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Effect of Voiding Position on Uroflowmetry in Women with Anterior Vaginal Wall Prolapse Stage II and III

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ABSTRACT

Objectives: To determine the effect of voiding position on uroflowmetry parameters in women with anterior vaginal wall prolapse stage II and III

Materials and Methods: A total of 51 women with anterior compartment prolapse stage II and III attending female pelvic medicine and reconstructive surgery clinic, Ramathibodi Hospital during June 2015 to April, 2016 were enrolled in the randomized controlled crossover study. After informed consent was obtained, participants were randomly allocated sequences of two voiding positions: sitting and modified squatting. The uroflowmetry was performed in both voiding positions for each participant. The post-void residual urine (PVR) volumes were measured using transabdominal ultrasound. Uroflowmetry parameters and PVR values were compared between the two different voiding positions.

Results: The mean age of the participants was 64.8 ± 9.1 years. The POP-Q staging was stage II in 30 (58.8%) and stage III in 21 (41.2%) women. There was no statistically significant difference in voided volume of women in sitting and modified squatting position which were 335.2 ± 160.1 and 362.7 ± 161.0 ml, respectively ($p > 0.05$). Mean maximum flow rate and mean average flow rate for the sitting (22.3 ± 11.2 and 10.7 ± 5.5 ml/s) and modified squatting position (23.8 ± 10.9 and 11.91 ± 6.4 ml/s) in the women were not significantly different ($p > 0.05$). PVR value in sitting voiding position was significant lower than in modified squatting position (52.6 ± 55.1 vs 75.0 ± 78.6) ($p < 0.05$).

Conclusion: Voiding positions either sitting or modified squatting does not affect urinary flow rate in women with anterior wall prolapse. Voiding in modified squatting position may results in higher post-void residual urine.

Keywords: Pelvic organ prolapse, voiding position, uroflowmetry.

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การศึกษาผลของท่าการปัสสาวะต่ออัตราการไหลของปัสสาวะในสตรีที่มีการหย่อนของผนังช่องคลอดด้านหน้าระยะที่สองและสาม

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บทคัดย่อ

***วัตถุประสงค์**: เพื่อศึกษาผลของท่าการปัสสาวะต่ออัตราการไหลของปัสสาวะในสตรีที่มีการหย่อนของผนังช่องคลอดด้านหน้าระยะที่สองและสาม*

***วิธีการศึกษา**: งานวิจัยนี้เป็นการศึกษาแบบสุ่มควบคุมแบบไขว้กลุ่ม (Randomized controlled crossover study) ในสตรีที่มีภาวะหย่อนของผนังช่องคลอดด้านหน้าระยะที่สองและสามที่มารับการรักษาที่คลินิกนรีเวชระบบสืบพันธุ์และทางเดินปัสสาวะ โรงพยาบาลรามาธิบดี ในช่วงมิถุนายน 2558 – เมษายน 2559 จำนวน 51 ราย ผู้เข้าร่วมวิจัยจะได้รับการสุ่มลำดับท่าการปัสสาวะ ทุกรายจะได้รับการตรวจอัตราการไหลของปัสสาวะและวัดปริมาณปัสสาวะเหลือค้างหลังการปัสสาวะทั้งท่าปัสสาวะแบบนั่งปกติและปัสสาวะแบบนั่งยองประยุกต์*

***ผลการศึกษา**: อายุเฉลี่ยของผู้เข้าร่วมวิจัย 64.8 ± 9.1 ปี มีการหย่อนของผนังช่องคลอดด้านหน้าระยะที่สอง 30 ราย (ร้อยละ 58.8) และระยะที่สาม 21 ราย (ร้อยละ 41.2) ไม่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติของปริมาณปัสสาวะที่ถ่ายออกมาจากการปัสสาวะในท่านั่งปกติ และท่านั่งยองประยุกต์ (335.2 ± 160.1 และ 362.7 ± 161.0 มิลลิลิตร) ($p > 0.05$) ค่าเฉลี่ยของอัตราการไหลของปัสสาวะสูงสุดและอัตราการไหลของปัสสาวะเฉลี่ยในท่านั่งปกติ (22.3 ± 11.2 และ 10.7 ± 5.5 มิลลิลิตรต่อวินาที) และท่านั่งยองประยุกต์ (23.8 ± 10.9 และ 11.91 ± 6.4 มิลลิลิตรต่อวินาที) ไม่แตกต่างกันอย่างมีนัยสำคัญทางสถิติ ($p > 0.05$) พบปริมาณปัสสาวะเหลือค้างหลังการปัสสาวะในท่านั่งปกติน้อยกว่าท่านั่งยองประยุกต์อย่างมีนัยสำคัญทางสถิติ (52.6 ± 55.1 และ 75.0 ± 78.6) ($p < 0.05$)*

