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CAN FREQUENCY-VOLUME CHART PREDICT BLADDER OUTLET OBSTRUCTION IN RATS?

Aims of study

To diagnose bladder outlet obstruction (BOO) urodynamicaly, it is necessary to perform pressure flow study via a transurethral (or suprapubic) catheter. Since this procedure is invasive, some tentative non-invasive techniques using flow interruption and condom catheter have recently been reported. However, all those non-invasive methods require ultimately the measurements of pressure and flow. On the other hand, frequency/volume chart (FVC) is an instrument for the objective assessment of micturition patterns and a truly non-invasive method. If FVC can predict BOO, invasive urodynamics may be spared. Thus, the present study was designed to investigate experimentally whether FVC can predict BOO in rats.

Study design, materials and methods

22 male six week-old SD rats weighing 203±6.3 g were used. Animals were divided into 2 groups and defined as group O (BOO, n=12) and group S (sham, n=10). *Operation for BOO:* On the rats of group O, a partial outflow obstruction was surgically created using sterile technique. Under anesthesia with pentobarbital, ventral portion of the proximal urethra was exposed through a midline incision. In order to create a mild obstruction, a longitudinally cutout Nelaton catheter (3 Fr. 3 mm in length) was placed loosely over the proximal urethra. A drop of quick-drying glue (Aronα A) was spilled over the catheter for fixation and the incision was closed. Sham surgeries were done on group S. *Micturition studies:* Micturition volume (V) and frequency (F) of all rats were evaluated for 2 consecutive days at the age of 18 weeks (12 weeks post operation). The rats were placed in metabolic cages with free access to water and food. Urine from each rat was collected in a container that rested on an electric scale located beneath each cage. The scales were connected to a central PC and the time of micturition and voided volume were recorded every ten seconds. From these recorded data, V, F and instantaneous diuretic rate(D=voided volume/the preceding micturition interval) for each micturition were derived. On the second day, in order to induce diuresis, the rats were given 5% sucrose in tap water to drink instead of water. *Pressure/Flow studies (PFS):* On the following day after the micturition studies in conscious rats, PFS were done in all rats anesthetized with urethane. A 24 G catheter was inserted into the bladder dome and the catheter was connected to a pressure transducer and an infusion pump. Voided volume was measured by a mechanotransducer, which provided the data to measure flow and compute the flow rate-time curve. Urethral opening pressure (Puo), detrusor pressure at maximum flow (PdetQmax), micturition time (T), maximum flow rate (Qmax), voided volume (V.V.) and post-void residual (PVR) were evaluated. *Bladder weight (BW):* Upon termination of the study, the wet bladder weights were measured and corrected for body weight (mg/Kg). *Statistics:* All results were expressed as mean ± SE. Statistical analysis was performed by means of paired Student's t-test and discriminant analysis. $P<0.05$ was accepted as statistically significant.

Results

Table summarizes the data of PFS and bladder weight.

Fig. 1 shows the relationship between D and F of the rats of group S and group O, respectively. As is shown, high diuresis increases urinary frequency and a linear relationship between D and F is demonstrated in both two groups. The slope of regression line for group O is steeper than that of group S. A linea relation is also found between D and V in both two groups, however, the slope of regression line for group O is conversely less steeper than that of group S (Fig2). Since this differnce of F,V behaviors seen between two groups becomes obvious when D is in higher range, only F-V points of which D is above 2 ml/hr are plotted (Fig 3). The distribution of F-V points in group O is shifted to upper F and lower V area, compared to that of group S(Fig 3). Discriminant analysis demonstrates that 82 % of F-V points is successfully divided by discriminant line (F=1.40V+0.35)(Fig.3). It is also shown that both F and V are statistically differentiating parameters between group S and group O (relative probability; 99% for F and 95% for V).

Interpretation of results

A. The results of PFS, and significantly heavier bladder weight of group O compared to group S indicate that the rats of group O have BOO. This BOO is assumed to be mild because there is no significant increase in PVR.

