

Review

Contemporary Management of Post-Prostatectomy Climacturia: A Review

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Abstract

Climacturia is estimated to affect approximately 30% of men after radical prostatectomy and has significant impact on patient quality of life. In this narrative review, our aim is to describe the pathophysiology of climacturia, its predictive factors, and the existing conservative and surgical treatment options in the modern era. Peer-reviewed publications on the post-prostatectomy climacturia were identified through a PubMed search, with terms included climacturia, arousal incontinence, post prostatectomy incontinence, orgasm and radical prostatectomy. While the pathophysiology of climacturia remains poorly understood and predictive factors poorly elucidated, men experiencing climacturia often report significant bother and reduction in quality of life. Various treatment options have been investigated for this condition, with conservative measures including pelvic floor physical therapy and variable penile tension loops, and operative strategies including the Mini-Jupette and traditional bladder slings. As providers of comprehensive urologic care for prostate cancer survivors, it is incumbent upon urologists to query patients about bothersome climacturia and offer these evidence-based treatment options.

Keywords: climacturia; male stress urinary incontinence; prostate cancer survivorship; male urethral sling

1. Introduction

Prostate cancer remains the most common solid organ malignancy in men, and while modern surgical technique boasts a 99% 5-year survival for localized disease, the adverse effects of radical prostatectomy (RP) remain significant [1]. Since Terence Millin performed the first retropubic RP in 1945, erectile dysfunction (ED) and stress urinary incontinence have been the procedure's most recognized morbidities [2]. As early detection and treatment of prostate cancer rose with the approval of PSA screening in 1994, a growing body of literature has characterized previously underrecognized sexual effects of RP [3]. Climacturia, or urinary incontinence associated with sexual climax, was first described as an adverse effect of RP in a 1996 qualitative study of 20 patients [4]. Despite being known as a clinical entity for over 25 years, clinical investigation and treatment options for climacturia remain sparse [5]. This purpose of this review is to summarize the epidemiology, pathophysiology, and treatment options of climacturia with the hope of clarifying existing knowledge on this important and under-investigated condition.

2. Prevalence and Clinical Significance

The estimated prevalence of climacturia following RP has ranged greatly since its first description. Notably, most studies have included sample sizes of less than 300 patients and relied on variable non-validated questionnaires [6–16]. For example, Barnas *et al.* [7] found the rate of climacturia could be reported as high as 93% if defined as at least one episode following RP. In the two largest pub-

lished reports, Mitchell *et al.* [12] prospectively examined 1459 patients from a single surgeon and Salter *et al.* [16] retrospectively reviewed 3207 men presenting at a single sexual medicine clinic. Rates of climacturia over a series of months were reported as 36% and 23%, respectively. Similarly, a 2020 systematic analysis of 23 articles found the prevalence of climacturia to fall between 21–38% when screening for high-quality studies [17].

Existing studies have shown post-RP climacturia to vary in both in clinical severity and rate of bother, with most men experiencing frequent but low volume orgasmic urinary loss [18]. Salter quantified volume of climacturia into small (drops), moderate (<30 mL), or large (>30 mL), finding respective frequencies of 70%, 24%, and 6% [16]. This distribution is similar to other reports, with Lee and Capogrosso reporting 58% and 84% of patients having only drops or less than 5 mL or leakage, respectively [8,15]. Furthermore, Capogrosso found 31% of climactic men to experience climacturia greater than half of their total of orgasms, while 94% to experience the symptoms in greater than 50% of orgasms [15]. Similarly, Salter found approximately 25% of effected men to experience climacturia in greater than half of orgasms, with approximately 75% having the symptom in less than half [16].

Climacturia can cause significant negative psychosexual effects, with approximately half of patients reporting some level of bother due to the symptoms. Affected patients report lower sexual satisfaction, as well as higher rates of depression and anxiety [6,10,12,16,19]. In comparison, a 3-year follow-up of the landmark CEASAR trial found stress urinary incontinence (SUI) to cause bother in only 19% of



affected men, despite this symptom being a more recognized and counseled effect of RP [20,21]. Two large single-center analyses have quantified severity of bother associated with climacturia. Salter found 62% of men to report mild bother, 29% moderate, and 9% severe, while Mitchell found 55.6% to report “No Problem”, 22% a “Minor Problem”, and 22.4% a “Major Problem” [12,16]. These studies suggest that while climacturia may not cause major bother in most of those affected, symptoms can be immensely impactful for a subset of men [18]. Indeed, one report found 36% of patients reporting avoidance of intercourse altogether as a result [10].

