EAU Guidelines on the management of female non-neurogenic lower urinary tract symptoms: Part 2 – Underactive Bladder, Bladder Outlet Obstruction and Nocturia

Salvador Arlandis[a]*, Kari Bø[b], Hanny Cobussen-Boekhorst[c], Elisabetta Costantini[d], Monica de Heide[e], Fawzy Farag[f], Jan Groen[g], Markos Karavitakis[h], Marie Carmela Lapitan[i], Margarida Manso[j], Serenella Monagas Arteaga[k], Arjun K. Nambiar[l], Aisling Nic An Riogh[m], Eabhann O'Connor[n], Muhammad Imran Omar[o], Benoit Peyronnet[p], Veronique Phé[q], Vasileios I. Sakalis[r], Néha Sihra[s], Lazaros Tselves[t], Mary-Lynne van Poelgeest-Pomfret[u], Tine W.L. van den Bos[e], Huub van der Vaart[v], Christopher K. Harding[w]

[a] Urology Department, n.
[b] Department of Sports Medicine, Norwegian School of Sport Sciences, Oslo, Norway.
[c] Department of Urology, Radboud UMC, Nijmegen, The Netherlands.
[d] Department of Medicine and Surgery, University of Perugia, Perugia, Italy.
[e] Bekkenbodem4All, Tiel, The Netherlands.
[f] Department of Urology, Sohag University Hospital, Sohag, Egypt; Department of Urology, East Suffolk and North Essex NHS Foundation Trust, UK.
[g] Department of Urology, Erasmus Medical Center, Rotterdam, The Netherlands.
[h] Department of Urology, Charing Cross Hospital, London, UK.
[i] College of Medicine/Philippine General Hospital/National institutes of Health, University of the Philippines Manila, Manila, Philippines.
[j] Department of Urology, Centro Hospitalar Universitário São João, Porto, Portugal.
[k] Department of Urology, University Hospital of San Agustín, Avilés, Spain.
[l] Department of Urology, Freeman Hospital, Newcastle-upon-Tyne, UK.
[m] Department of Urology, Cork University Hospital, Cork, Ireland.
[n] Department of Urology, Beaumont Hospital, Dublin, Ireland.
[o] University of Aberdeen, Aberdeen, UK; European Association of Urology, Arnhem, The Netherlands.
[p] Department of Urology, University of Rennes, Rennes, France.
[q] Department of Urology, Assistance Publique-Hôpitaux de Paris, Pitié-Salpêtrière Academic Hospital, Sorbonne University, Paris, France.
[r] Department of Urology, Agios Pavlos General Hospital of Thessaloniki, Thessaloniki, Greece.
[s] Department of Urology, Guy's and St Thomas' NHS Foundation Trust, London, UK.
[t] Second Department of Urology, National and Kapodistrian University of Athens, Sismanogleio General Hospital, Athens, Greece.
[u] World Federation of Incontinence and Pelvic Problems (WFIPP), Leiden, The Netherlands.
[v] Department of Obstetrics and Gynecology, University Medical Center, Utrecht, The Netherlands.
[w] Department of Urology, Freeman Hospital, Newcastle-upon-Tyne, UK; Translational and Clinical Research Institute, Newcastle University

*Corresponding author
Prof. Dr. Salvador A. Arlandis
La Fe, Universitary and Polytechnic Hospital
Dept. of Urology
Av Fernando Abril Martorell, 106

46026 Valencia
SPAIN

Word Count
Abstract: 228
Body text: 4213 (excl abstract)
Tables: 3
Keywords: Female lower urinary tracts symptoms, underactive bladder, bladder outlet obstruction, nocturia, conservative management.

Abstract

Context: Female lower urinary tract symptoms (FLUTS) are a common presentation in urological practice. Thus far, only a limited number of conditions within female LUTS have been included in the EAU guidelines compendium. The new non-neurogenic female LUTS guidelines expand the remit of the guidelines to include these symptoms and conditions.
Objective: This review article summarises the management of underactive bladder (UAB), bladder outlet obstruction (BOO) and nocturia.
Evidence Acquisition: The literature search was updated in September 2021 and evidence synthesis conducted using modified GRADE approach as outlined for all EAU guidelines. A new SR on BOO was carried out by the panel for purposes of this guideline.
Evidence Synthesis: The important considerations for informing guideline recommendations have been presented, along with a summary of all the guideline recommendations.
Conclusions: Non-neurogenic female LUTS are an important presentation of urological dysfunction. The initial evaluation, diagnosis and management should be carried out in a structured and logical fashion based on best available evidence. This guideline serves to present this evidence to practising urologists and other health providers in an easily accessible and digestible format.
Patient Summary: In this report we summarise the main recommendations from the EAU non-neurogenic female LUTS guideline, which relates to symptoms and diseases of the female lower urinary tract (bladder and urethra). We cover recommendations related to the treatment of underactive bladder, bladder outlet obstruction and nocturia.

1. Introduction

Part two of the EAU guidelines summary on non-neurogenic female lower urinary tract symptoms (FLUTS), focusses on the sections relating to underactive bladder (UAB), bladder outlet obstruction (BOO) and nocturia. This summary relates primarily to the patient pathway from presentation through diagnostics and to management of the specific conditions. The best available evidence is summarized and the main recommendations from the full version of the guidelines are presented in a concise and easily digestible format.

2. Evidence synthesis

2.1 Underactive Bladder

UAB is a common condition, defined by the International Continence Society (ICS) as "a symptom complex characterised by a slow urinary stream, hesitancy, and straining to void, with or without a feeling of incomplete bladder emptying sometimes with storage symptoms" (1).

Detrusor underactivity (DU) is a diagnosis based on urodynamic studies and defined by the ICS as "a 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" (2).

2.1.1 Diagnostic evaluation

Symptoms associated with detrusor underactivity
Based on current data, a pivotal symptom or collection of symptoms to specifically identify DU patients have not been identified. The ICI Questionnaire-underactive bladder (ICIQ-UAB) is a research tool, which needs further validation before use as a patient reported outcome measure (PROM) in common clinical practice (3).

Urodynamic studies
Non-invasive studies like uroflowmetry, post-void residual (PVR) measurement and bladder voiding efficiency (BVE) determination are potentially useful to identify women who might have DU. There is considerable symptomatic overlap with BOO and uroflowmetry and PVR findings may also be similar. Only invasive urodynamics with pressure-flow studies can reliably distinguish DU from BOO and these urodynamic diagnoses can co-exist. In addition, diagnosis in women is particularly difficult as women can void by relaxing the pelvic floor, that is, without a detectable detrusor contraction during the pressure-flow study and without increased abdominal pressure (4). The simplest methods to define and diagnose DU involve the use of cut-off values of Q_{max} and $P_{det}Q_{max}$. There is no consensus on which threshold values should be used (5) and consequently the prevalence of DU depends on the criteria used (6).

Several proposed measures of contractile strength exist. Watt's factor (WF) estimates the power generated by the detrusor per unit area of bladder (7). Projected isovolumetric

pressure (PIP) is a gross simplification of the bladder output relation and estimates the maximum detrusor pressure that can be generated by the bladder when the outlet is closed, the isovolumetric detrusor pressure. The bladder contractility index (BCI) is simply a reduction of PIP to an index (8). Projected isovolumetric pressure (PIP) also estimates the isovolumetric detrusor pressure, but was developed in an entirely female population via an experimental method (9). These parameters do not necessarily reflect what the detrusor might potentially achieve under optimum conditions (10).

