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Clinical score predictive of abdominal leak point pressure (ALPP) <60 cm H2O in the urodynamics study of women with stress urinary incontinence

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ABSTRACT

Objective: The aim of this study was to perform a score predictive of ALPP <60 cm H2O from clinical factors in women with stress urinary incontinence (SUI).
Study design: We performed a descriptive and observational study of women referred for a urodynamic study for stress urinary incontinence. Patients were divided into three groups: ALPP: >90 cm H2O, between 60 and 90 cm H2O and <60 cm H2O. A logistic regression study was performed in order to complete clinical predictors of ALPP < 60 cm H2O. Variables that were significant in the multivariate analysis were included in the score.
Results: We studied 158 patients: 65 presented ALPP > 90 cm H2O, 64 between 60–90 cm H2O and 29 <60 cm H2O. In the multivariate analysis, were presented as independent predictors of ALPP < 60 cm H2O, the presence of a fixed urethra (p 0.01), empty bladder test positive (p 0.02) and presence of symptoms grade III in the classification of Stamey (p 0.03). The accuracy of the test was: score 0, 42%; score 1, 58%; score 2, 81%. Receiver Operating Characteristic (ROC) analysis for the overall cutoff points revealed an area under the curve of 0,75.
Conclusions: Presence of a fixed urethra, positive empty bladder test and patients with a high degree of SUI symptoms according to the Stamey score are independent clinical predictors of intrinsic sphincter deficiency. This score could represent a useful clinical tool to predict the presence of ALPP <60 cm H2O based on clinical parameters.

Introduction

Stress urinary incontinence (SUI) is defined by the International Continence society (ICS) as the loss of urine that occurs with exertion, physical activity or secondary to sneezing or coughing [1]. This situation is related with two physiopathological features, urethral hypermobility and intrinsic sphincter deficiency (ISD).

The urodynamic evaluation in patients with SUI often includes measurements to evaluate the urethral function, including abdominal leak point pressure (ALPP). The International Urogynecological Association (IUGA) and the ICS define ALPP as the minimum intravesical pressure in which there is loss of urine in relation to an increase in abdominal pressure in the absence of involuntary contractions of the detrusor [2]. This parameter is widely accepted as a useful tool to assess the severity of the urethral damage; from the description of MacGuire [3], an ALPP value less than 60 cm H2O is associated with ISD. Currently, surgical procedures to treat SUI in patients with ISD have shown higher rate of failure due to poor coaptation and urethral functional deficit [4]. Therefore, the recognition of the presence of ISD in patients with SUI is of utmost importance when making decisions because this can change the surgical outcomes.

This evidence has led the physician to find objective parameters to quantify urethral functions, and in the absence of a uniform definition of ISD they use a urodynamic evaluation based on ALPP and MUCP in order to get their diagnosis. However, two recent studies have demonstrated non-inferiority in surgical outcomes of

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mid urethral sling in patients with and without prior urodynamic studies [5,6]. Considering that there is limited information about which clinical factors may be associated with ISD, its recognition could be important in order to create predictive models and thus improve the selection of patients when a surgical treatment is chosen.

The objective of the study is to perform a predictive score of ALPP <60 cm H2O from clinical factors in women with SUI.

Material and methods

This is a retrospective, observational and descriptive study of 185 women referred for a urodynamic study for stress urinary incontinence, with a surgical treatment plan, between September 2011 and June 2013. All patients underwent a complete urogynecological evaluation including interrogation, gynecologic and obstetric medical history, neurological and physical examination (urethral mobility by Q Tip test, vaginal trophism, pelvic organ prolapse quantification system (POP-Q) and presence of SUI), Stamey score to classify preoperative SUI (I: mild; II: moderate; III: severe) [7]. Questionnaire of medical epidemiology and aging and social aspects (MESA) according to conversion index (9 stress urinary incontinence questions, with a score from 0 to 3 each question: SUI score divided by 27 ($9 \times 3 = 27$) and 6 urgency urinary incontinence questions, with a score from 0 to 3 each question: UUI score divided by 18 ($6 \times 3 = 18$)) [8], questionnaire ICIQ-SF urinary incontinence [9], questionnaire of impact of incontinence (IIQ-7) [10] was performed. All patients had normal ultrasound of the urinary tract and negative urine culture. Fixed urethra was considered when the Q-Tip test was lower than 30°. All patients underwent a stress test with an empty bladder (defined as the presence of stress urinary incontinence in supine position after bladder evacuation in the absence of significant post-voiding residue). The uroflowmetry was performed with measurement of post-voiding residue. Subsequently, a multichannel urodynamic study was carried out, performing filling cystomanometry and pressure flow study. The nomenclature used was established according to the ICS recommendations [1] and the technique of the procedure was based on the protocols of a good urodynamic practice [11].

