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Long-term potency after early use of a vacuum erection device following radical prostatectomy

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OBJECTIVE

To evaluate the long-term potency after radical prostatectomy (RP) with the early use of a vacuum erection device (VED), and reasons for sexual inactivity and long-term attrition and maintenance of sexual activity, as RP is one of the most common treatments for prostate cancer but erectile dysfunction (ED) is a common side-effect.

PATIENTS AND METHODS

We identified 141 sexually active patients who underwent RP at Cleveland Clinic Foundation. Patients were offered various non-oral treatment options to prevent ED and were also motivated for early penile rehabilitation. At 5 years 62% remained sexually active, of whom 71% had natural erections sufficient for intercourse without assistance, 8.5% were still using sildenafil, 10% were using combined therapy (sildenafil plus VED). At 5 years 38% (43/113) men were sexually inactive. The reasons included loss of interest in 17 (40%), cardiovascular/neurological diseases in 18 (42%), hormonal therapy in three (7%), loss of partner in three (7%) and two had other surgery. The natural rate of erections for sufficient vaginal penetration without an erection aid were preserved and maintained in the early-prophylaxis group, and almost 60% of them had used a VED as early prophylaxis.

CONCLUSION

Despite current phosphodiesterase-5 inhibitor treatments for ED, VED is becoming recognized again as having a primary role in early penile rehabilitation in many patients, specifically those treated for prostate cancer.

KEYWORDS

prostate cancer, vacuum erection device, radical prostatectomy

INTRODUCTION

Prostate cancer is the most common cancer in men aged >50 years and the second most common cause of death from cancer in these patients [1]. Radical prostatectomy (RP) remains the standard treatment for organ-/specimen- confined prostate cancer [2]. Erectile dysfunction (ED) after RP has become a major quality-of-life issue for both men and their partners, as most patients regain urinary continence in due course after RP [3]. The overall incontinence rates in most published reports after RP are <5%, while potency rates are 11–86% [4–6]. While advances in screening techniques have contributed to early diagnosis and better cancer disease-free survival rates, these improvements have also led to the treatment of younger, more sexually active patients.

Age is considered to be one of the most important factors influencing erectile function in men, and the prevalence and severity of ED increases with advancing age. The Massachusetts Male Aging Study (MMAS) showed that 52% of men aged 50–70 years had some form of ED. Recent longitudinal analysis from the MMAS data showed that sexual desire also decreased significantly in men after the age of 50 years [7,8]. The factors shown to influence the potency rates were institution, single vs multi-surgeon series, duration from the time of surgery, preoperative potency status and age at the time of surgery [5,6]. The follow-up period in most reported series is 12–18 months; that in the recently reported largest series for 3477 patients is also 18 months [9]. The long-term influence of comorbid conditions on erectile function after RP has not been reported.

Early intervention with erectogenic agents to promote blood flow during recovery from RP has become an important focus for research in sexual medicine. This concept of penile rehabilitation has been supported by numerous reports involving many different treatment options, including oral phosphodiesterase type-5 inhibitors (PDE5i), intracavernous injections (ICI), intraurethral alprostadil (MUSE), and vacuum erection devices (VED) [10–13]. The proposed mechanism of penile rehabilitation is that providing regular, oxygenated blood flow to the corpora is necessary to maintain smooth muscle integrity and prevent fibrotic changes within the corpora during the period of neuropraxia that occurs even after nerve-sparing RP (NSRP) [14,15]. An increased incidence of veno-occlusive dysfunction (venous leak) has been documented in the absence of erections after RP, and penile shortening has been documented in more than half of patients at 3 months who lacked penile rehabilitation after NSRP [10,16].

Importantly, previous reports are inconclusive and often contradictory when examining

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proposed penile-rehabilitation regimens [16]. A high degree of variability in both trial design and outcome assessment also makes comparing the results of these reports very difficult. Low patient compliance, lack of adequate follow-up, investigator bias, and differences in surgical experience and/or technique have all contributed to the inability to provide a consensus recommendation for penile rehabilitation after RP. While some variables are extremely difficult to control for, the lack of reported long-term clinical trials remains a significant hurdle that can undoubtedly be overcome with proper patient follow-up. This concept prompted the present study of a long-term analysis of the sexual function and role of early penile rehabilitation. We evaluated the long-term potency status after RP and use of a VED, and the reasons for sexual inactivity and long-term attrition and maintenance of sexual activity.

