The Role of Nocturnal Penile Tumescence and Rigidity Monitoring in the Evaluation of Impotence

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The inability to achieve or maintain an erection of sufficient rigidity to perform sexual intercourse is a problem that affects between 10% and 20% of men at some time during their lives. Historically, the evaluation of impotence has been limited to history and psychological assessment. Nocturnal penile tumescence (NPT) monitoring is a procedure that can be used in the evaluation of impotence. Performed with appropriate measurement techniques and knowledge of the recording conditions and combined with a complete and accurate sexual history, NPT monitoring is the most effective noninvasive method of determining whether the underlying cause is organic or psychogenic.

Key words. Penile erection; impotence; physiologic monitoring. (*J Fam Pract 1994; 39:279-282*)

Impotence, the inability to achieve or maintain an erection of sufficient rigidity to perform sexual intercourse in more than 25% of attempts, is a problem affecting 10% to 20% of all men at some time.[1]

Evaluation and treatment of sexual problems are usually performed by urologists, gynecologists, psychiatrists, and practitioners in secondary or tertiary care centers and sleep laboratories. It is surprising that few general practitioners deal with such problems, since patients with sexual dysfunction might find it easier to broach the subject in a primary care setting.

Until recently, the evaluation of male sexual dysfunction has relied primarily on history and psychological assessment, the accuracy of which has long been questioned.[2] However, when properly performed, a complete history and physical examination will identify a group of patients who clearly have an organic reason for impotence and who therefore do not require additional diagnostic testing. The historical question with the greatest predictive power is that regarding early morning erections.[3] Although patient self-report is essential in the initial appraisal of erectile dysfunction,[4] men who experience erectile dysfunction often underestimate the rigidity and tumescence of their penile erections.[5]

Noctural penile tumescence (NPT) is a naturally occurring, nonsexually stimulated phenomenon whose mechanism is presumed to be similar to that of a sexually stimulated erection. In 1940, NPT was described in infants,[6] and 4 years later, it was observed in adults.[7] In 1966, an association between rapid eye movement (REM) sleep and erections was found,[8] and in 1970, Karacan was the first to suggest that it might provide the basis for a tool for "diagnosis and prognosis in impotence."[9] NPT occurs most often during REM sleep, but it can also occur in non–REM sleep.

For a number of years, the evaluation of NPT has been considered the best noninvasive method for differentiating organic from psychogenic impotence. A full noctural penile tumescence evaluation includes sleep electroencephalography, penile circumference measurements, and repeated axial rigidity measurement at or near the points of maximum penile circumference (Table). Penile rigidity is best measured axially with a tonometer, since axial rigidity correlates most accurately with the ability to achieve vaginal penetration. Results are expressed as grams of force required to produce penile buckling. Measurement of axial rigidity, unfortunately, requires a test that usually awakens the patient, with subsequent loss of erection. Furthermore, NPT recording in a sleep laboratory entails considerable expense because

Submitted, revised, June 2, 1994.

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 ISSN 0094-3509

Table. Nocturnal Penile Tumescence Monitoring Results Used As Criteria for Diagnosing Organic Impotence

- Maximum penile circumferential increase (tumescence) less than 3 cm at the base. (An increase of ≥3 cm is classified as normal.)
- Maximum penile tumescence of less than 2 cm at the tip. (An increase ≥2 cm is classified as normal.)
- Rigidity of less than 40%. (Rigidity of ≥40% [as compared with a standard hard-rubber cylinder] is classified as normal.)
- Dissociation: Penile rigidity that is greater at the base than at the tip, indicating a possible vascular problem, such as venous leakage.
- Uncoupling: Normal or near-normal penile tumescence in the absence of normal rigidity.
- Maximum erection frequency of less than two per night.
- Absence of a full erection lasting more than 5 minutes.

of the manpower and supplies required as well as the initial cost of the recording equipment. Despite these difficulties, the assessment of NPT in a sleep laboratory is considered valid and diagnostically useful.[10] Clearly, a technique that permits continuous measurement of penile rigidity without disturbing sleep would be a desirable advancement.

