Section: Urology/Radiodiagnosis

Original Research Article

A CROSS-SECTIONAL OBSERVATIONAL STUDY ON THE CORRELATION BETWEEN INTRAVESICAL PROSTATIC PROTRUSION AND LOWER URINARY TRACT SYMPTOMS IN ADULT MALES PRESENTING TO A TERTIARY CARE HOSPITAL

Manjushree B M[1], Shravankumar Savadatti[2], Channabasavaraj Hosangadi[3]

[1]Assistant Professor, Department of Radiodiagnosis, SDM College of Medical Sciences and Hospital, Shri Dharmasthala Manjunatheshwara University, Dharwad, Karnataka, India.
[2,3]Assistant Professors, Department of Urology, SDM College of Medical Sciences and Hospital, Shri Dharmasthala Manjunatheshwara University, Dharwad – 580009, Karnataka, India.

Received *: 12/11/2025*
Received in revised form *: 01/01/2026*
Accepted *: 18/01/2026*

Corresponding Author:
Dr. Shravankumar Savadatti,
Assistant Professor, Department of Urology, SDM College of Medical Sciences and Hospital, Shri Dharmasthala Manjunatheshwara University, Dharwad – 580009, Karnataka, India.
Email: shravanfs200@gmail.com

DOI: 10.70034/ijmedph.2026.1.152

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (1); 853-858

ABSTRACT

Background: Benign prostatic hyperplasia (BPH) is a common condition in aging males, frequently presenting with lower urinary tract symptoms (LUTS) that adversely affect quality of life. While total prostate volume has traditionally been considered a determinant of symptom severity, emerging evidence highlights the significance of specific morphological changes, particularly involving the median lobe. This study aimed to assess the correlation between intravesical prostatic protrusion (IPP) and LUTS severity in adult males.

Materials and Methods: This cross-sectional observational study was conducted at a tertiary care hospital over 18 months, involving 80 adult males aged ≥40 years presenting with LUTS. Patients were evaluated using the International Prostate Symptom Score (IPSS). Transabdominal ultrasonography was performed to measure IPP, prostate volume, and post-void residual (PVR) urine. Maximum urinary flow rate (Qmax) was also recorded. P value less than 0.05 was considered statistically significant.

Results: The study population had a mean age of 63.7 ± 8.9 years. A significant positive correlation was observed between IPP and IPSS ($\rho = +0.38$, $p = 0.002$). Patients with IPP >10 mm had significantly higher IPSS scores, lower Qmax, and higher PVR volumes ($p < 0.05$). IPP also showed a significant correlation with prostate volume ($\rho = +0.42$, $P < 0.001$).

Conclusion: Transabdominal ultrasonographic measurement of IPP is a reliable, non-invasive marker correlating with LUTS severity and surrogate parameters of bladder outlet obstruction. Incorporating this measurement into routine evaluation may improve clinical decision-making in BPH management.

Keywords: Prostatic Hyperplasia, Intravesical Prostatic Protrusion, Ultrasonography, Lower Urinary Tract Symptoms.

INTRODUCTION

Benign prostatic hyperplasia (BPH) is a common urological condition affecting aging males worldwide. It is common in individuals over the age of 60 years. It is a significant public health problem because of its association with lower urinary tract symptoms (LUTS) which adversely impact patients' quality of life. Globally, the burden of LUTS attributed to BPH is considerable with some studies reporting the prevalence of BPH to be between 50–75% of men aged over 60 years.[1] These patients experience varying degrees of urinary obstruction depending upon severity of BPH. The common symptoms in individuals with BPH include frequency, urgency, nocturia, weak stream, straining, intermittency and incomplete emptying. In addition to direct clinical consequences the social and psychological ramifications of LUTS are also important. Severe BPH is known to affect sleep

patterns, social interactions and emotional well-being.[2]

The pathophysiology of BPH is multifactorial and does not solely depend upon the size of the prostate gland. While total prostate volume has traditionally been viewed as a determinant of bladder outlet obstruction (BOO) increasing evidence suggests that specific morphological changes within the prostate particularly involving the median lobe may play a more direct role in symptom generation.[3] The median lobe of the prostate can enlarge in a cephalad direction leading to protrusion into the bladder neck and disrupting the normal urinary outflow mechanism. This morphological feature which is easily observable on ultrasound imaging has been recognized, by many authors, as an important anatomical marker associated with BOO. In particular, the protrusion of the median lobe — measured as intravesical prostatic protrusion (IPP) — has gained recognition as a surrogate for BOO and a predictor of treatment response. Although IPP has been extensively studied there remains a need to refine and validate its correlation with symptom severity across diverse clinical settings.[4]

