

**Can preoperative urodynamic studies predict de novo stress urinary incontinence following advanced pelvic organ prolapse surgery?**Kübra Keskin Toptas<sup>1</sup>, Mustafa Goksu<sup>2</sup>, Ozan Karadeniz<sup>3</sup>, Deniz Noyan Özlü<sup>4</sup>, Aysu Akca<sup>5</sup><sup>1</sup>Department of Gynecology and Obstetrics, Cam and Sakura City Hospital, Istanbul, Turkey; <sup>2</sup>Department of Gynecology and Obstetrics, Kanuni Sultan Suleyman Training and Research Hospital, Health Sciences University, Istanbul, Turkey; <sup>3</sup>Department of Gynecology and Obstetrics, Arnavutkoy State Hospital, Istanbul, Turkey; <sup>4</sup>Department of Urology, Bitlis State Hospital, Bitlis, Turkey; <sup>5</sup>IVF and Reproductive Genetics Centre, Memorial Sisli Hospital, Istanbul, Turkey**Cite as:** Toptas KK, Goksu M, Karadeniz O, et al. Can preoperative urodynamic studies predict de novo stress urinary incontinence following advanced pelvic organ prolapse surgery? *Can Urol Assoc J* 20205 January 14; Epub ahead of print.  
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**ABSTRACT****Introduction:** We aimed to assess the predictivity of preoperative urodynamics (UDS) on de novo stress urinary incontinence (SUI) in patients having advanced pelvic organ prolapse (POP).**Methods:** Between January 2016 and June 2019, 133 patients with symptomatic POP at stage 3 or higher were included in the study. The presence of postoperative SUI symptoms after a minimum of six months of followup was considered the primary outcome. The results of all patients' preoperative UDS were compared to their postoperative SUI symptoms. In addition, patients were divided into two groups based on whether SUI was detected during preoperative UDS testing (Group 1) or not (Group 2).**Results:** Although preoperative measurements, such as bladder capacity and residual urine volume, were not different between groups, group 1 had lower maximal urethral closure pressures ( $p=0.001$ ). Preoperative SUI symptoms had a sensitivity of 32.1% and a specificity of 91.4% for predicting de novo SUI. In patients with advanced POP, preoperative UDS had a sensitivity of 60.7% and a specificity of 87.6% for predicting de novo SUI.**Conclusions:** Urodynamic examination with a pessary can significantly predict the development of de novo SUI.

## INTRODUCTION

Pelvic organ prolapse (POP) is a group of clinical pathologies that occur when one or more pelvic organs displace downward or forward from their normal position adjacent to the vaginal vault due to pelvic floor insufficiency. Displacement-induced deviations from normal function can result in a variety of symptoms. POP has a prevalence of 3–6% when defined by symptoms, and it can be up to 50% when defined by vaginal examination.<sup>1</sup> POP surgery is performed twice as frequently as incontinence surgery, with a prevalence ranging from 6% to 18%. The annual incidence of POP surgery ranges between 1.5 and 1.8 per 1,000 women and peaks in women aged 60 to 69.<sup>2</sup>

Urinary incontinence (UI) is defined as the loss of urine that affects a woman's social life and can be objectively demonstrated.<sup>3</sup> The relationship between urinary incontinence and age is well characterized. The age-specific incidence of urinary incontinence in women under 40 is less than 2 per 1000 person-years in all current studies, but it increases with age.<sup>4</sup> Age, gender, race, smoking, childbirth, sex hormones, menopause, medications, family history, previous pelvic surgery, pelvic prolapse, obesity, and chronic constipation have all been linked to the development of urinary incontinence.<sup>3,4</sup>

UI and POP are frequently linked to gynecological issues. This is because a common factor often causes most UIs and all POPs: pelvic floor insufficiency. Bladder neck hypermobility and stress urinary incontinence (SUI) are common in women with anterior compartment prolapse attached to the anterior vaginal wall. Urethral obstruction increases as the degree of prolapse increases (stages III and IV), while symptoms of SUI decrease.<sup>5</sup>

Patients undergoing surgical correction of POP may experience urinary leakage. This is due to the prolapsed organ's support, which helps absorb the increased abdominal pressure and supports the urethra.<sup>6</sup> The loss of this support after prolapse surgery causes incontinence (de novo SUI). This study aims to see how well preoperative urodynamic testing predicts de novo SUI in patients undergoing POP surgery.

