



Voiding dynamics in women with urinary incontinence but without voiding symptoms

Juan P. Valdevenito^{1,2} | Alejandro Mercado-Campero¹ | Michel Naser² | Daniela Castro² | Marta Ledesma³ | Leandro Arribillaga³

¹Urodynamics Unit, Department of Urology, Hospital Clínico Universidad de Chile, Santiago, Chile

²Department of Obstetrics and Gynecology, Female Pelvic Floor Unit, Hospital Clínico Universidad de Chile, Santiago, Chile

³Female Pelvic Floor Department, Centro Urológico Profesor Bengiό, Córdoba, Argentina

Correspondence

Juan P. Valdevenito, Urodynamics Unit, Department of Urology, Hospital Clínico Universidad de Chile, Santos Dumont 999, Santiago 8380456, Chile.
Email: jpvaldevenito@gmail.com

Abstract

Aims: To describe the voiding pattern (VP) of women with urinary incontinence but without voiding symptoms and compare their clinical and urodynamic features between those voiding with and without a measurable detrusor contraction (DET-cont).

Methods: Retrospective analysis of a prospectively built database of female urodynamic studies (UDS). Women with voiding symptoms and having medical history of different factors that could alter the lower urinary tract function were excluded. All UDS were performed following the ICS guidelines. DET-cont and abdominal straining (ABD-strain) were defined as an increase ≥ 10 cm H₂O over the baseline for p_{det} and p_{abd} at Q_{max} , respectively.

Results: A total of 186 women were included in the analysis. Mean age was 58 ± 10.7 years (24-83). Most women showed a VP with DET-cont (77.4%), with or without ABD-strain. When compared to women voiding without DET-cont, those with DET-cont were younger ($P = .004$), more likely to have detrusor overactivity ($P = .035$) and better urinary sphincter competency in the UDS ($P = .018$). On multivariate analysis, the presence of DET-cont was associated with age ≤ 50 years ($P = .004$) and the absence of urodynamic stress urinary incontinence (SUI) or SUI with abdominal leak point pressure ≥ 100 cm H₂O ($P = .008$).

Conclusions: Most women without voiding symptoms show a VP characterized by a measurable detrusor contraction, with or without ABD-strain. The results suggest that the VP may vary independently with aging and with changes in the state of the urinary sphincter, emphasizing that for the interpretation of micturition in women different aspects must be considered.

KEYWORDS

lower urinary tract symptoms, micturition, urodynamics, women

1 | INTRODUCTION

Urodynamics plays an important role when evaluating women with lower urinary tract symptoms (LUTS), in

whom filling phase abnormalities are much more common than voiding phase abnormalities.

Most of our knowledge about the voiding function in women has been extrapolated from studies of patients

with lower urinary tract dysfunction.^{1,2} However, five decades ago, it was postulated that minimal or no detrusor contraction voiding is seen only in patients with low urethral closure pressure.³ More recently it has been demonstrated that women with stress urinary incontinence (SUI) void with significantly higher urinary flows and lower detrusor pressures than asymptomatic women.^{4,5} It has also been proposed that women with SUI void with lower detrusor pressures due to a decreased urethral resistance and that with an increase in resistance after surgery the detrusor contraction strength can be recovered.⁶

To date, there is no consensus on what is considered normal voiding in women. Few studies have described the voiding pattern of “healthy, continent and/or asymptomatic” women and all the women included in these studies urinate with a measurable detrusor contraction and with variable participation of the abdominal musculature,^{4,7-9} what could be considered the normal voiding pattern.

The main objective of this study is to describe the voiding pattern in women without voiding symptoms and to compare certain clinical and urodynamic characteristics between women who void with detrusor contraction (with or without participation of the abdominal musculature) and those who void without detrusor contraction. A secondary objective is to compare whether these clinical and urodynamic characteristics produce differences in voiding parameters. To our knowledge, this is the first study to investigate the voiding pattern on women with storage LUTS only.

