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Detrusor underactivity and complicated stress urinary incontinence: a cross-data study

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Introduction It is still uncertain whether detrusor underactivity (DUA) influences the outcomes of women undergoing surgery for stress urinary incontinence (SUI). Even less evidence is available about women with complicated stress urinary incontinence (C-SUI). The aim of the study was to assess outcomes of middle urethral sling (MUS) placement according to the type of SUI, and the impact of DUA on uncomplicated SUI (U-SUI) and C-SUI functional and surgical results.

Material and methods The study was conducted among patients undergoing MUS. The population was divided into 4 groups: 1: C-SUI with DUA; 2: C-SUI without DUA; 3: U-SUI with DUA; and 4: U-SUI without DUA. Women were qualified for the DUA group if they met one of the Jeong, Abarbanel and Marcus, BVE, and PIP1 Griffiths criteria. Post-operative functional outcomes and differences in POUR rate, de novo overactive bladder syndrome (OAB), and SUI recurrence were examined.

Results 142 women took part in the study, of whom 97 completed the 2-year follow-up. DUA was found in 54.6% (53/97) of patients. C-SUI was prevalent also in the no-DUA group (59.1%). Post-operative ICIQ-FLUTS improved more in the no-DUA patients compared to the DUA women. Post-operative Qmax was statistically significant higher the in no-DUA than in the DUA population. After surgery, neither the PVR nor the PVR ratio differed in the DUA and the no-DUA patients. C-SUI and U-SUI patients showed a POUR rate of 15.6%–12.1%, de novo OAB 12.5%–3%, tape incision 3.1%–3%, and SUI recurrence 4.6%–3%, respectively.

Conclusions The impact of pre-operative DUA on the outcomes of patients undergoing MUS was negligible, even in C-SUI cases. DUA women with SUI, even if complicated, should not be excluded from this kind of surgery.

Key Words: urodynamics ‹› detrusor underactivity ‹› complicated stress urinary incontinence ‹› uncomplicated stress urinary incontinence ‹› middle urethral sling

INTRODUCTION

Stress urinary incontinence (SUI) is the complaint of involuntary loss of urine with physical exertion or other activities that cause a rise in intra-abdominal pressure [1]. The incidence of SUI is estimated at 3%, with the main risk factors being age, ethnicity, and body mass index (BMI) [2]. Other factors related to SUI are parity and previous hysterectomy or pelvic surgery.

SUI can be divided into uncomplicated (U-SUI) and complicated (C-SUI), which is generally related to lower urinary tract dysfunction. Complicated SUI is a clinical diagnosis involving the association with disorders, comorbidities, and previous surgery or radiotherapy of the pelvic area or the lower urinary tract. Also, patients not naïve for SUI surgery are considered as C-SUI. Women reporting only SUI and with no associated disorders of the pelvic area and lower urinary tract a history are defined as U-SUI. However, C-SUI can be defined in multiple ways; the American Urological Association guidelines, for example, discern index patients, otherwise

healthy females who are candidate for surgery for SUI, from non-index patients, in whom SUI is associated with other lower urinary symptoms, pelvic organ prolapse, or previous pelvic surgery [3]. According to the International Continence Society (ICS), women affected by C-SUI are those who underwent previous surgery for incontinence, prior extensive pelvic surgery, or pelvic irradiation, have suspected urinary fistula or suffer from pain, haematuria, recurrent infection, or statistically significant voiding symptoms. Patients who do not fall into these categories are labelled as affected by U-SUI [1]. Currently, the most frequent surgical procedure for female SUI is mid-urethral sling (MUS) where available [4]. The MUS subjective cure rate has been reported up to 98%, depending on the definition of success, the modality of follow-up (telephone follow-up, objective or subjective success rate, follow-up duration), the route of insertion, and the cohort under study [5, 6, 7]. Even though slightly worse outcomes have been observed among the C-SUI population [8], MUS positioning is recommended for either type of SUI.