Recognition of the problems associated with NPT recording led to the development of less expensive and simpler methods. The first attempt used postage stamps pasted together to make a snug-fitting ring around the flaccid penis. Initial enthusiasm for this simple and inexpensive test was tempered by subsequent studies that demonstrated a significant incidence of false-negative and false-positive results. A more refined approach uses a velcro-attached snap gauge that has three separate bands, each calibrated to withstand varying forces before breaking. The gauge, a simple and inexpensive screen for diagnosing impotence, is placed on the penis before sleep and removed in the morning. The number of bands broken indicates the range of maximum force applied by penile expansion. Some studies, however, have shown that it is inaccurate. It also does not denote the duration or number of tumescent events.[11]

In 1985, Bradley and colleagues[12] described the first time use of the Rigiscan, a monitor that measures penile tumescence and rigidity concurrently and continuously. The role of noctural penile tumescence monitoring in the diagnosis of impotence has been described in the literature.[9–13] With a few exceptions, a normal recording indicates psychogenic impotence, whereas an abnormal recording suggests an organic cause.[2] The basic assumption of NPT monitoring is that anxiety, fear, hunger, and other feelings are neutralized during sleep and do not influence physiologic erections that occur during sleep.

Noctural Penile Tumescence Recording

The Rigiscan instrument (Dacomed Corp, Minneapolis, Minn) is a monitor that can be used by ambulatory patients to measure tumescence as well as rigidity. It can be used at home, thus reducing the cost of testing and maximizing patient privacy.[9–13]

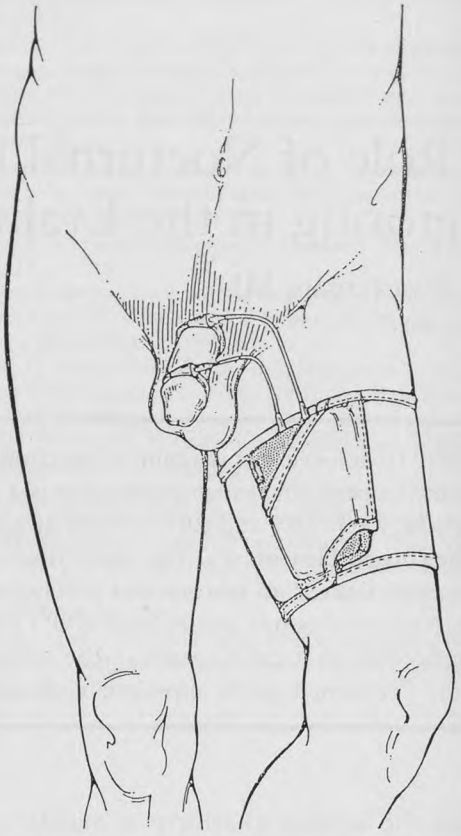

Figure 1. Patient wearing the Rigiscan, a device that monitors nocturnal penile tumescence and rigidity.

The Rigiscan monitor is a portable unit that is worn in a cloth pouch on the subject's thigh for one night. Two soft loops, connected to the instrument by flexible cables, are applied to the tip and the base of the penis (Figure 1). The loops gently contract at intervals of 15 seconds, exerting pressure on the penile shaft with each contraction. Tumescence (penile circumference) is measured every 15 seconds during each loop contraction and rigidity (penile hardness) is measured during alternate contractions (every 30 seconds).

Tumescence is expressed in centimeters (range 5 to 15 cm), and rigidity in percentages relative to a standard hard-rubber cylinder (range 0% to 100% of standard). Measurements obtained during a sleep session (maximum 10 hours per session) are stored in an internal memory then downloaded into a microcomputer for processing. At this stage, the data can be printed graphically.[12–13]

Patients are asked to abstain from drugs (except for prescription drugs taken regularly that would not affect test results), alcohol, and caffeinated beverages for approximately 6 to 8 hours before the test session. Testing

