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Comparison of nocturnal penile tumescence monitoring and cavernosal smooth muscle content in patients with erectile dysfunction

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Abstract. *Purpose*: Nocturnal penile tumescence monitoring was compared to cavernosal smooth muscle content in 48 cases of erectile dysfunction. *Materials and methods*: Pre-operatively nocturnal penile tumescence rigidity (NPTR) testing, colour Doppler sonography and if needed pharmaco cavernosometry-cavernosography were evaluated in 48 impotent patients before surgical intervention. The 40 patients whom all those diagnostic tools were abnormal constituted the first group. In the remaining 8 patients, which constitutes the second group, NPTR testing were normal but the other tests were abnormal. 10 potent patients with congenital penile curvature constituted the third group. Cavernous biopsies were obtained during the surgery and biopsies stained immunohistochemically to quantify smooth muscle cells (SMC) by anti-desmin and anti-SMA. *Results*: We observed statistical significant difference of corporeal SMC content with regard to first Vs second group and first Vs third group ($p < 0.05$). However we did not observe statistically significant difference with regard to second vs third group ($p > 0.05$). *Conclusion*: NPTR testing appears to correlate well with corporeal SMC, which is the key structures of erection. We think that with taking into the consideration of its specific reservations, NPTR testing is still one of the best non-invasive tool in the differential diagnosis of erectile dysfunction.

Key words: Impotence, Penile erection, Penis

Introduction

Penile erection is a neurovascular phenomenon produced by increased arterial flow, sinusoidal smooth muscle relaxation and decreased venous return [1]. Better understanding of those erectile mechanisms and the development of new investigative techniques have led to improvements both to recognize the aetiology of impotence and to permit appropriate medical or surgical treatments. Clinical investigations suggest that the majority of patients experiencing erectile impotence are impotent because of vascular abnormalities. Although several diagnostic modalities [e.g. Duplex sonography (USG) and pharmacocavernosometry-cavernosogrpahy (CM-CG)] have been used to evaluate vascular impotence they all have either theoretical or practical shortcomings [2, 3].

Nocturnal penile tumescence and rigidity (NPTR) testing has traditionally been performed to distinguish psychogenic from organic impotence [4]. Since the introduction of the rigiscan monitoring device NPTR testing has become an initial step to evaluate impotent men [5]. In several studies, NPTR testing was compared to penile duplex USG to measure the integrity of the cavernous arteries as well as to CM-CG to measure directly venous function [6–8]. However, to our knowledge there has not been a study done comparing NPTR testing with intracavernosal smooth muscle content (SMC). To evaluate the validity of NPTR in the diagnosis of erectile dysfunction, we performed a correlation study between the results of NPTR test and those obtained with the immunohistochemical analysis of the intracavernosal SMC.

Material and methods

The study included 3 group of patients: First group included 40 patients, who have erectile dysfunc-

tion of organic vascular aetiology (both NPTR and Doppler USG results were pathologic). Pre-operative evaluation included complete medical history, physical examination, routine serum biochemical analyses, serum testosterone and prolactine levels, sleep tumescence and rigidity monitoring by Rigiscan device (Dacomed, Minneapolis, USA), colour flow Doppler USG of the penis and CM-CG and neurologic tests in selected cases.

Using the Rigiscan device NPTR was performed at night and if this first test was abnormal, patients were scheduled for the second or more nights. We classified nocturnal erectile activity as normal if there was at least one erection lasting more than 10 minutes, increase in penile tip and base 2.5 cm are greater and penile rigidity 70% or greater at tip and base [9].

The second group included 8 patients who had erectile dysfunction with arterial disease and/or venoocclusive dysfunction diagnosed by Doppler USG and CM-CG but NPTR monitoring were normal. The mean age of these two groups was 46 years (range: 26–64). The third group included 10 potent men, 17 to 24 years old (mean 21 years) with congenital penile curvature which was regarded as the control group.

Cavernous biopsies were obtained from the mid shaft of the corpus cavernosum just under the tunica albugenia during correction of congenital penile curvature, or a venous operation or at implantation of a penile prosthesis. Before performing a venous operation or implantation of a penile prosthesis, we offered medical treatment to those 8 patients in the second group since their NPTR testing were normal but they refused further testing and non-invasive treatment and insist on surgical intervention.

