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ORIGINAL ARTICLE

Correlation between Transabdominal Ultrasound, Prostate Volume and Lower Urinary Tract Symptoms in Men with Benign Prostatic Enlargement

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ABSTRACT

Background: Benign prostatic enlargement (BPE) is a common condition in aging men and frequently presents with lower urinary tract symptoms (LUTS) that significantly affect quality of life. However, the severity of symptoms does not always correlate directly with prostate size. Transabdominal ultrasound (TAUS) provides a non-invasive method for measuring prostate volume, while the International Prostate Symptom Score (IPSS) evaluates symptom severity. Assessing the relationship between prostate volume and IPSS may improve understanding of symptom burden and guide clinical management.

Methods: A cross-sectional multicentre study conducted over a period of twelve months. One hundred and fifty men aged 50 years and above presenting with BPE-related LUTS were enrolled after informed consent. Prostate volume was measured via TAUS using the ellipsoid formula. Each patient completed the IPSS and the post-void residual urine (PVR) was recorded. Prostate cancer, previous surgery, active infection, stricture and neurogenic bladder all excluded. Stats: Pearson's correlation plus one-way ANOVA, $p < 0.05$ cutoff.

Results: A total of 150 patients had the mean age 63.1 year and prostate volume 47.4 mL. mean IPSS was 18.3 showing moderate symptom territory across the board. Our data showed a significant positive correlation between the prostatic volume and IPSS ($r = 0.57$, $p < 0.001$). Men above 50mL of PVR were more symptomatic with higher scores and higher residual volume. Weak stream and incomplete emptying dominated the complaint list.

Conclusion: TAUS-derived prostate volume correlates significantly with LUTS severity in BPE patients and that supports its routine use in clinical workup. Bladder dysfunction, diabetes, hypertension, all of these feed into symptoms independently. Residual volume is one useful data point. It shouldn't be the only one driving treatment decisions.

Keywords: Benign Prostatic Enlargement, BPE, Cross-Sectional Study, IPSS, Lower Urinary Tract Symptoms, LUTS, Prostate Volume, Transabdominal Ultrasound.

INTRODUCTION

Benign prostatic enlargement (BPE) is one of those condition that quietly dominates urology practice. Prevalence documented around 8% in men in their thirties then climbs past 80% by the eighties.[1,2] More aging patients every year means more BPE in every clinic. What matters does understand not just the anatomy, but what these men are actually going through day to day.

The symptoms split into two camps. Storage side: urgency, frequency, nocturia bladder struggling against years of outlet resistance. Voiding side: weak stream, hesitancy, straining, never feeling quite empty more mechanical, more directly tied to the gland. Most men come in with both, and severity varies wildly. Some barely notice it; others can't leave the house.[5]

For measuring prostate size, TAUS has become the practical standard in most outpatient settings. A radiologist takes three dimensions of the gland length, width, height and uses the ellipsoid formula to calculate volume in milliliters. No prep needed, no discomfort, no radiation. It's accessible even in district-level hospitals, which matters a great deal in a country like ours. Multiple validation studies have confirmed its measurements align closely with transrectal ultrasound, the traditional gold standard but TRUS requires bowel prep, causes discomfort, and carries a small infection risk.[4] Most patients, given the choice, would much rather have TAUS.

But wait here's the frustrating bit. You'd expect a bigger prostate to mean worse symptoms more compression, more obstruction, more bother. And the data does support a positive relationship. But consistently, the literature shows the correlation is moderate, not strong. I've seen men with prostates over 100 mL who were barely troubled, and men with 35 mL glands who could barely sleep through the night. Something else is clearly at play, and understanding the actual magnitude of this volume-symptom relationship matters clinically.

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This study set out to quantify that relationship in a defined patient cohort using TAUS-measured volume and IPSS-based symptom scoring. We also tracked post-void residual urine as a secondary functional measure because PVR tells you something IPSS can't: whether the bladder is actually managing to empty or just struggling through. The goal wasn't just to confirm that a correlation exists. It was to understand how strong it is, where it breaks down, and what that means for the clinician sitting across from a man who can't sleep through the night.

MATERIALS AND METHODS

A multicenter tertiary care hospitals cross-sectional observational study was conducted over a period of one year from March 2022 till February 2023. Every patient signed written informed consent. Declaration of Helsinki principles applied throughout. We also made sure both the radiologist performing scans and the urologist scoring symptoms were blinded to each other's findings.[6] We enrolled men aged 50 and above presenting to the urology outpatient clinic with BPE-related LUTS. Recruitment was consecutive we took patients as they came, to keep the sample representative. Based on an expected correlation of $r = 0.30$ to 0.40 between prostate volume and IPSS, we calculated a minimum of 120 patients to achieve 80% power at $p = 0.05$. IPSS has seven questions having a score of 0 to 5 each. Score Under 8 mild, 8 to 19 moderate and 20-plus means severe.

