

THE URODYNAMICS OF OVERACTIVE BLADDER AND URGE INCONTINENCE : DOES STANDARD URODYNAMICS MISS ESSENTIAL DETAILS?

Hypothesis / aims of study

Filling cystometry is the standard urodynamic examination (UDS) of overactive bladder (OAB) symptoms aiming at detection of detrusor overactivity (DO) as the urodynamic correlate of urgency and the cause of urge incontinence (UUI). However, the rate of DO observation (approx. 50%) as well as the correlation between urodynamics and OAB symptoms has been poor. We focused on the question if more comprehensive measurement with inclusion of urethral closure pressure and more detailed analysis could offer more information.

Study design, materials and methods

A group of 183 women over 60 years with at least 2 events of UUI per week underwent comprehensive urodynamics before and after 12 weeks of dedicated pelvic floor and sphincter training with biofeedback (BFB). We defined a reduction in UUI events by more than 50% as good response to therapy. A triple lumen 7 F transurethral catheter was used for filling and recording of intravesical (pves) and urethral pressure (pura) with the Brown/Wickham technique, and a rectal balloon for abdominal pressure recording. After the maximum urethra pressure had been established by repeated urethral pressure profiles (UPP) the catheter was positioned and fixed via a holder to record pura,max continuously during bladder filling. In addition to standard urodynamic analysis we paid special attention at DO to the speed of pressure increase dp/dt (DOspeed) and the amplitude (DOampl) as well as to any concurrent pura-changes.

Results

DO Severity. During the first UDS we could elicit DO in 79 (43%) and another 25 showed DO at the second UDS only, thus a total of 104 (57%). Good response to the therapy in 50% who initially showed DO is only slightly lower than in the non-DO group with 58%, but the response is markedly less with fast DO: patients with dp/dt > 3 cmH₂O/s had only a response rate of 32%. There is a strong correlation between DOspeed and DOampl (Pearson Corr 0.65, Spearman 0.52, p = .000). Average speed and amplitude of DO_pre are significantly higher in those where DO persists than in those where DO cannot be demonstrated at the second UDS, DOspeed 2.7 vs 1.65 cmH₂O/s and DOampl 27.1 vs 18.1cmH₂O, (p 0.03). cmH₂O This also reflects in the initial severity of UI as well as in improvement. Where DO is reproduced in both UDS compared to those where it only shows in one of the two UDS studies, initial values are leak volume (LV)_pre 6.8 vs 2,4 ml (p=0.02) and leak frequency (LF)_pre 4.1 vs 3.4 (p=0.2), and the LV_post 4.2 vs 0.7 (p=0.004) and LF_post 2.8 vs 1.6 (p=0.02), or in terms of good response this is 39% vs 70%.

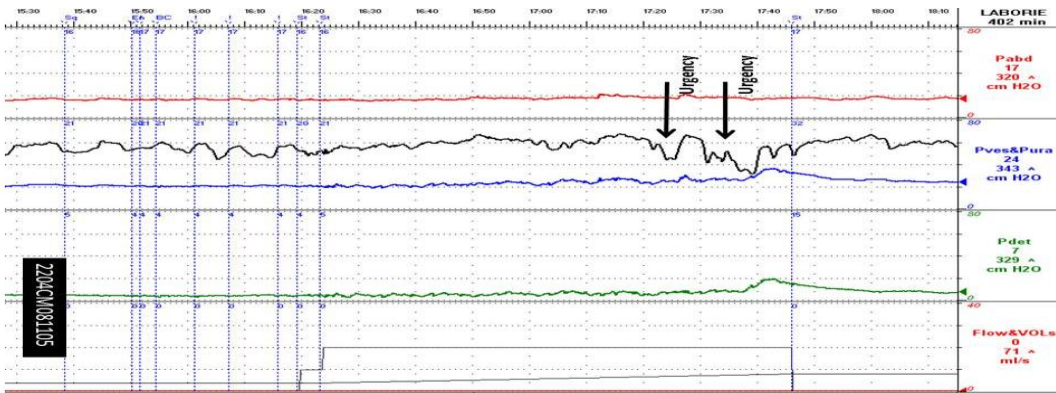
The differences between those with the milder DO_pre only and those who do not show any DO in both UDS, the never_DO, are interesting. All DO_pre volumes are smaller: first sensation of filling (fsF) 183 vs 237 ml, p=.05; first desire to void (fdV) 266 vs 339 ml, p=.01; strong desire to void (sdV) 375 vs 470 ml p=.01; capacity 541 vs 640 ml p=.007, (and post FdV 291 vs 379 p=.01 and SdV 291 vs 379 p = .000), and consequently the voiding frequencies are lower. However, good response is with 73% vs 63% slightly better in those with DO_pre only than in those who never showed DO. This could indicate a learning effect to control DO.

