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Original Research Article

Prevalence of Significant Intravesical Prostatic Protrusion and Its Correlation with Prostate Volume in Patients with Acute Urinary Retention due to Benign Prostatic Enlargement: A Cross-Sectional Study

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ABSTRACT:

Introduction: Benign prostatic enlargement (BPE) is common in elderly men, and its prevalence increases with age. Acute urinary retention (ARU) is one of the most significant events in the natural history of BPE. This study assessed the prevalence of significant intravesical prostatic protrusion (IPP) and its correlation with prostate volume (PV) in patients with ARU due to BPE. **Methods**: This hospital-based cross-sectional study was conducted in the Department of General Surgery at Lumbini Medical College and Teaching Hospital, Palpa, Nepal, over five months. A total of 94 men aged 45–85 years with ARU due to BPE were included using consecutive sampling. Assessment included clinical history, laboratory investigations, and transabdominal ultrasonography to measure PV and IPP. IPP >10 mm was considered significant. Statistical analysis included descriptive statistics and Pearson's correlation coefficient. **Results**: Mean age was 66.7 ± 10.4 years, mean PV was 42.9 ± 13.2 cc, and mean IPP was 10.8 ± 6.3 mm. Significant IPP (>10 mm) was present in 35 patients (37.2%). Grade I prostatomegaly (20–40 cc) was most common (54.3%). IPP showed a moderate positive correlation with PV ($r = 0.394$, $p < 0.001$). Half of the patients (50.0%) had previous ARU, and 33.0% had pyuria. **Conclusions**: Significant IPP was present in over one-third of patients with ARU due to BPE. IPP correlated moderately with PV, suggesting that PV alone cannot fully explain the degree of protrusion. IPP may serve as a useful non-invasive tool to identify patients who might benefit from early surgical intervention.

Keywords: Acute retention of urine; Benign prostatic enlargement; Intravesical prostatic protrusion; Prostate volume

INTRODUCTION

Benign prostatic enlargement (BPE) is the most common disease in elderly men, and its prevalence increases with advancing age. Nearly 40% of men aged 50–60 years and up to 90% of men older than 80 years are affected.[1] Among men in their seventies, 10% develop acute retention of urine (ARU) within the next 5 years, and this proportion rises to 30% among men in their eighties. Men with ARU have a higher likelihood of developing lower urinary tract symptoms (LUTS).[2]

ARU is predominantly associated with anxiety, discomfort, and patient inconvenience. The severity of symptoms and the degree of obstruction do not depend on the size of the prostate. Bladder outlet obstruction (BOO) and intravesical prostatic protrusion (IPP) are interrelated. IPP is a morphological change caused by the lateral and median lobes of the prostate. Ultrasonographic measurement of IPP can identify BOO in patients with BPE. Significant findings of IPP in patients with LUTS provide guidance for the early need for surgical intervention.[3] Assessed detrusor thickness has a high predictive value for BOO.[4] IPP is also

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associated with adverse consequences of BPE on the urinary tract and quality of life.[5]

This study aimed to assess the prevalence of significant IPP and its relationship with prostate volume in patients with ARU due to BPE. For the purposes of this study, significant IPP was defined as an IPP greater than 10 mm, in accordance with established literature.[6]

METHODS

A hospital-based, cross-sectional analytical study was conducted in the Department of General Surgery at Lumbini Medical College and Teaching Hospital (LMCTH), Palpa, Nepal. Data were collected prospectively over a five-month period from February 05 to July 04, 2026, following approval from the Institutional Review Committee (IRC) of LMCTH (Ref: 3/26/V1.R0). Written informed consent was obtained from each participant. Privacy and confidentiality were maintained by the principal investigator throughout the study.

The sample size was calculated using the standard formula for estimating a single population proportion: n1 = Z2.p.q/e2 where Z=1.96 represents the value corresponding to a 95% confidence interval, p = 0.43 is the prevalence of significant intravesical prostatic protrusion (IPP) in patients with acute retention of urine (ARU) as reported in a previous study,[1] q = 1 - p = 0.57 is the complement of the prevalence, and e = 0.10 is the margin of error. A margin of error of 10% was selected because this is a hospital-based, single-centre study with a modest expected sample size, and a more stringent margin (for example, 5%) would have required a substantially larger sample that was not feasible within the five-month study period and the resources available at our institution. The formula yields 94.1 which was rounded up to 95 to ensure that the minimum required number of participants was met and the study remained adequately powered to estimate the prevalence of significant IPP with the desired precision. A total of 95 patients were initially recruited. However, the record of one patient was incomplete, and that patient was therefore excluded from the final analysis, resulting in a final sample of 94 participants.

