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Does urination position have an effect on evaluation of lower urinary tract function ın children? A uroflowmetric study

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Abstract

Background: We aimed to determine whether different urination positions had significant impact on the parameters of uroflowmetry performed by healthy individuals and children with voiding dysfunction.

Methods: The study was conducted with a prospective and comparative design. Children between 5 and 15 years of age who met the inclusion–exclusion criteria of the study were enrolled. Children in the study were divided into two groups. Participants whose voiding dysfunction symptom score was ≥ 9 points were classified in group 1 and the remaining individuals were classified in group 2. Girls urinated in two different positions as sitting and squatting while boys urinated in three different positions as sitting, squatting and standing. Also, habitual urination position was asked and recorded for each individual participated in the study. Uroflowmetry parameters were compared for different urination positions in two groups separately and a *p* value of ≤ .05 was accepted for statistical significance.

Results: Voided volume, maximum flow rate (Qmax), time to reach Qmax, urination time and postvoid residual volume measured by abdominal ultrasound were recorded in every participant for each urination position in both groups. In group 1, girls with voiding dysfunction presented a significantly higher postvoid residual volume in squatting position compared to sitting position (the *p* value = 0.02). In group 2, healthy boys presented a significantly higher Qmax in standing position compared to sitting and squatting positions (the *p* value = 0.01). All participants provided a better uroflowmetry pattern in their habitual urination positions.

Conclusion: Urination position may affect uroflowmetry results; however, its impact on lower urinary tract function requires further research.

Keywords: Micturition, Toilet training, Urination position, Uroflowmetry, Voiding dysfunction

1 Background

Voiding dysfunction (VD) is a broad term which covers all types of lower urinary tract dysfunctions (LUTD) presenting with urinary incontinence (UI) in children. The prevalence of VD differs by age, as the neural network between cerebral cortex and bladder which commands voluntary micturition in healthy individuals matures within years. According to cross-sectional studies, an approximate rate of 10% can be estimated at the age of 7 [1] for both genders with a female/male ratio of 1.5.

Assessment of a patient with VD begins with obtaining a thorough history directly from the patient if possible. This part should be tailored to each individual as to the age and intellectual maturation status of the child. Our endeavor should be focused on to identify whether any anatomic or neurologic etiology leads to VD. If those are ruled out, then we should determine the type of underlying bladder and/or bowel dysfunction in order to guide further assessment. Uroflowmetry (UFM) is an

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indispensable noninvasive tool for evaluation of patients with VD [2]. It is widely available and easy to perform, however, attentive care should be taken to inform the patient and/or the parents about the test as to obtain a proper result regarding lower urinary tract (LUT) function. In addition, voiding dysfunction symptom score (VDSS) is reliable questionnaire, which includes 13 questions concerning VD and one question regarding quality of life. It could be applied in children with suspected VD.

Urination position (UP) is a habit, frequently acquired in childhood and lasts for lifetime. Actually, there is not a specific position identified to urinate properly and habitual acts regarding the position during micturition do not lead to VD or constitute any problems in LUT function. However, in patients with LUTD, it may be important. Limited research investigated the impact of UP on UFM parameters in the pediatric urology literature. Taking into account the points above-mentioned, in our study, we aimed to determine whether UP causes significant differences in UFM parameters of both healthy individuals and children with VD.

Fig. 1 Urination in squatting position

2 Methods

2.1 Study design, ınclusion and exclusion criteria

Our study was conducted in Ankara University School of Medicine with a prospective and comparative design. Boys and girls between 5 and 15 years of age were enrolled in the study. VDSS [3, 4] questionnaire was applied in all participants and those with a VDSS of ≥ 9 points except the quality of life score were accepted as patients with VD. Other individuals were regarded as control group. UFM was undertaken in both groups. Girls urinated in two different positions including sitting and squatting whereas boys urinated in three different positions including sitting, squatting (Fig. 1) and standing. All patients involved in the study were asked about their habitual UPs in their daily lives. Then, their parents were also enquired to confirm the children's statements. Hence, patient records regarding daily micturition habits were collated in order to determine whether they exhibited a better UFM pattern in their habitual UP. UFM patterns recorded on UFM were examined for each individual. If an abnormal voiding pattern indicating LUTD or an increased postvoiding residual (PVR) volume was detected on UFM in any participant of the study, then those were evaluated in VD group. Children with VD underwent additional tests according to the underlying pathology.