2 | MATERIAL AND METHOD

2.1 | Study design

Retrospective study of symptomatic women who underwent urodynamics in a university reference center between January 2014 and December 2016. The information was prospectively entered into an electronic database when the clinical evaluation and urodynamics were conducted in accordance with the definitions and recommendations of the International Continence Society (ICS) and the International Urogynecological Association (IUGA).¹⁰⁻¹³ All patients provided informed consent for the use of their clinical information in research studies. Confidentiality of the data was ensured. The project was approved by the institutional Scientific Ethics Committee.

2.2 | Clinical evaluation and urodynamics

The clinical evaluation included a detailed medical history and a directed pelvic examination. The following

LUTS were obtained in a systematic and directed manner and were recorded as present or absent, without stratification of severity: slow urinary stream, straining to void, intermittent urinary stream (intermittency), and feeling of incomplete bladder emptying (hesitancy and terminal dribble, not present in the AUA Symptom Index score,¹⁴ were not considered).

Urodynamic testing was performed in accordance with the recommendations of the ICS.^{11,13} First, a noninvasive uroflowmetry was performed in private and the post-void residual volume (PVR) was measured by catheterization (it was repeated in patients presenting a free or intubated maximum urinary flow (Q_{max}) \leq 12 mL/s or voided volume $<$ 150 mL). Then, filling cystometry was performed interactively. A double lumen 6F urethra-vesical catheter was used for bladder filling and intravesical pressure measurement, and a rectal 8F punctured balloon catheter was used to measure abdominal pressure. External pressure transducers were placed at the level of the upper edge of the pubic symphysis and the system was zeroed to atmospheric pressure. Room temperature 0.9% saline solution was infused at a rate of 70 mL/min. Pressure transmission was evaluated with coughs at the beginning and end of each testing, every 1 minute throughout the study, and before and after each major event, to correct artifacts immediately; this was the only method used to provoke detrusor overactivity. The stress test was conducted in a standardized and stepped manner, with the use of progressively increasing cough intensity, following successive stages in case urodynamic SUI was not demonstrated: (a) with 300 mL infused in the sitting position, (b) with 300 mL infused in standing position, and (c) at maximum cystometric capacity in standing position (with the corresponding height change of the transducers). In patients with a maximum cystometric capacity $<$ 300 mL, it was generally evaluated in the sitting and standing position. An attempt was made to obtain three abdominal leak point pressure (ALPP) values with cough, with the lowest value being considered. The pressure-flow study was carried out in private. Finally, PVR was measured through the urethro-vesical catheter.

In the pressure-flow study, the following was defined: (a) detrusor contraction (DET-cont), the increase in detrusor pressure at maximum flow ($p_{det}Q_{max}$) \geq 10 cm H₂O above baseline and (b) abdominal straining (ABD-strain), the increase in abdominal pressure at $Q_{max} \geq$ 10 cm H₂O above baseline. Based on these definitions, four voiding patterns were determined: (a) voiding with DET-cont exclusively, (b) voiding with DET-cont + ABD-strain, (c) voiding with ABD-strain exclusively, and (d) voiding without DET-cont or ABD-strain. Additionally, voiding dysfunction was defined as the repeated presence of a $Q_{max} \leq$ 12 mL/s and/or a PVR $>$ 100 mL.

2.3 | Data analysis

Patients with the presence of any of the following voiding symptoms were excluded: slow urinary stream, straining to void, and intermittent urinary stream (intermittency). To avoid other factors that could alter the lower urinary tract function, the following additional exclusion criteria were applied: (a) previous surgery on the lower urinary tract, (b) pelvic organ prolapse over stage II according to POP-Q classification,^{12,15} (c) history of pelvic radiotherapy, (d) active medications on the lower urinary tract, (e) bladder pain syndrome/interstitial cystitis, (f) insulin-dependent diabetes mellitus, and (g) neurological diseases affecting the lower urinary tract.

