Evaluation of two novel urodynamic parameters in the diagnosis of female obstructive voiding

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Introduction: The Blaivas-Groutz nomogram for female bladder outlet obstruction (fBOO) has received a lot of criticism concerning its diagnostic accuracy, especially in the zone of mild obstruction. Our purpose was to compare the diagnostic value of two novel urodynamic parameters, the $P_{\text{det}}Q_{\text{max}} \geq 2Q_{\text{max}}$ (equivocal BOOI=$P_{\text{det}}Q_{\text{max}}-2Q_{\text{max}} \geq 0$) and the urethral resistance factor $U_{\text{RA}} \geq 20$.

Material -Study: Females with mild BOO according to B-G nomogram were divided into three groups. Group A (BOOI <0), Group B (BOOI $\geq 0$ and $U_{\text{RA}} < 20$) and Group C (BOOI $\geq 0 + U_{\text{RA}} \geq 20$). Uroflow and pressure flow parameters were compared between those three groups of females. Females with totally dysfunctional abdominal urination, without any detrusor’s contraction or without urinary flow during P-F study, were excluded from the study.

One way ANOVA, unpaired two tailed t test and fishers exact two tailed test were used for statistical analysis.

Results: Sixty three females fulfill our inclusion criteria. Those were categorized as non obstructive (Group A, n=14) as obstructive only with BOOI $\geq 0$ (Group B, n=23) and as obstructive with both BOOI $\geq 0 + U_{\text{RA}} \geq 20$ (Group C, n=26). According to one way ANOVA test, statistically significant differences between those three groups of females. Females with totally dysfunctional abdominal urination, without any detrusor’s contraction or without urinary flow during P-F study, were excluded from the study.

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Conclusion: According to our results, we recommend the use of $U_{\text{RA}}$ cut off value 20 instead of $P_{\text{detQmax}} \geq 2Q_{\text{max}}$ as a second more strict urodynamic parameter especially in the grey (mild) zone of female BOO.

Key words
Urodynamic study; female bladder outlet obstruction

Abstract

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Introduction

Despite the sufficient number of UDS parameters, indexes and nomograms for the diagnosis of urodynamic obstruction in males, only limited and not generally accepted parameters are being proposed for defining female BOO. Subjective urodynamic definition of obstructed voiding in females with voiding symptoms (reduced flow, hesitancy, sensation of incomplete bladder emptying, difficulty voiding) is not yet generally established. The Blaivas - Groutz nomogram is probably the most simple and generally used nomogram for female BOO. However, this nomogram has received a lot of criticism as it concerns its sensitivity and specificity, with a trend to overestimate BOO, especially in the zone of mild obstruction.

Our purpose was to compare the diagnostic value of two novel urodynamic parameters, which both was presented during the annual 2014 European Association of Urology (EAU) Congress, at Stockholm. The PdetQmax ≥ 2 Qmax (4) (equivocal Bladder Outlet Obstruction Index, BOOI = PdetQmax - 2Qmax ≥ 0) and the Urethral Resistance Factor, URA ≥ 20 (5). Both of them were retrospectively evaluated in a cohort of females with mild BOO according to the Blaivas - Groutz nomogram.

Material - Methods

Females with urodynamic evaluation of refractory lower urinary tract symptoms (r-FLUTS) which were already categorized as mild obstructed according to the B - G nomogram, were retrospectively reviewed. Females with totally abdominal voiding, without any detrusor’s contraction or without urinary flow during P - F study, were excluded from the study. Exclusion criteria were also the history of neurogenic bladder, any obvious bladder pathology or a prior lower urinary tract system reconstruction intervention. Those
females with mild BOO according to B-G nomogram which finally included to the study were further divided into three groups of patients. Those with bladder outlet obstruction index (BOOI) below zero (Group A), those with both BOOI equal or above zero and urethral resistance factor, (URA) below 20 (Group B) and finally those with both BOOI equal or above zero and URA equal or above 20 (Group C). Group A were conventionally defined as non obstructive and was used as a control group for our study. Uroflow and pressure flow parameters were compared between those three groups of females and a number of correlations were made. One way ANOVA, two tailed unpaired t test and two tailed fishers exact test were used for statistical analysis.