Patient perception of partner bother is consistently noted to be a major source of distress among those experiencing climacturia. Salter and colleagues found this metric to have the greatest odds of predicting patient bother on multivariate analysis [8,16,19]. Furthermore, two studies examining both heterosexual and homosexual men found shorter relationship duration was associated with increased patient bother due to climacturia [16,22]. A qualitative review by Ussher further characterized this phenomenon. Interviewees in short-term relationships reported distress to arise from concern that climacturia would lead to rejection by potential new partners, in contrast to those in long-term relationships [23]. Notably, the literature remains mixed on the effect of volume and frequency of climacturia on patient bother, with Jimbo finding no association, but Salter finding both metrics to be significant [16,19].

3. Proposed Mechanisms of Climacturia

Normal male ejaculation is divided into two phases: emission, in which ejaculatory secretions collect in the prostatic urethra, and expulsion, in which semen is propelled through the penile urethra and meatus [24]. During expulsion both internal and external sphincters close while the pelvic floor musculature contracts rhythmically to generate a high-pressure chamber [24]. Although the exact trigger is unknown, the external urinary sphincter reflexively opens in tandem with contraction of the bladder and bladder neck, leading to antegrade passage of semen and retention of urine [24].

Koeman first theorized that removal of the internal urinary sphincter and damage to the bladder neck result in unencumbered passage of urine through the urethra during paired reflexive bladder contraction and external sphincter opening, thus leading to climacturia [4]. Corresponding with this theory is the observation that climacturia tends to improve with time from surgery, potentially allowing for improved coaptation of the bladder neck as operative trauma resolves [15]. It has been observed that prior transurethral resection of the prostate (TURP) increases risk of climacturia, possibly due to bladder neck alteration which is further exacerbated by RP [10,19]. However, this initial theory may not completely explain the pathophysiology of climacturia, as complete lack of a continence mech-

anism during orgasm would logically cause all RP patients to experience passage of urine with every orgasm.

Multiple authors have suggested that climacturia represents a form of stress urinary incontinence (SUI) in which increased intraabdominal pressure during orgasm causes leakage of urine [18]. Indeed, direct damage to the external urinary sphincter and injury to the prostatic nerve plexus during RP are thought to cause post-operative SUI due to sphincter insufficiency [25–27]. Correspondingly, a videourodynamics study of twelve subjects found climacteric men to have lower maximal urethral closure pressure than controls, though this finding did not reach significance ($p = 0.19$) and there was no difference in Valsalva leak point pressure [28]. Similarly, a review of preoperative multiparametric prostate MRI’s in 194 patients showed men who developed post-operative climacturia to have wider baseline urethral width, a finding which may correspond with lower baseline urethral resistance, though this parameter was not directly measured [29].

Similar to Koeman’s theory, improvement of climacturia with increased time since surgery also supports climacturia to be a manifestation of SUI, given external sphincter recovery, resolution of neuropraxia, and pelvic floor muscle compensation all underly the time-dependent improvement of post-RP SUI [30,31]. Most notably, three large observational studies cumulatively evaluating almost 3000 subjects found presence of SUI to be a major predictor of climacturia, with an odds ratio (OR) up to 3.09 [10,19,32]. This contrasts with several smaller earlier reports which found no relationship between overall continence and climacturia [4,6,8,29]. While this data strongly suggests a link between climacturia and SUI, large reports consistently found no relationship between BMI or nerve-sparing status and presence of climacturia, two factors that have been strongly associated with post-RP SUI [15,19,29,30,33].

Manassero found urethral length to be significantly lower in climacteric patients on videourodynamics when compared to controls [28]. A recent report showed increased urethral length on pre-operative MRI to predict faster return to continence following surgery, suggesting residual urethral length after surgery could play a role in preventing climacturia [34]. However, Sullivan *et al.* [29] did not find preoperative urethral length to differ between climacteric men and controls in their review of pre-RP MRI’s, pointing away from this conclusion. Further investigation into post-RP urethral length in men experiencing climacturia versus controls is warranted.

Multiple authors have noted decreased penile length and ED following RP to be predictors of climacturia. It is theorized that both these metrics are a result of nerve damage following RP, with increased ratio of sympathetic to parasympathetic tone causing constriction of helicine arteries, leading both to impotence and penile shortening from chronic erectile body ischemia [35]. While improvement of

Table 1. Summary of clinical and surgical findings associated with climacturia.

