EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 8
Issue: 3
384-387
Year: 2021

CORRELATION BETWEEN POST VOIDED RESIDUAL VOLUME AND UROFLOWMETRY PARAMETERS

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DOI: https://doi.org/10.17605/OSF.IO/NKGE4

Article Received on 14/01/2021 **Article Revised on 03/02/2021** **Article Accepted on 24/02/2021**

ABSTRACT

Introduction: Post-Void Residual volume (PVR) of urine is very significant in assessing the functions of bladder emptying. Our objective was to assess the correlation between post voided residual volume and the other uroflowmetry parameters. **Materials and Methods:** This study was conducted among 647 patients including 570 males and 77 females at Urology laboratory, Faculty of Medicine, University of Peradeniya, Sri Lanka. **Results:** There is a positive low degree correlation (r values lie below $\pm$ .29) between PVR volume and time to maximum flow as well as waiting time. Total voided volume, volume at max flow, maximum flow rate and average flow rate depict a negative low degree correlation with PVR volume. **Conclusions:** Based on our results, there is a significant correlation between residual volume and other uroflowmetry parameters. It is required to conduct further investigations with a large sample over broader geographical area accordingly.

KEYWORDS: Post voided residual volume, Uroflowmetry parameters, Sri Lanka.

INTRODUCTION

The volume of urine remains in the bladder after micturition is termed as the Post-Void Residual volume of urine.[1] PVR volume is very significant in assessing the functions of bladder emptying such as bladder outlet obstruction (BOO), neurogenic bladder dysfunction, severity of Benign Prostatic Hyperplasia (BPH) and selection of treatments.[2] In some countries, since urine flow rate results are not widely available, clinicians use only USS KUB (Ultra Sound Scan; Kidneys, Ureter, Bladder) as an investigation to decide the severity of BOO. Hence, it is important to perceive whether there is a correlation between PVR volume and other uroflowmetry parameters as well as whether they indicate the diagnosis and the severity of BOO accurately. Though the urethral catheterization is considered to be the most accurate method to measure PVR volume, it is not used since it is an invasive procedure, having a risk of trauma and infections. Therefore, currently, ultrasound scanning is used as a noninvasive method, to evaluate PVR volume.[3] Either of real-time ultrasound or portable bladder scanner can be used to estimate ultrasound bladder volume. According to previous studies, large volume of PVR volume has been identified as a common indication for transurethral resection of prostate, incidence of serious BPH complications such as urinary tract infections, bladder calculi, and upper urinary tract dilation with renal function impairment occur due to high detrusor pressure. Uroflowmetry parameters depend on various demographic factors like gender, age, general conditions related to social background as well as patient factors such as voided volume and other medications.[4] To estimate the PVR volume, anterior-posterior (height), longitudinal (length) and maximal transverse (width), diameter measurements are taken. According to the prolate ellipsoid method, the following formula is used to calculate PVR volume[5, 6]

Volume = length x width x height x 0.52 (mL)

As mentioned in some of the previous studies, the general post voided residual values are recognized as follows[7-9]

Adults[10]

- < 50mL PVR volume ; adequate bladder emptying
- >200mL PVR volume ; inadequate emptying

Elderly[11-13]

- 50-100 ml PVR volume; normal

MATERIALS AND METHODS

The present study was designed to assess the correlation between post voided residual volume and the other uroflowmetry parameters. The records of patients visited

to the Urology laboratory, Department of Surgery, Faculty of medicine, University of Peradeniya, Sri Lanka from January 2018 to December 2020 were retrospectively reviewed. Post voided residual volume was obtained by the real-time ultrasound scanner and the other uroflowmetry parameters were taken by the uroflow meter. This study was conducted among 645 patients [mean age of 61.74yrs, standard deviation: ± 13.932, (minimum age; 7yrs, maximum was 94 years)].

Figure 2: Uroflow meter.

STATISTICAL ANALYSIS

Pearson correlation was done in SPSS version 20. Calculated frequencies were used for further analysis. Statistical significance at $p< 0.05$ was accepted for all analysis. Data was analyzed using Statistical Package for the Social Sciences (SPSS) version 20.

RESULTS AND DISCUSSION

This study was conducted among 647 patients including 570 males (88%) and 77 females (12%) at Urology laboratory, Faculty of Medicine, University of Peradeniya, Sri Lanka.

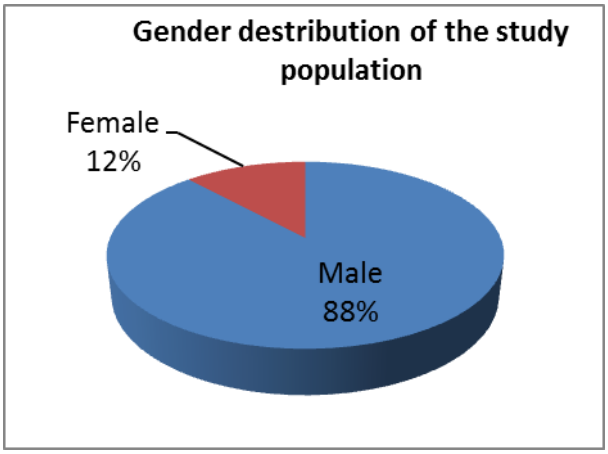

Figure 2: Gender distribution of the study population.

