International Journal of Impotence Research (2005) 17, 243–247
© 2005 Nature Publishing Group All rights reserved
0955-9930/05 $30.00
www.nature.com/ijir

Effect of penile size on nocturnal erections: evaluation with NPTR testing with men having micropenis

O Yaman[1]*, T Soygür[1], M Akand[1] and Z Tokatli[1]

[1]*Department of Urology, School of Medicine, University of Ankara, Ankara, Turkey*

There has been conflicting opinions in the literature regarding sexual function in hypogonadal men with micropenis. In this study we aimed to evaluate erectile function in hypogonadal men with micropenis by nocturnal penile tumescence and rigidity testing (NPTR) and compared the results with young potent normal penile sized men. A total of 15 men (ages 17–30 y) defined having a micropenis with a stretched penile length of less than 9.3 cm were constituted the study group. Mean stretched penile length was 6.8 ± 1.6 cm (range 3.6–7.8 cm). Karyotype analysis showed 46XY in all cases. Control group included 22 potent and normal penile sized men (23–29 y). All subjects completed three sessions of consecutive nights using the RigiScan Plus device. Comparison of the results of NPTR of control group with study group revealed that number and duration of erectile episodes ($P < 0.001$), duration of tip rigidity > 60% ($P < 0.01$), TAU tip and TAU base ($P = 0.001$), and RAU base ($P = 0.01$) were found to be significantly lower in men with micropenis. In conclusion, our study showed that men with micropenis are associated with decreased nocturnal erectile activity.
International Journal of Impotence Research (2005) **17,** 243–247. doi:10.1038/sj.ijir.3901292
Published online 3 February 2005

Keywords: micropenis; erectile function; NPTR testing

Introduction

The term micropenis defines a penis that is abnormally small but otherwise perfectly formed with the urethra opening at the tip of the glans.[1] Micropenis is believed to be the result of a defect in androgen synthesis and androgen response during a critical phase of embryogenesis commonly due to hypogonadotropic hypogonadism, hypergonadotropic hypogonadism, or androgen insensitivity.[2] The clinical management of micropenis includes testosterone treatment to induce a functionally adequate penile size.[3] The results of testosterone treatment are controversial, with disagreement about capacity of this form of treatment to induce an adequate adult penis.[3] As a consequence, some clinicians recommend sex reversal of affected male infants particularly where a small penis fails to achieve 2 cm of stretched length 1 month after intramuscular testosterone treatment.[4] Apart from adequate penile length, androgens also play crucial role in each step of the erection pathway.[5] Androgen deficiency in men can result in loss of libido, as well as erectile dysfunction of varying degrees.[6,7] For this reason, the evaluation of erectile activity in hypogonadal men with micropenis is important to decide whether these men will have sufficient erectile function. There have been some reports published about the male sexual role of hypogonadal men with micropenis.[8,9] Recently, Kadioglu *et al*[10] reported that erectile response to intracavernous injection combined with manual genital self-stimulation was effective in most man having a micropenis with low androgen levels. One another possible way to obtain objective recordings of erectile activity is monitoring of nocturnal penile erections by the RigiScan device.[11] In this study, we evaluated the 15 hypogonadal men with micropenis by monitoring their nocturnal penile erection by the RigiScan device and compared the results with nocturnal erections of young normal penile sized potent men.

Patients and methods

A total of 15 men, with a mean age of 18.5 y (range 17–30 y), defined having a micropenis with a

*Correspondence: O Yaman, MD, Şehit Ersan Cad., Pembe Köşk Sitesi, B-1 Blok, No. 15, Çankaya, 06680 Ankara, Turkey.
E-mail: yaman@medicine.ankara.edu.tr
Received 23 August 2004; revised 30 September 2004; accepted 14 October 2004

stretched penile length of less than 9.3 cm[1] were constituted the study group. Control group included 22 men medical students (*n*:8) and urology residents (*n*:14) 23–29 y old at our university. A disorder-free medical and sexual history, normal erectile function, and normal stretched penile length were the only inclusion criteria. An informed consent was obtained from the control group patients.

Patients were accepted as having micropenis after measuring their penile length by a ruler as proposed by Wessels *et al*.[12] The penis was stretched by gripping the glans firmly to the point of resistance by the corpora cavernosa, and the length was measured along the dorsum from the penopubic junction to the glans tip, disregarding the prepuce and prepubic fat. After obtaining a detailed medical and sexual history (by asking erections during masturbation, erections during visual stimulation, nocturnal erections, and IIEF questionnaire), patients underwent a detailed endocrinological evaluation, including serum free and total testosterone and prolactin levels. Patients with hypogonadism associated with a serum prolactin level higher than 15 ng/ml, history of perineal trauma or pelvic surgery or abnormal karyotype evaluation were excluded from the study.

