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ORIGINAL ARTICLE

Prospective validation of a novel visual analogue uroflowmetry score (VAUS) in 1000 men with lower urinary tract symptoms (LUTS)

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Abstract

Introduction and aims Family physicians are limited by lack of tools to monitor benign prostate hyperplasia. VAUS provides a cost-effective, easily administered non-invasive tool. Our primary aim was to validate VAUS correlation with uroflowmetry measured maximal flow rate (Q_{max}), voided volume and International Prostate Symptom Scores (IPSS) symptom scores. Secondary aim was to study how the VAUS fared at predicting poor flow ($Q_{max} < 10$ ml/s) compared to age, voided volume and IPSS. Tertiary aim was to predict the best VAUS as a cutoff for poor flow.

Methods After IRB approval, 1000 patients were prospectively recruited. They had VAUS, uroflowmetry and IPSS performed. VAUS is a novel five-point visual analogue scoring of urine flow, with one being the weakest and five the strongest. Data were analysed using SPSS where spearman's correlation coefficient and logistic regression analysis were performed looking for significance. Receiver operating curves (ROC) curves were used to identify best VAUS cutoff.

Results 1000 patients were studied with mean age of 68.99 (50–95). VAUS showed good correlation with Q_{max} $p < 0.001$, voided volume $p = 0.006$ and IPSS $p < 0.001$. On multivariate analysis both VAUS and voided volume predicted poor flow significantly with p value of <0.001 and $p = 0.001$, respectively. On ROC analysis VAUS of 2.5 was identified as best value for predicting poor flow with p value <0.001.

Conclusion VAUS is a validated tool for monitoring of lower urinary tract symptoms in our patients showing significant correlation with uroflowmetry, voided volume and IPSS.

Keywords Benign enlargement of prostate · International prostate symptom score · Visual prostate · Symptom score

Introduction and aims

Lower urinary tract symptoms (LUTS) due to benign prostatic hyperplasia (BPH) is extremely prevalent in elderly populations with rates as high as 90% by age 85 [1]. It is the patients' perception of bothersome symptoms that would determine decision and choice of therapy [2]. Free-flow uroflowmetry and the international prostate symptom score (IPSS) (Table 1) are widely used tools by urologists to asses severity of LUTS in men with BPH and to evaluate the response to medical or surgical therapy [3]. With the majority of BPH patients being now managed in primary care setting, the use of the above two tools confronts primary care practitioners with unique challenges.

Many patients find IPSS difficult to comprehend. Studies have shown 30–70% of men could not complete the IPSS because they found the questions too difficult to understand [4], and this problem was more common in men with a lower level of education [5]. In Asia, language barriers for patients who do not use English as a first language make interpretation difficult without validated translations. Further, the process is time consuming and that acts as a deterrence to the use of IPSS in busy clinics. Regarding uroflowmetry, its use in primary care is limited by costs and availability of trained nurses.

Van der Walt et al. [6] developed a visual prostate symptoms score (VPSS) using several pictograms to asses four IPSS questions related to frequency, nocturia, weak stream

This project has been presented and awarded at several conferences. Best abstract presentation UAA 2017 meeting Hong Kong, Best poster SIU 2018 Seoul and Best poster at Urofair 2019 Singapore. It was also presented as a moderated poster at EAU 2019 Barcelona.

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Table 1 The IPSS

International prostate symptom score (lPSS)							
Patient name: ----------			Dale of birth:--------		Date completed----------		
In the past month	Not at all	Less than 1 in 5 times	Less than half the time	About half the time	More than half the time	Almost always	Your score
1. Incomplete emptying How often have you had the sensation of not emptying your bladder?	0	1	2	3	4	5	
2. Frequency How often have you had urinate less then every two hours?	0	1	2	3	4	5	
3. Intermittency How often have you found you stopped and started again several times when you urinated?	0	1	2	3	4	5	
4. Urgency How often have you found it difficult to postpone urination?	0	1	2	3	4	5	
5. Weak stream Hoe often have you had a weak urinary stream?	0	1	2	3	4	5	
6. Straining How often have you had to strain to start urination?	0	1	2	3	4	5	
	None	1 time	2 times	3 times	4 times	5 times	
7. Nocturia How many times did you typically get up at night to urinate?	0	1	2	3	4	5	
Total IPSS score							
Score: 1–7: mild		8–19: moderate			20–35: severe		
Quality of life due to urinary symptoms	Delighted	Placed	Monthly satisfied	Mixed	Monthly dissatisfied	Unhappy	Terrible
If you were to spend the rest of your life with your urinary condition just the way it is now, how would you feel about that?	0	1	2	3	4	5	6

and quality of life (QoL). They found the VPSS correlated significantly with the IPSS and could be completed without physician assistance by a greater proportion of men with limited education, indicating it may be more useful than IPSS in patients who are illiterate or have limited education.

