

# Diagnostic Accuracy of Uroflowmetry and Postvoid Residual Urine Volume Measurements in Predicting Urodynamic Bladder Outlet Obstruction Due to Prostate Gland Enlargement in a Low Income African Country

## Abstract

**Background:** The most common cause of Bladder Outlet Obstruction (BOO) is benign prostatic enlargement (BPE) the elderly male. The lower urinary tract symptoms pertaining to the inability of the bladder to empty include straining to void, feeling of incomplete voiding and poor urine stream or flow. The past five decades has seen a lot of work done to understanding the correlation between these symptoms and obstruction using various methods of urodynamics studies such as uroflowmetry, cystometry and pressure flow studies. Today Pressure Flow Studies (PFS), a component of urodynamic studies is used to diagnose bladder outlet obstruction is acclaimed to be the gold standard in the diagnosis of BOO. In less endowed countries patients with lower urinary tract symptoms (LUTS) consult the urologist after several months and sometimes years after failed herbal treatment, traditional and other methods of self-medication with alkaline based solutions. It is therefore imperative that PFS is used to establish urodynamic BOO in these patients before considering prostatectomy as majority of them would have developed bladder decompensation. The urological surgeon would then be able to detect under active or acontractile bladders as well as overactive bladders to guide in the selection for surgery.

**Methods:** Data retrieved from medical records of 400 patients above 55 years with suspected BOO due to benign prostatic enlargement who had undergone uroflowmetry and pressure flow studies from 2010 to 2015 at Effia Nkwanta Regional Hospital, Ghana. Excluded from the data analysis were patients with diabetes mellitus, urinary tract infection, on diuretics for hypertension. Also excluded were patients who had urethral strictures or urethral surgery. All patients had their flow rates measured by uroflowmetry. Ultrasonography was used to measure the post void residual urine volume. They also filled an International Prostate Symptom Score (IPSS) questionnaire.

**Results:** Using the Bladder Outlet Obstruction Index (BOOI) as in the ICS nomogram, only 110(27.5%) of the 400 patients

## Open Access

## Research Article

Atawurah H<sup>1\*</sup> and Rahman GA<sup>2</sup>

<sup>1</sup>Department of surgery (Urology unit), School of Medical Sciences, University of Cape Coast, Cape Coast, Ghana


<sup>2</sup>Department of surgery, School of Medical Sciences, University of Cape Coast, Cape Coast, Ghana

### \*Address for Correspondence

Henry Atawurah, Department of surgery(urology unit), School of Medical Sciences, University of Cape Coast, Cape Coast, Tel: 233208172429, Ghana

**Submission:** December 21, 2020

**Published:** February 01, 2021

**Copyright:** ©  This work is licensed under Creative Commons Attribution4.0 License

were obstructed. However from uroflowmetry, 48.75% of patients with abnormal post void residual urine volume were unobstructed, 34.80% of patients with reduced flow rate as measured by uroflowmetry were also found to be unobstructed whilst 178(44.50%) were found obstructed. There were no boarder line cases with the ICS nomogram.

**Conclusion:** The use of pressure Flow Studies, to establish urodynamic Bladder Outlet Obstruction, is imperative in cases of failed conservative treatment for suspected BOO due to benign prostatic enlargement in order to rule out detrusor under activity or acontractile bladder before considering prostatectomy especially in low income countries.

**Keywords:** Bladder Outlet Obstruction. Benign Prostatic enlargement. Detrusor underactivity, Lower Urinary Tract Symptoms. Lower Urinary Tract Dysfunction. Postvoid residual urine volume. Pressure Flow Studies. Uroflowmetry.

**Abbreviations:** BOO: Bladder Outlet Obstruction; BOOI: Bladder Outlet Obstruction Index; BPE: Benign Prostatic Enlargement; FR: Flow rate; ICS: International Continence Society; IPSS: International Prostate Symptom Score; LUTS: Lower Urinary Tract Symptoms; LUTD: Lower Urinary Tract Dysfunction; PVR: Post Void Residual urine; PFS: Pressure Flow Studies; Qmax: Maximum flow rate

