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APPLICATION OF NON-INVASIVE URODYNAMICS TO LONGITUDINALLY STUDY CHANGES IN URINARY BLADDER CONTRACTILITY.

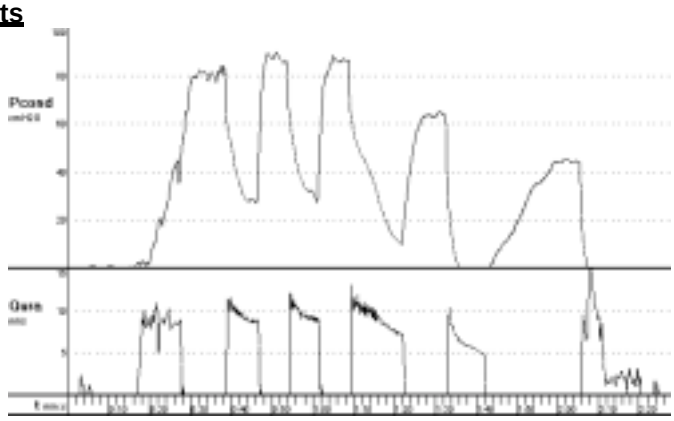
Aims of Study

As standard urodynamic measurements are invasive and therefore uncomfortable to the patient, they are not often applied in epidemiological studies. The introduction of non-invasive urodynamics [1] makes it possible to measure the contractility of the urinary bladder in such a study. We started a community study to longitudinally evaluate the changes in bladder contractility in response to age related prostatic enlargement in a group of 1200 healthy male volunteers. Presently, we report our experiences with applying the condom method for non-invasive urodynamics in the first 93 subjects.

Methods

Males aged 38-77 and without known voiding problems, previous prostate surgery or medication will be studied three times in five years. Each measurement includes one free flowrate and two pressure measurements. For the latter a modified incontinence condom is used. The condom is attached to a dome screwed on a pressure transducer. The dome has three metal outflow resistances. These are fitted with tubes that can be remotely and independently closed by pneumatic valves. At sufficient urgency the subject voids without straining through the condom and the tubes into a uroflowmeter. During the micturition the outflow resistance is stepwise increased untill a preload pressure in the condom between 20-40 cm H_2O is reached. Subsequently all valves are closed to measure the isovolumetric bladder pressure. When a pressure equilibrium is reached, the outflow resistance is restored to the previous value. This procedure is repeated several times. The interrupted flowrate and the condom pressure are recorded by computer. In between the measure-ments the men are invited to drink about 1.5 liter of mineral water. A transabdominal ultrasonography of the prostate volume is also made, a voiding diary is kept for three consecutive days and the International Prostate SymptomScore is completed by the subject. All measurements are done by one investigator.

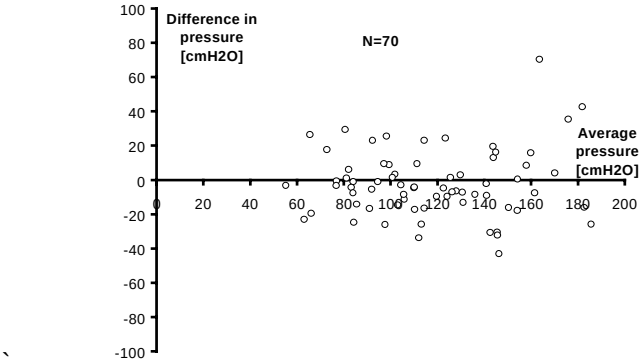
Results



The figure shows an example of a pressure measurement (Pcond) and the interrupted flow (Qura). At a preloading pressure in the condom of approximately 40 cm H_2O all valves were closed. The pressure then quickly rose and reached a plateau value. At that pressure equilibrium the condom pressure reflected the isovolumetric bladder pressure. Some valves were then reopened to restore the preload pressure and closed again. This action was repeated several times in one voiding. The highest measured isovolumetric bladder pressure here was 88 cm H_2O.

In 73 of the 93 subjects participating in the study (78%) the isovolumetric bladder pressure was successfully measured. The 20 unsuccessful measurements were caused by: a. Too low flowrate (< 5.4 ml/s) in 5 cases (25%), b. Unability to void in the presence of the investigator in 8 men (40%), c. Anomalia: coronal hypospadia in one man (5%) and d. equipment and investigator related problems in 6 cases (30%) that can be avoided in the future. In some of the successful measurements we were unexpectedly confronted with some adverse events. Tolerable and shortlasting pain or unpleasant feeling on the glans penis during

complete interruption of the flowrate was reported in 12 cases (16%). Terminal and self limiting macroscopic hematuria also in 12 cases (16%). In 5 of these some form of anticoagulation was used. A Pearson Chi-square test showed that hematuria and the use of anticoagulation were significantly associated ($p< 0.001$). We found a small hematoma on the skin of the penis in one man (1%). One man developed acute urine retention (1%). On his way home this man on purpose held up his urine too long.



In 70 subjects two pressure measurements were completed. The difference plot shows on the vertical axis the difference between the highest condom pressures in the two voidings. The horizontal axis shows the mean of those two highest pressures in each subject. Pressures measured ranged from 52-203 cm H_2O with a mean of 117 and a SD of 34. The mean difference in pressure was -2 cm H_2O with a SD of 20 which was not significantly different from zero (paired t- test $p = 0.52$). In 80% of the subjects a difference in pressure smaller than ± 26 cm H_2O was found. The mean of the highest pressures in subjects with adverse events did not deviate significantly from the overall mean.

Conclusions

We conclude that the non-invasive method seems very suitable for epidemiological studies. Unsuccessful measurements were mainly subject related. Pain and hematuria were not related to the pressures attained but rather to the subject's vulnerability and sensibility. By excluding subjects using anticoagulation from the study the incidence of hematuria can be reduced to approximately 11%. The measurements are not biased, i.e. a second measure-ment is not systematically different from the first. The reproducibility of the measurements is comparable to that of invasive pressure flow studies [2]. In the present population the pressures measured are considerable higher than those measured in earlier studies [3], reflecting the different population (among others higher ages) studied. At present we thus have some starting values of the isovolumetric bladder pressure. Measuring the changes in these values after 2 1/2 and 5 years will enable us to evaluate the changes in the urinary bladder contractility in response to age related prostatic enlargement.

References

[1] J. Urol. 165: 647-652 (2001); [2] Neurourol. Urodyn. 19: 637- 656 (2000);
[3] Neurourol. Urodyn. 18: 455- 475 (1999).

Acknowledgements

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