889

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URODYNAMIC ASSESSMENT: IMPACT OF URETHRAL CATHETER. PRELIMINARY RESULTS FROM LABORATORY TEST

Hypothesis / aims of study
A laboratory model was designed and built to simulate the mechanical behaviour of the lower urinary tract. In this study we considered the lower urinary tract similar to a hydraulic system whose physical behavior is governed by fluid mechanics laws.
The aim of the study is to evaluate the variation of main fluid dynamic parameters, due to the insertion of a catheter inside an elastic tube, thus simulating urodynamic investigations.

Study design, materials and methods
The model (Fig. 1) is composed by a 2 m cylindrical plexiglas tank (representing bladder) with a drain hole on the bottom connected to a 20 cm latex elastic collapsible tube with 6 mm inside diameter at rest (representing urethra). The human elastic compression on the urethra was simulated by placing the elastic tube between two 30x20x5 cm^3 foam blocks in order to have a uniform pressure on the tube equal to 10 cm H2O.
The water level H in the tank was measured by a pressure transducer placed on the bottom (acquisition frequency 12.5 Hz); during tank emptying, for each time interval, the variation of H allowed the evaluation of the variation of volume and consequently the evaluation of the flow rate Q.
The total head at the beginning of the elastic tube (Hr), evaluated at each instant by subtracting from the H level the energy losses upstream the elastic tube, was taken as representative of the pressure within the bladder. The catheter used is a 6 Fr Pressure/Flow Study standard.
The hydraulic behaviour of the system was analysed during the emptying of the tank with and wirhout catheter placement. We collected flow rate without (Q) and with (Qcat) catheter as a function of Hr. For each of the two set-up, the tests were repeated 5 times.
The tests were performed by varying Hr between 1.5 m and 0.2 m, in order to represent the variability of bladder pressure.

Results
For given Hr, Qcat is significantly lower than Q; in fact, at Hr = 1.5 m the relative reduction is 22.9%, which reaches 44.3% at Hr = 0.2 m (Fig. 2: Q and Qcat are shown as a function of Hr; Fig. 3: Qcat is represented as a function of Q).
The present experimental data were compared with those by Baseman et al in clinical measurements in 21 healthy males and with our results in 8 healthy males volunteers (Tab.1). Both groups performed a free uroflowmetry and a uroflowmetry with a 6 Fr catheter; Qpeak and Qcat_peak are the averaged urinary flow peak rate without and with catheter, respectively, while ΔQ is the average of the difference between the two measurements. Since in uroflowmetry the pressure in the bladder is not measured, the variation of flow in real data was evaluated at the same total volume drained, in this case it can be assumed equality even in bladder pressure. The experimental results approximate satisfactorily the data of male volunteers.

Interpretation of results
The use of a urethral catheter for measuring the intra-bladder pressure, as well as causing significant discomfort and possible complications in the patient, may also affect the correctness of diagnosis, because it determines a non-physiological condition which definitely affect the interpretation of the results.

Concluding message
Our results, in agreement with literature data, at equal total head, show a significant decrease of the flow rate in the presence of a urethral catheter. That may significantly influence the accuracy of measurements

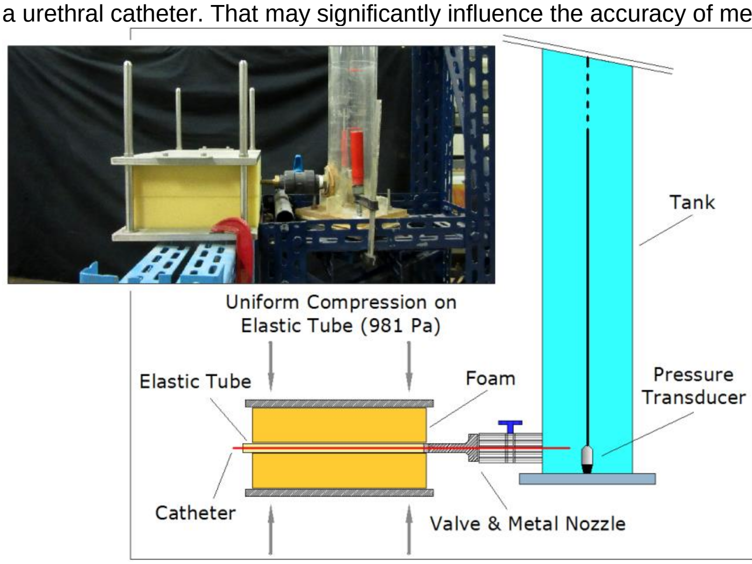

Figure 1: Physical laboratory model of the lower urinary tract.

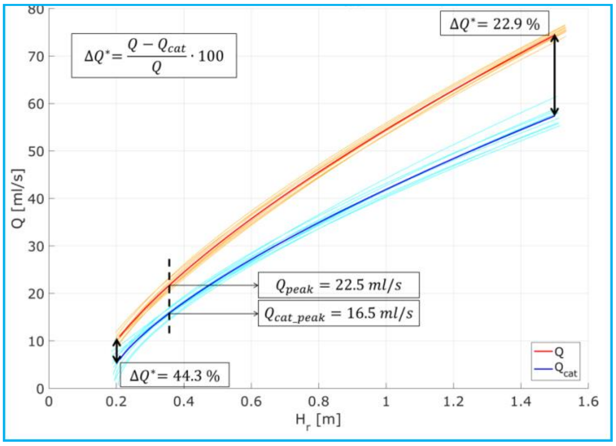

Figure 2

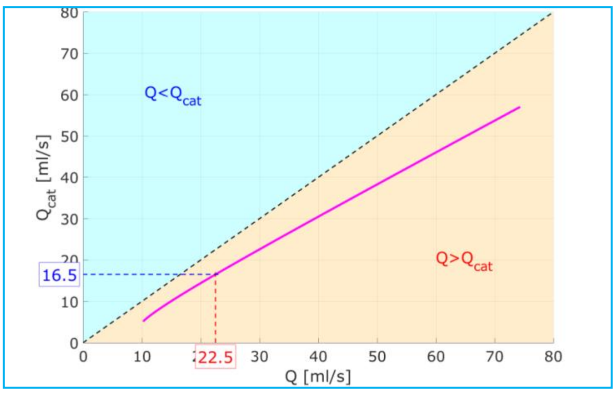

Figure 3

Data source	Q_{peak} (ml/s)	Q_{cat_peak} (ml/s)	ΔQ (relative)
Laboratory tests	22.5	16.5	6.0 ml/s (26.6 %)
i) Healthy volunteers (*Baseman et al.*, 2002)	22.65 ± 9.6	16.25 ± 7.2	6.4 ml/s (28.3 %)
ii) Healthy volunteers	24.13 ± 10.1	17.75 ± 8.3	6.4 ml/s (26.4 %)

Table 1

<u>Disclosures</u>

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