***สรุป**: การปัสสาวะในท่านั่งปกติและท่านั่งยองประยุกต์ ไม่ส่งผลต่ออัตราการไหลของปัสสาวะในสตรีที่มีการหย่อนของผนังช่องคลอดด้านหน้าระยะที่สองและสาม แต่อย่างไรก็ตาม การปัสสาวะในท่านั่งยองประยุกต์จะส่งผลให้มีปัสสาวะคงค้างหลังการถ่ายปัสสาวะมากขึ้นกว่าการปัสสาวะในท่านั่งปกติ*

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Introduction

Pelvic organ prolapse (POP) is one of the most troublesome problems in advanced age women with the reported prevalence varied from 24-50 %[1-5]. The reported prevalence in Thai menopausal and elderly women were 43% and 70%, respectively[6, 7]. According to the International Continent Society, POP is defined by a bulge or protrusion of pelvic organ and their associated vaginal segments into or through the vagina. It can be divided into anterior, apical, and posterior compartment prolapse[8,9]. Among the prolapse, anterior vaginal prolapse is the most common form of pelvic organ prolapse[2, 6, 10]. Due to the proximity of anterior compartment to the bladder and urethra, women with significant anterior compartment prolapse may have a functional outlet obstruction due to a "kink" in the normal urethral mechanism. The affected women may complain of hesitancy, slow or intermittent urine stream, frequent urination, incomplete bladder sensation, or urinary retention[10, 11]. This was confirmed by several studies which found abnormal voiding function test in prolapsed women, especially in anterior compartment and in advanced prolapse, using urodynamic study and uroflowmetry[12-17].

Most women suffering from this condition try to relieve their obstructive voiding symptoms by several methods including abdominal straining, suprapubic pressure, pushing the prolapse back inside to empty their bladder completely. Changing voiding position such as leaning forward or backward on the toilet seat, lift up theirs legs from the floor or urinate in a semi-standing position is also the adaptable method used by prolapsed women with voiding problems.

Uroflowmetry is a standard test, commonly used in screening for men and women with obstructive voiding problems[18, 19]. It is a simple, time-efficient, non-invasive test, performed by asking the patients urinate normally in a urinal or toilet fitted with a machine that has a measuring device. The machine will calculate the amount of urine voiding, the flow rate in seconds, and the length of time it takes to empty the bladder completely. Post-void residual urine (PVR) measurement is another test, usually performed with uroflowmetry, for evaluating voiding dysfunction. The test is performed by measuring the amount of urine left in the bladder after the end of micturition. PVR volume can be measured by either direct urethral catheterization or bladder ultrasound. Due to the comparable accuracy of bladder ultrasound in PVR measurement, compared to direct catheterization, it is now acceptable for use as an alternative to catheterization[20-22].

Although the study of the effect of voiding position on micturition has been studied for many years, but the results are varied and inconclusive[24-27]. The inconsistent findings of these studies may be due to different voiding position used in the studies and variations in study population. Most studies investigated in normal healthy subjects or in men with lower urinary tract symptoms (LUTS). At present, there is no published study that examined the effect of voiding position on voiding in women with pelvic organ prolapse.

In Thai culture, the two most common voiding positions in women are sitting and squatting. However, the ability to attain a squatting position or squatability is decreasing in elderly women. Therefore, the objective of this study is to compare uroflowmetry and PVR measurement between 2 voiding positions; sitting and modified squatting position in women with anterior vaginal wall prolapse stage II and III.

Materials and Methods

This was a randomized cross-over study, conducted in women attending female pelvic medicine and reconstructive surgery clinic, Department of Obstetrics and Gynaecology, Ramathibodi Hospital, Bangkok, Thailand, during June 2015 to April, 2016. This study was approved by the Ethics Committee on human rights related to research involving human subjects, based on Declaration of Helsinki, Faculty of Medicine,

Ramathibodi Hospital, Mahidol University.