The included patients were classified according to (a) age (≤ 50 years or > 50 years, arbitrarily), (b) parity (< 4 deliveries or ≥ 4 deliveries, arbitrarily), (c) previous hysterectomy, (d) presence of detrusor overactivity, and (e) presence of urodynamic SUI and degree of sphincter deficiency, by ALPP < 100 cm H₂O or ≥ 100 cm H₂O (the last usually associated with urethral hypermobility).¹⁶

Women who voided with DET-cont (with or without ABD-strain) were compared with those who voided without DET-cont (who voided with ABD-strain and voided without DET-cont or ABD-strain). In addition, the following voiding parameters were compared between patients groups: Q_{\max} , $p_{\det}Q_{\max}$, PVR, voided volume and projected isovolumetric pressure 1 ($PIP_1 = p_{\det}Q_{\max} + 1 Q_{\max}$).² A weak detrusor contraction was defined as a $PIP_1 < 30$.²

For the statistical analyzes of the quantitative variables, Student's *t* test or Wilcoxon's rank-sum test was used (according to data distribution). For the evaluation of the qualitative variables, the χ^2 test or Fisher's exact test was applied. The multivariate analysis was performed using logistic regression. The information was processed with the Stata, version 15.1 program (Stata-Corp 2017) and statistical significance was defined as $P < .05$.

3 | RESULTS

From the 580 women studied in the period, 224 (38.6%) did not have voiding symptoms. Thirty-eight other patients were excluded (23 with previous surgery on the lower urinary tract, 6 with pelvic organ prolapse over stage II, 5 with neurological diseases affecting the lower urinary tract, and 1 of each of the following: history of pelvic radiotherapy, active medications on the lower urinary tract, bladder pain syndrome/interstitial cystitis, and insulin-dependent diabetes mellitus), leaving 186 women to analyze. The mean age of the patients was

58 ± 10.7 years (range, 24-83 years), Table 1 summarizes their main clinical and urodynamic characteristics. Nine patients presented voiding dysfunction (4.8%).

3.1 | Voiding pattern

A voiding pattern with DET-cont was observed in the vast majority of women (77.4%, Table 1).

Table 2 shows the comparison of the clinical and urodynamic characteristics between the women who voided with DET-cont and those who voided without DET-cont. Women who demonstrated a voiding pattern with DET-cont were significantly younger ($P = .004$). There were no significant differences between the two groups when comparing Q_{\max} ($P = .513$), PVR ($P = .667$), and voided volume ($P = .630$). Women who had detrusor overactivity presented DET-cont more frequently than those who did not ($P = .035$). Women without urodynamic SUI in addition to those with urodynamic SUI with ALPP ≥ 100 cm H₂O ($n = 148$) presented DET-cont more frequently than those women with urodynamic SUI with ALPP < 100 cm H₂O ($P = .018$). In women in whom urodynamic SUI was demonstrated ($n = 152$), the ALPPs of those with DET-cont were significantly higher than those without DET-cont ($P = .022$).

Table 3 shows the association between the studied variables and the presence of DET-cont during voiding. On univariate analysis, three factors were significantly more frequent in women with a voiding pattern with DET-cont: age ≤ 50 years, presence of detrusor overactivity and the absence of urodynamic SUI or urodynamic SUI with ALPP ≥ 100 cm H₂O. On multivariate analysis, only an age ≤ 50 years and the absence of urodynamic SUI or urodynamic SUI with ALPP ≥ 100 cm H₂O maintained their significance. Detrusor overactivity was not associated with age ≤ 50 years ($P = .726$) or with the absence of urodynamic SUI or urodynamic SUI with ALPP ≥ 100 cm H₂O ($P = 1.0$). Patients with and without detrusor overactivity did not differ in age ($P = .478$) or in ALPP values ($P = .472$).

