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Incidence and Management of De Novo Lower Urinary Tract Symptoms After Pelvic Organ Prolapse Repair

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Abstract
Purpose of review Pelvic organ prolapse (POP) is a significant problem with many options for surgical correction. Following prolapse surgery, de novo lower urinary tract symptoms (LUTS) are not uncommon. We review the current literature on de novo lower urinary tract symptoms following POP repair and discuss the role of urodynamics in the evaluation of the prolapse patient.
Recent findings Patients with occult stress urinary incontinence (SUI) appear to be at higher risk of developing de novo SUI after POP repair. Prolapse reduction in patients undergoing urodynamic evaluation is important. Different types of POP repair influence rates of de novo SUI. Also, prophylactic anti-incontinence procedures at time of POP repair appear to lower the incidence of de novo SUI, but at the cost of increased risk of complications and morbidity. Pre-existing overactive bladder (OAB) symptoms may either improve or persist, and de novo OAB can develop. The specific role of urodynamic study testing for POP is still being determined.
Summary Increasingly, women are seeking surgical treatment for POP. Aside from complications related to surgery in general, proper patient counseling is important regarding the risk of development of de novo voiding problems following surgery. Despite a growing body of literature looking at de novo voiding symptoms after prolapse repair, more studies are still needed.

This article is part of the Topical Collection on *Lower Urinary Tract Symptoms & Voiding Dysfunction.*

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Introduction

Pelvic organ prolapse (POP) is defined as a downward descent of the female pelvic organs, including the bladder, uterus, or post-hysterectomy vaginal cuff, and the small or large bowel, resulting in protrusion of the vagina, uterus, or both [1] POP affects millions of women worldwide and is recognized as a global burden on women's health [2–4]. Over 300,000 surgeries for POP are performed in the USA annually [5]. Many options for surgical correction of POP exist, and the choice of procedure depends on different factors including type and severity of prolapse, patient preference, and comorbidities, as well as patient expectations.

Following prolapse surgery, de novo lower urinary tract symptoms (LUTS) are not uncommon and can include storage symptoms such as stress urinary incontinence (SUI), urgency and urgency incontinence, and voiding symptoms including incomplete bladder emptying, decreased stream, and urinary retention.

In this article, we will review the current literature on de novo lower urinary tract symptoms following pelvic organ prolapse repair and will also discuss the role of urodynamics in the evaluation of the prolapse patient.

Stress Urinary Incontinence

SUI is defined by the International Continence Society (ICS) and International Urogynecological Association (IUGA) as "patient complaint of involuntary loss of urine on effort or

physical exertion including sporting activities etc., or on sneezing or coughing" [6]. Oftentimes, patients with POP can be affected by more than one pelvic floor disorder. For example, SUI and POP very commonly occur together. In a Dutch population-based study of 2797 women, 55% of women with stage II or higher POP had concurrent SUI [7]. The incidence of de novo SUI following POP surgery was 15% after prolapse surgery in 1280 women [8–11]. When SUI is identified during urodynamic testing during increased abdominal pressure maneuvers in the absence of detrusor contraction, it is referred to as *urodynamic stress incontinence* [6, 9•]. The ICS and IUGA define *SUI on prolapse reduction* as "SUI only observed with prolapse reduction" [6]. Patients with a high degree of anterior or apical POP may not have symptoms of SUI due to theoretical kinking of the urethra that acts as a continence mechanism. In these patients, surgical correction of the prolapse can unmask pre-existing SUI. There is no standardized definition of de novo *SUI* by ICS and IUGA, but it is typically defined as new-onset SUI after POP repair in patients with no prior occult SUI [9•]. The incidence ranges from 4 to 51% [9•, 12–17].