The inclusion criteria were women with pelvic organ prolapse stage II and III, according to POP-Q staging and the leading edge of the most descended compartment was anterior, age between 40-80 years old, able to control micturition. The exclusion criteria included history of urinary tract infection within 1 week, had adrenergic, cholinergic, antidiuretics drugs or any drug which may have an effect on voiding, unwilling to participate the study. All eligible participants were informed about the research study and signed written informed consent.

On enrollment, all participants were informed about the uroflowmetry, PVR measurement, and details of each voiding position using picture card (Fig. 1). The demographic data including age, body mass index (BMI), parity, menopausal status, previous hysterectomy status and POP staging were collected. Then, they were randomly allocated sequences of producing two separate acts of micturition in the same day, using computer-generated numbers. Group one had uroflowmetry performed first in a sitting position and then in a modified-squatting position. Group two had uroflowmetry performed first in a modified-squatting position and then in a sitting position. The randomized treatment assignments were sealed in opaque envelopes and opened individually for each participant who agreed to be in the study.

Aquarius TT TM version 8 (Laborie, Mississauga, Canada) uroflowmeter was used in this study. All participants were asked to arrive with a comfortably full bladder for uroflowmetry and were instructed to void normally without any straining in both sitting and modified squatting positions. For the comfort of the participants, uroflowmetric study was performed in a private section, separated by room partition. Participants who had voided volume less than 150 ml were ask to come for a new measurement in the subsequent day. PVR volume was evaluate by CubeScanTM BioCon-700 bladder scanner (Mcube Technology, Seoul, Korea) immediately after complete each episode of micturition. The flow diagram of the study is shown in Fig. 2.

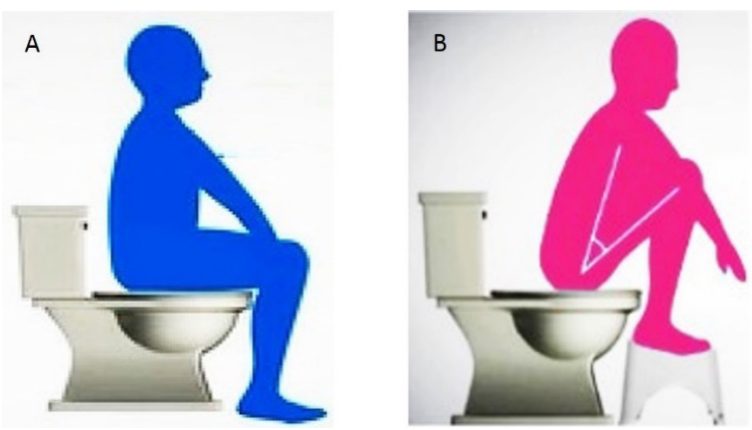

Fig. 1. Voiding position on the commode.

(A) Sitting position defined as sit back straight, feet rest on the floor, and both hands were placed on thigh.
(B) Modified-squatting position defined as sit leaning forward with forearm rest on the thigh, foot rest on the stool (up to 30 cm high), knee above anterior superior iliac spine level, and hug knees to the chest during urinate.

