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INVITED REVIEW

Prostate Disease

Orgasm-associated urinary incontinence (climacturia) following radical prostatectomy: a review of pathophysiology and current treatment options

Christopher Kannady¹, Jonathan Clavell-Hernández²

Orgasm-associated urinary incontinence, or climacturia, is a common side effect after radical prostatectomy (RP) that is gaining more attention due to the distress it causes to patients. A range of treatment options have been reported in the literature and are outlined in this review. The goal of our study is to review the pathophysiology and current management options for climacturia following RP. A PubMed search was used to review the current literature relating to the pathophysiology and the treatment of postprostatectomy climacturia. We reviewed the currently available treatment options and their success rates for climacturia. Several techniques were found to subjectively help improve the amount and bother of patients' climacturia. These include pelvic floor muscle training (PFMT), penile variable tension loop, soft silicone occlusion loop, artificial urethral sphincter, male urethral sling, and the Mini-Jupette graft. Success rates ranged from 48% to 100% depending on the modality used. For patients with erectile dysfunction and climacturia, the Mini-Jupette graft could be a valuable option. Given the lack of validated measurement tools and management options, climacturia has become a challenge for urologists. Albeit a condition that has not garnered much attention, there are several management options from conservative to invasive treatments that have shown a hopeful promise for the treatment of climacturia. These options should be discussed with patients to determine the best treatment for each individual. More clinical trials are needed to assess the efficacy and impact of the different treatment options before a definitive recommendation regarding management can be made.

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INTRODUCTION

Prostate cancer is the most common cancer in men, with an annual prevalence of approximately 120 per 100 000 cases per year in the general male US population.¹ The improvement and refinement in prostate cancer detection and treatment modalities have contributed to a younger patient population undergoing radical prostatectomy (RP).^{2–4} Because the current 5-year survival rate after prostate cancer treatment approximates 99%,¹ attention must be paid to the impact of potential treatments on overall patient functional status. One aspect that has created significant recognition among surgeons is erectile dysfunction, as return to sexual activity has been shown to be a major concern among patients undergoing RP. However, a variety of other understudied complications that occur as a consequence of RP have gained interest among researchers who aim to improve the quality of life of post-RP patients. One of these complications gaining increased attention is orgasm-associated urinary incontinence. Also known as climacturia, orgasm-associated urinary incontinence is defined as the

involuntary loss of urine at the time of orgasm. True rates of climacturia are currently unknown but are likely to be underreported in previous studies.⁵ A review of the literature of post-RP climacturia by Clavell-Hernandez *et al.*⁶ showed prevalence ranging from 20% to 93% over various studies but average being closer to approximately 30%.^{5–15} In addition to the prevalence, some studies have also quantified the bothersome nature to be as high as 47%.⁷ With these high prevalence rates and high degree of patient distress/embarrassment, there is a need to increase research investigating the treatment options for climacturia after RP as these patients may avoid sexual activity altogether.¹⁶ This article aims to review the treatment options along with their success rates for patients with orgasm-associated urinary incontinence after RP.

METHODS

A Medline PubMed search was used to identify articles of interest related to climacturia after RP. The following were included in the search for articles of interest: “orgasm-associated urinary incontinence”, “orgasm-induced urinary incontinence”, “climacturia”, “radical

¹Division of Urology, McGovern Medical School at The University of Texas Health Science Center at Houston, Houston, TX 77030, USA; ²St. Joseph Medical Center, Houston, TX 77002, USA.

Correspondence: Dr. J Clavell-Hernández (jclavell@urosurgeryhouston.com)

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prostatectomy and climacturia”, “climacturia treatment”, “pelvic floor muscle training and climacturia”, “pelvic floor rehabilitation and climacturia”, “penile variable tension loop”, “artificial urethral sphincter and climacturia”, “male urethral sling and climacturia”, “soft silicone occlusion loop”, and “Mini-Jupette Graft”.