B. F-V characteristics show no difference between sham and BOO rats when the urinary excretion rate is low. However, when the urinary excretion is increased to higher range by sucrose, two groups demonstarates different F-V characteristics. If higher F and lower V behavior in micturition is found under the higher diuretic condition, it can be predicted with high probability that the rat has BOO.

C. In rats with BOO, high urinary excretion may be compensated with increased urinary frequency, not with increased voided volume.

Concluding message

It is concluded that FVC can predict BOO with accuracy rate of 82% and therefore, invasive urodynamics can be spared in mildly obstructed rat with no residual.

Table (*<0.05, **<0.01)

	Puo (cmH_2O)	PdetQmax (cmH_2O)	T (sec)	Qmax (ml/sec)	V.V. (ml)	PVR (ml)	BW (mg/kg)
group S (n=10)	34.75 ± 3.62	31.55 ± 2.62	6.21 ± 0.82	44.85 ± 2.50	0.81 ± 0.06	0.04 ± 0.03	270 ± 11.3
group OI (n=12)	54.09 ± 3.37*	45.32 ± 3.13*	11.20 ± 0.06**	27.27 ± 1.51**	0.83 ± 0.05	0.06 ± 0.02	368 ± 11.2**

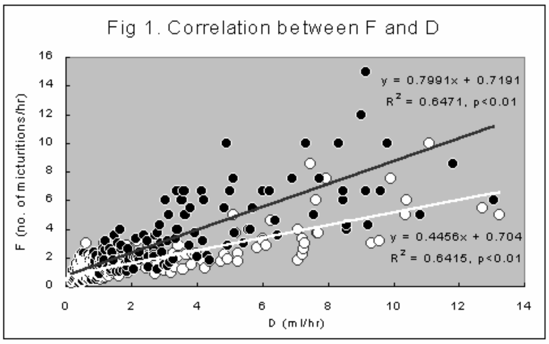

Fig 1. Correlation between F and D

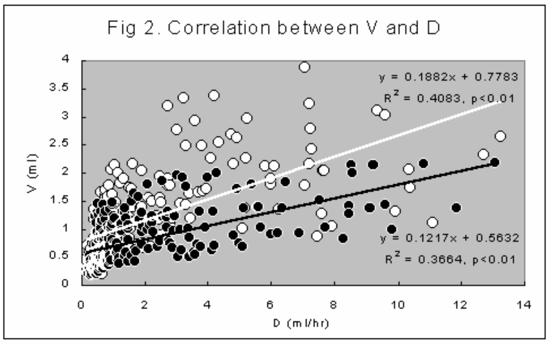

Fig 2. Correlation between V and D

● and black line;group O, ○ and white line;groupS

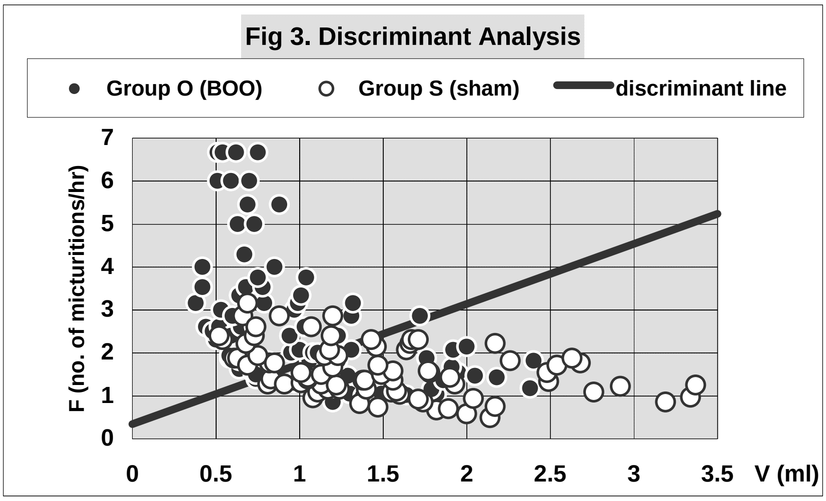

Fig 3. Discriminant Analysis