Review

Storage symptoms after surgical treatment of stress urinary incontinence in women: a clinical review

Tom Marcelissen¹, Tanja Hüsch², Tiago Antunes-Lopes³, Bogdan Geavlete⁴, Malte Rieken⁵, Jean Nicolas Cornu⁶, Mohammad Sajjad Rahnama’i⁷*, European Association of Urology (EAU) Young Academic Urologists (YAU) Functional Urology Working Group

¹Department of Urology, Maastricht University Medical Centre, 6229 Maastricht, The Netherlands
²Department of Urology and Pediatric Urology, University Medical Center of Johannes Gutenberg-University, 55131 Mainz, Germany
³Department of Urology, Centro Hospitalar São João, Faculty of Medicine of Porto University, 4200-319 Porto, Portugal
⁴Department of Urology, Saint John Emergency Clinical Hospital, 030171 Bucharest, Romania
⁵Faculty of Medicine, University of Basel, 4051 Basel, Switzerland
⁶Service d’urologie, CHU de Rouen, 76000 Rouen, France
⁷Department of Urology, University Hospital Aachen RWTH, 52074 Aachen, Germany

*Correspondence: sajjad_r@yahoo.com (Mohammad Sajjad Rahnama’i)

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Abstract

Objectives: Minimally invasive sling procedures for the treatment of stress urinary incontinence has gained a topic of great interest for the last decades. However, postoperative storage symptoms after sling implantation or conventional surgical techniques are one of the most distressing complications which can significantly impair quality of life. The current review aims to focus on the development of storage symptoms after surgical treatment in comparison of different surgical techniques. Mechanism: A narrative review has been performed to identify literature reporting the incidence of storage symptoms after female stress urinary incontinence surgery. The results of systematic reviews and meta-analysis have been included in this review. Findings in brief: Pubovaginal slings have a higher risk for developing storage symptoms. In contrast, standard midurethral slings (SMUS) and colposuspensions demonstrate comparable rates of postoperative storage symptoms. Regarding SMUS, the surgical route did not demonstrate significant differences in storage symptoms. In comparison between SIMS and SMUS, no significant difference of postoperative storage symptoms could be identified. Conclusions: Pubovaginal slings have the highest risk for postoperative storage symptoms in comparison to colposuspension and SMUS and SIMS. Furthermore, surgical technique and misplacement of sling may contribute significantly in the development of postoperative storage symptoms.

Keywords: Synthetic midurethral sling; Single-incision mini-sling; Storage symptom; Stress urinary incontinence; Lower urinary tract symptoms

1. Introduction

Stress urinary incontinence (SUI) is a bothersome symptom that can have a serious impact on social and psychological well-being [1]. When conservative management with pelvic floor training fails, surgical treatment can be considered. Several surgical procedures have been proposed for the treatment of SUI. Although these procedures are often effective for the resolution of stress incontinence, storage symptoms including urgency and urgency urinary incontinence (UUI) occur frequently after surgery [2]. Patients with mixed urinary incontinence (MUI) can experience persistence or even aggravation of overactive bladder (OAB) symptoms, whereas patient with pure SUI can develop de novo urgency. Potentially reversible causes such as infection, bladder outlet obstruction (BOO), and foreign bodies (mesh or suture material) are common complications after sling surgery causing OAB symptoms. Nevertheless, the cause remain unclear in many cases [3].

Complicating, the mesh ban for transvaginal meshes by the Food and Drug Administration (FDA) [4] also questioned the use of slings for the treatment of stress urinary incontinence. Although there is a consensus statement of the European association of urology and European urogynecology association indicating that the use of slings for the treatment of SUI is still safe [5], more critical recommendations have been given by NICE guidelines [6]. Nevertheless, although alternative surgical procedures are gaining interest in particular countries where mesh has been banned, most European recommendations still recommend slings for the treatment of SUI [7].

However, most studies on the surgical treatment of SUI focus on the success rate with little focus on storage symptoms. Furthermore, definitions and measurements for OAB symptoms vary between the studies, incidences are incongruent and consequently, direct comparison between studies are difficult to perform. Moreover, it is often un-
clear how symptoms were exactly recorded. In this paper, we reviewed the current literature on storage symptoms after SUI surgery. We compared the results of different surgical techniques and identified possible risk factors for the occurrence of de novo or persistent OAB symptoms and furthermore reviewed the pathophysiology for these symptoms.

2. Materials and methods

We conducted a narrative review in order to assess the incidence and management of OAB symptoms after SUI surgery. By extracting the relevant data from existing reviews and meta-analyses, we give an overview of the current evidence. Included for this review were the surgical techniques Burch colposuspension, pubovaginal sling and synthetic sling procedures.