## METHODS

The Ethics Committee of the Health Sciences University Dr Sadi Konuk Training and Research Hospital approved this retrospective cohort study (approval number KAEK/2019.25.10), and we followed the Helsinki Declaration's ethical guidelines. Prior to enrollment, all patients provided written informed consent. Patient data was obtained from the electronic medical database system and retrospectively screened from January 1, 2016, to June 1, 2019. A total of 191 patients, aged between 40 and 85, who underwent POP surgery of at least 3rd-degree or higher, were identified. Patients with urge-predominant incontinence before prolapse surgery underwent preoperative urodynamic testing; those who experienced bladder injuries during surgery were excluded from the study. Additionally, patients with neurological conditions such as neurogenic bladder, Parkinson's disease, and multiple sclerosis were also excluded.

When analyzing the data of 191 patients, it was discovered that records were absent for 20 patients. These patients could not be reached for post-operation follow-up because of inaccurate or invalid information. Consequently, they were not included in the study. Additionally, 11 patients were excluded from the study due to isolated urge incontinence.

Twenty-seven patients with preoperative symptoms of SUI chose to have anti-incontinence surgery at the same time as their POP surgery. All of these patients had urodynamics testing that was consistent with SUI. In order to assess the postoperative results of preoperative urodynamics accurately excluding the 27 patients as mentioned earlier, a total of 133 patients were enrolled in the study (Figure 1).

All patients underwent preoperative procedures, including a medical history review, physical examination, complete urine analysis, urine culture, and urodynamic study. The complex cytometry method was used to evaluate the patients' urodynamics at the Kanuni Sultan Suleyman Training and Research Hospital's urodynamic laboratory. The surgeries were performed by an experienced urogynecology team, and the patients were followed by the same team in the urogynecology outpatient clinic (K.K.T, M.G, O.K, A.A). Urodynamics were also interpreted by a single urogynecologist specialized in the subject (A.A).

A total of 133 patients, aged 39 to 86, who had undergone vaginal hysterectomy, were invited to the urogynecology clinic for reevaluation 6 months to 3 years after the procedure. These patients did not have significant urge incontinence prior to the procedure and had not previously undergone anti-incontinence surgery.

Urge incontinence is defined as a complaint of involuntary loss of urine associated with urgency. SUI is defined as a complaint of involuntary leakage on effort or exertion or on sneezing or coughing.<sup>3</sup> In dorsal lithotomy, a stress test is performed by provoking incontinence with maneuvers that increase intra-abdominal pressure, such as coughing or straining, while the patient's bladder is full. Additionally, urethral hypermobility was tested by performing a Q-Tip test. In the Q-Tip test, the movement of the rod was measured during maximal straining using a sterile cotton rod. 30° and above was considered hypermobility. Following their surgery, we contacted the study participants. At the urogynecology clinic, they were asked about their experience with UI during various activities such as coughing, sneezing, standing, and lying down. Those who reported urinary leakage were classified as having postoperative de novo SUI symptoms. Patients were also asked about urge incontinence and urgency symptoms in order to classify them into SUI, urge, and mixed-type urinary incontinence subgroups based on their symptoms. Individuals having mixed incontinence belong to the category where the primary aspect of urinary leakage is apparent. The patients were examined while they were in the dorsal lithotomy position.

Prior to the procedure, all patients underwent a urodynamic examination using the multichannel urodynamic device from 'Life-Tech, Inc.' available at our clinic. Patients who had completely emptied their bladders underwent filling cystometry and urethral pressure profilometry (UPP) after undergoing pressure reduction using a pessary.

During cystometry, the infusion rate was adjusted to 30 ml/min with isotonic NaCl. The initial sensation (ml), bladder capacity (ml), and compliance (ml/cm H<sub>2</sub>O) were noted during bladder filling. Uninhibited detrusor contractions above 15 cm H<sub>2</sub>O during filling were identified. Simultaneously, the presence of urinary leakage with increasing severity during coughing and straining was observed. If leakage occurred, the urinary leakage pressure (cm H<sub>2</sub>O VLPP) value was recorded using the Valsalva maneuver.

