mellitus, paraplegic patient, etc.), having missing data (n=146) were excluded from the study. A total of 204 patients with complete data and failed to comply with the exclusion criteria were included in the study.

Measurement of uroflowmetry and postvoid residual urine: All patients were performed uroflowmetric measurements prior to urodynamic evaluation. Uroflowmetry data including time to start voiding after the command, time between start voiding and maximum flow, maximum urinary flow, mean urinary flow, voiding time, voiding volume, postvoid residual urine volume were noted. For each patient, postvoid residual urine volume was determined by ultrasonography by multiplying distances at sagittal, transverse and vertical axis of the bladder by 3.14/6 and noted for all patients[6].

Urodynamic evaluation: With all patients planned for urodynamics, drugs that can affect LUT symptoms were interrupted 3 days in advance, in accordance with the International Continence Society guidelines[7]. In pressure flow studies, two-way 6 Fr urodynamics catheter and 12 Fr rectal balloon catheter were used. Pressure flow studies started with an empty bladder while the patient was in the sitting position.

Bladder contractility index (BCI) was determined during pressure-flow studies, by adding 5 times the maximum urinary flow (Qmax) value following the voiding command, to the detrusor pressure at the moment of maximum flow volume following the voiding command, (5 Qmax + PdetQmax). The values ≤100 were defined as underactive bladder[8].

Bladder outlet obstruction index however, also known as the Abrams-Griffiths (AG) number, was also determined during pressure-flow studies, by substracting twice the maximum flow value following the voiding command, from the value of detrusor pressure during the moment of maximum flow (PdetQmax - 2 Qmax) Bladder Outlate Obstruction Index (BOOI) was considered positive for the values ≥40[7,8].

Statistical Analysis

Statistical Package for the Social Sciences (SPSS) 15.0 (SPSS Inc, Chicago, IL, USA) statistical package was used in the statistical analysis of the data. Kolmogorov-Smirnov goodness-of-fit test was used to assess compliance with the normal distribution of data. Descriptive statistics of the data were calculated. Significance of differences between the groups was determined by Mann-Whitney U test. Statistically significance was accepted as $p<0.05$. Cut-off values of the statistically significant parameters were evaluated by the receiver operating characteristic (ROC) curve.

Results

Two hundred four patients were included in our study after exclusion criteria bladder obstriction group is 99 underactive bladder group is 105 patients. Mean age was 67.81 (±11.86) years for the bladder obstriction group and 79.94 (±11.78) years for the underactive bladder group. Underactive bladder group is older than other group ($p<0.001$) (Table 1).

In the analysis of the two groups with regard to uroflow parameters; mean time to start voiding after the command was 10.19 (±1.09) seconds in the underactive bladder group and 9.98 (±1.72) seconds in the bladder obstriction group and there was no statisticaly significant difference between the groups (p=0.731). Qmax was 8.46 (±0.59) mL/sec in the underactive bladder group and 8.94 (±0.68) mL/sec bladder obstriction group, with an insignificant difference between the groups (p=0.387). Mean flow rate 5.69 (±0.48) and 5.03 (±0.45) mL/sec, respectively for bladder obstriction and underactive bladder group, again with an insignificant difference (p=0.91). Mean total voiding time from the beginning to the end of the flow was 89.68 (±3.75) seconds and 39.06 (±2.73) seconds, respectively for underactive bladder and bladder obstriction group, with a statistically significant difference (p<0.001).

Measurement of postvoid residual urine volume showed that, mean volume was 281.0 (±35.52) mL in the bladder obstriction group, and 295.13 (±35.77) mL in the underactive bladder group, with an insignificant difference between the groups (p=0.508). Mean voided volume was 257.46 (±25.67) mL. In the bladder obstriction group and 576.90 (±48.82) in the underactive bladder group, with a statistically significant difference between the groups (p<0.001).

In short, underactive bladder group performed voiding at long time and high volume than bladder obstriction group (Table 1).

In the pressure-flow study; Maximum bladder capacity was at average 664.7 (±147.45) mL in uderactive bladder group and 335.1 (±123.48) mL in bladder obstriction group. Qmax values measured during pressure-flow studies was at average 5.3 (±3.86) in uderactive bladder group and 6.3 (±3.68) mL/sec in bladder obstriction group. Average vesical pressure values recorded at maximum measured flow were 36.3 (±18.32) cm H_2O in uderactive bladder group and 105.3 (±38.02) cm H_2O in bladder obstriction group. Vesical pressure values were higher in bladder obstriction Group, as expected.

Average BCI was 43.8 (±26.41) in uderactive bladder group and 141.1 (±35.63) in bladder obstriction group. Average A-G number was 18.0 (±4.82) in uderactive bladder group and 96.1 (±25.69) in bladder obstriction group (Table 2).