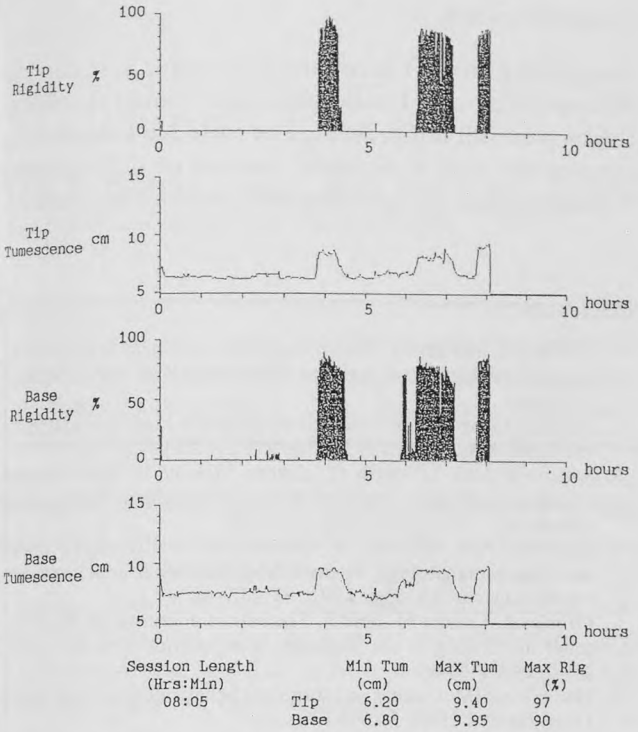

Figure 2. A normal nocturnal penile tumescence and rigidity monitoring result.

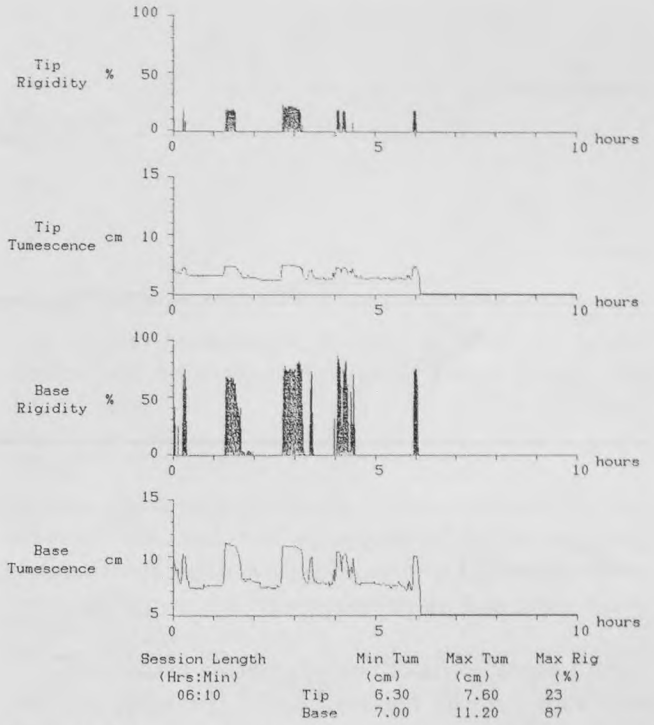

Figure 3. Nocturnal penile monitoring result illustrating dissociation. In a sleep session lasting 6 hours and 10 minutes, five erections were recorded, each of which had excellent tumescence, lasting 5 to 45 minutes, and had base rigidity of more than 60% (relative to a standard hard-rubber cylinder) but tip rigidity of less than 20%.

of NPT is conducted for one night and repeated only if the sleep time is shorter than 60 minutes or if there are technical problems.

Interpreting the NPT Recording

An erectile episode is defined as a .75-cm increase in penile base tumescence that is sustained for at least 10 minutes.[10] Total tumescence time (TTT) is the sum of the duration of all erectile episodes measured at the base. Using these guidelines, the ratio of tumescence time to sleep time (TTT/ST), the number of episodes per hour of sleep (number of episodes/ST), and the average tumescence time per episode (TTT/number of episodes) can be calculated.[12–13]

Total tumescence time decreases significantly from age 13 to age 79 years. Tumescence time during these years is approximately 90 minutes per night, or 20% of total sleep time. The number of erectile episodes per session does not significantly change with age, but the average length of an NPT episode tends to decline.[11–13]