Mechanism of climacturia

Despite its prevalence and bother to patients affected by it, the pathophysiology of climacturia after RP has yet to be determined. Various mechanisms have been suggested, but none have been adequately tested. Koeman *et al.*⁸ suggested that climacturia might be related to the removal of the internal urethral sphincter during RP in conjunction with external sphincter relaxation. Others associate the condition to intrinsic sphincter deficiency secondary to injury of the internal urethral sphincter and its supporting structures during RP surgery.^{9,17} Choi *et al.*⁹ described that at the time of emission, the external sphincter opens abruptly and the high intraprostatic pressure combined with periurethral musculature contraction leads to antegrade ejaculation. Simultaneous with ejaculation, the bladder contracts reflexively and, if the internal sphincters have been damaged, this bladder contraction could lead to a loss of urine during climax. This mechanism described by Choi *et al.*⁹ does not explicitly apply to patients after RP, but their description can be extrapolated to provide a hypothesis for the etiology of orgasm-associated urinary incontinence.

Another proposed mechanism for climacturia involves loss of penile length, which itself could reflect the loss of prostatic urethral length. Choi *et al.*⁹ suggested that loss of penile length after RP was a statistically significant independent predictor of climacturia. This association was later supported by Manassero *et al.*¹⁸ who performed the first functional and morphological evaluation of patients with climacturia after RP by using video-urodynamic studies (VUDS). From a group of 84 continent and potent men 1 year after RP, 24 (28.6%) had isolated climacturia. Of those, seven (29.2%) men underwent VUDS and were compared to five men without climacturia who served as the control group. They found that functional urethral length was statistically significantly lower in the climacturia group when compared with that in controls ($P = 0.02$).

Other studies have found an association between orgasm-related pain, also known as dysorgasmia, and loss of penile length in patients who have undergone RP.^{12,18} If this remained true, there could be a correlation in the mechanism that involves orgasmic pain, loss of penile length, and climacturia. Barnas *et al.*¹² suggested that dysorgasmia after RP was secondary to bladder neck spasms that occur at the level of vesicourethral anastomosis. Mulhall¹⁹ then proposed that cavernous nerve injury and the subsequent sympathetic hyperinnervation during autonomic repair of the nerves could be related to loss of penile length. Assuming that the cavernous smooth muscle is highly contractile in response to adrenergic tone, sympathetic overdrive after cavernous nerve injury would result in a hypertonic condition that may cause penile shortening. If the mechanisms that involve dysorgasmia and penile shortening are mediated by the sympathetic system, there exists the possibility that this mechanism could also explain the process that leads to climacturia.^{18,19}

There have also been suggestions of an association between climacturia and post-RP stress urinary incontinence (SUI). In 2014, O’Neil *et al.*¹⁰ published a review of 412 patients surveyed after RP which showed that 22.6% had climacturia and of those nearly two-thirds reported urinary incontinence. Despite these data, other studies have shown no correlation.^{7,9,11} In particular, Nilsson *et al.*’s study¹¹ of 268 patients reporting climacturia showed that 86% of those

surveyed were otherwise continent in all other aspects of life besides during an orgasm.

Regardless of its cause, urologists need to be vigilant in inquiring about climacturia but may not be doing so as there are few validated treatment options available. Nevertheless, there have been several treatment modalities that have been described in the literature that can be considered for treating climacturia. These are outlined in this review.

Treatment options for climacturia

Currently, patients have developed their own coping mechanisms that have been supported by physicians to help them manage their climacturia. These include voiding before sexual intercourse and using condoms to capture urine incontinence after orgasm.⁷ There has also been mention of the use of tricyclic antidepressants and antimuscarinics anecdotally, but no confirmatory studies have been conducted to date.²⁰ However, these strategies are not ideal and do not definitively treat the problem.

Pelvic floor rehabilitation

Sighinolfi *et al.*²¹ evaluated three previously potent and dry men with ED, SUI, and climacturia 12–18 months after nerve-sparing RP. These patients were managed for 4 months of weekly sessions with a pelvic floor rehabilitation program consisting of learning pelvic floor anatomy followed by being taught how to exercise a dominant pelvic muscle. These were measured and graded by a digital anal control. When they were able to perform active pelvic floor muscle exercises, they were suggested to perform ninety contractions per day at home in alternating positions as well as in activities of daily living. In addition to the exercises, electromyography biofeedback for strength and endurance, as well as electrical stimulation, was implemented. Each patient’s ED was measured by the International Index of Erectile Function (IIEF-5) scores pre- and post-rehabilitation. SUI was measured by pad usage. Moreover, the study also showed subjective improvements in climacturia in 100% of patients (three of three) when asked about the frequency and quantity of urine leakage. Limitations to this study include an extremely small sample size and the lack of objective measurement of climacturia.