## Background

**Pressure Flow Studies** is one of the methods of Urodynamic Studies (UDS) for investigating Lower Urinary Tract Symptoms and establishing bladder outlet obstruction. This is retrospective analyses of data of 400 patients from Effia Nkwanta Regional Hospital in the Western Region of Ghana who are suspected to have bladder outlet obstruction suggestive of benign prostatic enlargement. For several years the

symptoms of Lower Urinary Tract Dysfunction (LUTD) such as straining to void, feeling of incomplete voiding, poor stream, frequency, urgency, hesitation and nocturia have been attributed to Bladder Outlet Obstruction (BOO) due to enlarged prostate gland, urethral strictures, or bladder neck sclerosis. Studies however have shown that the correlation between these symptoms and the presence of obstruction is weak [1-4]. V.W Nitti found 30% of men with decreased flow rate of less than 10mls/sec not obstructed and 50% of obstructed men with lower urinary tract symptoms (LUTS) had elevated Post Void Residual(PVR) urine [5]. The aim of this study is to analyze data of patients with these symptoms in our setting, (low income country, Ghana) and who have had pressure flow studies done on them, to establish or otherwise whether there is bladder outlet obstruction due to enlarged prostate. In the setting of a low income economy like Ghana, patients try a lot of herbal medication for years before seeking the help of the urologist. Between the onset of these symptoms and time of seeking treatment at the urological clinic, most of these patients would have developed bladder decompensation due to persistent straining to void. The study was aimed at establishing urodynamic BOO or at least rule out detrusor underactivity, acontractile bladder or overactive bladder before such patients are considered for transversical prostatectomy, the most widely performed surgery for BOO due to benign prostatic enlargement.

## Methods

This is a retrospective study involving 400 men above 55years of age seen at Effia Nkwanta Regional Hospital in the Western Region of Ghana between 2010 and 2015 with Lower Urinary Tract Symptoms (LUTS) suggestive of bladder outlet obstruction due to benign prostatic enlargement. Excluded from the study were patients with diabetes mellitus, urinary tract infection, hypertensive men on diuretics, who had transurethral resection of the prostate or urethral surgery, urethral stricture, cardiovascular accident and those with over active bladder. The catchments area of the hospital according to recent census have about one hundred and eighty three thousand (183,000) men between the ages of 50 and 80 years [6]. Each patient completed an IPSS questionnaire with the assistance of a nurse. The score was as follows: IPSS 0-7 mild, 8-19 moderate and 20-35 severe in the absence of urethral strictures or other causes of bladder outlet obstruction. Ultrasonography to measure volume of residual urine, uroflometry and Pressure Flow Measurements were done in one setting.

## Technique

Initially abdominopelvic ultrasound with a convex probe (BK Medical, 2101 Falcon) of frequency 3.5MHz was done. Prostate size was measured, bladder wall and lumen assessed to exclude bladder calculi. Medical Measurement System(MMS) unit with non disposable transducers (Figure 3,4) were used for uroflometry and pressure flow studies. Initially uroflometry was done when the patient had the urge to void in standing position (MMS uroflow unit). Thereafter the post void residual urine was measured by the ultrasound machine. The bladder

was then emptied by catheterization if there is residual urine. A size 7Fr double lumen transducer was inserted into bladder transurethrally for filling and vesical pressure(Pves) measurements. Intra-abdominal pressure (Pabd) was measured by insertion of another transducer transrectally. Bladder filling was done by the infusion of normal saline at a pump speed of 50mls/min whilst patient was in the supine position (Fig1). The detrusor pressure (Pdet) was obtained by subtracting Pabd from Pves( automatically from the computer). At maximum bladder capacity (the amount of saline infused at the point when patient expressed a strong feeling to void), filling phase was completed. Patient then voided whilst in standing position behind a screen (Figure 2). Voiding phase was then accomplished. Pves, Pabd, Pdet, and maximum flow rate (Qmax), Bladder Outlet Obstruction Index( BOOI) were generated from the computerized Urodynamic Unit with installed nomograms. Bladder Outlet Obstruction Index (BOOI) which mathematically is  $Pdet @ Qmax - 2Qmax$  is computed automatically to by the MMS urodynamic unit into a ICS normogram (Figure 3).

BOOI>40= Obstructed  
BOOI 20-40= Equivocal  
BOOI<20=Unobstructed

Post void residual urine volume of more than or equal to 100mls was considered abnormal indicating incomplete bladder emptying, whilst a flow rate of 10ml/sec and below considered decreased. Voided volume of less than 200mls during uroflometry (Siroky nomogram used here) was deemed invalid. Pressure Flow Studies were done with the infusion of normal saline at room temperature and a pump speed of 50mls/min. ICS nomogram for calculating Bladder Outlet Obstruction Index(BOOI) [7] for all patients.