Any boy or girl who wanted to participate in the study between 5 and 15 years of age was included in the study, provided that their parents also allowed to do so. Patients presenting VD with an underlying neurologic etiology, patients or parents with poor cooperation or no desire to participate, patients who had a history of any surgical interventions regarding urinary tract such as hypospadias, meatoplasty, reconstructive procedures concerning LUT were excluded from the study.

Solar Uroflow (Medical Measurement System, flowmaster, The Netherlands) was used to perform the tests in our study. UFM was applied two times in each position in every participant to avoid possible errors. Two well-trained and experienced attendants among the nursery staff who were specifically educated on UFM testing, were selected to accompany the children during the test to ensure that they held the right position each time. However, attentive care was taken not to disturb the children or not to interfere with their privacy during micturition. A folding screen was utilized to provide a good ambience for the children.

2.2 Statistical analysis

SPSS version 21.0 (IBM Corp, Armonk, USA) was used for statistical analysis. Mann–Whitney *U* and Kruskal–Wallis tests were performed to compare the results obtained in UFM. Healthy individuals and VD patients were evaluated separately. UFM parameters for different UPs were compared in both groups. A p value of ≤ 0.05 was accepted for statistical significance.

3 Results

A total of 345 patients were enrolled in the study. They were divided into two groups. Group 1 consisted of VD patients and group 2 consisted of healthy individuals. 144 of 345 participants (41.8%) were male, mean age for males was 12.5 ± 3.7 years. Mean age for females was slightly lower as 10.2 ± 5.6 years.

Seventy-three girls with VD in group 1 made statement over their habitual UP in daily life. 60.3% of them used to urinate in sitting position while remaining 39.7% used to urinate in squatting position. Ninety-six boys with VD also mentioned their habits on the same subject and the results were 57.3% in standing position, 13.5% in sitting position and 29.2% in squatting position, respectively. UFM parameters such as voided volume, maximum flow rate (Qmax), PVR measured by abdominal ultrasound, time to reach Qmax and urination time were recorded for each individual in every UP. Results for group 1 are outlined in Table 1. Values obtained in different UPs for each parameter were compared to determine whether there was a difference between them. All results were similar for boys with VD; however in girls, a significantly higher PVR volume (42.5 ± 23.5 ml) was detected in squatting position (Table 1) compared to sitting position (the *p* value = 0.02).

128 healthy girls and 48 healthy boys comprised of group 2 in the study. Squatting position was reported as habitual UP in 53.1% of the girls which was higher compared to their peers in group 1 (39.7%). As to the boys, standing position was the most preferred as in group 1 among the three positions, with a reported rate of 57,3%. Sitting and squatting positions for boys were reported as 13,5% and 29,2%, respectively. Table 2 provides the results of UFM tests for group 2. In girls, results obtained in two different UPs were compared and no significant differences were observed (Table 2). Results for boys

Table 1 Uroflowmetry parameters recorded in group 1 (consisted of males and females with voiding dysfunction) in three different urination positions

UFM parameters	Gender	Sitting urination position	Squatting urination position	Standing urination position	*p* value
Voided volume (ml ± SD)	Male	151 ± 31	149 ± 47	153 ± 37	0.792
	Female	127 ± 34	133 ± 31	–	0.851
Qmax (ml/s)	Male	16.7 ± 5.6	16.8 ± 3.4	18.5 ± 3.1	0.628
	Female	17.3 ± 4.1	16.3 ± 4.4	–	0.721
Postvoid residual volume (ml ± SD)	Male	27.5 ± 14	32.4 ± 9.5	20.9 ± 9.7	0.571
	Female	38.8 ± 24.4	42.5 ± 23.5	–	0.02
Time to reach Qmax (s ± SD)	Male	6.1 ± 3.4	5.7 ± 4.2	5.1 ± 3.1	0.772
	Female	5.4 ± 2.9	6.1 ± 2.6	–	0.528
Urination time (s ± SD)	Male	13.4 ± 5.4	12.4 ± 4.4	11.4 ± 5.1	0.567
	Female	13.4 ± 8.4	13.7 ± 9.3	–	0.623

UFM Uroflowmetry, *Qmax* Maximum urine flow rate, *ml* milliliter, *s* second, *SD* Standard deviation

Table 2 Uroflowmetry parameters recorded in group 2 (consisted of healthy males and females) in three different urination positions