Transabdominal ultrasonography has become a widely accessible, and cost-effective method to evaluate prostatic morphology and function. Through this modality, detailed measurements of prostate size, amount of post void residual urine and morphological features such as the median lobe projection in the urinary bladder can be easily obtained. These imaging findings can then be correlated with clinical parameters such as the International Prostate Symptom Score (IPSS) which remains the most validated instrument for the quantification severity of LUTS in men.[5] The IPSS not only enables standardized symptom assessment but also helps in treatment planning and monitoring of therapeutic outcomes. Despite these advances there remains a need to refine imaging metrics that directly correlate with LUTS severity.[6] This is more so in resource-constrained settings where invasive urodynamic studies are not readily available or can't be afforded by majority of patients.[7]

Among various anatomical components of the prostate the median lobe plays a particularly disruptive role in urinary physiology when hypertrophied.[8] Its extension into the bladder neck can act as a "ball-valve" mechanism thereby exacerbating voiding symptoms disproportionate to the total prostate size.[9] IPP is a well-characterized sonographic parameter reflecting this intravesical protrusion and has been associated with BOO and LUTS severity.[10] Therefore, absolute IPP could serve as a more stable and reproducible parameter.[11]

This study aims to investigate the correlation between the transabdominal ultrasonographic IPP and the severity of LUTS in patients presenting to department of urology of a tertiary care hospital.

MATERIALS AND METHODS

This was a cross-sectional observational study conducted at the Department of Urology in a tertiary care teaching hospital over a period of 18 months. The study population included adult male patients aged 40 years and above presenting with lower urinary tract symptoms (LUTS). A total of 80 patients were enrolled based on a sample size calculation that aimed for a 95% confidence level, 80% power and an estimated correlation coefficient of 0.35 between intravesical prostatic protrusion (IPP) and IPSS based on earlier literature assessing similar variables in prostate morphology and LUTS. The final sample size was adjusted for possible dropouts and data inconsistencies. Written informed consent was taken from all participants.

Each patient underwent a detailed clinical evaluation. A detailed history was taken with respect to onset and severity of lower urinary tract symptoms including frequency, urgency, nocturia, weak urinary stream, intermittency, straining and sensation of incomplete bladder emptying as assessed using the International Prostate Symptom Score (IPSS) questionnaire. Physical examination was done in all cases. Transabdominal ultrasound examination was performed by a high-resolution 3.5 MHz convex probe. All scans were performed by an experienced radiologist to ensure maintenance of consistency and minimizing inter-observer variability. Ultrasound Imaging was conducted with full bladder. PVR measured immediately post-void. The IPP was defined as the linear distance between the bladder base and the apex of the prostate protruding into the bladder measured in the midsagittal plane. In addition to IPP total prostate volume and post-void residual (PVR) urine volume was also documented. Qmax recorded using uroflowmetry; test performed with comfortably full bladder; inadequate voided volume excluded.

All data were recorded in a structured proforma. The ultrasound data for patients fulfilling inclusion criteria was analysed. The integrity and completeness of data was cross-verified with clinical medical records to ensure consistency in measurement technique and clinical documentation.

Statistical analysis was performed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY). Continuous variables such as IPP, IPSS score, prostate volume was expressed as mean ± standard deviation. Post void residual urine was expressed in median. Categorical variables were expressed as frequencies as well as percentages. A p-value of less than 0.05 was considered statistically significant.

Inclusion Criteria

- Male patients above 40 years of age.
- Able and willing to provide informed consent
- Presenting with LUTS suggestive of Benign prostatic hyperplasia.

