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COMPARISON OF WITHIN SESSION REPRODUCIBILITY OF NON-INVASIVE AND INVASIVE URODYNAMICS

Aims of Study

Earlier we presented first results of the short term (within session) reproducibility of non-invasive urodynamics using the condom catheter method. These were based on measurements in the first 93 subjects in a longitudinal study of changes in urinary bladder contractility secondary to benign prostatic hyperplasia [1]. The comparison of this reproducibility to that of invasive urodynamics reported in the literature is not straightforward, as the parameters and statistics differ in definition and scale. In this abstract we compare the reproducibility in a much larger sample of our ongoing non-invasive longitudinal study with that of (invasive) pressure flow parameters in a comparable population.

Methods

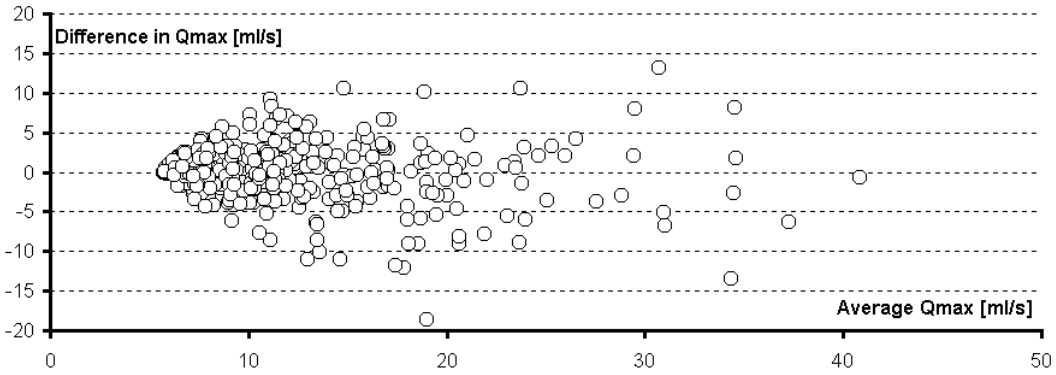
Patients of general practitioners were invited to participate in the study. The volunteers first underwent a free flow-rate, if the maximum free flow rate exceeded 5.4 ml/s, two non-invasive condom catheter measurements were attempted. In each measurement the maximum pressure, $p_{cond.iso}$, measured in the condom during interruption of voiding was automatically selected and, if necessary, corrected by the investigator.

Pressure-flow studies on males in the same age range (38-77), with a maximum flowrate > 5.4 ml/s were selected from the database of invasive urodynamic studies maintained in our centre since 1999. The studies were done with water filled lines (5F) and a rotating disc flowmeter. The maximum flowrate (Q_{max}), the associated detrusor pressure ($p_{det.qmax}$), the maximum detrusor ($p_{det.max}$) and vesical ($p_{ves.max}$) pressure, the urethral resistance parameters URA and BOOI (the former AG-number) and the detrusor contractility (w_{qmax}) were automatically calculated. The reading of Q_{max} was corrected by the investigator if necessary.

For both non-invasive and invasive parameters, the difference in parameter values of two measurements in the same patient was plotted as a function of the mean of the two values. If difference and mean were found independent, the standard deviation of the differences was calculated. The standard deviation was normalised by dividing by the difference between the 97.5th percentile and the 2.5th percentile of the mean.

Results

In 457 volunteers of 501 studied thus far, two measurements were made. The mean of $p_{cond.iso}$, and the standard deviation of the difference in this pressure, see table, first row, were hardly different from the results earlier reported in 73 volunteers, confirming the stability of these measures. The other rows give values for invasive urodynamic parameters. The difference plot of Q_{max} had a peculiar shape, see figure, suggesting a dependence of the



standard deviation on the mean. This resulted from the applied selection criterium >5.4. A similar selection "distortion" may be expected for any parameter that has a cut-off value, e.g. a parameter that cannot attain values < 0. For Q_{max} we therefore calculated the standard deviation of the difference only for those patients in whom the mean Q_{max} was >12 ml/s. w_{qmax} results were only available for measurements made with the newest software version. For a comparison the standard deviations calculated should be normalised. Frequently this is done by dividing by the mean. It has been argued [2, editorial comment] that this may lead to erroneous results. We normalised by dividing by the difference between the 97.5 and 2.5 percentiles of the mean pressures. The validity of this concept may be appreciated by the fact that the normalised standard deviations of URA and BOOI are almost identical, as they should.

Conclusions and discussion

The within patient sd's of $p_{det.qmax}$, URA and BOOI reported in [2] (a different center) are almost identical to the ones reported here, but for Qmax an sd of 2 ml/s is reported while we find 5 ml/s. The selection distortion that we noted may explain this difference. $p_{cond.iso}$ is an estimate of the maximum isovolumetric vesical pressure. A comparable pressure is not measured in pressure flow studies. The normalised standard deviation of $p_{cond.iso}$ is slightly

Parameter	Unit	N	Mean	Percentile 2.5	Percentile 97.5	Standard Deviation of difference	Sd/ (% 97.5- % 2.5)
$p_{cond.iso}$	cm H_2O	457	101	44	166	18	0.15
Q_{max}	ml/s	142	18	12	35	5	0.22
$p_{det.qmax}$	cm H_2O	397	48	16	108	11	0.12
$p_{det.max}$	cm H_2O	397	66	29	141	24	0.21
$p_{ves.max}$	cm H_2O	397	136	77	233	42	0.27
URA	cm H_2O	397	24	7	55	6	0.12
BOOI		397	23	-32	94	14	0.11
W_{qmax}	W/m^2	126	8.8	4.7	19.1	3.1	0.22

larger than that of $p_{det.qmax}$, which is understandable as $p_{det.qmax}$ is not a maximum. Maxima are more vulnerable to noise. The normalised reproducibility of $p_{cond.iso}$ is better than that of $p_{det.max}$ and $p_{ves.max}$, which both are maxima. From a modeling point of view $p_{cond.iso}$ is comparable to w_{qmax} as both estimate the bladder contractility, however, the reproducibility of the latter was worse. We conclude that the reproducibility of non-invasive urodynamics is equal to or slightly better than that of invasive urodynamics. It should be noted that the data that we analysed was not measured for the purpose of this comparison. When reviewing difference plots of the data, some huge outliers were identified, some of which were caused by human error. These errors were not corrected for this analysis, that therefore represents a worst case.

References

[1] Neurourol Urodyn. 2002;21(4):351-352.
[2] Neurourol Urodyn. 2000;19(6):637-651; discussion 651-656.

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