The voiding pattern with ABD-strain (with or without DET-cont, $n = 58$) was not associated with age ≤ 50 years, parity ≥ 4 , previous hysterectomy, presence of detrusor overactivity or with the absence of urodynamic SUI or urodynamic SUI with ALPP ≥ 100 cm H₂O. These patients tended to be older than the rest, without statistically significant difference (60.2 ± 10.7 vs 57.0 ± 10.6 , $P = .058$).

The feeling of incomplete bladder emptying (an ICS post micturition symptom)¹⁰ was present in 71 (38%) patients and was not associated with differences in the voiding pattern (with the symptom: 78.9% with DET-cont;

TABLE 1 Clinical and urodynamic characteristics of women without voiding symptoms

Variable	Results
<i>Clinical characteristics</i>	
Age, y, mean ± SD (range)	58 ± 10.7 (24-83)
≤50	42 (22.6%)
Parity	2.67 ± 1.26 (0-7)
≥4 deliveries	41 (22%)
Previous hysterectomy	39 (21%)
Symptoms of	
Stress urinary incontinence	42 (22.6%)
Urgency urinary incontinence	7 (3.8%)
Mixed urinary incontinence	134 (72%)
Other types of urinary incontinence	3 (1.6%)
<i>Urodynamic characteristics</i>	
Filling cystometry	
Detrusor overactivity	93 (50%)
No urodynamic SUI	34 (18.3%)
Urodynamic SUI with ALPP ≥ 100 cm H ₂ O	114 (61.3%)
Urodynamic SUI with ALPP < 100 cm H ₂ O	38 (20.4%)
Pressure-flow study, mean ± SD (range)	
Voided volume, mL	412 ± 154 (126-879)
Q _{max} , mL/s	26 ± 9 (5-63)
p _{det} Q _{max} , cm H ₂ O	23 ± 11 (0-69)
p _{det} max, cm H ₂ O ^a	33 ± 14 (7-77)
PVR, mL	11 ± 40 (0-290)
PIP ₁ , cm H ₂ O	50 ± 13 (17-90)
Voiding dysfunction	9 (4.8%)
Weak detrusor contraction ^b	10 (5.3%)
Voiding pattern	
DET-cont	102 (54.8%)
DET-cont + ABD-strain	42 (22.6%)
ABD-cont	16 (8.6%)
Absence of DET-cont and ABD-strain	26 (14%)

Abbreviations: ABD-strain, abdominal straining; ALPP, abdominal leak point pressure; DET-cont, detrusor contraction; PIP₁, projected isovolumetric pressure 1; PVR, post-void residual volume; SUI, stress urinary incontinence.

^ap_{det} max includes after-contractions.

^bWeak detrusor contraction: PIP₁ < 30.

without the symptom: 76.5% with DET-cont, $P = .709$). It was also not associated with differences in PVR (with the symptom: 7.73 ± 29.94 mL; without the symptom: 12.21 ± 45.22 mL; $P = .447$).

It is important to make explicit that of the 93 women who presented detrusor overactivity on the filling cystometry, only 4 (4.3%) voided with an involuntary detrusor contraction.

3.2 | Voiding parameters

Table 4 shows the voiding parameters according to the classification of the patients. In women ≤50 years, p_{det}Q_{max} was significantly higher than in those women older than that age ($P = .028$). In women with ≥4 deliveries, voided volume was significantly lower ($P = .040$). In women with detrusor overactivity, p_{det}Q_{max} was significantly higher ($P = .023$) and voided volume significantly lower ($P < .001$). In women with urodynamic SUI, Q_{max} was significantly higher ($P = .037$) and p_{det}Q_{max} significantly lower ($P = .016$). Furthermore, women with urodynamic SUI with ALPP <100 cm H₂O had a significantly lower p_{det}Q_{max} than those with ALPP ≥100 cm H₂O (18.0 ± 9.3 vs 24.2 ± 12.4 cm H₂O; $P = .003$).

