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Reproducibility of Uroflowmetry Variables in Elderly Males

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Summary. In the evaluation of prostatism urodynamics and especially uroflowmetry has received widespread attention. Review of the literature, however, revealed little information on the consistency of flow variables. Therefore eleven male volunteers above fifty years of age were asked to void five times during a short period of time. Each subject was found to reproduce his own flow curve fairly well. Statistical analysis of various flow variables, i.a. Q_{1s}, Q_{max}, volume-corrected Q_{max}, $Q_{max\,time}$, Q_{ave} and volume voided, demonstrated a high degree of reproducibility. In conclusion a single flow curve is sufficient for clinical routine on the assumption that the patient declares the voiding to be typical.

Key words: Uroflowmetry, Reproducibility, Males of prostate-age.

Introduction

Uroflowmetry is considered a fundamental diagnostic tool in the evaluation of lower urinary tract disorders as well as in postoperative followup [14, 18]. Often therapeutic decisions in urologic practice are based on a single or on a few curves, and therefore, it is crucial to know whether the procedure is reproducible to a clinically acceptable degree. While several studies have been carried out on the reliability of cystometry [10, 21], the literature on uroflowmetry is insufficient. Children were proved to reproduce their own flow curve fairly well [7] and several authors have reached the same result examining single or few adults of both sexes [1–4, 13, 17, 19]. Owing to the small numbers, however, no statistical analysis of the data was possible. Furthermore, most of the subjects in these trials were young. No conclusions were drawn about males of the "prostate-age".

The purpose of the present study was to obtain statistically valid information concerning the reproducibility of uroflowmetry in males older than 50 years of age. Both the flow curve pattern and various flow variables were examined.

Materials and Methods

The survey comprised 11 male volunteers with a median age of 67 years (range 58–84 years) representing an unselected subgroup from a random sample of 121 men selected from the national register (Jensen et al., unpublished data). Seven subjects had slight prostatism and one individual had had a transvesical prostatectomy. There was no evidence of neurological or metabolic disorder in any of the subjects but 3 were taking drugs relevant to bladder/urethral function (2 beta-blocking agents for ischemic heart disease and 1 tricyclic antidepressant with anticholinergic action).

Each subject voided five times in the outpatient clinic, usually in the afternoon (80% of the voidings) in order to obtain optimal volumes [5].

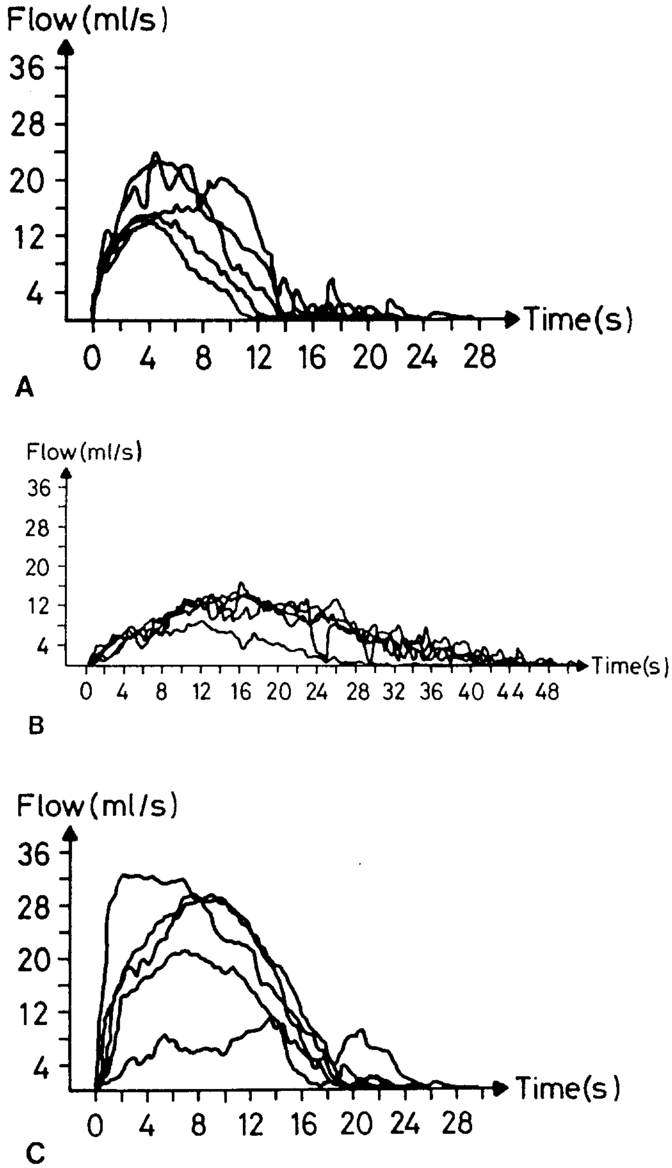
Measurements were made in private surroundings employing the DISA mictiograph type 14F43. The mictiograph was tested using standard flows of 8, 12.5 and 20.5 ml/s. The voided volumes were measured in calibrated glasses.

The flowcurves were evaluated by curve pattern in the five voidings and the following variables were read from the curves: flow after 1 s (Q_{1s}), maximum flow (Q_{max}), time from initiation of voiding until Q_{max} ($Q_{max\,time}$) and flow time. Then average flow (Q_{ave}) was calculated as voided volume/flow time. In order to obtain a volume-independent estimate of Q_{max} a "corrected" Q_{max} = actual Q_{max} divided by the square root of the voided volume was calculated. It was based on the assumption, that Q_{max} as a function of the square root of the corresponding voided volume produces a straight line, as described by von Garrelts [4].

