Current Urology Reports (2019) 20: 16
https://doi.org/10.1007/s11934-019-0879-3

SURGERY (J SIMHAN, SECTION EDITOR)

Management of Climacturia During Inflatable Penile Prosthesis Surgery

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Published online: 26 February 2019

Abstract
Radical prostatectomy, the preferred treatment option for organ-confined prostate cancer, is associated with a wide variety of sexual dysfunctions including erectile and orgasmic dysfunctions. Climacturia is a type of orgasmic dysfunction that has been reported to occur in 20–60% of men after radical prostatectomy. Several treatment strategies for climacturia have been evaluated and recommended including behavioral changes, use of special devices, medications, specialized therapies, and surgeries. Inflatable penile prosthesis implantation might be the treatment of choice when conservative management approaches fail to treat erectile dysfunction. In this review article, the different options and approaches for the management of climacturia during inflatable penile prosthesis surgery will be discussed.

Keywords Climacturia · Prostate cancer · Inflatable penile prosthesis · Sling

Introduction

Prostate cancer is the most common solid cancer and the second leading cause of cancer death in men [1]. Radical prostatectomy (RP) is the preferred treatment option for organ-confined prostate cancer in healthy men [1]. A wide variety of sexual dysfunctions are associated with RP, such as erectile dysfunction (ED) and orgasmic dysfunctions, which occur in 25–75% [2] and 25–60% [3] of patients, respectively. These side effects can have a significant negative impact on the patients' quality of life [2].

Climacturia, a type of orgasmic dysfunction, is defined by the International Society for Sexual Medicine (ISSM) as orgasm-associated incontinence that occurs when a man leaks urine as he ejaculates. Unfortunately, post-prostatectomy patients are rarely questioned about this dysfunction which frequently makes it under-reported, and current literature suggests that climacturia may be present in 20–48% of men who have undergone radical prostatectomy [4•]. A recent review by Fode et al. [5] found that climacturia can occur in 20 to 64% of men after RP. In a postsurgical questionnaire, Barnas et al. [6] reported that 93% of the 239 patients surveyed had experienced climacturia at least once. In a study sample that had 475 patients, climacturia was reported in 20% of men who underwent open RP, in 24% of men who underwent laparoscopic radical prostatectomy and 6% of men who underwent cystoprostatectomy [7]. Due to its considerable prevalence among men after RP and its consequences on both the patient and his partner, several treatment strategies are available. These include behavioral changes, device usage (e.g., variable tension loops and pelvic floor muscle retrainer tools), medications, pelvic floor therapy, and surgery, such as a suburethral sling placement [4•, 8••, 9–11, 12•, 13•, 14–22, 23•].

When conservative management fails to treat ED, an inflatable penile prosthesis (IPP) implantation is usually recommended [9]. In this review article, we will discuss how climacturia can be managed during IPP surgery.

Materials and Methods

We conducted a MEDLINE and PubMed search from 2012 to 2018 to identify all publications related to climacturia

This article is part of the Topical Collection on *Surgery*

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management during IPP surgery. Original studies and review articles were included. Key words used for the search were climacturia, coital incontinence, radical prostatectomy, erectile dysfunction, inflatable penile prosthesis, sling, and artificial urinary sphincter.

Pathophysiology of Climacturia

Signals from both sympathetic and parasympathetic nervous systems, in addition to proximal urethral support, internal sphincter, and external sphincter activity all contribute to achieving continence [10]. To prevent urine leakage during orgasm, closure of the bladder neck should be maintained during ejaculation through the innervation of the sympathetic and pudendal nerves [11]. Although there is no universal consensus on the pathophysiology of climacturia, recurrent themes of neural injury and anatomic alteration appear throughout the literature [8••]. In one study, men who underwent non-surgical treatment modalities for their prostate cancer also reported climacturia [12]. It was found that climacturia was reported by 28.3%, 5.2%, and 28.6% of those treated with surgery, radiation, or both, respectively ($p < 0.001$) [12]. The fact that climacturia was reported in patients treated with radiation supports the idea that neuronal injury plays an essential role in its pathophysiology. With regard to surgical treatment, Capogrosso et al. [13•] explored whether the type of surgical approach affected climacturia incidence. In their study, 749 patients underwent either robotic-assisted laparoscopic prostatectomy (RALP) or open radical retropubic prostatectomy (RRP). They found that approximately 30% of patients reported climacturia with no significant difference in rates between the two approaches. A difference, however, was noted at the level of the recovery rate; men who underwent RALP recovered faster than those who underwent RRP (8.5% vs 5%, respectively, at 24 months, and 48% vs 15%, respectively, at 84 months) without any surgical intervention to treat climacturia [13•]. This difference can be due to the better exposure provided in robotic procedures which enables the surgeon to perform a more careful dissection of the neurovascular bundle, facilitating better recovery. These findings support the notion that anatomic alterations play a role in the pathophysiology of climacturia.

