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Rosier P[1], Bosch R[1]
1. Department of urology, University Medical Centre Utrecht, The Netherlands

CURRENT BLADDER OUTFLOW OBSTRUCTION AND DETRUSOR VOIDING CONTRACTION- NOMOGRAMS DO NOT ELUCIDATE THE CAUSE OF INEFFICIENT EMPTYING IN FEMALE PATIENTS.

Hypothesis / aims of study

We postulate that the result of a sensible method of voiding-analysis should associate with voiding efficiency (post void residual urine PVR). The result of analysis of the pressure flow relation should clarify why the voiding results in (prolonged and/or) incomplete emptying. We have studied contemporary analysis of BOO and detrusor function during voiding in relation with voiding efficiency of female micturitions. The hypotheses: Only a very small proportion of patients in a given 'normal' range, which is: 'no bladder outlet obstruction (BOO) and normal detrusor function during voiding ('contraction')' should have PVR end, on the contrary, a substantial percentage of patients with PVR should obtain a diagnosis of either 'BOO', or detrusor underactivity, or a combination of these.

Normal voiding has to take place in limited time and, clinically more important, has to empty the bladder completely. Cystometry, as part of a urodynamic investigation (UDI) allows quantitative and objective analysis of detrusor and 'outlet' -function during filling and voiding. The detrusor contraction generates the pressure to empty. When the bladder outlet 'resistance' is high ('obstruction'), the detrusor pressure to empty is necessarily elevated, voiding time increases and residual urine may remain. However, also when detrusor contraction is weak (detrusor underactivity) with or *without* bladder outlet obstruction (BOO), voiding time prolongs and the prevalence of relevant PVR increases.
Nomograms are available to classify male UDI-voiding (prostatic) BOO by 'plotting' of pressure at maximum flow ($P_{det}Q_{max}$) with corresponding flowrate (Q_{max}). In male, BOO and - or detrusor underactivity are related with prolonged emptying and with PVR. For inter-patient comparison, residual urine can also be quantified as 'voiding efficiency'; voided percentage; void% = (voided volume / total bladder volume) x100.
Inefficient voiding and low Q_{max} with prolonged voiding are signs of BOO, weak contraction or both. There exist some consensus that >100 ml PVR is 'substantial' in patients and a void% limit of 80% is suggested to be relevant.
Bladder contraction can be computed as detrusor muscle work, using 'detrusor watt's factor': WF. In elderly male patients WF_{max} is, related to the void% since within a given class of BOO an underactive detrusor (low WF_{max}) leaves more PVR than a normal contraction. The predictive value of the individuals' voiding efficiency in male patients with prostatic enlargement is fair for the ICS nomogram and for Griffiths' URA (urethral resistance) and bladder contraction parameter W_{max}. The ICS nomogram can be 'reduced' to ICS numbers: 'bladder outlet obstruction index' = BOOI = $P_{det}Q_{max} - 2\ Q_{max}$ and 'bladder contractility index' = BCI = $P_{det}Q_{max} + 5Q_{max}$.
Various investigators have shown that women with continence problems have also voiding symptoms and objective voiding abnormalities. Neither the ICS nomogram/ indexes nor Griffiths' analysis, nor the 'female- specific' Blaivas-Groutz nomogram (BGN) have however, been analyzed in relation to female voiding efficiency. ICS nomogram and Griffiths analysis are repeatedly used in analysis of female voiding although never 'calibrated' for this purpose. BGN is developed on the basis of 'pre-set' P_{det} and flow limits in combination with (*citation:*) '...obvious radiographic evidence of BOO', or 'inability to void with a transurethral catheter'.