Geraerts *et al.*²² conducted a randomized controlled trial of 33 men using pelvic floor muscle training (PFMT) 12–15 months after nerve-sparing RP. This study focused primarily on ED, with a secondary end point being climacturia. Patients with concurrent SUI were excluded from the study. The treatment arm of the study consisted of 16 patients who underwent PFMT for 3 months starting 12 months after RP. The control arm consisted of 17 patients who also had PFMT but started at 15 months after RP. Each patient was asked to fill out an IIEF-5 questionnaire and to answer yes/no regarding climacturia at inclusion, at the start of treatment, at conclusion, and 3 months after treatment. They found statistically significant improvement in ED as well as climacturia ($P = 0.004$). Specifically, their data showed that after 3 months of PFMT, climacturia statistically significantly improved between the start of the study ($n = 17$ reported climacturia) compared to after PFMT ($n = 5$ reported climacturia) regardless of the timing of intervention ($P = 0.001$).

Penile variable tension loop

Mehta *et al.*²³ aimed to investigate an economical noninvasive option for the management of orgasm-associated incontinence. Their group looked at variable tension loops originally used for augmenting transurethral alprostadil suppositories.²³ The tension loop relies on the post-RP male achieving an erection suitable and durable enough for obtaining an orgasm. This device is placed over the base of the

penis after achieving the best possible rigidity and is then adjusted to securely encircle the girth of the penis so that a patient can determine how much tension is applied (as opposed to penile constriction bands), thus improving patient comfort. Their study included 124 patients who reported the degree of pretreatment climacturia as small, moderate, and large in 16%, 72%, and 12% of patients, respectively. After using the penile variable tension loop, it was 28%, 26%, and 0%, respectively, all of which were statistically significant ($P < 0.01$). Of note, 48% of patients reported no climacturia while using the loop. Distress levels were also reported as 14% and 61% of patients and partners at baseline, respectively. At a follow-up of 6 months from enrollment, a statistically significant improvement was found, with patients and partners reporting distress levels of 2% and 11%, respectively ($P < 0.01$). Limitations of the study included lack of a control arm and multivariate analysis to adjust for confounders. Given it is reusable and affordable (<20 US dollars), the penile variable tension loop provides patients with an option in managing their climacturia.

Soft silicone occlusion loop

Another alternative to the surgical correction of climacturia was presented by Bella and Littlemore at the Sexual Medicine Society of North America annual meeting in 2016.^{24,25} They studied a small cohort of five patients that had previously been conservatively treated for their climacturia, failed, and were not interested in the surgical correction of their climacturia. Their failure after treatment was determined by persistent leak during sexual activity, patient discomfort, interference of sexual activity, and partner's external genitalia discomfort. The group used a Food and Drug Administration (FDA)- and Health Canada compliant-device, called the soft silicone occlusion loop (SSOL). This loop yielded no urine leakage during sexual activity for four of the five patients, with the fifth patient having significant subjective decrease in his climacturia. The study also noted positive acceptance from all partners of patients using the SSOL. A difference that should be pointed out is that this study quantified any urinary leakage during the entire act of sexual intercourse and not just the climax as other studies for various techniques have described. However, leakage of urine during any aspect of sex, if not desired, is potentially disturbing and embarrassing to both the patient and his partner.

Artificial urethral sphincter and male urethral sling

As stated earlier, some theories draw a possible connection between climacturia and SUI after RP. Patients suffering from postprostatectomy incontinence (PPI) will typically undergo anti-incontinence procedures. Jain *et al.*²⁶ conducted a single-center study to determine the impact of anti-incontinence surgery using artificial urinary sphincter (AUS) or male sling on bother from orgasm-associated incontinence. Out of 11 sexually active men with both climacturia and PPI, 4 underwent AUS and 7 underwent male sling. They noted that all the patients who had AUS and more than half of the male sling patients had subjective improvement in their climacturia in addition to their PPI as determined by a questionnaire. AUS was further evaluated by Mendez *et al.*²⁷ who implanted an AUS using the transcorporeal technique in a case series of three patients with prior inflatable penile prosthesis (IPP) placement. These patients also had previous urethral surgeries, as well as atrophy after prior AUS with continued climacturia.²⁷ The group placed a 6-ply acellular graft posterior to the dorsal aspect of the urethra and sutured it to the lateral edges of the corporotomies, covering the current IPP rear tip extenders. After a mean follow-up of 10.7 months, all the three patients noted resolution of climacturia in addition to using one pad or fewer pads per day and normal IPP function in sexual activity.