According to the study protocol, nocturnal penile tumescence and rigidity testing (NPTR) was performed at home for three consecutive nights using the 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, and rigidity level 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.

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.

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 recognize an erectile event if there is a 20% increase in base loop circumference 3 min or more in duration. It also calculates TAU and RAU for each night separately. Sessions less than 5 h duration were excluded from further analysis. Erectile activity during sleep was measured by determining the following parameters: numbers of erectile events (with tip rigidity greater than 60% and longer than 10 min in duration) and TAU-RAU values.

Statistical analysis was based on the Mann Whitney U test and Wilcoxon rank sum test.

Results

Endocrinological evaluation revealed low serum free and total testosterone levels in all patients (range 21.34–256.4 ng/dl) (normal values of serum testosterone levels in our laboratory is 280–800 ng/dl). According to the serum LH and FSH levels, hypogonadotropic hypogonadism, hypergonadotropic hypogonadism, and idiopathic hypogonadism were found in nine (60%), six (40%), and two (13.4%) patients, respectively. Karyotype analysis showed 46XY in all cases. The sexual histories of the patients revealed that all had slightly decreased libido and normal nocturnal erections although none had any previous sexual experience.

The mean stretch penile length of the patients was 6.8 ± 1.6 cm (range 3.6–7.8 cm). Physical examination showed that poorly developed secondary sex characteristics in all patients. None of the patients had any type of previous treatment regarding micropenis.

All 15 patients completed NPTR testing and no session was less than 6 h in duration. The average duration of sleep was 7 h. The results of NPTR testing with comparison with the normal healthy control group are summarized in Table 1. Number and duration of erectile episodes ($P<0.001$), duration of tip rigidity $>60\%$ ($P<0.01$), TAU tip and TAU base ($P=0.001$) and RAU base ($P=0.01$) were found to be significantly lower in patients with micropenis. In addition, we observed slight decrease in RAU tip in patients with micropenis, however, it was not statistically significant ($P>0.05$). Figures 1 and 2 shows the difference in the RigiScan documents.

Discussion

Micropenis may be viewed as a mild form of ambiguous genitalia with medical, psychological,

and social impacts similar to those of other intersex problems. A decision to rear a child with micropenis as a boy produces worry that genitalia will be inadequate for sexual intercourse and that he will not be able to assume a satisfactory masculine self-image. On the other hand, the sexual role of men with micropenis depends on sufficient erectile function, apart from an adequate penile length.

Table 1 Results of NPTR observed during the two nights of recording

	Patients with micropenis (n = *15*) *(mean ± s.d.)*	*Controls* (n = *22*) *(mean ± s.d.)*	P-*value*
Number of erectile episodes	1.8 ± 1.4	4.21 ± 1.1	< 0.001
Duration of erectile episodes (min)	52 ± 49	143 ± 57	< 0.001
Duration of tip rigidity > 60%	38 ± 38	84 ± 32	< 0.01
RAU tip	48 ± 45	71 ± 23	> 0.05
RAU base	45 ± 36	89 ± 42	= 0.01
TAU tip	19 ± 19	45 ± 16	= 0.001
TAU base	25 ± 24	60 ± 21	= 0.001

RAU: tumescence activity units.
TAU: rigidity activity units.

Most cases with micropenis are to be associated with hypogonadism.[1] Hypogonadism in men is believed to be associated with erectile failure, although the relationship between serum testosterone level and male sexual behavior is still not completely clear.[13] In the study of Bancroft *et al*,[14] it was revealed that the penile circumference increase during erotic films was found to be significantly lower and the latency period during sexual fantasy was prolonged. On the contrary, Kadioglu *et al*[10] suggested that the erectile response to intracavernous injection combined with manual genital self-stimulation is not androgen dependent in most hypogonadal men with micropenis. In agreement to this study of Kadioglu,[10] Kwan *et al*[15] showed that erotic films evoked normal erection in hypogonadal men. These authors considered that this response to visual erotic stimulation was unrelated to androgen levels. On the other hand, it is generally known that sleep-related erections increase after onset of puberty, indicating that increasing serum testosterone levels is associated with nocturnal penile tumescence.[16]

Owing to these conflicting results in the literature regarding sexual function, we proposed to evaluate erectile function in hypogonadal men with micropenis by nocturnal penile erection monitoring that is known as a possible way to evaluate the erectile

