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Changes in Bladder Volumes with Repetition of Water Cystometry

S. S. Sørensen, J.B. Nielsen, J.P. Nørgaard, L.M. Knudsen and J.C. Djurhuus

Department of Urology, Municipal Hospital of Aarhus, Denmark

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Summary. Fifty-six patients were investigated by repetitive cystometry in the supine or sitting position. The incidence of detrusor hyperreflexia and the circumstances under which it was found did not differ from previous studies. The cystometry data concerning volumes showed a remarkable degree of variability. Values for first sensation and maximal capacity could vary more than 500%. An increment from the first cystometry to the fourth was consistently found. The increments were most pronounced when cystometry with fast filling followed cystometry with medium filling regardless of the patient's position. The major factor in the changes is considered to be the patient's adaptation to the investigational situation. This finding might have major significance in the evaluation of drug studies where repeated cystometries with different time intervals are used.

Key words: Cystometry, Reproducibility.

Introduction

Cystometry is one of the most important diagnostic tools in urology. From the earliest studies with pressure measurements and free flow fluctuating infusion cystometry has gradually been refined by means of better pressure measurement devices and continuous infusion furnished by mechanical pumps. It is now used for evaluation of the state of the nerve supply to the bladder as well as the reservoir function.

Questions have been raised about the validity of cystometry. It is known that the incidence of bladder hyperreflexia depends on the position of the patient [1]. The effect of repeated cystometry has been studied in several investigations, but the results are conflicting, showing no change in capacities [2, 4] or decreasing capacity [3].

The present study was performed in order to investigate the reproducibility of data obtained by cystometry, the influence of position and of the filling rate.

Material and Methods

The material comprised 56 patients (18 males and 38 females) consecutively referred for urodynamic investigation. Excluded were patients with vesico-ureteral reflux, significant residual urine, neurogenic bladder dysfunction, and patients with urinary tract infection. The overall mean age of the patients was 36.4 years with a range from 13 to 63 years. The patients were randomly allocated into one of four groups. In all four groups, 4 consecutive examinations were performed but with a different sequence of filling rate and position for each group as seen in Table 1. The mean age and the age range together with the number of patients in the individual groups are seen in Table 2.

All investigations were performed transurethrally with an 8 F filling catheter and a 5 F pressure measuring catheter. Additionally, rectal pressure was monitored. Saline at room temperature was used as the filling medium, and all cystometries were done by peri-

Table 1. The sequence of the four cystometric examinations in the four groups of patients. S = sitting position, L = supine. The figures indicate filling rates in ml/min

	Filling No			
	1	2	3	4
Group I	S 120	S 60	L 120	L 60
Group II	L 60	L 120	S 60	S 120
Group III	S 60	S 120	L 60	L 120
Group IV	L 120	L 60	S 120	S 60

Table 2. The mean age, age range and number of patients in the different groups

	Mean age	Range	*N*
Group I	37.9	13–63	12
Group II	34.5	18–60	17
Group III	39.7	15–58	17
Group IV	31.9	13–63	10

Table 3. The relationship between filling rate position and hyperreflexia

	7 patients	S 120
		S 60
		L 120
		L 60
	10 patients	S 120
		S 60
	2 patients	S 120
	1 patient	S 120
		S 60
		L 60
	1 patient	S 60
Total	21 patients	

Table 4. Statistical significance of change in cystometric volumes between first and fourth cystometry

Group I	max C	$0.01 < p < 0.02$
	F S	$p < 0.001$
Group II	max C	$0.001 < p < 0.005$
	F S	$p < 0.001$
Group III	max C	$p < 0.001$
	F S	$p < 0.001$
Group IV	max C	$0.05 < p < 0.1$
	F S	$0.001 < p < 0.005$

staltic infusion with a roller pump. The bladder pressure and the rectal pressure together with the subtracted detrusor pressure were continously recorded by way of a Disa 2100 uroflow system and an ink recorder. The cystometrograms were analysed according to ICS recommendation.

Statistical Analysis

Students t-test and students t-test for paired comparison were used to analyse the data. The variability of values for first sensation and maximal capacity obtained during the first cystometry was analysed according to the following equation:

variability index = volume obtained in the first cystometry – volume differing maximally from this divided by volume obtained in the first cystometry. The uncertainty was expressed in per cent.

Results

Table 3 shows the number of hyperreflexic traces obtained and the circumstances under which they were found. Fig. 1 shows the mean value and standard error of the mean for first sensation and maximal capacity obtained during the four cystometric examinations in the four groups of patients. Statistical analysis comparing results obtained from the first cystometry revealed no significant difference between the four groups, neither in first sensation, nor maximal capacity. Students t-test for paired comparison revealed a significant increase in volume from the first to the fourth filling for all groups. One exception was the maximal capacity in group IV (Table 4). As seen from Fig.