There are many described methods of reducing prolapse at time of urodynamic testing, including reduction with pessaries, swabs, ring forceps, speculum, and even manual reduction, but a gold standard has not been established [12, 18–20]. The speculum and pessary for prolapse reduction were not found to have an acceptable positive predictive value to identify women in need of concomitant continence procedure; however, the negative predictive values ranged from 91.1–92.5% (95% CI 88.5–1.00). Thus, women who did not demonstrate occult SUI preoperatively are at low risk of developing SUI after POP repair [12, 18, 19, 21]. The American Urological Association (AUA) recommends that patients with stage II or greater POP undergo preoperative urodynamics with prolapse reduction to assess for occult SUI [9•, 22].

In patients who do not have any symptoms or demonstrable SUI prior to POP repair, the rate of de novo SUI may be influenced by the type of surgical procedure. Multiple randomized controlled studies (RCTs) have demonstrated that anterior native tissue repair has lower rates of de novo SUI compared to transobturator anterior mesh procedures [18]. Baessler and Maher performed a systematic review and reported an overall de novo SUI rate of 9% after anterior repairs (five RCTs and two prospective studies) The authors found the overall cumulative rate of de novo SUI in transobturator mesh procedures to be higher at 14% (six RCTs and eight prospective trials). Five RCTs directly compared anterior colporrhaphy and transobturator mesh procedures (mesh kits or self-fashioned). Unfortunately, meta-analysis was not possible due to heterogeneity of questionnaires and instruments used.

Altman et al. conducted a multicenter, parallel-group RCT comparing trocar-guided, transvaginal polypropylene mesh-augmented anterior repair kit with traditional colporrhaphy in women with anterior prolapse in patient with stage II or higher anterior prolapse [2]. 389 women were randomized, with 200 undergoing prolapse repair with transvaginal mesh kit and 189 undergoing traditional anterior colporrhaphy. At 1 year, the rate of de novo stress urinary incontinence was significantly higher in the transvaginal mesh group (12.3% transvaginal mesh vs. 6.3% colporrhaphy group, $p = 0.05$. In addition, the primary outcome of repair success (defined using a composite of subjective and objective measurements) was higher in patients undergoing transvaginal mesh repair compared to anterior colporrhaphy (60.8 vs. 34.5%; 95% CI 15.6–37.0).

Another large RCT by Hiltunen et al. also examined the outcomes of transvaginal polypropylene mesh compared to traditional anterior colporrhaphy and also found higher rates of new-onset SUI following mesh-augmented anterior repair [23]. Two hundred two women with anterior vaginal prolapse to the hymen or beyond were randomized to traditional anterior colporrhaphy ($n = 97$) or anterior colporrhaphy reinforced with self-tailored, low-weight polypropylene mesh ($n = 105$) [23]. None of these patients underwent concomitant anti-incontinence surgery at the time of prolapse repair. In the no-mesh group, 10 of 97 patients had preoperative SUI, while in the mesh group, 19 of 105 patients had preoperative SUI. In patients with preoperative SUI, 7 of 10 patients (70%) in the no-mesh group and 11 of 19 patients (58%) had resolution of SUI ($p = 0.4$). Furthermore, in patients with persistent SUI, 10% (1 of 10 patients) in the no-mesh group compared to 42% (8 of 19 patients) in the mesh group had persistence of SUI after 12 months ($p = 0.02$). Rates of de novo SUI were similar between the groups with 10% (9 out of 96 patients) of patients in the no-mesh group compared to 14% (15 of 104 patients) in the mesh group ($p = 0.2$). Despite these findings, few patients underwent anti-incontinence operation within the first 12 months of their prolapse surgery. Six patients (6.2%) in the no-mesh group and four patients (4.1%) in the mesh group underwent TVT repair within the first 12 months after their initial prolapse repair. Interestingly, longer term follow-up of patients in Hiltunen's trial showed that more women developed new SUI later after anterior repair without mesh; hence, SUI rates between mesh and no-mesh groups were equally 17% by the 3-year mark [24, 25].