**Results**

Sixty three females were fulfilled our inclusion criteria. Those were categorized as non obstructive (Group A, n=14) as obstructive only with BOOI ≥ 0 (Group B, n=23) and as obstructive with both BOOI ≥ 0 + URA ≥ 20 (Group C, n=26). According to one way ANOVA test, statistically significant differences between those three groups were found for: f - PVR(Post Void Residual during uroflow, p=0.005), f - BVE (Bladder Voiding Efficiency during uroflow, p=0.001), Qmax (maximum flow during pressure flow study, p<0.0001) Pdetmax (maximum detrusor pressure, p=0.01), PdetQmax (detrusor’s pressure during maximum flow, p=0.002) and of course as it was expected for BOOI (Bladder Outlet Obstruction Index, p<0.0001), (Table 1a and 1b). The proposed PdetQmax ≥ 2 Qmax (= BOOI≥0) agreed with the diagnosis of mild obstruction according to B-G nomogram in 77.78% (n=49/63) of cases while the proposed URA≥20 only in 41.27% (n=26/63) (Fishers exact test two tailed, p<0.0001), (figure 1). As it was expected, based on the high percentage of agreement, none uroflow parameter where found to be statistically significant different between mild obstructive females according to B - G nomogram (n=63) and the obstructive females according to PdetQmax ≥ 2 Qmax (n=49) (Table 2a). On the contrary, f - BVE was found to be statistically significant different between the B - G mild obstructive (n=63) and the URA ≥ 20 (n=26) obstructive females (67.58 % vs 52.54%, unpaired two tailed t test=0.017), (Table 2b). PdetQmax (29.87 vs 36.69, unpaired two tailed t test p=0.0085) and Qmax during P - F study (10.57 vs 6.69, p=0.0015) were found to be statistically significant different during the direct comparison.
between Groups B and C, respectively, (Table 3). By plotting the PdetQmax and Qmax from pressure flow study to the Blaivas - Groutz nomogram we constructed, based on four urodynamic parameters (Pdetmax, f-Qmax, PdetQmax, and Qmax) a modified B - G nomogram with surprisingly three distinct zones of the mild BOO zone. (figure 2).

**Discussion**

According to the most recently published definitions of the Internation Continence Society (ICS) and the International Urogynecological Association (IUGA) there is not a definitive urodynamic definition for female outflow obstruction. Additionally, the definition of detrusor underactivity (DU) according to the ICS, is at least partially quite general both for males and females. Incomplete bladder emptying it is in a constant correlation between the detrusor’s contraction (isometric and isotonic) and the outflow resistance(active and passive). In both genders, pathologic post void residual after urination should be considered to be due detrusor’s insuf-
ficiency only when bladder outlet obstruction has been excluded. Without a generally accepted definition of female obstructive voiding, it is also not possible to define with accuracy female Detrusor Underactivity (DU) and the urodynamic diagnosis of obstruction versus underactivity will be partially objective and operative physicians depended, especially in the equivocal cases. Therefore, it is urgently needed for the international medical community to define a number of more strict urodynamic parameters for increased outflow resistance (anatomic or functional), especially at females.

Females with symptom of voiding difficulty probably represents an heterogeneous patients population. According to Nitti et al., only 29%(n=76) of females with non neurogenic voiding dysfunction had been diagnosed with outflow obstruction. while the rest 71%(n=184) was not obstructed during videourodynamic evaluation 7. According to Gomez MC et al., in elderly patients lower urinary tract, symptoms suggestive of BOO frequently have other than outflow obstruction pathophysiology. Even females may have obstructive symptoms although they are not obstructive 8. Lowenstein L et al., came to the same conclusion in a more recent published study 9.

