DETRUSOR FORCE IN WOMEN: EVALUATION FROM MATHEMATICAL MODELING OF PRESSURE-FLOW STUDIES AND ANALYSIS OF THE EFFECT OF AGEING ON THE DETRUSOR FORCE.

Hypothesis / aims of study
Evaluation of detrusor force in women is a difficult challenge. Our hypothesis was that female voidings were governed by similar parameters than male voidings: the detrusor force and a "urethral resistance". Our objectives were, using the VBN mathematical model of micturition [1-2], first to analyze pressure-flow (P-F) data to evaluate the detrusor force (k) in women and to search for a correlation with a "urethral resistance" simulated by a compressive obstruction (gamma), and second, to search for an effect of ageing on these mechanical parameters.

Study design, materials and methods
P-F studies of non-neurogenic women referred for evaluation of lower urinary tract dysfunction (LUTD) were retrospectively analyzed. Criteria for inclusion were P-F tracings providing maximum flow rate Q\text{max} and detrusor pressure at Q\text{max} (p_{det,Q\text{max}}) without significant contribution of abdominal pressure (<±3 cm H\text{2}O between onset of flow and Q\text{max}), an initial bladder volume (V\text{ini})>100 mL, and a non-interrupted flow. VBN computations needed to know V\text{ini} and the urethral catheter diameter. Evaluated parameters were k (without unit) and gamma (unit cm H\text{2}O). Standard values were k = 1.0 and gamma = 0.

Results
The population comprised of 125 women (mean age 58.8±17.0 y). The VBN parameter k and gamma were identified. k mean was .49±.25, range [0.14 - 1.55] and gamma mean .16.1±14.4 cm H\text{2}O range [0.0 - 73.0 cm H\text{2}O] with a significant correlation (p<.0001) between k and gamma (Fig 1): \( k = .259 + .015 \times \text{gamma} \) (R\textsuperscript{2} =.723).

The value of k and of gamma was independent of the main complaint.

<table>
<thead>
<tr>
<th>complaint</th>
<th>urge incontinence No = 37</th>
<th>mixed incontinence No = 32</th>
<th>stress urinary incontinence No = 12</th>
<th>frequency No = 15</th>
<th>other No = 29</th>
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</thead>
<tbody>
<tr>
<td>k</td>
<td>0.55±0.28</td>
<td>0.44±0.21</td>
<td>0.47±0.24</td>
<td>0.49±0.19</td>
<td>0.49±0.28</td>
</tr>
<tr>
<td>gamma (cm H\text{2}O)</td>
<td>19.5±16.1</td>
<td>12.0±12.5</td>
<td>14.6±16.4</td>
<td>15.1±11.8</td>
<td>17.1±14.7</td>
</tr>
</tbody>
</table>

Sub-groups were defined according with age:

<table>
<thead>
<tr>
<th></th>
<th>&lt; 30 y No = 10</th>
<th>30-39 y No = 12</th>
<th>40-49 y No = 18</th>
<th>50-59 y No = 28</th>
<th>60-69 y No = 21</th>
<th>70-79 y No = 24</th>
<th>&gt; 80 y No = 12</th>
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</thead>
<tbody>
<tr>
<td>k</td>
<td>.63±.35</td>
<td>.63±.18</td>
<td>.65±.32</td>
<td>.54±.25</td>
<td>.43±.13</td>
<td>.37±.14</td>
<td>.30±.13</td>
</tr>
<tr>
<td>gamma (cm H\text{2}O)</td>
<td>25.0±21.3</td>
<td>20.2±16.0</td>
<td>24.5±20.3</td>
<td>16.1±13.3</td>
<td>13.9±7.5</td>
<td>10.2±8.8</td>
<td>8.4±7.0</td>
</tr>
</tbody>
</table>

The values of k and gamma remained similar in sub-groups less than 50 y old (mean menopause age is 50.1 y in France) and decreased regularly with ageing (Fig 2). Evolution with ageing was significant: p < .0001 for k and p = .0030 for gamma.
Interpretation of results
Modelled analysis of pressure-flow studies allows to evaluate the detrusor force in women. A study limitation is that VBN analysis cannot be carried out in case low $p_{\text{det}.\text{Qmax}}$ associated with high $Q_{\text{max}}$ (funnelling of both bladder neck and urethra?). Detrusor force is smaller than in men where the range is $[0.3 - 4.0]$ [1]. As in men the detrusor force is adjusted to the “urethral resistance” and this, whatever the complaint or the age.
If the detrusor force is not correlated with the main complaint, it is correlated with ageing. The detrusor force begins to decrease at menopause and deteriorate sharply with ageing.

Concluding message
The VBN analysis can evaluate the detrusor force in women who void without major straining efforts with a non-interrupted flow. The detrusor force is smaller than in men [1] and the range less spread out. As in men, there is an adjustment of the detrusor force to compensate a “urethral resistance”. Further study will be devoted to analyse the mechanisms underlying the voidings at low pressure.

References

Disclosures
Funding: none Clinical Trial: No Subjects: HUMAN Ethics not Req’d: It involved retrospective analysis of urodynamic studies from a database. Helsinki: Yes Informed Consent: No