Discussion

It is well known that the bladder's ability to contract is with increasing age in both sexes, like all body function. It results in UB and BO and also causes LUT symptoms. Structural

Table 1. Demographic, uroflowmetric data of the patients

Parameters	Underactive bladder group	Bladder obstriction group	p value
Number of patients	105	99	
Mean age (year)	79.94 (±11.78)	67.81 (±11.78)	<0.001
Uroflowmeter parameters			
Time to start voiding after the command (sec)	10.19 (±1.09)	9.98 (±1.72)	0.731
Time between start voiding and maximum flow(sec)	14.52 (±0.85)	8.85 (±0.58)	<0.001
Maximum urinary flow (mL/sec)	8.46 (±0.59)	8.94 (±0.68)	0.387
Mean urinary flow (mL/sec)	5.03 (±0.45)	5.69 (±0.48)	0.091
Total voiding time (sec)	89.68 (±3.75)	39.06 (±2.73)	<0.001
Voided volume (mL)	576.9 (±48.82)	257.46 (±25.67)	<0.001
Postvoid residual urine volume (mL)	295.13 (±35.77)	281.0 (±35.52)	0.508

Table 2. Urodynamic data of the patients

Pressure-volume studies	Uderactive bladder group	Bladder obstruction group
Maximum bladder capacity	664.7 (±147.45) mL	335.1 (±123.48) mL
Qmax (mL/sec)	5.3 (±3.86) mL/sec	6.3 (±3.68) mL/sec
PdetQmax (cm H_2O)	36.3 (±18.32) cm H_2O	105.3 (±38.02) cm H_2O
Bladder contractility index (PdetQmax + 5 Qmax)	43.8 (±26.41)	141.1 (±35.63)
A-G number (PdetQmax - 2 Qmax)	18.0 (±4.82)	96.1 (±25.69)

Qmax: Maximum urinary flow

changes are related with intense band decreases, decreased density of axonal connections, decreased collagen/muscle ratio, changes in muscarinic receptors, as determined by ultrastructural studies by electron microscopy[9,10]. Bladder obstriction secondary to benign prostatic hyperplasia is well known to increase with age. Surgery for bladder obstriction, diagnosed with urodynamic testing, was shown to increase success rate in "e.g. transurethral resection of the prostate (TURP)".

Many studies reported up to date have emphasized the need for urodynamic diagnosis of bladder obstriction and 3 different states were set as obstructive, intermediate and non-obstructive[11]. These studies are mostly based on post-operative observations of the patients who underwent an operation for bladder obstriction and having previously had TURP. Besides, Pdet/Qmax values decreased postopeartively in the obstructive group, decreased insignificantly in the equivocal group and remained unchanged in the non-obstructive group[12-14].

Uderactive bladder and bladder obstriction patients present with the same clinical symptoms and uroflowmetric findings although they are totally opposite clinical entities requiring completely different treatment. Surgery is usually the treatment of choice for bladder obstriction, while rather unusual for uderactive bladder, where medical treatment (cholinergic agonists, cholinesterase inhibitors, etc.), clean intermittent catheterization and conservative approach are more prominent.

Urodynamic testing, which is the gold standard method, is an invasive diagnostic method used for differential diagnosis in these two clinical entities. In this context, with a view to differentiate between these two types of clinial cases, we attempted to use non-invasive uroflow parameters for differential diagnosis. Subsequent studies of Abraham indicated a combination nomogram of 6 groups according to the BCI and the BOOI and noted that to this nomogram would be more appropriate to decide both surgical and medical treatment modalities and to interpret the progression of the disease.

Relationship between clinical pictures of uderactive bladder and bladder obstriction with age and gender, and reported higher increase in prevalance of uderactive bladder with aging when compared to bladder obstriction in the male group, and as for the female group this relation was opposite, prevalance of bladder obstriction was increasing more with age, with respect to uderactive bladder[15]. Mean age of our study group which consisted only male patients was higher in the uderactive bladder group compared to the other group. We interpret this fact as bladder obstriction might cause some kind of compensation as a result of increased effort against increased resistance in the bladder and prevent uderactive bladder development at advanced ages. We think uderactive bladder has closer correlation with aging but bladder obstriction pathogenesis is multifactorial.

Uderactive bladder group displayed higher values for voided volume, total voiding time and time between start voidingand maximum flow than bladder obstriction group. For the patients of uderactive bladder and bladder obstriction groups respectively, for voided volume in uroflow 576.9 (±48.82) mL and, 257.46 (±25.67) mL ($p<0.001$) and for total voiding time 89.68 (±3.75) sec and 39.06 (±2.73) sec ($p<0.001$) for time between start voiding and maximum flow 14.52 (±0.85) sec and, 8.85 (±0.58) sec ($p<0.001$).