As already mentioned, there are no generally accepted urodynamic criteria for the definition of BOO at females. Different cut off values from pressure flow study parameters, with different sensitivity and specificity has been proposed 10, 11, 12, 13. There are also limited published data about the diagnostic value of Urethral Resistant Factor (URA) in the diagnosis of female BOO. Kranse R. and van Maastrict proposed the idea of relative obstruction not only for males but also for females using a new urodynamic parameter (URA/W20) 14. According to Méndez - Rubio S. et al., after videourodynamic evaluation of 88 females with significant PVR, positive linear correlation was found between PVR and the URA parameter (ρ=0.001) and between PVR and voiding with abdominal straining (ρ<0.05) 15. Complete bladder emptying at females was also associated with increased urethral resistance (URA parameter) according to Salinas JC et al. 16. According to Vírseda Chamorro M. et al. the only urodynamic parameter which showed statistically significant correlation with voiding dysfunction and the PVR in 80 females (24 controls with a maximum flow percentile greater than or equal to 50 and no residual volume, and 56 cases with a maximum flow percentile less than or equal to 10) was the URA 17. Even less studied in the diagnosis of female BOO is the BOOI. Quite interesting and groundbreaking was the study of Gravina G et al. 18. According to their results, the BOOI cut off > or = - 8 provides a sensitivity of 80.8% and specificity of 86.1%. On the other hand, the proposed BOOI cut off value 0 as proposed by Solomon et al. 4 separates the radiographically obstructed and unobstructed with 0.94 sensitivity and 0.93 specificity. According to our material the BOOI with the cut off value - 8 and the cut off value 0 had an 95.23% (n=60/63) and 77.8% overall agreement with the mild BOO according to B-G. It is obvious that both of those different cut of values of BOOI are not enough to “make the difference” in order to increase the overall sensitivity and specificity of the mild BOO zone and subsequently there is no reason to be combined with the B - G nomogram.

According to the “title” of wisdom “Detrusor contractility - order out of chaos” by Griffiths D 19 it seems a little bit easier and wiser for both functional urologists and gynecologists to be sustained focused primarily in an afford to find a generally accepted and definitive urodynamic diagnosis of female BOO. Then the approximation of DU diagnosis will be mainly a diagnosis by exclusion, based basically on repeatedly and reproducibly incomplete bladder emptying during uroflow. As Aganovitz et al. 20 proposed the use of URA cut off value 29 in those equivocal cases of male BOO in order to define “clear” BOO, we respectively recommend the use of the same parameter but with a lower cut off value (URA ≥ 20) in order to approximate the “clear” obstructive females, especially in the grey (mild) zone of female BOO. The parabolic area of the mild zone of BOO, as it was defined in our study by the URA ≥ 20 (Group C, figure 3), it seems to concentrate less probabilities for wrong diagnosis of obstruction compared to the other two distinct areas of the same zone. Based on voiding dynamics proposed by Schäfer w., it is also our opinion that the non parabolic urodynamic parameters are less precise than the parabolic parameters, because they do not take into account the detrusor’s contribution to the flow rate adjusted to the different bladder capacity, at each voiding 21.

Our proposed cataract from very loose to very strict urodynamic criteria of female BOO are also showed in figure 3. It is always a matter of personal choice how strict or how loose criteria wants a researcher or a phy-
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Physician for a study or for the real’s - life daytime medical practice. Unfortunately that makes data and articles a little bit objective and physicians depended especially in the “grey” zones of medicine.

Limitations of our study is the retrospective nature and the relatively small number of females with mild BOO. Functional or anatomic increased outlet resistance was not the primary point of our study. A larger, prospectively designed and multicenter study is considered necessary in order to validate the sensitivity and specificity of the mild BOO zone and the URA combination.

Conclusion
The grey zone of female BOO, the mild BOO according to B - G, represents an heterogeneous group of females. We recommend the use of URA cut-off value 20 as a second more strict urodynamic parameter for the differential diagnosis of female BOO especially in those cases of physicians’ disagreement, the grey (mild) zone of female BOO of the Blaivas - Groutz nomogram. We recommend the URA cut off value 20 especially in this group of patients in an afford to increase the diagnostic accuracy of female BOO and indirect the diagnosis of female underactive bladder.

Conflict of interest:

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