ORIGINAL RESEARCH—BASIC SCIENCE

Design and Application of a New Rat-Specific Vacuum Erectile Device for Penile Rehabilitation Research

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ABSTRACT

Introduction. Radical prostatectomy has a potential negative impact on penile health. The vacuum erection device (VED) has been used to promote the recovery of penile function and to maintain penile length. However, there is skepticism in the urological community due to its elusive mechanisms in penile rehabilitation.
Aim. To design a rat-specific VED and assess its application and safety.
Methods. Based on rat penile measurement and the principle of human VED, the rat-specific VED was designed, and the application for rats was evaluated.
Main Outcome Measures. The vacuum pressure of the rat-specific VED was measured. The VED application on rat penis and its side effects were studied.
Results. The rat-specific VED is a safe and applicable device to study the mechanism of VED in penile rehabilitation.
Conclusions. The newly designed rat-specific VED is a good simulator of the human VED. The application of this device on bilateral cavernous nerve crush rat model will be used to study the mechanisms of the VED in the penile rehabilitation. **Yuan J, Westney OL, and Wang R. Design and application of a new rat specific vacuum erectile device for penile rehabilitation research. J Sex Med 2009;6:3247–3253.**

Key Words. Rat Specific Vacuum Erectile Device; Penile Rehabilitation; Vacuum Pressure; Radical Prostatectomy

Introduction

Prostate cancer is the most common solid-organ cancer in men and one of the leading causes of death [1]. With early detection and radical prostatectomy, the 15-year overall actuarial cancer-specific survival rate has reached 90% [2,3]. Unfortunately, radical prostatectomy is associated with several quality-of-life issues, mainly urinary incontinence and erectile dysfunction [4,5]. With improvements in technique and the application of robotic procedures, incontinence rates have dropped to an acceptable level [6–9]. However, the same cannot be said for erectile dysfunction, as the incidence of erectile dysfunction after radical prostatectomy ranged from 10% to 100% [10]. To improve the patients' quality of life after radical prostatectomy, penile rehabilitation is now widely applied in the clinical practice [3,11–13]. Currently, penile rehabilitation methods include the use of phosphodiesterase type 5 inhibitors, intracavernosal injection/intraurthral suppositories, and the vacuum erectile device (VED) or combination therapy [3,11–13].

Vacuum therapy utilizes negative pressure to distend the corporal sinusoids and to increase the blood inflow to the penis [14]. Clinical studies indicated that vacuum therapy is the only penile rehabilitation method that preserves penile length. VED therapy can also improve the patient and partner sexual satisfaction and allows earlier return of spontaneous erection [15–17]. However, the unknown mechanism of VED therapy for penile rehabilitation hampered physician recommendation and patient compliance [3].

Figure 1 Three types of human vacuum devices.

To explore the underlying mechanism of vacuum therapy after radical prostatectomy, we designed a ra-specific vacuum device and successfully applied to Sprague-Dawley rat penis. We report the design of our device and its application.

The Rat VED

The rat VED was created on exactly simulation of human vacuum devices in clinical use.

There are three types of vacuum devices for human use: (i) two piece: a suction cylinder and a pump to induce negative pressure connected with a tube (left side in the Figure 1); (ii) one piece: condense the suction cylinder and pump into one piece (right side in the Figure 1); (iii) one piece, substitute the handed pump by a battery-driven motor (middle in the Figure 1) [18]. The single-handed one-piece device is more desirable to novice users and elderly patients with limited manual dexterity [19]. However, for use on rats, the one piece is not convenient. Therefore, we combined the two-piece device design with battery-driven motor (EROS CTD, UroMetrics, St. Paul, MN, USA) (Figure 2). Three cylinder sizes were created based on published literature [20] and our own measurements of rat penile sizes (Figure 2) (Table 1) to mimic the human VED

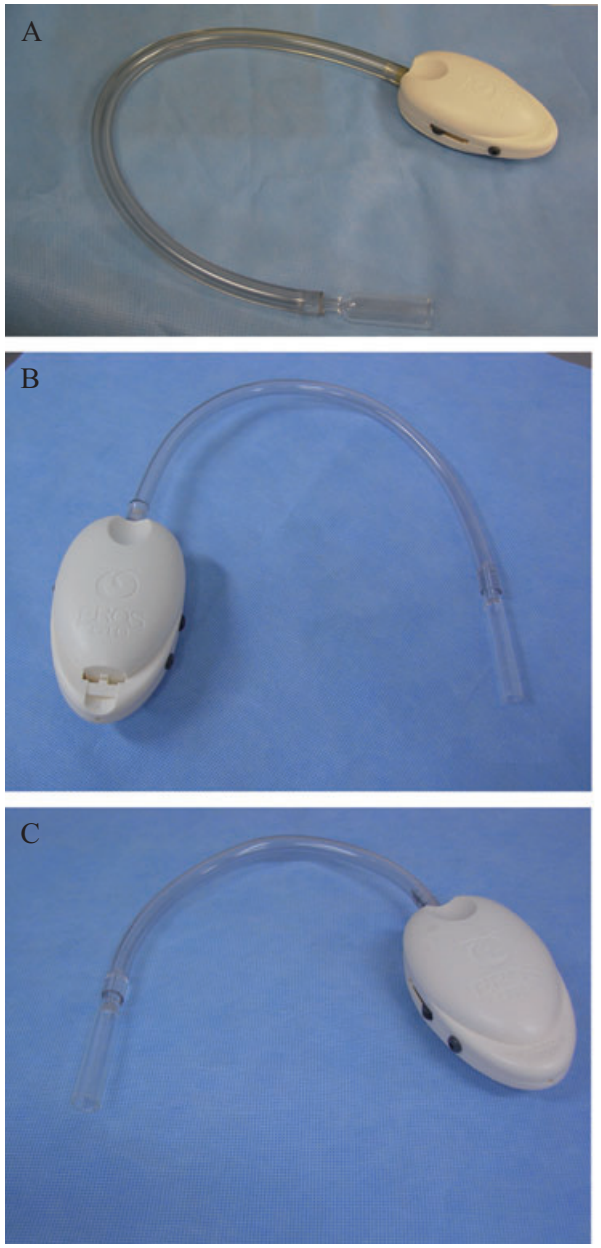

Figure 2 Rat vacuum device with three different sizes of cylinder. (A) Large: cylinder inside diameter 15.28 mm; (B) medium: cylinder inside diameter 9.78 mm; (C) small: cylinder inside diameter 7.82 mm.

cylinder, which has a lining to adjust its inner diameter to smaller-size penis. Thus, an ergonomic and stable negative pressure vacuum set is created (Figures 2–4).

Table 1 Cylinder sizes

	Large	Medium	Small
Inner diameter (mm)	15.28	9.78	7.82
Length (mm)	50.00	50.00	50.00