The review of the relevant literature addressing OAB symptoms after SUI surgery was performed in February 2018 using the PubMed database. Search terms included Medical subject heading (MeSH) as well as free text. The terms “urgency”, “overactive bladder”, “detrusor overactivity” or “storage” in combination with the “urinary stress incontinence”, “midurethral sling”, “transobturator tape”, “transvaginal tape” or “colposuspension”. Reviews and meta-analyses between 2010 and 2018 evaluating the efficacy and safety of SUI surgery were analysed. Studies, which reported the number of storage symptoms after SUI surgery were included in this review.

3. Results

3.1 De novo storage symptoms

Newly diagnosed storage symptoms are a known complication after surgical treatment of SUI [8]. These include both urgency/frequency symptoms and UUI. However, no widely accepted definition of de novo storage symptoms following surgery for SUI exists. A prerequisite is that the patient has no bother from these symptoms pre-operatively which usually rely on the subjective report of the patient. The origin of these symptoms is poorly understood. They may be the result of partial BOO or irritation of the urethra [3]. Bladder outlet obstruction is often regarded as the most important mechanism of developing storage symptoms due to changes in the innervation of the bladder or changes in the detrusor muscle [9]. It has been previously reported that women whose maximum flow rate decreases significantly after sling surgery are more likely to develop storage symptoms [10]. However, BOO is not well defined in women and no universally accepted nomograms exist.

Antunes-Lopes et al. [11] found an increase in urinary neurotrophin levels (nerve growth factor and brain-derived neurotrophic factor) after the placement of a midurethral sling. There was a significantly higher percentage increase of these neurotrophins in women with de novo urgency than in those without these symptoms. These findings suggest that increased bladder outlet resistance after midurethral sling surgery may play a key role in the rise of urinary neurotrophins, promoting sensitization of bladder primary afferents. Furthermore, damage to the bladder autonomic nerve innervation resulting in detrusor overactivity has also been suggested to be a cause of de novo urgency [12]. This could be caused by bladder denervation in abdominal surgery or extensive dissection, for example with an autologous fascial sling.

3.2 Persistent storage symptoms

Persistent storage symptoms refer to symptoms which were present preoperatively and do not resolve after surgery. Despite the absence of an established definition of persistent storage symptoms, these include persistence of urgency or UUI. In an updated guideline of the American Urological Association, the incidence of persistent storage symptoms after SUI surgery was reported between 14–52% for all procedures [2]. Approximately 30% of all women with urinary incontinence suffer from an overlap of SUI and UUI [13]. Although the success rate of surgical treatment for mixed incontinence is lower than for SUI, many studies have reported improvement of urgency symptoms in patients with MUI after a sling procedure [14–16]. It has been suggested that the mechanism through which OAB symptoms occur in MUI is stimulation by urine leakage into the proximal urethra by increasing abdominal pressure [17]. Therefore, by counteracting the leakage of urine with a sling procedure or suspension, urgency symptoms may resolve.

3.3 Surgical technique

A variety of surgical procedures have been reported for the treatment of women with SUI. At large, three categories exist: colposuspensions, pubovaginal slings, and synthetic midurethral slings. Other techniques, such as artificial sphincters, injectables or laparoscopic procedures are not discussed in this review. Burch colposuspensions and pubovaginal slings are both well-established procedures with long-term data on efficacy and complications [18,19]. However, since the introduction of the minimally invasive synthetic midurethral sling in the 1990s, this has become the most commonly performed procedure today in the treatment of female SUI. In the last two decades, a large number of clinical trials have been published comparing the efficacy and complication rates between these surgical treatments. The comparative data have been pooled and reviewed in various meta-analyses, which are demonstrated in Table 1 (Ref. [20–32]) and discussed in the following sections.

3.4 Colposuspension vs pubovaginal sling

In a Cochrane review by Lapitan et al. [33], 6 trials were identified comparing open retropubic colposuspensions with traditional pubovaginal slings. Only one trial evaluated the OAB symptoms after surgery [34]. Seventy-
two patients were randomised to undergo colposuspension or traditional fascial sling. Two of 36 patients (5.6%) in the colposuspension group developed de novo OAB symptoms versus 5 of 36 patients (13.9%) in the sling group. Two studies reported on the incidence of DO after surgery. Both found a higher incidence of DO in the colposuspension group.

