Treatment options for male stress urinary incontinence

Jaspreet S. Sandhu

Abstract | The diagnosis and management of male stress urinary incontinence (SUI) is complex. Various etiologies exist, with radical prostatectomy being the most common cause in men seeking treatment. SUI in this setting is often temporary and resolves within the first postoperative year. Therefore, it is important to understand the natural history of male SUI before initiating treatment. Generally, the initial management of SUI that persists after 12 months consists of conservative measures, such as pelvic floor muscle exercises. Several treatments are available for men whose continence does not improve after pelvic floor muscle exercises. In order of increasing complexity they are urethral bulking agents, male slings, and the artificial urinary sphincter (AUS). With over 30 years of published data suggesting excellent long-term outcomes, the AUS is considered the gold standard treatment of male SUI. Male slings have recently demonstrated efficacy for selected patients and are likely to be used more often in the future as experience with these devices grows.

Sandhu, J. S. *Nat. Rev. Urol.* **7**, 222–228 (2010); doi:10.1038/nrurol.2010.26

Introduction

Male stress urinary incontinence (SUI) is an increasingly recognized problem, particularly after treatment for prostate cancer. As recently as a decade ago, the prevalence of male urinary incontinence was thought to be 3–11%, with isolated SUI accounting for less than 10% of that number.[1] However, several studies in the last decade have demonstrated that urinary incontinence in males is more prevalent than previously thought; a survey of 840 male veterans in the US revealed a prevalence of 32.3%,[2] and a cross-sectional and longitudinal population-based study in the UK revealed that 14.2% of all men over the age of 40 suffered from urinary incontinence over a 1-year period.[3] The latter study also revealed higher rates for older men, with a prevalence of 30.5% in men over the age of 80 years. Similarly, an evaluation of cross-sectional data from the 2004 Medicare Health Outcomes Study revealed that 27.9% of male Medicare beneficiaries reported urinary incontinence over a 6-month period.[4] A recent US population-based study of 1,000 adults aged 18 years or over revealed a 5.4% rate of urinary incontinence in men, with 26% of these men suffering from isolated SUI.[5] The Urologic Diseases in America Project, using cross-sectional data from the National Health and Nutrition Examination Survey, estimated the prevalence of male urinary incontinence in the US to be 17% in 2007.[6]

As the impact of male SUI is increasingly recognized,[6] treatment options continue to evolve. In this Review, we will examine the etiology and impact of male SUI, and discuss the conservative and surgical management of this common malady.

Etiology

The etiology of male SUI is likely to be related, in part, to demographic factors such as advancing age and obesity,[6] but it is also associated with the treatment of prostate diseases. In particular, surgical treatment of benign prostatic hyperplasia or prostate cancer is a well-known cause of SUI. The rate of SUI after transurethral resection of the

Urology Service, Department of Surgery, Memorial Sloan–Kettering Cancer Center, 353 East 68th Street, New York, NY 10065, USA.
sandhuj@mskcc.org

Competing interests
The author declares an association with the following company: American Medical Systems. See the article online for full details of the relationship. The CME questions author D. Lie has served as a nonproduct speaker for "Topics in Health" for Merck Speaker Services. The Journal Editor S. Farley declares no competing interests.

prostate (TURP)—the most frequently performed surgical treatment for lower urinary tract symptoms secondary to benign prostatic hyperplasia—is thought to be quite low. The AUA clinical guideline on management of benign prostatic hyperplasia reports an incidence of incontinence after TURP of less than 3%.[7] A recent study reported rates of iatrogenic SUI following TURP to be less than 0.5%.[8] Other endoscopic procedures, including laser ablation and transurethral incision of the prostate, result in similar low rates of SUI. Radical prostatectomy (RP), on the other hand, is associated with much higher rates of urinary incontinence. Regardless of approach, RP causes changes in urinary function that usually resolve by the end of the first postoperative year. It should be noted that SUI is only one type of urinary incontinence; urge urinary incontinence and overflow urinary incontinence can sometimes be mistaken for SUI. The specific type of incontinence can be determined with a detailed history and physical examination along with urodynamics testing and cystoscopy. Unfortunately, many reports—particularly epidemiologic studies—do not differentiate between SUI and urinary incontinence in general.

Proposed risk factors for urinary incontinence after RP are: advancing age at the time of RP;[6,9,10] neurovascular bundle resection;[9–11] the presence of an anastomotic stricture;[8] high BMI;[12] increased prostate volume;[13] previous history of TURP;[14] and decreased membranous urethral length.[15,16] Several surgical maneuvers have been proposed to reduce the incidence of postprostatectomy urinary incontinence, including bladder neck preservation, sparing of the seminal vesicles, suspension of the urethra, bladder neck intussusception, and mucosal eversion of bladder neck.[9,14,15,17] Surgeon experience and technique also impact on urinary outcomes after RP.[18] The etiology of urinary incontinence can be difficult to ascertain because of its multifactorial nature. However, treatment can generally be tailored to the patient based on straightforward evaluations. Men are generally not evaluated unless they actively seek treatment for their urinary incontinence, and even then it is usually not until at least a year after RP.