Preoperative invasive urodynamics (UD) is not routinely recommended in U-SUI patients, after several RCTs showed its irrelevance in terms of surgical outcomes in this population [3, 4, 9–12]. On the contrary, there is still general consensus on routinely performing UD in C-SUI patients.

Detrusor underactivity (DUA) is defined by the ICS as detrusor contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or failure to achieve complete bladder emptying within a normal time span [1]. The definition relies on UD, even though it lacks standardized parameters. Moreover, the broad range of symptoms that can be observed in this condition makes it difficult to delineate a pathognomonic clinical sign of DUA. Underactive bladder syndrome (UAB) was recently referred to as a clinical syndrome correlated with DUA [13]. This definition is accepted by the ICS, even though it is insufficient to confidently recognize detrusor underactivity from a clinical point of view. Thus, the diagnosis remains challenging, and its true incidence still uncertain. To overcome this issue different urodynamic criteria have been proposed. The most used are those by Jeong et al. [14], Abarbanel and Marcus [15], the BVE criteria [16], and Griffiths-PIP1 [17]. These criteria rely on different thresholds and are thus unsuitable for a homogeneous and unique definition of DUA.

To date, it is uncertain whether DUA influences the outcomes of women undergoing surgery for SUI, given the lack of published data [18, 19]. Even less evidence is available of what concerns women affected by C-SUI.

C-SUI and DUA are recognized as potential conditions affecting MUS results; however, available studies have assessed these factors only separately, not analysing the relationship between C-SUI and DUA and the potential impact of DUA on the results of the type of SUI [18, 19, 20]. Our research aimed to clarify the influence of each of these conditions – the type of SUI and detrusor impairment – on MUS positioning. Therefore, the purpose of this study was to assess outcomes of MUS placement according to the type of SUI (U-SUI versus C-SUI) and the impact of DUA on U-SUI and C-SUI functional and surgical results.

MATERIAL AND METHODS

This was a prospective study including women who underwent surgery for SUI from January 2015 to January 2019 at a tertiary high-volume referral centre. Female patients aged 18 years or older diagnosed with SUI, who chose to undergo trans-obturator MUS (in-out) implantation, naïve or not for SUI surgery, with or without pelvic organ prolapse were included. Exclusion criteria were inability to sign informed consent, fixed urethra and neurogenic bladder as spinal cord injury, multiple sclerosis, Parkinson's disease and major central and spinal cord neurogenic disorders, and missing objective evaluation at follow-up. After adequate counselling, patients were offered the MUS procedure as the first-choice treatment. Informed consent for the surgical procedure and for participation in the study was collected from each patient. All surgical procedures were performed by 2 skilled surgeons (M.B. and E.R.).

Pre-operative evaluation included medical history, physical examination, and UD according to Good Urodynamic Practice [21]. Furthermore, the ICIQ-FLUTS questionnaire was administered to each patient [22]. Women were affected by DUA if they belonged to at least one of the categories defined by Jeong [14], Abarbanel and Marcus [15], BVE [16], and PIP1 Griffiths criteria [17].

Afterward, the population was divided into 4 groups depending on the presence of DUA and the kind of SUI: 1: C-SUI with DUA; 2: C-SUI without DUA; 3: U-SUI with DUA; and 4: U-SUI without DUA. The bladder catheter was removed 24 hours after surgery and three consecutive bladder scan testing were performed before discharge. Due to the lack of accepted standardized definition of post-operative urinary retention (POUR), we considered it as the occurrence of PVR ≥200 ml in ≥2 evaluations. This definition is among the most accepted and reported in the literature [23, 24]. Treatment options for POUR were clean intermittent catheterization

(CIC) or indwelling catheter (IC) depending on the patient's choice. In the case of persistent POUR (>30 days), tape incision or persistent catheterization were proposed after adequate counselling. Success of the intervention was defined as negative stress tests at 250–300 ml repletion in supine and standing position by coughing and Valsalva manoeuvres.

Follow-ups were scheduled at 3, 6, and 12 months and then annually, by office evaluation including physical examination, UF, ICIQ-FLUTS, PVR, and PVR ratio. All patients reached at least 2 years of follow-up. Post-operative functional outcomes and the differences between the 2 SUI populations were investigated. We also evaluated differences in the following: POUR rate, de novo overactive bladder syndrome (OAB), and SUI recurrence.

