**228**

Schaefer W[1], Chen Y[2], Tadic S[1], Griffiths D[1], Resnick N[1]
***1.** University of Pittsburgh, **2.** Tongij Hospital Wuhan China*

# URODYNAMIC GRADING OF BLADDER OUTFLOW CONDITIONS IN FEMALES

Hypothesis / aims of study

The urodynamics of bladder outflow obstruction, BOO, is well established in males. Particularly the identification and classification of the most common type of proximal compressive BOO in men is largely standardized. Such agreement does not exist for the evaluation of voiding function in females. There are some overlapping but also contradicting proposals for grading and cut-off values, but also emphasis that fluoroscopy may be needed to come to final conclusions about BOO in females. We performed a systematic analysis of the current proposals for the urodynamics of female BOO using the same biomechanical principle as have been used successfully to analyze the pressure-flow plot in men, identify advantages and problems, and suggest a new concept of grading for clinical use.

Study design, materials and methods

Repeated voiding studies with free flow rate and pressure/flow studies in 168 females older than 60 years with signs and symptoms of urinary urge incontinence, many with previous surgery, and different forms and degrees of prolapse have been analyzed on the basis of p/Q-plots, various nomograms (provisional ICS, Schaefer (SCH), Blaivas-Groutz (BG), including Salvatore, Lemack & Zimmern, Kuo) (Ref 1)), and numbers (Abrams' BOOI obstruction index previously Abrams/Griffiths number, obstruction coefficient OCO = pdet,Qmax/(40+2Qmax) (Ref 2), DECO) using pressure-flow data and free flows. It was comprehensively assessed how the pressure/flow-data data from women fit the underlying concepts of these obstruction nomograms and numbers, and how free flow affects classification.

Results

Mean values for free flow and for p/Q-voiding for all: $Q_{max}$ = 23/18 ml/s, Vv 239/417 ml, PVR 37/88 ml; and mean $p_{det,Qmax}$ = 25 $cmH_2O$. A higher free flow rate is found in 63% and these mean values are $Q_{max}$ = 26.4/15.6 ml/s, Vv 271/378, PVR 41/119 ml; and mean $p_{det,Qmax}$ = 20.5 $cmH_2O$. Provisional ICS nomogram: on the basis of p/Q-data 2 voidings are obstructed and 3 equivocal, using free flow none obstructed and 4 equivocal, i.e. almost 3%. According to BG 3 are moderately obstructed, 36/38 with mild obstruction: SCH nomogram Grade II obstructed are 5, in I with possibly mild obstruction 20/25, rest in 0. BOOI mean are -21/-16; OCO mean 0.31/0.35. Combining the free flow with the pressure from p/Q study results in an increase of DECO from 116 to 140 for all, and from 98 to 152 for those with higher free flow. Calculating a theoretical detrusor pressure at maximum free flow based on the assumption that contractility as assessed by DECO was the same in both voids leads to lower and often negative pressure values, indicating over-correction.

Interpretation of results

There is agreement between that approximately 2-3% may be obstructed. There is some disagreement that approximately 14 - 22 % are possibly, mildly obstructed in the SCH or BG nomogram, respectively. Using a higher free flow in combination with the pressure as suggested (Ref 1) has relatively little influence and is only useful on an individual basis. BOOI shows significant variability with the standard deviation being higher than mean value, is by definition very sensitive to the maximum flow value, and thus to the volume voided (correlation -0.63). BOOI originally is reflecting the minimum voiding pressure and with 81% showing a negative value it is clear that the fit between BOOI and the actual p/Q plot in women is very poor. OCO is not sensitive to flow rate with a correlation of OCO with OCOfree of 0.94. The mean opening pressure calculated from OCO is 14.9 cmH2O compared to the measured value of 15.9 cmH2O. The mean OCO for this group of women is with OCO = 0.35 significantly lower than the value for asymptomatic young men and older men after TURP with OCO = 0.56 (Ref 2). Using a higher free flow in combination with the pressure at maximum flow during a p/Q-study is biomechanically equivalent to increasing detrusor power. This increases DECO by 55% to 152, for females an unrealistic high value, higher than DECO 136 for normal young males. Obviously it is more realistic to assume that a lower flow in a p/Q-study results from increased resistance, an insufficiently relaxed bladder outlet, or catheter-influence, than to assume that the detrusor was insufficiently stimulated. A theoretical voiding pressure for the free flow can be calculated by assuming a lower resistance at same contractility DECO. This results in much lower voiding pressures, but obviously is an over-correction for most patients as the mean value for such theoretical $p_{det,Qmax}$ becomes negative. This also shows the limitations of using the DECO parameter. Further, this points to a basic problem of simply using the $p_{det}$/Q-relationship in female voiding. In males with proximal obstruction such as with BPH the flow is indeed driven by $p_{det.}$ similarly, in women after surgery supporting the proximal urethra/bladder neck any obstructive flow will be driven by pdet. Without such proximal obstruction in women the flow rate is usually driven by $p_{ves}$, and any straining very effectively results in increase in flow. This higher flow rate combined with the actual $p_{det}$ does mimic a very strong detrusor, but is unrealistic, as shown by DECO.