PATIENTS AND METHODS

In this study we identified 141 sexually active patients who underwent RP at the Cleveland Clinic Foundation. All patients were operated by one surgeon. Baseline and long-term follow-up data were available on all patients. Variables include age, ethnicity, PSA level, Gleason score of the preoperative biopsy and NS status. All patients had T1–T3 disease and only two had right regional lymph nodal involvement (Table 1). The mean (SD) age was 65.08 (6.68) years and the follow-up 6.4 (1.5) years. Patients receiving adjuvant hormonal and radiation treatments after RP were also included in the study. Patients were offered various treatment options to prevent ED and were also motivated to adopt early penile rehabilitation. Potency was defined as ability to have erections sufficient for satisfactory sexual intercourse with or without erectile aids. Spontaneous erections were further divided into natural erections sufficient for satisfactory intercourse with no erectile aids or natural erections requiring erectile aids for sufficient satisfactory intercourse.

The following information was obtained from each patient in the study at 1 year after RP; sexually active or not, return of any natural erections, return of natural erections sufficient for satisfactory intercourse, erectile aids used, and reasons for sexual inactivity (loss of interest, cardiovascular factors, urinary incontinence, loss of spouse, hormonal treatment). Patients who were sexually active at 1 year were re-evaluated after a follow-up of ≥5 years. The information obtained was as above but also included NS status.

The groups were compared statistically using Fisher's exact test, and all statistical tests were two-tailed, with $P < 0.05$ considered to indicate statistical significance; continuous variables are summarized as the mean (SD).

RESULTS

Of 141 sexually active patients included in the study, 113 (80%) were sexually active (including drug therapy and erectile aids) and 28 (20%) were sexually inactive at 1 year after RP. The reasons for sexual inactivity included incontinence (15/28, 53%), loss of interest in sex (10, 36%), loss of libido (3/28, 11%; hormonal therapy; Table 2). Of the 113 patients, four (3.5%) had natural erections sufficient for intercourse, 55 (48.7%) were using a VED, 26 (23%) intraurethral alprostadil (MUSE), 19 (16.8%) ICI, and nine sildenafil citrate. Due to a lack of response to oral therapy most of the patient had good erections from non-oral therapy for sexual rehabilitation after RP.

Of the 113 sexually active patients at 1 year, 50 (44%) had a return of spontaneous erections; all 50 were using non-oral standard treatments like VED, ICI and MUSE. Of these 50 patients almost 60% (30) tried early VED and had better compliance, efficacy and fewer economical constraints.

At 5 years, 70/113 (62%) patients remained sexually active; of these 70, 50 (71%) had natural erections sufficient for intercourse, with no assistance, six (9%) were still using sildenafil, seven were using combined therapy (sildenafil with VED), and seven patients switched to tadalafil alone. At 5 years, 38% (43/113) were sexually inactive; the reasons are listed Table 2. Almost all patients who had tried earlier penile-rehabilitation therapy with VED, ICI and MUSE were sexually active. The natural rate of erections for sufficient vaginal penetration with no erectile aid was preserved and maintained in the early-prophylaxis group and almost 60% of them had used a VED as early prophylaxis.

DISCUSSION

Methods for early penile rehabilitation have included early intervention with all types of ED treatments, including oral PDE5i, ICI, MUSE and VED. However, the importance of non-oral therapies for penile rehabilitation within the first year after RP cannot be understated. The cost of oral therapy combined with the likelihood that a perceivable erection will be absent in patients during the period of neuropraxia has led to some reports of high discontinuation rates in patients after NSRP.