The largest series of climacturic men who were treated with the transobturator male sling was presented in 2016.²⁸ Christine and Bella²⁸ reviewed a registry of men treated with the AdVance transobturator male sling (AMS; Boston Scientific, Minnetonka, MN, USA) after robotic-assisted laparoscopic RP from January 2010 to April 2016. Their series identified 44 post-RP patients who had climacturia with concurrent SUI and 2 men with stand-alone climacturia.²⁸ Of the 46 patients, 100% had resolution of their climacturia and 84% had complete resolution of their SUI after AdVance sling placement. Although there were a small number of patients with isolated climacturia, this study was the first to report surgical treatment for this subset of patients.

Given that AUS and male sling are surgical treatments originally designed for patients with PPI, some researchers have wondered if this procedure would be beneficial or considered too invasive for patients with only orgasm-associated incontinence without other SUI.¹⁶ Regardless, it remains an option for patients with isolated climacturia who are distressed with this condition.

Mini-Jupette graft

Currently, the treatment option gaining popularity among prosthetic urologists for patients with climacturia and concomitant postprostatectomy ED is the Mini-Jupette graft. Originally described by Robert Andrienne in 2005²⁴, the concept involves placing a graft across the urethra during IPP placement. The graft is sutured to the medial aspect of each corporotomy (Figure 1) and, as the cylinders expand during inflation, the graft applies tension on the urethra (Figure 2), thus limiting climacturia. Yafi *et al.*²⁹ reported the results of a prospective, multi-institutional study of patients with post-RP ED and climacturia and/or mild SUI (defined as <2 pads per day) who underwent IPP insertion with concomitant placement of a Mini-Jupette graft. Data were collected for procedures performed at 17 centers in the United States, France, Belgium, Germany, and Korea by high-volume IPP implanters (>50 per year). Thirty-eight patients with postprostatectomy ED, climacturia, and/or mild urinary incontinence (defined as no more than two pads per day) were



Figure 1: The graft is sutured to the medial aspect of each corporotomy (informed consent obtained).

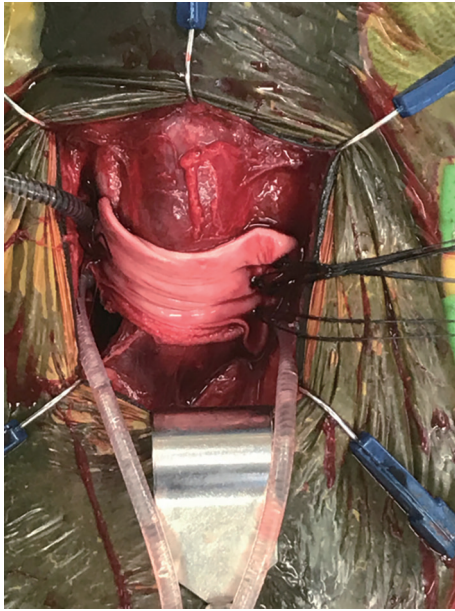


Figure 2: As the cylinders expand during inflation, the graft applies tension on the urethra, thus limiting climacturia (informed consent obtained).

included in the study, of which 30 had climacturia and 32 had SUI. The patients were asked to quantify the frequency of their climacturia preoperatively and at 3 and 6 months after their procedure. Graft types included human pericardium (52.6%; Tutoplast; Coloplast Corp., Minneapolis, MN, USA), polypropylene Biomesh (18.4%), Virtue mesh (10.5%; Coloplast Corp), bovine pericardium (7.9%), vicryl-prolene (5.3%), polymer polyvinylidene fluoride (2.6%; Dynamesh, FEG Textiltechnik, Aachen, Germany), and fetal bovine dermis (2.6%; SurgiMend®, Integra LifeSciences, Boston, MA, USA).