Figure 1: Filling phase

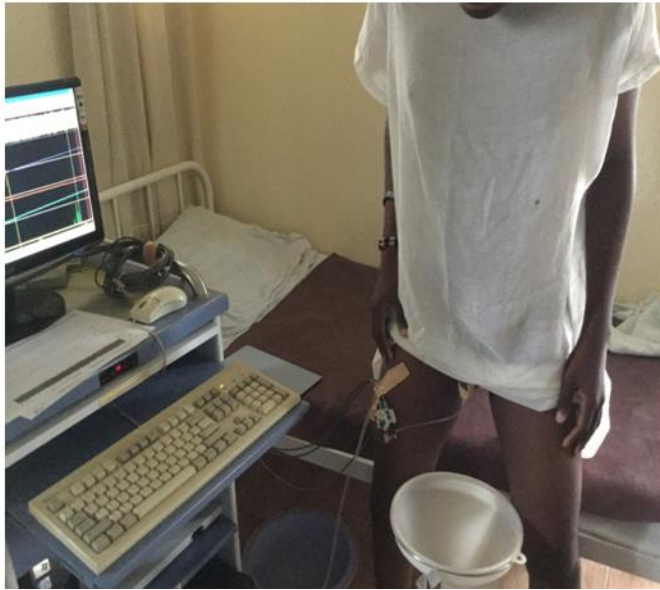


Figure 2: Voiding phase



Figure 3: Rectal transducer



Figure 4: Vesical transducer

Results

Of the 400 men with LUTS suspected to be due to benign prostatic enlargement and who had uroflometry and subsequently pressure flow studies, 365 had postvoid residual urine of more than 100mls. 273 of them had a flow rate of less than 10mls/sec as measure by uroflometry. 200 patients had IPSS being severe (score of 20-35). Using Siroky nomogram generated from uroflometry, 195 patients (53.42%) who had PVR >100mls were not obstructed, whilst 170 (46.58%) of them were obstructed. 273 patients with flow rate of less than 10mls/sec. Of these 95 patients (34.80%) were also found to be unobstructed. Only 50 patients (25%) with severe IPSS score of 20-35 were found obstructed on uroflowmetry.

	Name	Unobstructed	Obstructed
Patients with PVR>100	365	195(53.42%)	170(46.58%)
Patients with FR< 10mls/sec	273	95(34.80%)	178(44.505)
Patients with IPSS of 20-35	200	150(75.00%)	50(25.00%)

Table 1: Data from uroflometry (Siroky nomogram used)

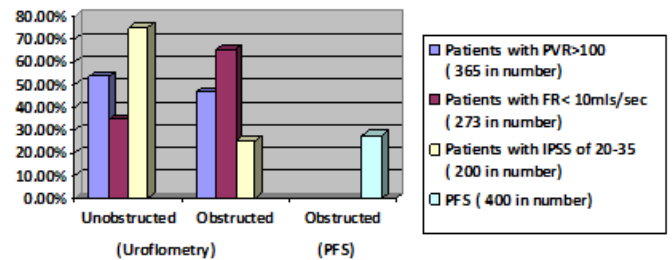


Figure 5

However the results generated from the pressure flow studies of these 400 men, only 110 (27.5%) were found obstructed in accordance to ICS nomogram after pressure flow studies. This is far lower than obtained from uroflowmetry for patients with slow flow or with abnormal volume of residual urine (Figure 5)

Discussion

The assumption that LUTS, which most often cause patients to seek treatment, is caused by obstructing enlarged prostate has been held for several years. This general entity of LUTS has multifactorial etiology [8]. Over the past 30 years with the acceptance of Urodynamic studies which was discredited by Victor Bonney [9], better understanding of the bladder and prostate function [10, 11] and the relationship to these symptoms have emerged. Recent studies have shown the presence of these symptoms and that of obstruction have very weak correlation. Pressure Flow Studies, a component of Urodynamic Studies (UDS) is the most objective method available to identify the reason for Bladder Outlet Obstruction in patients with LUTS since these symptoms by themselves are not enough to adequately make a diagnosis of bladder outlet obstruction [12]. Besides it is already known from previous research that there is a weak correlation between absolute