Also those with mostly milder DO_post only compared to the never_DO also show significantly smaller urodynamic volumes pre, when no DO could be demonstrated: Vol.fsF 179 vs 238 l p=.009; fdV 253 vs 340 p=.002; sdV 393 vs 472 p=.04; Vol.cap 527 vs 641 p=.008; post: fdV 274 vs 380 p=.01; sdV 402 vs 506 p=.02; cap 495 vs 617 p=.01. This underlines that the group in which DO occasionally can be demonstrated differs from no_DO.

Interesting are the similarities and differences between those who show DO only at pre or at post, DO_pre vs DO_post: in average they have indeed comparable DO severity with DOspeed 1.6 vs 1.3 cmH₂O/s and DOampl 18 vs 18 cmH₂O; Those with DO_pre have higher diuresis pre 2100 vs 1660 ml; all other parameters are not significantly different, except the leakage volume post, LV_post with .67 vs 3.8 ml (p=.03) and the percentage with good response is different 73% vs 42%. Thus DO_pre only, presumably those who learn to suppress DO are more often improved than DO_post, those who show DO at the end only.

Pura,max. The only suitable signal for measuring sphincter function is pura,max. There is no technique available to continuously record accurate sphincter pressure during a complete urodynamic study, as any movement of the patient will inevitably result in artifacts which can be identified but not corrected. Only during the initial filling phase with the patient in a stable immobile position reliable pura,max can be recorded. However, this is exactly the time and condition when DO and UI do not often occur which limits the number of our reliable recordings to 19 patients. DO was always accompanied by a decline in pura which often started before any detrusor pressure increase could be observed (see Fig).

UUI was not observed without sphincter relaxation. And even when UUI was observed during UDS without urethral pressure recording, we still can conclude from the leakage pressure level being lower than pura,max recorded at UPP, that UUI occurred at sphincter relaxation.



Interpretation of results

In addition to the detection of DO it is meaningful to perform a more detailed analysis. Speed of pressure rise and amplitude of DO are highly correlated and together provide a suitable and plausible measure for grading DO severity. From this small study we can only suggest that a DO speed of $> 2.5 - 3 \text{ cmH}_2\text{O/s}$ and a DO amp of $> 25 \text{ cmH}_2\text{O}$ could be labelled severe DO, however, larger studies are needed to develop a detailed grading. Only comprehensive UDS with pdet and pura can reveal the actual dysfunction and will allow to fully understand the interdependence and exact sequence of involuntary urethral relaxation and DO

Concluding message

Pressure rise and amplitude of DO are highly correlated and together provide a suitable and plausible measure for grading DO severity. Grading of DO is relevant as more severe DO causes more severe UI in terms of higher leakage volume and frequency, is easier to reproduce in UDS, and the response rate from BFB therapy is significantly lower.

Only simultaneous recording of detrusor and sphincter pressure provides the information needed to understand OAB, UI, and the effect of treatment. Pelvic floor/sphincter training does not increase the urethral closure pressure level, i.e. sphincter strength, but rather improves sphincter control.

The observation that phasic DO as well as UI both show inverse pressure changes of pdet and pura indicate that these are definitely not isolated detrusor events and the bladder/detrusor-focused terminology "OAB, DO" is insofar misleading. We need more comprehensive urodynamic measurement, and most importantly, better techniques of continuous and reliable measurement of urethral pressure must be developed.

Disclosures

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Subjects: HUMAN **Ethics Committee:** University of Pittsburgh IRB#0311084 **Helsinki:** Yes **Informed Consent:** Yes