Natale et al. compared safety and efficacy of anterior repair augmented by transvaginal polypropylene mesh (Gynemesh®) to anterior repair augmented by biologic graft (Pelvicol®) in patients with ≥ stage II anterior vaginal wall prolapse. One hundred ninety patients were randomized to Gynemesh® ($n = 96$) and Pelvicol® ($n = 94$) [26]. All patients were treated with tension-free cystocele repair and levator myorrhaphy. Concomitant hysterectomy was performed in 13.5% of Gynemesh® group and 27.6% of Pelvicol® group. Rates of de novo SUI was similar for Gynemesh® (2%) and Pelvicol® (1%) groups [26]. It was not known if any of these patients went on to have subsequent anti-incontinence procedures; however,

available data suggests that rates of de novo SUI do not appear to be different between synthetic or biologic materials.

When comparing abdominal sacrocolpopexy to vaginal repairs and sacrospinous fixation, a single RCT showed that de novo SUI was more common after sacrospinous fixation and vaginal repairs. Maher et al. studied 95 patients with vaginal vault prolapse and randomized them to abdominal sacrocolpopexy (n = 47) and sacrospinous colpopexy (n = 48) [27]. At a 2-year follow-up, the subjective success rate was 94% in the abdominal group versus 91% in the vaginal group (p = 0.19). The objective success rate was 76% in the abdominal group versus 69% in the vaginal group. The abdominal group had longer operative time, slower recovery, and higher cost compared to vaginal colpopexy. De novo SUI was more common with vaginal sacrospinous colpopexy (33%) compared to abdominal sacrocolpopexy (9%) [27]. These results should be interpreted with caution as patients receiving abdominal sacrocolpopexy also had paravaginal repairs that may limit de novo SUI postoperatively [18].

Prophylactic Anti-incontinence Surgery

The development of de novo SUI after POP repair raises an interesting clinical question: should prophylactic anti-incontinence procedures be performed at the time of POP repair? One of the first large multicenter RCT to address this question was the CARE (Colpopexy and Urinary Reduction Efforts) trial [28]. Three hundred twenty-two patients with ≥ stage II POP who were continent preoperatively, were randomized to undergo abdominal sacrocolpopexy with (n = 157) and without (n = 165) Burch colposuspension. At 3 months following surgery, 33.6% in the Burch group and 57.4% in the non-Burch group had SUI (p < 0.001). The Burch and non-Burch groups had similar rates of urgency incontinence (32.7 vs 38.4%, p = 0.48). In patients with SUI postoperatively, those who did not have Burch had higher bothersome symptoms than those who did undergo Burch (24.5% vs 6.1% respectively, p < 0.001) [28]. At the 2 year follow-up, 32% of patients with Burch and 45.2% of patients in the non-Burch groups had SUI [29]. Criticisms of the trial include different definitions of SUI were used for patients preoperatively compared to postoperatively. Thirty-nine percent of patients that were defined as continent preoperatively would have been actually incontinent using the postoperative definition [18].

Since the CARE trial results were published showing reduced risk of de novo SUI in patients who received prophylactic Burch colposuspension, other studies have looked at the use of anti-incontinence procedures at time of other types of POP repair. Recently, there have been more POP repairs being performed transvaginally, and since the advent of the synthetic midurethral sling (MUS) in 1998, it has become the gold standard for treatment of SUI in developed countries and replaced bladder neck suspensions [13, 30].

The OPUS (Outcomes Following Vaginal Prolapse Repair and Midurethral Sling) trial by Wei et al. was a multicenter RCT that studied 337 women with ≥ stage II POP and no SUI undergoing transvaginal POP repair [13]. These patients were randomized to prophylactic MUS (n = 165) vs sham incisions (n = 172). The rate of urinary incontinence or need for treatment of incontinence at 3 months was 23.6% in the MUS group versus 49.4% in the sham group (p < 0.001). By 12 months, this rate was 27.3% in the MUS group versus 43% in the sham group (p = 0.002). The NNT (number needed to treat) with a sling to prevent one episode of incontinence was 6.3. Higher rates of bladder perforation (6.7 vs 0%), major bleeding complications (3.1 vs 0%), and incomplete bladder emptying 6 weeks after surgery was present in the MUS group compared to the sham group, respectively (p < 0.05 for all).