Student's T-test for continuous parametric variables and Pearson's chi-squared test for independent variables were used for statistical analysis.

Ethical standards were performed according to the 1964 Declaration of Helsinki and its later amendments. Informed consent was obtained before enrolment in the study. The Local Ethics Committee for Clinical Trials (CESC) determined that approval for this investigation was unnecessary because it only involved standard clinical practice. This research was registered in the clinical audit in our hospital.

RESULTS

A total of 193 women underwent MUS positioning, of whom 142 were eligible for this study and 97 completed the 2-year follow-up. The C-SUI group comprised 64 patients (66%), while the remaining 33 (34%) women showed a U-SUI. DUA was found in 54.6% (53/97) of patients; most of them (71.7%) suffered from C-SUI. C-SUI was the prevalent form of incontinence in patients without DUA (59.1%), as well (table 1). Table 2 reports pre-operative and post-operative data for females with C-SUI, while table 3 shows data for U-SUI. The mean age was 63.6 ±9.6 for patients with DUA and 59.5 ±11.1 for patients without DUA.

C-SUI and U-SUI groups showed de novo OAB 12.5% and 3%, tape incision 3.1% and 3%, and SUI recurrence 4.6% and 3%, respectively. No statistically significant difference was observed between the above data between the C-SUI and U-SUI groups.

Women with C-SUI showed a mean pre-operative ICIQ-FLUTS of 84.9 ±24.2 in DUA patients, and 79 ±24.7 in the no-DUA population (p = 0.3). Conversely, U-SUI patients reported an ICIQ-FLUTS of 77.5 ± 27.9 and 78 ± 23.8 for the DUA and no-DUA groups, respectively (p = 0.9). Mean pre-operative Qmax was statistically significantly higher among the no-DUA population compared to the DUA population, either if affected by complicated or uncomplicated SUI. The pre-operative PVR and PVR ratio did not statistically significant differ in both sub-groups of SUI.

Post-operative ICIQ-FLUTS improved more in the no-DUA patients than in the DUA women, but without statistical significance. Furthermore, post-operative urinary symptoms, assessed with ICIQ-FLUTS scores, did not statistically significantly differ according to SUI type. Post-operative Qmax was statistically significantly higher in the no-DUA than in the DUA population. After surgery, neither PVR nor PVR ratio differed statistically significantly in the DUA and no-DUA populations, in both study arms. Moreover, there was no statistically significant difference in terms of bladder emptying features (Qmax and PVR) between the C-SUI and U-SUI groups.

The POUR rate was slightly higher in the C-SUI group (15.6%), in which we observed 10/64 cases. Six of these episodes happened in patients with DUA. However, in women with U-SUI we registered a mean POUR rate of 12.1%, and all of them had pre-operative DUA. Nevertheless, there was

Table 1. *Data stratified according to type of stress urinary incontinence and detrusor contractility*

	C-SUI, n = 64 (66%)		U-SUI, n = 33 (34%)	
	DUA	No DUA	DUA	No DUA
N, %	38 (59.4%)	26 (40.6%)	15 (45.9%)	18 (54.5%)
Age (mean, SD)	63.6 (±9.4)	61 (±10.7)	63.8 (±9.9)	60 (±11.3)
	DUA, n = 53 (54.6%)		No DUA, n = 44 (45.4%)	
	C-SUI	U-SUI	C-SUI	U-SUI
N, %	38 (71.7%)	15 (28.3%)	26 (59.1%)	18 (40.9%)
Age (mean, SD)	63.6 (±9.4)	63.8 (±9.9)	61 (±10.7)	60 (±11.3)

C-SUI – complicated stress urinary incontinence; U-SUI – uncomplicated stress urinary incontinence; DUA – detrusor underactivity; No DUA – no detrusor underactivity; SD – standard deviation.