We enrolled 150 to allow for incomplete data and improve our estimates. In practice, data were complete for all 150 no dropouts, no missing IPSS forms.

Inclusion criteria were male, 50 years and above, at least one LUTS complaint, willing to do the scan and fill the questionnaire. Exclusion criteria were patients with prostate cancer, any prior prostate or bladder surgery, active UTI, urethral stricture, neurogenic bladder, spinal cord or peripheral nerve origin both counted. Every patient's information was documented onto an IPSS performa including age, BMI, symptoms duration and comorbidities like hypertension, diabetes mellitus and heart disease. The urologist

scoring symptoms had no access to the ultrasound results at the time kept deliberately separate to avoid bias.

A 3.5 MHz convex-array transducer, patients supine, bladder comfortably full. Three measurements per patient: craniocaudal length, transverse width, anteroposterior height. Volume calculated using the standard ellipsoid formula. All scans were done by the same radiologist throughout consistency matters more than most people appreciate when you're comparing volumes across 150 patients. **Volume (mL) = (pi/6) x L (cm) x W (cm) x H (cm).** Each measurement was taken three times; we used the mean. Post-void residual was measured immediately after the patient voided voluntarily, using the same machine and the same formula applied to bladder dimensions. On the basis of PVR, the participants were divided into three groups. Prostate volume in milliliters was the independent variable. LUTS severity and the total IPSS score were the dependent variables. Age and PVR were tracked as secondary covariates. PSA was noted where available in the clinical record but wasn't used as a primary analytical variable.

Statistical Analysis: Mean ± SD was calculated for the Continuous variables and for the categorical variables frequencies and percentages were calculated. Shapiro-Wilk for normality and Pearson's r for volume-IPSS direction and strength were calculated. R-squared to see how much symptom variance volume actually explained. Three volume groups small under 30 mL, moderate 30 to 50, large over 50 compared by one-way ANOVA with Tukey post-hoc. SPSS version 26 was used for statistical analysis and significance was determined at p value < 0.05.

RESULTS

150 men enrolled. Mean age 63.1 years (SD 8.7), mostly 55 to 70. Hypertension in 62 (41.3%), type 2 diabetes in 37 (24.7%). Mean BMI was 26.4 as mentioned in Table 1.

Prostate volume and IPSS showed a significant positive correlation ($r = 0.57$, $p < 0.001$). R-squared of 0.325 volume accounted for 32.5% of symptom variability. Age correlated weakly with both IPSS ($r = 0.31$, $p = 0.008$) and prostate volume ($r = 0.36$, $p = 0.002$). Mean IPSS was 18.3 ± 6.2, placing the cohort in moderate symptom territory. Mean QoL score 3.7 ± 1.0.

Volume also correlated with PVR ($r = 0.48$, $p < 0.001$). Larger glands corresponded with greater post-void residual. See Table 2.

Small group (under 30 mL): 40 patients (26.7%). Moderate (30–50 mL): 64 (42.7%). Large (over 50 mL): 46 (30.7%). IPSS increased significantly across groups ($F = 24.6$, $p < 0.001$). PVR followed the same pattern. All pairwise comparisons on Tukey post-hoc were significant. See Table 3.

Weak stream and incomplete emptying scored highest across all volume groups. Nocturia was prominent in the large volume group 85% reported two or more nocturnal voids. Urgency increased significantly with volume ($p = 0.009$). All seven IPSS domains trended upward with increasing prostate size. Obstructive symptoms showed a steeper gradient than storage symptoms.

Table 1: Baseline demographic and clinical characteristics of study participants (n = 150).

Characteristic	Value	Range
Age (years)	63.1 ± 8.7	50 – 86
BMI (kg/m²)	26.4 ± 3.2	18.9 – 35.8
Symptom Duration (months)	28.2 ± 15.6	4 – 78
Prostate Volume (mL)	47.4 ± 19.2	17.6 – 118.3
IPSS Score (total)	18.3 ± 6.2	4 – 34
Quality of Life (QoL) Score	3.7 ± 1.0	1 – 6
Post-Void Residual (mL)	62.4 ± 38.7	8 – 210

Table 2: Correlation coefficients between key study variables.

Variable Pair	Pearson r	p-value	Interpretation
Prostate Volume vs. IPSS	0.57	< 0.001	Moderate positive
Prostate Volume vs. PVR	0.48	< 0.001	Moderate positive
Age vs. IPSS	0.31	0.008	Weak positive
Age vs. Prostate Volume	0.36	0.002	Weak positive

Table 3: Stratified comparison of IPSS and PVR by prostate volume group.