After a mean follow-up of 5.1 months, 78.6% of the patients had improvement in their climacturia when queried about episode frequency and 68% showed complete resolution. They also noted that 92.8% showed subjective improvement in climacturia. As expected, their sexual dysfunction showed a dramatic improvement with placement of an IPP. Furthermore, the authors reported that 25 of 28 patients (89.3%) with preoperative SUI had objective improvement, of which 21 had complete resolution, defined as 0 pad per day (75%). These results compare favorably with alternate devices used for PPI.^{30–33} Although being an invasive surgical procedure, there are minimal risks involved. There were no intraoperative complications reported. Postoperative complications were noted in five patients (13.2%). These included 4 requiring device explantation for unrelated psychiatric problems, postoperative bleeding from IPP reservoir placement resulting in device infection, urethro-corporal fistula, and urethral erosion.

More recently, Valenzuela *et al.*³⁴ reported outcomes after performing a modified approach for the Mini-Jupette graft using a modified Virtue monofilament polypropylene mesh sling placed over the bulbar urethra. Instead of using the medial aspect of the penile implant's corporotomy for the placement of the sling, the authors described extending their dissection proximal to the corporotomy in order to expose the mid-to-proximal bulbar urethra. This way, the surgeon can place the sling proximal to the planned corporotomy and suture it to the lateral aspect of each corpora in order to create support for the bulbar urethra (**Figure 3a** and **3b**).

Their retrospective review involved 36 patients, of which 30 (83%) reported climacturia, 27 (75%) reported SUI, and 21 patients (58%)

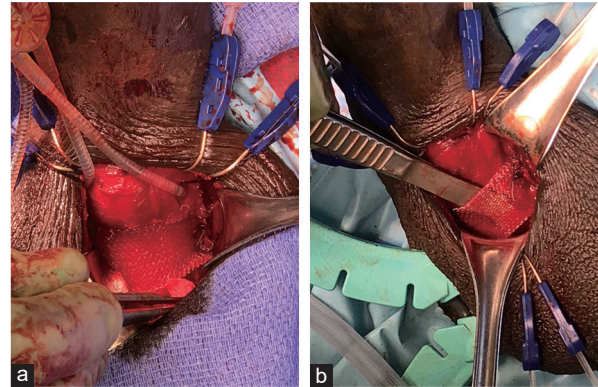


Figure 3: (a) Mini-Jupette graft using Virtue sling. The sling is placed proximal to the IPP's corporotomy and sutures to the lateral aspect of the corporal body (Courtesy: R. Valenzuela, MD) (informed consent obtained). (b) Mini-Jupette graft using Virtue sling. Graft is noted to be free of tension (Courtesy: R. Valenzuela, MD) (informed consent obtained).

experienced both climacturia and SUI. At a mean follow-up of 5.9 months, climacturia resolved in 28 of 30 patients (93%). Subjective SUI also improved in 23 of 27 patients (85%), of which 16 (59%) had complete resolution of incontinence. Complications included transient urinary retention in two patients (6%), urethral mesh erosion requiring mesh excision and primary urethral repair without IPP explantation in 1 patient, and chronic scrotal pain in 1 patient which improved with anti-inflammatory drugs.

These studies have limitations which included a small cohort, lack of a control group, and long-term follow-up. Nevertheless, the Mini-Jupette graft procedure follows well-established surgical principles that are less invasive than alternatives such as the male sling and AUS. Although the ideal type of graft to be used as the Mini-Jupette graft has yet to be ascertained, Valenzuela *et al.*'s early experience³⁴ has favored nonabsorbable mesh over biomaterials. More studies with longer follow-up and larger patient cohorts are needed to confirm the long-term benefits of this procedure.