A static UPP was utilized to measure functional urethral length and maximum urethral closure pressure (MUCP). In our study, normal urodynamics was defined as a VLPP greater than 150 cm H<sub>2</sub>O with no involuntary detrusor contractions. A VLPP of 100 cm H<sub>2</sub>O or higher was defined as SUI caused by proximal urethral hypermobility. Conversely, SUI due to intrinsic sphincter deficiency was indicated when VLPP was below 60 cm H<sub>2</sub>O. If VLPP was between 60 and 100 cm H<sub>2</sub>O, it was assumed that both proximal urethral hypermobility and intrinsic sphincter deficiency contributed to the pathology.

Detrusor instability is an involuntary phasic contraction of the detrusor muscle (>15 cm H<sub>2</sub>O) accompanied by a sense of urgency or urinary leakage.

The SPSS (Statistical Package for Social Sciences) for Windows 20.0 program was utilized for statistical analysis in evaluating the study findings. Descriptive statistical methods (mean, standard deviation, and frequency) were employed to assess the study data. The student's T-test was used to compare parameters with a normal distribution between the two groups, while the Mann-Whitney U test was utilized for parameters without a normal distribution. The Spearman correlation test was employed to examine the relationships between parameters, and the Chi-square test was used to compare qualitative data. Preoperative SUI symptoms were correlated with preoperative urodynamics and postoperative SUI symptoms. The results were assessed with a 95% confidence interval and a significance level of  $p < 0$ .

## RESULTS

The study retrospectively analyzed the demographics and patient characteristics of 133 individuals who had POP surgery from January 2016 to June 2019. The parameters include age, gravidity, parity, body mass index, mode of delivery, history of previous surgery, surgical indication, postoperative hospital stay, and preoperative urinary incontinence.

Patients were divided into groups based on preoperative UI (solely SUI or mixed incontinence with SUI predominance). Information regarding preoperative incontinence surgery was provided to 18 patients with evident incontinence, but they declined the intervention. The number of patients with occult SUI (SUI observed after reduction with a pessary) was found to be 16. Both clinical and urodynamic evaluations were negative for 99 patients.

The demographic and clinical characteristics of the patients included in the study are presented in Table 1. When examining the demographic and clinical characteristics based on patients' preoperative urodynamic results, no significant differences were observed in terms of age, gravida, parity, menopausal status, and length of hospital stay between the groups (Table 2). In the preoperative urodynamic assessment, patients without observed SUI had lower BMIs. ( $30.7 \pm 3.6$  vs  $29.1 \pm 3.8$ ,  $p = 0.04$ ) Additionally, when comparing the time intervals for patients called for postoperative follow-up, the average duration for the 30 patients with preoperative stress urinary incontinence (SUI+) was 15.8 months, while the average duration for the 103 patients without SUI (SUI-) was 12.4 months, revealing a significant difference between the groups ( $p = 0.01$ ).

Patients with preoperative SUI have statistically significantly lower MUCP (mmHg) compared to those without SUI ( $p < 0.01$ ). However, no differences were observed in mean bladder capacities and residual urine volumes between the groups (Table 3).

The prediction of postoperative de novo SUI based on preoperative SUI symptoms showed a specificity of 91.4%, indicating a high ability to identify the symptom-free group. Similarly, the specificity of the urodynamic assessment was 87.6%. However, the sensitivity of preoperative symptom presence in predicting postoperative de novo SUI was considerably low at 32.1%, and urodynamic sensitivity was found to be 60.7% (Table 4).

When preoperative SUI symptoms and preoperative urodynamic findings are correlated with postoperative de novo SUI symptoms, a weak association with preoperative SUI symptoms is observed (Table 5). However, there is a moderately significant correlation with preoperative urodynamic findings.

## DISCUSSION

Lower urinary tract symptoms are often associated with POP. The utilization of urodynamics before POP surgery varies considerably.<sup>3,7-9</sup> The main objective of this retrospective cohort study is to assess the importance of preoperative urodynamics in the evaluation, treatment, and monitoring of women who undergo POP surgery. Our findings indicate that preoperative urodynamics can predict postoperative de novo SUI with a sensitivity of 60.7% and a specificity of 87.6%.