Importantly, the present trial provides the first 5-year follow-up of a prospective population after early prophylactic intervention with all three non-oral treatments for ED. Patients in the present study were offered all standard non-oral treatments, and had higher compliance with a VED. This analysis documented the degree of patient discontinuation across all methods, as well as the attrition in sexual activity over time. Even patients who were sexually active at 1 year after RP were prone to discontinuing sexual

TABLE 1 The characteristics of the 141 patients

Variable	Mean (SD) or *n*
Age, years	65.08 (6.68)
PSA level, ng/mL	9.57 (8.81)
Gleason score (4–9)	6.4 (0.8)
≤6	90
>6	51
Ethnicity	
Caucasian	123
African-American	12
Asian	6
Clinical stage (N0*, M0)	
T1	81
T2	53
T3	7

**N1 in two patients.*

TABLE 2 Reasons for discontinuation of VED at 1 and 5 years

	n (%) at	
Reasons	1 year	5 years
Total	28 (20)	43 (38)
Loss of interest in sex	10 (36)	17 (40)
Cardiovascular & CNS	0	18 (42)
Urinary incontinence	15 (53)	0
Loss of libido	3 (11)	3 (7)
Loss of partner	0	3 (7)
Others	0	2 (5)

activity, making it extremely difficult to assess the overall return to natural erections in all patients. It must be assumed that patients refraining from sexual activity at 5 years after RP had a return to natural erectile function.

Patients in this analysis responded differently to the three treatments. The most important outcome was continued sexual activity and interest, with a potential return of natural erections sufficient for vaginal penetration comparable to that before RP. Most importantly, at 1 year the rate of natural erections sufficient for vaginal penetration was very low without erectile aids. Thus, early intervention with standard non-oral therapy was important to maintain sexual activity, interest and penile tissue integrity via some degree of oxygenation, which is not feasible through natural erections.

At 5 years the attrition in sexual activity was multifactorial, including comorbidity, lack of early penile rehabilitation, hormonal therapy and partner relationship. The only important variable that was associated with attainment and maintained long-term sexual activity was the early treatment after RP. Physician should not miss this opportunity for early treatment and should initiate any mode of treatment to maintain some sexual activity. In our experience ICI are a more physiological and effective mode of early penile rehabilitation, but due to problems with manual dexterity, and pain or fear, the long-term compliance was very poor. In the long term most patients used a VED as an early and adjunctive treatment for ED. MUSE was also helpful but due to poor long-term compliance, cost and penile 'burning pain' was not preferred over a VED for use over 5 years. Only those patients who had used early non-oral therapies for penile rehabilitation had a return of natural erections at 5 years, and of those, 60% preferred a VED as a long-term method.

A VED can last for ≥5 years and is therefore, in the long-term, a cost-effective treatment for ED. A VED is the standard option and one of the most commonly prescribed forms of treatment for ED. The VED is easy to use and after repeated use, a man can produce an erection in 2–3 min, thereby increasing spontaneity as well as patient compliance. A VED generally takes the form of a tube or cylinder which is placed over the penis and a vacuum then is applied to promote an increase in penile blood flow. More recently, we advised patients to use a constriction ring (SureErec™, Osbon ErecAid, MediPlus Ltd. High Wycombe, Bucks, UK), which is pre-placed at the base of the penis before using the VED pump. The SureErec is an ideal alternative for many men who find the standard tension ring too loose [16]. For users who find it uncomfortable to slip the ring off the cylinder and onto the penis, the SurErec also eliminates the transfer process, thus increasing compliance. Once an erection is attained, a constriction ring should not be kept on for >30 min, to prevent ischaemia [17].