Aside from patients who do not have occult SUI demonstrable preoperatively, even patients who do have occult or asymptomatic urodynamic SUI may not necessarily require an anti-incontinence procedure at the time of POP repair. Schierlitz et al. performed a multicenter RCT and randomized 80 patients with ≥ stage II POP and absence of SUI on history but demonstration of occult SUI to prolapse surgery alone (n = 43) or prolapse surgery with concurrent transvaginal tape (TVT) MUS [31•]. At 6 months follow-up, 7% of patients in the prolapse surgery-alone group requested a sling operation compared to 0% in the TVT group (p = 0.11). At 2 years follow-up, one further participant in the prolapse surgery-alone group (9.3%) requested a sling compared to none (0%) in the TVT group (p = 0.06). Patients in both groups had improvement in quality of life (QoL) difference scores and there was no significant difference between groups. These findings suggest that even in patients with occult SUI, the decision to insert a sling or not should be a shared decision-making between the patient and surgeon [31•].

Overactive Bladder Symptoms

Overactive bladder (OAB) is defined by the ICS as "urgency with or without urgency incontinence, usually associated with frequency and nocturia" [6]. OAB can be associated with POP [18]. Patients with OAB prior to POP repair may have resolution, persistence, or even worsening of symptoms postoperatively. Additionally, patients without any pre-existing OAB symptoms can also develop de novo OAB symptoms following POP repair [18].

A Cochrane review on surgical management of POP reported de novo OAB symptoms in 12% of patients when analyzing nine trials with different types of prolapse surgery [8, 26, 27, 32–36]. The rate of de novo OAB symptoms among patients who underwent POP repair with transobturator anterior mesh procedure (7%) was similar to those who underwent anterior repair with or without MUS (10%) (p = 0.4). In the RCT by Schierlitz et al. discussed

earlier, there was no difference in rates of urgency ($p = 0.47$) and urgency urinary incontinence (UUI) ($p = 0.73$) between patients who had POP repair alone or POP repair with TVT [31•]. Resolution of pre-existing urgency (87 vs 87%) and urgency urinary incontinence (65 vs 52%) was similar between patients who had TVT and those who did not [31•]. Findings in another study by Basu et al. suggest that resolution of urgency after prolapse repair may be associated with increased urinary flow rate [37].The authors prospectively observed 128 women with ≥ stage II POP and pre-existing urgency or UUI undergoing POP repair. 61.7% of patients had resolution of urgency, and resolution was associated with a significant increase in maximum urinary flow rate from 11.2 (CI 3.4–20.1) to 26.9 mL/s (CI 17.1–35.2) ($p = 0.03$), correcting for voiding volume [37].

Van der Ploeg et al. performed a multicenter RCT comparing POP repairs with and without MUS in women with occult SUI [38].Ninety-one women were randomized to POP repair with sling ($n = 43$) and without sling ($n = 47$). During follow-up, the rates of subsequent treatment for OAB (MUS group 10%; control group 6%; $p > 0.05$) and urgency urinary incontinence (MUS 20%; control 34%; $p > 0.05$) were the same between both groups. Also, patients with occult SUI were more likely to report UUI compared to patients without UUI (38 vs 8%; RR 4.70; 95% 2.40–9.21) [38].

De novo OAB and pre-existing OAB is a challenging problem in prolapse surgery. Prediction of outcomes after POP repair is difficult and, in general, does not appear to be influenced significantly by the choice of POP repair or concomitant anti-incontinence procedure.