CONCLUSIONS

Climacturia is a condition that is rarely volunteered by the patients who experience it, but should be elucidated by the physician who is evaluating them to assess the degree of bother and attempt to increase their quality of life. For this reason, climacturia is a condition that is gaining more interest among sexual medicine specialists as its effects are distressing and embarrassing not only to the patient suffering from the condition but to their partners as well. Conservative management, such as wearing condoms or voiding before sexual activity, have not been formally assessed in clinical studies. However, anecdotal reports show them being less than ideal and ineffective. Noninvasive techniques with pelvic floor rehabilitation or various penile loops offer easy and affordable options for patients with climacturia. Albeit successful and easy to use, they are not definitive therapies and carry a set of limitations. Pelvic floor rehabilitation requires significant commitment and compliance, which may hinder its long-term success. Penile loops, on the other hand, may potentially interfere with sexual activity by being uncomfortable and causing bruising or superficial injuries. Surgical options include AUS, male urethral sling, and the Mini-Jupette graft. Some patients may be hesitant to undergo invasive surgical procedures if their symptoms are relatively mild or nonbothersome. Yet, those with significant distress or embarrassment may be inclined to undergo a surgical procedure to help improve their sexual quality of life.

Table 1: Summary of climacturia treatment studies.

Study	Year	Treatment	Sample size (n)	Follow-up (month)	Study design	Condition assessed	Significant findings
Lee <i>et al.</i> ⁷	2006	Behavioral (prevoiding, condoms)	42	Mean: 23.6	Prospective	Climacturia	Anecdotal improvement
Sighinolfi <i>et al.</i> ²¹	2009	PFMT	3	4	Prospective Nonrandomized Nonplacebo	ED, UI, and climacturia	100% subjective improvement
Jain <i>et al.</i> ²⁶	2012	Standard AUS	4	Mean: 34.9	Retrospective case series	UI and climacturia	100% subjective improvement
Jain <i>et al.</i> ²⁶	2012	Male urethral sling	7	Mean: 34.9	Retrospective case series	UI and climacturia	71% subjective improvement
Salonia <i>et al.</i> ²⁰	2012	Medications	Multiple	Unspecified	Retrospective literature review	ED, SD, OF, and climacturia	Anecdotal improvement
Mehta <i>et al.</i> ²³	2013	Penile variable tension loop	124	Mean: 6	Prospective Nonplacebo	Climacturia	48% complete resolution
Geraerts <i>et al.</i> ²²	2016	PFMT	30	3 and 6	Randomized controlled trial	ED and climacturia	67% subjective improvement
Bella and Littlemore ²⁵	2017	Soft silicon occlusion loop	5	Unspecified	Prospective Nonrandomized Nonplacebo	Climacturia	80% complete resolution 20% subjective improvement
Christine and Bella ²⁸	2018	Male urethral sling	46		Retrospective registry review	Climacturia and UI	100% resolution
Mendez <i>et al.</i> ²⁷	2017	Transcorporal AUS	3	Mean: 10.7	Prospective Nonrandomized Nonplacebo	ED, UI, and climacturia	100% complete resolution
Yafi <i>et al.</i> ²⁹	2018	Mini-Jupette	28	Mean: 5.1	Prospective Nonrandomized Nonplacebo Multicentric pilot study	Climacturia and UI	Climacturia: 92.8% subjective improvement 78.6% measured improvement 68% complete resolution UI: 89.3 objective improvement 75% complete resolution
Valenzuela <i>et al.</i> ³⁴	2019	Modified Mini-Jupette	36	Mean: 5.9	Retrospective case series	Climacturia and UI	Climacturia: 93% complete resolution UI: 85% subjective improvement 59% complete resolution

AUS: artificial urinary sphincter; ED: erectile dysfunction; OF: orgasmic function; PFMT: pelvic floor muscle training; SD: sexual desire; UI: urinary incontinence

Although a definitive treatment recommendation cannot be provided at this time, the Andriane Mini-Jupette graft is an easy and feasible procedure that serves as a viable option for patients with concomitant post-RP ED undergoing IPP placement. Further studies evaluating patient outcomes are needed to truly validate the aforementioned treatment options. The majority of studies describing climacturia have low sample sizes and are underpowered. **Table 1** summarizes the treatment options outlined in this article. Further clinical trials as well as questionnaires and/or tools assessing climacturia are needed in order to evaluate the prevalence and determine the best management options for orgasm-induced urinary incontinence.

AUTHOR CONTRIBUTIONS

CK was involved in the data collection, drafting, writing, revision, and editing processes. JCH was involved in the drafting, writing, revision, and editing processes. Both authors read and approved the final manuscript.

COMPETING INTERESTS

Both authors declared no competing interests.

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