Original Article

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Prostatic Urethral Length as a Predictor for Surgery in Benign Prostatic Hyperplasia

Surendra Basnet,[1] Parash Mani Shrestha,[1] Anil Shrestha,[1] Robin Bahadur Basnet[1] Prabodh Regmi,[1] Chitaranjan Shah,[1] Arvind Kumar Shah,[1] Udita Mishra,[1] Baikuntha Adhikari[1]

[1]Department of Urology, National Academy of Medical Sciences, Bir Hospital, Mahaboudha, Kathmandu, Nepal.

ABSTRACT

Background: Benign prostatic hyperplasia is associated with structural and morphological changes including elongation of prostatic urethral length. The aim of our study was to assess whether prostatic urethral length could predict need of surgery in patients with benign prostatic hyperplasia.

Methods: This prospective observational study was conducted over a 12-months duration. All the patients who presented with lower urinary tract symptoms secondary to benign prostatic hyperplasia were evaluated with International Prostate Severity Score, serum Prostate Specific Antigen, Transrectal Ultrasound was done to measure prostatic urethral length, prostate volume, Intravesical prostatic protusion and Post-void Residual Urine. Patients not responding to medical treatment and complications secondary to benign prostatic hyperplasia underwent surgery. Logistic regression analysis was performed to identify risk factors associated with surgery.

Results: A total of 153 patients were included in the study. Eighty-three (54.2%) patients underwent surgery during the study period. Prostate volume, intravesical prostatic protrusion, post-void residual volume, serum prostate specific antigen, and prostatic urethral length were significantly higher in the surgical group. The mean prostatic urethral length in the surgical group was 39.47 + 10.2 mm and in the nonsurgical group was 26.20 + 6.72 mm ($p < 0.0001$). According to the ROC curve-based prediction of surgery, the area under the curve for PUL was 0.866 and the best cutoff value was 31.5mm (81% sensitivity and 84.3% specificity).

Conclusions: BPH patients with longer PUL may require surgical management. PUL measured by TRUS may be a predicting factor for the need of surgery in BPH

Keywords: Benign prostatic hyperplasia; lower urinary tract symptoms; prostatic urethral length.

INTRODUCTION

Benign prostatic hyperplasia (BPH) is nonmalignant growth of prostate, mainly affects aging males, with the prevalence, peaking at 88% in men in their 80s.[1-2]

Medical management remains the primary management option for patients with moderate to severe lower urinary tract symptoms (LUTS), however a significant proportion of patient with failure of medical management require surgery. There is no single objective parameter that predict need of surgery. Surrogate parameters such as prostate volume (PV), transitional zone (TZ) volume, intravesical prostatic protrusion (IVPP), prostatic urethral angle (PUA) alone or in combination have been utilized to support decision making. However, poor association of these parameters with LUTS have been documented.[3-4]

Recently prostatic urethral length (PUL) has been suggested to correlate with LUTS. Increase in PV leads to the lengthening of the prostatic urethra.[5] Thus, we conducted a study to assess the relation of PUL in patients with BPH requiring surgery in our setting.

Correspondence: Surendra Basnet, Department of Urology, National Academy of Medical Sciences, Bir Hospital, Mahaboudha, Kathmandu, Nepal. Email: surenbasnetms@gmail.com.

METHODS

This prospective observational study was conducted in the Department of Urology, NAMS, Bir Hospital, Nepal over a 12-months duration from June 2021 to May 2022. Ethical clearance was obtained from the National Academy of Medical Sciences institutional review board (Ref. number 975/2078/79). Written Informed consent was taken from all the participants. Patients presenting to Department of Urology, Bir Hospital with LUTS were included in the study. Patients were assessed with medical history, general physical examination including digital rectal examination, and brief neurological examination. Diagnosed lower urinary tract malignancy, urethral stricture, and diagnosed neurogenic bladder were excluded from the study. The sample size was calculated using Cochran's formula for sample size calculation: $n = Z^2 pq/ e^2$. Probability of surgical management of BPH (P) = 0.054 taken from the study conducted by Kim et al. 2018[25], desired level of precision of 5% and 95% confidence interval, the sample size was calculated to be 79.