volume of prostate and severity of LUTS and also that there is no direct correlation between prostate volume and BPO or BOO [13, 14]. Nomograms have therefore become important for accurate prediction of BOO [15]. One of them is the ICS nomogram. Pressure Flow Study comprises of a filling and storage phase and the voiding phase. During the voiding phase actual detrusor pressure can be measured and the outlet resistance calculated using the ICS nomogram which is now recommended for the diagnosis of obstruction [16]. Based on the works of Lim, Abrams, Griffiths [17] ICS nomogram was published according to which men can be divided based on Bladder Outlet Obstruction Index(BOOI) into obstructed, equivocal and unobstructed.  $BOOI = P_{det} @ Q_{max} - 2Q_{max}$ .  $BOOI > 40 =$  obstructed;  $BOOI 20-40 =$  equivocal; and  $BOOI < 20 =$  unobstructed.

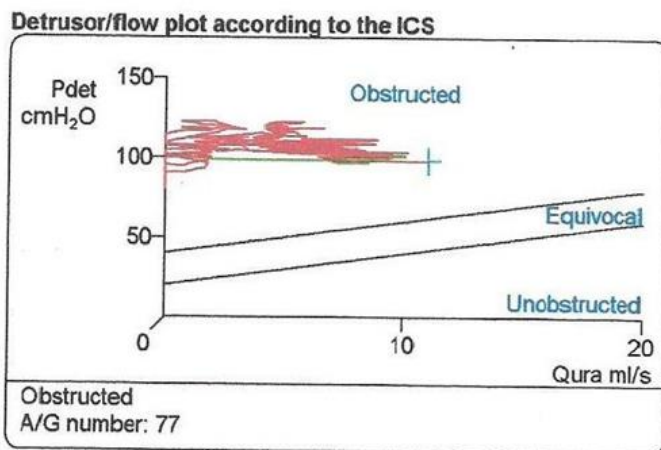


Figure 6

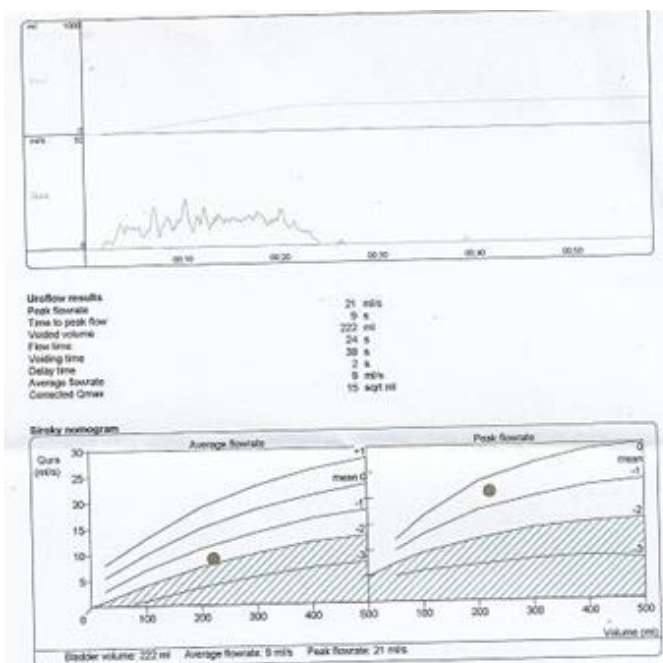


Figure 7

Uroflowmetry (Figure 7), one of the non invasive Urodynamic tests which indicates whether the voiding pattern is normal or abnormal, cannot make a definitive diagnosis of obstruction. Uroflowmetry parameters as well as features of the curve cannot allow a definitive distinction between obstruction and underactivity of the detrusor [18]. Decreased uroflow can be a result of impaired detrusor contractility or obstruction. Normal flow rates do not necessarily exclude obstruction [19]. Without the measurement of detrusor pressure ( $P_{det}$ ) at the same time, uroflow alone would not distinguish the two entities. 34.80 percent of patients with decreased flow rate were found to be unobstructed in this study. Neither can measurement of postvoid residual urine volume help make the diagnosis of obstruction [20]. Elevated volume of Postvoid residual urine is weakly related to bladder outlet obstruction. Detrusor underactivity is a very frequent type of voiding dysfunction in men with LUTS and is responsible for the residual urine and weak stream [21]. 53.42% of patients with elevated PVR urine were found to be unobstructed. It can therefore not be used in the diagnosis of BOO as detrusor failure would record high PVR urine (Table 1). In Pressure Flow Studies low detrusor pressure and high flow rate does not indicate obstruction; high detrusor pressure and low flow rate would suggest obstruction; whilst low detrusor pressure with low flow rate would indicate poor detrusor contractility. There is significant clinical resemblance between the symptoms of detrusor underactivity and bladder outlet obstruction. This makes it difficult to identify the later without Pressure Flow Studies [22]. Patients with