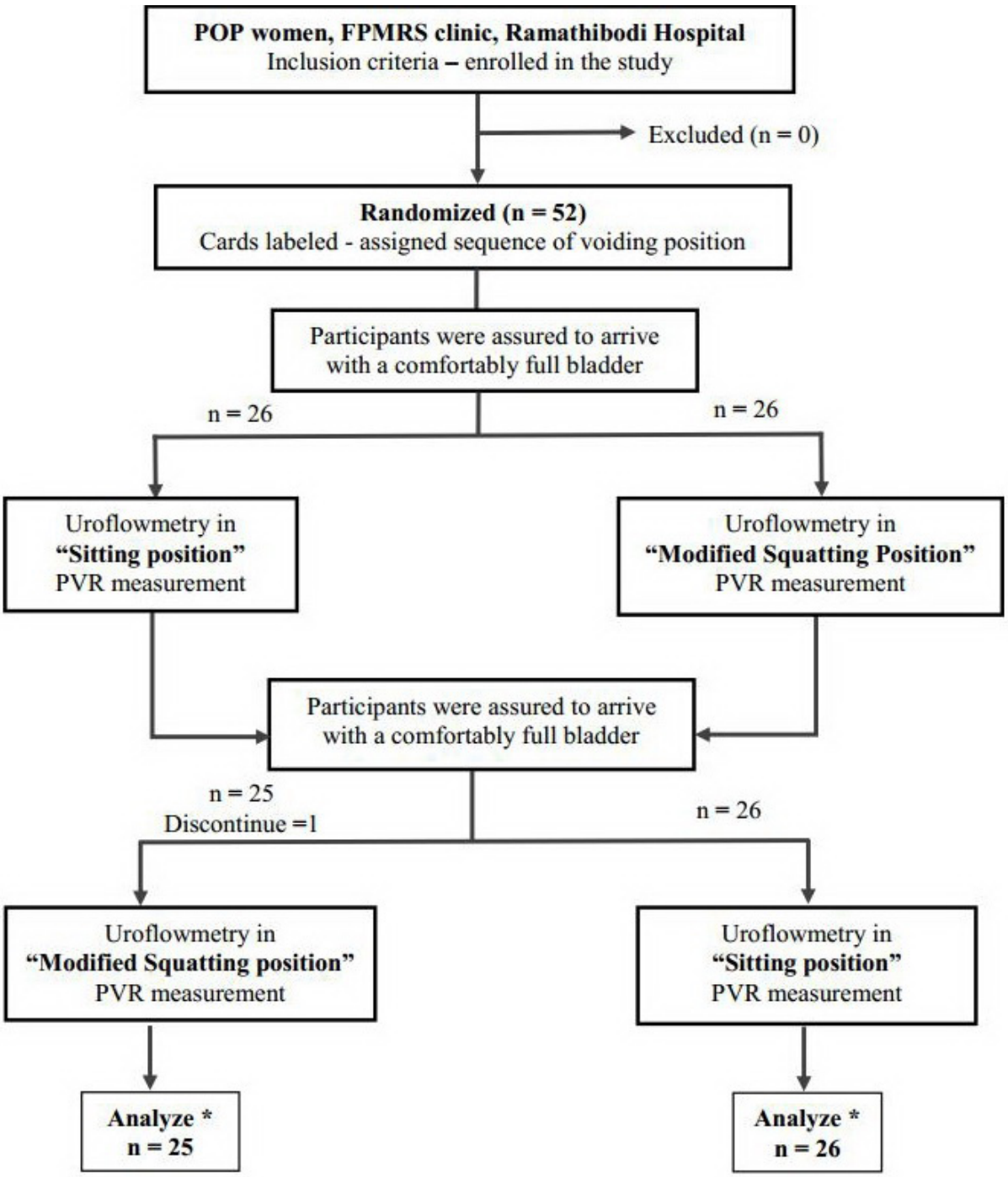

Fig. 2. Flow diagram of the study.

Sample size calculation

The sample size was calculated according to the following formula:

$$N = \left[\frac{(Z\alpha_2 + Z\beta)\,\delta}{\Delta} \right]^2$$

From the pilot study included 10 women with anterior vaginal wall prolapse stage II and III, mean maximal flow rate (Q_{max}) in sitting position was 24.09 ±7.21 mL/s, mean Q_{max} in modified-squatting position was 28.59 ± 9.10 mL/s, the different (Δ) Q_{max} was 4.5 mL/s. $Z\alpha$ was set as 1.96 with a type I error of 5%, $Z\beta$ was set as 1.28 with a power of 90%. The calculated number was then added with 20% of the calculated number of subjects who might be excluded due to data loss. Therefore, 52 subjects would need to be enrolled in the study.

Statistical analysis

Statistical analyses were performed using STATA version 14.0 software (Stata Corporation, College Station, TX). Continuous data were reported as the mean and standard deviation. Categorical data were shown as the number and percentage. Linear mixed-effect model was used to analyze repeated measures data. All reported probability values are two-tailed; $p < 0.05$ was considered to be statistically significant.

The uroflowmetric parameters and corresponding PVR values of two voiding postures are shown in Table 2. No participant in the study urinates less than 150 ml. There was no statistically significant difference in voided volume and voiding time between two voiding positions ($p > 0.05$). Mean Q_{max} during urination in sitting position and modified squatting was not different (22.28 ± 11.21 ml/s and 23.80 ± 10.88 ml/s, respectively). Women urinate in modified squatting position tended to have better average flow (Q_{aveg}) rate than that in sitting position, but the difference did not reach statistical significance. Mean PVR volume in modified squatting group was significant higher than in sitting group ($p < 0.01$).