Most men suffer from incontinence immediately after RP. Recovery of urinary continence usually takes up to a year, but can take up to 3 years in a small minority of men.[19] Up to 95% of patients presenting with postprostatectomy incontinence have SUI, as opposed to any other type of urinary incontinence.[21] Radiotherapy for prostate cancer can also cause urinary incontinence, but SUI after modern radiotherapy is rare, with a recent report claiming a rate of 0.7% in the absence of TURP.[22] One must be cautious in the treatment of bladder outlet obstruction after radiotherapy or cryotherapy, as these patients are more likely to develop SUI.[22,23] Men who undergo salvage RP after previous attempts at definitive treatment with primary radiotherapy or cryotherapy have failed have much higher rates of urinary incontinence, reported to be roughly 50%.[24,25]

Other causes of SUI include pelvic trauma or surgery and neurologic or muscular disorders that affect the pudendal nerve or the urethral sphincter. Currently, most incontinence surgery for men is performed on individuals with SUI secondary to RP.[26]

Key points

- Currently, the most common etiology of male stress urinary incontinence (SUI) is radical prostatectomy (RP)
- The diagnosis of male SUI can be made with a detailed history, physical examination, and appropriate tests, such as urodynamics and cystoscopy
- Most patients will recover urinary continence within 1 year of prostatectomy, therefore it is very important to understand the natural history of SUI after RP
- Pelvic floor muscle exercises can hasten continence immediately after RP and should be attempted in all men presenting for evaluation of SUI after prostatectomy
- The artificial urinary sphincter and male slings are efficacious in the treatment of male SUI

Burden and impact on quality of life

Many investigators have demonstrated the significant burden of male urinary incontinence. A cross-sectional survey of 840 men receiving primary care at Veteran Affairs facilities across the US showed a high prevalence of urinary incontinence, with 32.3% of men reporting at least one episode over the previous year and 13.8% of men reporting weekly episodes of urinary incontinence.[2] This study revealed a small, but significant, effect of urinary incontinence on emotional health, social relationships, physical activity, and travel. A comprehensive population study to evaluate the effect of urinary incontinence on the health-related quality of life of Medicare beneficiaries was recently performed using the Medical Outcomes Study short form 36.[27] This study relied on a total of 141,815 completed surveys and showed a high prevalence of urinary incontinence of 20.9%. The striking finding of this study was that all health-related quality of life subscores—including 'physical functioning', 'role physical', 'bodily pain', 'general health', 'vitality', 'social functioning', 'role emotional', and 'mental health'—were adversely impacted by urinary incontinence. In addition, two summary scores (physical and mental) were also significantly negatively affected.

The economic burden of male urinary incontinence is also significant. The Urologic Diseases in America Project estimated total expenditures for the treatment of urinary incontinence in male Medicare beneficiaries aged 65 years and over to be $39 million dollars in 1998, and the individual expense for those suffering with male incontinence to be greater than $7,000 per year.[6]

Management of male SUI

Male SUI is only one of many types of male urinary incontinence. It is important to ensure accurate diagnosis via a thorough evaluation, because the management of SUI is markedly different to that of urge urinary incontinence, which is treated pharmacologically. It is also important to understand the etiology and natural history of male SUI, especially if the cause is an intervention such as RP. In general, the management of male SUI consists of both conservative measures, such as pelvic floor muscle exercises and injection of urethral bulking

agents, and surgical therapies, such as implantation of male slings and the artificial urinary sphincter (AUS).

Surgical treatments, endoscopic or open, are not usually considered for men with SUI until conservative treatments have failed. In those patients who are incontinent after RP, it is prudent to wait at least a year after the operation before undergoing further surgery, and during this time pelvic floor exercises seem to have great benefit.

Conservative management

Conservative management has an important role in the treatment of urinary incontinence after RP. In general, this includes limiting fluid intake (particularly at night), avoiding known bladder irritants (such as caffeine and alcohol), and pelvic floor exercises. Although bladder training and timed voiding can be efficacious in women, particularly in the short term, they have not been shown to be useful in men.[28,29]

Pelvic floor exercises and behavioral modifications

Pelvic floor exercises, also known as 'Kegel exercises' after the physician who popularized them, consist of intermittent voluntary contractions of the urethral sphincter muscle. The duration and the number of contractions performed per day have not been standardized, but most experts believe that these exercises should be performed multiple times daily for a few months to see any effect. If patients are unable to generate a urethral sphincter muscle contraction, aides such as biofeedback can be helpful. Pelvic floor exercises have been studied in the setting of postprostatectomy incontinence and appear to be beneficial at hastening return of continence. A randomized controlled trial to evaluate the effect of pelvic floor exercise in men who had undergone RP used urinary continence (measured by 24 h pad weight) at 3 months after surgery as the primary end point.[30] In this study, 88% of men in the treatment group achieved complete continence, compared to 56% in the placebo group. At 1 year after prostatectomy, the difference between the two groups was only 14%. Subsequently, Filocamo *et al.*[31] randomized 300 consecutive patients who had undergone RP for clinically confined prostate cancer to either a structured pelvic floor muscle training program that began before discharge and consisted of Kegel exercises, or to the control group, who did not receive formal pelvic floor muscle training. Incontinence was assessed objectively using the 1 h and 24 h pad test, and the International Continence Society male questionnaire. This trial showed an earlier return to continence in the patients on the pelvic floor muscle training progam, with 74% of the treated men being dry at 3 months, compared to 30% in the untreated group.[31] Although this difference was statistically significant, the difference at 1 year (98.7% versus 88.0%) was not. Most men regain continence after RP without intervention; it appears that pelvic floor exercises can reduce time to continence, at least in the first postoperative year. Although the benefit of pelvic floor muscle exercises appears to be limited to the early postoperative period, it has not been rigidly studied in patients presenting for the treatment of incontinence after RP. As such, a trial of pelvic floor exercises appears prudent for all men presenting for management of SUI, particularly those men who have recently undergone RP. Pelvic floor muscle exercises should also be first-line therapy for men suffering from SUI secondary to TURP[32,33] or radiotherapy, although the benefit in the latter group is not clearly defined.