ALPP was calculated with patients in a semi-sitting position and represented by the lowest intravesical pressure, which showed loss of urine in relation to the Valsalva maneuver or cough. This was measured at 200 ml of the irrigation and if it was not observed at that volume, Valsalva or cough was requested every 100 ml until the loss was observed. Patients were divided into three groups according to the ALPP value: >90 cm H2O, between 60 and 90 cm H2O and <60 cm H2O.

27 women were excluded, with predominant symptoms of overactive bladder according to MESA questionnaire (urge score > stress score), prolapse > stage 2, bladder capacity less than 200 ml, history of urinary retention or post-voiding residue >100 ml, patients with neurogenic history, active urinary tract infection or other urological diseases and patients consuming drugs that impact on the bladder or urethral functions.

Data collection and processing were performed with the statistical program INFOSTAT. Categorical variables were expressed as a percentage. Continuous variables are described as medium. Univariate analysis was performed by Chi-square or *t*-test for categorical or continuous variables respectively. The multivariate study was performed by the logistic regression method in order to determine clinical predictors of ALPP < 60 cm H2O. In all cases a p-value < 0.05 was considered statistically significant. Variables that were significant in multivariate analysis were included in the score and it was constructed from the number of significant parameters that each patient had. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of each score was determined. A ROC curve was made to calculate the area under the curve of the score and thus determine the predictive capacity of the same in relation to the presence of ALPP < 60 cm H2O.

The Institutional Review Board (IRB) approval was not requested since this was a retrospective study. All patients provided a signed consent for the anonymous collection and eventual publication of their data.

Results

Our study population was 158 women. General demographic characteristics, clinical history and physical examination of the series are exposed in Table 1.

Patients with ALPP > 90 cm H2O were 65, between 60–90 cm H2O 64 and <60 cm H2O 29. Table 2 shows the association of the groups with the variables studied.

In the univariate analysis, we found that a value of ALPP < 60 cm H2O is associated with age> 60 years, menopause, hysterectomy, Stamey grade III, presence of fixed urethra and positivity in empty bladder test.

In the multivariate analysis we found that the independent clinical predictors of presence of ALPP < 60 cm H20 in the urodynamic study are the presence of a fixed urethra, positivity in the empty bladder test and the presence of SUI grade III in the Stamey classification (Table 3).The predictive score was calculated according to the number of significant variables presented by each patient and subdivided into score 0 (no present parameter), score 1 (presence of a parameter) and score 2 (presence of 2 or 3 parameters). This last score was grouped into a single group (Score 2) since only 3 patients had 3 positive parameters.

The presence of ALPP < 60 cm H2O for score 0, 1 and 2 was 5.7%, 20.6% and 48%, respectively.

Sensibility, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of the different score groups are shown in Table 4.

The accuracy of the test was: score 0, 42%; score 1, 58%; score 2, 81%.

The cutoff point of the model is 1 and the area under the curve for the proposed predictive score is 0.75. (Fig. 1).

Table 1
Basic characteristics of the population.

Variable	n 158
Age	56,11 (38–84)
Type of incontinence:	100 (63%)
SUI	58 (37%)
MUI	
Menopause	95 (60%)
Pregnancies	3,17 (0–9)
Vaginal births	2,49 (0–9)
Greater weight of the newborn	3489 (0–5000)
Obstetric injury	33 (21%)
Previous antiincontinence surgery	14 (9%)
Hysterectomy	35 (22%)
Stamey score:	20 (13%)
I	113 (72%)
II	25 (16%)
III	
Daily protectors	3,33 (0–12)
ISIQ-SF score	13,9 (4–21)
IIQ7 score	9,26 (0–20)
Urethral hipermovility	147 (93%)
Fixed urethra	11 (7%)
POP stage 1-2	71 (45%)
Positive empty stress test	80 (51%)
Q Max (ml/seg)	27 (8–77)

Table 2
Univariate comparison between clinical variables and studied groups.

