European Journal of Obstetrics & Gynecology and Reproductive Biology 205 (2016) 127–132

Contents lists available at ScienceDirect

European Journal of Obstetrics & Gynecology and Reproductive Biology

journal homepage: www.elsevier.com/locate/ejogrb

Can we predict detrusor overactivity in women with lower urinary tract symptoms? The King's Detrusor Overactivity Score (KiDOS)

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ARTICLE INFO

Article history:
Received 3 February 2016
Received in revised form 18 June 2016
Accepted 26 July 2016

Keywords:
Detrusor overactivity
Lower urinary tract symptoms
Prediction model
Urinary incontinence
Urodynamics

ABSTRACT

Objective: Traditionally, urodynamic studies (UDS) have been used to assess lower urinary tract symptoms (LUTS), but their routine use is now discouraged. While urodynamic stress incontinence is strongly associated with the symptom of stress urinary incontinence (SUI) and a positive cough test, there is a weak relationship between symptoms of overactive bladder and detrusor overactivity (DO). The aim of our study was to develop a model to predict DO in women with LUTS.

Study design: This prospective study included consecutive women with LUTS attending a urodynamic clinic. All women underwent a comprehensive clinical and urodynamic assessment. The effect of each variable on the odds of DO was estimated both by univariate analysis and adjusted analysis using logistic regression.

Results: 1006 women with LUTS were included in the study with 374 patients (37%) diagnosed with DO. The factors considered to be the best predictors of DO were urgency urinary incontinence, urge rating/void and parity (p-value < 0.01). The absence of SUI, vaginal bulging and previous continence surgery were also good predictors of DO (p-value < 0.01). We have created a prediction model for DO based on our best predictors. In our scoring system, presence of UUI scores 5; mean urge rating/void ≥ 3 scores 3; parity ≥ 2 scores 2; previous continence surgery scores -1; presence of SUI scores -1; and the complaint of vaginal bulging scores -1. If a criterion is absent, then the score is 0 and the total score can vary from a value of -3 to +10. The Receiver Operating Characteristic (ROC) analysis for the overall cut-off points revealed an area under the curve of 0.748 (95%CI 0.741, 0.755).

Conclusion: This model is able to predict DO more accurately than a symptomatic diagnosis alone, in women with LUTS. The introduction of this scoring system as a screening tool into clinical practice may reduce the need for expensive and invasive tests to diagnose DO, but cannot replace UDS completely.

Introduction

Lower urinary tract symptoms (LUTS) are common in women with a reported prevalence up to 66.6% in large epidemiological studies [1]. They are under-reported and under-treated despite their significant adverse effect on quality of life (QoL) [2]. Traditionally, urodynamic studies (UDS) have been used to assess LUTS, but their routine use is now questioned. As UDS are invasive and expensive tests without evidence-based additional value in the management of women with urinary incontinence (UI), their routine use is discouraged by international professional bodies [3,4].

Conventionally, stress urinary incontinence (SUI) is the predominant symptom associated with urodynamic stress incontinence (USI) and urgency urinary incontinence (UUI) with the urodynamic observation of detrusor overactivity (DO). The correlation between the clinical and urodynamic diagnosis in women is weaker than the correlation in the male population [5]. Several studies have compared clinical and urodynamic diagnoses of UI in women. A recent systematic review showed that the positive predictive value (PPV) of SUI to diagnose USI was 75% (range 41–95%), but the PPV of UUI to diagnose DO was only 58% (range 22–100%) [6]. A combined assessment including history,

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http://dx.doi.org/10.1016/j.ejogrb.2016.07.495
0301-2115/

physical examination and bedside tests is less helpful in diagnosing DO compared to USI [7].

Few researchers have attempted to identify clinical predictors of DO. Variables such as the maximum urge rating in an urgency scale [8], the presenting bladder volume at urodynamics [9] have been proposed as potential predictors. A number of prediction tools have been developed to help to diagnose DO, but their use in clinical practice has been limited due to the required complex calculations [10,11]. A prediction model combining symptoms, examination findings and non-invasive tests such as bladder diaries incorporating urgency scales is probably closer to daily clinical practice and is likely to show better agreement with UDS. The purpose of this study was to develop a simple prediction model to estimate the risk of DO in female patients with LUTS.

Materials and methods

Participants

This was a cross-sectional study in a tertiary referral Urogynaecology Unit. Consecutive women attending a one-stop urodynamic assessment clinic with LUTS were included in the study. Ethical approval was granted by the regional Research Ethics Committee.

We excluded women unable to read and complete a questionnaire in the English language; younger than 18 years; with dementia or memory disorders; with known neurological conditions such as stroke, multiple sclerosis, spinal cord injury or Parkinson's disease; on antimuscarinic medication within seven days of the attendance in the clinic; with evidence of urinary tract infection on urinalysis (presence of nitrites with or without leucocytes) on the day of the appointment.