All patients with BPE presenting with ARU, aged 45–85 years, were included in the study. Patients with bladder calculus, neurological conditions predisposing to neurogenic bladder (e.g., Parkinson's disease or cerebrovascular accident), known malignancy, or bladder diverticulum were excluded.

Data were collected by the principal investigator using a consecutive sampling technique after obtaining written informed consent from all participants. A thorough history, clinical examination, laboratory investigations, and radiological findings were recorded. Patients diagnosed with BPE, ARU, and LUTS completed a full workup according to standard hospital protocol. The diagnosis of BPE with ARU was based on clinical findings, laboratory results, and imaging parameters.

Transabdominal ultrasound was used to measure prostate volume and IPP. Routine urine examination was performed to detect pyuria, which was defined as the presence of ≥10 pus cells (leukocytes) per high-power field (HPF) in centrifuged urine, in accordance with European Association of Urology guidelines.[7] As this was a cross-sectional study, urine culture was not performed; therefore, pyuria on routine examination was used as a surrogate marker for possible urinary tract infection. Digital rectal examination (DRE) was performed to assess prostate size and tenderness; however, ultrasound-based volume measurement was considered the primary measure of prostate size.

IPP less than 10 mm was considered not significant, whereas IPP greater than 10 mm was considered significant.6 Normal prostate volume was defined as 15–20 cc.[8-11] The correlation between IPP and prostate volume, as well as the prevalence of significant IPP in patients presenting with ARU, was calculated.

Data were analyzed using PSPP 2.1.1 statistical software. Quantitative or continuous variables (age, prostate volume, and IPP) were expressed as mean ± standard deviation. Categorical variables (prostate grade, IPP significance group, and age distribution groups) and binary/dichotomous variables (significant IPP >10 mm, previous ARU, pus cells in routine urine examination, and prostate tenderness) were summarized as frequencies and percentages. Pearson's correlation coefficient was applied to assess the relationship between IPP and prostate volume. A p-value <0.05 was considered statistically significant. A scatterplot was generated to visualize the relationship between IPP and prostate volume.

RESULTS

A total of 94 patients were included in the study. The mean age of participants was 66.7 ± 10.4 years (range 45–85 years), the mean prostate volume was 42.9 ± 13.2 cc (range 25.3–88.0 cc), and the mean intravesical prostatic protrusion (IPP) was 10.8 ± 6.3 mm (range 2.0–33.3 mm) (**Table 1**).

The majority of participants were aged 60–69 years (34.0%), followed by 70–79 years (22.3%), 50–59 years (21.3%), 80–89 years (16.0%), and 40–49 years (6.4%). Overall, 35 participants (37.2%) had significant IPP (>10 mm), while 59 (62.8%) had IPP ≤10 mm. No participant in the 40–49 years age group had significant IPP (**Table 2**).

Of the study participants, 54.3% had grade I prostatomegaly (20–40 cc), 34.0% had grade II (>40–60 cc), and 11.7% had grade III (>60–90 cc). No patient had grade IV prostatomegaly (>90 cc). This prostate grading was performed according to the standard system.[12] Among patients with significant IPP (>10 mm), 11 had grade I prostate, 15 had grade II, and 9 had grade III. Among those with IPP ≤10 mm, 40 had grade I, 17 had grade II, and 2 had grade III (**Table 3**).

Significant IPP (>10 mm) was present in 35 patients (37.2%) who presented with acute retention of urine (ARU). Half of the study population (50.0%) had a history of previous ARU. Pus cells were detected on routine urine examination in 33.0% of participants, and 18.1% had prostate tenderness (**Table 4**).

