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Effect of sildenafil on nocturnal erections of potent men

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We try to evaluate the effect of sildenafil on nocturnal penile erections of potent men. We recruited 22 potent men (eight medical students and 14 urology residents) 23–29 years old into the study. A disorder-free medical and sexual history and normal erectile functions were the only inclusion criteria. All subjects completed three sessions of consecutive nights using the RigiScan Plus device. After a first night of adaptation, night 2 recordings were their baseline values whereas they received sildenafil 100 mg on night 3. We observed statistically significant improvement with regard to those NPT parameters at the nights with sildenafil: number of erectile episodes; duration of tip rigidity >60%, RAU tip, RAU base and TAU tip ($P<0.005$). Although the duration of erectile episodes (min) and TAU base were greater during the sildenafil night, these did not reach statistical significance. In conclusion, our study showed that sildenafil can improve nocturnal erectile quality not only in patients with erectile dysfunction as previously published but also in potent males.
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Introduction

The advent of the first effective oral agent in the management of erectile dysfunction (ED), sildenafil, has had a revolutionary impact on management. Sildenafil is one of the most studied of the drug therapies, with clinical trials documenting efficacy in patients of all ages and ED of various etiologies and degrees of severity.[1,2] Further, it has been effective in men who had diabetes, hypertension, coronary artery disease, peripheral vascular disease and men who had undergone prostatectomy. The efficacy in achieving and maintaining erections and the quality of erections were associated with dose and superior to placebo.[3–5]

Although its clinical efficacy for improving erectile function (achieving and maintaining erections) was well documented in clinical trials among men who had ED, the effect of the drug on the erectile function of potent men is still not known. However, as we all know it is a fact that also men with normal erectile function are using sildenafil occasionally in order to potentiate either the rigidity or number or the duration of their otherwise normal erections. In order to answer the questions of those normal potent men using sildenafil, we designed this study. We investigated the effect on nocturnal erections of sildenafil taken at bed time of potent men.

Materials and methods

Twenty-two medical students (*n*: 8) and urology residents (*n*: 14) 23 to 29 years old at our university were recruited for the study. A disorder-free medical and sexual history and normal erectile function were the only inclusion criteria. According to the study protocol nocturnal penile tumescence and rigidity testing (NPTR) was performed at home for three consecutive nights using RigiScan device. The RigiScan monitoring device was applied on the patient's penis to record changes in penile tumescence and radial rigidity during the whole duration of each night. The RigiScan Plus software 4.0, which was used in this study, is able to recognize erectile activity as an event following a 20% increase in the base loop circumference persisting for at least 3 min. Summary statistics provided by the software include the number of events detected and integrated time intensity area measures of tumescence (tumescence activity units [TAU]) and rigidity (rigidity activity units [RAU]). These two units of measurement, RAU and TAU, were developed to facilitate the interpretation of the time-dependent nature of rigidity and tumescence. RAU represents the product of the minutes spent at a given rigidity level,

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and the rigidity level is expressed in decimal form. This value is calculated on a point-by-point basis and summarized for the entire erectile event. Similarly, TAU represents the time of duration of an erectile event multiplied by the percentage increase of circumference (expressed as a decimal) over the estimated baseline tumescence. RAU and TAU for both tip and base measurements are calculated and evaluated separately.[6]

During the first night, which was considered an adaptation night (night 1), the RigiScan device was applied to the penis and turned to the off position; participants were then studied for two further nights involving the recording of penile erectile activity. Night 2 recording was their baseline values whereas they received sildenafil 100 mg before night 3. Participants were invited to go to bed at their usual time, at least 2 h after the end of a meal without intake of any alcoholic and caffeine-containing beverages as well as any kind of medication.

After each monitoring period all data were transferred to a personal computer. At the end of the study, data were analyzed with RigiScan Plus software version 4.0. The software recognizes an erectile event if there is a 20% increase in base loop circumference 3 min or more in duration. It also

Table 1 Results of NPT observed during the two nights of recording (mean ± s.d.)