Volume Group	n (%)	Mean Vol. (mL)	Mean IPSS	Mean PVR (mL)	p-value
Small (< 30 mL)	40 (26.7%)	23.8 ± 4.1	12.6 ± 4.3	34.2 ± 18.1	Reference
Moderate (30–50 mL)	64 (42.7%)	40.3 ± 6.4	18.4 ± 5.1	58.7 ± 28.4	0.002
Large (> 50 mL)	46 (30.7%)	73.8 ± 17.2	23.1 ± 6.9	96.3 ± 42.6	< 0.001

DISCUSSION

Men above 50 mL were clearly more symptomatic. But R-squared of 0.325 is the real story: prostate size explains only a third of symptom variability. The other two-thirds come from factors a volume measurement simply can't capture. That's a clinically crucial reality an ultrasound number alone won't tell you how a patient is feeling or how aggressively to treat him.

The pathophysiology behind the correlation is well understood. Enlarging prostate, rising outlet resistance, detrusor working harder over time the bladder wall thickens, compliance drops, overactivity sets in.[7,8] That's why men start rushing to the toilet when the bladder's only half full. Obstructive and storage symptoms reinforce each other, both worsening as the gland grows. Mechanistically sound.

This discordance between anatomical size and symptomatic burden is well documented. Published data consistently show that men with comparable prostate volumes can present with markedly different IPSS scores, and symptom progression does not follow a linear path as the gland grows.[10] Detrusor overactivity, nocturnal polyuria, metabolic syndrome, cardiovascular disease, poorly controlled diabetes, and age-related neurological changes all influence how the bladder behaves independently of gland size. None of that is captured on an ultrasound, which is precisely why volume must be interpreted alongside a full clinical assessment.[8,9]

The subgroup data sharpens this picture. A mean IPSS of 12.6 in the small volume group versus 23.1 in the large group shows the difference between mild inconvenience and severe daily impairment. It crosses a clinical threshold that matters. The accompanying rise in PVR, from 34.2 mL to 96.3 mL is significant. High residual volumes increase infection risk, promote stone formation, and in advanced cases can threaten the upper tracts.[11] The 50 mL threshold we observed aligns with the guidelines of European association of urology and American urological association, which recommend 5-alpha reductase inhibitors alone or in combination with alpha-blockers for men above this level, given their higher risk of progression.[12,13]

The volume-PVR correlation ($r = 0.48$, $p < 0.001$) is worth pausing on. PVR is easy to measure during the same TAUS session, at essentially no additional cost or patient burden. It adds real functional information it tells you whether the bladder is actually coping. Men with large prostates and high PVRs need more active management. Capturing both in one sitting makes TAUS a genuinely efficient clinical tool.[14]

Our findings sit comfortably within the range reported in comparable studies. Awaisu et al. found a similar moderate correlation between prostate volume and IPSS in a Nigerian cohort, reinforcing that this volume-symptom relationship holds across different populations and healthcare settings.[12] Raza et al., working in a Pakistani tertiary care context, similarly reported that prostate volume and IPSS correlated positively, though uroflowmetry added independent predictive value.[14] What our data adds is a clearer picture of the subgroup thresholds specifically the 50 mL cutoff and the parallel behaviour of PVR across volume categories. Taken together, the evidence from multiple settings now consistently points

in the same direction: volume matters, but it is one variable among several, and management decisions should reflect that.

We chose TAUS over TRUS deliberately. Patients tolerate it far better in terms of cost and side effects. In a public hospital setting, where the same probe and the same machine handles 30 patients a day, that practicality matters enormously. The volumetric data it produces is reliable. Validation studies consistently report concordance coefficients above 0.90 against TRUS.[4,15] Using a single experienced radiologist throughout also kept our measurements consistent, removing inter-operator variability from the equation.

What this data also tells us and this is something clinicians in this part of the world need to hear is that TAUS is genuinely underutilized as a first-line assessment tool. In many centres, patients are started on alpha-blockers based on symptoms alone, with no volumetric data at all. That's not necessarily wrong, but it means we're flying blind on whether a 5-alpha reductase inhibitor is warranted, whether the patient is at risk of retention, and what his trajectory is likely to be. A single TAUS adds ten minutes to the consultation. The information it provides can redirect management entirely.[12]

CONCLUSION

This study confirms a statistically significant, moderate positive correlation between TAUS-derived prostate volume and LUTS severity in BPE patients ($r = 0.57$, $p < 0.001$). The stepwise worsening of symptoms and residual volumes across volume subgroups supports routine TAUS use in BPE assessment. The 50mL threshold stands out as a clinically useful marker men above it tend to be more symptomatic, retain more urine, and are more likely to benefit from volume-reducing pharmacotherapy. In a busy outpatient setting, having that number available changes the conversation with the patient.

LUTS in BPE is driven by multiple overlapping factors, and I'd caution against letting a single ultrasound measurement drive management decisions. Taken together with symptoms, bladder function, and the patient's own account of how his life is affected, TAUS volume becomes genuinely useful. In isolation, it tells only part of the truth.

Future Recommendations: Future research integrating TAUS volumetry with uroflowmetry, urodynamic data, PSA density, and patient-reported outcomes will be needed to build the kind of predictive models that can guide truly individualized BPE management. Until then, TAUS remains a practical, accessible, and clinically valuable part of the initial workup and this study adds to the evidence supporting its use.

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