There were only 10 cases with weak detrusor contraction (5.4%) and only 5 patients with PVR over 100 mL (2.7%). Patients with weak detrusor contraction tended to be older than the rest, without statistically significant difference (63.9 ± 8.3 vs 57.6 ± 10.7 , $P = .075$). The presence of detrusor overactivity was associated with a significant lower existence of weak detrusor contraction (1.1% vs 9.7%, $P = .018$). Patients with weak detrusor contraction tended to have higher PVR, without statistically significant difference (41.4 ± 93.1 vs 8.7 ± 34.5 , $P = .170$), and had PVR over 100 mL significantly more frequently than the rest (20% vs 1.7%, $P = .024$).

4 | DISCUSSION

This study included patients with urinary incontinence but without voiding symptoms. Besides not having voiding symptoms, the included patients have no medical history of other factors that could alter the lower urinary tract function, such as previous surgery on the lower urinary tract, pelvic organ prolapse over stage II, pelvic radiotherapy, use of active medication on the lower urinary tract, bladder pain syndrome/interstitial cystitis, insulin-dependent diabetes mellitus, and neurological diseases affecting the lower urinary tract.

4.1 | Voiding pattern

It has been stated in the literature that “healthy, continent and/or asymptomatic” women urinate with a measurable detrusor contraction and with a variable use of the abdominal musculature ranging from 0% to 77%.^{4,7-9} However, it should be borne in mind that the definition of both aspects varies greatly in the different studies. Both studies by Rud et al did not define detrusor contraction or the use of the abdominal musculature during voiding.^{7,8} Karam et al defined detrusor contraction as an increase of 5 cm

TABLE 2 Comparison of clinical and urodynamic characteristics between women voiding with and without DET-cont

Variable	DET-cont	No DET-cont	P value
Age, y	56.8 ± 10.8	62.2 ± 9.6	.004
Parity	2.65 ± 1.26	2.73 ± 1.28	.725
Previous hysterectomy	76.9%	77.5%	.934
Detrusor overactivity	83.8%	70.6%	.035
No urodynamic SUI	85.2%	75.6%	.224
No urodynamic SUI or ALPP ≥ 100 cm H ₂ O	81%	63.1%	.018
ALPP, cm H ₂ O	134.1 ± 44.5	115.3 ± 37.9	.022
Q _{max} , mL/s	26.02 ± 8.81	27.88 ± 11.45	.513
PVR, mL	8.63 ± 32.85	16.92 ± 58.46	.667
Voided volume, mL	407.23 ± 147.70	429.59 ± 176.24	.630

Note: Bold characters are used only to highlight significant results.

Abbreviations: ALPP, abdominal leak point pressure; DET-cont, detrusor contraction; PVR, post-void residual volume; SUI, stress urinary incontinence.

H₂O above baseline, and the use of abdominal musculature during voiding as an increase in abdominal pressure of at least 10 cm H₂O above baseline. All the asymptomatic and continent women presented detrusor contraction and 73% used the abdominal musculature during voiding. Patients with urodynamic SUI (and stable bladders) voided with detrusor contraction in 84.3% of cases and 60% of them used the abdominal musculature during voiding.⁴ In Pauwels et al study, all women (healthy, without medical history, and continent) presented an increase in detrusor pressure of at least 15 cm H₂O above baseline during voiding. The use of abdominal musculature was defined as an increase in abdominal pressure of at least 10 cm H₂O above baseline during the entire voiding phase, which occurred in 42% of cases. If this definition is considered at any time during

voiding, 77% of the patients used their abdominal muscles to void.⁹ The study by Nygaard et al that evaluated whether urethral competence affects urodynamic voiding parameters in women with pelvic organ prolapse, defined detrusor contraction as any increase in detrusor pressure during Q_{max} which makes it difficult to make comparisons. It defined the use of abdominal musculature during voiding as an increase in abdominal pressure at Q_{max} ≥ 15 cm H₂O above baseline, which occurred in 24.4% of all patients.¹⁷ Our study was able to evaluate the changes in pressure above baseline at the time of Q_{max} (point of the greatest importance in the interpretation of pressure-flow study), defining DET-cont as the increase in p_{det}Q_{max} ≥ 10 cm H₂O above baseline and ABD-strain as the increase in abdominal pressure at Q_{max} ≥ 10 cm H₂O above baseline. With these