	Night without sildenafil (mean ± s.d.)	*Night with sildenafil (mean ± s.d.)*	P-*value*
Number of erectile episodes	1.21 ± 1.1	5 ± 1.7	$<0.05^a$
Duration of erectile episodes (min)	143 ± 57	170 ± 54	$>0.05^b$
Duration of tip rigidity >60%	84 ± 32	115 ± 48	$<0.05^b$
RAU tip	71 ± 23	92 ± 32	$<0.05^a$
RAU base	89 ± 42	115 ± 11	$<0.05^b$
TAU tip	45 ± 16	56 ± 22	$<0.05^b$
TAU base	60 ± 21	71 ± 27	$>0.05^b$

[a]Wilcoxon test.
[b]Paired *t*-test.

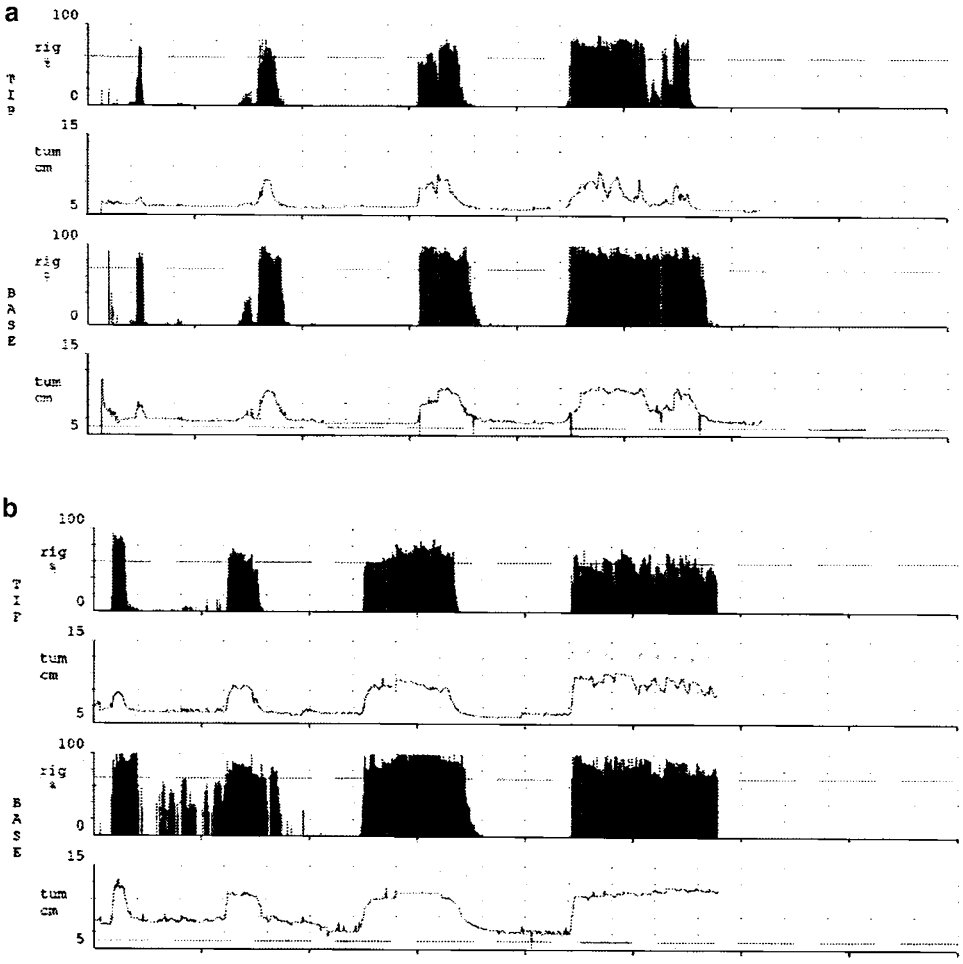


Figure 1 RigiScan traces of nocturnal erections (a). Nocturnal erections without sildenafil (b). Nocturnal erections with sildenafil.

calculates TAU and RAU, for each night separately. Sessions less than 5 h duration were excluded from further analyses. Erectile activity during sleep was measured by determining the following parameters: number of erectile events (with tip rigidity greater than 60% and longer than 10 min in duration) and TAU–RAU values.

Statistical analyses were based on the Wilcoxon rank sum, unpaired *t*-test and repeated measures analysis of variance.

Results

All 22 subjects completed the protocol and no session was less than 6 h in duration. The average duration of sleep was 7 h. We observed only one transient headache as side effect of sildenafil.