Concluding message

Bladder outflow conditions during voiding in female are much more difficult to assess than in men. However, with careful consideration of the fundamental biophysical principles as used to develop the obstruction nomogram for males it is possible to judge bladder outflow conditions in females urodynamically. It is always meaningful to consider the free flow rate as a control for the flow rate recorded at p/Q-studies, because in a significant proportion (2/3) this

free flow rate will be higher. The influence of a difference between classification based on pressure/flow or free flow is the smaller the better the methods approximates the real p/Q-plot. In women it is necessary to consider the effect of straining. Women voiding with low detrusor and intravesical pressure are clearly unobstructed. When flow is driven by straining alone, outflow conditions may be judged by replacing pdet with pves in the SCH nomogram.
The analysis of bladder outflow conditions relies on the correct interpretation of the pressure/flow plots. According to ICS standardisation the old A/G number, now Abrams' obstruction index BOOI, can be used to define the borders for equivocal and obstructed in men with BPO. Outside this range the deviations between the BOOI and the real p/Q-plot become so pronounced that a meaningful classification cannot be expected, particularly not for females with low outflow resistance where BOOI is negative. Obviously any negative minimal opening pressure is unrealistic and indicates deviation from the real p/Q-plot. BG nomogram and OCO show agreement in the definition of "unobstructed", but grading of higher urethral resistance, and identification of obstruction, can be more realistically achieved with OCO on a continuous scale (Fig 1, from Ref 1, with OCO lines)

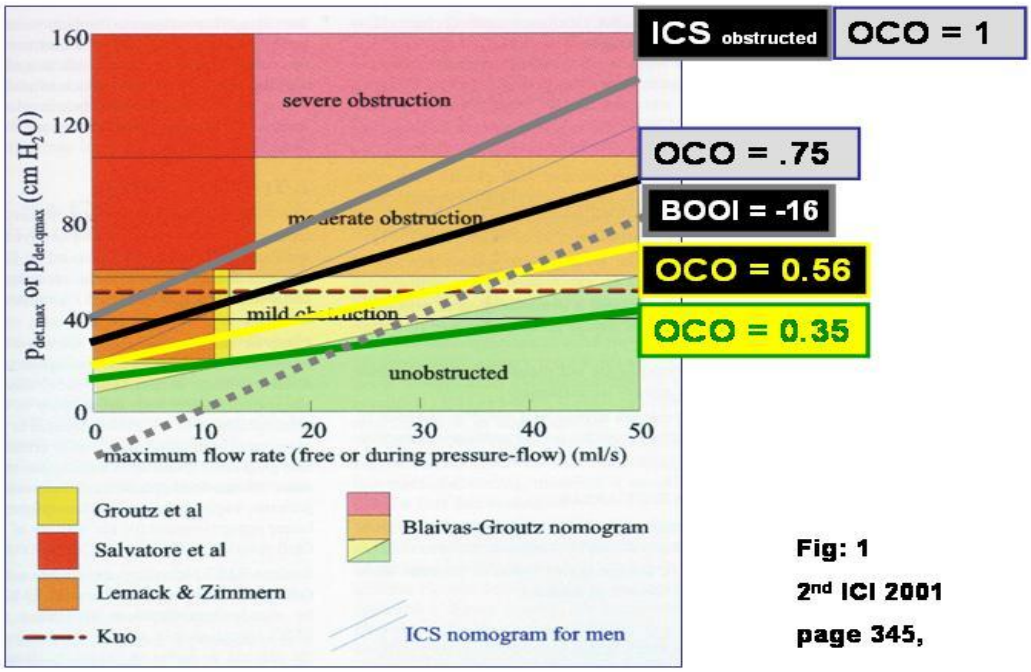


**Fig: 1**
**2nd ICI 2001**
**page 345,**


References
1. ICI 2002, 2nd International Consultation on Incontinence, page 345
2. Schäfer W, Liao L, van Waalwijk von Doorn E, de Ridder D, Brady C, Fowler C, Lightner D, de Lepeleire I, de Smet M, Sciberras D, Bonfiglio C, Bach MA: Normal urodynamic data: Measurements in asymptomatic young males. Neurourol Urodyn 19:484-486, 2000



| | |
|---|---|
| ***Specify source of funding or grant*** | **NIH NIA RO1AG020629** |
| ***Is this a clinical trial?*** | **Yes** |
| ***Is this study registered in a public clinical trials registry?*** | **Yes** |
| ***Specify Name of Public Registry, Registration Number*** | **Clinicaltrials.gov NCT00177541** |
| ***What were the subjects in the study?*** | **HUMAN** |
| ***Was this study approved by an ethics committee?*** | **Yes** |
| ***Specify Name of Ethics Committee*** | **IRB University of Pittsburgh** |
| ***Was the Declaration of Helsinki followed?*** | **Yes** |
| ***Was informed consent obtained from the patients?*** | **Yes** |