2.1.2 Disease management

Treatment of female DU includes strategies to ensure bladder drainage, increase bladder contraction, decrease urethral resistance, or a combination (11). The management goals for UAB are to improve symptoms and quality of life (QoL) as well as to reduce the risk of complications.

2.1.2.1 Conservative management

Behavioural interventions
Regular or timed voiding should be encouraged in women with impaired bladder sensations. Assisted voiding by abdominal straining with adequate relaxation of the pelvic floor muscle (PFM) has been recommended, as well as double or triple voiding, in an attempt to improve bladder emptying. None of these manoeuvres have proven their efficacy in any randomised study. There is a possible association between voiding by excessive abdominal straining and the risk of pelvic organ or rectal prolapse (12). A small retrospective study in neurogenic patients showed that Valsalva voiding may increase the risk of rectal prolapse compared with clean intermittent self-catheterisation (CISC) (13).

Pelvic floor muscle relaxation training with biofeedback
There are no randomised controlled trials (RCT)s examining PFMT (relaxation) in adult women with UAB. One study found significant relaxation of the PFM after PFM contraction (14) and another study found that PFM relaxation training over time increased the speed of relaxation after a single contraction (15). In the absence of RCT data in women, the findings of an RCT in children with non-neuropathic UAB and voiding dysfunction comparing the effect of PFM relaxation and biofeedback plus combined treatment (hydration, scheduled voiding, toilet training and diet) vs combined treatment alone, can be cautiously extrapolated to an adult population (16). The paediatric trial showed that additional PFM relaxation conferred a significant increase in mean number of voiding episodes and Q_{max}, decrease in PVR volume and voiding time(16).

Clean intermittent self-catheterisation (CISC)
CISC has proven efficacy in patients who are unable to empty their bladder and remains as a gold standard to reduce the adverse consequences of a high PVR and incomplete voiding, despite the low level of evidence that supports this statement.

Indwelling catheter
Indwelling urinary catheter may be an option for some women who have failed all other

treatments and are unable to perform CISC. Complications include urinary tract infection (UTI), stone formation and urethral damage. Suprapubic catheterisation may be preferable over urethral catheterisation to minimise the risk of urethral trauma and pain (17).

Intravesical electrical stimulation
According to a retrospective study (18) intravesical electrical stimulation may be useful in some patients after prolonged bladder overdistension. However, this must be investigated in high quality RCTs.

2.1.2.2 Pharmacology management

Parasympathomimetics
A systematic review (SR) on the use of parasympathomimetics in patients with UAB included ten RCTs (19). The SR did not support the use of parasympathomimetics for treating UAB, especially when frequent and/or serious adverse effects are taken into account.

Alpha-blockers
There is limited evidence regarding effectiveness of *alpha*-blockers. One prospective study showed similar improvements of uroflowmetry parameters (specifically in the percentage of patients who had a good therapeutic response) in women with BOO (39.4%) or DU (32.7%) using tamsulosin (20). Another longitudinal study including fourteen women with DU showed clinical and urodynamic improvements after tamsulosin (21). A prospective single-blind RCT in female patients with DU compared efficacy of alpha-blocker, cholinergic drugs or combination therapy, with the latter exhibiting the best results (22).

Prostaglandins
Prostaglandin E2 and F2 have been used intravesically to treat urinary retention after surgery. A Cochrane SR showed a statistically significant association between intravesically administered prostaglandin and successful voiding among post-operative patients with urinary retention. However, the success rate was low (32%) compared to placebo, with a very low certainty of evidence (23).

2.1.2.3 Surgical management

Sacral nerve stimulation
An RCT included 37 patients in the implantation arm and 31 in the standard medical therapy arm, showing a mean decrease in PVR volume in the implantation group (24). A meta-analysis of seven studies (one RCT and six observational) showed a mean difference in PVR volume reduction of 236 mL and a mean voided volume increase of 299 mL (25). The response rate during the trial phase ranged from 33-90% (mean 54.2%) and the success rate of permanent implantation ranged from 55-100% (mean 73.9%), highlighting that patient selection is crucial (26). A subgroup of women with idiopathic urinary retention (Fowler's syndrome) had a higher response rate of 68-77% (27). Sacral nerve stimulation (SNS) is a valid option for female patients with DU, with proper patient selection. Patients with evidence of anatomical BOO, suspected loss of intrinsic detrusor contractility or neurogenic bladder dysfunction showed lower response rates (28).

OnabotulinumtoxinA
There is low-level evidence that OnabotulinumtoxinA injections to the external striated urethral sphincter may improve voiding in patients with DU by reducing outlet resistance and suppressing the guarding reflex. Retrospective case studies have shown improvement in voiding symptoms, recovery of spontaneous voiding, and improvement in urodynamic parameters (29,30). The duration of symptomatic relief is typically three months.

Transurethral incision of the bladder neck
Transurethral incision of the bladder neck has been described in short series of women with refractory DU. In a retrospective case study, 40/82 (48.8%) women achieved satisfactory outcomes (spontaneous voiding with voiding efficiency ≥ 50%), but five (6.1%) of the patients developed stress urinary incontinence (SUI) and two (2.4%) developed a vesico-vaginal fistula (31).

Other procedures
Reduction cystoplasty and myoplasty are uncommon procedures with very limited evidence for effectiveness.

Recommendations for the management of UAB are provided in Table 1.

Please insert Table 1 here

CISC = clean intermittent self-catheterisation; UAB = Underactive bladder.

2.2 Bladder Outlet Obstruction

Bladder outlet obstruction (BOO) is defined by the ICS as "obstruction during voiding, characterised by increased detrusor pressure and reduced urine flow rate" (2).

2.2.1 Diagnostic evaluation

Clinical history
Evidence regarding clinical utility of symptoms, for the diagnosis of BOO is inconclusive. In a single-centre retrospective study including women with BOO, the authors concluded that symptom assessment alone was insufficient for diagnosis and a full urodynamic evaluation was essential (32). Studies have found that significant proportions of women presenting with symptoms of urinary incontinence (UI) also have concomitant voiding symptoms and BOO on urodynamics (33,34).

Clinical examination
There are no studies evaluating the clinical utility of physical examination in women with suspected BOO; nevertheless, it is universally considered a key part of the medical assessment.

Uroflowmetry and post-void residual volume

Studies have shown reasonable correlation between low flow rates, significant PVR and urodynamic BOO (34-37).

Ultrasound
The major utility of ultrasound (US) scanning in women with BOO is to detect possible complications such as bladder wall thickening or upper tract dilatation/hydronephrosis. One study reported that transvaginal ultrasonography was able to demonstrate a closed bladder neck during attempts at micturition and concluded that this modality was useful for the evaluation of possible causal factors of female BOO (38).

Magnetic resonance imaging
There are no reports of clinical utility of MRI in the diagnosis of female BOO. MRI in patients with urethral stricture can determine the degree of peri-urethral fibrosis, although the prognostic and clinical significance of such a finding has not been established (39).

