

## THE NORMAL VOIDING PATTERN ASSESSED BY A FREQUENCY VOLUME CHART (FVC)

### Hypothesis/aims of the study

The definition of a normal voiding pattern is associated with some variability due to both age and gender, and especially the aging process is accompanied by significant alterations of bladder function, e.g. idiopathic detrusor instability, impaired detrusor contractility and changed compliance.

In the elderly, the increased frequency observed during night-time has previously been attributed to an increased diuresis and not to a lower bladder capacity.

This study was designed to explore into changes in the voiding patterns by investigation of young versus elderly male volunteers, especially focusing on relation between the voided volume and the maximum voided volume.

### Study design, materials and methods

Thirty-one healthy young males (age 25.0 years, range 21-32 years, bodyweight 76.9 kg, range 63-95 kg) and 18 healthy elderly males (age 60.4, range 55-73 years, body weight 78.5, range 71-88 kg) were included in the study. There was no history of nocturia (all participants documented fewer than seven nocturnal voids/week (mean less than one void/night)) or any other urological complaints. Both the young and the elderly had a normal physical examination. Subjects with bladder outlet obstruction were excluded.

Their voiding habits were assessed by self-completion of frequency /volume chart (FVC) recording the time and volume of each voiding and each fluid intake for at least three days and nights.

The young males recorded their voidings on a home-flow-device (Dantec Dacapo ®). The elderly men recorded the voided volume with a measuring cup. Fluid intake and food intake was *ad-libitum*, and there was no restrictions regarding type of fluids or smoking. The subjects were allowed to ambulate at will.

From the FVC voiding frequency, voided volume (VV), average voided volume (AAV) and maximum voided volume (MVV) was obtained. The day time urine production was parted in three different periods. Morning void-2pm, 2 pm-8 pm and 8 pm-bedtime. The AVV was calculated as average voided volume during day and night (including first morning void) respectively. Values were corrected for body weight.

T-test were used when possible, otherwise variables in the young and in the elderly were compared using Exact Wilcoxon rank sum test. Results are presented either as mean  $\pm$  SEM or as median and quartiles/range.

### Results

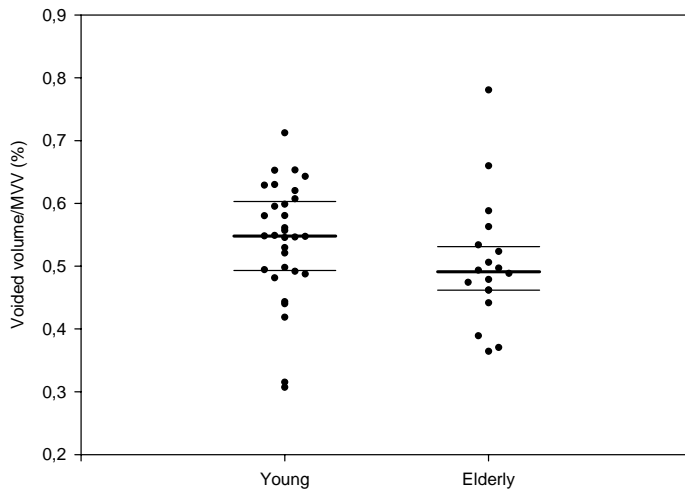
All 49 participants completed the study. They all fulfilled the FVC in 3-7 days. The average fluid intake in the young group was 32.9 ml/kg bodyweight and the comparable value in the elderly was significantly lower (26.8 ml/kg body weight,  $p=0.007$ ). We observed 31 nocturia nights in the elderly (33 voidings) and 0 nocturia episodes in the young males.

Both young and elderly males displayed a large intra-individual and inter-individual variation in frequency. In average the elderly participants had a slightly higher frequency, though not significant. (6.77 vs. 6.21,  $p=0.18$ ).

Average voided volume showed a circadian variation with higher night time values. AVV late morning, afternoon, and evening differed significantly between the two groups ( $p=0.001$ ,  $p=0.0006$ ,  $p=0.01$ ), whereas no difference was observed during the night ( $p=0.81$ ). MVV was higher in the young males ( $8.19 \pm 0.40$  vs.  $6.58 \pm 0.44$ ,  $p=0.0136$ ), whereas the ratio between voided volume and MVV did not differ between groups (0.548 vs. 0.491, NS).(figure 1)

		Young males		Elderly males	
		Median	Range	Median	Range
Average voided volume (AVV)	Late morning	3.69	1.91-11.13	2.68*	1.45-4.85
	Afternoon	4.46	1.83-7.36	3.22*	1.91-5.08
	Evening	3.84	1.04-6.99	2.85*	2.15-5.92
	Night	5.29	2.25-8.40	5.07	3.15-7.95

**Table 1: \* Significant difference between groups.**



**Figure 1: Voiced volume/MVV (%). Horizontal lines represent medians and 25/75%-kvartils**

#### Interpretation of results

Aging is associated with changes in the voiding pattern. Nearly all symptoms from the lower urinary tract increases with age (1). In this study of healthy volunteers where bladder outlet obstruction had been excluded, we found significant lower AVV and MVV in the elderly subjects. This is consistent with the age-dependent structural and functional changes in the bladder. Surprisingly in both groups most of the voided volumes were considerably lower than the MVV. This makes these healthy males very similar to both normal and enuretic children (2). The variability in voiding pattern reflects influence by behavior, physiology and social factors. Some of the differences maybe attributed to the changes in fluid intake with age. Smaller intake is associated with smaller bladder capacity values. In children, it has been observed that fluid intake regulates frequency and not capacity (3), whereas in this study, average voided volume, except at night is related to intake.

#### Concluding message

Description of the normal voiding pattern needs completion of a FVC. This study shows normal physiological age changes with a decreasing bladder reservoir function. Surprisingly most voidings seems to occur at bladder volumes smaller than the MVV. The evaluation of the voiding pattern is essential in all urological settings.

#### References

- 1) Scand J Urol Nephrol Suppl. 1994;157:27-30.
- 2) J Urol. September 2006, accepted for publication.
- 3) Unpublished data under preparation.

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**HUMAN SUBJECTS: This study was approved by the Ethics Committee of Aarhus County, Denmark and followed the Declaration of Helsinki Informed consent was obtained from the patients.**