Procedures

All women were asked to complete a disease-specific health related quality of life (HRQoL) questionnaire (King's Health Questionnaire, KHQ) [2] and 3-day bladder diary incorporating the validated Patient's Perception of Intensity of Urgency Scale (PPIUS) [12], before attending the urodynamic clinic. The symptom domain of the KHQ was used to assess the presence of LUTS. The five grades of the PPIUS (from 0: no urgency, to 4: urgency incontinence) were used to assess the degree of urgency associated with each void. Urgency episodes were counted as suggested by Cardozo et al. as voids with PPIUS level 3 and 4 (without or with urgency incontinence respectively) [13]. Daytime urinary frequency, nocturnal frequency and the functional bladder capacity were recorded from the bladder diary.

Initial assessment included medical history, physical examination and urinalysis. Pelvic organ prolapse was assessed in both the lithotomy position and standing with the patient exerting a maximal Valsalva manoeuvre using the pelvic organ prolapse quantification (POPQ) system [14]. The participants then underwent multichannel urodynamics according to the ICS recommendations [15]. Women, whose symptoms of urgency were not reproduced during the laboratory test, underwent a 4-hour ambulatory urodynamics test following a standardised protocol [16].

Statistical analysis

Analysis of descriptive data was carried out in three ways. Firstly we looked at continuous variables and investigated their distribution. If a variable was found to be symmetrical, then the mean and standard deviation was used to summarise the variable, otherwise the median and interquartile range was used to summarise the variable. To test any differences for continuous variables either a parametric or non-parametric test was used depending on whether the variable was symmetrical or not. Secondly, we considered nominal categorical variables and tabulated the proportions in the DO group and non-DO group and the differences were tested by using either the chi-squared test or Fisher's exact test depending on whether the expected assumptions for chi-squared test were satisfied or not. Thirdly, we considered categorical variables with ordinal values. For these variables, proportions were analysed and the Cuzick's test for trend was carried out [17].

The effect of each of the 27 variables on the odds of DO was estimated both by univariate analysis and adjusted analysis using logistic regression. Assuming a bladder diary completion rate of 75% and a DO prevalence of 36% in our population [18] we estimated a minimum sample size of 1000 patients based on the work by Peduzzi et al. ($N = 10k/p$, where k equals the number of covariates and p the smallest of the proportions of negative or positive cases in the population) [19].

An investigator-led best model selection approach was used to select the best predictors of DO in the multiple logistic regression model, as opposed to machine-led step-wise regression, which is not advisable. For ordinal explanatory variables, Mantal-Haenszel odds ratio for trend was used to estimate the odds ratio taking account of the ordinal nature of the data [20]. To deal with missing data in the adjusted model, we explored complete case analysis but also used multiple imputation methods [21,22]. We carried out 20 multiple imputations and estimated the best predictors of DO. We used estimates from the adjusted model after multiple imputations to create the prediction scoring tool. To test how the prediction tool agreed with the observed values, Kappa statistics was calculated. The overall predictive ability for our prediction model was measured by the area under the Receiver Operating Characteristic (ROC) curve. Sensitivity, specificity and likelihood ratio for each cut-off point of the scoring system were calculated. All analyses were performed using STATA software, version 12.1 SE (Stata Corporation, College Station, TX, USA).

Results

1006 women with LUTS were included in the study. The mean age was 51.4 years (SD: 14.8) and 52% of them were postmenopausal. 374 patients (37%) were diagnosed with DO. The basic characteristics of our population with the univariate comparison are presented in Table 1.

As a result of the multiple logistic regression with multiple imputations the investigating team determined that the factors considered best predictors of DO were UUI, urge rating/void and parity. The absence of SUI, no vaginal bulging and no history of previous continence surgery were also good predictors of DO (Table 2).

Using estimates from the adjusted model and the relevant odds ratios (Table 2), we developed a prediction model called King's DO Score (KiDOS). The scoring system is such that for those that had decreased effect in DO, a negative score was given, for those with an increased effect, a positive score was given with respect to odds ratio. In KiDOS, presence of UUI scores 5; mean urge rating/void ≥ 3 scores 3; parity ≥ 2 scores 2; history of previous continence surgery scores -1; presence of SUI scores -1; and the complaint of vaginal bulging scores -1 (Table 3). If a criterion is absent, then the score is 0 and the total score can vary from a value of -3 to +10.

The overall predictive ability for our prediction model, measured by the area under the Receiver Operating Characteristic (ROC) curve was 0.748 (95%CI 0.741, 0.755) (Fig. 1). The agreement