Uroflowmetry tests and measurements of post-void residual urine (PVR) are the most frequently used first-line tests in pediatric urodynamic practice because of their noninvasive characteristics. Children who are toilet-trained or aged more than 5 years, whichever occurs first, with symptoms of bladder dysfunction can be screened with uroflowmetry and PVR tests. From the results of uroflowmetry and PVR tests, one can obtain clues to the underlying etiology of bladder dysfunction. One can then decide whether children younger than 15 years should undergo further invasive diagnostic tests, i.e., urodynamic study, voiding cystourethrography or cystourethroscopy. Therefore, urologists should be familiar with the advantages and limitations of the tests.

During examination, the uroflowmeter should be placed in a private and quiet place. The children should be kept well hydrated. Regarding the position of performing uroflowmetry, boys should void in a standing position and girls in a sitting position with adequate foot support. One should keep in mind that the parameters generated from uroflowmetry and PVR tests including peak flow rate (Qmax), voiding time, voided volume (VV), and the shape of uroflow curves are determined by the volume of urine in the bladder, contractility of the detrusor muscle, abdominal straining force and bladder outlet resistance.

Since Qmax, uroflow curves, and PVR are all greatly affected by VV, the International Children’s Continence Society (ICCS) suggests that uroflowmetry of VV less than 50 mL is not enough for interpretation. Yang et al. further suggested that a VV >50% of expected bladder capacity (EBC) is more reliable for the interpretation of uroflowmetry. EBC for children aged 3–12 years is defined as [(age in years) + 1] × 30 mL. Bladder over-distention with bladder capacity (VV + PVR) of more than 115% of EBC or VV of more than 100% of EBC was associated with high rates of abnormal uroflow patterns and elevated PVRs. Caution should be taken to avoid bladder over-distention during uroflowmetry examination. The variability in Qmax was small for consecutive uroflowmetry tests, while the variability in consecutive PVRs was large. As a result, even though it is time-consuming, we recommend at least two PVR tests to help identify the underlying problem.

Among the parameters generated from uroflowmetry tests, the shape of the uroflowmetry curve is the most important factor in interpreting pediatric uroflowmetry. However, the variability in inter- and intraobserver interpretation of uroflowmetry curves can be large. Therefore, one should be familiar with the definition of each uroflow curve. According to the ICCS recommendation, uroflowmetry curves can be classified into five types: bell, tower, plateau, staccato and interrupted. Only bell-shaped curves are regarded as normal (Figure 1A). Tower-shaped curves are defined as high amplitude curves with short duration suggestive of pediatric overactive bladder (Figure 1B). Staccato curves are defined as continuous curves with sharp peaks and troughs with fluctuations larger than the square root of Qmax, and are suggestive of sphincter overactivity (Figure 1C). Interrupted or fractionated curves are defined as curves separated with zero flow rate suggestive of detrusor underactivity (Figure 1D). Plateau curves are defined as even flowmetry curves with low amplitude suggestive of anatomical bladder outlet obstruction (Figure 1E). Although abnormal uroflow patterns are not guaranteed
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The edition of ICCS terminology to “an even flow curve with $Q_{\text{max}}/\text{flow time} < 0.5$ without bladder over-distension”, which may be better for practical use. We reported good interobserver agreement in differentiating normal from abnormal uroflowmetry curves. However, there was low interobserver agreement in defining various types of abnormal flow patterns. As such, we recommend classifying uroflowmetry simply into two types: normal bell-shaped and abnormal non-bell-shaped curves.

As shown in this article, abnormal uroflowmetry can be detected in healthy normal children. We suggest that in cases with any abnormal flow pattern, repeat examination is mandatory. Invasive urodynamic examination

Figure 1  (A) Normal bell-shaped curve in a 10-year-old girl ($Q_{\text{max}}/VV/PVR = 17.1/83.8/3.7$). (B) Tower-shaped curve in a 10-year-old boy ($Q_{\text{max}}/VV/PVR = 27.9/58.7/3.8$). (C) Staccato curve in an 11-year-old girl ($Q_{\text{max}}/VV/PVR = 17.3/95.0/1.8$). Because the drop in flow rate is greater than the square root or 1/4 of $Q_{\text{max}}$, this curve is interpreted as being a staccato curve. (D) Intermittent curve in a 5-year-old girl ($Q_{\text{max}}/VV/PVR = 4.9/69.8/31.0$). The flow rate reached zero. (E) Plateau curve in a 6-year-old boy ($Q_{\text{max}}/VV/PVR = 10.9/135.0/4.5$). It is an even curve with a $Q_{\text{max}}$/flow time $< 0.5$ without bladder over-distension. $Q_{\text{max}} = \text{peak flow rate}; VV = \text{voided volume}; PVR = \text{post-void residual urine}.$
Figure 2  (A) Atypical curve in a 10-year-old boy (Qmax/VV/PVR = 21.1/279.0/4.9). Because the drop in flow rate is not greater than the square root of Qmax, this curve is interpreted as being bell-shaped. (B) Atypical curve in a 12-year-old boy (Qmax/VV/PVR = 11.7/277.0/1.6). It is a combination of plateau and staccato type curves. (C) Atypical curve in a 10-year-old girl (Qmax/VV/PVR = 22.3/343.0/3.4). The sharp rise in flow rate suggests no bladder outlet obstruction. The later significant variation in flow rate may be due to bladder over-distension. Qmax = peak flow rate; VV = voided volume; PVR = post-void residual urine.

is indicated only if there is repeat abnormal uroflowmetry without bladder over-distention.

References