Percentile nomograms for urine flow acceleration

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Introduction

Hypothesis/aims of study: Uroflowmetry is an essential, non-invasive, easy-to-use, widely accessible, and quick urodynamic diagnostic tool in the evaluation of voiding function [1,2]. Urine flow rate measurements are generally used to determine lower urinary tract (LUT) dysfunction.
We have previously established normal reference values for maximum (Q_{max}) and average urine flow (Q_{ave}) in children.
Decreased acceleration of the detrusor muscle contraction (Q_{acc}) may be an appropriate indicator for the early signs of autonomic neuropathy in children and adolescents with type 1 diabetes [3,4].
Q_{acc} has also been found to be superior to Q_{max} in the diagnosis of bladder outlet obstruction in adult men with benign prostate hyperplasia [5].
A possible damage in the detrusor muscle function may also impair Q_{acc}.
Since there is no consensus on the cut-off values of Q_{acc} in pediatric population which limits the use of Q_{acc}, our aim was to establish normal ranges of it in both genders by voided volumes.

Methods

Study design, materials and methods: Data were collected from healthy children who underwent uroflowmetry. Children were divided into those with body surface areas of <0.92 m^2, between 0.92 and 1.42 m^2, and > 1.42 m^2. Exclusion criteria were voided volume less than 20 ml, and postvoid residual more than 15%. Baseline characteristics and uroflowmetry parameters were collected from girls and boys aged between 6 and 18 years.
Voided volume, voiding time, time to maximum flow rate, Q_{max} and Q_{ave} were measured, and Q_{acc} was calculated. Postvoid bladder diameter was measured by ultrasonography and converted to volume.
Quantile method was used to establish the 3–97th percentile levels with SPSS (version 25.0, Armonk, NY: IBM Corporation, US) statistical software package. The centile curves of acceleration by voided volume were estimated by using lmsChartMaker Pro 2.3 (Medical Research Council, UK 1997–2006; Cole and Green 1994; Cole and Pan 2004) software based on the LMS method.
The study is reported as per the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) 2004 Statement [6].

Conclusions

As acceleration of urine flow can provide a finer diagnosis of abnormalities of the LUT and various chronic diseases (diabetes mellitus etc.), our results could form a basis on studies about the diagnostic significance of uroflow parameters in different diseases in children.
These are the first nomograms for normative reference values of Q_{acc} in the pediatric population in centile forms. These may be useful to interpret abnormal Q_{acc} values and diagnose LUT diseases over a wide range of voided volumes.
Concluding message: Since there are only a few studies evaluating Q_{acc} in adult and pediatric population with different diseases, and normative reference values of it are lacking, we found it important to establish normal ranges of Q_{acc} in both genders by voided volumes in children. Since we evaluated the Q_{acc} patters of healthy asymptomatic pediatric population, we formed the basis of future prospective studies. Prospective studies comparing healthy children and pediatric population of different diseases with or without LUT symptoms will be needed to establish cut-off values to differentiate normal and abnormal uroflow patterns.

References

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Results

Uroflowmetry parameters of 208 children (≤18 years old, 45.2% girls, mean age 9.68 ± 3.09 years) who performed 404 micturition were analyzed.

Median voided volume is 130 [20–460] ml, median voiding time is 10 [3–56] sec, median time to Q_{max} is 3 [1–14] sec, median Q_{ave} is 11.7 [2.5–36.6] mL/sec, median Q_{max} is 20.5 [5–50] ml/sec, median Q_{acc} is 6 [0.81–25] mL/sec^2, and median postvoid residual volume 1.83 [0–38.62] ml.

Q_{acc} nomograms were given in centile forms for each body surface area group in both girls and boys, which show an inversely proportional correlation between voided volumes.