Bladder obstriktion group voided less volumes in shorter time period and earlier than other group. Even if it is not exactly the same with our study, in the study et al. [16], relationship of uroflowmetry parameters with age, urethral resistance and bladder contractility were evaluated and a closer and directly proportional relationship was determined between urethral resistance and uroflowmetry parameters. A nomogram with the uroflowmetry parameters was established in the study Bosch et al. [16] and suggested to be used for analysing potential retention risks of these patients in the future, but long-term results were not covered in this study. Unlike our study, post-voidal residual urine volume was measured by catheterization, in the study of Bosch et al. [16]. They checked if the bladder was completely emptied or not by instilling with an opaque material; hence much more realistic values were obtained, but the measurements were performed just after the pressure-flow studies. In our study, uroflowmetry parameters was used for differential diagnosis of two opposite entities: Uderactive bladder and bladder obstriction. In another study by Abrahams, a columnar nomogram divided into 9 groups was established with Qmax and Pdet/Qmax values obtained by flowmetric measurements in seperate columns and this was utilized to estimate whether medical, surgical or conservative approach is needed.

It is apparent that voiding time increases with increased voided volume for uderactive bladder and bladder obstriction groups, having equal average flow rates in the uroflowmetric measurements. Voided volume was found considerably higher in the uderactive bladder group. We realized that our patients in the uderactive bladder group had larger bladder capacity, which is the main factor affecting voided volume and voiding time. In another approach, we can mention that patients with uderactive bladder pathology have smaller bladder capacity and thus void in lesser volumes and for shorter time.

A statistically significant difference was detected between the two groups for time between start voiding and maximum flow (sec), total voided time and total voided volume. In the analysis of determining the cut-off by ROC curve, the area under the curve of maximum diagnostic value was for total voiding volume, which was 0.97 (±0.014). The area under the curve for total voiding time was 0.941 (±0.025) and for time between start voiding and maximum flow (sec), it was 0.871 (±0.032).

As the best cut-off points, seperate ROC curve analysis for 3 parameters displayed 56 s total voiding time with 93% sensitivity and 88% specificity; 376 mL total voided volume with 95% sensitivity and 86% specificity; and 10.5 sec time between start voiding and maximum flow (sec) with 93% sensitivity and 80% specificity (Figure 1).

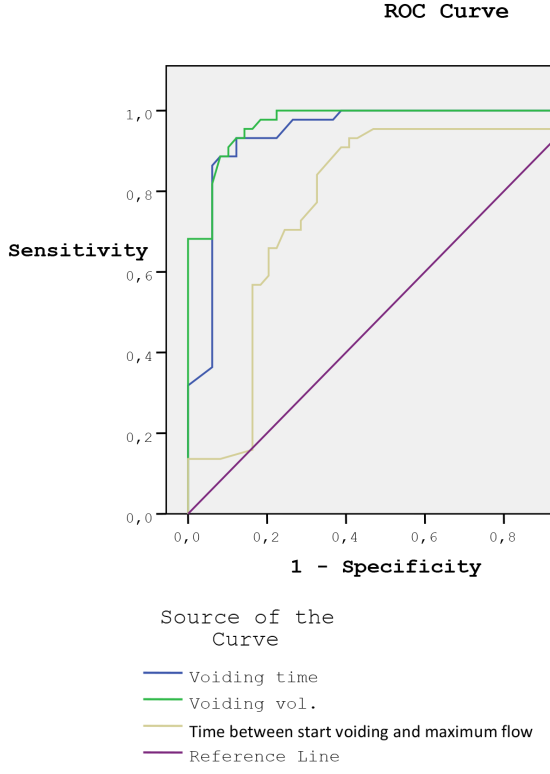

Figure 1. ROC curves for voiding time, voided volume and time between start voiding and maximum flow

Study Limitations

Limitations of our study may be mentioned as that bladder outlet obstriction index between 20 to 40 was not examined in our study and also that the cut-off was taken as 40 (AG-number).

Conclusion

In this retrospective study on 204 male patients, we intended to develop an alternative non-invasive diagnostic tool instead of invazive pressure-flow testing, which is recognized as the gold standard for differential diagnosis between two group patients that present with identical clinical pictures. In conclusion, bladder obstriction can be diagnosed with at least 94% sensitivity and 89% specificity in men, with uroflowmetry masurments however, longer-term prospective studies with larger populations are obviously needed in the follow-up of these patients, in terms of retention and upper urinary tract involvement rates.

Ethics

Ethics Committee Approval: The study were approved by the University of Health Sciences Turkey, İzmir Tepecik Education and Research Hospital of Local Ethics Committee (decision no: 26, date: 19.06.2013).

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: M.Y., M.Z.K., Concept: M.Y., Design: M.Y., Data Collection or Processing: M.Y., M.Z.K., Analysis or Interpretation: M.Y., M.Z.K., Literature Search: M.Y., Writing: M.Y.

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