Biofeedback

Biofeedback involves the use of equipment to provide auditory or visual feedback to the patient concerning their pelvic floor muscle contractions, in order to enable patients to perform these exercises adequately. Burgio *et al.*[34] studied the use of preoperative biofeedback-assisted behavioral training to decrease postprostatectomy incontinence. Using a rectal probe to measure the strength of pelvic floor muscle contractions and visual feedback, participants were taught pelvic floor muscle control. Patients were then given instructions for daily pelvic floor muscle exercise, which involved contraction of the sphincter muscles for periods of 2–10 s separated by 2–10 s of relaxation, depending on initial ability. The main outcome measurements were duration of incontinence as derived from bladder diaries, severity of incontinence, impact of incontinence, and pad use. The Hopkins Symptom Checklist was used to measure psychological distress and the Medical Outcomes Study short form 36 was used to assess impact on health-related quality of life. The authors concluded that preoperative behavioral training could hasten the recovery of urine control and decrease the severity of incontinence after RP. A similar study performed by Wille *et al.*[35] analyzed the benefit of early biofeedback after RP compared with pelvic floor muscle exercises only; the outcomes measured included a 20 min pad test and a urine symptom questionnaire. This group did not find a difference between patients treated with biofeedback versus those treated with pelvic floor muscle exercises alone.

Urethral bulking agents

Urethral bulking agents have long been used to treat female SUI and have more recently been applied to male SUI, particularly after RP. Gluteraldehyde crosslinked collagen has been approved by the FDA for the treatment of intrinsic sphincter deficiency since 1993. In males with postprostatectomy SUI, the technique consists of endoscopic injection of collagen in the submucosa overlying or just distal to the urethral sphincter, at four sites circumferentially, until the urethra coapts. Injection can be repeated after 4 weeks.

Cummings *et al.*[36] reviewed the use of glutaraldehyde crosslinked collagen for the therapy of postprostatectomy SUI. Preoperative severity of incontinence was measured as mild (1–2 pads per day), moderate (3–4 pads per day) or severe (more than 4 pads per day or total incontinence). Success was based on a scale that rated 'good' as the patient being completely dry or wearing only an occasional pad, 'improved' as a decrease of leakage by 75% or more by patient estimate, and 'failure' as no improvement. Men were also questioned at follow-up regarding the presence of voiding difficulties, retention or irritative symptoms.

The authors reported that 58% of patients had a 'good' or 'improved' result at a mean follow-up of 10.3 months. Smith *et al.*[37] also reviewed a series of men with post-prostatectomy SUI who underwent injection of glutaraldehyde crosslinked collagen, and stratified patients as being 'totally dry' if they experienced no incontinence or 'socially continent' if they used no more than 1 pad daily. Their analysis revealed that 8.1% of the men were totally dry and 38.7% of the men achieved social continence after a median of 4 injections.[37] In a more recent review, Westney *et al.*[38] calculated pad usage before and after collagen therapy. Maximal response was calculated as a percentage, related to the ratio of the number of pads at maximum response to the number of pads required at presentation. 17% of patients were classified as completely dry (using no pads and reporting absolutely no leakage) after collagen injection. Published success rates of urethral bulking agents are difficult to compare because different studies use different numbers of injections and various outcome measures, but they range from 17% to 38%.[36–38]

It should be noted that most authorities do not consider urethral bulking agents as durable treatment for male SUI, particularly after prostatectomy. At the most recent International Consultation on Incontinence,[39] a consensus meeting of incontinence experts, urethral bulking agents were considered as showing only modest success rates with low cure rates for male SUI.

Surgical management

Surgical management with implantable devices remains the mainstay for the correction of male SUI. The most common treatments are the artificial urinary sphincter (AUS) and a variety of male slings. The AUS was first introduced over 30 years ago and has been shown to be efficacious in men with any degree of SUI. It is particularly useful in patients with significant or large-volume SUI. Male slings have gained popularity because they do not require manual manipulation to void, and the current generation has been noted to be efficacious in men with mild to moderate SUI. Selection criteria to determine which patient would be better suited for a particular device do not exist yet; in current practice, surgeon and patient preference are the main determinants.