Electromyography
Abnormal EMG activity may be associated with non-relaxation of the striated sphincter, abnormally high urethral pressure, poor bladder sensation and reduced detrusor contractile strength (40,41). Complex repetitive discharges and decelerating bursts are specific EMG abnormalities (using peri-urethral concentric needles) that have been described in patients with high-tone non-relaxing sphincter, although these abnormalities also occur in asymptomatic volunteers (42,43). A review of voiding dysfunction in women showed that increased EMG activity of the PFM using surface electrodes during voiding or non-relaxation, coupled with pressure–flow information from urodynamics may be useful to differentiate between functional and anatomical obstruction (44).

Cystourethroscopy
Cystourethroscopy can be useful to visualise anatomical/mechanical obstruction and provide information regarding its nature, location and calibre. Given that pelvic malignancy may cause anatomical BOO, cystourethroscopy is considered an essential part of the diagnostic pathway.

Urodynamics and video-urodynamics
Pressure-flow studies are the mainstay of BOO diagnosis and the characteristic abnormalities are a combination of low flow and high voiding pressure(45). The urodynamic definition of female BOO remains controversial (46). The Blaivas-Groutz nomogram is one of the most popular urodynamic criteria for female BOO (47) but has been suggested to overestimate obstruction (48). The addition of fluoroscopic imaging introduces a video-urodynamic criterion for obstruction (49). However, both methods lack data supporting their clinical validity, especially regarding their predictive value for treatment outcomes (50).

Several urodynamic cut-off values have been proposed to optimise diagnostic accuracy of video-urodynamic studies (36):

- $P_{det}Q_{max} \geq 30$ cm H_2O for differentiating BOO from bladder dysfunction and normal studies, (Receiver operating characteristic (ROC) area = 0.78);

- the Abrams–Griffiths number > 30 for differentiating anatomical from functional BOO (ROC area = 0.66);
- $P_{det}Q_{max} \geq 30$ cm H_2O for differentiating dysfunctional voiding from poor sphincter relaxation (ROC area = 0.93).

More recently, Solomon and Greenwell devised a female BOO nomogram allowing calculation of the female BOO index (BOOIf) using a formula $BOOIf = P_{det}Q_{max}-2.2Q_{max}$ (51):

BOOIf < 0: < 10% probability of obstruction
5 < BOOIf < 18: equivocal, ≥ 50% likelihood of obstruction
BOOIf > 18: > 90% likelihood of obstruction

Voiding cystourethrography alone or in conjunction with concomitant pressure-flow studies may be useful in delineating the site of obstruction (49).

2.2.2 Disease management

Therapeutic interventions for BOO aim to decrease outlet resistance and increase urinary flow, improve bladder emptying and reduce LUTS (46,50,52). Treatment choice is dictated by the nature of the underlying cause of the obstruction.

2.2.2.1 Conservative management

Behavioural modification
Behavioural modification aims to improve/correct maladaptive voiding. It can include elements such as education regarding normal voiding function, self-monitoring of symptoms, changes in lifestyle factors, avoidance of constipation, and alteration of voiding technique. Ultimately, techniques aim to improve the coordination and synergistic action between the detrusor and sphincter (46,50,52). General interventions such as those listed above may help with symptoms resulting from BOO but no quantification of their effect is possible from existing published data.

Pelvic floor muscle training +/− biofeedback
PFM relaxation training with biofeedback may result in relaxation of the PFM/urethral sphincter in women with dysfunctional voiding. A case-series involving women with pelvic muscle or external urethral sphincter hyperactivity during voiding reported improved relaxation and voiding function following PFMT with biofeedback (53). High quality RCTs are needed to confirm such observations.

Use of vaginal pessary
In a prospective study of eighteen women with grade three or four cystoceles and urodynamic BOO, normal voiding was noted in seventeen (94%) following placement of a vaginal pessary (54).

Urinary catheterisation
In a series of twenty patients with voiding dysfunction after tension-free vaginal tape (TVT) surgery who adopted a CISC programme, 59% had consistent residual volume < 100 mL and 50% were voiding normally within twelve weeks (55).

Intraurethral inserts
In a study among women with voiding dysfunction, device removal within seven days of insertion occurred in 60% of cases due to discomfort, peri-catheter leakage or technical difficulty. The 20% who continued to use the device long-term were satisfied, with PVR volumes remaining < 100 mL. Adverse events included device migration and symptomatic UTI (56,57). There is no convincing evidence from RCTs to support their use.

Extracorporeal magnetic stimulation
In a small prospective non-randomised trial, alfuzosin was compared to electromagnetic stimulation (EMS) and to the combination of both in women with functional BOO. Significant increases of Q_{max} and decreases in symptoms was seen in all groups with greater improvements in the combination therapy group (58).

2.2.2.2 Pharmacological management

Alpha-adrenergic blockers
In the only placebo-controlled RCT reporting subgroup analyses in women with urodynamically-proven BOO, no significant difference was observed in symptoms, Q_{max}, PVR after eight weeks of alfuzosin versus placebo (59). A small non-randomized trial compared the use of tamsulosin and prazosin. More patients treated with tamsulosin showed decrease symptoms and treatment satisfaction. More adverse events were reported with prazosin (60).

Striated muscle relaxants
A randomised placebo-controlled crossover trial investigated oral baclofen in 60 women diagnosed with BOO. It showed a lower number of voids, improvements in Q_{max} and $P_{det}Q_{max}$ with four weeks of baclofen compared with placebo (61).

Sildenafil
A placebo-controlled, randomised crossover trial in women with BOO showed that sildenafil is not superior to placebo in improving symptoms or urodynamic parameters of female BOO(62).

Thyrotropin-releasing hormone
A small RCT including women with voiding problems of mixed aetiologies showed no difference in urodynamic outcomes between intravenous thyrotropin-releasing hormone (TRH) and placebo(63).

2.2.2.3 Surgical management

Intra-sphincteric botulinum toxin injection
A SR in women with dysfunctional voiding showed improvements in symptoms and reductions in residual volume as well as voiding pressure. Larger series in adults describe success rates of 86–100% (64). In a randomised study 100 U onabotulinumtoxinA resulted in significantly lower IPSS score and larger voided volume in adults with voiding dysfunction (65). Two small case series in women with BOO who underwent 100 U intra-sphincteric

injection of BTA showed improvements in symptoms, significant reduction in PVR, increased Q_{max} and improved static urethral pressure profile (UPP)(40,66). The average symptom-free duration was 16.8 weeks (66). Adverse events included UTI and temporary need for CISC. No SUI was reported.

Sacral nerve stimulation

A cohort study of women who underwent SNS for urinary retention associated with outlet obstruction showed an overall spontaneous voiding rate of 72% over a mean follow-up of 4 years (67). In a single-centre series of patients with idiopathic urinary retention who underwent SNS, 62.5% achieved a > 50% reduction in CISC rate (68).

Pelvic organ prolapse surgery

A multicentre prospective study involving women with at least grade 2 symptomatic POP who underwent surgery demonstrated a significant reduction in voiding symptoms and PVR volume 1 year postoperatively (69). A retrospective study of women who underwent laparoscopic sacrocolpopexy for POP showed a significant increase in mean postoperative Q_{max} and decrease in $P_{det}Q_{max}$ and PVR in those aged ≥ 65 years (70).