Table 2. *Functional and surgical data of complicated stress urinary incontinence patients with and without detrusor underactivity*

	Pre-operative			Post-operative		
	DUA	NO DUA	p-value	DUA	NO DUA	p-value
ICIQ-FLUTS	84.9 ±24.2 84.9 ±24.2	79 ±24.7 79 ±24.7	0.3	26.3 ±25.4 26.3 ±25.4	16 ±24.3 16 ±24.3	0.1 <0.05 <0.05
Q Max	12.2 ±4.9 12.2 ±4.9	21.1 ±8.2 21.1 ±8.2	<0.05	16.7 ±4.7 16.7 ±4.7	23.4 ±5.9 23.4 ±5.9	<0.05 <0.05 0.2
PVR	92.3 ±134.2 92.3 ±134.2	56.9 ±119.9 56.9 ±119.9	0.2	27.1 ±55.9 27.1 ±55.9	30.9 ±47.5 30.9 ±47.5	0.7 <0.05 0.2
PVR ratio	0.08 ±0.1 0.08 ±0.1	0.09 ±0.1 0.09 ±0.1	0.7	0.08 ±0.1 0.08 ±0.1	0.09 ±0.1 0.09 ±0.1	0.7 1 0.4
POUR				6/38 (15.8%)	4/26 (15.4%)	0.7
CIC duration (days)				3/38 (7.9%) 8.8 ±49.3	1/26 (3.8%) 0.2 ±1.4	0.9 0.3
Indwelling catheter duration (days)				4/38 (10.5%) 0.8 ±2.3	4/26 (15.4%) 2.1 ±6.3	0.9 0.2
Tape incision				1/38 (2.6%)	1/26 (3.8%)	0.6
De novo OAB				4/38 (10.5%)	4/26 (15.4%)	0.9
Recurrence SUI				2/38 (5.2%)	1/26 (3.8%)	0.7

DUA – detrusor underactivity; No DUA – no detrusor underactivity; PVR – post-void residual; POUR – postoperative urinary retention; CIC – clean intermittent catheterization; OAB – overactive bladder syndrome, SUI – stress urinary incontinence.

Table 3. *Functional and surgical data of uncomplicated stress urinary incontinence patients with and without detrusor underactivity*

	Preoperative			Postoperative		
	DUA	NO DUA	p-value	DUA	NO DUA	p-value
ICIQ-FLUTS	77.5 ±27.9 77.5 ±27.9	78 ±23.8 78 ±23.8	0.9	20.2 ±14.8 20.2 ±14.8	11.4 ±26.8 11.4 ±26.8	0.2 <0.05 <0.05
Q Max	12.7 ±4.6 12.7 ±4.6	22.4 ±5.3 22.4 ±5.3	<0.05	14.4 ±7.2 14.4 ±7.2	21.1 ±6.3 21.1 ±6.3	<0.05 0.4 0.5
PVR	18.6 ±38.9 18.6 ±38.9	13.3 ±29.5 13.3 ±29.5	0.6	24.1 ±39.2 24.1 ±39.2	23.8 ±32.5 23.8 ±32.5	0.9 0.7 0.3
PVR ratio	0.07 ±0.1 0.07 ±0.1	0.04 ±0.1 0.04 ±0.1	0.4	0.03 ±0.8 0.03 ±0.8	0.09 ±0.1 0.09 ±0.1	0.07 0.2 0.1
POUR				4/15 (26.6%)	0/18 (0%)	0.1
CIC duration (days)				2/15 (13.3%) 4 ±10.5	0/18 (0%)	0.4 0.1
Indwelling catheter duration (days)				2/15 (13.3%) 0.8 ±2.6	0/18 (0%)	0.4 0.2
Tape incision				0/15 (0%)	1/18 (5.5%)	0.9
de novo OAB				0/15 (0%)	1/18 (5.5%)	0.9
Recurrence SUI				0/15 (0%)	1/18 (5.5%)	0.9

DUA – detrusor underactivity; No DUA – no detrusor underactivity; PVR – post-void residual; POUR – postoperative urinary retention; CIC – clean intermittent catheterization; OAB – overactive bladder syndrome, SUI – stress urinary incontinence

no statistically significant difference among POUR rate, POUR treatment (CIC or indwelling catheter), and duration of bladder drainage between the DUA and no-DUA groups despite the sub-group of SUI.
We observed a mean tape incision rate of 3.1% and 3% in C-SUI and U-SUI patients, respectively.
Regarding de novo OAB and SUI recurrence, we did not find differences in the C-SUI and U-SUI groups despite detrusor contractility status, with a de novo OAB rate of 12.5% and 3% and a SUI recurrence rate of 4.6 and 3%, respectively.