We observed statistically significant improvement with regard to those NPT parameters at the nights with sildenafil medication: number of erectile episodes, duration of tip rigidity >60%, RAU tip, RAU base and TAU tip ($P<0.05$). Besides we observed slight increase in the remaining two parameters, duration of erectile episodes (min) and TAU base; however, those were not statistically significant ($P>0.05$). So it is worthwhile to note that TAU base was unaffected by sildenafil. Table 1 summarizes those results. Overall improved quality of nocturnal erectile activity after sildenafil was evident. Figures 1–4 show this effect on different participants, RigiScan documents.

Discussion

Penile erection is a vascular process that involves relaxation of the smooth muscle cells of the corpus cavernosum and associated arterioles.[7] Major role in the relaxation of smooth muscle cells is mediated by nitric oxide through cyclic guanosine monophosphate (cGMP).[8,9] In response to sexual stimulation, nitric oxide is released by nerve endings and endothelial cells and this increases the production

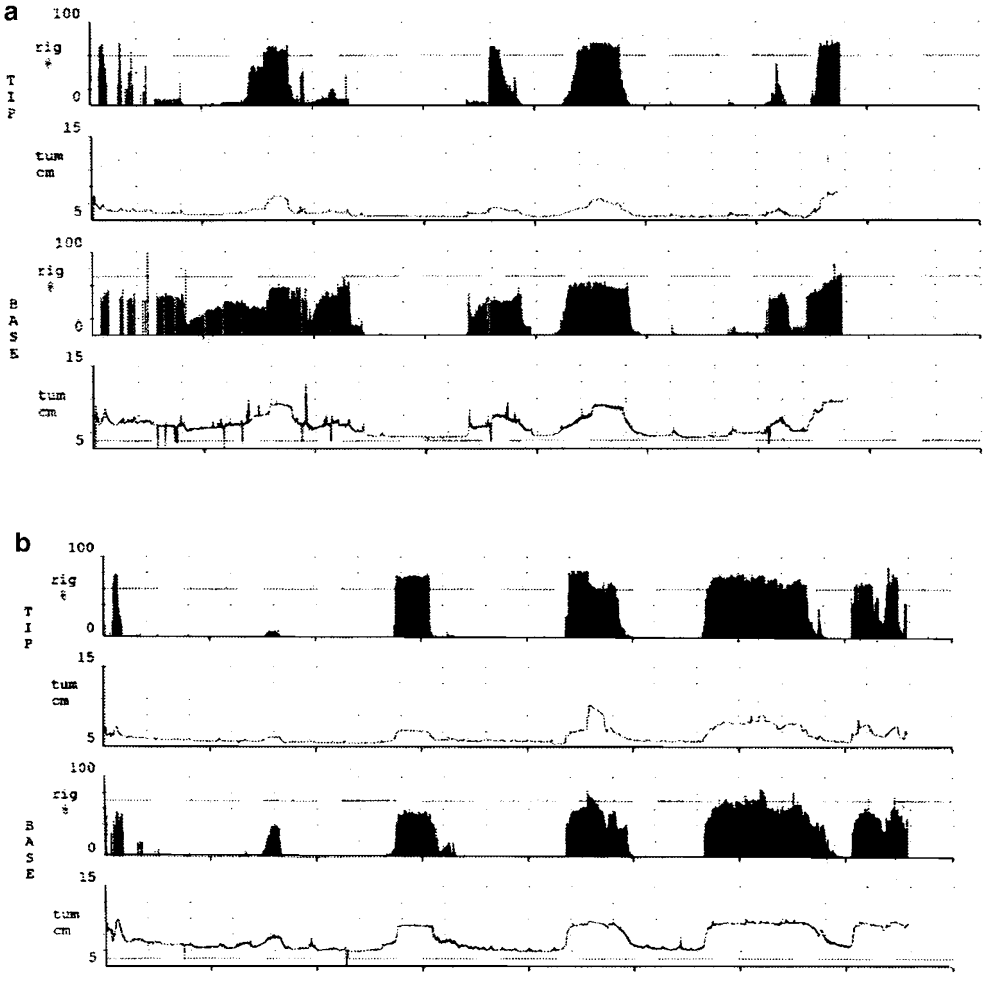


Figure 2 RigiScan traces of nocturnal erections (a). Nocturnal erections without sildenafil (b). Nocturnal erections with sildenafil.