Male slings

Urethral compression procedures were introduced in the early 1970s when Kaufman published a series of manuscripts evaluating three different techniques designed to improve continence after prostatectomy.[40] His first technique consisted of detaching the crural bodies from their attachment at the ischial tuberosity and reattaching them to the contralateral side, making an 'X' configuration under the bulbar urethra. His second procedure involved mobilization of the crural bodies without detaching them from the ischial tuberosity, and suturing them together under the the bulbar urethra, effectively compressing the urethra. Success rates, defined as 'no leakage', were 32% for the first and 45% for the second procedure. The final procedure, a compressive silicone gel implant placed just under the bulbar urethra, had a success rate, defined as dry without protection, of 63% in 21 men at short-term follow-up.[40] The positive results of these procedures, along with the success of the pubovaginal sling for female SUI, led to the development of many types of male urethral slings.

A male sling based on the needle suspension procedures used for incontinence in women was introduced in the late 1990s. This sling consists of three synthetic bolsters that are placed under the bulbar urethra and suspended above the rectus fascia in the lower abdomen via sutures through the retropubic space. Schaeffer *et al.*[41] reviewed their results of this bulbourethral sling for postprostatectomy SUI in 64 men. Pad usage was measured daily and the patients were stratified into 'dry', 'improved' (greater than 50% reduction in pad usage), and 'wet' groups. The success rate, defined as being completely dry, was 56%.[41] Clemens *et al.*[42] reviewed a series of patients undergoing the same procedure and introduced satisfaction rate as an outcome measure by asking the patient if they would undergo the procedure all over again, and reported a satisfaction rate of 90.2%. A bone-anchored variant of the male sling was reported in 2001.[43] To implant this sling, which is still used and commercially available, a perineal incision is made that exposes the periosteum of the ischiopubic rami on both sides, and three bone anchored polypropylene sutures are placed approximately 1 cm apart on each side. The position of the first, most superior bone anchor is important; it should be a few millimeters away from the pubic symphysis along the medial surface of the ischiopubic ramus. A silicone-coated polyester mesh, with or without antibiotic impregnation, is then attached to all six sutures. Intraoperative maneuvers including retrograde leak point pressure testing or cough testing can be performed, although leak point testing remains controversial, because the mechanism of action of the male sling is unclear. Most surgeons, however, place the mesh so that it is essentially flat across the pelvic outlet, in the belief that during valsalva conditions this will limit movement of the urethra and therefore diminish incontinence. Initial success with this technique, defined as being completely dry or needing a pad only for security without any episodes of incontinence, was reported to be 87.5% in 14 men followed for a mean of 12 months. Comiter[44] prospectively evaluated 21 men who underwent the bone-anchored sling surgery, who were stratified according to their pad usage as well as their score on the UCLA/RAND Prostate Cancer Index urinary function score. This includes 5 questions regarding leakage, frequency, quantity, and bother. In this study, 76% of men demonstrated success, defined as the need for no pads, after a mean of 12 months.[44] Although these patients did not use a pad, no mention is made of whether they leaked urine.

In the series reviewed by Ullrich and Comiter,[45] 22 men were evaluated for pad usage, urodynamic parameters, and the UCLA/RAND Prostate Cancer Index questionnaire before and after placement of a bone-anchored male sling. Average daily pad usage decreased from 4.6 to 0.74 pads and they found no significant change in maximum flow rate or detrusor pressure at maximum flow rate. In terms of satisfaction, 73% of patients reported little or no problem after bone-anchored male sling surgery. Rajpurkar *et al.*[46]

utilized a similar classification to assess cure in their series of 46 patients. They defined patients as 'cured' if they were dry, 'improved' if they were using 1–2 pads per day and 'failed' if they utilized more than 2 pads a day. The authors noted a cure rate of 37% and an improved rate of 37%. In addition, they reported patient satisfaction rates of 70%.

More recently, Fischer *et al.*[47] evaluated the male perineal sling in 62 men and attempted to determine preoperative parameters that could predict success. Patients completed multiple validated questionnaires including the International Prostate Symptom Score, UCLA/RAND Prostate Cancer Index urinary function score, International Consultation on Incontinence short form, Incontinence Impact Questionnaire short form, Patient Global Impression of Improvement (PGI-I), and the Urogenital Distress Index short form. The PGI-I measures patient perception of their lower urinary tract condition. In this study, using the PGI-I responses 'very much improved' or 'much improved' to define success and 'a little better', 'no change', 'a little worse' or 'much worse' to define failure, the authors reported a success rate of 58%. They also found that the patients' perception of success, measured by PGI-I, correlated with their 24 h pad weight and the results of their postoperative questionnaires. While there are many measures of outcome after anti-incontinence surgery, this study suggests that a global question such as PGI-I, is a reasonable way to measure outcomes of male sling surgery.

A transobturator version of the male sling has recently been introduced and is currently used extensively in the US and Europe.[48] This sling is made of polypropylene and is placed through a perineal incision and tensioned via trocars passed through a transobturator route. Initial results with this sling are comparable to initial results with the bone-anchored sling. Published success rates with male slings of all types range from 38% to 76% depending on outcome measures used. The most common complications are infection (reported at a rate of 6% in a recent series[47]) and temporary urinary retention.[40–47] Less common complications include persistent urinary retention (3% rate[47]) and erosion of the sling into the urinary tract (2% rate[47]). Infection or erosion requires removal of the sling, during which the surgeon might encounter significant fibrosis. For this reason, it is important to dissect in close proximity to the sling material. Urinary retention can be dealt with by incising the sling and thereby allowing volitional voiding again.