Author	Year	Study description	Study size	Findings
Manassero [28]	2012	Videourodynamic assessment	7	Decreased urinary flow rate ($p = 0.09$) Decreased functional urethral length (20 cm vs 35 cm), ($p = 0.02$) Decreased maximal urethral closure pressure ($p = 0.19$) No difference in bladder capacity ($p = 0.28$), Leak point pressure ($p = 0.18$)
Choi [6]	2007	Retrospective Review	475	Less than 12 months since surgery: (Unadjusted OR 0.39, CI 0.22–0.70, $p < 0.01$) Loss of penile length (Multivariate Analysis OR 5.35, CI 1.25–22.92, $p < 0.01$) Orgasm associated pain (Multivariate Analysis OR: 2.98, CI 1.17–7.59, $p < 0.05$) Insignificant: Nerve sparing status, SUI, (OR, p -values not reported)
O’Neil [32]	2014	Cross Sectional Analysis	412	Use of erectile aide (Multivariate Analysis OR 2.24, CI 1.08–4.93, $p = 0.035$) SUI (Multivariate Analysis OR 3.09, CI 1.66–5.88, $p < 0.001$) Insignificant: Nerve sparing status (Chi-square, $p = 0.64$)
Nilsson [10]	2011	Cross Sectional Analysis	1288	Penile Shortening (Unadjusted RR 1.4, CI 1.1–1.7, $p < 0.05$) SUI (Unadjusted RR 2.0, CI 1.6–2.4, $p < 0.05$) Erectile Dysfunction (Unadjusted RR 1.3, CI 1.1–1.6, $p < 0.05$) Prior TURP (Unadjusted RR 1.4, CI 1.0–2.0, $p < 0.05$) Insignificant: orgasmic pain (RR 1.1, CI 0.9–1.4. No p -value reported)
Capograsso [15]	2016	Prospective Cohort	749	Reduction in prevalence, 29.5% at 3 months to 23.9% at 60 months (Chi square 2.52, $p = 0.1$) Faster recovery from climacturia for robotic vs open procedure (cox regression $p = 0.01$) Insignificant: Nerve-sparing status (HR 2.31, CI 0.81–9.12, $p = 0.97$) Insignificant: BMI (HR 0.99, CI 0.88–1.11, $p = 0.94$)
Mitchell [12]	2018	Prospective Cohort	1459	Reduction in bother, 44.2% at 3 months and 36.1% at 24 months
Jimbo [19]	2020	Retrospective Review	192	Reduction in prevalence from 56.5% before one year and 31.5% after one year (Chi-square $p = 0.02$) Prior Prostate Surgery (Mutivariate Analysis OR 11, CI 4.0–30.6, $p < 0.001$) SUI: (Unadjusted OR 2.9, CI 1.3–7.1, $p = 0.01$) Insignificant: Nerve sparing status (Unadjusted OR 1.3, CI 0.5–3.1, $p = 0.6$)
Sullivan [29]	2020	Retrospective Review	194	Wider urethral width on MRI (Unadjusted OR 1.34, CI 1.05–1.71, $p = 0.02$) Increased patient BMI (Chi-square $p = 0.02$) Insignificant: SUI (Chi-square $p = 0.2$) Insignificant: Nerve-sparing status (Chi-square $p = 0.8$)

Abbreviations: SUI, Stress Urinary Incontinence; BMI, Body Mass Index; OR, Odds ratio; CI, Confidence Interval; RR, Risk Ratio.

neuropraxia following RP could help explain the resolution of climacturia with time from surgery, multiple reports have failed to demonstrate an association between nerve-sparing status and climacturia, making this unlikely to be a major factor [6,10,15,19,29,32]. Table 1 (Ref. [6,10,12,15,19,28,29,32]) summarizes clinical and surgical findings associated with climacturia.

4. Non-Surgical Management of Climacturia

Several conservative management strategies have been proposed for climacturia, although most are based on clinical principal or anecdotal evidence [5]. Coping mechanisms such as emptying the bladder prior to intercourse and condom use to contain urine have been reported by patients [36]. Some clinicians recommend patients try standing or laying supine for intercourse to reduce pressure placed on bladder [37]. As reflexive bladder contraction with orgasm is proposed to contribute to climacturia, use of anticholinergics or mirabegron have been proposed as options for medical management [21]. Tricyclic antidepressants have also been suggested, as the combination of norepinephrine reuptake and cholinergic blockade will lead to higher bladder neck tone and prevention of bladder contraction [36].