UFM parameters	Gender	Sitting urination position	Squatting urination position	Standing urination position	*p* value
Voided volume (ml ± SD)	Male	147 ± 29	145 ± 44	150 ± 35	0.891
	Female	125 ± 32	137 ± 35	–	0.452
Qmax (ml/s)	Male	16.7 ± 4.5	18.1 ± 4.3	18.5 ± 4.1	0.01
	Female	18.3 ± 4.2	19.5 ± 5.4	–	0.121
Postvoid residual volume (ml ± SD)	Male	12.1 ± 8.7	7.5 ± 5.6	14.9 ± 9.1	0.544
	Female	19.4 ± 12.1	20.1 ± 10.7	–	0.652
Time to reach Qmax (s ± SD)	Male	4.4 ± 3.4	4.7 ± 2.2	4.2 ± 3.1	0.679
	Female	5.4 ± 3.1	5.9 ± 2.8	–	0.481
Urination time (s ± SD)	Male	11.4 ± 6.4	12.4 ± 7.2	9.4 ± 6.1	0.658
	Female	10.4 ± 8.4	11.1 ± 9.3	–	0.516

UFM Uroflowmetry, *Qmax* Maximum urine flow rate, *ml* milliliter, *s* second, *SD* Standard deviation

in three different positions also demonstrated similar values, except Qmax which was reported significantly higher in standing position (18.5 ± 4.1 ml/s) compared to sitting and squatting (the p value = 0.01).

As to the UFM patterns, a bell-shaped curve was observed in healthy children whereas tower-shaped, staccato or interrupted curves[5] were recorded in children with VD [6]. Another point which should have been taken into account was that either healthy participants or those with VD demonstrated a better micturition pattern which denoted a model similar to normal bell-shaped pattern in their habitual UPs compared to other micturition positions.

4 Discussion

UFM is a noninvasive and informative test used for assessment of LUT function. It is an essential element of the initial workup in a child with VD. UFM may provide important and valuable information on LUT function unless use of improper implements and/or inaccurate application of the test was executed.

UP can affect UFM results. There are studies in the literature which evaluates the effect of UP on UFM parameters [7] in adults, both men [8] and women [9]. However, number of studies conducted concerning this issue are relatively limited in the pediatric urology literature. Learnings from the research over adults offer a presumption which indicates that there might be some differences in Qmax, urination time and PVR in several UPs. However, the point worthy of consideration is that these differences generally do not lead to a clinically significant effect on LUT function of healthy individuals. Material effect seems to occur in patients with preexisting LUTD. For instance, a man with a considerable PVR due to lower urinary tract symptoms (LUTS) secondary to benign prostatic hyperplasia (BPH), or a woman who has a significantly low Qmax and long urination time caused by cystocele might be negatively affected by an improper UP and accordingly can encounter complications such as urinary tract infection (UTI) or UI which may require additional treatments. Taking into account those points and adapting the hypothesis to children, UP would be important in children with VD as it may worsen preexisting LUTS. In fact, this point is a matter of concern in all children suffering from LUTD, which is why possible long-term complications both in lower [10] and upper urinary tract might be observed. Additionally, those symptoms, particularly UI can have a substantial impact on a child's quality of life by several means. For instance, those children may have psychological problems, get low academic success at school or encounter social distinction by their peers. So both children and parents can be supposed to handle additional problems caused by LUTD secondary to VD.

As to the different studies conducted regarding the subject in the pediatric urology literature, conflicting results were observed. A study conducted by Furtado et al. [11] assessing the relation of UP with UFM pattern and pelvic floor muscle activity (PFMA) recorded by electromyography (EMG) in patients with VD concluded no significant differences between different UPs in terms of UFM parameters, however, a higher electrical activity was recorded in girls with atypical UP. The results were conspicuous, however, were not decisive as there was no control group including healthy individuals. Uluocak et al. [12] conducted a study regarding the effect of UP on voiding dynamics in children with non-neurogenic bladder dysfunction and concluded that different UPs significantly affected detrusor pressure at maximum flow rate (PdetQmax) values which was found higher in sitting position compared to squatting position in girls. Similar to the before-mentioned study, no control group was involved. However, our study provided information about influence of UP on UFM parameters in both healthy individuals and children with VD as to find out whether a significant effect appeared in any manner. The results indicated a significantly higher Qmax in standing position in healthy boys and also a significantly higher PVR in squatting position in girls with VD. Though sitting position in girls and standing position in boys during micturition seem reasonable according to those results, clinically significant differences should be obtained as to make a certain recommendation on UP in both genders.

