RESEARCH ARTICLE

Anticipating bladder outlet obstruction in enlarged prostate: non-invasive clinical parameters as predictive tools

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Abstract

Objective: To determine the positive predictive value of clinical evaluation with maximum flow rate, prostatic volume and international prostate symptom score in predicting bladder outlet obstruction due to prostatic enlargement.

Method: The cross-sectional, prospective study was conducted at the Urology Department of the Sindh Institute of Urology and Transplantation, Karachi, from September 2021 to May 2023, and comprised male patients with refractory lower urinary tract symptoms in whom surgical intervention had been planned. All patients with prostate volume ≥40ml, maximum flow rate ≤8ml/sec and international prostate symptom score ≥7 were labelled as bladder outlet obstruction cases, and were subjected to urodynamic analysis. They were subsequently labelled as true positive or false positive cases. Data was analysed using SPSS 25.

Results: There were 177 male patients with mean age 67.79±8.931 years (range: 40-80 years). Mean duration of symptoms was 5.77±2.822 years. Mean international prostate symptom score was 21.69±2.775, mean maximum flow rate was 4.753±2.0342 and mean prostate volume was 61.243±10.57. Overall, 163(92.1%) patients were true positive, and 14(7.9%) were false positive. The positive predictive value of clinical evaluation to find out bladder outflow obstruction secondary to enlarged prostate was 0.92.

Conclusion: Maximum flow rate combined with total prostate volume and international prostate symptom score could be used for the prediction of bladder outflow obstruction.

Key Words: Prostate volume, Urinary flow rate, Bladder outlet obstruction, Benign prostatic hyperplasia.

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Introduction

The prevalence of lower urinary tract symptoms (LUTS) among males ranges 45.2-72.3% and demonstrates an age-associated escalation.[1] There is a proposition that adopting symptom-focussed approaches could enhance the management of LUTS, emphasising the importance of personalised diagnoses in clinical practice.[2,3] Prostatic surgery may become imperative for individuals experiencing LUTS attributed to benign prostatic obstruction (BPO), underlining the necessity for intervention in certain cases.[3]

Accurate identification of bladder outlet obstruction (BOO) holds significance in practical clinical scenarios, especially when managing men exhibiting LUTS indicative of BPO. This precise diagnosis plays a pivotal role in guiding appropriate treatment approaches, facilitating decisions on prostatic surgery for some individuals, while preventing unnecessary surgical interventions for others.[3] Currently, urodynamic assessment with a pressure-flow study (PFS) is considered the gold standard for confirming a diagnosis of significant BOO.[4]

Nonetheless, conducting a urodynamic study (UDS) necessitates optimal patient cooperation for optimal outcomes, and is not entirely devoid of discomfort and invasiveness. Consequently, it may lead to various morbidities in a certain proportion of patients.[5] Therefore, it may not be practical to perform UDS in all men with LUTS, especially those that are frail, elderly or mentally impaired.[6]

To overcome this problem, some non-invasive methods or parameters to predict the probability of BOO have been proposed in men with treatment-naïve or common LUTS.[6-8] However, it has not been clarified whether these provide consistently good performance for clinical use in a large sample. In addition, the application of some methods with specific equipment is not always feasible in real-life practice.[8]

Trumbeckas et al. found that the positive predictive value (PPV) of maximum flow rate (Qmax) plus prostatic volume

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(PV) in predicting BOO in patients presenting with LUTS was 92%.[9] Despite such promising results, to our knowledge, there is no published data from Pakistan on the subject.

The current study was planned to fill the gap in literature by determining the PPV of clinical evaluation with Qmax, PV and international prostate symptom score (IPSS) in predicting BOO due to prostatic enlargement.

Patients and Methods

The cross-sectional, prospective study was conducted at the Urology Department of the Sindh Institute of Urology and Transplantation (SIUT), Karachi, from September 2021 to May 2023.

After approval from institutional ethics review committee, the sample size was calculated by open epi sample size calculator using formula n=Z2α/2.p. (1-p)/d2[9], by taking 95% confidence level and 4% margin of error while taking expected positive predictive value of maximum flow rate plus prostatic volume and IPSS in predicting bladder outlet obstruction to be 92% taking urodynamic studies as gold standard.[9] The sample was raised using non-probability consecutive sampling technique. Male patients aged 40-80 years with suspected BOO secondary to prostatic enlargement on the basis of clinical features, including PV ≥40ml, Qmax ≤8ml/sec and IPSS ≥7, with no active urinary tract infection UTI were selected. All the patients were due for surgical intervention. Informed written consent was obtained from each patient. Those with established diagnosis of urinary bladder stone, neurogenic bladder, stricture urethra, active UTI, history of lower urinary tract surgery, PV <40ml and prostate-specific antigen (PSA) ≥10ng/ml were excluded. PV was measured using transrectal ultrasound probe at 5-7.5MHz frequency, and volume was calculated with formula 0.52 x width x height x length. Uroflowmetry was performed to measure Qmax.

Each patient was subjected to standard non-ambulatory UDS in awake and supine position. Bladder filling was started at the rate of 20-30ml/min with 37°C saline via 7Fr multi-lumen transurethral urodynamic catheter. Another catheter was inserted into the rectum to measure intrabdominal pressure. Both the catheters were taped to the patient to avoid expulsion and artifacts. The test was repeated two times and lower degree of obstruction-showing data was taken into account. The UDS showing Abrams-Griffiths (AG) number, also known as BOO index (BOOI)[10], >40 was labelled to have BOO. UDS findings were interpreted by a consultant urologist and a trained physician assistant with minimum 3 years' experience in UDS. BOOI was calculated as BOOI = detrusor pressure [Pdet] Qmax – (2 × Qmax)[10]. Patients with findings of BOO on UDS were labelled as true positive (TP), and those with no BOO were labelled as false positive (FP). The PPV was calculated by the following formula: PPV = (True Positive / True Positive + False Positive) x 100

Data was collected regarding demographic details, PV, duration of symptoms, urine culture, serum PSA, Qmax and IPSS. Explanatory variables, like place of residence, socioeconomic status (SES), diabetes, hypertension and smoking status, defined as >5 packs/year, were also noted.