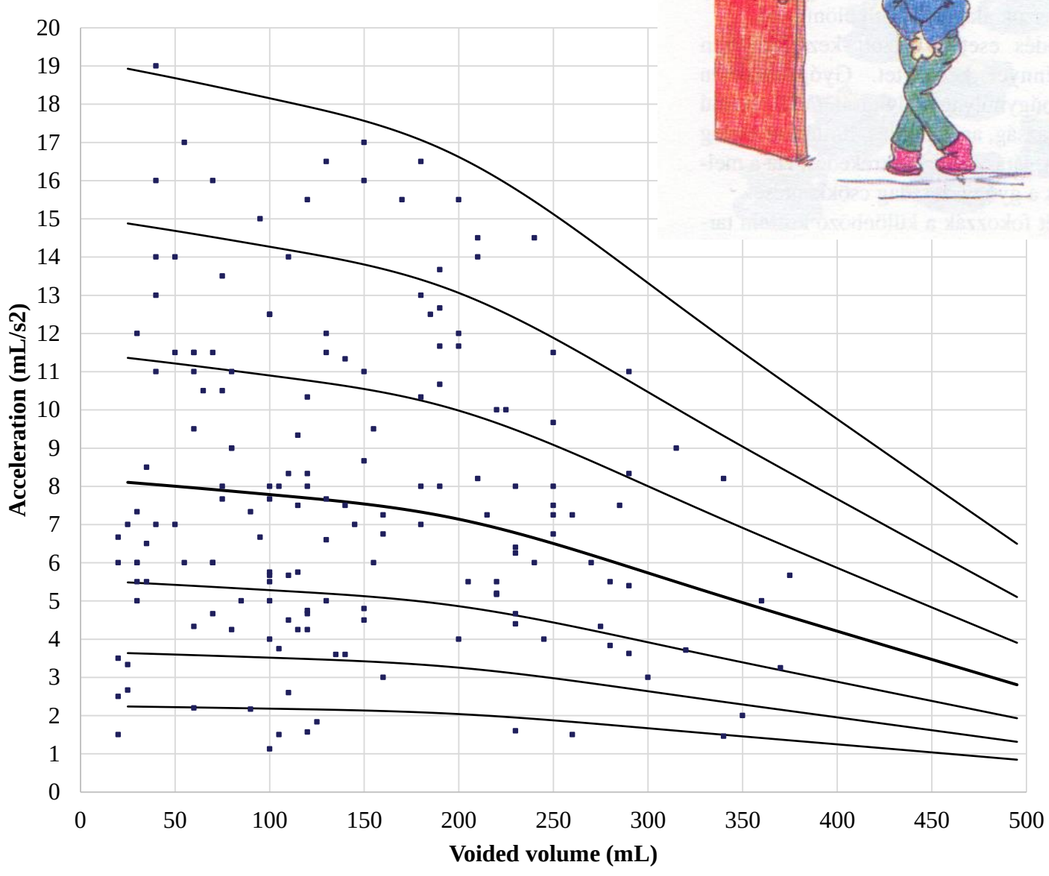

Figure 1. Urine flow acceleration (Q_{acc}) nomogram for girls. Q_{acc} is demonstrated by voided volumes in female population ≤18 years of age.

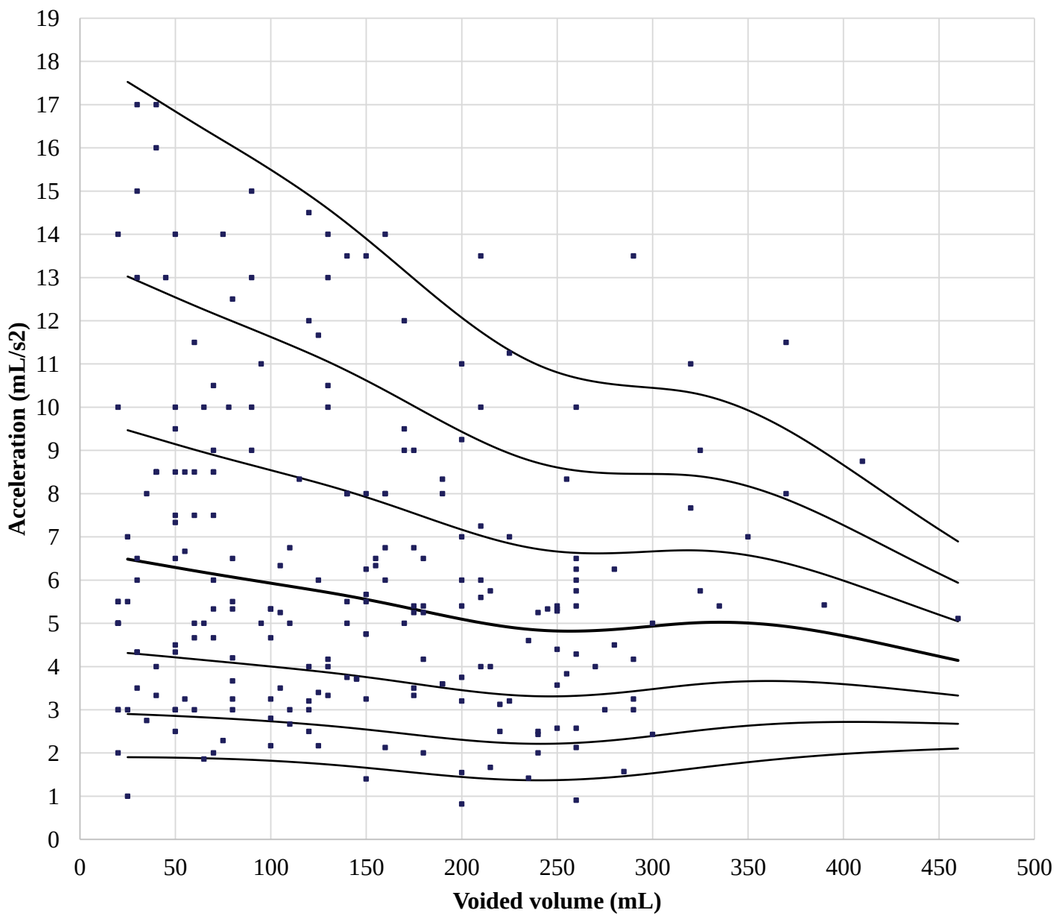

Figure 2. Urine flow acceleration (Q_{acc}) nomogram for boys. Q_{acc} is demonstrated by voided volumes in male population ≤18 years of age.

We have established nomograms for normative reference values of Q_{acc} in paediatric population (girls and boys separately) by voided volumes in centile forms.
We found an inversely proportional correlation between voided volumes and Q_{acc} parameters.

Up to 350 ml of voided volume, higher Q_{acc} values were observed in girls than in boys. This phenomenon might be explained by the shorter and straighter urethra in female population.
Above 350 ml of voided volume, Q_{acc} values below at the 50th percentile were minimally lower in girls than in boys.
A relatively small number of cases may play a role in the latter.