Artificial urinary sphincter

Many urologists believe the AUS to be the gold standard for male SUI. This device was first introduced in the mid-1970s,[49] and was initially intended to provide external control for urinary incontinence, primarily of neurological origin, in both men and women. The first cohort of patients was 59% female. Of the total study population, 56% had neurologic incontinence, 24% had SUI and 15% had postprostatectomy incontinence. At that time, the device consisted of a urethral cuff placed at the bladder neck, which was connected to an abdominal reservoir via two pumps—one to inflate and one to deflate the cuff. The technique has been modified over time, and the current AUS consists of a urethral cuff (available in multiple sizes), a pressure regulating balloon (available in three different pressures), and a single control pump that is responsible for deflating the cuff and has an auto-refill mechanism. The first series of patients treated with the AUS had an objective cure rate of 100%, which was determined by filling the bladder to capacity with radio-opaque medium and asking the patient to cough or strain while standing in the vertical position, with no leakage noted.[49] It is unclear how long after surgery this test was performed, but 'clinical success' over a longer period of time revealed no urinary leakage at any time under all conditions in 79% of patients.

In the original report by Scott *et al.*,[49] the authors described long-term success as 'no urinary leakage'. Subsequently, Leach *et al.*[50] introduced the concept of pad score as a measure of success after AUS. A pad score of 0 signifies that no protection is required, a score of 1 means that less than two pads are required daily, a score of 2 describes the use of 2–4 pads daily and a score of 3 is given to patients that use more than 4 pads a day. The authors reported a decrease in average pad score from 2.69 to 1.05 in 39 men who underwent AUS placement. Haab *et al.*[51] used a standardized questionnaire to evaluate the severity of incontinence before and after AUS insertion. Part 1 comprised a functional inquiry into patient voiding habits, with questions on frequency, urgency, nocturia, urge incontinence, stress incontinence and overall satisfaction with the device. Part 2 of the questionnaire consisted of two validated and disease-specific quality of life instruments: the urogenital distress inventory and the incontinence impact questionnaire. The total score provided a single index of quality of life impact associated with urinary incontinence. Montague *et al.*[52] and Gousse *et al.*[53] added a patient satisfaction score to their outcome measures, and both noted high rates of patient satisfaction after AUS insertion. In addition to objective success, the reliability of the device has to be taken into consideration too. Overall complication rates and AUS durability have been reported in multiple contemporary large series.[54–58] Published success rates, generally reported as 'socially continent rates' of up to one pad per day, range from 58% to 88%.[49,51,52–58] Many modifications have been made to the original device, the most important of which is the introduction of a narrow backing to the cuff, which results in significantly better outcomes.[55] The most likely reason for this improvement is the even distribution of fluid within the cuff in contact with the urethra, which subsequently decreases rates of urethral erosion and atrophy. Nonmechanical reasons for failure decreased from 17% to 9% after introduction of the narrow backed device.[55]

Common complications of an AUS include infection, erosion, and device malfunction. In a recent large series,[58] the infection rate was 5.5% at a median of 3.7 months after surgery, and erosion rate was 6.0% at a median of 19.8 months after surgery. Device malfunction occurred in 6% of patients at a median of 68.1 months after surgery. Following the development of an antibiotic-coated urethral cuff in 2007, infection rates might be expected to

decrease. A common cause for erosion is urethral instrumentation, including catheterization. It is prudent to counsel patients regarding this etiology and if possible they should wear identification notifying medical professionals that they have an AUS implanted. In the setting of an infection, the entire device should be removed, and most surgeons wait 3–6 months before implanting another AUS. In the setting of erosion, the entire device usually needs to be removed and a urethral catheter should be left indwelling for about 3 weeks to allow the urethra to heal. In the setting of mechanical failure or recurrent incontinence owing to urethral atrophy, the device or malfunctioning components can be replaced.

The standard operating technique for AUS insertion in men consists of placing a urethral cuff, measured to size, around the bulbar urethra through a perineal incision. A second incision in the lower abdomen allows access to the rectus fascia, below which the pressure-regulating balloon is placed. A control pump is then routed to the scrotum through the abdominal incision. The tubing from the urethral cuff is directed into the abdominal incision and all tubes are connected in an airtight manner. Changes in surgical technique have been introduced over the years, including the transverse scrotal approach, the transcorporal approach, and tandem cuff placement. The transverse scrotal approach is an attempt to simplify surgery by allowing the entire operation to be performed through a high penoscrotal incision. However, there are concerns about the efficacy of this technique compared to the standard perineal approach.[59] The tandem cuff is used typically in patients that have recurrent incontinence after a single cuff procedure has been performed, or occasionally as primary treatment for patients with severe urinary incontinence.[60] The transcorporal approach is used primarily in patients who have had an eroded AUS in the past and are not concerned about erectile function.[61] It should be noted that results for the AUS are similar in men who have undergone RP or radiation therapy, or have other etiologies.[62,63] The AUS has also been used in patients with recurrent incontinence after the placement of a male sling with reasonable results.[64] In this case the sling can be left in place or removed if feasible.

Other therapy

Several other procedures have been introduced recently for the correction of SUI after RP. An adjustable continence procedure is currently under investigation in the US, which involves implanting two balloons under the bulbar urethra and filling them with a set amount of fluid.[65] Compression can then be adjusted by the removal or addition of fluid. Most other emerging techniques are modifications of the male sling.