3.5 Colposuspensions vs standard midurethral slings (SMUS)

Three meta-analyses compared the results of colposuspensions with SMUS [20,21,33]. Novara et al. [20] evaluated 10 randomized controlled trials (RCTs) between 2002 and 2008, comparing 580 patients in the SMUS group with 548 patients in the colposuspension group. No significant difference between the groups was identified for the incidence of post-operative lower urinary tract symptoms (LUTS) (98/580 (16.9%) vs 89/548 (16.2%) respectively). Although an updated review was published by the same working group in 2017 by Fusco et al. [22], the comparison between colposuspension and SMUS did not include the complication rates. Ogah et al. [21] evaluated 4 RCTs comparing SMUS. They found no significant difference in de novo urgency or urgency incontinence rates reporting a comparative risk of 129/1000 vs 89/1000 for open colposuspension and SMUS respectively. Also, no significant difference was identified in the occurrence of post-operative detrusor overactivity. Lapitan et al. [33] compared the results of 6 RCTs, with a total of 521 patients. Again, no significant difference was found in the rate of storage symptoms and detrusor overactivity.

3.6 Pubovaginal slings vs standard midurethral slings (SMUS)

In a meta-analysis by Novara et al. [20], 3 RCTs were evaluated comparing the incidence of storage symptoms between pubovaginal and SMUS. A significant better outcome in favour of the synthetic slings was identified (38/188 (20.2%) vs 80/193 (41.5%)). All three studies demonstrated a lower incidence of post-operative storage LUTS in the synthetic sling group. Ogah et al. [21] also evaluated 3 RCTs (of which one was equal to the study by Novara) comparing pubovaginal with SMUS. Meta-analysis demonstrated a significant better outcome for the SMUS group regarding de novo urgency and UUI (7/123 (5.7%) vs 19/113 (16.8%). However, no significant difference in detrusor overactivity could be identified.

3.7 SMUS technique

Two surgical implantation techniques (retropubic vs transobturator) are available for Standard midurethral slings (SMUS).

Fusco et al. [22] compared in a recent meta-analysis a total of 5231 patients with a retropubic or transobturator sling regarding storage symptoms. Similarly, no significant differences between the groups could be identified (299/2664 (11.2%) vs 282/2567 (11.0%). Ford et al. [23] identified a comparative risk for storage symptoms of 82/1000 for retropubic and 80/1000 for transobturator slings which demonstrated no significant difference.

In one review, the transobturator technique was associated with a lower rate of storage symptoms compared to the retropubic technique [2]. However, Ogah et al. [21] did not identify a significant difference in their meta-analysis of 14 studies. Latthe et al. [24] compared two routes of transobturator tape (inside-out and outside-in) with the
retropubic procedure. De novo urgency was seen more frequently in transobturator procedures, although no difference was observed between the inside-out and outside-in technique [24]. Madhuvrata et al. [25] also found no difference in de novo urgency rates in their meta-analysis of 5 randomised trials. Jain et al. [26] reviewed the effectiveness of SMUS in patients with mixed urinary incontinence. A meta-analysis demonstrated no significant difference in the urgency incontinence cure rate between tapes used by retropubic or transobturator routes.

### 3.8 Sling route

Both, retropubic and transobturator slings, can be inserted either by an outside-in or inside-out technique. Regarding retropubic slings, the outside-in technique tends to inferior cure rates despite increased complications in comparison to the inside-out technique [21,35]. However, cure rates have been proven comparable in both sling routes of transobturator slings [21,35]. Focusing on storage symptoms, only three trials reported storage symptoms in the meta-analysis of Ogah et al. [21] including a total of 260 patients which demonstrated no significant difference between the groups. Fusco et al. [22] identified two trials with a total of 194 patients comparing both sling routes. No significant differences could be identified between the groups (11/101 (10.9%) inside-out vs 7/93 (7.5%) outside in).

#### 3.9 Single-incision mini-sling (SIMS) vs Standard midurethral slings (SMUS)

Currently, the implantation of SIMS is gaining interest as an alternative method of treating SUI. In a meta-analysis by Schimpf et al. [27] 8 studies were evaluated comparing the minisling technique with either retropubic or transobturator synthetic sling. They found an estimated incidence of 5.4% urgency symptoms which was comparable to the full-length sling group (5.3% in obturator and 6.9% in retropubic techniques).

Mostafa et al. [28] conducted a meta-analysis including 26 RCTs and quasi-RCTs comparing SIMS with SMUS. They found no significant differences in de novo urgency and/or worsening of pre-existing symptoms, although there was a trend towards more de novo urgency with the TVT-Secur. Nambiar et al. [29] included 8 RTC comparing postoperative storage symptoms between SMUS with SIMS. They demonstrated as well no significant difference between the groups.