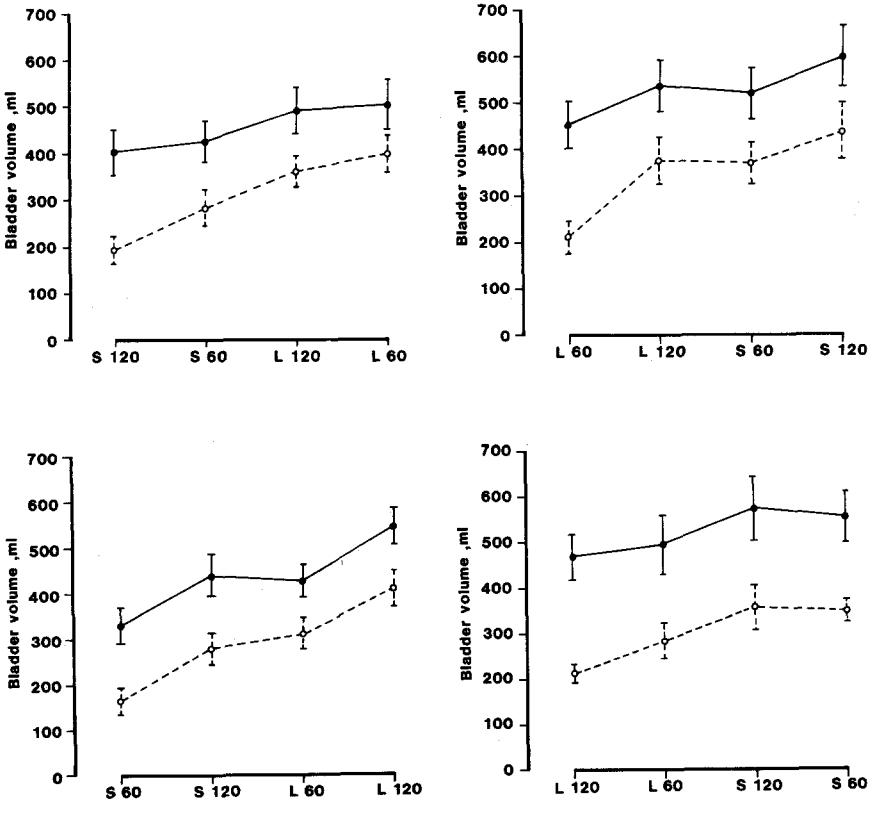

Fig. 1. Mean values and standard error of the mean for first sensation (*open circles, dotted line*) and maximal capacity (*closed circles, solid line*) obtained in four consecutive cystometric examinations in four different sequences in the four groups of patients. Regardless of sequence there is an increase in volume at first sensation and the maximal bladder capacity from the first to the fourth cystometry in all four groups with exception of maximal capacity in group four

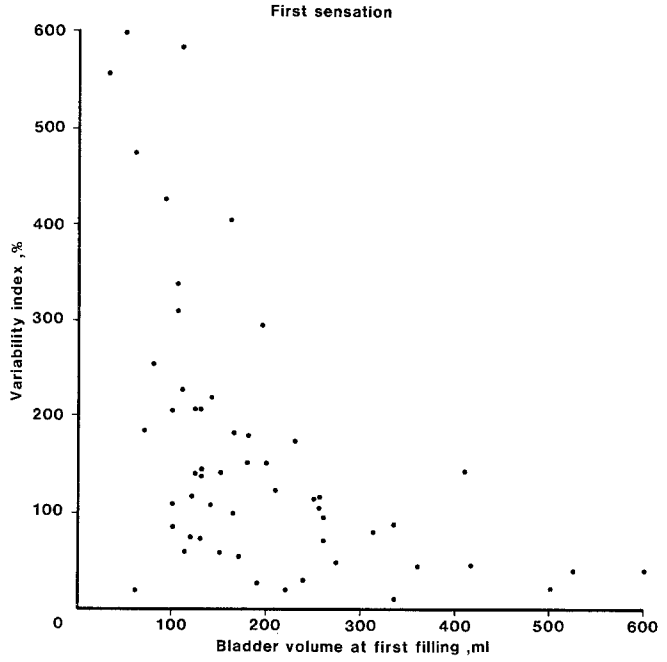

Fig. 2. The variability index for the volume at first sensation in relation to the bladder volume at first sensation in the first cystometry