Autologous stem cells have shown promise in many animal studies. However, the ideal tissue to use for the generation and harvest of stem cells, the best approach for injecting stem cells into the urinary sphincter, and their long-term efficacy remain under study.[66]

Conclusions

Male SUI is a complex problem with a host of treatments. The etiology and natural history of urinary function are important considerations when selecting treatment for men with SUI. Various algorithms have been used in the treatment of male SUI, and some authorities advocate a graded approach, starting with conservative management, followed sequentially by urethral bulking agents, male sling, and AUS until satisfactory continence is achieved. However, with the recognition of adverse risk factors for various therapies (for example, large-volume SUI for male slings, history of radiation therapy for urethral bulking agents), targeted approaches are now the norm. The initial management of male SUI consists of conservative measures, in particular a program of pelvic floor muscle exercises. If these do not resolve SUI, it can be treated satisfactorily with contemporary male slings and the AUS. Although the AUS is the current gold standard for treatment of male SUI, increased adoption of male slings and satisfactory published outcome data regarding these devices will ensure that they continue to gain in popularity. Stem cell therapy to regenerate the urethral sphincter musculature or newer devices will continue to be evaluated and might be used in the future.

Review criteria

A PubMed/MEDLINE search was conducted using the search terms “male stress urinary incontinence”, “prostatectomy incontinence”, “prostatectomy continence” and “male incontinence population”. Articles written in English during the last decade that demonstrated unique results (according to author) or were well-done/seminal studies were reviewed. Select references from these articles were also reviewed to determine if there were any interesting or novel results.

1. Nitti, V. W. The prevalence of urinary incontinence. *Rev. Urol.* **3** (Suppl. 1), S2–S6 (2001).
2. Smoger, S. H., Felice, T. L. & Kloecker, G. H. Urinary incontinence among male veterans receiving care in primary care clinics. *Ann. Intern. Med.* **132**, 547–551 (2000).
3. McGrother, C. W. *et al.* Storage symptoms of the bladder: prevalence, incidence and need for services in the U. K. *BJU Int.* **93**, 763–769 (2004).
4. Mardon, R. E., Halim, S., Pawlson, L. G. & Haffer, S. C. Management of urinary incontinence in Medicare managed care beneficiaries: results from the 2004 Medicare Health Outcomes Survey. *Arch. Intern. Med.* **166**, 1128–1133 (2006).
5. Herschorn, S., Gajewski, J., Schulz, J. & Corcos, J. A population-based study of urinary symptoms and incontinence: the Canadian Urinary Bladder Survey. *BJU Int.* **101**, 52–58 (2007).
6. Stothers, L., Thom, D. H. & Calhoun, E. A. Urinary incontinence in men. *Urologic Diseases in America. US Department of Health and Human Services, Public Health Service, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases* [online], http://kidney.niddk.nih.gov/statistics/uda/Urinary_Incontinence_in_Men-Chapter06.pdf (2010).
7. American Urological Association. *Guideline on the Management of Benign Prostatic Hyperplasia (BPH)* [online], http://www.auanet.org/content/guidelines-and-quality-care/clinical-guidelines.cfm?sub=bph (2010).
8. Rassweiler, J., Teber, D., Kuntz, R. & Hofmann, R. Complications of transurethral resection of the prostate (TURP)–incidence, management, and prevention. *Eur. Urol.* **50**, 969–979 (2006).
9. Eastham, J. A. *et al.* Risk factors for urinary incontinence after radical prostatectomy. *J. Urol.* **156**, 1707–1713 (1996).
10. Wei, J. T., Dunn, R. L., Marcovich, R., Montie, J. E. & Sanda, M. G. Prospective assessment of patient reported urinary continence after radical prostatectomy. *J. Urol.* **164**, 744–748 (2000).
11. Burkhard, F. C. *et al.* Nerve sparing open radical retropubic prostatectomy—does it have an