All the patients without Foley catheters were evaluated with LUTS symptoms severity score, serum Prostate Specific Antigen PSA, Transrectal Ultrasound (TRUS), and uroflowmetry. LUTS symptoms severity score was assessed by International Prostate Severity Score (IPSS) and classified as mild (0 to 7), moderate (8 to 19), or severe (20 to 35). Patients with Foley catheters were assessed with serum PSA, and TRUS only. TRUS was done by an experienced radiologist. PUL, prostate volume (PV), IVPP, and Post Voidal Residual urine (PVR) were measured by TRUS. PV was calculated as

Prostate volume = L x B x H $\pi\pi$ /6 [6]

PUL was measured from the base to the apex of the prostate. Voided volume and Peak Flow Rate (PFR) were measured by uroflowmetry (Nidhi, India). Patients with moderate to severe LUTS refractory to medical therapy, acute urinary retention, chronic urinary retention, recurrent or persistent Urinary Tract Infection (UTI), medical refractory gross hematuria, bladder calculi, bladder diverticula, and impaired renal function underwent monopolar Transurethral Resection of Prostate (TURP) after routine preoperative investigations and a pre-anesthetic checkup.

Patients were divided into two groups, those managed with monopolar TURP (surgical group) and those managed with medicines (nonsurgical group).

Data analysis was done using the Statistical Package For Social Sciences (SPSS) Windows version 25 (SPSS Inc, Chicago, I.L.). Baseline characteristics age and IPSS were compared between surgical and nonsurgical groups using the Chi-square test/Fisher's exact test, and the Student t-test/Mann-Whitney U test for continuous data (PUL, PFR, and PVR). Initially univariate comparison of baseline characteristics between those with and without surgery was done using Student t-test for continuous variables. Multivariate logistic regression analysis was then performed including covariates that were significant in the univariate analysis to determine factors independently associated with need of surgery as the dichotomous variable. Association of the variables with the need of surgery was evaluated using Cox proportional hazard regression models and summarized with the OR and 95% CI. ROC curve was generated for PUL to compare its predictive performance for need of surgery. The Youden Index was used to define the optimal cutoff values. P<0.05 was considered significant.

RESULTS

A total of 153 patients with a clinical diagnosis of BPH were enrolled in this study. Out of which 83 (54.2%) patients underwent surgery (monopolar TURP) during the study period. The most common indication for surgery was acute retention of urine secondary to BEP (49.39%) followed by moderate to severe LUTS not responding to medical therapy (43.37%) (Table 1).

Table 1. Indications of surgery

Surgical indications	Number (%)
ARU	41 (49.39)
CRU	5 (6.02)
Failed Medical Therapy	36 (43.37)
UB Calculi	1 (1.20)
Total	83

A total of 44 patients were with a Foley catheter (41 for ARU and 3 for CRU).

The mean age of the nonsurgical group was 67.4 + 8.98 years and the surgical group was 68.5 + 8.56 years (p=0.424). The patients in the surgical group had higher IPSS (24.92±5.19) as compared with the non-surgical group (19.78±6.98), which was statistically significant (p<0.001). The mean PSA value for the non-surgery group was 2.13 compared to 4.42 for the surgery group (p=.0001). The mean prostate volume, IVPP, and PVRU of the surgical group were 54.37 ± 20.9 gram, 12.1 ± 7.19 mm, and 127.09 ±114ml respectively and that of the nonsurgical group were 38.55 ±14.1gram, 6.95

± 6.74 mm and 65.92 ± 57.8 ml respectively. All these findings were higher in the surgical group, which was statistically significant. The mean PUL in the surgical group was longer than the nonsurgical group i.e 39.47 + 10.2 mm and 26.20 + 6.72 mm respectively, which was also statistically significant (p <.0001). On multivariable linear regression analysis only age, IPSS, and PUL were significantly associated with the need for surgery (Table 3).

Table 2. Comparisons of preoperative characteristics between nonsurgical and surgical groups.