Variable	Alpp >90 (n 65)	Alpp 60-90 (n 64)	Alpp <60 (n 29)	p
Age	53,05	56,8	61,4	0,003
> 60 year	15 (23,1%)	26 (40,6%)	16 (55,2%)	0,007
Type of incontinence	41 (63,1%)	40 (62,5%)	19 (65,5%)	0,96
SUI	24 (36,9%)	24 (37,5%)	10 (34,5%)	
MUI				
Menopause	30 (46,1%)	43 (67,2)	22 (75,8%)	0,008
Number of Pregnancies	2,8	3,45	3,32	0,64
Number of vaginal births	2,23	2,84	2,28	0,45
Greater weight of the newborn	3348	3568	3629	0,38
Obstetric injury	17 (26,1%)	10 (15,6%)	6 (20,7%)	0,33
Previous anti- incontinence surgery	4 (6,15)	5 (7,8%)	5 (17,2%)	0,049
Hysterectomy	13 (20%)	11 (17,2%)	11 (37,9%)	0,02
Stamey grades	11 (16,9%)	7 (10,9%)	2 (6,9%)	0,006
I	48 (73,8%)	49 (76,5%)	16 (55,2%)	
II	6 (9,2%)	8 (12,5%)	11 (37,9%)	
III				
Number of daily protectors	3,2	3,1	4,2	0,11
ISIQ SF score	13,85	13,89	14,24	0,66
IIQ7 score	8,72	9,83	9,21	0,61
Presence of fixed urethra	4 (6,1%)	1 (1,6)	6 (20,7)	0,003
Empty stress test (+)	26 (40%)	32 (50%)	22 (75,8%)	0,005
Q max (ml/seg)	24,7	30,2	25,2	0,32

Table 3
Independent predictors of ALPP < 60 cm H2O in multivariate analysis in women with SUI.

VARIABLE	OR (CI 95%)	p
Age > 60 years	2,47 (0,77–7,97)	0,13
Menopause	0,85 (0,23–3,09)	0,80
Hysterectomy	1,41 (0,51–3,91)	0,50
Stamey grade III	**2,81 (1,03–8,30)**	0,04
Fixed urethra	**5,35 (1,25–22,8)**	**0,02**
Empty stress test (+)	**3,14 (1,11–8,85)**	**0,03**

In the title is specified the meaning of ALPP.

Table 4
Sensibility, especifity, PPV, NPV and accuracy of the score parameters.

	Sensibility(%)	Especifity (%)	PPV (%)	NPV (%)	Accuracy (%)
Score 0	13,8	48,8	5,7	71,6	42
Score 1	44,8	61,2	20,6	83,2	58
Score 2	41,4	89,9	48	87,2	81

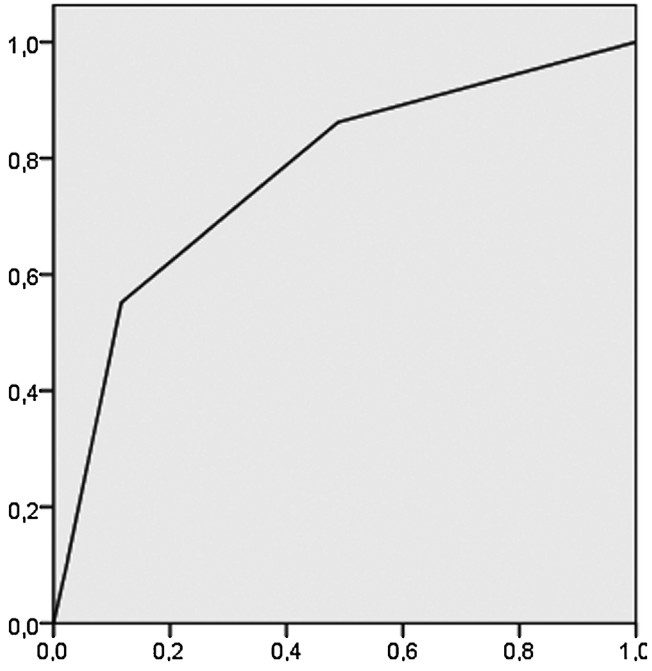

Fig. 1. Receiver operating characteristic (ROC) analysis.

Discussion

In the physiopathology of stress urinary incontinence, two different mechanisms have been historically described: anatomic SUI and ISD [12,13]. Anatomic SUI is caused by urethral hypermobility in patients with an intact urethral sphincter, in whom the urethral support fails. It has been traditionally treated with various techniques repositioning the bladder neck or placing a new urethral support.

