9

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Title: NON INVASISE PRESSURE-FLOW STUDY USING A VOIDING SIMULATION AND SCORING OF RESULTS

Aims of Study:

To prepare a pressure-flow diagram using intraurethral pressure loss and urinary flow rate, and to score the results of the pressure-flow study by grading urethral frictional resistance and power.

Methods:

A total of 116 subjects, 60 healthy males and 56 patients with benign prostatic hypertrophy, were studied. The uroflowmetry curves were approximated using a voiding model(1). As a result, we were able to express urinary flow rate (Q(t) by the function of time as well as calculate urethral pressure loss ($\Delta P(t)$) and urethral frictional resistance (R). By using Q(t) and $\Delta P(t)$, we then calculated the power (P) consumed in the urethra during voiding. When pressure loss at maximum urinary flow rate (Qmax) was expressed as ΔP at Qman, R and ΔP at Qmax/Qmax as well as P end ΔP at Qmax XQmax had a linear relation. A pressure - flow diagram can be prepared by plotting R and P with Qmax as the horizontal axis and ΔP at Qmax as the vertical axis (Figure). R was graded at 2, 5 and 10 cmH_2O s/ml, and R scores were decided as follows: less than 2 was scored as 0, 2 to less than 5 as 1, 5 to less than 10 as 2 and 10 or more as 3. Power was graded at 20 and 40 mW, and power scores were decided as follows: less than 20 as 2, 20 to less than 40 as 1 and 40 or more as 0. Total score (TS) was calculated by adding the R and P scores. TS was regarded as normal at 0, 1.

Results:

The relation of TS with Qmax and Qmax/Flow time (Qmax/T) was studied in a total of 161 subjects including 10 healthy females and 35 males in addition to the above 116 subjects. The results are shown in the following table. There was a significant difference between each score group ($p<0.01$).

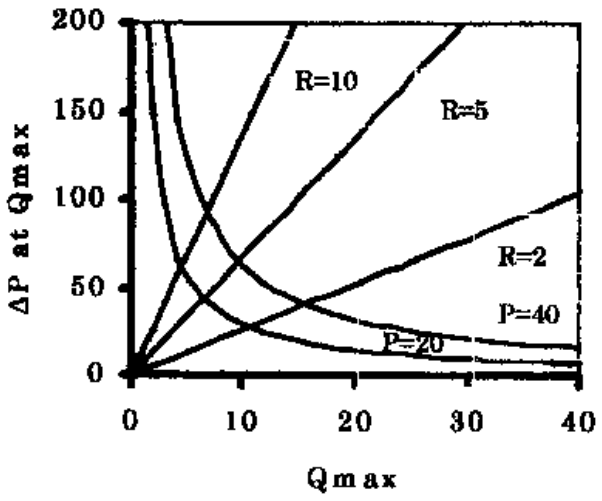

Figure : Pressure-flow diagram

Table: Mean Qmax and Qmax/T in each TS grou

Total Score	N	Qmax (ml/s)	Qmax/T(ml/s
0	30	23.7±1.0	1.63±0.14
1	79	17.7±0.4	1.00±0.06
2	41	11.2±0.6	0.55±0.06
3	11	7.6±0.8	0.30±0.03
4	0		
5	0		

N=161. mean±S.E.

Conclusions:

Urethral frictional resistance and power can be directly evaluated from the pressure-flow diagram by using

intraurethral pressure loss upon voiding and urinary flow rate. This simulation method using a voiding model is non-invasive, as only the uroflowmetry curve is used. In healthy males, Qmax was 15 ml/s or more and Qmax/T was 0.78 or more (2). In the normal groups with TS of 0, 1, mean Qmax was 17.7 ml/s or more and Qmax/T was 1.00 or more, which satisfied both standards. When TS was higher, Qmax and Qmax/T values were lower (Table), so we conclude that from its distribution scoring is appropriate. When comparing cases in which R and P are different, TS is useful in that the degree of urinary disturbance taking into consideration both values can be quantitatively compared. As flow rate is proportional to the pressure difference in the urethra, total urethral resistance can be calculated by pressure difference (ΔP) and flow rate (Q). As for turbulent flow in the lumen, ΔP is not proportional to Q, but we supposed that pressure required for frictional resistance is proportional to Q, as urethral elastic resistance was also taken into consideration in this voiding model. In this simulation, when the uroflowmetry curve was approximated using the voiding model, R and P could be automatically calculated. However, with TS, the judgment of voiding conditions ale taking into consideration R and P could be quantified. That is, changes in the conditions of voiding due to treatment can be judged by one score. References:

1. Acta Urol. Jpn. 41: 27-32, 1995
2. Br. J. Urol. 73: 494-497, 1994.