We aimed to create an even more simplified novel visual likert score for easy patient understanding and self-reporting, named the visual analogue uroflowmetry score (VAUS). As a primary aim VAUS would be prospectively validated against uroflowmetry measured maximal flow rate (Q_{max}), voided volume and IPSS. Secondary aim was to study how VAUS fared in predicting poor flow as defined as $Q_{max} \leq 10$ ml/s when compared to other factors like age, voided volume (VV) and IPSS. The tertiary aim was to determine the best VAUS cutoff value for predicting poor flow.

Patients and methods

After institutional review board approval, men with LUTS due to BPH above the age of 50 years were prospectively recruited. They all completed the IPSS comprising the following questions : Q1—incomplete emptying, Q2—frequency, Q3—intermittency, Q4—urgency, Q5—weak stream, Q6—straining, Q7—nocturia, Q8—quality of life (QoL). They were also requested to complete the VAUS (Fig. 1) comprising a simple pictogram where they scored their flow stream from 1 to 5. VAUS is a novel likert score with 1 being the slowest stream and least volume and five being fastest stream and highest volume. The score is easily administered in a language that patients can understand, and we primarily administered the score in English, Mandarin, and Malay language. Patients may select any number from 1 to 5 to best describe their usual urinary flow. They all subsequently had a full medical history and physical examination. The Q_{max}, average urinary flow rate (Q_{ave}) and voided volume (VV) were measured with a MMS flowmaster uroflowmeter, after which post void residual urine was (PVR) calculated trans-abdominally was measured with a BK ultrasound machine and a 2.3 MHz probe. For uroflowmetry readings to be accepted minimum voided volume was set as 100 ml.

Statistical analysis was performed with SPSS software with Spearman's test for correlation analysis, logistic regression for univariate and multivariate analysis and receiver operating characteristic (ROC) for identifying the best VAUS cutoff. Statistical significance was taken as p value of <0.05.

Results

During the period of June 2017 till March 2019, a total of 1000 men were enrolled (mean age 69, range 48–95). Uroflowmetry was performed on all with mean Q_{max} 13.2 ml/s (range 2.9–44.9) and mean voided volume 232 ml (range 99–826). On taking the IPSS, our cohort was divided into three groups based on IPSS, mild (score <7), moderate (score 8–19) and severe (20–35). The distribution was 42.6%, 45.9%, and 11.5%, respectively. (Table 2).

On studying age and Q_{max} distribution we expectedly noticed a higher proportion of poor flow in older patients as defined as age≥70 years, 30 vs 35%. (Table 3).

When VAUS was compared with flow characteristics we found a higher proportion with poor flow had poor VAUS (score 1–2), while higher proportion of those with good flow (>10 ml/s) had good VAUS (score 3–5). This was statistically significant $p < 0.005$ (Table 4).