We did not consider the differences obtained in our study as clinically important though the numbers presented a statistically significant difference. As to girls with VD, the difference in PVRs between two UPs was less than 4 ml. Similarly, the differences between Qmax values of healthy boys in three UPs were all less than 2 ml/s. Therefore, overall consideration of the results in the study tell us that there is no clinically significant difference between different UPs in children. As opposite to adults, UP seems to be unimportant for children irrespective of preexisting VD.

On the other hand, improper UP can be both associated with psychological stress and VD in toilet training children. Parents should be instructive, however, should also be tolerant and patient in toilet training. The main point to resolve or prevent VD is to acquire the skill of maintaining proper communication in the neural network between LUT and cerebral cortex [13]. Maturation of the network depends on both aging and also proper toilet training which is considered as remarkably significant to resolve detrusor–sphincter dyssynergia that is frequently observed in early childhood. In failure of

training by parents, urotherapy by trained medical staff should be provided in the first stage [14]. Once a child acquires a proper micturition habit which denotes adequate discharge of the LUT by maintaining the synergia between detrusor and urethral sphincter, then it is not important which UP is preferred. Undoubtedly, social values acquired in a society have a considerable impact on this subject. For instance, in westernized countries, sitting position is generally applied during micturition in females and standing position is preferred by most males whereas in Muslim countries squatting position is commonly preferred by both genders. This difference abovementioned leads to no considerable problem in urinary tract function of those populations.

Habitual UP might have some influence on UFM patterns. In our study, though differences between different UPs in terms of UFM results were not significant in general, patients presented a better UFM pattern which was more similar to normal bell-shaped pattern in their habitual UPs. This finding of our study underscores the significance of acquired habits regarding UP in children. We think, this result signifies that it is not the UP which is significant but the habit acquired during toilet training. If we consider that mean age of the population was over 10 years in our study, it sounds reasonable to tell that almost all of the participants have already acquired a habit concerning micturition. Children may feel themselves more relaxed and comfortable in their habitual UP which possibly aids to resolve detrusor–sphincter dyssynergia in patients with VD or to maintain the synergia between detrusor and urethral sphincter in healthy individuals. Presumably, the reason behind that the children demonstrated a better UFM pattern in their habitual UP is the possible psychological comfort felt by them on that occasion.

4.1 Study limitations

As a limitation of our study, we can state that we did not utilize EMG or perform urodynamics as to make a comprehensive evaluation of LUT function of the study participants. Different UPs might give distinct results in terms of PFMA, detrusor compliance or urethral sphincter activity. Though UFM generally provides valuable information on LUT functions, conflicting results could be obtained on occasions which may require repetition of the test or further research with other possible facilities. Another limitation was the unavailability of the tangible and objective documentation of UFM patterns recorded. This would have given us the opportunity to make a more precise assessment. Last, we were not capable to provide the information regarding the bowel function assessment of patients with VD which might have affected the UFM results in group 1 as Bristol Stool Scale [15] could not be adequately applied in those participants.

5 Conclusion

Urination position may affect UFM results and lead to differences in parameters such as Qmax and PVR. In addition, it can make alterations in UFM patterns. The significance of these effects on LUT function requires further research.

Abbreviations

EMG: Electromyography; LUT: Lower urinary tract; LUTD: Lower urinary tract dysfunction; LUTS: Lower urinary tract symptoms; Qmax: Maximum urine flow rate; PdetQmax: Detrusor pressure at maximum flow rate; PFMA: Pelvic floor muscle activity; PVR: Postvoid residual volume; UFM: Uroflowmetry; UI: Urinary incontinence; UP: Urination position; UTI: Urinary tract infection; UUT: Upper urinary tract; VD: Voiding dysfunction; VDSS: Voiding dysfunction symptom score.

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Author contributions

Al contributed to data acquisition and analysis. MÖ contributed to making the draft of the work and substantial revision. AA interpreted the data. PH created the software used in the work. BB conceptualized and designed the work. All authors have read and approved the final version of the manuscript.

Availability of data and materials

Study data are available in 'https://tez.yok.gov.tr.'

Declarations

Ethics approval and consent to participate

Our study was conducted in accordance with the ethical standards of clinical research accepted in Turkey, in addition to the ethical principles pronounced in 'The Declaration of Helsinki 1964' and its later amendments. An ethical approval was obtained from Ankara University Faculty of Medicine Ethical Committee before the commencement of the study. In addition, all patients and their parents provided an informed consent to participate in the study.

Consent for publication

All patients and their parents provided a written informed consent for the publication of the study results and sharing details such as images in the text.

Competing interests

The authors declare that they have no competing interest.

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