TABLE 3 Univariate and multivariate analysis of variables associated with voiding with DET-cont (with or without ABD-strain)

Variable	P value	Odds ratio	95% CI
<i>Univariate analysis</i>			
Age ≤ 50 years	0.006	7.692	1.775-33.326
Parity ≥ 4 deliveries	0.462	0.741	0.334-1.645
Previous hysterectomy	0.934	0.964	0.416-2.234
Detrusor overactivity	0.038	2.127	1.044-4.332
No urodynamic SUI	0.230	1.866	0.673-5.168
No urodynamic SUI or ALPP ≥ 100 cm H ₂ O	0.021	2.500	1.149-5.437
Urodynamic SUI: ALPP ≥ 100 cm H ₂ O	0.041	2.307	1.034-5.148
<i>Multivariate analysis</i>			
Age ≤ 50 years	0.004	9.092	2.038-40.559
Detrusor overactivity	0.056	2.068	0.980-4.361
No urodynamic SUI or ALPP ≥ 100 cm H ₂ O	0.008	3.184	1.356-7.473

Note: Bold characters are used only to highlight significant results.

Abbreviations: ABD-strain, abdominal straining; ALPP, abdominal leak point pressure; CI, confidence interval; DET-cont, detrusor contraction; SUI, stress urinary incontinence.

TABLE 4 Voiding parameters according to the classification of patients

Variable	Q_{\max} , mL/s	$p_{\det} Q_{\max}$, cm H ₂ O	PVR, mL	Voided volume, mL	PIP ₁ , cm H ₂ O
Age, y					
≤50	26.9 ± 9.2	25.9 ± 9.3	2.3 ± 5.8	407.1 ± 149.0	52.9 ± 12.4
>50	26.2 ± 9.5	22.5 ± 11.6	12.8 ± 45.1	413.7 ± 156.3	48.8 ± 13.2
<i>P</i> value	.658	.028	.608	.862	.163
Parity					
≥4	25.4 ± 7.6	23.8 ± 11.7	11.7 ± 41.4	371.2 ± 148.1	49.2 ± 10.1
<4	26.7 ± 9.9	23.1 ± 11.1	10.1 ± 39.7	423.8 ± 154.6	49.9 ± 13.8
<i>P</i> value	.655	.518	.894	.040	.928
Previous hysterectomy					
Yes	25.5 ± 10.6	23.6 ± 13.6	22.5 ± 61.4	378.0 ± 167.4	49.2 ± 15.3
No	26.6 ± 9.1	23.2 ± 10.5	7.4 ± 31.9	421.0 ± 150.1	49.9 ± 12.5
<i>P</i> value	.436	.827	.330	.093	.809
Detrusor overactivity					
Yes	26.6 ± 9.6	25.0 ± 11.0	6.1 ± 25.8	365.9 ± 139.1	51.7 ± 12.2
No	26.1 ± 9.3	21.6 ± 11.2	14.8 ± 50.2	458.6 ± 155.6	47.7 ± 13.7
<i>P</i> value	.688	.023	.482	<.001	.056
Urodynamic SUI					
Yes	27.0 ± 9.2	22.3 ± 10.7	4.3 ± 15.4	421.0 ± 146.3	49.3 ± 12.8
No	23.7 ± 10.1	27.8 ± 12.5	11.8 ± 43.6	373.2 ± 183.6	51.6 ± 14.4
<i>P</i> value	.037	.016	.672	.063	.558

Note: Bold characters are used only to highlight significant results.