Previous studies in the literature have reported higher sensitivity, specificity, PPV, and NPV for the predictivity of urodynamics.<sup>10</sup> This could be attributed to the patients' lack of pelvic organ prolapse in those studies, as well as the comparison of definitive diagnoses based on abstract diagnoses made by doctors at the same hospital. We believe that the effects of prolapse on the vagina and bladder, the extent of improvement in postoperative cystocele, and age-related changes all influence the diagnostic accuracy of preoperative urodynamics, even after reduction with a pessary.

Around 20–30% (increasing to 80%) of patients who are continent and have occult SUI before pelvic organ prolapse surgery may experience incontinence even after the operation.<sup>11,12</sup> In our study, we identified 18 cases (13.5%) of SUI and 16 cases (12%) of occult SUI. These numbers are consistent with the existing literature. In the postoperative period, it was observed that 28 out of 34 patients continued to experience symptoms of SUI, while 6 patients did not. Determining whether simultaneous prophylactic anti-incontinence surgery for SUI should be added or not will be guided by urodynamic evaluation, along with informing patients about the possibility of SUI after prolapse surgery.

The role of urodynamic evaluation in the preoperative assessment of patients with pelvic organ prolapse is significant. Performing a urodynamic evaluation before correcting prolapse in patients is important, and then proceeding with correcting prolapse using a suitable pessary is crucial.

Although patients with POP rarely complain of SUI, some of these women may have SUI but remain clinically continent.<sup>13,14</sup> This is because the bladder's kinking effect on the urethra due to a wide cystocele defect and the bladder's ability to absorb and support part of the increased intraabdominal pressure act as a cushion, maintaining continence. As a result,

the pressure in the urethra is higher than the pressure in the bladder, which ensures continence.

In 2011, The American College of Obstetricians and Gynecologists reported that there is limited data available for performing urodynamic testing before POP surgery.<sup>15</sup> Recently, a systematic review stated in its summary that urodynamics should be utilized in the clinical management of UI in adults. However, there is still insufficient evidence to support improved clinical outcomes.<sup>16</sup> This is because female lower urinary tract management is difficult.<sup>17</sup> The translation of theoretical knowledge into clinical application of these fundamental deficiencies is difficult due to uncertainty about the etiology of SUI, whether it is caused by an anatomical disorder or an intrinsic factor in the urethra.<sup>18</sup>

According to the International Continence Society (ICS), the urodynamic test can provide clinicians with objective information in cases of recurrent lower urinary tract symptoms.<sup>19</sup> It has been observed that during urodynamic interpretations by the ICS, there is an 80% agreement among experts in the diagnosis. However, Van Leijssen and colleagues stated in their study that urodynamics alone is insufficient to predict UI.<sup>20</sup> This situation may be attributed to the differences in urodynamic characteristics across different centers. Furthermore, these studies included patients with urge incontinence who frequently take anticholinergic drugs before surgery, and their bladder function may be impacted by these medications, potentially influencing the results of the studies. We did not include patients with urge incontinence in our study, which might have influenced the precision of urodynamics.

Hextall et al. conducted tests using vaginal pessaries on patients with POP to provoke incontinence. Before undergoing prolapse surgery, urodynamic testing was scheduled for these women. The results indicated that 19 out of 70 patients had evidence of SUI. The authors emphasized the high sensitivity of urodynamics in detecting SUI, supporting its use before POP surgery.<sup>21</sup>

Patients undergoing POP surgery were subjected to preoperative and postoperative urodynamic examinations in a study conducted by Stanton SL et al. Urodynamic data revealed no notable change. The occurrence of detrusor instability and voiding challenges did not escalate.<sup>22</sup> In our study, we only conducted preoperative urodynamics on patients and compared them with postoperative symptomatic outcomes.

In 50% of women with POP who do not report SUI, there is hidden SUI. Patients with prolapse often exhibit urethral hypermobility due to pelvic floor insufficiency, and sphincteric insufficiency is frequently present.<sup>23</sup> Despite this, if the urethra is well supported by the prolapsed organ, incontinence can be prevented. However, after surgical correction of prolapse, incontinence may occur in patients. In this study, we investigated the postoperative clinical assessment of patients who had undergone prolapse surgery with preoperative urodynamics. We excluded patients who had undergone anti-incontinence surgery and those with urge incontinence. The aim was to determine the correlation between urodynamics and postoperative clinical findings.

