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CARRYING OUT A NOMOGRAM FOR EVALUATION OF DETRUSOR CONTRACTILITY IN WOMEN.

Hypothesis / aims of study
In women, unlike what exists in men, there is no nomogram to classify detrusor contractility. The methods developed for men: Schäfer contractility nomogram (and related parameter DECO) and the projected isovolumetric pressure (PIP/BCI) greatly overestimates the detrusor contraction strength in women [1]. A reliable parameter PIP1 (= $p_{det.Qmax} + Q_{max}$) has been proposed for older women [1] but to our knowledge, there is no nomogram or parameter allowing to evaluate detrusor contractility in women over the life span.

As nomogram is an easy to use tool, we tried to carry out a nomogram allowing to evaluate detrusor contractility in women from the data obtained during a pressure-flow (P-F) study (maximum flow rate Q_{max} and detrusor pressure at maximum flow $p_{det.Qmax}$). For that purpose we used the VBN model which is a mathematical knowledge model of micturition [2].

Study design, materials and methods
Analysis of P-F using the VBN model allowed to evaluate 2 mechanical parameters: the detrusor force or detrusor contractility (**k**) and the urethral obstruction, mainly compressive, (**gamma**). Computations needed to know the initial bladder volume (filling volume V_{ini}) and the diameter of the urethral catheter (7Fr was chosen).

Theoretical computations were made for some thousands of conditions (**k**, **gamma**, V_{ini}) to obtain a set of iso-contractility curves (nomogram) in the plane $p_{det.Qmax}$- Q_{max}. More precisely, for each value of V_{ini}, a range of **k** values was applied and, for each **k** value a large range of **gamma** value. Then these curves were fitted by algebraic equations.

To simplify, the following notations have been used: P= $p_{det.Qmax}$; Q = Q_{max}; V = V_{ini}.
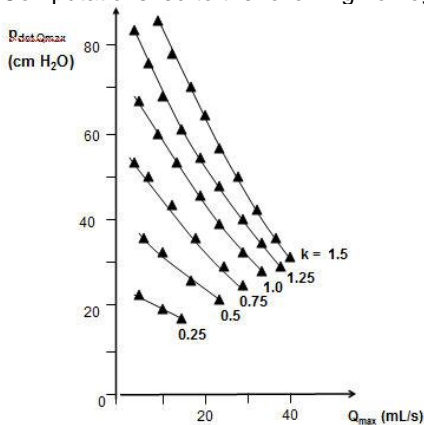
Then, the nomogram was retrospectively applied to the P-F studies of 125 non-neurogenic women without grade >2 prolapse who underwent UDS for various lower urinary tract symptoms (LUTS), and the results compared to the VBN analysis.

Results

1- Building the nomogram (abacus)
1-a: First step: V = 300mL
Computations led to the following nomogram:

Each curve shows the change in the coordinates of the point PQ for a **k** value and a large range of **gamma** value (triangles).
Algebraic fitting led to k = .965*(A/B) - .0405 where A and B are polynomials.
$A = (1 + .25*Q_{300})*(c + a*Q_{300} + P_{300}*(d + b* Q_{300})) - 4*(d + b*Q_{300})$
$B = 1 + .25*Q_{300} + 12*(d + b*Q_{300})$
With: a = - .00325; b = .000709; c = - .0948; d = .0172
1-b: Second step: from a particular case to the general case
The same method was applied to other V values. It was found that, for any set of conditions (P, Q, V), the following intermediate relations should be introduced in the formula:
$Q_{300} = (300/V)^{.25}$ and $P_{300} = P - .5*(Q - Q_{300})$

2- Application of the nomogram
Bland-Altman plot for **k** showed a good agreement between values obtained from nomogram use and VBN analysis for the studied population.

(kaba + k)/2
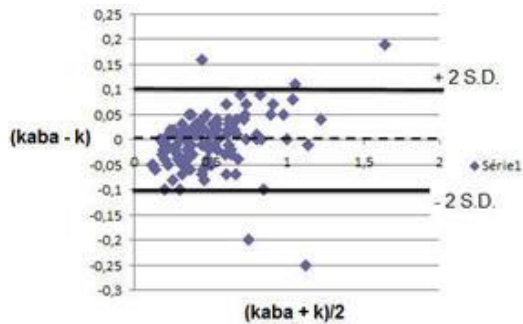
Interpretation of results
Theoretical computations using a mathematical knowledge model of micturition allows to build a nomogram for detrusor contractility in women. Algebraic fitting of abacus is easily computed by any pocket calculator. Then, the time needed for evaluation for evaluation of **k** from the direct use of the model is greatly reduced. In this study direct use of the model to analyze data from 125 women implies about 20 hours, while algebraic fitting use implies less than 2 hours.

Concluding message
This study proposed for the first time a nomogram for detrusor contractility in women which could be used over the life span. The curves' fitting is easily programmable on a pocket calculator which will allow a rapid assessment of detrusor contractility from a pressure-flow study when an impaired detrusor function is suspected in women.

References
1. Tan TL, Bergmann MA, Griffiths D, Resnick NM. Stop test or pressure-flow study? Measuring detrusor contractility in older females. NAU 2004; 23: 184-9
2. Valentini FA, Besson GR, Nelson PP, Zimmern PE. Clinically relevant modelling of urodynamics function: The VBN model. NAU 2014; 33(3): 361-66. doi 10.1002/nau.22409

Disclosures
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