Results

Of 52 women, one participant was excluded due to unwilling to perform the second uroflowmetry. Therefore, a total of 51 data was left for analysis. The mean age of study population was 64.9 ± 9.1 years. There were 6 participants with previous hysterectomy due to benign condition. The demographic characteristics and POP staging of subjects are presented in Table 1.

Table 1. Demographic Characteristics (N = 51).

Characteristics	n = 115
Age (years), mean ± SD	64.9 ± 9.1
BMI (kg/m^2), mean ± SD	26.1 ± 3.3
Parity, n (%)	
1	6 (11.8)
2	17 (33.3)
≥ 3	28 (54.9)
Menopause, n (%)	44 (86.3)
Previous hysterectomy, n (%)	6 (11.8)
POP-Q (anterior compartment), n (%)	
Stage II	30 (58.8)
Stage III	21 (41.2)
Most distal portion of prolapse, n (%)	
Above hymen	26 (51.0)
Below hymen	25 (49.0)

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Using the maximum flow rate less than 15 ml/s and post-void residual urine volume over 100 ml as cut-off point to classify abnormal uroflowmetry[28], there was no significant difference in abnormal flow rate ($p = 0.477$) and abnormal PVR ($p = 0.087$) between sitting and modified squatting position. (Fig. 3.)

Table 2. Uroflowmetric parameters and PVR in sitting and modified squatting position (N = 51).

Uroflowmetric parameters	Sitting position (mean ± SD)	Modified Squatting position (mean ± SD)	Difference (95%CI)	p value*
Q_{max} (ml/s)	22.28 ± 11.21	23.80 ± 10.88	1.52 (-0.46 - 3.49)	0.132
Q_{aveg} (ml/s)	10.65 ± 5.48	11.91 ± 6.40	1.26 (-0.01 - 2.53)	0.052
Voided volume (ml)	335.19 ± 160.12	362.65 ± 161.00	27.46 (-13.73 - 68.66)	0.192
Voiding time (sec)	41.75 ± 24.21	44.79 ± 27.76	3.04 (2.98 - 9.07)	0.322
PVR (ml)	52.63 ± 55.08	74.98 ± 78.60	22.35 (6.03 - 38.86)	0.007

Q_{max}, maximum flow rate; Q_{aveg}, average flow rate; *Linear mixed-effect model

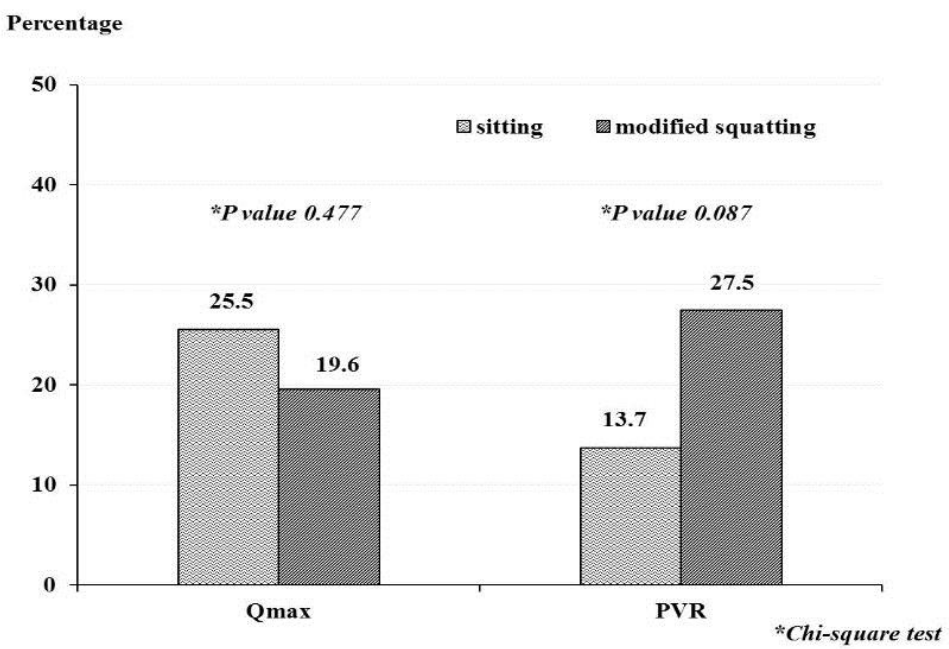

Fig. 3. Abnormal uroflowmetry: maximal flow rate and PVR volume.