DISCUSSION

Overall, the C-SUI group did not have inferior results to the U-SUI group, showing that the type of SUI based on clinical features had no relevant influence on surgical complications and success rates.
Post-operative voiding complications, POUR, and bladder emptying function did not statistically significantly differ, according to clinical and urodinamically demonstrated C-SUI or U-SUI. The success rate was high in both groups. However, the observation of a 4-fold higher rate of de novo OAB in C-SUI highlights the importance of adequate counselling in this subgroup of patients about this potential complication.
To our knowledge, this is the first study to cross-reference data on detrusor contractility, SUI, and outcomes after SUI surgery. DUA did not influence results and patients' satisfaction after MUS implantation. Interestingly, in the C-SUI group the DUA and no-DUA patients experienced almost the same number of post-operative voiding complications. Conversely, in the U-SUI group, the POUR rate was 4 times higher in patients with DUA. A possible explication was that in the 'U-SUI and DUA' subgroup, detrusor impairment was the only pathological condition of the lower urinary tract and pelvic area, while C-SUI can be associated with multiple other conditions affecting the lower urinary tract. Therefore, it is likely that detrusor impairment was more impactful on POUR in the 'U-SUI and DUA' subgroup than in the 'C-SUI and DUA' subgroup.
Based on these findings, DUA should neither be a contraindication nor a limitation to SUI surgery, regardless of SUI type, and C-SUI patients with DUA should also be considered good candidates for this treatment. Due to the lack of previous reports on the occurrence of complicated or uncomplicated SUI and the relationship between DUA and the kind of SUI, our new data are relevant to the scientific community. Different studies showed that DUA could be related to a prolonged return to normal voiding and higher post-operative urinary complications [19, 25]. Others found that preoperative Pdet/Qmax [18] or Qmax [20] could be predictive factors of a negative effect of DUA on SUI surgical outcomes. However, the lack of correlation between DUA and the type of SUI did not allow an assessment of whether DUA or C-SUI affected the voiding complications. Our data highlight that, regardless the category of SUI, the MUS outcomes were successful. DUA can exert its negative influence on the POUR rate, mostly in U-SUI women rather than in C-SUI. Thus, our study showed that neither the type of SUI, nor the detrusor impairment can be identified as negative predictive factors for surgical outcomes of MUS.
A limitation of our study was that all patients underwent transobturator MUS. Thus, we did not investigate the effect of retropubic route MUS on complicated and uncomplicated SUI. Another limitation is the sample size, which did not allow for a high number of events, such as POUR. The observed trend of a higher number of POUR episodes in patients with DUA could have been confirmed with a higher number of patients. This limitation did not affect the validity of our finding because each episode was transient.

CONCLUSIONS

Our data showed that the impact of pre-operative DUA on outcomes of patients undergoing MUS was negligible, even in C-SUI cases. DUA women with SUI, even if complicated, should not be excluded from this surgical treatment.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

ETHICAL STANDARDS

Ethical standards were performed according to the 1964 Declaration of Helsinki and its later amendments.
Local institutional review board and ethics committee (A.O.U.I Verona, dept. of Urology, University of Verona) approvals were obtained.
The Local Ethics Committee for Clinical Trials (CESC) determined that approval for this investigation was unnecessary because it only involved standard clinical practice. The study is not a clinical trial; therefore, the registration number is not reported. The data of the study are available. Informed consent was acquired from all enrolled patients before inclusion in the study. There is no material reproduced from other sources. There is no source of extra-institutional funding from commercial sources.

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