Table 1*: Variables of Study Participants*

Variable	Minimum	Maximum	Mean (SD)
Age (years)	45.0	85.0	66.7 (10.4)
Prostate Volume (cc)	25.3	88.0	42.9 (13.2)
IPP (mm)	2.0	33.3	10.8 (6.3)

Table 2: Age Distribution and IPP in the Study Group

Age Distribution	40–49 years	50–59 years	60–69 years	70–79 years	80–89 years	Total
Frequency (n)	6	20	32	21	15	94
Percent (%)	6.4	21.3	34	22.3	16	100
IPP >10 mm (n)	0	12	8	9	6	35
IPP ≤10 mm (n)	6	8	24	12	9	59

Table 3*: Distribution of Prostate Grade in the Study Group*

Prostate Grade	I (20–40 cc)	II (>40–60 cc)	III (>60–90 cc)	IV (>90 cc)	Total
Frequency (n)	51	32	11	0	94
Percent (%)	54.3	34.0	11.7	0.0	100
IPP >10 mm (n)	11	15	9	0	35
IPP ≤10 mm (n)	40	17	2	0	59

There was a moderate positive correlation (r = 0.394, p < 0.001) between intravesical prostatic protrusion and prostate volume (**Fig. 1**).

Table 4*: Significant IPP, ARU, Pus Cells in Urine Examination, and Prostate Tenderness in the Study Group*

Variable	Category	n (%)
Significant IPP (>10 mm)	Yes	35 (37.2)
	No	59 (62.8)
Previous ARU	Yes	47 (50.0)
	No	47 (50.0)
Pus cells in urine routine examination	Yes	31 (33.0)
	No	63 (67.0)
Prostate tenderness	Yes	17 (18.1)
	No	77 (81.9)

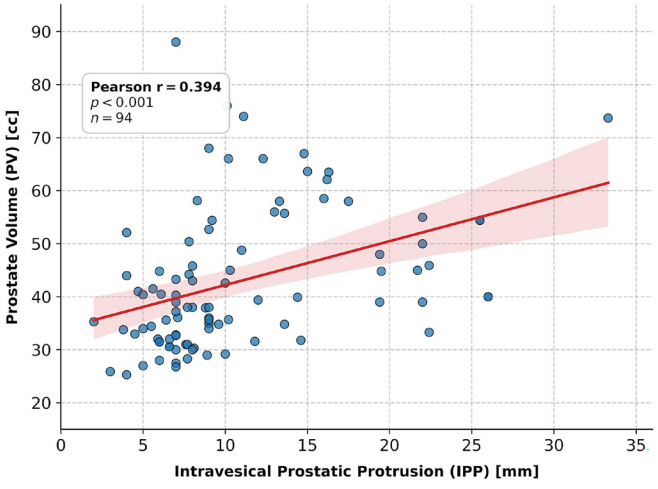

Fig 1*: Correlation between IPP and prostate volume (N=94)*

DISCUSSION

Benign prostatic enlargement (BPE) is not life-threatening but it adversely affects quality of life. Many patients seek treatment for bothersome symptoms.[13] BPE is a common cause of bladder outlet obstruction (BOO) and can lead to acute urinary retention (ARU) as a long-term consequence.[14] Urodynamic studies remain the gold standard for diagnosing BOO, but their invasive, time-consuming, and expensive nature has limited routine clinical use. Consequently, various non-invasive alternatives have been explored to guide prompt therapy for patients most likely to benefit.[15]

ARU is a common complication of BPE and is usually associated with BOO. Intravesical prostatic protrusion (IPP), measured by transabdominal

ultrasonography, has emerged as a simple, non-invasive parameter for assessing obstruction severity and predicting disease progression. In this study, 37.2% of patients presenting with ARU had significant IPP (>10 mm), and IPP showed a statistically significant positive correlation with prostate volume (r = 0.394). The mean age of participants was 66.7 ± 10.4 years, with most patients in the 60–69-year age group (34.0%). This is consistent with the well-established age-related increase in BPE and ARU prevalence. Similar age distributions have been reported by Galeit et al.[1] and Bajpai et al.[3], where most patients with ARU were older than 60 years. Progressive prostate enlargement and increasing bladder outlet resistance with age may explain these observations.