Exclusion Criteria

- Refusal to give informed and written consent to be part of study.
- History of prostate cancer or suspicion of malignancy
- Prior prostatic surgery or instrumentation
- Current urinary tract infection
- Presence of urethral stricture or neurogenic bladder
- Patients already on medical treatment for BPH

RESULTS

The analysis of the age distribution of the studied cases showed that the majority of patients belonged to the 60–69 years age group (42.5%). This was followed by 50–59 years and 70–79 years (each accounting for 22.5%). A smaller number of patients were in the 40–49 years age (7.5%) whereas the least represented group was those aged 80 years and above (5.0%). [Table 1]

Table 1: Age distribution of the study population (n = 80)

Age Group (Years)	Number of Patients	Percentage (%)
Up to 49 years	6	7.5%
50–59	18	22.5%
60–69	34	42.5%
70–79	18	22.5%
≥80	4	5.0%
Total	**80**	**100%**

The analysis of individual IPSS symptom prevalence among the studied cases showed that nocturia was the most commonly reported symptom (85.0%). This was followed closely by weak urinary stream (82.5%) and increased daytime frequency in 65 cases (81.3%). Sensation of incomplete emptying was noted in 59 patients (73.8%), while intermittency was reported by 57 individuals (71.3%). Urgency was present in 54 patients (67.5%) and straining was the least reported symptom, seen in 53 cases (66.3%). [Figure 1]

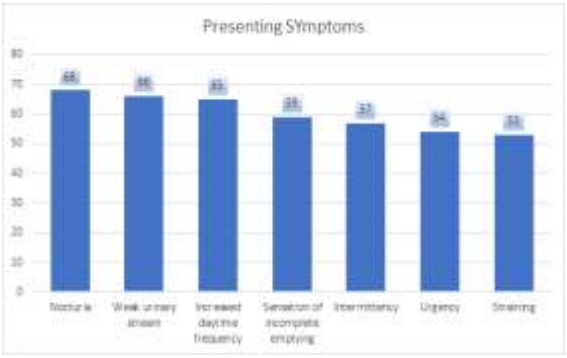

Figure 1: Distribution of lower urinary tract symptoms among the study population.

The analysis of the IPSS severity distribution of the studied cases showed that the majority of patients presented with severe symptoms (50.0%) falling into the severe category (IPSS 20–35). This was followed closely by 34 patients (42.5%) who had moderate symptoms (IPSS 8–19). Only a small proportion, 6 patients (7.5%), exhibited mild symptoms (IPSS 0–7). [Figure 2]

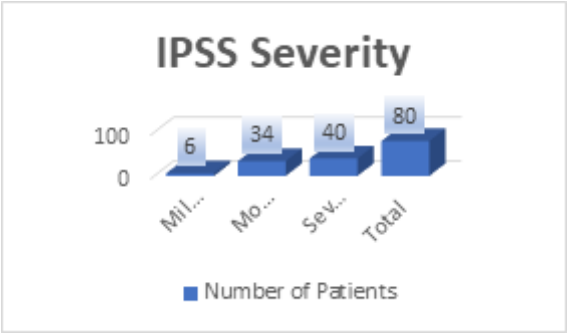

Figure 2: Distribution of IPSS severity scores (n = 80)

Patients with an IPP greater than 10 mm were most commonly found to have severe symptoms. 24 (70.6%) patients with an IPP more than 10 mm belonged to severe IPSS category. Among those patients with an IPP of 5–10 mm, 10 had moderate symptoms and 9 had severe symptoms. In contrast, patients with an IPP less than 5 mm were primarily clustered in the mild and moderate IPSS categories, with 5 of the 6 mild cases (83.3%) and 14 of the 34 moderate cases (41.2%) in this group, while only 7 patients (17.5%) with severe symptoms had an IPP under 5 mm [Table 2].

Table 2: Categorization of IPP and its correlation with IPSS severity

intravesical prostatic protrusion	Mild IPSS (n=6)	Moderate IPSS (n=34)	Severe IPSS (n=40)	Total	p-value
<5 mm	5	14	7	26	**0.003***
5–10 mm	1	10	9	20	
>10 mm	0	10	24	34	
Total	**6**	**34**	**40**	**80**	

The analysis of clinical and urodynamic parameters across different IPP categories showed that patients with an IPP greater than 10 mm had the highest mean prostate volume (69.4 ± 26.1 cc), the lowest mean Qmax (9.8 ± 3.6 ml/s), and the highest median post-void residual (PVR) urine volume (85 ml). Those with an IPP of 5–10 mm had intermediate values, with a mean prostate volume of 55.8 ± 22.3 cc, mean