Data was analysed using SPSS 25. Numerical variables were presented as mean ± standard deviation, while categorical variables were expressed frequencies and percentages. Data were stratified to deal with effect modifiers. Post-stratification chi-square test was applied for categorical variables, and independent sample t-test for continuous variable. P0.05 was taken as significant.

Results

There were 177 male patients with mean age 67.79±8.931 years (range: 40-80 years). The majority of the patients

Table: Stratification of age, diabetes, hypertension, smoking status and duration of symptom to ass the effect on positive predictive value (PPV) of clinical diagnosis.

	True positive	False positive	Total	p-value
Age groups				
40-50 years	4	0	4	0.276
	100.00%	0.00%	100.00%	
51-65 years	59	8	67	
	88.10%	11.90%	100.00%	
≥66 years	100	6	106	
	94.30%	5.70%	100.00%	
Diabetes mellitus				
Yes	46	3	49	0.586
	93.90%	6.10%	100.00%	
No	117	11	128	
	91.40%	8.60%	100.00%	
Hypertension				
Yes	65	7	72	0.459
	90.30%	9.70%	100.00%	
No	98	7	105	
	93.30%	6.70%	100.00%	
Smoking				
Yes	74	6	80	0.855
	92.50%	7.50%	100.00%	
No	89	8	97	
	91.80%	8.20%	100.00%	
Duration of symptoms				
≤5 years	54	4	58	0.727
	93.1%	6.9%	100.0%	
>5 years	109	10	119	
	91.6%	8.4%	100.0%	

106(59.9%) were aged ≥66 years, while 4(2.3%) and 67(37.9%) patients were aged 40-50 years and 51-65 years, respectively. Mean duration of symptoms was 5.77±2.822 years. Mean IPSS was 21.69±2.775, mean Qmax was 4.753±2.0342 and mean PV was 61.243±10.57.

Overall, 163(92.1%) patients were TP, and 14(7.9%) were FP, and the PPV was 0.92 with sensitivity 100%, specificity 97.83% and diagnostic accuracy 98.26%.

PPV had no significant association with age, diabetes, hypertension, smoking status and duration of symptoms (Table).

Discussion

In the face of numerous micro-invasive techniques for the treatment of enlarged prostate, transurethral resection of prostate (TURP) is still the main and the best option. By far, TURP is the most commonly performed surgical procedure around the globe, while open and robotic-assisted simple prostatectomy are reserved only for very large prostate.[11]

TURP is an effective procedure with good or excellent results in 80-85% cases.[12,13] However, the possibility of an unfavourable outcome is still high. One of the reasons for unfavourable results is unsatisfactory preoperative selection of patients. To avoid unfavourable results, literature has suggested performing invasive UDS to make sure if BOO is due to prostatic enlargement and not due to impaired detrusor activity.[14]

Prediction of obstruction by non-invasive clinical methods is of utmost importance to predict desirable postoperative effects. Literature suggests that one of the key factors to predict BOO is reduced Qmax on uroflowmetry. A study suggested the likelihood of obstruction about 67% when Qmax was 10-14ml/s and with Qmax >15ml/s the likelihood of obstruction was only 30%.[11]

Reddy et al. proved clinical parameters i.e., PV, intravesical prostatic protrusion (IPP), bladder wall thickness and post-void residual (PVR) volume, as useful predictors for BOO in 164 patients with mean age 66.72±9.8 years.[7] The current study only used IPSS, PV and Qmax parameters, and the results were almost similar.

In a retrospective analysis of 1,148 patients, de la Cruz et al. also found clinical parameters, including flow rate, as valid predictors of BOO.[15] In a prospective analysis of 240 patients with LUTS due to prostatic enlargement, Garg et al. found 92.41% PPV of clinical parameters in predicting BOO[16], which was comparable to the current finding of 92%. Another study reported an accuracy of 80.9%.[17]

In a meta-analysis of 18 studies having 4,128 patients, clinical features, especially IPP, strongly correlated with UDS) in determining BOO.[18] Although the current study did not measure IPP, 92% PPV of clinical assessment was strongly associated with UDS in determining BOO.

Al-Mosawi et al. found PPV of IPP and PVR for BOO to be 67.9% and 58.3% respectively.[19] In contrast, the current study had much higher PPV of about 92%.

The current study has several limitations, with a primary constraint being the omission of measuring IPP, which is a crucial clinical assessment tool for predicting BOO secondary to enlarged prostate. Despite being the country's largest tertiary care centre for urological diseases, the study had a relatively small sample size, and was confined to a single centre.

Conclusion

Qmax combined with IPPS and PV could be used for prediction of BOO secondary to prostate enlargement. The use of this probabilistic model can help determine patients who need urgent attention and care without the need of invasive UDS.

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AUTHOR'S CONTRIBUTION:

MF: Concept, literature search, review and critical analysis.
NAM: Concept, design, data analysis, drafting, interpretation and literature review.
HHQ: Concept, data collection and literature review.
SK: Concept, data analysis, drafting, literature review and data collection.
UAA: Data collection, drafting, literature search, review and critical analysis.
AH: Critical review of draft, final drafting, supervision and final approval.