VEDs are drug-free and with limited side-effects. However, drawbacks to the system are instability at the base of the penis, leading to unnatural pivoting, a bluish or cyanotic aspect, and a cooler erection due to constriction of the blood flow [18]. The VED is an important treatment and is a better first-line treatment for ED than other treatments in certain circumstances. Although most often considered as a second-choice of treatment compared with PDE-5i, some types of patients (neurogenic, psychiatric, arteriogenic) are more likely to benefit from the first-line use of a VED [19,20]. Studies suggest that a VED can assist in penile rehabilitation after RP and radiotherapy, and prevent penile shrinkage in both length and girth in patients undergoing definite treatment for prostate cancer [12,21]. Currently the role of VED in penile rehabilitation after prostate brachytherapy and cryotherapy is being explored. Other types of patients for whom the VED has proved most popular include the elderly, patients with suboptimal or adverse results from oral therapy, and those with moderate or severe ED. The use of a VED in combination with other forms of therapy (i.e. ICI, oral drugs, MUSE) also has a place in the first-line treatment for ED [22,23]. In our centre, at 5 years those patients with various comorbidities have tried oral therapy in combination with IC, MUSE and VED; surprisingly most of them used a VED in combination with PDE5i for sexual activity.

In conclusion, currently, the most popular initial choice for patients with ED is an oral PDE5i. The limited efficacy of PDE5i in the presence or absence of a periprostatic neurovascular bundle, 'neuropraxia', or transient cavernosal nerve dysfunction after RP, and the concept of combined therapy, has convinced urologists to revisit and explore the role of non-oral therapies for managing ED after RP. As a result, the VED is being recognized as a valuable and effective first-line treatment option in a wide variety of patient types. More recently, the role of VED has expanded in use as a combined therapy with PDE5I for penile rehabilitation after RP and radiotherapy, and as an adjuvant therapy before penile implant surgery and graft repair for Peyronie's disease.

A complete understanding of patient preferences will lead to better long-term use of any form of ED therapy. Factors such as spontaneity, 'naturalness', and onset and duration of action each have a role in influencing the choice. Providing patients with full information on the pros and cons of treatment options is important, and the clinician needs to educate the patient, to provide the best available treatment for him [24,25]. The appropriate initial choice of therapy is also essential because costs associated with changes related to successive treatment failures can be high [26]. In addition, partner involvement is often vital to the success of the treatment [27].

In the era of PDE5i treatment for ED, the VED is becoming recognized again as having a primary role in early penile rehabilitation in many patient types, specifically those treated for prostate cancer. The ability of VEDs to facilitate penile rehabilitation and stimulate sexual intercourse, especially after radical prostate surgery and radiotherapy, is a unique strength for which it stands alone from other forms of treatment. Due to its excellent efficacy rates, combined with its ease of use, non-invasiveness and cost-effectiveness, the VED must be recognized as a front-line treatment of choice for ED.

CONFLICT OF INTEREST

None declared.

REFERENCES

1 **Landis SH, Murray T, Bolden S *et al.*** Cancer statistics, 1999. *CA Cancer J Clin* 1999; **49**: 8–31

2 **Shrader-Bogen CL, Kjellberg JL, McPherson CP *et al.*** Quality of life and treatment outcomes: prostate carcinoma patients' perspectives after prostatectomy or radiation therapy. *Cancer* 1997; **79**: 1977–86

3 **Walsh PC, Marschke P, Ricker D *et al.*** Patient-reported urinary continence and sexual function after anatomic radical prostatectomy. *Urology* 2000; **55**: 58–61

4 **Catalona WJ, Carvalhal GF, Mager DE *et al.*** Potency, continence and complication rates in 1870 consecutive radical retropubic prostatectomies. *J Urol* 1999; **162**: 433–8

5 **Rabbani F, Stapleton AM, Kattan MW *et al.*** Factors predicting recovery of erections after radical prostatectomy. *J Urol* 2000; **164**: 1929–34

6 **Catalona WJ, Basler JW.** Return of erections and urinary continence following nerve sparing radical retropubic prostatectomy. *J Urol* 1993; **150**: 905–7

7 **Derby CA, Barbour MM, Hume AL *et al.*** Drug therapy and prevalence of erectile dysfunction in the Massachusetts male aging study cohort. *Pharmacotherapy* 2001; **21**: 676–83

8 **Derby CA, Araujo AB, Johannes CB *et al.*** Measurement of erectile dysfunction in population-based studies: the use of a single question self-assessment in the Massachusetts male aging study. *Int J Impot Res* 2000; **12**: 197–204