Qmax of 12.5 ± 4.3 ml/s, and a median PVR of 40 ml. In contrast, patients with an IPP less than 5 mm had the smallest mean prostate volume (42.1 ± 18.6 cc), the highest mean Qmax (14.2 ± 5.1 ml/s), and the lowest median PVR (25 ml). The differences in all three parameters across the IPP groups were statistically significant. [Table 3]

Table 3: Comparison of prostate volume, Qmax and PVR across IPP categories

intravesical prostatic protrusion category	Mean Prostate Volume (cc)	Mean Qmax (ml/s)	Median PVR (ml)	P value
<5 mm	42.1 ± 18.6	14.2 ± 5.1	25	<0.05*
5–10 mm	55.8 ± 22.3	12.5 ± 4.3	40	
>10 mm	69.4 ± 26.1	9.8 ± 3.6	85	

There was a statistically significant positive correlation between IPP and total IPSS score (ρ = +0.38, p = 0.002). Similarly, statistically significant positive correlations were found with both IPSS voiding subscore (p = 0.004) and storage subscore (p = 0.01). IPP also had significant positive correlation with prostate volume (p < 0.001) and post-void residual volume (p < 0.001). A statistically significant negative correlation was found with Qmax (p = 0.005) indicating that increased IPP is linked to reduced urinary flow rate. [Table 4]

Table 4: Spearman correlation between Intravesical prostatic protrusion and clinical parameters

Parameter (correlated with IPP)	Spearman's ρ	p-value
IPSS (total score)	+0.38	0.002*
IPSS (voiding subscore)	+0.34	0.004*
IPSS (storage subscore)	+0.29	0.01*
Prostate Volume	+0.42	<0.001*
Qmax	–0.33	0.005*
Post-void Residual Volume	+0.47	<0.001*

DISCUSSION

This was a cross sectional observational study of 80 adult male patients with lower urinary tract symptoms (LUTS). We found a statistically significant correlation between the transabdominal ultrasonographic intravesical prostatic protrusion (IPP) and LUTS severity. In this study increasing IPP was associated with greater LUTS severity, lower maximum urinary flow rate (Qmax), higher post void residual (PVR) urine volumes and larger prostate volume. These findings are consistent with prior literature demonstrating that morphological features of the prostate significantly influence LUTS and bladder outlet obstruction (BOO). For example, Hamza et al in their study on IPP showed that IPP correlates with symptom severity and can be a reliable non-invasive marker for BOO in BPH patients.[12] Moreover literature suggests that anatomical changes such as protrusion of the median lobe into the bladder neck can result in a "ball valve" type obstruction thereby exacerbating urinary symptoms. Similar findings were also reported by authors such as Lim KB et al,[13] and Park SC et al,[14] In this study Spearman correlation coefficient revealed a positive correlation between IPP and total IPSS (ρ = +0.38; p = 0.002). These findings are similar to findings from other morphological studies indicating that specific anatomical features (such as intravesical prostatic protrusion) are more predictive of symptomatic severity than overall prostate volume. In a similar study Okedere et al found that significant IPP on transabdominal ultrasound correlated positively with increased LUTS symptom severity.[15] These findings underscored the role of ultrasound parameters other than overall prostatic size and weight in cases of BPH. Furthermore, studies examining the relationship between prostate morphological indices (e.g., prostatic urethral length and IPP) and LUTS have shown a positive correlation between IPP as well as length of prostatic urethra and voiding dysfunction. In a similar study Kim BS et al highlighted that prostatic urethral length — influenced by median lobe enlargement — may serve as a predictive factor for surgical intervention.[16] These studies underlined the importance of such parameters in clinical decision making.

Interestingly, our study also demonstrated significant differences in objective urodynamic surrogates such as Qmax and PVR across IPP categories. Patients with IPP >10 mm had higher IPSS scores. Additionally, these patients also exhibited significantly lower Qmax and higher PVR volumes as compared to those with lesser IPP (p < 0.01). This suggests that IPP may contribute to functional obstruction through increased resistance at the bladder outlet. These findings find support in the broader literature on BOO where non-invasive measures like IPP, prostate volume as well as related morphological features are shown to correlate with urodynamic evidence of obstruction. For example, a study by Eze BU et al reported that patients with significant median lobe protrusion had more severe symptoms and signs of obstruction compared with those without pronounced protrusion.[17] Additionally Mangat et al noted that the shape and protrusion dynamics of the prostate determine the degree of obstruction and symptom severity.[18] These findings are similar to our observations regarding IPP and severity of symptoms in cases of BPH.