The prevalence of significant IPP in this study was 37.2%, comparable to the 43% reported by Galeit et al.[1] Differences in prevalence across studies may relate to variations in sample size, ultrasound techniques, and thresholds used to define significant IPP. Despite these variations, both studies demonstrate that a considerable proportion of patients presenting with ARU have clinically significant prostatic protrusion into the bladder. Mariappan et al. similarly reported that IPP >10 mm carries a six-fold risk of unsuccessful trial without catheter in men with ARU.[8]

The mean prostate volume in this study was 42.9 ± 13.2 cc. Grade I prostatomegaly (20–40 cc) was present in 54.3% of participants, while only 11.7% had Grade III (>60–90 cc). ARU can occur even in patients with relatively small prostates. This supports previous reports that prostate size alone does not reliably predict BOO.[9,11] Morphological changes, particularly median lobe protrusion into the bladder, may contribute more significantly to obstruction than overall prostate size. Indeed, while prostate volume correlates with BOO index (r = 0.51), IPP has been shown to be a stronger independent predictor of obstruction.

A significant positive correlation was observed between IPP and prostate volume (r = 0.394), indicating that larger prostates tend to have greater protrusion into the bladder. The correlation was only moderate, suggesting that prostate volume alone cannot fully explain the degree of IPP. Bajpai et al.[3] also reported a positive correlation between IPP and prostate volume. Lim et al.[15] found that IPP correlated more closely with BOO than prostate volume alone, with IPP demonstrating the highest area under the ROC curve (0.772) compared to PV (0.637) and PSA (0.703). These findings indicate that IPP provides additional anatomical information beyond prostate size and may better reflect BOO severity. The distribution of significant IPP across prostate grades in our study further supports this: significant IPP was more frequently observed in Grade II and III prostatomegaly than in Grade I, although some patients with smaller prostates also had significant protrusion. This suggests that the direction of prostatic growth, specifically median lobe enlargement into the bladder lumen, is clinically more important than prostate size alone.

Half of the patients (50.0%) had a previous episode of ARU, highlighting the recurrent nature of urinary retention in men with BPE. Additionally, 33.0% had pyuria on routine urine examination, suggesting frequent coexistence of urinary tract infection in patients with ARU. Although these variables were not analyzed for association with IPP in this study, they reflect clinically important findings that may influence patient management and outcomes.

The clinical implication of this study is that IPP can be measured easily by routine transabdominal ultrasonography without additional cost or invasive investigation. While pressure-flow urodynamic studies remain the gold standard for diagnosing BOO, they are not readily available in many resource-limited settings. IPP offers a practical alternative for initial evaluation of patients with BPE presenting with ARU. Patients with significant IPP may benefit from closer follow-up and earlier consideration of surgical intervention, particularly when conservative management fails.[4,8]

Several limitations should be acknowledged. First, IPP and prostate volume were measured via transabdominal ultrasound, which is operator-dependent and may introduce inter-observer variability. Transrectal ultrasound would have provided more accurate measurements of both IPP and prostate volume, but it is more invasive and less well tolerated in patients presenting with acute urinary retention. Second, the single-centre design and relatively small sample size limit generalizability. Third, the sample size was calculated using a 10% margin of error, which provides a less precise prevalence estimate than a 5% margin would have; a larger sample would have been preferable but was not feasible within the study period and resources available. Fourth, urine culture was not performed; pyuria on routine examination was used as a surrogate marker for urinary tract

infection, which cannot distinguish true infection from non-infectious causes of leukocyturia. Fifth, no adjustment was made for potential confounders such as age in the correlation analysis. Finally, the absence of urodynamic confirmation of BOO means that the relationship between IPP and objectively confirmed obstruction could not be directly assessed. Future multi-centre studies utilizing transrectal ultrasound, uroflowmetry parameters, and urodynamic confirmation would strengthen these findings.

CONCLUSIONS

This study demonstrates that IPP and prostate volume correlate moderately with one another (r = 0.394). There is a considerable prevalence of significant IPP (37.2%) in patients presenting with ARU due to BPE. IPP may serve as a useful non-invasive tool to identify patients who might benefit from more aggressive treatment strategies, including early surgical intervention. However, larger, multi-center studies with urodynamic correlation are needed to validate these findings and establish definitive thresholds for clinical decision-making.

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