Urethral dilatation

Pooled analysis of data from a systematic review retrospective studies of females with urethral stricture showed a mean success rate of 49% after urethral dilation to 41 Fr with a mean follow-up of 46 months. Mean time to failure was 12 months. In treatment-naïve patients, success rate was 58%, compared with 27.2% in patients who had undergone previous dilatation (39). Significantly greater improvements in Q_{max} and PVR were seen with intermittent urethral dilatation compared to on-demand dilation for primary urethral stricture (71). Worsening or new-onset SUI, frequency and urgency post-dilatation have been reported (72).

Urethrotomy

A prospective study of women with urethral strictures who underwent tis urethrotomy to 40 Fr followed by 6-weekly dilatations demonstrated improvement in international prostate symptom score (IPSS), QoL, voided volume, Q_{max} and PVR volume at six months. Only the improvements in PVR volume and QoL were maintained on long-term follow-up (73).

Bladder neck incision/resection

A review of case studies on bladder neck incision for the treatment of bladder neck obstruction in women reports success rates of 76–100% (45). Several prospective case series consistently reported significant improvements in IPSS, QoL, Q_{max}, $P_{det}Q_{max}$ and PVR after treatment regardless of the site of the incision, type of energy used or length of follow-up (74–77). Reported complications included vesico-vaginal fistula (VVF) (3.6%), SUI (4.7%) and urethral stricture (3.6%). Complications of VVF and SUI were noted in the cohort of patients who had their incisions at 5 and 7 o'clock positions, and not in those who had their incisions at 2 and 10 o'clock (77).

Bladder neck incision and V-Y-reconstruction using Nesbit's technique in women with BOO showed similar symptomatic improvement rates and postoperative PVR volume. V-Y plasty

had a longer operating and catheter time, lower improvement rate, higher transfusion rate, and higher adverse event rate (78).

Urethroplasty/urethral reconstruction
Retrospective studies reporting outcomes of urethroplasty detail success rates of 57–100% (39,79). Pooled analysis from studies using vaginal or labial flaps showed a mean success rate of 91% with a mean follow-up of 32 months. Vaginal or labial graft urethroplasty had an 80% success rate with a mean follow-up of 22 months. Oral mucosal grafts had a mean success of 94% after a mean follow-up of fifteen months (39). A later review of retrospective studies on dorsal buccal mucosal graft reported success rates of 62–100%, with a pooled success rate of 86% (80). A long-term study with a mean follow-up of 32 months showed a stricture recurrence rate of 23.1% (79).

A retrospective study compared women who underwent urethral dilatation or dorsal onlay pedicled labium flap urethroplasty, reported significant improvements in both groups. The urethroplasty group had significantly better QoL scores and Q_{max} at follow-up compared with the dilatation group (81). Adverse events associated with urethroplasty include new-onset SUI and urgency and worsening of UUI.

Urethrolysis
Case series show improved voiding and lower residual volumes, improvement or resolution of symptoms and QoL, and improvement of urodynamic parameters after treatment (82–84). *De novo* SUI was reported in 39% in one study (84). A greater delay in performing urethrolysis was found to be associated with persistent bladder symptoms (85).

Removal/excision/section/loosening of midurethral sling
Several small retrospective reviews of cases using different techniques of sling revision (incision, partial excision, or excision) showed good success rates in terms of symptom reduction, resumption of voiding with significant reduction in PVR volume and improvement of urodynamic parameters. SUI recurs in a small proportion of patients and often to a lesser degree than prior to the sling procedure. Studies have shown long-term efficacy, including preservation of continence.

No significant difference in success rates was demonstrated when comparing different techniques. There was a greater need for surgery for recurrent SUI after partial sling excision group without an anti-SUI procedure(86).

One study showed that patients who underwent surgical release > 180 days after initial anti-UI surgery had significantly less recurrent SUI compared with patients who underwent the release sooner (87).

Recommendations for the management of female BOO are provided in Table 2.

Please insert Table 2 here

BOO= bladder outlet resistance; CISC = clean intermittent self-catheterisation; PFMT = pelvic floor muscle training; PFM = pelvic floor muscle; POP = pelvic organ prolapse; PVR = post-void residual; QoL = quality of life; SUI = stress urinary incontinence; TRH = thyrotropin-releasing hormone; VVF= vesico-vaginal fistula; UI= urinary incontinence.

2.3 Nocturia

Nocturia was defined by the International Continence Society in 2002 as "the complaint that the individual has to wake at night one or more times to void" and quantified in an updated document in 2019 as "the number of times an individual passes urine during their main sleep period, from the time they have fallen asleep up to the intention to rise from that period" (88).

2.3.1 Diagnostic evaluation

Evaluation of nocturia should include a thorough medical history and physical examination with particular reference to history of sleep disorders, fluid balance, associated LUTS, cardiovascular and endocrine comorbidity, renal disease, current medications and history of urological disease (89).

A bladder diary is a vital initial investigation in patients complaining of nocturia. A low nocturnal bladder capacity or global bladder capacity will be highlighted by reduced voided volumes. Global polyuria is defined as 24-hour urine production > 40 mL/kg (90) and may be present in conditions such as diabetes mellitus or diabetes insipidus. The definition of nocturnal polyuria is age dependent and the thresholds for this diagnosis range from 20% (in younger persons) to 33% (age > 65 years) of the 24-hour urine volume produced during sleep. A large study conducted across European and American centres involving ~2000 patients identified nocturnal polyuria as a contributory cause of nocturia in 89% of patients who were being treated for LUT abnormalities.

2.3.2 Disease management

2.3.2.1 Conservative management

Due to the lack of high-quality evidence, most recommendations are derived from consensus methodology. Interventions that may help with nocturia include:

- reduction of fluid intake at specific times;
- avoidance/moderation of intake of caffeine or alcohol;
- distraction techniques;
- bladder retraining;
- PFMT;
- reviewing medication;
- treatment of constipation.

In the EAU systematic review (91), three studies (92–94) were favourable for conservative treatment with PFMT, with another failing to confirm a benefit (95).
Individual or group PFMT appears to be equally effective for reduction in nocturia episodes (95) . Most studies evaluating PFMT for nocturia in women with additional urinary symptoms have shown positive results compared with placebo, transcutaneous electrical nerve stimulation (TENS) or anticholinergic drugs (92,93,95).

In patients with obstructive sleep apnoea who complain of nocturia, continuous positive airway pressure has been shown to be effective in a systematic review and meta-analysis of five RCTs involving both sexes (96).

2.3.2.2 Pharmacology management

Desmopressin

In a recent SR (91), three trials specifically conducted in women were found. A dose-response relationship was observed. Significant changes in nocturnal urine volumes were reported in favour of higher desmopressin doses. Differences in the nocturnal polyuria index also tended to favour desmopressin over placebo. The level of certainty of the evidence from these trials are low. Desmopressin treatment for nocturia shows significant reductions in nocturnal urine output, nocturnal urinary frequency and nocturnal polyuria index (97–99). Most nocturia patients tolerate desmopressin treatment without clinically significant hyponatraemia; however, the risk increases with increasing age and decreasing baseline serum sodium concentration (91).

Desmopressin treatment in elderly patients should include careful monitoring of the serum sodium concentration and should be avoided in patients with a baseline serum sodium concentration below normal range (100).

