

## Neurophysiological Testing to Assess Penile Sensory Nerve Damage After Radical Prostatectomy

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### ABSTRACT

**Introduction.** Radical prostatectomy (RP) can lead to erectile dysfunction due to surgical injury of the cavernous nerves. However, there is no simple, objective test to evaluate cavernous nerve damage caused by RP in clinical practice.

**Aim.** To assess the value of the measurement of penile thermal and vibratory sensory thresholds to reflect cavernous nerve damage caused by RP.

**Methods.** We included 42 consecutive patients who underwent RP with cavernous nerve sparing (laparoscopic approach, N = 12) or without cavernous nerve sparing (laparoscopic, N = 13; retropubic, N = 11; or transperineal, N = 6). Penile thermal (warm and cold) and vibratory sensory thresholds were measured twice, together with the Erectile Dysfunction Symptom Score (EDSS), 1 month before and 2 months after RP.

**Main Outcome Measures.** Penile sensory thresholds for warm, cold, and vibration sensations.

**Results.** Penile sensory thresholds for warm ( $P < 0.0001$ ) and cold ( $P < 0.0001$ ) sensations significantly increased after non-nerve-sparing RP, but not after nerve-sparing RP. Vibration threshold only increased after transperineal non-nerve-sparing RP ( $P = 0.031$ ). EDSS values were significantly increased in all groups of patients 2 months after surgery.

**Conclusions.** Sensory nerve fibers carrying penile skin sensations travel with the cavernous nerves in the pelvis. Therefore, testing these sensations may help to evaluate the extent of cavernous nerve damage caused by RP. In this series, post-operative changes in penile sensory thresholds differed with the surgical technique of RP, as the cavernous nerves were preserved or not. The present results support the value of quantitative penile sensory threshold measurement to indicate RP-induced cavernous nerve injury. **Yiou R, De Laet K, Hisano M, Salomon L, Abbou C-C, and Lefaucheur J-P. Neurophysiological testing to assess penile sensory nerve damage after radical prostatectomy. J Sex Med 2012;9:2457–2466.**

**Key Words.** Cavernous Nerves; Erectile Dysfunction; Neurophysiological Investigation; Nerve Sparing; Post-operative Autonomic Nerve Dysfunction; Quantitative Sensory Testing; Surgery; Thermal Sensation; Vibratory Sensation

### Introduction

Radical prostatectomy (RP) is the treatment of reference for organ-confined prostate cancer but often induces erectile dysfunction, despite recent methodological improvement in the surgical technique [1–6]. Post-prostatectomy erectile dysfunction is classically associated with an injury to the penile neurovascular bundles containing the

cavernous nerves. The cavernous nerves run along the posterolateral aspects of the prostate and provide most of the autonomic input to the erectile tissue. The first surgical technique that spares the cavernous nerves during RP was described by Walsh and Donker in 1982 [7]. Since then, considerable efforts have been made to further increase the potential for preservation of penile autonomic innervation during RP. Numerous

techniques have been developed using transperineal, retropubic, or laparoscopic approaches; and a minimally invasive robotic procedure has been described [8–10]. All these procedures have been associated with variable rates of erectile function preservation, ranging from 10% to 80% [11–16]. Differences in the methods used to evaluate erectile function may partly explain this variability.

Erectile function is generally evaluated using self-questionnaires, which provide subjective data. However, no objective tests have been validated for assessing damage to the penile autonomic nerve supply. Thus, the comparison of surgical techniques is based on subjective criteria.

To investigate penile autonomic nerve fibers, the most usual neurophysiological test is the recording of penile sympathetic skin responses to electrical stimulation. However, the amplitude of these responses is known to be highly variable [17], and this may explain the lack of sensitivity of this test for longitudinal studies. Determination of penile sensation thresholds to cold and warm stimuli was shown to be valid to assess penile innervation of which damage is associated with neurogenic erectile dysfunction [18–20]. Cold and warm sensations are conveyed by small-diameter A $\delta$  and C fibers, respectively, which have a caliber similar to that of the autonomic fibers. Thus, increased thermal thresholds could indirectly reflect autonomic neuropathy. For instance, disturbance of penile thermal sensation was found to correlate with clinical severity of erectile dysfunction in diabetic patients with impotence [20]. Altered penile thermal sensation was also associated with erectile dysfunction following transurethral resection of the prostate for benign prostatic hyperplasia [19]. This was likely revealing the damage of the autonomic and somatic nerve fibers travelling close to the prostatic capsule, caused by the heat released by the cutting loop during transurethral resection of the prostate. However, RP potentially induces a more focal injury, affecting the cavernous nerves, which run above the levator ani muscle near the prostatic capsule [21], but not the pudendal nerves, which run below the levator ani muscle within Alcock's canal. Most somatic sensory afferents from the penis and perineum are believed to travel through the pudendal nerve, whereas penile autonomic efferents travel through the cavernous nerves. It is not clear in the literature whether penile sensory nerve fibers can be found in the cavernous nerves [22]. Therefore, the value of penile sensory testing for assessing

RP-induced nerve damage is not obvious at first. To address this issue, we measured the penile sensory thresholds to thermal and vibratory stimuli before and after either nerve-sparing RP (NS-RP) or non-nerve-sparing RP (NNS-RP). The secondary objective of this study was to determine the factors associated with the severity of erectile dysfunction at baseline, before RP, or its potential worsening, after RP.

## Materials and Methods

We prospectively included 42 consecutive patients scheduled for RP to treat localized prostate cancer in our department of urology. All NS-RP procedures were performed with a laparoscopic approach. In contrast, retropubic, transperineal, and laparoscopic approaches were used for NNS-RP procedures. In our center, surgeons have a high level of experience in these types of surgical approaches that were made in the usual way and were the subject of several comparative studies published a few years ago [23–25]. In the present study, selecting the type of surgical approach was at the discretion of the surgeon (Pr Abbou or Pr Salomon). In case of laparoscopic approach, NS was decided based on intraoperative findings. When a NS procedure was considered, the prostatic pedicles were exposed and dissected using scissors and hemoclips to avoid coagulation. To release the neurovascular bundle, the periprostatic fascia was incised at the apex and opened retrogradely, pushing the neurovascular bundle laterally [26,27].

We recorded patient age, Gleason score at prostate biopsy, and prostate-specific antigen (PSA) level before RP. Erectile function was evaluated 1 month before and 2 months after RP, before than any specific treatment of post-prostatectomy erectile dysfunction was initiated. As in previous studies [19,20], we used the French version of the Erectile Dysfunction Symptom Score (EDSS) questionnaire (Table 1). This questionnaire was chosen because we are trained to use it in our department, although we know that other scores of erectile function, such as the International Index of Erectile Dysfunction [28], are more widely used in the scientific community.

At the same time points (1 month before and 2 months after surgery), quantitative penile sensory testing was performed. Thermal thresholds were determined using a TSA 2001 device (Medoc, Ramat Yishai, Israel) with a Peltier-based thermode (16 × 16 mm) placed on the dorsal

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