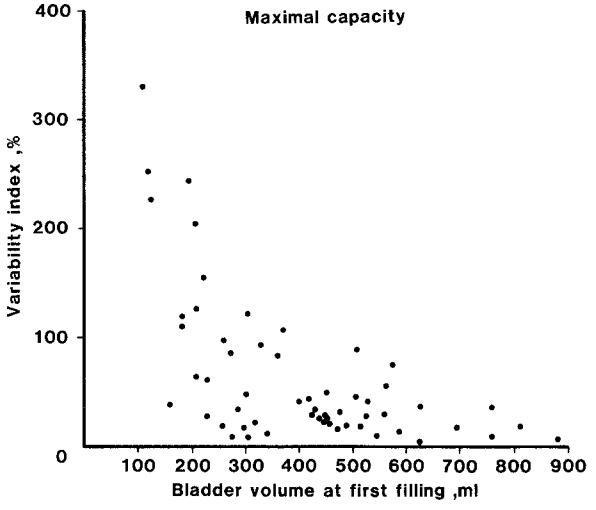

Fig. 3. The variability index for maximal capacity in relation to the bladder volume at maximal capacity in the first filling

1 there was a tendency in all four groups for both first sensation and maximal capacity to increase more after fast filling than after slow filling. Also seen from Fig. 1 is that position apparently did not influence this tendency neither in a positive nor in a negative direction.

In Figs. 2 and 3 the variability index for both first sensation and maximal capacity for the first cystometry in the individual patients is plotted against the actual volume obtained. Combining the patients, there seems to be a tendency to a higher degree of reproducibility the larger the volume obtained in the first cystometry. Only 11 patients had a difference in first sensation of less than 50%, while the difference for maximal capacity was less than 50% in 37 cases. When patients with hyperreflexia were excluded from the analysis, statistics revealed no significant change in bladder compliance obtained during the first cystometry compared to compliance obtained in the fourth filling.

Discussion

Previous studies have documented an increased frequency of hyperreflexia when cystometry is done in the sitting position [1]. This is confirmed in the present study. In 20 patients the hyperreflexia was disclosed in the sitting position, while it was only reproduced in 7 cases in all four examinations.

The present material does not indicate any influence of the filling rate on the induction of hyperreflexia. In the 20 patients with hyperreflexia in the sitting position, hyperreflexia was a consistent finding in 17 of them both during fast and during slow filling. This finding is in agreement with Ramsden et al. [4], although the techniques were not directly comparable.

Reports concerning the influence of the filling rate on bladder capacity are conflicting [2–4]. In our material, the first cystometry data showed no difference either in mean first sensation or in mean maximal capacity between the four groups. This was in spite of the four different situations of obtaining the first cystometry. Seen from Table 4 there is, however, a significant increase in both first sensation and maximal capacity during the four repeated examinations in all four groups. This observation is in conflict with the study by Nordling and Walter [3], who reported a decrease in maximal capacity during repeated cystometries. However, they used CO_2 as filling medium which is known to cause bladder discomfort during repetition. Using saline as filling medium, Ramsden et al. [4] and Cass et al. [2] found no change in maximal capacity by repetition of the cystometry. This might be due to the fact that only two examinations were performed in contrast to the present study with four.

Judged from Fig. 1, there is a tendency for a larger increase during fast filling in both first sensation and maximal capacity than during slow filling in consecutively performed cystometry. The reason could be that the patient during the first cystometry associated his bladder sensation with the time interval to reach the feeling of first desire to void and the feeling of maximal capacity. If the filling rate was then doubled, it is not surprising that bladder volumes increased. On the other hand, the consequence of this hypothesis would be that halving the filling rate should decrease the volume, and this was not the case. Therefore, other factors must be considered. An obvious factor is the patient's overall adaption to accept larger volumes. This is in accordance with the fact that although there is a significant increase in maximal capacity during

the four cystometric examinations, there is no significant change in bladder compliance.

The significant increase in bladder volume observed during repeated cystometry has a major impact on the interpretation of data obtained during drug studies. A beneficial drug response could accordingly be mere adaptation. The intraindividual variability in volumes seems to make it impossible to speak of absolute values of first sensation and maximum capacity when these parameters are judged from only one cystometry. Even during four consecutive cystometric studies there is an on-going increase in volumes. In the light of the data obtained here comparison of cystometry performed with weekly or monthly intervals would be very informative, since this might reduce the influence of the factors mentioned. Such studies are in progress.

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J. C. Djurhuus
Institute of Experimental Clinical Research
University of Aarhus
D-8000 Aarhus C
Denmark