Study design, materials and methods

We retrospectively analyzed urodynamic (UDI) voidings of 156 (all subsequent in 7 months) female patients (49,6 years, range17-82) that were referred with symptoms of lower urinary tract dysfunction. UDI's of patients with neurological abnormalities were not included in this study. No patient had signs of urinary tract infection at the time of the UDI.
Patients included in our analysis had clinical and/or urodynamic diagnosis of stress urinary incontinence (17%) overactive bladder and overactive bladder syndrome (27%) mixed urinary incontinence (8%) recurrent urinary tract infections (24%) normal function (9%) and nocturnal enuresis (15%).
We performed filling and voiding cystometry according to ICS recommendations. Patients were sitting during the investigation –after insertion of a 8F double lumen transurethral catheter and a fluid filled rectal catheter-. All patients had completed an 48 hour bladder diary and the maximum voided volume in this diary was used as a 'predictor' for cystometric capacity. Medium – room temperature- filling rate was 10-15% of this 'predicted' capacity so that a filling-cystometry took ±10 minutes in each patient. Permission to void was given when the patient reported a strong desire to void, if approximately related to the maximum voided (diary) volume.
Griffiths' analysis (URA and Wmax), ICS numbers (BOOI and BCI) and BGN were respectively applied for classification of UDI-voiding. For Griffiths' analysis and ICS numbers resulting classes were 'obstructed' or 'not obstructed' and contraction 'weak' or 'normal' according to the accepted limits.

Results

UDI pressure flow analysis and:
Percentages of patients with efficient voiding (void% ≥ 80%):

Griffiths (URA)		Griffiths (W_{max})		ICS nomogram		ICS nomogram		BGN	
OBS	NOBS	Normal	Weak	OBS	NOBS	Normal	Weak	OBS	NOBS
4,9%	95,1%	38,8%	61,2%	7,1%	92,9%	81,2%	18,8%	49,1%	50,9%

Percentages of patients with inefficient voiding (void% < 80%):

Griffiths (URA)		Griffiths (W_{max})		ICS		ICS		BGN	
OBS	NOBS	Normal	Weak	OBS	NOBS	Normal	Weak	OBS	NOBS

26,7%	73,3%	16,7%	83,3%	27,3%	72,7%	30,3%	67,7%	33,3%	66,7%

OBS= obstructed NOBS =not obstructed; ICS= International Continence Society; Normal=Normal contraction; Weak= Weak contraction; BGN= Blaivas Groutz Nomogram

Interpretation of results

If pressure flow analysis could predict (in)efficient voiding all grey cells in this table would approach 100% of patients. In many cells this is not the case, indicating that the analysis is unspecific in this regard, or insensitive. Also when contractility and obstruction are combined (one ór both abnormal) the predictive values of positive tests are low: Griffiths 0.29; ICS 0.52 and BGN 0.74. Predictive value of negative tests: Griffiths 0.92; ICS 0.91 BGN 0.16.

We have observed that pressure flow analysis with one of the contemporary methods does not predict inefficient voiding in female patients. Female patients that have efficient micturition (Void% >80%) are in the 'obstructed' range of the BGN in almost 50% of the cases, which is much higher than expected. Also 66% of patients that do not void efficient (void%<80%) is in the 'not obstructed' range of this nomogram. The fact that 50% of patients is diagnosed with obstruction in an untreated population raises concern when the tool is proposed as evaluation (*citation*:)'…after potentially obstructive procedures (such as anti-incontinence surgery)'.

Voiding efficiency is 'good' in 91% of the patients with 'no-obstruction (BOOI) and normal contraction (DCI)' on the basis of ICS numbers. However (only) 48% of patients has ineffective voiding when one or both numbers are in the abnormal range. This indicates that these patients have emptied to completion despite having a diagnosis of BOO or detrusor underactivity, or both. Again a 'simple' solution would be to state that 'the detrusor has compensated' in the case of BOO and effective emptying or that 'bladder outlet resistance is so low that the detrusor doesn't need to contract' in the case of detrusor underactivity and effective emptying, however this is hypothetical and if confirmed, probably is going to justify adjustments of the ICS-indexes for analysis of female voiding.

Concluding message

Contemporary methods for analysis of BOO and detrusor voiding function are, in female patients, over diagnosing bladder outlet obstruction and detrusor underactivity. Readjustment and recalibration of pressure flow analysis for diagnosis of female voiding function is necessary.

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