Several studies have established a positive relationship between prostate size and LUTS severity. A recent study by Sadiq et al found that transabdominal prostatic volume positively correlated with IPSS. This simply indicated that larger prostate glands are often associated with more severe symptoms.[19] However it is a well reported fact that predictive value of prostate volume alone remains limited and inconsistent across populations. This limitation had practical implications in terms of managing patients with BPH and the need to examine other morphological markers like intravesical prostatic protrusion (IPP). Various studies have concluded that these alternative parameters can better capture the anatomical basis of BOO and LUTS. On the other hand, the conflicting findings also needs to be taken into account. For example, Basawaraj et al reported that sonographic prostatic volume was not associated with significant increases in IPSS in their cohort, pointing to variability in how morphological changes translate to symptoms across diverse patient populations and study methodologies.[20]

The clinical implications of our findings are manifold. First, measuring IPP by ultrasound offers a simple and non-invasive imaging parameter that correlates well with both symptomatic severity as well as objective measures of voiding dysfunction. This parameter could be incorporated into routine prostate evaluations particularly in settings where urodynamic studies are not readily available. Second identifying patients with significant IPP may help in risk stratification and treatment planning. This can also help in guiding decisions toward earlier surgical intervention or tailored medical therapy. Our study contributes to the growing body of evidence advocating for a more anatomy focused approach in assessing BPH and LUTS one that goes beyond total gland volume to include specific morphological features such as IPP.

CONCLUSION

There was a significant positive correlation between the ultrasonographic IPP of the prostate and the severity of lower urinary tract symptoms (LUTS) in patients with BPH. Increasing IPP was associated with higher IPSS, lower Qmax, higher PVR, and larger prostate volume. These findings highlight importance of assessment of IPP as a distinct morphological contributor to bladder outlet obstruction which can be used in addition to traditionally measured total prostate volume.