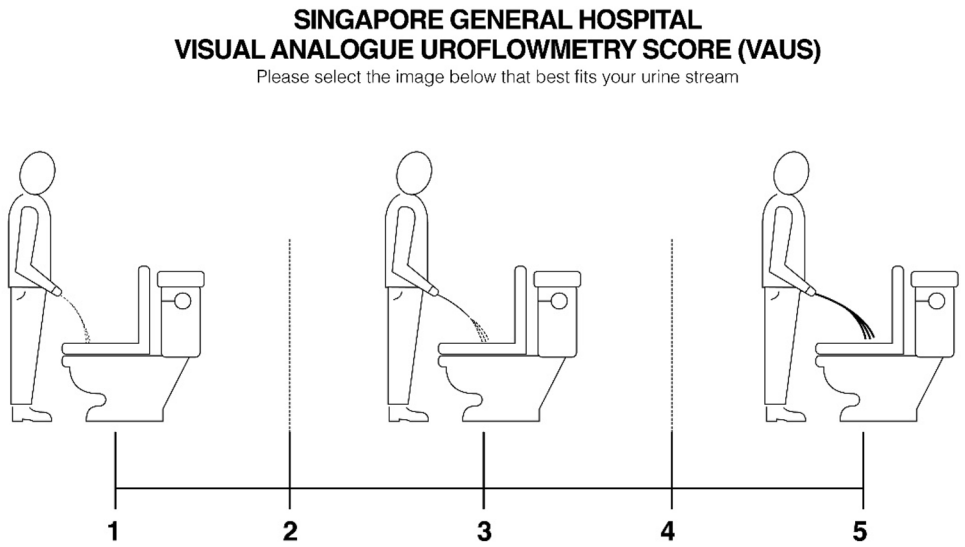

Fig. 1 Visual analogue uroflowmetry score. A novel likert score with one being slowest stream and least volume, and five being fastest stream and highest volume

Table 2 Patient characteristics

Patient characteristics	Mean (range)
Age (years)	69 (48–95)
Q_{max} (ml/s)	13.2 (2.9–44.9)
Voided volume (ml)	232 (99–826)
VAUS	2.7 (1–5)
IPSS quality of life (QoL) score	3 (0–6)
Patient characteristics	***n* (%)**
IPSS symptom score	
Mild LUTS (1–7)	426 (42.6)
Moderate LUTS (8–19)	459 (45.9)
Severe LUTS (20–35)	115 (11.5)

Table 3 Age and Q_{max} distribution

Age (years)	Poor flow (Q_{max} < 10) *n* (%)	Good flow (Q_{max} > 10) *n* (%)
< 70	157 (30)	361 (70)
> 70	170 (35)	312(65)

Table 4 VAUS and Q_{max} distribution

VAUS	Poor flow (Q_{max} < 10) *n* (%)	Good flow (Q_{max} > 10) *n* (%)
Poor VAUS (1–2)	143 (42)	192 (58)
Good VAUS (3–5)	184(28)	480 (72)

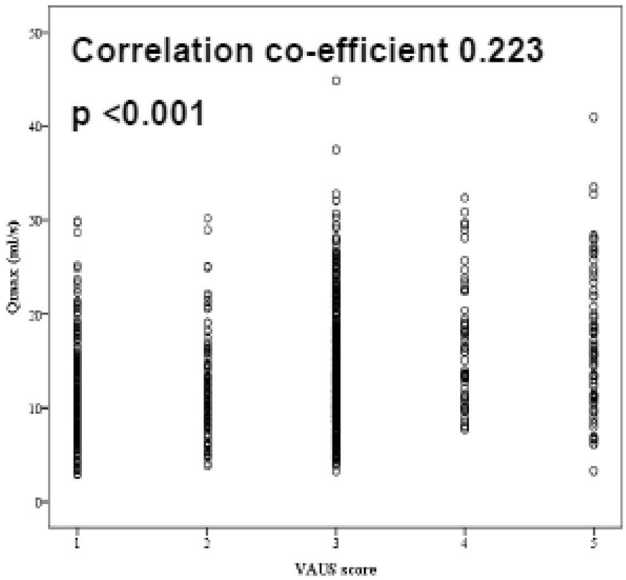

Fig. 2 VAUS positive correlation with Q_{max} (ml/s)

There were statistically significant positive correlations between VAUS and Q_{max} (r=0.223, p <0.001) (Fig. 2), VAUS and VV (r=0.87, p <0.001) (Fig. 3)and a statistically significant negative correlation between VAUS and IPSS (r=−0.325, p <0.001) (Fig. 4).

On logistic regression univariate analysis several factors were analysed to assess how well they predicted poor flow. Voided volume (p <0.001), IPSS measured severe LUTS (p <0.001) and VAUS (p <0.001) all predicted significantly for poor flow (Table 5).

On multivariate analysis only voided volume (p <0.001) and poor VAUS (VAUS 1 and 2) (p <0.001) predicted for poor flow. Notably, poor VAUS predicted poor flow better than IPSS on this multivariate analysis (Table 6). The odds of a poor VAUS (score 1 and 2) predicting poor flow was 1.7 times that of a good VAUS (score 3–5).

Receiver operating curve analysis was used to asses for the best VAUS cutoff for predicting poor flow, and we found that a VAUS cutoff 2.5 predicted poor flow the best. (Fig. 5, Table 7). This helps in clinical management of patients as it provides us a more objective means of classifying the patients.