Voiding Symptoms

Aside from de novo OAB and de novo SUI, other forms of voiding dysfunction can occur with POP repair. Acute urinary retention (AUR) is one of the most common complications after POP or anti-incontinence surgery [39, 40]. Rates of urinary retention in the literature in patients undergoing POP repair with or without concomitant anti-incontinence surgery range from 29 to 62% [41–45]. Patients undergoing vaginal POP surgery without anti-incontinence procedures have lower reported rates of urinary retention but still range from 29 to 32% [41, 44, 45]. Levator muscle plication, increased blood loss, and large cystoceles are risk factors for subsequent postoperative urinary retention after vaginal POP repair [41, 45]. Prolonged urinary retention can cause bladder overdistention and lead to long-term voiding dysfunction; hence, it is important to recognize and manage this problem appropriately.

Turner et al. analyzed 290 patients undergoing laparoscopic or robotic-assisted sacrocolpopexy. All patients had a retrograde fill voiding trial (RGVT) on the first postoperative day [41]. 72.8% of patients passed their voiding trial, and of the remaining patients, the mean (SD) duration of acute urinary retention was 3.7 (4.2) days. The median (SD) age was 58.5 (8.6) years with a median POPQ stage III (76.1% of patients were ≥ stage III). There were no identifiable predictors of acute urinary retention (AUR) in patients undergoing minimally invasive sacrocolpopexy. The authors did not find large cystoceles and concurrent anti-incontinence procedure to affect AUR in patients undergoing abdominal sacrocolpopexy [41].The etiology of AUR after pelvic floor surgery is likely multifactorial, affected by neural injury, edema, bladder neck or urethral angulation changes, perioperative analgesic use, and changes in bowel habits [41]. Ghafar et al. identified risk factors for postoperative impaired emptying by retrospectively reviewing 225 patients who underwent surgery for POP and/or SUI [39]. Levator contraction strength was affected by median patient age, PVR volume, and urogenital hiatus size ($p < 0.05$). Overall, a wide urogenital hiatus, weak levator ani muscles, increased age, and elevated PVR increased risk of postoperative AUR. A wide urogenital hiatus reflects a weakened pelvic floor [39].

In patients that develop AUR with an elevated PVR >150 mL, it is recommended to perform clean intermittent catheterization over leaving an indwelling foley catheter for 3 days. Lower rates of bacteriuria, UTI, and length of required catheterization have been noted [46].

Role of Urodynamics in POP

Because many patients with POP have associated storage symptoms, voiding dysfunction, and urinary incontinence, urodynamics has become a standard tool in evaluation of POP by many providers; however, increasingly, this practice has come under increased scrutiny due to attempts to reduce healthcare costs and distinguish patients who would not necessarily need urinary dynamics study (UDS).

Araki et al. retrospectively studied 87 patients with POP and urgency [47]. Of these 87 patients, 48 patients (55%) had urgency. Of the 48 patients with urgency, 26 patients (30%) also had urgency urinary incontinence. Detrusor overactivity (DO) was seen on preoperative UDS in 15 of 48 patients (31%) with urinary urgency alone and 13 of 26 patients (50%) who also had urgency urinary incontinence. Patients then underwent transvaginal POP repair using polypropylene mesh (GyneMesh). Patients with symptomatic SUI and/or a positive stress test could opt to have a transobturator midurethral sling placed concurrently. Following surgery, urgency resolved in 25 patients (52%) with urgency alone, and in 18 patients (69%) who also had urgency urinary incontinence. In patients with DO on preoperative UDS, following POP repair, urinary urgency persisted in 13 patients (87%) with DO on preoperative UDS but it resolved in 23 of 33 patients (70%) who did not have DO on UDS [20•, 47].These findings would seem to suggest that UDS findings of DO increase the risk of persistent urgency ($p = 0.0003$) and

urgency urinary incontinence (p = 0.048) after POP repair compared to patients who did not have demonstrable DO. Regarding SUI, 16 patients (18%) had symptomatic SUI. In the 71 patients without SUI symptoms, 22 (31%) demonstrated occult SUI. Of the 22 patients with occult SUI, 9 underwent concurrent transobturator tape (TOT) with POP repair, 8 developed symptomatic SUI postoperatively, and within the 8 patients, 3 went on to have subsequent anti-SUI surgery later. In the 49 patients with negative stress test, 2 patients (4%) developed postoperative SUI, but none required further therapy. The authors found that concurrent TOT at time of prolapse repair was not associated with postoperative persistence of urgency, UUI, or development of de novo urgency.