Biopsy specimens were fixed in formalin processed routinely and stained with H.E. for histologic evaluation. For immunostaining the 5 μm thick sections were incubated with monoclonal anti-SMA (Ylem; 1/75; 3 hours) and anti-desmin (Immunon; 1/75; 30 minutes) for SMC. The average percentage of the positive anti-SMA and anti-desmin were evaluated in minimum 20 high power fields (HPF: 10$\times$ ocular; 40$\times$ objective) for each case.

Statistical analyses were performed by using one-way Anova after using square root transformation.

Table 1. The percentage of smooth muscle cells (both stained anti-SMA and anti-desmin) in three patient groups. First group: Patients with erectile dysfunction of organic aetiology (both Doppler USG, CM-CG, NPTR testing were abnormal). Second group: patients with erectile dysfunction with pathologic Doppler USG and/or MC-CG but a with normal NPTR test. Third group: potent patients with congenital penile curvature

	Anti-SMA (%)	Anti-desmin (%)	
First group	41.6	33.4	$p < 0.05$
Seconder group	49.8	39.6	$p < 0.05$
Third group	51.3	41.5	$p > 0.05$

Results

The mean percentage of cavernous SMC in tissues from each of the three groups of patients is given in Table 1. We observed statistical significant difference of corporeal SMC content with regard to first vs second group and first vs third group ($p < 0.05$). However we did not observe statistically significant difference with regard to second to third group ($p > 0.05$).

We used two different anti-bodies (anti-SMA and anti-desmin) for immunostaining of SMC in order to double-check the results and observed similar results.

Discussion

In the differential diagnosis of male erectile dysfunction many diagnostic tests have become available over the past few years but unfortunately no tests have proved to be perfect. In general, there have been two kinds of diagnostic modalities used to evaluate impotence: invasive and non-invasive techniques. Invasive tests were colour Doppler USG and CM-CG which involve injections of vasoactive substances into the cavernosal bodies. Lue et al. introduced duplex ultrasound to measure the size and dilatation of the cavernous arteries as well as blood velocity and flow volume in the cavernous and dorsal arteries [2]. However, the diagnostic modality, has an uncertain value for the diagnosis of impotence. The reason is the assessment of peak systolic velocities in the cavernous arteries is probably reasonably accurate as this phase of the erection response to vasoactive drugs

seems less influenced by anxiety than the corpora-venous occlusive phase. However, since complete smooth muscle relaxation is quite subject to anxiety one should be cautious about making the diagnosis of corpora-venous occlusive dysfunction especially if the end diastolic velocity does not return to zero. On the other hand, CM-CG also has limitations since criteria for impotence diagnosis in normal men and determining the flow needed to maintain erection remains imprecise [10]. So, taking into consideration the above mentioned limitations of those invasive tests one can ask the question: "In the area of goal directed therapy are those tests necessary?" [11]. We think that the answer is yes if the patients elects surgical treatment or the patients need to know the kind of illness. Our strategy in evaluating the impotent patient is performing non-invasive NPTR testing along with the history for differential diagnosis of erectile dysfunction. On the other hand, both Shabsigh et al. [6] and Sattar et al. [8] noted a good correlation among NPTR testing and penile duplex USG. This observation also makes the non-invasive NPTR testing the first choice in the diagnostic algorithm.

However, NPTR testing is still not considered perfect. The opponents of NPT testing maintain that sexually induced erections and sleep erections are not the same. Sexually induced erections are a combination of erotic and reflex erection activity; whereas the mechanism initiating and maintaining sleep erections is unknown. Nevertheless the difference between sleep and sexually induced erections involve the same vascular and penile structural components [9]. Also NPTR testing may not be valid in men with depression, hypogonadism, sleep disorders and neurological disease [12–15]. Recently, Hatzıchrıstou et al. showed that sexual intercourse may suppress nocturnal erectile activity and speculate about the criteria used to determine UPTR recordings [16].

Knowing the fact that SMC represent the structural basis for sinusoidal relaxation and these key structures regarded as fundamental for erection [17–19] we performed this correlation study among NPTR findings with SMC content. Our observations are interesting in two ways. First, if a patient takes the diagnosis of organic impotence after comprehensive evaluation (both Doppler USG, CM-CG and NPTR) we would estimate very low levels of intracorporeal SMC. Secondly, if the NPTR testing is normal but Doppler USG and CM-CG testing are abnormal the results of those invasive tests should be regarded cautiously since those patients might have relatively normal levels of intracorporeal SMC. They can be regarded as psychogenic type of erectile dysfunction and might need further testing in order to determine surgical treatment.

In conclusion, we think that, with specific exceptions, NPTR testing is still one of the best non-invasive tool in the differential diagnosis of erectile dysfunction.

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