Discussion

The proposal for the novel VAUS stems from the anticipated challenges faced by primary care physicians in Singapore when managing patients with BPH. With an aging population, the incidence of BPH is increasingly rapidly [7] and as such, primary care physicians will shoulder a heavier responsibility. We feel that the primary care physicians will benefit from more tools to empower their safe, confident and efficient management of BPH patients in the community.

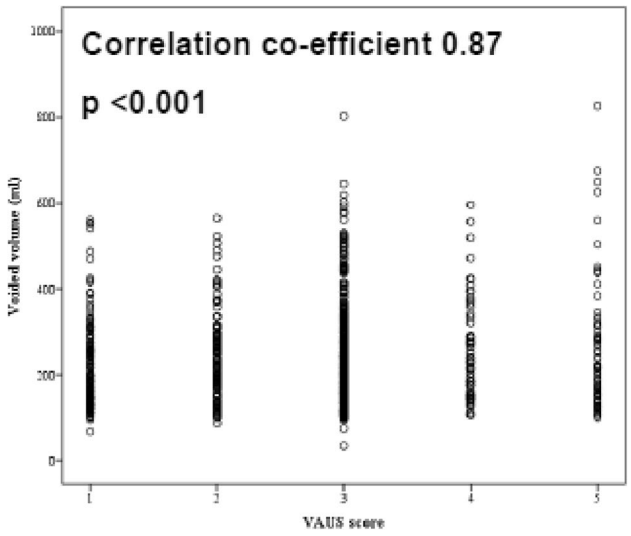

Fig. 3 VAUS positive correlation with voided volume (ml)

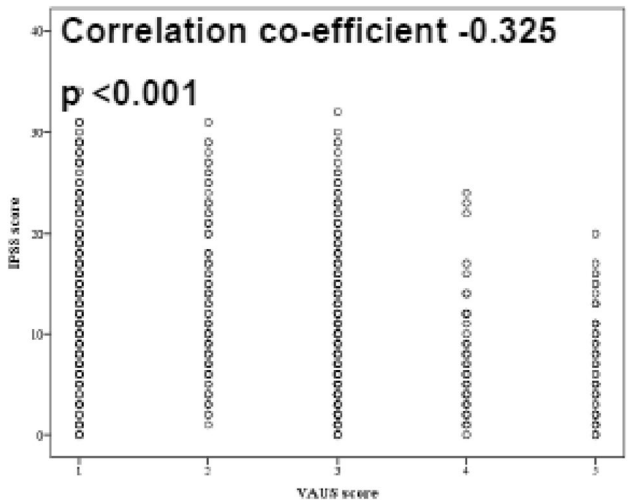

Fig. 4 VAUS negative correlation with IPSS

Table 5 Univariate analysis of factors predicting poor flow

Factors predicting $Q_{max} < 10$	*p* value
Age	0.017
Voided volume	< 0.001
IPSS	
Moderate LUTS	0.025
Severe LUTS	< 0.001
VAUS	< 0.001

The IPSS is an internationally validated patient-administered questionnaire for quantifying severity of LUTS [8] and is used as a non-invasive tool for monitoring of LUTS.

Table 6 Multivariate analysis of factors predicting poor flow

Factors predicting $Q_{max} < 10$	*p* value
Age	0.648
Voided volume	< 0.001
IPSS	
Moderate LUTS	0.251
Severe LUTS	0.490
Poor VAUS (1–2)	0.001