Non-surgical Treatment Options

As previously mentioned, non-surgical treatment options for climacturia include behavioral therapy, pelvic floor physical therapy (PFPT), device application, and pharmacologic treatments (Table 1).

The first and easiest behavioral intervention is to recommend emptying the bladder just before sexual activity and restricting both fluid and caffeine intake ahead of planned intercourse. In one small study, Lee et al. [14] found that 84% of men who emptied their bladder before sexual activity had limited accidents.

When behavioral therapy fails, a variety of specialized devices may be entertained. One such device is the compressive variable tension loop which is circumferentially placed around the base of the penis and tensioned until urinary leakage stops. Mehta et al. [15] examined the effect of this device in a group of 124 sexually active men after prostatectomy. At baseline, 84% reported moderate to large degrees of climacturia. After the use of the compressive variable tension loop, 48% of patients reported no leakage of urine, and patient and partner bother decreased from 14 to 2% and 61 to 11%, respectively [15].

Another option is PFPT, which has been used successfully for stress urinary incontinence [16]. Geraerts et al. [17] performed a small randomized controlled trial to assess the effectiveness of PFPT in patients with climacturia. Thirty-three sexually active men who underwent prostatectomy were enrolled (16 men in PFPT group, 9 with climacturia; 17 men in the control group, 8 with climacturia). Results showed that early intervention with PFPT improved climacturia in six out of nine men in the study group compared with zero out of eight men in the control group ($p = 0.004$) [17]. No other studies exploring PFPT in climacturia are currently available.

Finally, there is scant literature regarding pharmacological treatment of climacturia. While anticholinergic therapy is a well-established treatment for overactive bladder, its use in climacturia has yet to be investigated.

Surgical Treatments

Inflatable Penile Prosthesis

As per the American Urological Association guidelines, management of ED is a shared decision-making process between the urologist and the patient [18]. One option with very high success rates, particularly in post-prostatectomy patients, is implantation of an IPP. It has also been suggested that, in some patients with minimal incontinence and/or climacturia, simple IPP insertion and inflation of cylinders may potentially resolve these issues, owing to the ensuing compression on the urethra. While this idea has been observed and discussed by some prosthetic surgeons, as far as can be determined, evidence has yet to be published in the literature. Several adjunctive procedures have, however, been attempted at the time of IPP insertion to resolve concomitant climacturia and are summarized below (Table 1).

Dual Implantation

It remains debatable whether, in the setting of post-RP ED and climacturia, dual procedures should be performed in a synchronous or asynchronous fashion. In a study by Rolle et al.

Table 1 Treatment options for men with climacturia

Author	Year	Intervention	No. of patients	Outcomes	Complications
Lee	2006	Voiding before intercourse	42	Limited climacturia	None
Mehta	2013	Compressive variable tension loop	124	Decreased climacturia	None
Geraerts	2016	Pelvic floor physical therapy	33	Improved climacturia	None
Rolle	2012	Synchronous implantation of IPP and AUS	23	Improved climacturia and erections	None
Rhee	2005	Synchronous implantation of IPP and sling	4	Improved climacturia and erections	None
Gorbatiy	2010	Synchronous implantation of IPP and sling	8	Similar operative time and length of hospital stay to patients who underwent asynchrounous implantation	Acute urinary retention (12.5%)
Christine	2016	Transobturator sling	46	Complete resolution of climacturia	None
Christine	2011	Two-incision technique for sling	78	Infection rate to be 1.2%	–
Mancini	2008	Synchronous implantation of IPP and AUS	95	Pad usage was similar	Sub-cuff atrophy (12.9%)
Mendez	2017	Trans-corporal AUS placement along with IPP	3	Resolution of climacturia and functioning IPP	None
Yafi	2018	Mini-Jupette graft	38	Improved climacturia	Pain, psychological distress, and erosion (13.2%)
Kent	2018	Mini-Jupette graft	14	Resolution of climacturia	None