detrusor underactivity do not have a good outcome after prostatic surgery as the symptoms of inability of the bladder to empty would still persist and quality of life of such patients would not be significantly improve. Therefore, it is important to differentiate between detrusor underactivity and bladder outlet obstruction. Pressure Flow Studies do not always enable this absolute classification into obstructed and non-obstruct. Border line cases would be those which have a combination of impaired detrusor contractility and obstruction. In this study there were no border line cases. In our experience here in Ghana and might be applicable other low income countries, patients with bladder outlet obstruction would for months if not years, try herbal treatment or other unorthodox methods as a remedy. Patients often get retention of urine several times during the course of such treatment and are content with a one time relief of the obstruction by catheterization in nearby clinics. Those seen by urologist most of the time do not comply to medical treatment with alpha blockers. Some patients even self medicate with herbal and other alkaline based preparations advertised on mass media. Thus eventually such patients come to the urologist with decompensated and hypocontractile urinary bladders. There was also obvious difficulty in filling IPSS questionnaire due to illiteracy. It is precisely for this that it necessary to be sure there is no impaired bladder contractility by establishing urodynamic obstruction when contemplating on prostatectomy for benign prostatic obstruction. This study is by no means a conclusive in our setting in view of the controversies about the ability of Pressure flow studies to predict post prostatectomy outcomes [23, 24]. There are reports where prostatectomy benefited selected patients with weak detrusor contractility [25-

28]. A retrospective study of the outcome of intervention in these 400 patients needs to be done. In this study cystoscopy was not done to rule out bladder neck sclerosis. There is also the need of a prospective study which would take note of the previous herbal or other treatments as well as duration of such conservative treatment. This study among others would also document the number of times patients had retention of urine and how relief was sought.

## Conclusion

The use of pressure Flow Studies, to establish urodynamic Bladder Outlet Obstruction, is imperative in cases of failed conservative treatment for suspected BOO due to benign prostatic enlargement in order to rule out detrusor under activity or acontractile bladder before considering prostatectomy especially in low income countries.