Desmopressin can be safely combined with anticholinergics with significant additional benefit in women with OAB and nocturnal polyuria, as shown by a multicenter RCT of 97 patients (101).

Anticholinergics

A SR (91) identified three RCTs involving anticholinergics such as oxybutynin (94) and tolterodine (95, 101). Treatment of nocturia in OAB patients with anticholinergic drugs shows reduction in nocturia episodes.

Oestrogens

In a recent systematic review (91) only a single RCT investigating the efficacy of oestrogen for nocturia was identified (102). Vaginal oestrogen may be beneficial in the treatment of nocturia in around 50% of women, but the certainty of evidence for this outcome was low.

Diuretic treatment

A randomised placebo-controlled study investigated afternoon (timed) diuretic treatment with furosemide, observing a reduction of nocturia episodes and nocturnal voided volume in men, but no similar studies have been conducted in women (103).

Recommendations for the management of Nocturia are provided in Table 3.

Please insert Table 3 here

LUT(S) = lower urinary tract (symptoms); OAB = overactive bladder; PFMT = pelvic floor muscle training; UUI = urge urinary incontinence.

3. Conclusion

Non-neurogenic FLUTS encompasses a broad range of symptomatology and conditions, and diagnostic uncertainty is common. A thorough history and stepwise, logical approach to investigation is required to arrive at an accurate diagnosis. Management should be guided by individual patient factors as well as utilizing a collaborative approach with patients to guide treatment decisions.

References

1. Chapple CR, Osman NI, Birder L, Dmochowski R, Drake MJ, van Koeveringe G, et al. Terminology report from the International Continence Society (ICS) Working Group on Underactive Bladder (UAB). Neurourol Urodyn [Internet]. 2018;37(8):2928–31. Available from: http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1520-6777
2. Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, Ulmsten U, et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. Neurourol Urodyn [Internet]. 2002;21(2):167–78. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=11857671
3. Uren AD, Cotterill N, Harding C, Hillary C, Chapple C, Lasch K, et al. The development of the ICIQ-UAB: A patient reported outcome measure for underactive bladder. Neurourol Urodyn. 2019;38(3):996–1004.
4. Kira S, Mitsui T, Kobayashi H, Haneda Y, Sawada N, Takeda M. Detrusor pressures in urodynamic studies during voiding in women. Int Urogynecol J [Internet]. 2017 May 20 [cited 2017 Jun 4];28(5):783–7. Available from: http://link.springer.com/10.1007/s00192-016-3203-5
5. Osman NI, Esperto F, Chapple CR. Detrusor Underactivity and the Underactive Bladder: A Systematic Review of Preclinical and Clinical Studies [Internet]. Vol. 74, European Urology. 2018. p. 633–43. Available from: https://doi.org/10.1016/j.eururo.2018.07.037
6. Jeong SJ, Lee JK, Kim KM, Kook H, Cho SY, Oh SJ. How do we diagnose detrusor underactivity? Comparison of diagnostic criteria based on an urodynamic measure. Investig Clin Urol [Internet]. 2017;58(4):247–54. Available from: http://www.icurology.org/index.php?body=instruction
7. Griffiths DJ, Constantinou CE, van Mastrigt R. Urinary bladder function and its control in healthy females. Am J Physiol [Internet]. 1986 Aug [cited 2020 Sep 23];251(2 Pt 2):R225-30. Available from: http://www.ncbi.nlm.nih.gov/pubmed/3740303
8. Abrams P. Bladder outlet obstruction index, bladder contractility index and bladder

voiding efficiency: Three simple indices to define bladder voiding function. BJU Int. 1999;84(1):14–5.
9. Tan TL, Bergmann M a, Griffiths D, Resnick NM. Stop test or pressure-flow study? Measuring detrusor contractility in older females. Neurourol Urodyn [Internet]. 2004 Jan [cited 2013 Dec 1];23(3):184–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15098212
10. Griffiths DJ. Assessment of detrusor contraction strength or contractility. Neurourol Urodyn [Internet]. 1991 Jan 1 [cited 2020 Sep 23];10(1):1–18. Available from: http://doi.wiley.com/10.1002/nau.1930100102
11. Van Koeveringe GA, Vahabi B, Andersson KE, Kirschner-Herrmans R, Oelke M. Detrusor underactivity: A plea for new approaches to a common bladder dysfunction [Internet]. Vol. 30, Neurourology and Urodynamics. John Wiley & Sons, Ltd; 2011 [cited 2020 Aug 3]. p. 723–8. Available from: http://doi.wiley.com/10.1002/nau.21097
12. Salvatore S, Rademakers K, DeLancey J, Igawa Y, Koelbl H, Laterza R, et al. Pathophysiology of urinary incontinence, faecal incontinence and pelvic organ prolapse. In: Abrams P, Cardozo L, Wagg A, Wein A, editors. Incontinence 2017. 6th ed. ICS-ICUD; 2017. p. 361–495.
13. El Akri M, Brochard C, Hascoet J, Jezequel M, Alimi Q, Khene Z eddine, et al. Risk of prolapse and urinary complications in adult spina bifida patients with neurogenic acontractile detrusor using clean intermittent catheterization versus Valsalva voiding. Neurourol Urodyn [Internet]. 2019 [cited 2020 Sep 28];38(1):269–77. Available from: http://www.ncbi.nlm.nih.gov/pubmed/30311685
14. Naess I, Bø K. Can maximal voluntary pelvic floor muscle contraction reduce vaginal resting pressure and resting EMG activity? Int Urogynecol J [Internet]. 2018 Nov [cited 2020 Oct 5];29(11):1623–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/29532122
15. Mercier J, Morin M, Tang A, Reichetzer B, Lemieux M-C, Samir K, et al. Pelvic floor muscle training: mechanisms of action for the improvement of genitourinary syndrome of menopause. Climacteric [Internet]. 2020 Oct [cited 2020 Oct 5];23(5):468–73. Available from: http://www.ncbi.nlm.nih.gov/pubmed/32105155
16. Ladi-Seyedian S, Kajbafzadeh A-M, Sharifi-Rad L, Shadgan B, Fan E. Management of non-neuropathic underactive bladder in children with voiding dysfunction by animated biofeedback: a randomized clinical trial. Urology [Internet]. 2015 Jan [cited 2020 Aug 3];85(1):205–10. Available from: http://www.ncbi.nlm.nih.gov/pubmed/25444633
17. Apostolidis A, Drake MJ, Emmanuel A, Gajewski J, Hamid R, Heesakkers J, et al. Neurological Urinary and fecal incontinence. In: Abrams P, Cardozo L, Wagg A, Wein A, editors. Incontinence 2017. 6th ed. ICS ICUD; 2017. p. 1095–308.
18. Huber ER, Kiss G, Berger T, Rehder P, Madersbacher H. [The value of intravesical electrostimulation in the treatment of acute prolonged bladder overdistension]. Urologe A [Internet]. 2007 Jun [cited 2020 Aug 3];46(6):662–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17356837
19. Barendrecht MM, Oelke M, Laguna MP, Michel MC. Is the use of parasympathomimetics for treating an underactive urinary bladder evidence-based? BJU Int [Internet]. 2007 Apr 1 [cited 2017 Jun 3];99(4):749–52. Available from: http://doi.wiley.com/10.1111/j.1464-410X.2006.06742.x