[19], out of 23 patients who had a RP, 15 underwent simultaneous implantation of IPP and artificial urinary sphincter (AUS), and 8 had implantation performed in two stages. Results showed no intraoperative complications in either group, and all patients were continent and were able to have satisfactory intercourse at 1-year mark [19].

Similarly, dual synchronous placement of an IPP and sling has been reported by Rhee [20] and demonstrated no increased complication risks compared to single device placements. In eight patients who had simultaneous dual implantations, Gorbatiy et al. [21] demonstrated similar operative times compared with the total time for the individual procedures ($p > 0.05$), and similar length of hospital stay ($p > 0.05$). One complication reported was acute urinary retention, which resolved with 5 days of catheter drainage [21].

It is worth noting that when dual implantation is contemplated, it is usually recommended to complete placement of the sling or AUS prior to insertion of the IPP in the event of an accidental urethrotomy, preventing implantation of the IPP [22].

Male Sub-urethral Sling

A male suburethral sling is usually composed of a synthetic macroporous monofilament polypropylene mesh. Its main mechanism of action relies upon proximal urethral relocation during Valsalva [23]. It is hypothesized that concomitant placement of a sling at the time of IPP implantation could result in significant improvement in patient-reported climacturia. Christine et al. [4•] presented data on 46 men who underwent transobturator sling placement for the management of post-robotic prostatectomy climacturia and SUI [4•]. All 46 patients reported complete resolution of climacturia (100%), and 84% reported complete resolution of SUI with no complications reported [4•]. In another study where the infection rate was the primary outcome, Christine et al. [24] reported the rate to be 1.2% when they performed the two-incision technique in their series of 78 men at mean of 16 months follow-up [24]. This is similar to what is observed with solitary IPP placement.

Artificial Urinary Sphincter

The artificial urinary sphincter (AUS) is considered the gold standard treatment option for men with moderate to severe stress urinary incontinence (SUI) [25]. There is, however, no reported data regarding AUS placement and climacturia. Mancini et al. [26] compared outcomes of 95 post-RP patients who underwent dual implantation with those receiving AUS or IPP alone. A total of 95 men were evaluated and divided as such: 31 received an IPP alone, 31 received an AUS alone, and 33 underwent dual implantation [26]. At a mean postoperative follow-up of 19 months, daily pad usage decreased from 4.6 to 0.8 pads with AUS alone and from 6.1 to 1.3 pads with dual implantation; thus, there was no significant difference in reduction of pad use between groups (76% versus 77%, $p = 0.92$) [26]. The major complication suggested in this study was sub-cuff atrophy, as six men (18.2%) in the dual implantation group and four men (12.9%) in the AUS-alone group required revision surgery due to this complication [26].

In either group, pain was minimally reported [26]. A recent case study examined trans-corporal AUS placement along with IPP insertion using a six-ply acellular graft in patients who had a radical prostatectomy, more than three previous urethral surgeries, and who reported climacturia [27•]. Results showed that 100% (3/3) of the patients who underwent this procedure reported resolution of climacturia and had a functioning IPP [27•].

Mini-Jupette

The Mini-Jupette (mini-skirt in French) graft is a novel surgical approach that provides intermittent urethral compression for patients with climacturia undergoing IPP placement. First described by Professor Robert Adrienne in Belgium, the premise of the Mini-Jupette is to obstruct urinary flow; as the cylinders of the IPP inflate, the sling becomes taut leading to compression of the urethra and ultimately decrease of leakage. After standard corporotomies are made, the distance between the medial corporotomies is measured, and a graft is fashioned according to the width and the length of the corporotomies [8••]. It is important to ensure that there is no tension on the urethra before suturing it in place to avoid mesh erosion, urinary obstruction, and pain [28••]. Once the sling is in place, the IPP reservoir and bilateral cylinders are placed, and the corporotomies are closed with a running suture. Once the IPP is fully rigid, the graft becomes functional and prevents climacturia, due to tension across the urethra. A wide variety of grafts can be used for this purpose such as human pericardium, polypropylene, bovine pericardium, vicryl-prolene, dynamesh (polymer, polyvinylidene fluoride), and SurgiMend (fetal bovine dermis) [http://vjpu-issm.info/videos/peer-reviewed/item/109-the-mini-jupette-an-adjunctive-procedure-to-inflatable-penile-prosthesis-for-minimal-stress-incontinence-following-radical-prostatectomy].