The presence of ISD denotes a malfunction of the urethral sphincter by itself [14]. Although there is no single and definitive criterion for this concept, the two objective measures that are most commonly accepted for diagnosis are the abdominal leak point pressure (ALPP) and the maximum urethral closure pressure (MUCP) [15].

The measurement of ALPP is a very important urodynamic parameter when evaluating women with SUI; in simple terms, we could say that it represents the lowest intravesical pressure when there is loss of urine before abdominal efforts [16]. McGuire determined that a value of ALPP ≤ 60 cm H2O correlates with ISD and suggests that it should be used as a measure of the severity of incontinence. However, this parameter has not been standardized in terms of its measurements related to various circumstances that can vary its value (catheter size, patient position, bladder volume and type of effort performed), making more difficult to diagnose ISD accurately. However, we can make a pragmatic use of this measurement of urethral function in clinical practice, trying to predict results in anti-incontinence surgeries. Some authors have observed that patients with low ALPP values have a greater risk of failure after surgery than those with a higher value of this measurement [4,17,18]. Likewise, several observations have suggested that in patients with ISD (measured by ALPP < 60 cm H2O) the results of the retropubic sling are superior in terms of

effectiveness than the transobturator sling [19,20,21]. Moreover, recent studies in patients with uncomplicated SUI comparing the performance of urodynamics vs evaluation in the office without urodynamics prior to surgery did not show inferiority in surgical results [5,6]; therefore, it is essential to find clinical parameters that indicate the presence of ISD.

Many factors have been associated with the development of ISD. Advanced age, over 60-year-old women mainly, and the prolonged menopausal state with concomitant estrogen deficiency may produce loss in urethral vascularization and insufficiency in the coaptation of the urethra, producing a deficit in the urethral sphincter function [14,21]. A history of hysterectomy, prolapse surgery, radical pelvic surgery and pelvic radiation therapy can impact urethral function due to denervation and devascularization in relation to extensive dissections or residual scars [22,23].

In our study, presence of fixed urethra, positive empty bladder test and a Stamey grade III score were independent predictors of ALPP < 60 cm H2O.

Intrinsic sphincter deficiency has also been related to the severity of SUI symptoms reported by patients. Several authors investigated the correlation between SUI symptoms with urethral function measured by ALPP in women with ISD. They reported that the degree of effort that triggers the escape of urine can predict sphincter deficit; therefore, the presence of SUI at minimum efforts has a high probability of low ALPP [24–26].

The presence of a fixed urethra has been historically a parameter described by Mcguire related to ISD, since it relates in many cases with urethral injury by involvement of innervation and sphincteric structures produced by periurethral fibrosis due to previous injuries (pelvic surgery, radiotherapy). However, the lack of urethral mobility has not been associated with lower ALPP in various studies [27]. In our series, patients with a fixed urethra show higher incidence of ALPP < 60 cm H2O.

Empty bladder stress test was identified as a marker of lower ALPP; similarily, previous studies have identified this test as a marker of ISD, being of the utmost importance its identification [28,29].

From these parameters we constructed a predictive score to determine the presence of ALPP < 60 cm H2O; in the presence of score 0 (absence of these parameters), only 5.7% of patients presented ALPP < 60 cm H2O, score 1 (presence of a parameter) showed 20.6% probability and score 2 (2 or 3 parameters present) 48% probability.

Considering that the urodynamic study generates discomfort to patients due to its invasiveness, the results in the VALUE study [5] have not shown differences in the surgical results between the realization of this method and the simple evaluation in the clinical practice when evaluating patients with uncomplicated SUI, and the fact that the retropubic sling has higher success rates in patients with ISD, the use of this score could be really helpful when we choose this type of surgical procedure (retropubic sling or transobturator) to be performed, taking into account that only 5% of patients with score 0 have ALPP < 60 cm H2O and almost half of patients (48%) with Score 2 have ALPP < 60 cm H2O. This score could help those professionals who don't want to use urodynamics in order to determine the presence of ISD taking clinical factors, allowing them to choose the best therapeutic options.

Conclusions

In our series of women with SUI, presence of fixed urethra, positive empty bladder test and patients with a high degree of SUI symptoms according to the Stamey score are independent clinical predictors of intrinsic sphincter deficiency. This score could represent a useful clinical tool to predict the presence of ALPP < 60 cm H2O based on clinical parameters.

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