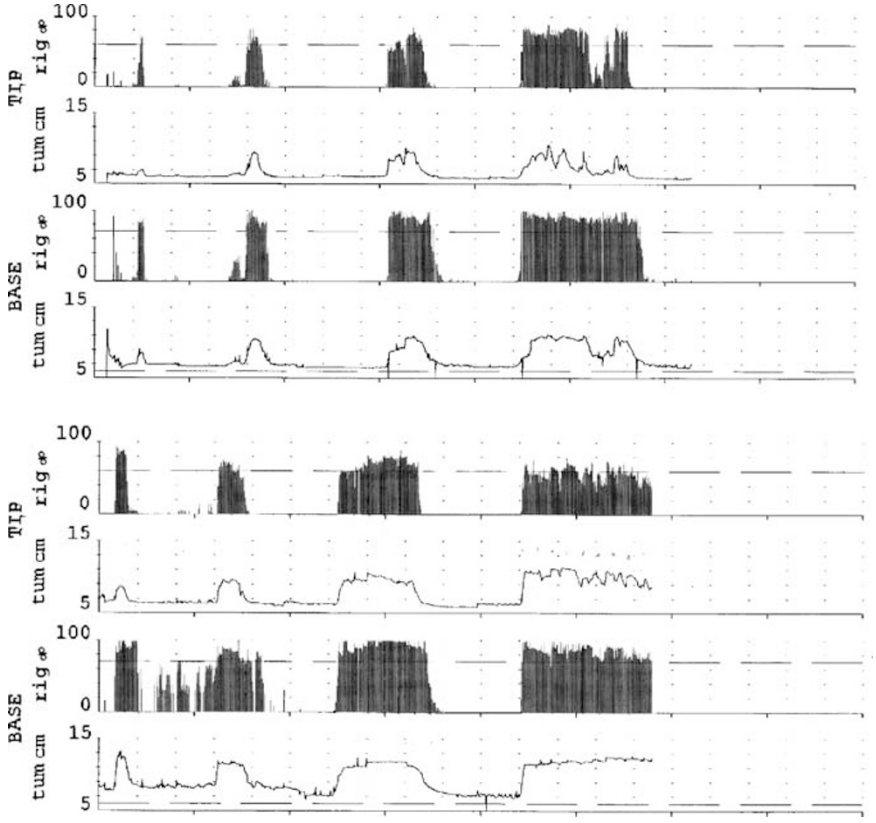


Figure 1 RigiScan traces of nocturnal erections in the control group.

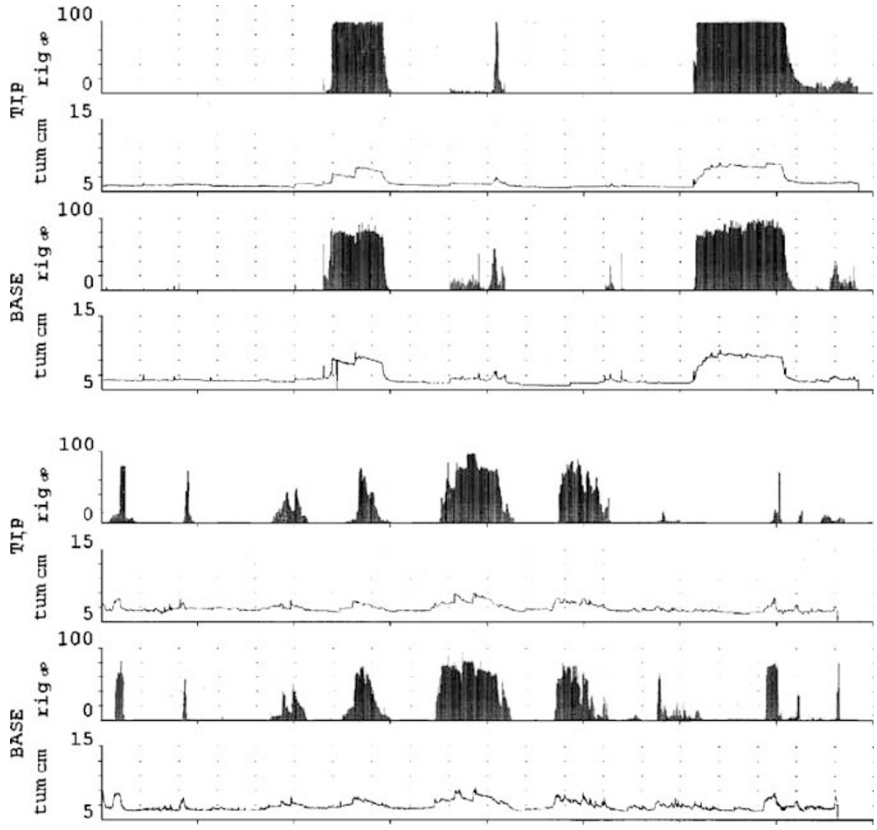


Figure 2 RigiScan traces of nocturnal erections in the study group.

capacity in men.[11] Nocturnal penile erection monitoring by the RigiScan device make it possible to obtain objective recording of penile erectile activity. Although it has been claimed that it has not been possible to measure the frequency and rigidity of erections by the RigiScan device since the width of the cuff does not fit the micropenis,[10] we did not have any technical difficulties during cuff placement. In our study, we also compared our results with those healthy potent controls by using data from the previous study of our group.[17]

Our NPTR results revealed that all parameters but RAU tip were significantly lower in men with micropenis. Although, their sexual history revealed almost normal libido and sleep erections, NPTR results were not correlated with this statement.