20. Chang SJ, Chiang IN, Yu HJ. The effectiveness of tamsulosin in treating women with voiding difficulty. Int J Urol. 2008;15(11):981–5.
21. Costantini E, Lazzeri M, Bini V, Zucchi A, Fioretti F, Frumenzio E, et al. Open-label, longitudinal study of tamsulosin for functional bladder outlet obstruction in women. Urol Int [Internet]. 2009 [cited 2020 Aug 30];83(3):311–5. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19829032
22. Yamanishi T, Yasuda K, Kamai T, Tsujii T, Sakakibara R, Uchiyama T, et al. Combination of a cholinergic drug and an α-blocker is more effective than monotherapy for the treatment of voiding difficulty in patients with underactive detrusor. Int J Urol [Internet]. 2004 Feb [cited 2017 May 30];11(2):88–96. Available from: http://doi.wiley.com/10.1111/j.1442-2042.2004.00753.x
23. Buckley BS, Lapitan MCM. Drugs for treatment of urinary retention after surgery in adults. Cochrane Database Syst Rev [Internet]. 2010 Oct 6 [cited 2019 Sep 15];(10):CD008023. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20927768
24. Jonas U, Fowler CJ, Chancellor MB, Elhilali MM, Fall M, Gajewski JB, et al. Efficacy of sacral nerve stimulation for urinary retention: results 18 months after implantation. J Urol [Internet]. 2001 Jan [cited 2020 Aug 2];165(1):15–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11125353
25. Gross C, Habli M, Lindsell C, South M. Sacral neuromodulation for nonobstructive urinary retention: a meta-analysis. Female Pelvic Med Reconstr Surg [Internet]. 2010 Jul [cited 2017 May 27];16(4):249–53. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22453352
26. Gani J, Hennessey D. The underactive bladder: Diagnosis and surgical treatment options. Transl Androl Urol [Internet]. 2017 Jul;6(Supplement2):S186–95. Available from: http://tau.amegroups.com/article/download/14668/14851
27. Swinn MJ, Kitchen ND, Goodwin RJ, Fowler CJ. Sacral neuromodulation for women with Fowler's syndrome. Eur Urol [Internet]. 2000 Oct [cited 2017 May 28];38(4):439–43. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11025383
28. Panicker JN, Fowler CJ, Kessler TM. Lower urinary tract dysfunction in the neurological patient: Clinical assessment and management [Internet]. Vol. 14, The Lancet Neurology. Lancet Neurol; 2015 [cited 2020 Aug 6]. p. 720–32. Available from: https://pubmed.ncbi.nlm.nih.gov/26067125/
29. Kuo HC. Recovery of Detrusor Function After Urethral Botulinum A Toxin Injection in Patients with Idiopathic Low Detrusor Contractility and Voiding Dysfunction. Urology [Internet]. 2007 [cited 2020 Aug 6];69(1):57–61. Available from: https://pubmed.ncbi.nlm.nih.gov/17270614/
30. Kuo HC. Effect of botulinum A toxin in the treatment of voiding dysfunction due to detrusor underactivity. Urology [Internet]. 2003 [cited 2020 Aug 6];61(3):550–4. Available from: https://pubmed.ncbi.nlm.nih.gov/12639645/
31. Lee, Kuo H-CC, Lee YK, Kuo H-CC. Therapeutic Efficacy and Quality of Life Improvement in Women with Detrusor Underactivity following Transurethral Incision of the Bladder Neck. Urol Sci [Internet]. 2019 [cited 2020 Aug 5];30(6):266–71. Available from: http://www.e-urol-sci.com/article.asp?issn=1879-5226;year=2019;volume=30;issue=6;spage=266;epage=271;aulast=Lee
32. Groutz A, Blaivas JG, Chaikin DC. Bladder outlet obstruction in women: definition and characteristics. Neurourol Urodyn [Internet]. 2000;19(3):213–20. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=C

itation&list_uids=10797578
33. Massey JA, Abrams PH. Obstructed voiding in the female. Br J Urol [Internet]. 1988;61(1):36–9. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=3342298
34. Gravina GL, Costa AM, Galatioto GP, Ronchi P, Tubaro A, Vicentini C. Urodynamic obstruction in women with stress urinary incontinence--do nonintubated uroflowmetry and symptoms aid diagnosis? J Urol. 2007 Sep;178(3 Pt 1):954–9.
35. Brucker BM, Shah S, Mitchell S, Fong E, Nitti MD, Kelly CE, et al. Comparison of urodynamic findings in women with anatomical versus functional bladder outlet obstruction. Female Pelvic Med Reconstr Surg. 2013;19(1):46–50.
36. Hsiao SM, Lin HH, Kuo HC. Videourodynamic Studies of Women with Voiding Dysfunction. Sci Rep [Internet]. 2017;7(1):6845. Available from: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed18&NEWS=N&AN=626152190
37. Klijer R, Bar K, Białek W. Bladder outlet obstruction in women: difficulties in the diagnosis. Urol Int. 2004;73(1):6–10.
38. Galica V, Toska E, Saldutto P, Galatioto GP, Vicentini C. Use of transvaginal ultrasound in females with primary bladder neck obstruction. A preliminary study. Arch Ital di Urol Androl organo Uff [di] Soc Ital di Ecogr Urol e Nefrol. 2015 Jul;87(2):158–60.
39. Osman NI, Mangera A, Chapple CR. A systematic review of surgical techniques used in the treatment of female urethral stricture. Eur Urol [Internet]. 2013;64(6):965–73. Available from: http://dx.doi.org/10.1016/j.eururo.2013.07.038
40. Panicker JN, Anding R, Arlandis S, Blok B, Dorrepaal C, Harding C, et al. Do we understand voiding dysfunction in women? Current understanding and future perspectives: ICI-RS 2017. Neurourol Urodyn [Internet]. 2018;37(S4):S75–85. Available from: http://doi.wiley.com/10.1002/nau.23709
41. Webb RJ, Fawcett PR, Neal DE. Electromyographic abnormalities in the urethral and anal sphincters of women with idiopathic retention of urine. Br J Urol. 1992 Jul;70(1):22–5.
42. Tawadros C, Burnett K, Derbyshire LF, Tawadros T, Clarke NW, Betts CD. External urethral sphincter electromyography in asymptomatic women and the influence of the menstrual cycle. BJU Int. 2015 Sep;116(3):423–31.
43. Fowler CJ, Christmas TJ, Chapple CR, Parkhouse HF, Kirby RS, Jacobs HS. Abnormal electromyographic activity of the urethral sphincter, voiding dysfunction, and polycystic ovaries: a new syndrome? BMJ. 1988 Dec;297(6661):1436–8.
44. Abdel Raheem A, Madersbacher H. Voiding dysfunction in women: How to manage it correctly. Arab J Urol [Internet]. 2013 [cited 2017 May 27];11(4):319–30. Available from: http://www.sciencedirect.com/science/article/pii/S2090598X13000855
45. Nitti VW. Primary bladder neck obstruction in men and women. Rev Urol. 2005;7 Suppl 8(Suppl 8):S12-7.
46. Hoffman DS, Nitti VW. Female Bladder Outlet Obstruction. Curr Urol Rep. 2016 Apr;17(4):31.
47. Blaivas JG, Groutz A. Bladder outlet obstruction nomogram for women with lower urinary tract symptomatology. Neurourol Urodyn. 2000;19(5):553–64.
48. Akikwala T V, Fleischman N, Nitti VW. Comparison of diagnostic criteria for female bladder outlet obstruction. J Urol. 2006 Nov;176(5):2093–7.

