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TOWARDS A NEW NOMOGRAM AND AN INDEX FOR FEMALE BLADDER OUTLET OBSTRUCTION

Hypothesis / aims of study
Evaluation of bladder outlet obstruction in women remains controversial. Some cutoff values [1] and nomogram [2] have been proposed but without consensus as evaluation of detrusor pressure in difficult.

The VBN mathematical micturition model [3] allows evaluating both detrusor contractility (k) and urethral obstruction (gamma) from UDS recordings.

Our purpose was to build a nomogram in the plane [p_{det}.Q_{max}-Q_{max}] allowing an evaluation of the urethral obstruction without any computation.

Study design, materials and methods
Using the VBN model (3), theoretical computations of intubated flow (catheter 7F) were performed for various values of initial bladder volume (V_{ini}) [200-600mL], k [0.25-1.5] and gamma [0-60 cmH₂O]. So, for computation with n values of each parameter (n=10), n² computations (10²=1000) were necessary. Then the curves p_{det}.Q_{max}(Q_{max}) were plotted for various values of gamma. In addition, a retrospective application of gamma measurement was tested in 125 non-neurogenic women without grade >2 prolapse who underwent UDS for various lower urinary tract symptoms (LUTS).

Results
1- Building of nomogram and definition of an index

1a- The curves p_{det}.Q_{max}(Q_{max}) were found linear of equation p_{det}.Q_{max} = A+B*Q_{max}.
1b- For the different V_{ini}, it was observed that A and B did not depend of V_{ini}.
1c- The straight lines were close to parallel lines with B=0.5.
1d- The straight lines were regularly spaced out (A was a linear function of gamma).

So, a new index was defined: A = (p_{det}.Q_{max} – 0.5*Q_{max}), called WOI (Woman Obstruction Index) with gamma = (1.16*A – 11.13).

2- Application of the nomogram
From comparisons a posteriori between obtained from VBN analysis (UDS recordings) and from nomogram (p_{det}.Q_{max} and Q_{max}) error was <5%. Three tracing examples are displayed on Fig (left): green= detrusor overactivity (DO), black= intrinsic sphincter deficiency (ISD), and blue= normal UDS.

On Fig (right) are displayed data from 125 women showing classification using cutoff values from [1]. Circles represent obstructed; crosses represent non-obstructed. According to the values of p_{det}.Q_{max} and Q_{max}, 2 equivocal zones (high p_{det}.Q_{max}-high Q_{max} and low p_{det}.Q_{max}-low Q_{max}) and a non obstructed zone (low p_{det}.Q_{max}-high Q_{max}) were defined.

Interpretation of results
Use of a mathematical model of micturition allows carrying out a nomogram which to evaluate urethral obstruction in women from a pressure-flow study. Building of the nomogram reveals a simple relation between p_{det}.Q_{max} and Q_{max} which shows a similarity of bladder function in women and men. Based on this theoretical study, analysis of data of women who underwent urodynamic
testing for various LUTS allows, using the cutoff values defined in [1], to propose a cutting of the non-obstructed zone in equivocal and non-obstructed.

Concluding message
Mathematical modeling can produce a nomogram for evaluation of urethral obstruction in woman. In addition, an obstruction index for woman (WOI), similar to BOOI in man, can be defined. Future studies will investigate its relevance in large populations of women with anatomic bladder outlet obstruction.