Sighinoffi *et al.* [38] first examined the use of pelvic floor rehabilitation for climacturia in a 2009 case series of three patients, all of whom reported subjective symptom improvement after 4 months. Geraerts conducted a randomized trial of 33 patients after RP and found pelvic floor muscle therapy in combination with electrostimulation to cause resolution of climacturia in 6/14 subject compared to 0/17 controls ($p = 0.004$) [39]. Contrastingly, a meta-analysis published in 2019 concluded pelvic floor physical therapy does not influence climacturia resolution [40]. However, this conclusion should be interpreted with caution as the meta-analysis results are largely based on data from the 2011 MAPS trial, which did not publish climacturia as an outcome, and utilized ICIQ-UI SF questionnaire score as their main endpoint, an instrument which does not include questions specific to climacturia [41]. Therefore, these authors feel pelvic floor muscle therapy remains a potential strategy for treatment of climacturia (as well as post-RP SUI) and should be recommended as baseline treatment for patients with bothersome climacturia [41].

Vacuum erection devices (VED), a common treatment for post-RP ED and penile rehabilitation, are typically used with concurrent placement of a rubber constriction ring at the base of the penis to promote trapping of blood within the corporal bodies [42]. Gauy and Seftel first described the use of a penile constriction ring for sexual incontinence in an observational study of 24 men following RP. The authors found that men using the penile constriction ring for ED also noted it to effectively eliminate foreplay incontinence, likely due to compression of the urethra during climax, physically preventing the expulsion of urine [43]. Rubber penile constriction rings and variable tension

loops were subsequently introduced as potential strategies for treatment of climacturia [21]. The use of the penile variable tension loop for climacturia was investigated in a 2012 observational study of 124 men, and was shown to eliminate climacturia in almost half of patients while reducing frequency of climacturia in the remainder of the cohort [44]. Notably, use of a variable tension loop was seen to significantly reduce both patient and partner distress [44]. There are multiple commercially available brands of variable tension loop, all of which can be reused and cost less than \$50 USD, making this an attractive, cost-effective treatment of climacturia in patients who desire conservative management.

5. Surgery

5.1 Mini-Jupette Sling

Surgical management of climacturia was first investigated by Robert Andrienne in 2006 with the invention of the Mini-Jupette sling [18,45]. This technique involves concurrent placement of a mesh graft between the bilateral corporal cylinders during inflatable penile prosthetic (IPP) insertion [46]. The graft is sutured to the medial aspects of the corporotomies, and is secured by inclusion in the running suture during corporal closure [46]. “Mini-Jupette” translates to English as “Mini-Skirt”, and the procedure was named because the graft is thought to resemble a skirt overlying two legs represented by the implant cylinders. IPP inflation for sexual activity causes stretch to the graft, thereby compressing the urethra and preventing anterograde passage of urine with orgasm. Notably, this procedure has also been found to reduce or treat daytime SUI, as men can partially inflate their prosthetic to reach a level of urethral tension that prevents leakage, though the safety of this practice has not been evaluated in the long term [47].

Andrienne published a case series in 2019 reporting on the outcomes of 6 patients that underwent IPP and Mini-Jupette procedure since its inception in 2006 [45]. Eighty-two percent of patients had resolution of climacturia at 6 months, and the effect was durable at an average follow-up time of 107 months with no major complications reported [45]. Yafi *et al.* [48] performed the first prospective trial of this technique in 2018, finding 67% of 30 climacturic participants to have complete symptom resolution, and 92% to have subjective improvement at an average of 5 months follow-up. Five of the 35 total participants in this cohort experienced post-operative complications requiring graft explanation. Of these, only two were attributable to the actual graft procedure: a urethrocorporal fistula thought arise from inadvertent suturing of graft into the urethra, and urinary retention leading to prolonged catheterization and subsequent device erosion thought to a result improper graft tensioning.

The graft material utilized for Mini-Jupette placement has varied between authors. While Andrienne’s series included only polypropylene monofilament mesh, Yafi’s report included various synthetic and biological grafts, with

Table 2. Clinical outcomes of surgical management options for climacturia.