For the statistical calculations we employed the Friedman-test for non-parametric analysis of variance (paired observations) [15]. *P*-values less than 0.05 were considered significant.

Results

Each subject was found to reproduce his own flow curve rather accurately. The initial part of the curve appeared constant and independent of the volume. In seven subjects all five curve patterns were identical, while three persons



◀ **Fig. 1.** Repeated uroflow studies in three elderly males selected at random

had four identical and one had three identical flow curve patterns. Some examples are shown in the Fig. 1.

The analysis of the six flow variables under consideration are shown in Table 1. As demonstrated there was a considerable interindividual variability of the various parameters. However the intraindividual variability was slight and actually no statistically significant differences were revealed in any of the variables during five successive voidings. Moreover no tendency to increase or decrease in any variable was proved. No differences between the voidings were found when Q_{max} was considered, even if corrections for differences in volume were carried out.

Discussion

Although Rehfisch [12] described the first uroflowmeter in 1897 measurement of the urinary flow rate in patients with prostatism did become routine until recently [14, 18]. Several flow variables can be read from a flow curve, but it is generally agreed that Q_{max} more reliably than Q_{ave} distinguishes between patients with benign prostatic hypertrophy and normal individuals [8, 14, 18]. One reason might be that flow time is difficult to ascertain accurately because of terminal dribbling. As uroflowmetry and primarily Q_{max} has gained increasing popularity it is relevant to mention that it is dependant on several factors, which might influence reproducibility and clinical usefullness. The most predominant factor is the corresponding volume, but also psychological inhibition, age and abdominal straining may affect Q_{max} [2–4, 16].

Table 1. Median and range (in parenthesis) values of various flow variables in eleven elderly males during five successive voidings

Flow variable	Voiding number					Statistics
	1	2	3	4	5	
Q_{1s} ml/s	6 (2–13)	10 (1–27)	8 (2–18)	8 (2–13)	5 (2–14)	$p > 0.5$
Q_{max} ml/s	21 (14–30)	22 (7–32)	18 (11–22)	19 (8–30)	15 (11–26)	$0.3 < p < 0.5$
Q_{ave} ml/s	11.5 (5.8–18.3)	11.9 (3.6–21.4)	8.4 (4.6–12.4)	9.4 (4.8–20.6)	7.9 (4.9–13.3)	$p > 0.5$
Corrected Q_{max} $ml^{0.5}/ml$	1.07 (0.86–1.55)	1.10 (0.58–1.63)	0.98 (0.78–1.58)	1.06 (0.72–1.81)	0.93 (0.78–1.66)	$0.3 < p < 0.5$
Q_{max} time s	7.5 (4.5–11)	9 (2.5–15.5)	8.5 (5–16)	7 (4–12.5)	9 (3.5–16.5)	$0.2 < p < 0.3$
Voided volume ml	310 (150–440)	340 (158–492)	282 (133–705)	304 (96–488)	300 (105–425)	$p > 0.5$

Q_{max} is positively correlated with the volume and this relationship has been described as linear, parabolic, exponential, logarithmic, hyperbolic and quadratic [2, 4, 13, 16, 17]. According to the latter authors only hyperbolic and quadratic equations describe this relationship reliably for all volumes. Simple square root equations, as employed in this study, are adequate up to approximately 450 ml, i.e. sufficient for most clinical practice.

Whether voided volume, without catheterisation, or bladder volume should be preferred remains unclear. Some authors state that measurement of voided volume will result in overestimation of the voiding ability in the presence of residual urine [17], while others find that the difference may be insignificant [9]. The influence of age is controversial. In a comprehensive study Drach et al. [2] demonstrated a progressive decrease in Q_{max} with age regardless of the voided volume. This finding was later confirmed by Ryall and Marshall [13]. The conclusion, however, is questioned because it may reflect otherwise asymptomatic benign prostatic hypertrophy [16]. Psychological influence on bladder and urethral function is welldocumented [11, 20], but difficult to quantitate exactly, which is also true for abdominal straining [6]. Because of these variables the reliability of flow data needs to be proved statistically. However, review of the literature does not reveal such information. Various authors showed a reasonable consistency of Q_{max}, but in general only in a single individual of young age [2, 3, 13, 17, 19]. Examining repeated voidings in five young men Dutartre and Susset [3] found Q_{max} to increase progressively until it stabilised after twelve voidings. The same tendency was demonstrated for Q_{Ave}, while Q_{2s} and $Q_{max\ time}$ did not stabilise after as many as twenty-four tests. These data suggest a learning effect, probably the result of decreasing psychological inhibition as the test becomes familiar. No comments on the corresponding volumes were given.

In the present study these shortcomings have been avoided and uroflowmetry in elderly males was proved a highly reproducible procedure with respect to flow curve patterns and other flow variables. No learning effect was demonstrable, implying less concern in elderly than in younger individuals as regards the test situation, confirming the findings of Pznanski and Pznanski [11]. The practical clinical consequence is, that it is sufficient to obtain a single flow curve, if the patient is able to state 1) voiding desire prior to the test and 2) that the voiding process proceeded in the usual way.

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