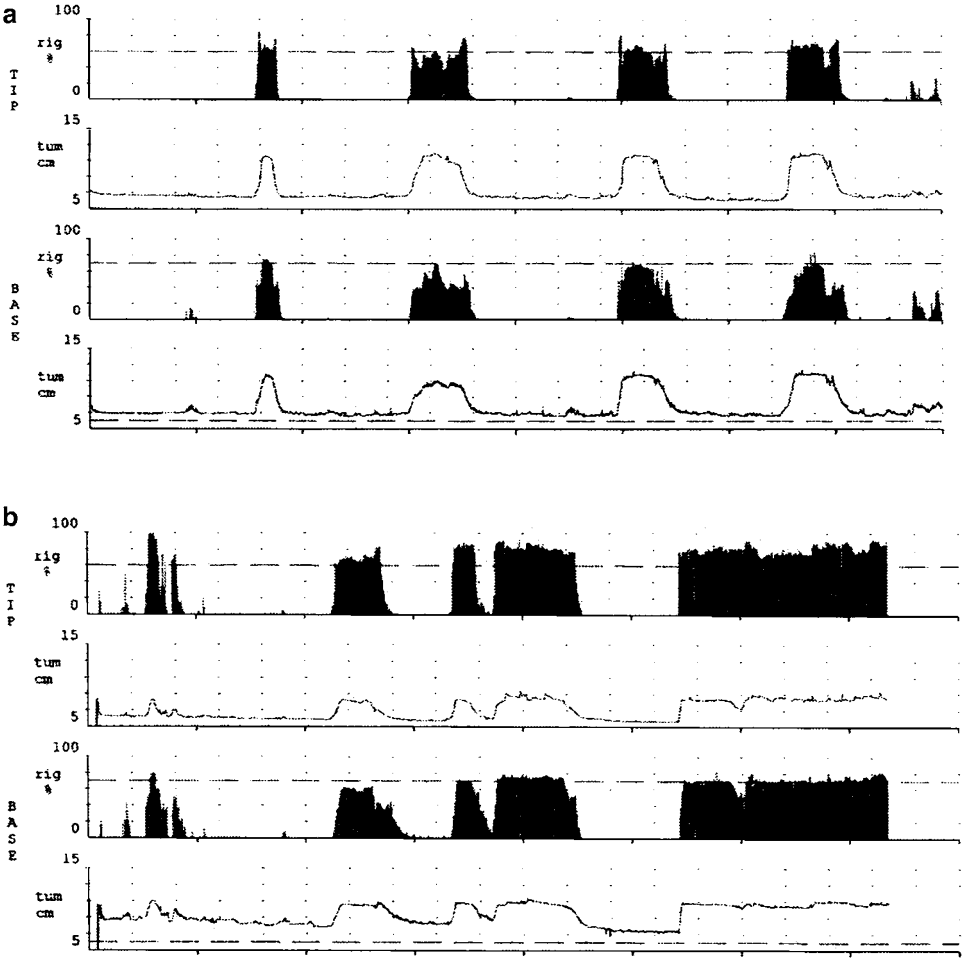


Figure 3 RigiScan traces of nocturnal erections (a). Nocturnal erections without sildenafil (b). Nocturnal erections with sildenafil.

of cGMP by guanylate cyclase, resulting in relaxation of cavernosal smooth muscle cells and penile erection[10]. Subsequently, cGMP is catabolized by cGMP-specific phosphodiesterase type 5 (PDE 5), resulting in restoration of muscle tone and detumescence. As a selective inhibitor of cGMP catabolism in the corpus cavernosum, sildenafil restores cGMP-induced penile erectile activity in subjects with ED, but only under conditions where sexual stimulation occurs.[2]

However, as a contrast to the above-mentioned classical knowledge about sildenafil, we observed significant improvement of nocturnal erections with sildenafil for the male without ED and without sexual stimulation (during sleep). It has been suggested that erections occurring during REM sleep are initiated by the release of nitric oxide from nonadrenergic–noncholinergic nerves that then activates the hemodynamic cascade of events leading to rigidity.[11] Since sildenafil uses the same cascade this can be used for the explanation of the night time effect of sildenafil. In fact, there is no sexual stimulation during nocturnal penile erections, but the other steps of erection is the same.