9 **Kundu SD, Roehl KA, Eggener SE *et al.*** Potency, continence and complications in 3,477 consecutive radical retro pubic prostatectomies. *J Urol* 2004; **172**: 2227–31

10 **Raina R, Agarwal A, Zippe CD.** Management of erectile dysfunction after radical prostatectomy. *Urology* 2005; **66**: 923–9

11 **Raina R, Pahlajani G, Agarwal A *et al.*** The early use of transurethral alprostadil after radical prostatectomy potentially facilitates an early of erectile function and successful sexual activity. *BJU Int* 2007; **100**: 1317–21

12 **Schwartz EJ, Wong P, Graydon RJ.** Sildenafil preserves intracorporeal smooth muscle after radical retropubic prostatectomy. *J Urol* 2004; **171**: 771–4

13 **Köhler TS, Pedro R, Hendlin K *et al.*** A pilot study on the early use of the vacuum erection device after radical retropubic prostatectomy. *BJU Int* 2007; **100**: 858–62

14 **Daley JT, Brown ML, Watkins T *et al.*** Prostanoid production in rabbit corpus cavernosum. I. Regulation by oxygen tension. *J Urol* 1996; **155**: 1482–7

15 **Iacono F, Giannella R, Somma P *et al.*** Histological alterations in cavernous tissue after radical prostatectomy. *J Urol* 2005; **173**: 1673–6

16 **Mulhall JP, Slovick R, Hotaling J *et al.*** Erectile dysfunction after radical prostatectomy: hemodynamic profiles and their correlation with the recovery of erectile function. *J Urol* 2002; **167**: 1371–5

17 **Zippe CD, Pahlajani G.** Vacuum erection devices to treat erectile dysfunction and early penile rehabilitation following radical prostatectomy. *Curr Urol Rep* 2008; **9**: 506–13

18 **Utida C, Truzzi JC, Bruschini H *et al.*** Male infertility in spinal cord trauma. *Int Braz J Urol* 2005; **31**: 375–83

19 **Sidi AA, Lewis JH.** Clinical trial of a simplified vacuum erection device for impotence treatment. *Urology* 1992; **39**: 526–8

20 **Seckin B, Atmaca I, Ozgok Y *et al.*** External vacuum device therapy for spinal cord injured males with erectile dysfunction. *Int Urol Nephrol* 1996; **28**: 235–40

21 **Aloui R, Iwaz J, Kokkidis MJ, Lavoisier P.** A new vacuum device as alternative treatment for impotence. *Br J Urol* 1992; **70**: 652–5

22 **Dalkin B.** Preservation of penile length after radical prostatectomy (RP). Early intervention with a vacuum erection device (VED) Presented at the Society of Urologic Oncology Meeting. Anaheim, CA; May 19–14, 2007 Abstract

23 **Raina R, Agarwal A, Allamaneni SS *et al.*** Sildenafil citrate and vacuum constriction device combination enhances sexual satisfaction in erectile dysfunction after radical prostatectomy. *Urology* 2005; **65**: 360–4

24 **Marmar JL, DeBenedictis TJ, Praiss DE.** The use of a vacuum constrictor device to augment a partial erection following an intracavernous injection. *J Urol* 1988; **140**: 975–9

25 **Hatzimouratidis K, Hatzichristou DG.** A comparative review of the options for treatment of erectile dysfunction: which treatment for which patient? *Drugs* 2005; **65**: 1621–50

26 **Hackett GI.** Patient preferences in treatment of erectile dysfunction: the continuing importance of patient education. *Clin Cornerstone* 2005; **7**: 57–65

27 **Tan HL.** Economic cost of male erectile dysfunction using a decision analytic model: for a hypothetical managed-care plan of 100,000 members. *Pharmacoeconomics* 2000; **17**: 77–107

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Abbreviations: **(NS)RP**, (nerve-sparing) radical prostatectomy; **ED**, erectile dysfunction; **VED**, vacuum erection device; **MMAS**, Massachusetts Male Aging Study; **PDE5i**, phosphodiesterase type-5 inhibitors; **ICI**, intracavernous injection.