Clinical Parameters	Nonsurgical Group mean±SD	Surgical Group mean±SD	p-value
Age (years)	67.4 + 8.98	68.5 + 8.56	0.4248
IPSS (mm)	19.78 ± 6.98	24.92 ± 5.19	<0.001
Prostate Volume (PV) (gm)	38.55 ±14.1	54.37 ± 20.9	<0.001
IVPP (mm)	6.95 ± 6.74	12.1 ± 7.19	<0.0001
PVRU (ml)	65.92 ± 57.8	127.09 ±114	0.0002
PSA (ng/ml)	2.12 ±1.23	4.42 ± 4.47	0.0001
Prostatic Urethral Length (PUL) (mm)	26.20 ± 6.72	39.47 ±10.2	<0.0001

Table 3. Univariable and multivariable analysis of factors predicting surgery.

Variables	Univariate analysis		Multivariate analysis	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Age (years)	0.985 (.95-1.022)	0.417	1.152 (1.044-1.27)	0.005*
IPSS (mm)	0.878 (.878-.943)	<0.001	0.804 (.700-.924)	0.002*
Prostate Volume (gm)	0.947 (0.925-0.970)	<0.001	1.034 (0.968-1.105)	0.317
IVPP (mm)	0.893 (0.845-0.943)	<0.001	0.878 (.754-1.023)	0.095
PVRU (ml)	0.990 (0.984-0.996)	0.002	0.998 (.990-1.006)	0.632
PSA (ng/ml)	0.572 (0.437-0.749)	<0.001	0.584 (.302-1.131)	0.111
PUL (mm)	0.831 (0.783-0.881)	<0.001	0.822 (.741-.912)	<0.001*

According to the receiver operating characteristic (ROC) curve-based prediction of surgery the area under the curve for PUL was 0.866 and the best cutoff value was 31.5mm (81% sensitivity and 84.3% specificity).

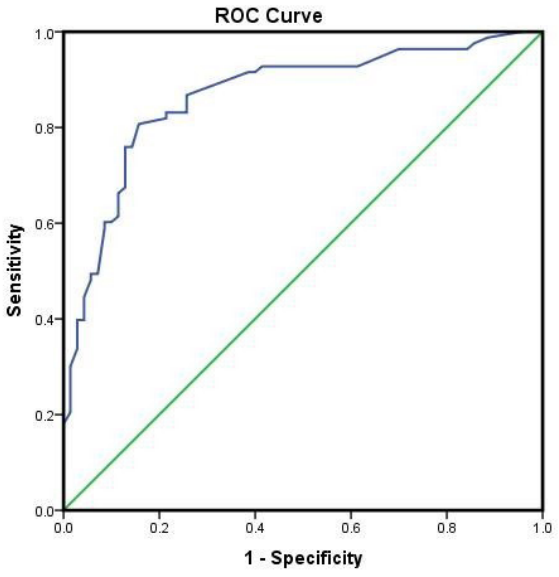

Figure 1. ROC curve for PUL.

DISCUSSION

Management of men with LUTS due to BPH is driven by symptom status (IPSS), objective parameters (PVR and uroflowmetry), risk of disease progression, and the presence of BPH-related complications, such as recurrent urinary retention, bladder stones or hydronephrosis/decline in renal function, hematuria.[7] Surgical management of BEP is reserved for moderate to severe LUTS not responding to medical therapy and the presence of BPH-related complications. Management guidelines in BEP depend on the LUTS severity score and complications, but the exact pathophysiology of LUTS secondary to BPH is incompletely understood and so is to predict which patient will need surgical management. Several attempts have been made to find predicting factors for the surgical management of BPH.