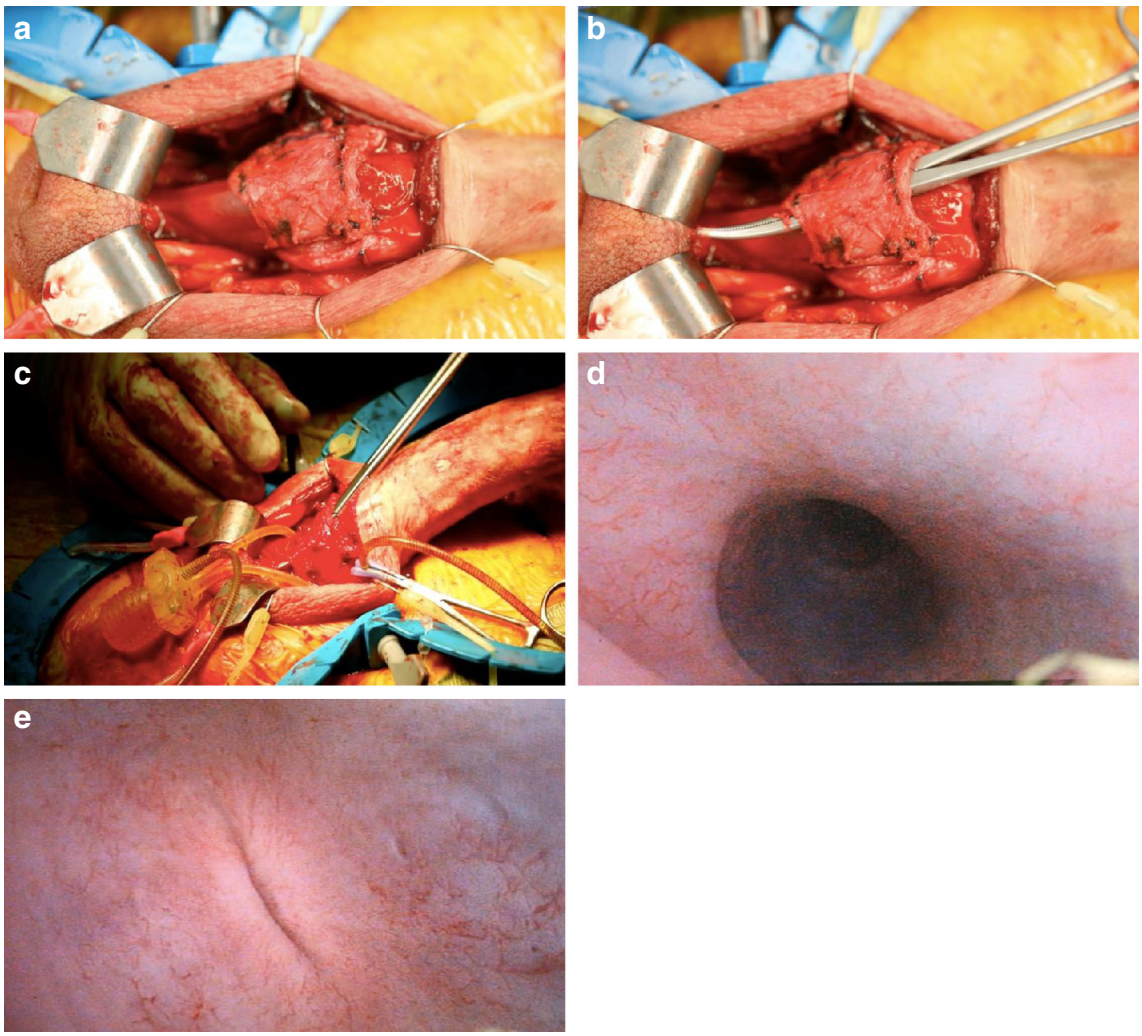

Fig. 1 Modified Mini-Jupette sling using autologous rectus fascia sling. **a** Sling sutured to medial corporotomies. **b** Sling loose against urethra with the cylinders deflated. **c** Sling tense against urethra with cylinders inflated. **d** No urethral coaptation with cylinders deflated. **e** Complete urethral coaptation after cylinder inflation