When evaluating tumescence with the Rigiscan, normal tumescence is indicated by a change in circumference of 3 cm or greater at the base of the penis and 2 cm or greater at the tip of the penis (Figure 2). Much more important than circumferential change, however, is the measurement of rigidity. A rigidity of 70% or greater represents a nonbuckling erection, whereas rigidity below 40% is classified as a flaccid penis. Rigidities between 40% and 70% represent various degrees of stiffness. The interpretation of the Rigiscan data includes viewing the printout (Figures 3 and 4) for absent or reduced amplitude of tumescence and rigidity.[11–13] Classifications of NPT monitoring results are presented in the Table.

Discussion

Normal NPT in a man with sexual dysfunction suggests psychogenic impotence, whereas an abnormal recording indicates there may be an organic cause. There have been numerous articles describing abnormal NPT associated with various disorders, such as diabetes mellitus,[14] alcoholism,[15] chronic obstructive pulmonary disease,[16] and narcolepsy.[17] Abnormal NPTs have also been reported in smokers and in persons ingesting certain drugs. Karacan and associates[8] reported that NPT was disrupted in some subjects by dreams with high anxiety content[8] and by severe depression.[18]

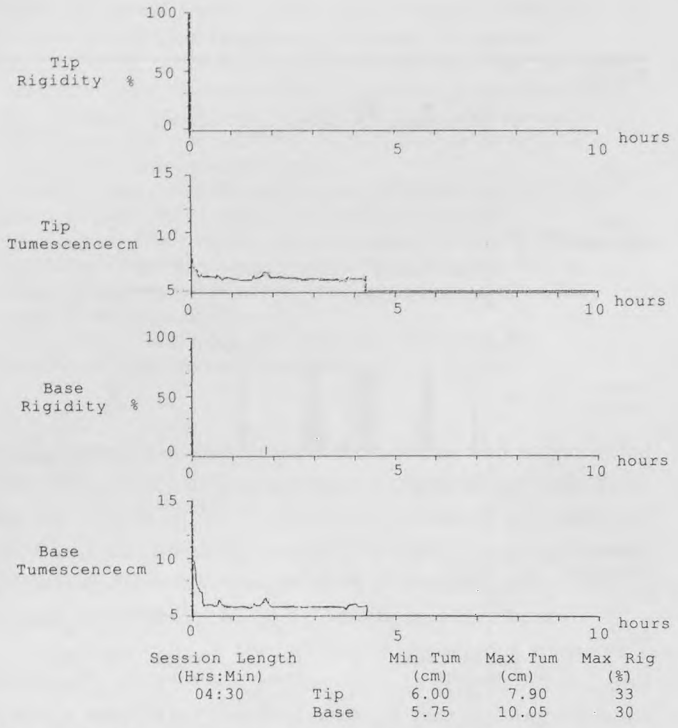

Figure 4. Nocturnal penile monitoring result illustrating flat trace. No significant tumescence or rigidity were recorded.

When investigating the impotent patient, it is essential to study both tumescence and rigidity, since a man with normal penile tumescence may be unable to achieve or maintain sufficient rigidity for sexual intercourse.[19,20] This problem is particularly common among men with vascular insufficiency, who may experience considerable tumescence with almost no rigidity.

The Rigiscan produces an objective, permanent record of rigidity and tumescence and monitors responses at both the base and the tip of the penis. Rigiscan has a positive correlation of 0.94, and a smaller "first-night effect" than found in monitoring done in sleep laboratories. Rigiscan has also been observed to have a false-negative rate of 10% to 20%. The absence of concurrent measurements of sleep, respiration, and leg movements can result in an incorrect interpretation of resulting data.

In addition to diagnosing impotence, the measurement of noctural penile tumescence and rigidity can be useful for determining the dosage of intracorporeal vasodilators and the probability of success or failure when this therapeutic option is chosen.[21]

Conclusions

Interpreting an NPT recording is as simple as reading an electrocardiogram. Family physicians should familiarize themselves with this procedure because NPT monitoring remains the best noninvasive method of differentiating between organic and psychogenic causes of impotence.

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