In our study the mean age of the patient in the surgical group was non-significantly higher than in non-surgical group. This can be accounted by the fact that prevalence of histologically proven BPH is 14%, 37%, and 39% at 50 to 59, 60 to 69, and older than 70 years of age respectively.[8] Also the prevalence of moderate/severe LUTS (IPSS >7) also has a positive correlation with age which is around 20% in the 5th, 30% in the 6th, and 40% in the 8th decade of life.[9]

The relation between prostate volume and LUTS manifests is complex. Although the histologic evidence of BPH is noticed in the majority of men over 40 years, only a fraction of them experienced LUTS. Many studies

have not shown correlation between prostate size and symptoms severity score (IPSS), but a correlation does seem to exist between prostate volume and the decision for surgical intervention.[10-13] In our study, there was a significant correlation between prostate volume and surgical intervention (p<0.0001). With the increase in prostate volume other factors also play a synergistic role like obstruction-induced changes in the bladder, age-related changes in the bladder and nervous system (overactive bladder, neurogenic bladder) urinary tract infection, urinary tract stone or tumor, urethral stricture, and even behavioral factors, such as metabolic syndrome, physical activity, and alcohol consumption.[14-17]

BPH first develops in the periurethral transition zone of the prostate.[18] The presence of prostatic capsule in human limits the expansion of prostate outwards thus directly conveying the pressure of enlarged nodules to the prostatic urethra. High pressure within the prostatic urethra may lead the compensatory morphological and structural changes. [19] These changes include elongation of PUL, change in PUA, and in some cases, predominant growth of periurethral nodules at the bladder neck gives rise to the "middle lobe". This middle lobe also results in the elongation of PUL. Marcio A. Babinsk et. al. in their study have shown that BPH nodules caused a significant decrease of elastic system fibers and collagen in the prostatic urethra; as a result, there is diminished elasticity, thus again contributing to elongation of prostatic urethra.[20] PUL can be measured by TRUS or cystoscopy. There is not only a positive correlation between the PUL, and the severity of LUTS but also with the risk of surgery.[21-22] In our study the mean length of PUL in surgical and nonsurgical groups were 39.47 ±10.2mm and 26.20 ± 6.72mm respectively. The PUL in the surgical group was longer than the nonsurgical group which was statistically significant (p <0.0001).

IVPP is the protrusion of the prostatic adenoma into the bladder due to an enlarged middle lobe. Higher IVPP has been shown to predict failure of trial without catheter in patients with AUR and is also regarded as one of the risk factors for bladder stone formation in patients with BPH.[23-27] We also noted higher IVPP in patients undergoing surgical management for BPH. This protruding median lobe causes ball-valve obstruction of the bladder which aggravates voiding symptoms and complications.

In our study, serum PSA and PVRU were significantly higher in the surgical group. The mean serum PSA was 2.12 ±1.23 ng/ml and 4.42 ± 4.47 ng/ml in the nonsurgical and surgical groups respectively (p <0.0001). Serum PSA has a linear correlation with age and prostate volume.[28] Adhikari et. al. in their study have shown that patients with AUR under Foley catheter have higher PSA. Larger prostate and acute inflammation lead to ARU and raised PSA.[29] Impaired emptying function due to BPO leads to persistent high post-void residual urine (PVRU). PVRU of more than 100 mL is predictive of subsequent acute urinary retention. In a pooled analysis of 11 controlled studies with Alfuzosin (n = 953), 6 out of 7 patients who subsequently developed acute urinary retention (AUR) had a PVRU of more than 100 mL at initial evaluation.[30] These findings were similar to the results of our study. The mean PVRU in the surgical and nonsurgical groups were 127.09 ±114 ml and 65.92 ± 57.8 ml respectively which was statistically significant (p=0.0002).

There were few limitations of our study. We examined only a small population at a single institution over 12 months period. Second, the response bias by patients when reporting the IPSS and the difficulty in comprehension of IPSS was not accounted. The postoperative outcomes and the postoperative changes in PUL were not assessed. The follow up was relatively short for patients under pharmacotherapy. Multicentric studies with larger sample and inclusion of other confounding variables in the analysis together with the assessment of postoperative change in PUL and patients symptoms are recommended for further characterization.

CONCLUSIONS

The evaluation of PUL in patients with BPH could assist surgeons in selecting patients requiring surgery. This simple and easily reproducible parameter can be included in the regular assessment of patients with moderate to severe bothersome LUTS with BPH.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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