Yafi et al. [28••] conducted a prospective, multicenter, pilot study of patients with ED and climacturia post-RARP undergoing IPP insertion with concomitant placement of a Mini-Jupette graft. Thirty-eight patients were included in the study. Climacturia improved in 22 out of 28 patients (78.6%) upon follow-up, of which 19 (67.9%) had complete resolution ($p < 0.001$). Improvement was reported by 92.8% of patients [28••]. Results were favorable when compared to other climacturia treatment strategies, such as tension loops and pelvic floor muscle therapy [8••]. Regarding urinary incontinence, the average number of pads per day improved from 1.6 ± 0.6 preoperatively to 0.3 ± 0.4 postoperatively ($p < 0.001$) [28••]. Overall, incontinence improved in 89.3% (25/28) of the patients of which 21 had complete resolution, defined as 0 pads per day (75.0%) [28]. Complications were noted in five patients (13.2%) undergoing this technique, one of whom reported pain while four needed surgical explantation for various reasons (psychological distress and erosion) [28••].

Although the Mini-Jupette sling is a relatively new technique, complication rates are comparable to those reported with urethral slings alone (12.3%) [29]. Furthermore, most of the complications occurred early in the investigators' experience and were due to increased tensioning of the graft, or to improper placement of corporotomies, the technique has since been refined to encourage more proximal and lateral corporotomies for better distribution of tension of the graft over a larger surface area. As it stands, the Mini-Jupette graft is a promising technique due to its safety, feasibility with IPP insertion, and efficacy in treating climacturia.

A similar retrospective study reported results on 14 patients who underwent IPP and a Mini-Jupette-like sling placed by a single surgeon [30]. Of the 14 patients, 7 patients reported complete resolution of their climacturia ($p = 0.02$). No complications were reported [30].

More recently, the same group from the University of California, Irvine, has explored the use of an autologous rectus fascial graft to create a modified Mini-Jupette sling. A transverse lower abdomen incision followed by harvesting of the rectus fascia graft was performed in a similar fashion to the standard Mini-Jupette technique (https://www.vjpu-issm.info/videos/peer-reviewed/2-incontinence-devices-artificial-urinary-sphincter-aus-slings/2-f-ipp-sling/item/146-autologous-fascial-mini-jupette-sling-for-the-management-of-post-prostatectomy-climacturia) (Fig. 1).

Future Perspectives

The Mini-Jupette appears to be a safe and efficient technique to treat climacturia during IPP surgery. The optimum graft to be used as a Mini-Jupette sling has yet to be determined, as both synthetic and cadaveric fascia have been used.

Rising data seems to suggest that anatomical difference in membranous urethra length (MUL) could explain the occurrence of climacturia in patients undergoing RP; ideally, MUL can be conserved without jeopardizing surgical margins, thereby preventing climacturia [31]. Stem cell therapy injections during RP may also present a future solution for this problem [32].

Conclusions

Climacturia is an underreported but often devastating condition for men following radical prostatectomy. It affects both the patient and his partner, and may lead to avoidance of sexual intercourse. Multiple techniques are available for the treatment of climacturia, and several surgical options have been used synchronously and asynchronously with IPP insertion. The Mini-Jupette is the only technique to date that has been studied in a multi-institutional cohort with excellent rates of climacturia and incontinence control. Longer follow-up and larger patient cohorts are, however, needed to confirm the long-term safety and benefits of this intervention.

Compliance with Ethical Standards

Conflict of Interest Farouk M. El-Khatib, Maxwell Towe, Judy Choi, and Faysal A. Yafi each declare no potential conflicts of interest.

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

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- •• Of major importance

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