Original Research Article

WHAT IS THE BEST INDEX FOR EVALUATION OF DETRUSOR CONTRACTILITY IN WOMAN DEPENDING ON URODYNAMIC DIAGNOSIS AND AGE?

ABSTRACT

Aims

Detrusor contractility governs the voiding process. Its evaluation in women derived from an intubated flow is obtained from the contractility indices PIP1 and the VBN-derived parameter k. Both values of PIP1 and k are dependent of the urodynamic diagnosis (UD) and decrease with aging. Our goal was to find out if one of these indexes was more informative depending on UD and age.

Methods

Contractility was evaluated from pressure-flow studies of 354 non-neurologic women (age range 20-96 y) who were referred for investigation of various lower urinary tract dysfunctions and who fulfilled criteria for inclusion: non-interrupted flow, voided volume >100 mL and Q_{max}> 2mL/s.

UD were bladder outlet obstruction (BOO), detrusor hyperactivity with impaired contractility (DHIC), detrusor overactivity (DO), detrusor underactivity (DU). Some investigations were found “normal” (N) and other related to urethral dysfunction (intrinsic sphincter deficiency (ISD)) or voiding triggered by urethral relaxation (URA)). Data were interpreted across age-groups with 20 years interval, at least 3 patients with one UD in a given age-group interval.

Results

Among all the UD, only 2 did not have a sufficient number of patients to be reported: DHIC for 20-40y and URA for >80y. For each UD, variations of k and PIP1

demonstrated a decrease with age, which was more important for k in the age group >80y (compared with all age groups). Age–groups 20-40 and 41-60 gave comparable values of k and PIP1 for UD BOO, DO and DU. Analysis of percentage of contractility value variation showed a more important and significant decrease for k vs. PIP1 between age-groups 61-80 and >80 for all UD (p=.0028)

Conclusions

If both detrusor contractility indexes have values well related to urodynamic diagnosis which decrease with age, use of k is more informative than PIP1 in elderly women.

Introduction and Objectives

Detrusor contractility governs the voiding process.Definition of detrusor contractility remains confused as its two aspects depend partially of pressure (strength of the detrusor contraction) and partially of flow (contraction adequately sustained). Thusevaluation of detrusorcontractility in womenremains a great challenge mainlybecausedefinition of contractilityis not simple and alsobecause first attempts to define a contractility index in womenweremostlyderivedfrom the evaluation of detrusorcontractility in men.

Assessment of detrusor contractility can be made from isometric testing or pressure-flow studies. Various indexes have been proposed: firstly the Watts factor (WF) introduced by Derek Griffiths [1] well correlated with maximum isovolumetric contraction pressure but needing sophisticated computations and with poor reproducibility, secondly a simplified approach the projected isovolumetric pressure (PIP) based on the linearized bladder output relation which obeys the formula PIP = $p_{det.Qmax}$+ K*$Q_{max}$where K value is 5 cmH_2O/mL.s^{-1} proposed by Werner Schafer [2]. To obtain a coefficient without dimension, Werner Schafer defined DECO which is

the ratio PIP/100 cmH_2O. PIP was later called bladder contractility index (BCI) by Paul Abrams [3].

Tan et al. observingthat the PIP index proposed for men led to a greatoverestimation of detrusorcontractility in womenintroduced a modifiedprojectedisovolumetric pressure where K value is 1 $cmH_2O/mL.s^{-1}$: PIP1 = $p_{det.Qmax}$+ Q_{max}[4]. PIP1 has been defined for ‘‘elderly’’ women (range 53-89 yearsold) sufferingfrom ‘‘urge incontinence’’.

The VBN, mathematical model of miction [5]introduced the parameterk, whichcharacterizeddetrusorcontractility. Then a nomogram, based on thismathematical model, wasproposed to calculate the detrusorcontractility in womenfrom a pressure-flow study (PFs) [6].

If PIP1 has been proposed for olderwomen, parameter k wasdefinedregardless of age or gender. In addition, evaluation of parameter k takesintoaccount the bladder volume at initiation of voiding.

It has been demonstratedthat PIP1 and the VBN-derived parameter kproduced comparable and consistent results, thattheir values decreasedwithageing and weredependent of the urodynamicdiagnosis (UD) [6]. Our goal was to find out if one of these contractility indices was more informative depending on UD with age.

Methods

Of urodynamicstudies of womenreferred for investigation of various lower urinary tract dysfunctions in one practice, contractility was retrospectively evaluated from pressure-flow studies of 354 consecutive non-neurologic women (age range 20-96 y) who fulfilled criteria for inclusion.

Exclusion criteria were diabetes, grade>2 prolapse, previous pelvic floor surgery and MMSE ≤ 20.

Detrusor contractility parameters (PIP1and VBN parameter k) were mainly derived from $p_{det.Qmax}$and Q_{max}, measured during IF; VBN parameter k also needed to know initial bladder volume (Vini). Voided volume was measured during IF and post void residual volume (PVR) using a Bladder-scan. So Vini was calculated by adding the PVR to the voided volume.

Thus, women unable to void during the PFS, with an interrupted flow, a voided volume less than 100 mL or who expelled their urethral catheter during the PFS were excluded.

Urodynamic investigations were carried out according to the International Continence Society Good Urodynamic Practices [7], using a urodynamic unit from Laborie (Mississauga Canada). Filling cystometry was performed, with saline at room temperature at a medium filling rate of 50 mL/min. Filling cystometrogram was obtained via a triple lumen urethral catheter 7F allowing for urethral pressure recording and followed by an intubated flow (IF). PFS started as the patient was given the ‘‘permission to void’’; detrusor and urethral pressures, and urine flow rate were recorded during the whole voiding phase.