## Funding

None

## Conflict of Interest

None

## References

- Nitti VW, Kim Y, Combs AJ (1994) Correlation of the AUA symptom index with urodynamics in patients with suspected benign prostatic hyperplasia. *Neurourol Urodyn* 13: 521-527.
- Yalla SV, Sullivan MP, Lecamwasam HS, DuBeau CE, Vickers MA, et al., (1995) Correlation of American Urological Association symptom index with obstructive and nonobstructive prostatism. *J Urol* 153: 674-679.
- Sirls LT, Kirkemo AK, Jay J (1996) Lack of correlation of the American Urological Association symptom 7 index with urodynamic bladder outlet obstruction. *Neurourol Urodyn* 15: 447-457.
- Van Ventrooij GE, Boon TA (1996) The value of symptom score, quality of life, maximum urinary flow rate, residual volume and prostate size for the diagnosis of obstructive benign prostatic hyperplasia: A urodynamic analysis. *J Urol* 155: 2014-2018.
- Nitti VW (2005) Pressure Flow Urodynamic Studies: The Gold Standard for Diagnosing Bladder Outlet Obstruction. *Rev Urol* 7: 14-21.
- Ghana Statistical Service, June 2013. 2010 Population and Housing Census.
- Griffiths D, Hofner K, van Mastrigt R, Rollema HJ, Spångberg A, et al., (1997) Standardisation of terminology in lower urinary tract function: pressure flow studies of voiding, urethral resistance and urethral obstruction. *Neurourol Urodyn*. 6: 1-18.
- Gratzke C, Bachmann A, Descazeaud A, Drake MJ, Madersbacher S, et al., (2015) EAU Guidelines on the Assessment of Non-neurogenic Male Lower Urinary Tract Symptoms including Benign Prostatic Obstruction. *Eur Urol* 67: 1099-1109.
- Bonney V (1923) On Diurnal Incontinence of Urine in Women. *BJOG: An International Journal of Obstetrics & Gynaecology* 30: 358-365.
- Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, et al., (2003) The standardization of terminology in lower urinary tract function: Report from the standardization sub-committee of the International Continence Society. *Urology* 61: 38-49
- Abrams P (1994) New word for old: Lower urinary tract symptoms for "prostatism. *BMJ* 308: 929-930.
- D'Silva KA, Dahm P, Wong CL (2014) Does this man with lower urinary tract symptoms have bladder outlet obstruction? The Rational Clinical Examination: a systematic review. *JAMA* 312: 535-542.
- Bushman W (2009) Etiology, epidemiology, and natural history of benign prostatic hyperplasia. *Urol clin North Am* 36: 403-415.
- Ezz el Din K, Kiemeny LA, de Wildt MJ, Debruyne FM, de la Rosette JJ (1996) Correlation between uroflowmetry, prostate volume, postvoid residue, and lower urinary tract symptoms as measured by The International Prostate Symptom Score. *Urology* 143: 393-397.
- Rollema HJ, Van Mastrigt R (1992) Improved indication and followup in transurethral resection of the prostate using computer program CLIM: a prospective study. *J urol* 148: 111-115.
- Abrams PH, Griffiths DJ (1979) Assessment of prostatic obstruction from urodynamic measurements and from residual urine. *Brit J urol* 51: 129-34.
- Lims CS, Abrams P (1995) The Abram-Griffiths nomogram. *World J Urol* 13: 34-39.
- Chancellor MB, Blaivas JG, Kaplan SA, Axelrod S (1991) Bladder outlet obstruction versus impaired detrusor contractility: The role of uroflow. *J urol* 145: 810-812.
- Gerstenberg TC, Andersen JT, Klaskov P, Ramirez D, Hald T, et al., (1982) High flow infravesical obstruction in men: Symptomatology, urodynamics and the results of surgery. *J Urol* 127: 943-945.
- Griffiths DJ (1996) Pressure-flow studies of micturition. *Urol Clin North Am* 23: 279-297.
- Rademakers KL, Van Koeveeringe GA, Oelke M (2016) Detrusor underactivity in men with lower urinary tract symptoms/benign prostatic obstruction: characterization and potential impact on indications for surgical treatment of the prostate 26: 310.
- Ahmed A, Farhan B, Vernez S, Ghoniem GM (2016) The challenges in the diagnosis of detrusor underactivity in clinical practice: A minireview. *Arab J Urol* 14: 2237.
- Rodrigues P, Lucon AM, Freire GC, Arap S (2001) Urodynamic pressure flow studies can predict clinical outcome after transurethral prostatic resection. *J Urol* 165: 499-502.
- Seki N, Kai N, Seguchi H, Takei M, Yamaguchi A, et al., (2006) Predictives regarding outcome after transurethral resection for prostatic adenoma associated with detrusor underactivity. *Urology* 67: 306-10.
- Van Venrooij GEP, van Melick HHE, Boon TA (2003)

- Comparison of outcomes of transurethral prostate resection in urodynamically obstructed versus selected urodynamically unobstructed or equivocal men. *Urology* 62: 672-676.
26. Gotoh M, Yoshikawa Y, Kondo A, Ono Y, Oshima S (1999) Prognostic value of pressure-flow study in surgical treatment of benign prostate obstruction. *World J Urol* 17: 274-278.
27. Masumori N, Furiyuya R, Tanaka Y, Furaya S, Ogura H, et al., (2009) The 12-year symptomatic outcome of transurethral resection of the prostate for patients with lower urinary tract symptoms suggestive of benign prostatic obstruction compared to the urodynamic findings before surgery. *BJU Int* 105: 1429-1433.
28. Han DA, Jeong YS, Choo MS, Lee KS (2008) The efficacy of transurethral resection of the prostate in patients with weak bladder contractility index. *Urol* 71: 657-661.

#### Assets of Publishing with us

Global archiving of articles  
Immediate, unrestricted  
online access Rigorous Peer  
Review Process Authors  
Retain Copyrights

<https://www.biomedress.com>

**Submission Link:** <https://biomedress.com/online-submission.php>