Abbreviations: PIP₁, projected isovolumetric pressure 1; PVR, post-void residual volume;

SUI, stress urinary incontinence.

definitions, in a selected group of women without voiding symptoms and with the exclusion of several factors that could alter the lower urinary tract function, we found 77.4% of voiding with DET-cont and 31.2% of voiding with ABD-strain.

It is important to highlight that on the multivariate analysis, our study found an association between voiding with DET-cont and age and the degree of the urinary sphincter competency, suggesting that the voiding pattern may vary independently with aging and with changes in the state of the urinary sphincter. To our knowledge, this is the first study to find this. The loss of significance between voiding with DET-cont and presence of detrusor overactivity (present on univariate analysis) did not appear to be related to age or state of the urinary sphincter. All this information emphasizes that for the interpretation of micturition in women different aspects must be considered.

4.2 | Voiding parameters

When comparing women with SUI symptoms (only 40% of whom had urodynamic SUI) with asymptomatic women, Lemack et al found that the former had a significantly

higher Q_{\max} and significantly lower $p_{\det}Q_{\max}$, although the voided volume was higher in women with SUI symptoms, which may have affected the Q_{\max} values.⁵ Karam et al found that women with urodynamic SUI presented weaker detrusor contractions than asymptomatic volunteer women, without reporting Q_{\max} differences or describing voided volumes. In their continent and incontinent patients, the maximum detrusor pressure ($p_{\det} \max$) did not correlate with age, parity, bladder neck mobility, or descent of the anterior vaginal wall up to or below the hymen. Premenopausal women had a significantly higher $p_{\det} \max$ than postmenopausal women.⁴ Seki et al compared their asymptomatic patients with those with SUI and found lower $p_{\det}Q_{\max}$ and lower $p_{\det} \max$, with similar Q_{\max} and voided volumes.¹⁸ In our study of women without voiding symptoms, those with urodynamic SUI presented a significantly higher Q_{\max} and a significantly lower $p_{\det}Q_{\max}$ than the rest of the patients. This result is similar to that of Lemack et al,⁵ although without significant differences in voided volume and therefore, our Q_{\max} results are more reliable. Furthermore, the $p_{\det}Q_{\max}$ were even lower in women with more severe SUI (ALPP < 100 cm H₂O). To remember, the detrusor acts as a source of energy and the bladder outlet dictates the way this energy is splitted into pressure and flow rate, following an inverse relationship

called bladder output relation.¹⁹ As proposed, SUI patients have lower urethral resistance⁶ which explains why they urinate with higher urinary flows and lower detrusor pressures. In addition, we found that women ≤ 50 years old presented significantly higher $p_{\text{det}}Q_{\text{max}}$, which may be related to the observation made by Karram et al whose premenopausal patients had significantly higher $p_{\text{det}} \text{ max}$ than postmenopausal patients.⁴

Finally, the strengths of the study are the following: (a) patients evaluated in a standardized way, (b) prospective recording of the data analyzed at the time of the examination, and (c) definitions and recommendations of ICS and IUGA¹⁰⁻¹³ were followed. The study has the following limitations: (a) retrospective, (b) symptoms obtained in a directed manner and not using a validated questionnaire (with the consequent possible bias and absence of grading), and (c) includes patients with evident filling phase abnormalities (preventing extrapolation of results to normal women).

5 | CONCLUSION

Most women without voiding symptoms presented a voiding pattern characterized by a measurable detrusor contraction of at least 10 cm H₂O above baseline, with or without the use of abdominal musculature. The statistically significant association on multivariate analysis between voiding with detrusor contraction and age and the degree of the urinary sphincter competency suggests that the voiding pattern may vary independently with aging and with changes in the state of the urinary sphincter. Although additional studies are required to define normal and abnormal voiding patterns in women, our results add relevant information to the available literature.

ORCID

Juan P. Valdevenito  <https://orcid.org/0000-0003-0052-5977>

Leandro Arribillaga  <https://orcid.org/0000-0002-0972-7383>

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