Author	Year	Study size	Study design	Intervention	Key findings
Jaine [54]	2012	11	Retrospective Review	Artificial Urinary Sphincter or Male Urethral Sling	All patients had subjective improvement in climacturia AUS had greater rates of climacturia, but worse baseline SUI MUS had lower rates of climacturia, but less severe baseline SUI No complications reported
Christine [51]	2017	37	Case Series	Male Urethral Sling	Complete resolution of climacturia in all participants Follow-up time, complication rates not reported
Mendez [53]	2017	3	Case Series	Placement of AUS in men with existing IPP	Resolution of climacturia in all participants No complications reported
Yafi [48]	2018	38	Multicenter Pilot Trial	Concurrent Mini-Jupette Sling and IPP Placement	Subjective improvement in 93% and resolution in 67% at 5 month follow-up 4 Patients had complications requiring explant at 5 months
Valenzuela [50]	2019	36	Case Series	Concurrent Male Urethral Mini-Sling and IPP Placement	Climacturia resolved in 93% of patients No complications requiring explantation
Andrienne [45]	2019	6	Case Series	Concurrent Placement of Mini-Jupette Sling and IPP	82% of patients reported resolution of climacturia Continued Resolution of all respondents at mean follow-up of 105 Months No complications requiring explantation
Nolan [52]	2020	17	Retrospective Review	Placement of a bulbourethral sling	Decreased frequency, volume, and bother with climacturia Decrease in subjective bother ($p = 0.27$) No complication rate reported
Towe [49]	2020	2	Case Series	Placement of Mini-Jupette with Autologous Rectus Facial Graft	Both patient and partner reporting subjective improvement at 4 months No complications occurring at 4 months

no difference in outcomes reported between graft types [45,48]. In a later report, Yafi expressed preference for the polypropylene glycol Restorelle® graft (Coloplast Corp, Minneapolis, MN, USA), given its relative availability and approval for use in female urethral procedures [46]. Given the concern of mesh complications, Towe *et al.* [49] recently published a report of two patients who underwent autologous rectus facial graft, both of whom saw resolution of climacturia at 4-month follow-up.

Valenzuela *et al.* [50] offered a modified approach to the Mini-Jupette with the male urethral “Mini Sling” in a 2019 series of 30 climactic patients. Rather than placing a graft between the device cylinders, the “Mini Sling” technique involves exposing urethra proximal to the corporotomies to the ischiocavernosus muscle [50]. Dissection is brought down to the level of the tunica albuginea where a Coloplast Virtue sling® mesh (Coloplast Corp, Minneapolis, MN, USA) is applied across the urethra and anchored to tunica albuginea, followed by standard IPP placement. The authors reported resolution of climacturia in 28 of 30 participants at 6 months, with two cases of transient urinary retention being the only complications [50]. Potential advantages cited for this procedure over the classic Mini-Jupette technique include smaller corporotomy size and a theoretical reduced risk of incidental damage to the IPP during corporotomy closure [50].

5.2 Male Urethral Sling

One of the primary limitations to either the traditional Mini-Jupette or the “Mini sling” techniques are the applicability to men in whom erectile function is preserved or do not wish to undergo placement of IPP. In these men, more traditional approaches such as male urethral sling or artificial urinary sphincter (AUS) may be considered. The traditional male urethral sling has been shown to be an effective approach to treatment of climacturia and represents an option for patients who do not require or desire IPP placement. In a retrospective review of 44 men, Christine *et al.* [51] found all patients who identified climacturia prior to transobturator male sling placement to have resolution of climacturia postoperatively. In a similar review of 13 men with climacturia or arousal incontinence, Nolan *et al.* [52] demonstrated reduction in both leakage and bother after sling procedure. Several small case studies have found AUS placement to improve climacturia, however application of this device in men with climacturia and mild or no SUI may be unreasonable [53,54]. Surgical trials and series published for treatment of climacturia are summarized in Table 2 (Ref. [45,48–54]).

6. Conclusions

Climacturia remains a poorly recognized side effect of radical prostatectomy, despite having a significant impact on patient quality of life. Fortunately, several conservative and surgical treatment strategies exist. Evidence

suggests conservative measures, such as pelvic floor physical therapy and variable penile tension loops can effectively improve or alleviate climacturia in many men. Surgical management with the Mini-Jupette sling, male urethral “Mini sling”, and traditional male urethral slings have shown promising results in definitively curing climacturia in most patients. As providers of comprehensive urologic care for prostate cancer survivors, it is incumbent upon us to query patients about bothersome climacturia and offer these evidence-based treatment options.

Author Contributions

CC—data collection, drafting manuscript; MCH—conception and design of work, critical revision of article, final approval of version to be published; equal author contribution—data analysis and interpretation.

Ethics Approval and Consent to Participate

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