Wolter et al., however, showed that in 111 patients undergoing anterior POP repair and sling procedure, 54% had mixed urinary incontinence (MUI), 25% had SUI, and 9% had UUI [48].Of patients with UUI, 31.5% had DO on preoperative UDS. The rate of urgency and UUI decreased from 63 to 30% after POP repair. The authors did not find preoperative DO to be predictive of postoperative urgency persistence. Postoperatively, 28.6% of patients with DO and 30.3% of patients without DO had urgency persistence [48].These findings do not seem surprising though, given that symptoms of urgency do not correlate well with the presence of DO on UDS. UDS is not recommended routinely for patients that have POP and OAB, but should be done in patients with neurologic disease, recurrent UTIs, hydronephrosis, incomplete bladder emptying, and risk factors for impaired bladder compliance, especially if concomitant anti-incontinence surgery is planned [20•].

The American Urological Association (AUA) and Society for Urodynamics and Female Urology (SUFU) recommend that if UDS are to be done prior to surgery, UDS should be done with prolapse reduction to assess for detrusor dysfunction. UDS may help distinguish between detrusor underactivity or bladder outlet obstruction (BOO) or both [20•]. Romanzi et al. evaluated 60 women with grades 1–4 POP and found that 70% of patients with high-grade POP [3, 4,] had BOO compared to 3% of patients with grade 1 or 2 POP [49]. Interestingly, with the use of a pessary device to reduce the prolapse, 94% of patients with high-grade POP had normal uroflowmetry. Because of conflicting findings in the literature around UDS and POP, the utility of UDS is still being determined. The need for UDS should be individualized for each patient, and the decision to undergo UDS should be based on how the results will affect patient management and planning [20•].

Conclusion

Pelvic organ prolapse affects millions of women and the number of patients seeking surgical treatment is increasing. In addition to the complications related to surgery in general, proper patient counseling is important regarding the risk of development of de novo urinary storage and voiding problems following surgery including stress urinary incontinence. Patients with occult SUI appear to be at higher risk of developing de novo SUI after POP repair. Prolapse reduction in patients undergoing urodynamic evaluation is important because those patients who do not demonstrate occult SUI are at lower risk of de novo SUI. Also, the choice of surgical repair also appears to influence incidence of de novo SUI. Transobturator vaginal mesh repairs appear to have a higher incidence of de novo SUI compared to traditional anterior colporrhaphy. Transvaginal repairs and sacrospinous ligament fixations may have higher incidences of de novo SUI compared to abdominal sacrocolpopexy. Rates of de novo SUI following vaginal anterior repair augmented with mesh or biological graft are likely similar. Prophylactic anti-incontinence procedures appear to lower incidence of de novo SUI, but at the cost of increased risk of complications and morbidity. The decision for concomitant anti-incontinence surgery should be a shared decision between the patient and physician. Patients with OAB symptoms prior to prolapse surgery need to be counseled that these symptoms may either improve or persist, and patients without symptoms of OAB should be warned that there is a risk of de novo OAB following POP repair. In addition, AUR can be a bothersome problem after POP repair. Resolution is common, but may require clean intermittent catheterization until this occurs. The specific role of UDS testing for POP is still being determined, but is a useful tool when the clinician is seeking a specific question that may influence patient management. Despite a growing body of literature looking at de novo voiding symptoms after prolapse repair, more studies are still needed.

Compliance with Ethical Standards

Conflict of Interest Henry Tran and Doreen E. Chung each declare no potential conflicts of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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