In the study of Reilly and Woodhouse,[9] it was found that despite the very short penile length, sexual function was satisfactory in 20 men with micropenis and 75% of them had successful sexual intercourse with proper endocrine management and treatment before puberty. In our studies, none of the patients received any type of endocrine treatment. Money *et al* revealed that hypogonadal patients with micropenis without proper endocrine management and treatment were less successful regarding male sexual function. On the other hand, Kadioglu *et al*[10] showed that although 57.2% of hypogonadal men with micropenis had penile arterial deficiency of varying degrees confirmed by color Doppler ultrasound, adequate erectile response was obtained in one half of them.

The limited clinical data seems to support the evidence that a man with a micropenis is compatible with a normal male sexual function, especially with proper androgen treatment during neonatal period and before puberty[3,8,9] although there is no consensus regarding the dosage, method of administration, timing or duration of androgen treatment in patients with micropenis.[18]

To our knowledge, this is the first study objectively demonstrating the frequency and rigidity of erections in hypogonadal men with micropenis without previous endocrine treatment.

Our results emphasize the importance of proper endocrine management and androgen treatment with parental and medical support of children with micropenis, since without this meticulous approach they will probably be suffering erectile dysfunction besides inadequate penile length for intercourse.

Although, additional comparative NPTR studies with patients who had proper androgen treatment before puberty or patients who are diagnosed after puberty and received testosterone replacement therapy are essential to draw a definitive conclusion, hypogonadal men with micropenis are asso-

ciated with decreased nocturnal erectile activity that has been objectively shown in our limited NPTR study.

References

1 Lee PA *et al.* Micropenis. Criteria, etiologies and classification. *Johns Hopkins Med J* 1980; **146**: 156–161.
2 Evans BA, Williams DM, Hughes IA. Normal postnatal androgen production and action in isolated micropenis and isolated hypospadias. *Arch Dis Child* 1991; **66**: 1033–1036.
3 Bin-Abbas B, Conte FA, Grumbach M, Kaplan SL. Congenital hypogonadotropic hypogonadism and micropenis: effect of testosterone treatment on adult penile size—Why sex reversal is no indicated. *J Pediatr* 1999; **134**: 579–583.
4 McLorie GA, Khoury AE, Husmann DA. Surgery for micropenis in childhood. *Dial Pediatr Urol* 1989; **12**: 6.
5 Mills TM, Lewis RW. The role of androgens in the erectile response: a 1999 perspective. *Mol Urol* 1999; **3**: 75–80.
6 Granata AR, Rochira V, Lerchl A. Relationship between sleep-related erections and testosterone levels in men. *J Androl* 1997; **18**: 522–527.
7 Tenover JL. Testosterone and aging male. *J Androl* 1997; **18**: 103–106.
8 Woodhouse CRJ. Sexual function in boys born with extrophy, myelomeningocele and micropenis. *Urology* 1998; **52**: 3–11.
9 Reilly JM, Woodhouse CRJ. Small penis and the male sexual role. *J Urol* 1989; **142**: 569–571.
10 Kadioğlu P *et al.* Penile hemodynamics in hypogonadal men with micropenis. *Urology* 2003; **61**: 426–430.
11 Levine LA, Lenting EL. Use of nocturnal penile tumescence and rigidity in the evaluation of male sexual dysfunction. *Urol Clin N Am* 1995; **22**: 775–788.
12 Wessels H, Lue T, McAninch JW. The relationship between penile length in the flaccid and errect status: guidelines for penile lengthing. *J Urol* 1995; **153**(Part 2): 379A.
13 Cunnigham GR *et al.* Testosterone replacement therapy and sleep-related erections in hypogonadal men. *J Clin Endocrinol Metab* 1990; **70**: 792–797.
14 Bancroft J, Wu FCW. Changes in erectile responsiveness during androgen replacement therapy. *Arch Sex Behav* 1983; **12**: 59–66.
15 Kwan M *et al.* The nature of androgen action on male sexuality: a combined laboratory self report study of hypogonadal men. *J Clin Endocrinol Metab* 1983; **57**: 557–562.
16 Karacan I *et al.* Sleep-related penile tumescence as a function of age. *Am J Psychiatry* 1975; **132**: 932–937.
17 Yaman Ö, Tokatlı Z, Inal T, Anafarta K. Effect of sildenafil on nocturnal erections of potent men. *Int J Impot Res* 2003; **15**: 117–121.
18 Judson JVW, Calikoglu A. Should boys with micropenis be reared as girls. *J Pediatr* 1999; **134**: 537–538.