49. Nitti VW, Tu LM, Gitlin J. Diagnosing bladder outlet obstruction in women. J Urol. 1999 May;161(5):1535–40.
50. Rademakers K, Apostolidis A, Constantinou C, Fry C, Kirschner-Hermanns R, Oelke M, et al. Recommendations for future development of contractility and obstruction nomograms for women. ICI-RS 2014. Neurourol Urodyn. 2016 Feb;35(2):307–11.
51. Solomon E, Yasmin H, Duffy M, Rashid T, Akinluyi E, Greenwell TJ. Developing and validating a new nomogram for diagnosing bladder outlet obstruction in women. Neurourol Urodyn. 2018;37(1):368–78.
52. Meier K, Padmanabhan P. Female bladder outlet obstruction: an update on diagnosis and management. Curr Opin Urol. 2016 Jul;26(4):334–41.
53. Deindl FM, Vodusek DB, Bischoff C, Hofmann R, Hartung R. Dysfunctional voiding in women: which muscles are responsible? Br J Urol. 1998 Dec;82(6):814–9.
54. Romanzi LJ, Chaikin DC, Blaivas JG. The effect of genital prolapse on voiding. J Urol. 1999 Feb;161(2):581–6.
55. Bailey C, Matharu G. Conservative management as an initial approach for post-operative voiding dysfunction. Eur J Obstet Gynecol Reprod Biol. 2012 Jan;160(1):106–9.
56. Madjar S, Sabo E, Halachmi S, Wald M, Issaq E, Moskovitz B, et al. A remote controlled intraurethral insert for artificial voiding: a new concept for treating women with voiding dysfunction. J Urol. 1999 Mar;161(3):895–8.
57. Madjar S, Halachmi S, Wald M, Issaq E, Moskovitz B, Beyar M, et al. Long-term follow-up of the in-flowtrade mark intraurethral insert for the treatment of women with voiding dysfunction. Eur Urol. 2000 Aug;38(2):161–6.
58. Koh JS, Kim SJ, Kim HS, Kim JC. Comparison of alpha-blocker, extracorporeal magnetic stimulation alone and in combination in the management of female bladder outlet obstruction. Int Urogynecol J. 2011 Jul;22(7):849–54.
59. Lee Y-S, Lee K-S, Choo M-S, Kim JC, Lee JG, Seo JT, et al. Efficacy of an Alpha-Blocker for the Treatment of Nonneurogenic Voiding Dysfunction in Women: An 8-Week, Randomized, Double-Blind, Placebo-Controlled Trial. Int Neurourol J. 2018 Mar;22(1):30–40.
60. Hajebrahimi S, Asrbadr YA, Azaripour A, Sadeghi-Bazargani H. Effect of tamsulosin versus prazosin on clinical and urodynamic parameters in women with voiding difficulty: a randomized clinical trial. Int J Gen Med. 2011 Jan;4:35–9.
61. Xu D, Qu C, Meng H, Ren J, Zhu Y, Min Z, et al. Dysfunctional voiding confirmed by transdermal perineal electromyography, and its effective treatment with baclofen in women with lower urinary tract symptoms: a randomized double-blind placebo-controlled crossover trial. BJU Int. 2007 Sep;100(3):588–92.
62. Datta SN, Kavia RBC, Gonzales G, Fowler CJ. Results of double-blind placebo-controlled crossover study of sildenafil citrate (Viagra) in women suffering from obstructed voiding or retention associated with the primary disorder of sphincter relaxation (Fowler's Syndrome). Eur Urol. 2007 Feb;51(2):487–9.
63. Rosario DJ, Woo HH, Parkhouse H, Chapple CR. Effects of intravenous thyrotropin-releasing hormone on urethral closure pressure in females with voiding dysfunction. Eur Urol. 1995;28(1):64–7.
64. Kao YL, Huang KH, Kuo HC, Ou YC. The therapeutic effects and pathophysiology of botulinum toxin a on voiding dysfunction due to urethral sphincter dysfunction [Internet]. Vol. 11, Toxins. 2019 [cited 2020 Sep 28]. p. 728. Available from:

https://www.mdpi.com/2072-6651/11/12/728
65. Jiang Y-H, Wang C-C, Kuo H-C. OnabotulinumtoxinA Urethral Sphincter Injection as Treatment for Non-neurogenic Voiding Dysfunction - A Randomized, Double-Blind, Placebo-Controlled Study. Sci Rep. 2016 Dec;6:38905.
66. Pradhan AA. Botulinum toxin: An emerging therapy in female bladder outlet obstruction. Indian J Urol. 2009 Jul;25(3):318–20.
67. Datta SN, Chaliha C, Singh A, Gonzales G, Mishra VC, Kavia RBC, et al. Sacral neurostimulation for urinary retention: 10-year experience from one UK centre. BJU Int [Internet]. 2008 [cited 2017 Jun 5];101(2):192–6. Available from: http://doi.wiley.com/10.1111/j.1464-410X.2007.07282.x
68. Peeters K, Sahai A, De Ridder D, Van Der Aa F. Long-term follow-up of sacral neuromodulation for lower urinary tract dysfunction. BJU Int. 2014;113(5).
69. Espuña Pons M, Cassadó J, Díez Itza I, Valero Fernández EM. Post-void residual and voiding dysfunction symptoms in women with pelvic organ prolapse before and after vaginal surgery. A multicenter cohort study. Actas Urol Esp. 2021;45(1):57–63.
70. Togo M, Kitta T, Kanno Y, Ouchi M, Tokiwa S, Huang T, et al. Lower urinary tract function improves after laparoscopic sacrocolpopexy for elderly patients with pelvic organ prolapse. Low Urin Tract Symptoms. 2020 Sep;12(3):260–5.
71. Heidari F, Abbaszadeh S, Ghadian A, Tehrani Kia F. On demand urethral dilatation versus intermittent urethral dilatation: results and complications in women with urethral stricture. Nephrourol Mon. 2014 Mar;6(2):e15212.
72. Popat S, Zimmern PE. Long-term management of luminal urethral stricture in women. Int Urogynecol J. 2016 Nov;27(11):1735–41.
73. Grivas N, Tsimaris I, Makatsori A, Hastazeris K, Kafarakis V, Stavropoulos NE. The effectiveness of otis urethrotomy combined with six weeks urethral dilations until 40 Fr in the treatment of bladder outlet obstruction in women: a prospective study. Urol J. 2014 Jan;10(4):1063–6.
74. Fu Q, Xu Y-M. Transurethral incision of the bladder neck using KTP in the treatment of bladder neck obstruction in women. Urol Int. 2009;82(1):61–4.
75. Jin X, Qu H, Liu H, Li B, Wang J, Zhang Y. Modified transurethral incision for primary bladder neck obstruction in women: a method to improve voiding function without urinary incontinence. Urology. 2012 Feb;79(2):310–3.
76. Shen W, Ji H, Yang C, Zhang H, Xiong T, Wu X, et al. Controlled transurethral resection and incision of the bladder neck to treat female primary bladder neck obstruction: Description of a novel surgical procedure. Int J Urol Off J Japanese Urol Assoc. 2016 Jun;23(6):491–5.
77. Zhang P, Wu Z-J, Xu L, Yang Y, Zhang N, Zhang X-D. Bladder neck incision for female bladder neck obstruction: long-term outcomes. Urology. 2014 Apr;83(4):762–6.
78. Choudhury A. Incisional treatment of obstruction of the female bladder neck. Ann R Coll Surg Engl. 1978 Sep;60(5):404–7.
79. Hampson LA, Myers JB, Vanni AJ, Virasoro R, Smith TG 3rd, Capiel L, et al. Dorsal buccal graft urethroplasty in female urethral stricture disease: a multi-center experience. Transl Androl Urol. 2019 Mar;8(Suppl 1):S6–12.
80. Gomez RG, Segura FJ, Saavedra A, Campos RA. Female urethral reconstruction: dorsal buccal mucosa graft onlay. World J Urol. 2020 Dec;38(12):3047–54.
81. Tao T, Xu Q, Hu Q, Huang X, Chen J, Wang W, et al. Novel surgical technique for female distal urethral stricture disease: An evaluation of efficacy and safety