The decision not to perform postoperative urodynamics was based on the study's retrospective nature and cost-effectiveness considerations. However, the most important

limitation of our study is its retrospective nature. Other important limitations are that SUI symptoms are not classified according to their severity and that their effect on quality of life (QoL) is not examined in patients who develop de novo SUI.

The higher number of patients in our study may have contributed to the increased significance of urodynamic assessments. Additionally, it could be related to the specific urodynamic method employed in our clinic. However, relying solely on urodynamic studies to decide for surgery can sometimes result in excessive treatment. Voiding dysfunction and detrusor overactivity are the key factors to consider in this regard.<sup>24</sup> In our study, MUCP was examined, but it should also be noted that the diagnostic accuracy of urethral pressure profilometry measurement in SUI is generally poor.<sup>6</sup> Since our study involved a retrospective review of data, no anti-incontinence surgery was performed simultaneously with the POP surgery. Additionally, patients who underwent anti-incontinence surgery were excluded from our study. In addition to the study we performed, incorporating postoperative urodynamics enables the comparison of urodynamics with postoperative symptoms. Its sensitivity can be enhanced by utilizing more advanced techniques in performing urodynamics, making it a valuable direct diagnostic test.

## CONCLUSIONS

History and physical examination are insufficient to determine the type of incontinence and to select the appropriate medical or surgical treatment. As highlighted in numerous literature studies, a urodynamic evaluation is necessary for a precise diagnosis. In this study, we excluded patients who underwent urodynamics before prolapse surgery, patients who underwent anti-incontinence surgery, and patients with urge incontinence and made a postoperative clinical evaluation of the patients to see whether the urodynamics were compatible with the postoperative clinic. In our data, the postoperative SUI prediction sensitivity of preoperative urodynamics was found to be 60.7% and its specificity was 87.6%. This shows us that urodynamic examination with a pessary can significantly predict the development of de novo SUI.

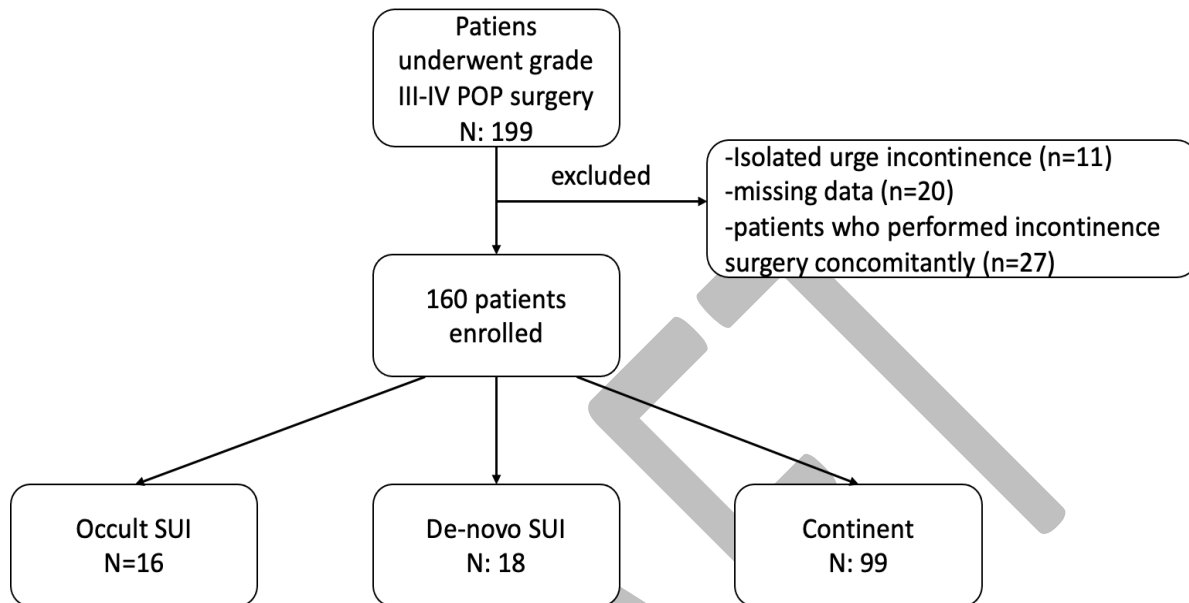
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## FIGURES AND TABLES

