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WATER CONSUMPTION, URINE PRODUCTION AND DETRUSOR FUNCTION

Aims of Study

In previous studies we evaluated the pattern of the urodynamic characteristic of normal male micturition, considering this to be a useful standard in the analysis of data from patients complaining of voiding dysfunction [1]. The validity of such a standard is based on the need to obtain baseline parameterisation of pressure/flow values, an important consideration in the diagnosis of prostatic obstruction and it's treatment. While current numerical pressure/flow values provide a useful summary of the voiding sequence, a more comprehensive consideration of normal voiding may reveal functionally more useful information concerning micturition. In the present study, we examined the influence of water consumption on the contractility of the bladder as a possible contributory factor involved in the urodynamic parameterisation of micturition. This was done by expanding the use of the original experimental protocol, initially designed to simulate the conditions of normal voiding, of physiologically produced urine by the kidneys, measured over time intervals that represent real stages of bladder filling. We report here the results of an investigation, specifically designed to study consecutive micturitions, at bladder volumes that are determined by water consumption and the endogenous circadian rhythm of urine production, as distinct from artificial external bladder filling by the CMG. Our particular focus is to characterize the urodynamic parameters of normal male micturition and obtain evidence to support the hypothesis that fluid consumption plays an important role in determining detrusor function.

Methods

Urodynamic studies were conducted on 39 asymptomatic male volunteers, age 25.8 (21-31) years and weighing 75.5Kg(63-95). Volunteers were divided into groups according to the following water consumption regimen: group1 (n=17), drinking 30/ml/kg/day and group2 (n=12) drinking 60ml/kg/day. Bladder pressure was monitored via a supra-pubic catheter and abdominal pressure via a rectal balloon using a UPS2020 ambulatory system. Average duration of each monitoring period was 20.5 hours. Detrusor pressure and flowrate records from each subject were identified and consecutive filling and voiding phases were averaged over the entire monitoring period using the onset of micturition as a time marker. The averaged pattern of pressure, flowrate, cumulative volume, and contractility for each subject, of each group, was computed. For each group the averaged parameters of Urethral opening pressure, Max Detrusor pressure, Detrusor pressure at max flow rate, Bladder capacity, and Contractility in terms of WF were calculated and compared statistically. Numerical values are given as mean±standard error.

Results

Table 1 , identifies the principal urodynamic parameters measured during the two water consumption regimens. Predictably, water consumption directly influences the rate of urine production. However as shown by this Table the majority of the micturition phase urodynamic parameters are also significantly affected by water consumption. Examination of the pattern of micturition shows that in both groups, the maximum detrusor pressure occurs before voiding starts, at which time it has its highest numerical value. Furthermore as shown by the Table, doubling of water consumption significantly increases Opening pressure as well as Detrusor pressure at maximum urine flowrate. Finally Table 1 shows that Detrusor contractility increases significantly with higher water consumption.

Table 1: Effect of water consumption on derusor function during micturition

Urodynamic Parameters	***Water Consumption***	
	30mL/kg/day	***60ml/kg/day***
Max. Detrusor Pressure (cmH_20)	58.9±4.5	70.0±6.2*
Opening pressure (cmH_20)	51.2±3.2	61.5±5.1*
Detrusor Pressure @ Max. Flow (cmH_20)	47.8±2.2	58.7±3.1**
Total volume micturated (mL)	1629±135	3197±228***
Volume voided/micturition (mL)	286±20	329±15
Max. Urine flow rate (mL/sec)	24.4±1.4	25.2±1.8
Max. Contractility WF (Watts/m2)	15.4±1.4	17.7±1.4*
Frequency of Micturition (/hr)	0.28±0.03	0.43±0.03***
Duration of monitoring (hr)	22.2±0.07	22.8±0.0
# of Micturitions	5.8±0.40	9.8±0.5***

*p<0.05, **p<0.01, ***p<0.001

Conclusions

The observation that, in the human male, micturition pressures and bladder contractility increased significantly with a higher rate of water consumption and urine production was an unexpected finding of the present study. In view of this observation, it is speculated that uropharmacologic treatment for enuresis, bladder overactivity and or prostate obstruction can indirectly impact on both water consumption and urine production rate thereby modulating the urodynamics characteristics of micturition. Similarly, the observation that maximum detrusor pressure occurs prior to the onset of urine flow, suggests that an accurate prediction of prostatic obstruction can be made with a combination of isometric detrusor contraction pressure and maximum urinary flow rate. This is because isometric detrusor contraction pressure increases with outlet obstruction and maximum urinary flow rate tends to decrease with obstruction. This is in agreement with recent reports suggesting that specific criteria consisting of a combination of high isometric pressures and maximum flow rates may be able to differentiate obstructive from non-obstructive voiding dysfunction better than either parameter alone. [2] On this basis, our observations further confirm previous reports that there is a practical advantage in combining the results of uroflowmetry and isometric pressures as appropriate measures to be used in treatment strategies [3]

[1] Neuroul Urodyn 20;#4. 571-2, 2001, [2] Urology 48:723-9, 1996, [3] J Urol 155 1995-2000, 1996