compared with urethral dilatation. Int J Clin Exp Med [Internet]. 2018;11(11):12002–7. Available from: http://www.embase.com/search/results?subaction=viewrecord&from=export&id=L625290686
82. McCrery R, Appell R. Transvaginal urethrolysis for obstruction after antiincontinence surgery. Int Urogynecol J Pelvic Floor Dysfunct. 2007 Jun;18(6):627–33.
83. Mouracade P, Lang H, Jacqmin D, Saussine C. Transvaginal tape lysis for urinary obstruction after suburethral tape placement. When to do an immediate replacement? Int Urogynecol J Pelvic Floor Dysfunct. 2008 Sep;19(9):1271–4.
84. Giannis G, Bousouni E, Mueller MD, Imboden S, Mohr S, Raio L, et al. Can urethrolysis resolve outlet obstruction related symptoms after Burch colposuspension for stress urinary incontinence? Eur J Obstet Gynecol Reprod Biol. 2015 Dec;195:103–7.
85. Leng WW, Davies BJ, Tarin T, Sweeney DD, Chancellor MB. Delayed treatment of bladder outlet obstruction after sling surgery: association with irreversible bladder dysfunction. J Urol. 2004 Oct;172(4 Pt 1):1379–81.
86. Agnew G, Dwyer PL, Rosamilia A, Edwards G, Lee JK. Functional outcomes for surgical revision of synthetic slings performed for voiding dysfunction: a retrospective study. Eur J Obstet Gynecol Reprod Biol. 2012 Jul;163(1):113–6.
87. Van den Broeck T, De Ridder D, Van der Aa F. The value of surgical release after obstructive anti-incontinence surgery: An aid for clinical decision making. Neurourol Urodyn. 2015 Nov;34(8):736–40.
88. Hashim H, Blanker MH, Drake MJ, Djurhuus JC, Meijlink J, Morris V, et al. International Continence Society (ICS) report on the terminology for nocturia and nocturnal lower urinary tract function. Neurourol Urodyn [Internet]. 2019 Jan 15;(November 2018):1–10. Available from: http://doi.wiley.com/10.1002/nau.23917
89. Weiss JP, Everaert K. Management of Nocturia and Nocturnal Polyuria. Urology. 2019 Nov;133S:24–33.
90. Van Kerrebroeck P, Abrams P, Chaikin D, Donovan J, Fonda D, Jackson S, et al. The standardisation of terminology in nocturia: Report from the standardisation sub-committee of the international continence society. Neurourol Urodyn. 2002;21(2):179–83.
91. Bedretdinova D, Ambühl D, Omar MI, Sakalis V, Thiruchelvam N, Schneider M, et al. What Is the Most Effective Treatment for Nocturia or Nocturnal Incontinence in Adult Women? Eur Urol Focus. 2021 Mar;7(2):453–63.
92. Lo SK, Naidu J, Cao Y. Additive Effect of Interferential Therapy Over Pelvic Floor Exercise Alone in the Treatment of Female Urinary Stress and Urge Incontinence: A Randomized Controlled Trial. Hong Kong Physiother J [Internet]. 2003;21(1):37–42. Available from: https://www.sciencedirect.com/science/article/pii/S1013702509700387
93. Aslan E, Komurcu N, Beji NK, Yalcin O. Bladder training and Kegel exercises for women with urinary complaints living in a rest home. Gerontology. 2008;54(4):224–31.
94. Johnson TM 2nd, Burgio KL, Redden DT, Wright KC, Goode PS. Effects of behavioral and drug therapy on nocturia in older incontinent women. J Am Geriatr Soc. 2005 May;53(5):846–50.
95. Fitzgerald MP, Lemack G, Wheeler T, Litman HJ. Nocturia, nocturnal incontinence prevalence, and response to anticholinergic and behavioral therapy. Int Urogynecol J Pelvic Floor Dysfunct. 2008 Nov;19(11):1545–50.

96. Wang T, Huang W, Zong H, Zhang Y. The Efficacy of Continuous Positive Airway Pressure Therapy on Nocturia in Patients With Obstructive Sleep Apnea: A Systematic Review and Meta-Analysis. Int Neurourol J. 2015 Sep;19(3):178–84.
97. Yamaguchi O, Nishizawa O, Juul KV, Nørgaard JP. Gender difference in efficacy and dose response in Japanese patients with nocturia treated with four different doses of desmopressin orally disintegrating tablet in a randomized, placebo-controlled trial. BJU Int. 2013 Mar;111(3):474–84.
98. Lose G, Lalos O, Freeman RM, van Kerrebroeck P. Efficacy of desmopressin (Minirin) in the treatment of nocturia: a double-blind placebo-controlled study in women. Am J Obstet Gynecol. 2003 Oct;189(4):1106–13.
99. Hilton P, Stanton SL. The use of desmopressin (DDAVP) in nocturnal urinary frequency in the female. Br J Urol. 1982 Jun;54(3):252–5.
100. Rembratt A, Riis A, Norgaard JP. Desmopressin treatment in nocturia; an analysis of risk factors for hyponatremia. Neurourol Urodyn. 2006;25(2):105–9.
101. Rovner ES, Raymond K, Andruczyk E, Juul K V. Low-dose Desmopressin and Tolterodine Combination Therapy for Treating Nocturia in Women with Overactive Bladder: A Double-blind, Randomized, Controlled Study. Low Urin Tract Symptoms [Internet]. 2018 Sep [cited 2020 Sep 22];10(3):221–30. Available from: http://www.ncbi.nlm.nih.gov/pubmed/28560762
102. Lose G, Englev E. Oestradiol-releasing vaginal ring versus oestriol vaginal pessaries in the treatment of bothersome lower urinary tract symptoms. BJOG. 2000 Aug;107(8):1029–34.
103. Reynard JM, Cannon A, Yang Q, Abrams P. A novel therapy for nocturnal polyuria: a double-blind randomized trial of frusemide against placebo. Br J Urol [Internet]. 1998 Feb [cited 2019 Nov 12];81(2):215–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/9488061