In a recent meta-analysis by Kim et al. [30], SIMS were compared to SMUS in which TVT-Secur was excluded. Furthermore, this meta-analysis provides the so far longest follow-up period. In conclusion, there were no significant differences between the groups regarding urgency or de novo urgency. However, voiding dysfunction was less observed in patients with a mini sling (p < 0.002) but definition of voiding dysfunction was not explained in this meta-analysis.

Pergialiotis et al. [36] investigated the incidence of de novo overactive bladder (OAB) following SIMS and SMUS. Including a total of 3139 patients in this meta-analysis, he could not identify a significant difference between the groups regarding the incidence of de novo OAB (mini slings 9.7%, Tension-free vaginal tape-obturator (TVT-O) 11.2%, Transobturator tape (TOT) 8.7%, TVT 9.8%).

In comparison of Ajust with SMUS surgery, no significant differences regarding urgency, de novo urgency or voiding dysfunction could be identified [31]. Jiao et al. [32] compared MiniArc with SMUS regarding de novo urgency. Equally, he could not identify a significant difference between the groups.

#### 3.10 Tape position and storage symptoms

Placement of the sling under the mid-urethra was first described by Ulmsten et al. [37]. Earlier, it was believed that the surgical support should be mainly provided to the proximal urethra or bladder neck. Since there is extensive high-quality evidence on the efficacy and safety of synthetic slings, the midurethral position has become generally accepted as the preferred position. It has been postulated that a suboptimal position of the tape can be associated with urgency symptoms. Flock et al. [38] reported on a prospective study of 206 women who underwent transvaginal ultrasound 10 weeks after surgery. The development of urgency incontinence or voiding dysfunction was compared with the position of the tape in relation to the length of the urethra. There was no apparent difference in the tape position in the women who developed de novo urgency incontinence when compared to the women without these symptoms. Jiang et al. [39] also found no correlation between de novo urgency and tape position on transrectal ultrasound in 153 women after TVT procedure.

Yang et al. [40] used 4-D transvaginal ultrasound to determine tape position and tension in 56 women who underwent TVT procedure (Monarc). They demonstrated that women with postoperative OAB symptoms had a more caudal ventral resting tape position relative to the symphysis pubis compared with women without OAB symptoms. The authors speculated that a distally placed tape along with some tension on the urethra, but not sufficient to cause the development of urethral encroachment during resting, may be factors associated with postoperative OAB symptoms.

Kociszewski et al. [41] evaluated the proximity of the tape to the urethral lumen. They found that in most patients who experienced urgency symptoms, the tape was located less than 3 mm from the longitudinal smooth muscle complex. The authors concluded that storage symptoms are probably more attributable to the proximity of the tape to the urethral lumen than the exact tape position along the urethra.
4. Discussion

Different surgical techniques are available in the treatment of SUI. Of these, SMUS and colposuspensions demonstrate comparable rates of postoperative storage symptoms. Pubovaginal slings are associated with an increased risk of developing storage symptoms, possibly due to a higher degree of obstruction or autonomic bladder denervation. Regarding SMUS, the surgical technique (retropubic vs transobturator) did not demonstrate significant differences in de novo or persistence of storage symptoms. The utilised route in transobturator slings (inside-out vs outside-in) does not affect the rate of storage symptoms. In comparison of SIMS with SMUS, no significant difference of postoperative storage symptoms could be identified. Nevertheless, in a recent meta-analysis voiding dysfunction was less existent in SIMS. Considering, that SMIS are inferior to SMUS in regard to long-term efficacy, the lower rates of storage symptoms could be correlating to less correctness of the surgery [42]. Furthermore, the correct positioning of the sling may not only contribute the efficacy of sling surgery but also the prevention of storage symptoms. Illiano et al. [43] evaluated the sling position in women by ultrasound in women after MUS surgery. The sling position beneath the proximal urethra was significantly associated with the development or persistence of storage symptoms. Thus, the surgical technique may have significant impact for the overall outcome of SUI surgery. Other factors such as tape tension and proximity to the urethral lumen could also be involved in the development of storage symptoms. Further research is needed in order to clarify the pathophysiology of postoperative storage symptoms.

Author contributions

TM, TH, TAL, MR, BG, JNC and MSR designed the review, collected data, analysed the data, wrote and edited the manuscript. All authors contributed to editorial changes in the manuscript, read and approved the final version.

Ethics approval and consent to participate

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Conflict of interest

The authors declare no conflict of interest.

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