There were statistically significant correlations between Post-void residual volume of urine and other Uroflowmetry parameters. The mean post voided residual volume of the study population was 81.33 ± 104.35 mL (minimum PVR volume; 0.00, maximum PVR volume; 1272.36mL) while the total voided volume was 381.88 ± 222.49 mL (minimum voided volume; 46mL, maximum; 1427 mL), mean maximum flow rate was 14.77 ± 8.56 mL/sec (minimum; 2.2 mL/sec, maximum; 61.7 mL/sec), mean average flow rate was 6.42 ± 3.61 mL/sec (minimum; 2 mL/sec , maximum; 18 mL/sec), mean voiding time was 64.56± 36.25 sec (minimum; 13.9sec, maximum; 239.9sec), mean flow time was 63.94± 35.83 sec (minimum;13.8sec, maximum; 239.4sec), mean time to maximum flow 14.44± 16.36 sec (minimum; 0.2sec, minimum; 178.1sec). Descriptive characteristics of the patients are shown in Table 1.

Table 1: Descriptive statistics.

Parameter	Minimum	Maximum	Mean	Std. Deviation
Age (Yrs.)	7	94	61.74	13.93
Total Voided Volume(mL)	46.00	1427.00	381.88	222.49
Volume at Max Flow (mL)	2.00	757.00	124.96	103.13
Maximum Flow rate (mL/sec)	2.20	61.70	14.77	8.56
Average Flow rate (mL/sec)	0.90	26.90	6.92	4.21
Voiding Time (sec)	13.90	239.90	64.56	36.25
Flow Time (sec)	13.80	239.40	63.94	35.83
Time to Max Flow (sec)	0.20	178.10	14.44	16.36
Residual Volume (mL)	0.00	1272.36	81.33	104.35

Correlation between Residual Volume, age and gender is shown in table 2. According to the results of this study, age and gender have a strong negative correlation with PVR volume**.**

Table 2: Correlation between Residual Volume, age and gender

	r value	p value
Age	-0.008	0.849
Gender	-0.071	0.074

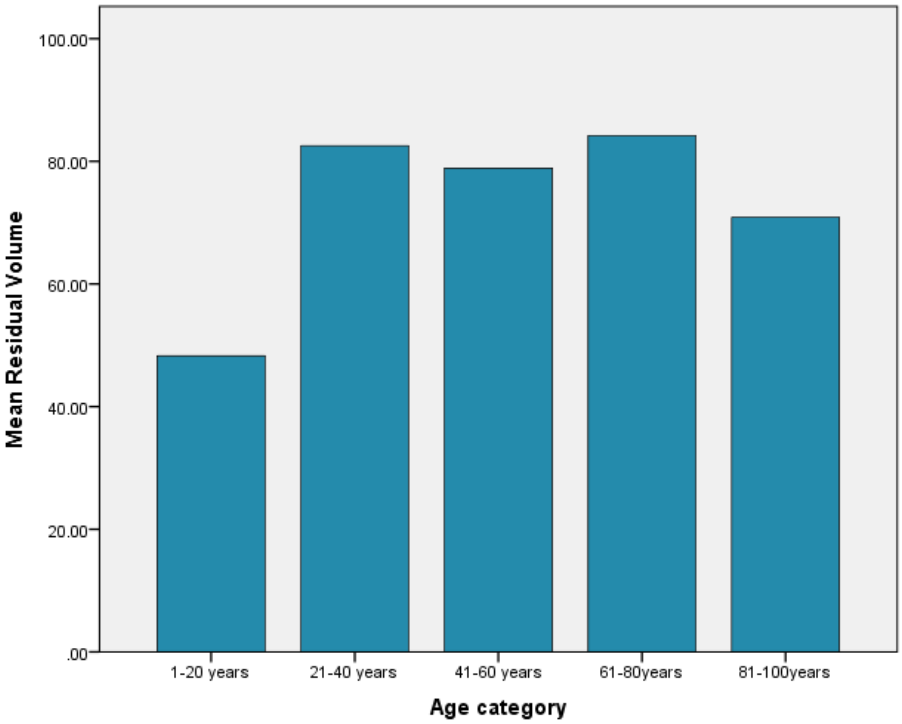

Figure 3: Simple bar means of Residual Volume by age category.

It is interesting to state that younger patients below <20 years has a mean PVR value of 48.28 mL while the other age groups of 21-40 years, 41- 60 years, 61- 80 years and 81- 100 years show a mean PVR volume of 82.54 mL, 78.89 mL, 84.20 mL and 70. 85 mL respectively.

Table 3: Correlation between Residual Volume and other uroflowmetry parameters.

Uroflowmetry parameters	r value (Pearson correlation)	p value
Total Voided Volume	-0.041	0.295
Volume at Max Flow	-0.135**	0.001
Maximum Flow	-0.195**	0.000
Average Flow	-0.220**	0.000
Voiding Time	0.218**	0.000
Time to Max Flow	0.02	0.617
Waiting Time	-0.018	0.738

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

As stated in table 3, there is a positive low degree correlation (r values lie below ± .29) between PVR volume and time to maximum flow as well as waiting time. Total voided volume, volume at max flow, maximum flow rate and average flow rate depict a negative low degree correlation with PVR volume.

CONCLUSIONS

Based on our results, there is a significant correlation between the residual volume and other uroflowmetry parameters. Lesser the PVR volume better the flow rate hence even if only an US KUB with PVR volume is available one can get a reasonable idea about the patients, urine flow rate hence bladder out flow obstruction. In developing countries since the Urology units are not wide spread its mostly general surgeons and physicians who manage patients with BOO and they don't have access to uroflowmetry. Further investigations with a large sample over broader geographical area will be advantageous.

ACKNOWLEDGEMENTS

All subjects who participated in this study and staff members of surgical clinic, Teaching Hospital, Peradeniya, Sri Lanka who supported in data collection.

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