**Figure 1.** Flow chart diagram for patient selection and allocation. POP: pelvic organ prolapse; SUI: stress urinary incontinence.**Table 1. Demographic and clinical characteristics of patients**

Demographics	Allocated patients (N=133)
Age	62.2±9.4 (39–86)
Gravida	4.8±2.2 (1–12)
Parity	3.6±1.8 (1–11)
BMI	29.5±3.8 (19.1–38.4)
Menopause status, n (%)	
Premenopausal	31 (23.3)
Postmenopausal	102 (76.6)
Route of previous delivery, n (%)	
Vaginal	124 (93.2)
C/S	2 (1.5)
Vaginal + C/S	7 (5.2)
Indications for surgery, n (%)	
Descensus uteri + cystorectocele	121 (91)
Descensus uteri+ cystocele	12 (9)
Performed surgical procedures	
VAH + CA	15 (11.2)
VAH + CAP	60 (45.1)

VAH + CAP + SSF	57 (42.8)
VAH + colpocleisis	1 (0.8)
Hospitalization (days)	3.7±0.9
Postoperative followup (months)	13.3±6.6
Preoperative urinary incontinence:	
No SUI	99 (74.4)
Occult SUI	16 (12)
SUI	18 (13.5)

BMI: body mass index; CA: anterior colporrhaphy; CAP: anterior-posterior colporrhaphy; C/S: Cesarean section; SSF: sacrospinous fixation; SUI: stress urinary incontinence; VAH: vaginal hysterectomy.

Parameters	Detection of SUI during preoperative urodynamics		p
	Yes (n=30) Group 1	No (n=103) Group 2	
Age, mean ± SD	62.4±9.2	61.9±9.7	0.79
Gravity, mean ± SD	5.3±2.6	4.7±2.0	0.20
Parity, mean ± SD	3.4±1.9	3.6±1.7	0.63
BMI, mean ± SD	30.7±3.6	29.1±3.8	<b>0.04</b>
Postmenopausal patients, n (%)	24 (80)	78 (75)	0.62
Hospitalization* (days), mean ± SD	3.6±1.0	3.6±0.9	0.53
Postoperative followup* (months), mean ± SD	15.8±7.5	12.4±6.1	<b>0.01</b>

Bold values indicate statistical significance; BMI: body mass index; SD: standard deviation; SUI: stress urinary incontinence.

<b>Table 3. Comparison of urodynamic parameters in patients with and without preoperatively detected SUI</b>			
<b>Parameters</b>	<b>SUI detection during preoperative urodynamics</b>		<b>p</b>
	<b>Yes (n=30) Group 1</b>	<b>No (n=103) Group 2</b>	
Bladder capacity (ml), mean $\pm$ SD	472.5 $\pm$ 56	483.6 $\pm$ 49	0.29
MUCP (mmHg), mean $\pm$ SD	60.8 $\pm$ 26	77.3 $\pm$ 23	<b>0.001</b>
Residual urine volume (ml), mean $\pm$ SD	7.8 $\pm$ 28.6	11.0 $\pm$ 41	0.63

Bold values indicate statistical significance. MUCP: maximal urethral closure pressure; SD: standard deviation; SUI: stress urinary incontinence.

<b>Table 4. The diagnostic value of preoperative urodynamic assessment and the presence of preoperative symptoms in de novo SUI</b>		
	<b>De novo SUI prediction</b>	
	<b>Preoperative symptoms</b>	<b>Urodynamics</b>
Sensitivity	32.1%	60.7%
Spesifity	91.4%	87.6%
PPD	50%	56.6%
NPD	83.4%	83.4%

NPD: negative predictive value; PPD: positive predictive value; SUI: stress urinary incontinence

<b>Table 5. Correlation between de-novo SUI symptoms and preoperative urodynamic findings and symptoms</b>			
	<b>De novo SUI symptoms</b>		<b>Confidence interval</b>
	<b>R</b>	<b>p</b>	
Preoperative urodynamic SUI	0.49	<0.001	0.34–0.60
Preoperative SUI symptoms	0.31	<0.001	0.15–0.45

SUI: stress urinary incontinence.

DRAFT