impact on urinary continence? *J. Urol.* **176**, 189–195 (2006).
12. Anast, J. W. *et al.* The impact of obesity on health related quality of life before and after radical prostatectomy (data from CaPSURE). *J. Urol.* **173**, 1132–1138 (2005).
13. Konety, B. R., Sadetsky, N. & Carroll, P. R. Recovery of urinary continence following radical prostatectomy: the impact of prostate volume—analysis of data from the CaPSURE Database. *J. Urol.* **177**, 1423–1425 (2007).
14. Cambio, A. J. & Evans, C. P. Minimising postoperative incontinence following radical prostatectomy: considerations and evidence. *Eur. Urol.* **50**, 903–913 (2006).
15. Myers, R. P. Male urethral sphincteric anatomy and radical prostatectomy. *Urol. Clin. North Am.* **18**, 211–227 (1991).
16. Coakley, F. V. *et al.* Urinary continence after radical retropubic prostatectomy: relationship with membranous urethral length on preoperative endorectal magnetic resonance imaging. *J. Urol.* **168**, 1032–1035 (2002).
17. Walsh, P. C. Radical prostatectomy with reduced morbidity: an anatomic approach. *NCI Monogr.* **7**, 133–137 (1988).
18. Begg, C. B. *et al.* Variations in morbidity after radical prostatectomy. *N. Engl. J. Med.* **346**, 1138–1144 (2002).
19. Saranchuk, J. W. *et al.* Achieving optimal outcomes after radical prostatectomy. *J. Clin. Oncol.* **23**, 4146–4151 (2005).
20. Kielb, S. J. & Clemens, J. Q. Comprehensive urodynamics evaluation of 146 men with incontinence after radical prostatectomy. *Urology* **66**, 392–396 (2005).
21. Groutz, A., Blaivas, J. G., Chaikin, D. C., Weiss, J. P. & Verhaaren, M. The pathophysiology of post-radical prostatectomy incontinence: a clinical and video urodynamic study. *J. Urol.* **163**, 1767–1770 (2000).
22. Stone, N. N. & Stock, R. G. Long-term urinary, sexual, and rectal morbidity in patients treated with iodine-125 prostate brachytherapy followed up for a minimum of 5 years. *Urology* **69**, 338–342 (2007).
23. Liu, M. *et al.* Urinary incontinence in patients treated with external beam radiotherapy. *Radiother. Oncol.* **74**, 197–201 (2005).
24. Stephenson, A. J. *et al.* Morbidity and functional outcomes of salvage radical prostatectomy for locally recurrent prostate cancer after radiation therapy. *J. Urol.* **172**, 2239–2243 (2004).
25. Ward, J. F., Sebo, T. J., Blute, M. L. & Zincke, H. Salvage surgery for radiorecurrent prostate cancer: contemporary outcomes. *J. Urol.* **173**, 1156–1160 (2005).
26. Lee, R., Te, A. E., Kaplan, S. A. & Sandhu, J. S. Temporal trends in adoption of and indications for the artificial urinary sphincter. *J. Urol.* **181**, 2622–2627 (2009).
27. Ko, Y., Lin, S. J., Salmon, J. W. & Bron, M. S. The impact of urinary incontinence on quality of life of the elderly. *Am. J. Manag. Care* **11**, S103–S111 (2005).
28. Eustice, S., Roe, B. & Paterson, J. Prompted voiding for the management of urinary incontinence in adults. *Cochrane Database Syst. Rev.* **2**, CD0002113 (2000).
29. Wallace, S. A., Roe, B., Williams, K. & Palmer, M. Bladder training for urinary incontinence in adults. *Cochrane Database Syst. Rev.* **1**, CD001308 (2004).
30. Van Kampen, M. *et al.* Effect of pelvic-floor re-education on duration and degree of incontinence after radical prostatectomy: a randomised controlled trial. *Lancet* **355**, 98–102 (2000).
31. Filocamo, M. T. *et al.* Effectiveness of early pelvic floor rehabilitation treatment for post-prostatectomy incontinence. *Eur. Urol.* **48**, 734–738 (2005).
32. Chang, P. L. *et al.* The early effect of pelvic floor muscle exercise after transurethral prostatectomy. *J. Urol.* **160**, 402–405 (1998).
33. Porru, D. *et al.* Impact of early pelvic floor rehabilitation after transurethral resection of the prostate. *Neurourol. Urodyn.* **20**, 53–59 (2001).
34. Burgio, K. L. *et al.* Preoperative biofeedback assisted behavioral training to decrease post-prostatectomy incontinence: a randomized, controlled trial. *J. Urol.* **175**, 196–201 (2006).
35. Wille, S., Sobottka, A., Heidenreich, A. & Hofmann, R. Pelvic floor exercises, electrical stimulation and biofeedback after radical prostatectomy: results of a prospective randomized trial. *J. Urol.* **170**, 490–493 (2003).
36. Cummings, J. M., Boullier, J. A. & Parra, R. O. Transurethral collagen injections in the therapy of post-radical prostatectomy stress incontinence. *J. Urol.* **155**, 1011–1013 (1996).
37. Smith, D. N., Appell, R. A., Rackley, R. R. & Winters, J. C. Collagen injection therapy for post-prostatectomy incontinence. *J. Urol.* **160**, 364–367 (1998).
38. Westney, O. L., Bevan-Thomas, R., Palmer, J. L., Cespedes, R. D. & McGuire, E. J. Transurethral collagen injections for male intrinsic sphincter deficiency: the University of Texas-Houston experience. *J. Urol.* **174**, 994–997 (2005).
39. Herschorn, S. *et al.* Surgical treatment of stress incontinence in men. *Neurourol. Urodyn.* **29**, 179–190 (2010).
40. Kaufman, J. J. Surgical treatment of post-prostatectomy incontinence: use of the penile crura to compress the bulbous urethra. *J. Urol.* **107**, 293–297 (1972).