REFERENCES

1. Langan RC. Benign Prostatic Hyperplasia. Prim Care. 2019 Jun;46(2):223-232. doi: 10.1016/j.pop.2019.02.003. Epub 2019 Apr 1. PMID: 31030823.
2. Lingzhi S, Zhang H, Luo Y. The Impact of Self-Management Abilities, Sleep Quality, and Anxiety on the Well-Being of Patients With Benign Prostatic Hyperplasia: A Cross-Sectional Analysis. J Patient Exp. 2025 May 7;12:23743735251341726. doi: 10.1177/23743735251341726. PMID: 40351737; PMCID: PMC12062591.
3. Gharbieh S, Reeves F, Challacombe B. The prostatic middle lobe: clinical significance, presentation and management. Nat Rev Urol. 2023 Nov;20(11):645-653. doi: 10.1038/s41585-023-00774-7. Epub 2023 May 15. PMID: 37188789.
4. Ashley MS, Phillips J, Eure G. How I Do It: The prostatic urethral lift for obstructive median lobes. Can J Urol. 2023 Apr;30(2):11509-11515. PMID: 37074752.
5. Yao MW, Green JSA. How international is the International Prostate Symptom Score? A literature review of validated translations of the IPSS, the most widely used self-administered patient questionnaire for male lower urinary tract symptoms. Low Urin Tract Symptoms. 2022 Mar;14(2):92-101. doi: 10.1111/luts.12415. Epub 2021 Nov 3. PMID: 34734477.
6. Rukstalis DB. Pelvic ultrasound evaluation for benign prostatic hyperplasia: prediction of obstruction. Curr Urol Rep. 2014 May;15(5):403. doi: 10.1007/s11934-014-0403-8. PMID: 24658830.
7. Winters JC, Dmochowski RR, Goldman HB, Herndon CD, Kobashi KC, Kraus SR, Lemack GE, Nitti VW, Rovner ES, Wein AJ; American Urological Association; Society of Urodynamics, Female Pelvic Medicine & Urogenital Reconstruction. Urodynamic studies in adults: AUA/SUFU guideline. J Urol. 2012 Dec;188(6 Suppl):2464-72. doi: 10.1016/j.juro.2012.09.081. Epub 2012 Oct 24. PMID: 23098783.
8. Duijn M, Hovius MC, Boevé LMS. Intravesical protrusion of giant median prostatic lobe: A case report. Urol Case Rep. 2022 Jul 4;44:102152. doi: 10.1016/j.eucr.2022.102152. PMID: 35832858; PMCID: PMC9272338.
9. Gandhi J, Weissbart SJ, Kim AN, Joshi G, Kaplan SA, Khan SA. Clinical Considerations for Intravesical Prostatic Protrusion in the Evaluation and Management of Bladder Outlet Obstruction Secondary to Benign Prostatic Hyperplasia. Curr Urol. 2018 Oct;12(1):6-12. doi: 10.1159/000447224. Epub 2018 Jun 30. PMID: 30374274; PMCID: PMC6198776.
10. Rieken M, Presicce F, Autorino R, DE Nunzio C. Clinical significance of intravesical prostatic protrusion in the management of benign prostatic enlargement: a systematic review and critical analysis of current evidence. Minerva Urol Nefrol. 2017 Dec;69(6):548-555. doi: 10.23736/S0393-2249.17.02828-4. Epub 2017 Mar 6. PMID: 28263050.
11. Bulbul E, Oztekin O, Yavuz Ilki F. Intravesical prostatic protrusion volume: effect on lower urinary tract symptoms and urinary flow in patients with benign prostatic enlargement. World J Urol. 2025 Oct 4;43(1):588. doi: 10.1007/s00345-025-05986-7. PMID: 41044460.
12. Hamza BK, Ahmed M, Bello A, Tolani MA, Awaisu M, Lawal AT, et al. Correlation of intravesical prostatic protrusion with severity of lower urinary symptoms among patients with benign prostatic hyperplasia. Afr J Urol 2021;27:1–7.
13. Lim KB, Ho H, Foo KT, Wong MY, Fook-Chong S. Comparison of intravesical prostatic protrusion, prostate volume and serum prostatic-specific antigen in the evaluation of bladder outlet obstruction. Int J Urol. 2006 Dec;13(12):1509-13. doi: 10.1111/j.1442-2042.2006.01611.x. PMID: 17118026.
14. Park SC, Lee JW, Rim JS. The relationship between intravesical prostatic protrusion and pressure flow study findings in patients with benign prostate obstruction/lower urinary tract symptoms. Actas Urol Esp. 2012 Mar;36(3):165-70. Spanish. doi: 10.1016/j.acuro.2011.06.023. Epub 2011 Oct 21. PMID: 22018947.
15. Okedere TA, Idowu BM, Onigbinde SO. Ultrasonographic Intravesical Prostatic Protrusion in Men with Benign Prostatic Hyperplasia in Southwest Nigeria. J West Afr Coll Surg. 2023 Apr-Jun;13(2):16-22. doi: 10.4103/jwas.jwas_270_22. Epub 2023 Mar 20. PMID: 37228883; PMCID: PMC10204911.
16. Kim BS, Ko YH, Song PH, Kim TH, Kim KH, Kim BH. Prostatic urethral length as a predictive factor for surgical treatment of benign prostatic hyperplasia: a prospective, multiinstitutional study. Prostate Int. 2019 Mar;7(1):30-34.

doi: 10.1016/j.prnil.2018.06.002. Epub 2018 Jun 18. PMID: 30937296; PMCID: PMC6424679.
17. Eze BU, Ani CO, Mbaeri TU. Is intravesical prostatic protrusion associated with more complications in benign prostatic hyperplasia patients? Low Urin Tract Symptoms. 2021 Oct;13(4):468-474. doi: 10.1111/luts.12394. Epub 2021 Jun 2. PMID: 34080315.
18. Mangat R, Ho HSS, Kuo TLC. Non-invasive evaluation of lower urinary tract symptoms (LUTS) in men. Asian J Urol. 2018 Jan;5(1):42-47. doi: 10.1016/j.ajur.2017.12.002. Epub 2017 Dec 8. PMID: 29379736; PMCID: PMC5780291.
19. Sadiq H, Bilal R, Shafique M, Waqar S, Ghazanfar QUA, Azam S. Correlation between prostatic volume and international prostatic symptom score in patients with benign prostatic hyperplasia. Pak Armed Forces Med J. 2024;74(6):1694-1697. doi:10.51253/pafmj.v74i6.7154
20. Basawaraj NG, Dasan TA, Patil SS. Correlation of sonographic prostate volume with international prostate symptom score in South Indian men. Int J Res Med Sci. 2015;3(11):3126-3130. doi:10.18203/2320-6012.ijrms20151149.