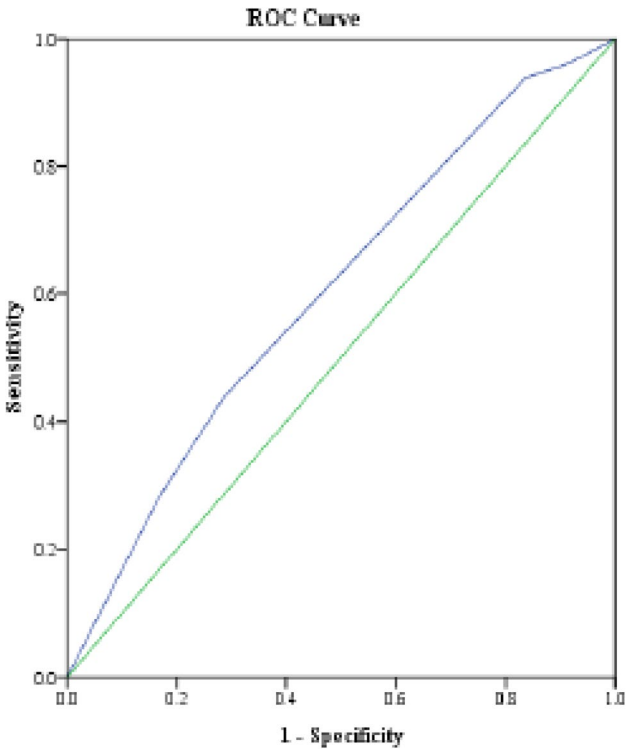

Fig. 5 ROC curve analysis showing plot of VAUS 2.5

Table 7 Characteristics of VAUS 2.5

AUC	0.603
p value	< 0.001
Sensitivity	43.7%
Specificity	71.4%
PPV	42.7%
NPV	72.3%

There have been reports from several centres in Africa and Asia documenting challenges faced using this survey in elderly patients [6, 9]. These challenges arise owing to problems with literacy, cognitive ability and visual acuity of the patients. In addition, the increased time spent to perform the scoring acts as a disincentive to physicians administering it in a busy clinic setting. Difficulties with IPSS have

also prompted French authors Teillac et al. [10] to study concordance between IPSS and visual analogue scale (VAS) in a pilot study of 65 patients. The authors found significant correlation between the easy-to-administer VAS and IPSS severity categories with high correlation coefficients and significant p values. They concluded that their results needed to be validated by larger-scale studies under actual practice conditions, which we did perform in our large 1000 patient study.

Uroflowmetry although being an objective test of flow may not be suitable in primary care owing to costs involved and lack of technical expertise to run the tests. We aimed to find a suitable symptom score that would correlate well with both IPSS and uroflowmetry. Many previous studies have evaluated the correlation between symptom scores and uroflowmetry parameters. Bosch et al. [11] reported a weak correlation of the IPSS with total prostate volume, Q_{max} and post void residual urine (PVR). Another study by Groeneveld et al. [12] of the multidiagram visual prostate symptom score (VPSS) ($n=96$) showed significant correlation between IPSS and Q_{max} ($r=-0.30$, $p=0.016$) and VPSS and Q_{max} ($r=-0.38$, $p<0.002$). It led the authors to conclude that VPSS was equivalent to IPSS for predicting Q_{max} and thus should be used over IPSS for men of limited education. The VPSS was further studied by another group in Nepal [9] ($n=45$) finding similar correlation between VPSS, IPSS and uroflow leading them to recommend it instead of IPSS.

We decided to craft a new visual score apart from VPSS because we found VPSS having several diagrams to be still too complex for our elderly patients to interpret. As it was our first foray into diagrammatic flow measurements, we developed a simple scoring system to use as an initial pilot. Our VAUS (Fig. 1) incorporated the flow rate (distance from patient to where stream landed) and voided volume (thickness of the stream). The correlation coefficients were similarly statistically significant when compared to Q_{max} and IPSS as the preceding VPSS scores were.

We used univariate and multivariate analysis to study how VAUS fared when compared with other parameters in measuring poor flow. On univariate analysis VAUS-matched voided volume and severe LUTS category IPSS for predicting poor flow ($p<0.001$). Interestingly, here we see that moderate LUTS category on IPSS did not reach significance in poor flow prediction ($p=0.025$). On multivariate analysis the subcategory of poor VAUS defined as score 1 or 2 actually predicted poor flow better than the severe LUTS category of IPSS (p value 0.001 vs 0.490). This may point to patients not being able to report their LUTS accurately on IPSS, for reasons we have discussed previously.

ROC curve analysis and finding the cutoff for poor VAUS at 2.5 was a clinically useful measure as it helped us to use VAUS for rapid identification of poor flow patients, without them having to perform a uroflowmetry. This could help primary care physicians better select patients for closer monitoring or referral to specialist care.

We do feel the strength of this study is the 1000 patients who were prospectively recruited, being the largest study in the area of visual uroflowmetry scores to date. We believe our patient cohort was representative of the usual elderly male patients seen in most centres thus allowing for our results to be applicable internationally.