41. Schaeffer, A. J., Clemens, J. Q., Ferrari, M. & Stamey, T. A. The male bulbourethral sling procedure for post-radical prostatectomy incontinence. *J. Urol.* **159**, 1510–1515 (1998).
42. Clemens, J. Q., Bushman, W. & Schaeffer, A. J. Questionnaire based results of the bulbourethral sling procedure. *J. Urol.* **162**, 1972–1976 (1999).
43. Madjar, S. *et al.* Bone anchored sling for the treatment of post-prostatectomy incontinence. *J. Urol.* **165**, 72–76 (2001).
44. Comiter, C. V. The male sling for stress urinary incontinence: a prospective study. *J. Urol.* **167**, 597–601 (2002).
45. Ullrich, N. F. & Comiter, C. V. The male sling for stress urinary incontinence: urodynamic and subjective assessment. *J. Urol.* **172**, 204–206 (2004).
46. Rajpurkar, A. D., Onur, R. & Singla, A. Patient satisfaction and clinical efficacy of the new perineal bone-anchored male sling. *Eur. Urol.* **47**, 237–242 (2005).
47. Fischer, M. C., Huckabay, C. & Nitti, V. W. The male perineal sling: assessment and prediction of outcome. *J. Urol.* **177**, 1414–1418 (2007).
48. Rehder, P. & Gozzi, C. Transobturator sling suspension for male urinary incontinence including post-radical prostatectomy. *Eur. Urol.* **52**, 860–866 (2007).
49. Scott, F. B., Bradley, W. E. & Timm, G. W. Treatment of urinary incontinence by an implantable prosthetic urinary sphincter. *J. Urol.* **112**, 75–80 (1974).
50. Leach, G. E. *et al.* Post-prostatectomy incontinence: urodynamic findings and treatment outcomes. *J. Urol.* **155**, 1256–1259 (1996).
51. Haab, F., Trockman, B. A., Zimmern, P. E. & Leach, G. E. Quality of life and continence assessment of the artificial urinary sphincter in men with minimum 3.5 years of followup. *J. Urol.* **158**, 435–439 (1997).
52. Montague, D. K., Angermeier, K. W. & Paolone, D. R. Long-term continence and patient satisfaction after artificial sphincter implantation for urinary incontinence after prostatectomy. *J. Urol.* **166**, 547–549 (2001).
53. Gousse, A. E., Madjar, S., Lambert, M. M. & Fishman, I. J. Artificial urinary sphincter for post-radical prostatectomy urinary incontinence: long-term subjective results. *J. Urol.* **166**, 1755–1758 (2001).
54. Leibovich, B. C. & Barrett, D. M. Use of the artificial urinary sphincter in men and women. *World J. Urol.* **15**, 316–319 (1997).
55. Elliott, D. S. & Barrett, D. M. Mayo Clinic long-term analysis of the functional durability of the AMS 800 artificial urinary sphincter: a review of 323 cases. *J. Urol.* **159**, 1206–1208 (1998).
56. Venn, S. N., Greenwell, T. J. & Mundy, A. R. The long-term outcome of artificial urinary sphincters. *J. Urol.* **164**, 702–706 (2000).
57. Raj, G. V., Peterson, A. C., Toh, K. L. & Webster, G. D. Outcomes following revisions and secondary implantation of the artificial urinary sphincter, *J. Urol.* **173**, 1242–1245 (2005).
58. Lai, H. H., Hsu, E. I., Teh, B. S., Butler, E. B. & Boone, T. B. 13 years of experience with artificial urinary sphincter implantation at Baylor College of Medicine. *J. Urol.* **177**, 1021–1025 (2007).
59. Henry, G. D., Graham, S. M., Cleves, M. A., Simmons, C. J. & Flynn, B. Perineal approach for artificial urinary sphincter implantation appears to control male stress incontinence better than the transscrotal approach. *J. Urol.* **179**, 1475–1479 (2008).
60. DiMarco, D. S. & Elliott, D. S. Tandem cuff artificial urinary sphincter as a salvage procedure following failed primary sphincter placement for the treatment of post-prostatectomy incontinence. *J. Urol.* **170**, 1252–1254 (2003).
61. Guralnick, M. L., Miller, E., Toh, K. L. & Webster, G. D. Transcorporal artificial urinary sphincter cuff placement in cases requiring revision for erosion and urethral atrophy. *J. Urol.* **167**, 2075–2078 (2002).
62. Gomha, M. A. & Boone, T. B. Artificial urinary sphincter for post-prostatectomy incontinence in men who had prior radiotherapy: a risk and outcome analysis. *J. Urol.* **167**, 591–596 (2002).
63. Sotelo, T. M. & Westney, O. L. Outcomes related to placing an artificial urinary sphincter using a single-incision, transverse-scrotal technique in high-risk patients. *BJU Int.* **101**, 1124–1127 (2008).
64. Fisher, M. B., Aggarwal, N., Vuruskan, H. & Singla, A. K. Efficacy of artificial urinary sphincter after failed bone-anchored male sling for postprostatectomy incontinence. *Urology* **70**, 942–944 (2007).
65. Trigo-Rocha, F., Gomes, C. M., Pompeo, A. C., Lucon, A. M. & Arap, S. Prospective study evaluating efficacy and safety of Adjustable Continence Therapy (ProACT) for post radical prostatectomy urinary incontinence. *Urology* **67**, 965–969 (2006).
66. Smaldone, M. C., Chen, M. L. & Chancellor, M. B. Stem cell therapy for urethral sphincter regeneration. *Minerva Urol. Nefrol.* **61**, 27–40 (2009).

Acknowledgments
Désirée Lie, University of California, Orange, CA, is the author of and is solely resonsible for the content of the learning objectives, questions and answers of the MedscapeCME-accredited continuing medical education activity associated with this article.