Discussion

Pelvic organ prolapse is the troublesome problems in women especially in elderly. Women with pelvic organ prolapse may present with various symptoms including bulging mass, lower urinary tract symptoms, or bowel symptoms depend on compartment and degree of prolapse. Obstructive voiding symptoms, such as hesitancy, slow stream, feeling of incomplete emptying and frequent urination are the common bothered problems that affect quality of life in women with anterior compartment prolapse. The associations between anterior vaginal wall prolapse and voiding difficulty have been demonstrated in many studies.(14-16) Many prolapsed women tried to improve their voiding by several methods; changing their voiding position is the commonly used method in real life.

There are many studies examined the effect of different voiding positions on urinary flow rates and the PVR volume in normal women. Moore and colleague(23) found decreasing average and increasing flow rate in crouching over position, compared with sitting position. The result could be explained by the contraction of adductor muscle in crouching position interfere with pelvic floor muscle relaxation during urination. Most studies that compared voiding parameters between squatting, near squatting with sitting position, found better flow rate in both squatting and near squatting voiding position.(24-27) Rad and colleague's study found the increase in anorectal angle in squatting position which causes relaxation of puborectalis muscles. This may lead to easier bladder and bowel evacuation.(29) This findings were also supported by Rane and colleague's study(27) which found an increase in intra-abdominal pressure with no increase in detrusor pressure and increase levator hiatus dimension in squatting position. Pelvic floor muscle relaxation in squatting or near squatting position, together with passively increase intra-abdominal pressure seems to facilitate bladder emptying.

In the present study, we compared flow rate and PVR volume between two voiding positions; sitting and modified squatting position. The result was not similar to the previous report. Urine flow rate did not improve by a change in voiding position from sitting to modified squatting. Moreover, voiding in modified squatting position resulted in higher PVR volume. This could be explained by the physioanatomy changes in prolapsed women. Most women with pelvic organ prolapse usually had pelvic muscle weakness and relaxation, therefore increase in levator hiatus dimension in squatting position did not result in more relaxed pelvic floor. In anterior vaginal wall prolapse, a weakness supporting tissue may allow the bladder and urethrae drop down from their normal position. Thus, passively increased intra-abdominal pressure from modified squatting position could not help complete bladder emptying.

Although, higher PVR volume was found in women voiding in modified squatting position, but the urine volume left in the bladder might not have any clinical importance. This was confirmed by similar proportion of abnormal PVR volume in both voiding positions found in this study.

Several previous studies reported abnormal voiding function in prolapse women, especially in anterior compartment and/or advanced prolapse.(12-17) In this study, we emphasized on the effect of two voiding positions on uroflowmetry in women with predominately anterior compartment prolapse. Some participants may have other compartments of prolapse, but with less severity, comparing to anterior compartment. To study the association between severity of prolapse and voiding parameters in different voiding positions, more number of sample size are enrolled to perform subgroup analysis either for different stages or compartments of prolapse in further study.

Uroflowmetry and PVR measurement were the voiding tests used in this study. Both tests are acceptable tests, widely used in evaluating women with obstructive voiding problems. As micturition is a dynamic event, it may be influenced by several factors such as age, sex and anatomical properties of lower urinary tract and adjacent tissues, voiding habit and environment. To avoid the influence on voiding test, a crossover randomized trial was used. This type of study could reduce inter-variable confounding between two acts of voiding. All participants were instructed to void normally,

without the need to strain during uroflowmetric testing. This is the first study determined the effect of changing voiding position on voiding functions in prolapsed women. This study focused on the uroflowmetric parameters and PVR measurement. Problems related slow flow and high PVR including hesitancy, frequency, incomplete bladder sensation, overflow incontinence and recurrent UTI did not include in this study. The clinical effect of different PVR, patient's LUTS symptoms and preferred voiding posture are needed in further study.

Acknowledgments

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Potential conflicts of interest

The authors declare no conflict of interest.

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