UD was posed according to the ICS/IUGA recommendations [8]: bladder outlet obstruction (BOO), detrusor hyperactivity with impaired contractility (DHIC), detrusor overactivity (DO), detrusor underactivity (DU). Some investigations were found “normal” (N) and other related to urethral dysfunction (intrinsic sphincter deficiency (ISD)) or voiding triggered by urethral relaxation (URA)). The data was interpreted across age groups with 20 years interval, unless the UD was present in less than 3 patients in a given age group interval.

Criteria for urodynamic diagnoses were: BOO: Q_{max}< 12 mL/s and $p_{detQmax}$> 25 cmH_2O [9], DO: occurrence of Non-Inhibited Detrusor Contraction ≥ 5 cmH_2O during filling [10], DHIC: same as DO during filling and underactive detrusor during voiding [11], DU: In absence of real consensus $p_{detQmax}$< 20 cmH_2O, Q_{max}< 15 mL/s, high t_{mic}[12], N: no symptom reproduced during the assessment, ISD: low MUCP [13-14], and/or positive VLPP [15], URA: voiding triggered by urethral relaxation.

Main complaints were incontinence: stress (SUI), mixed (MUI), urge (UUI); some complaints did not involve incontinence (OTHER).

This retrospective study was conducted in accordance with the declaration of Helsinki. The local practice of our Ethics Committee does not require a formal institutional review board approval for retrospective studies.

Statistical analysis

Data were presented as mean ± SD. Analysis of variance (ANOVA), *t* test, and the Chi2 test were used as appropriate. Post-hoc analysis was done to explore differences between multiple groups means. Analyses were performed on the overall study population and stratified by age. All statistical results were considered significant at *P*< 0.05. Statistical analyses were performed using SAS, version 5.0 (SAS Institute, Inc., Cary, NC).

Results

Among all UD, only 2 did not have a sufficient number of patients to be reported: DHIC for 20-40y and URA for > 80y. Variations of k and PIP1 for each UD demonstrated a decrease with age, which was more important for k in the age group

> 80y (compared with all age groups). Age–groups 20-40 and 41-60 gave comparable values of k and PIP1 for UD BOO, DO and DU (figure).

Analysis of percentage of contractility value variation for all UD showed a decrease for k vs. PIP1 for all age-groups but that decrease was more important and significant only between age-groups 61-80 and >80 (mean 58.6 ± 20.1 vs 10.4 ± 5.8, P=0.0028).

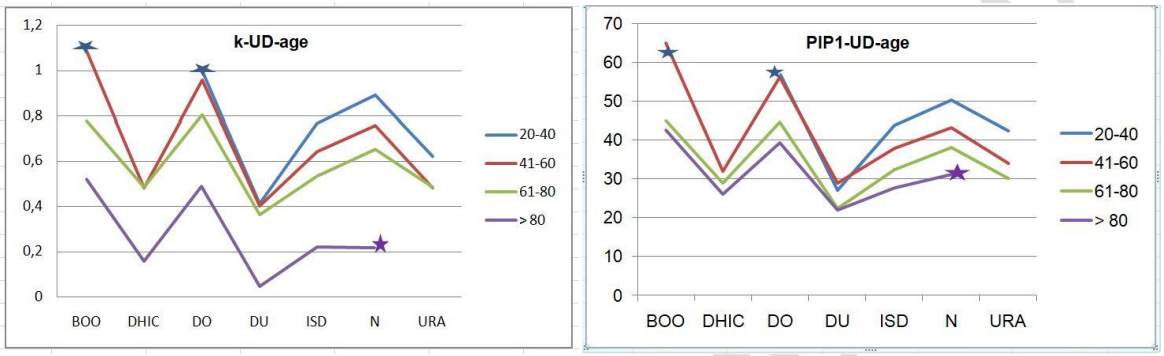

Figure 1: variation of value of detrusor contractility indices with age and urodynamic diagnosis. k is without unit, PIP1 in cmH_2O; stars show gaps (no DHIC for 20-40 y; no URA for >80 y).

Discussion

Recently, Fry and Gammieproposed a detrusorcontractilityparameter (DCP) alsonamed*t*20—80 (time intervalbetweendetrusor pressure risingfrom 20 to 80% of its value once the flow starts) [16].Unfortunately, thisproposed indice isseldom relevant because of inherent limitations in the urodynamic tracing, including the need for very high qualityurodynamictracings [17].

The Watts Factor calculationisdifficultwithout a computer and its value has poorreproducibility.

In ourstudy, evaluation of PIP1 isobtainedfromcoordinates ($p_{det.Qmax}$and Q_{max}) of a remarkable point of the intubated flow, i.e. the point of maximum flow. Evaluation of

the VBN contractilityparameterkisalsoobtainedfrom the values of the coordinates of this point but takeintoaccount the filling volume (Vini, $p_{det.Qmax}$and Q_{max}) to use the nomogram. This finding is novel as PIP1 has only been studiedso far in a group of elderlyfemales (53-89 yearsold) sufferingfrom urge urinary incontinence [4]. Instead, in ourstudy, 41 of 143 womenyoungerthan 55 yearscomplained of urge incontinence. So ourstudycouldbroaden the age range for which PIP1 can beused for detrusorcontractilitymeasurements. Lastly, there are limitations to the use of kas a detrusorcontractility index, and those are primarilyrelated to the voiding performance. As alreadyalluded to, theyinclude a non-interrupted flow untilreachingQ_{max} and no significant abdominal straining. Althoughthesetwo conditions wereapplied in the mathematical computation of the kindex, to ourknowledgethey have not been evaluated in the development of PIP1.

Conclusion

If both detrusor contractility indexes, PIP1 and VBN parameter k, have values well related to urodynamic diagnosis which decrease with age, use of k is more informative than PIP1 in elderly women.

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