There are several limitations of this study. First, we acknowledge that VAUS tested primarily for flow and voided volume, while IPSS tests many other facets of LUTS. We did not perform an individual comparison of the IPSS question related to weak stream alone with VAUS. This is because this study was an initial pilot to assess the relationship of this simplified novel score to IPSS as a whole, trying to simulate actual clinical practice conditions, where patients would fill up the whole score. Aim of keeping the score simplified initially was to allow ease of use by patients. Future plans would be to further enhance the visual score to cover other LUTS symptoms. Second limitation was the possible overlay of subjectivity on VAUS, which is a patient-reported score. We accept that as a subjective score, the patient's perception of his subjective flow may change when influenced by prior knowledge of his objective results (Q_{max}). As such, further studies will be conducted on the role of subjectivity in this score, looking at the relationship of the score before and after revelation of uroflowmetry results. The third limitation would be the relatively modest correlation coefficients in this study, which could be partly due to using single-void flow rate measurements in this study [13]. However, the magnitude of these correlations is similar to preceding studies on visual uroflowmetry scores, potentially showing VAUS to be comparable to other more complex visual scoring systems.

Conclusion

We conclude from this large study that VAUS is a validated tool that correlates significantly with Q_{max}, voided volume and IPSS. VAUS predicted for poor flow well, with subset of poor VAUS outperforming IPSS. The best VAUS cutoff for measuring poor flow was found to be 2.5. As such we believe that VAUS provides a cost-effective, easily administered non-invasive tool perfectly suited for primary care management of elderly, less literate BPH patients with LUTS.

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Author contributions RT: project development, data collection, manuscript writing. MYN: data management, data analysis. SHN: data

collection, project development. RM: project development. HH: project development.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethics approval All procedures in the studies involving human participants were in accordance with ethical standards of the institution (Singhealth IRB 2016/2746) and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Human and animal rights This article does not contain any studies with animals performed by any of the authors.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Thorpe A, Neal D (2003) Benign prostatic hyperplasia. Lancet 361(9366):1359–1367
2. Foo KT (2016) Solving the benign prostatic hyperplasia puzzle. Asian J Urol. 3(1):6–9
3. Roehrborn CG (2008) BPH progression : concept and key learning from MTOPS. ALTESS, COMBAT and ALF-ONE, BJU Int 101(suppl 3):17–21
4. Rodrigues Netto N Jr., de Lima ML, de Andrade EF et al (1997) Latin American study on patient acceptance of the International Prostate Symptom Score (IPSS) in the evaluation of symptomatic benign prostatic hyperplasia. Urology 49(1):46–49
5. Cam K, Akman Y, Cicekci B, Senel F, Erol A (2004) Mode of administration of international prostate symptom score in patients with lower urinary tract symptoms: physician vs self. Prostate Cancer Prostatic Dis 7(1):46–49
6. Van der Walt CLE, Heyns CF, Groeneveld AE, Edlin RS, van Vuuren SPJ (2011) Prospective comparison of a new visual prostate symptoms score versus the international prostate symptoms score in men with lower urinary tract symptoms. Urology 78(1):17–20
7. Foo KT, Ho SSH, Wong M, Lim KB, Teo CCP et al (2017) Singapore urological association clinical guidelines for male lower urinary tract symptoms/benign prostate hyperplasia. Singapore Med J 58(8):473–480
8. Graves S, Cornu JN, Gacci M, Gratzke C, Hermann TRW et al (2019) European association of urology guidelines panel non-neurogenic male lower urinary tract symptoms. Eur Urol 67(6):1099–1109
9. Gupta DK, Gupta S, Jha N (2015) Correlation between visual prostate symptoms score and uroflowmetry parameters in patients with benign enlargemet of prostate. J Nepalgunj Med Coll 13(2):2–5
10. Teillac P, Rozet F, Terrier N, Mongiat-Artus P, Rambeaud JJ (2004) Value of a visual analogue scale for evaluation of the severity of symptoms of benign prostate hyperplasia (BPH): pilot study of 2 urological centres. Prog Urol 14(4):493–500 **(Discussion 499)**
11. Bosch JL, Hop WC, Kirkels WJ, Schroder FH (1995) The international prostate symptom score in a community based sample of men between 55 and 74 years of age: prevalence and correlation of symptoms with age, prostate volume, flow rate and residual urine volume. Br J Urol 75(5):622–630
12. Groeneveld AE, Heyns CF, van der Walt CLE (2012) Correlation between a new visual prostate symptoms score (VPSS) and uroflowmetry parameters in men with lower urinary tract symptoms. S Afr Med J 102(4):237–240
13. Golomb J, Lindner A, Siegel Y, Korzak D (1992) Variability and circadian changes in home uroflowmetry in patients with benign prostate hyperplasia compared to normal controls. J Urol 147(4):1044–1047