Nocturnal penile erection monitoring by RigiScan makes it possible to obtain objective recordings of penile erectile activity. To our knowledge there were three reports assessing the effect of sildenafil on penile erections by RigiScan: Montorsi *et al*, Terrades *et al*, Boolell *et al*,.[11–13] Boolell *et al* evaluated the erectile response to sildenafil during visual sexual stimulation in a group of patients with ED in the awaken state and observed improved erectile response under this drug.[12]

Our study results were partly similar to the results of Montorsi *et al*'s study in which improved quality of nocturnal erectile activity after sildenafil was observed.[11] However, their study population included patients with ED without control group. Terrades *et al* studied the effects of sildenafil on nocturnal penile erections of patients with organic or psychogenic impotence and normal potent men.[13] They found that sildenafil improved nocturnal penile erectile activity in patients with organic impotence. However, they also stated that this action could not be shown in patients with psychogenic impotence or in normal males. This observation is almost totally contradictory to our

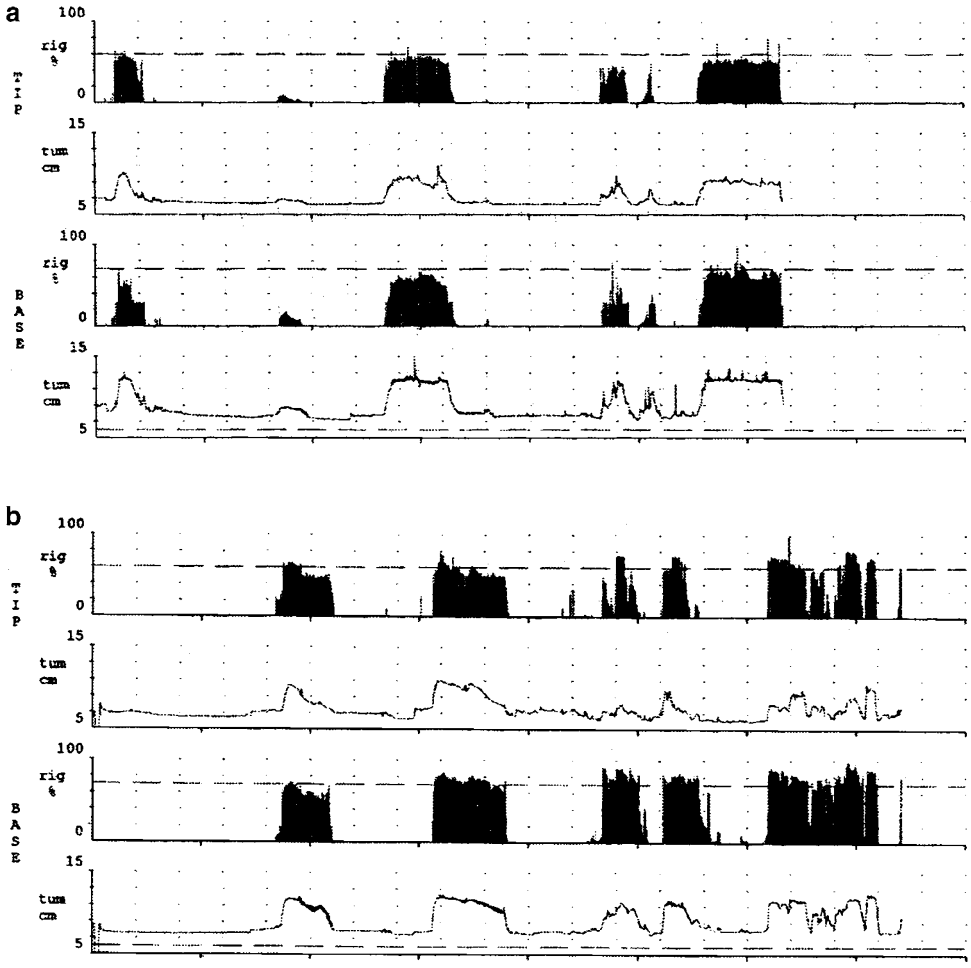


Figure 4 RigiScan traces of nocturnal erections (a). Nocturnal erections without sildenafil (b). Nocturnal erections with sildenafil.

study. To be honest we could not explain this discrepancy but further research is probably required to answer this controversy.

In conclusion, our study showed that sildenafil could improve nocturnal erectile quality not only in organic impotence as previously published but also in potent males. It can be speculated that sildenafil might be used either for prevention of ED or for different indications other than ED, for example, precox ejaculation. However, such points need other studies to address these specific issues.

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