

The Relationship Between Nocturnal Enuresis, Time of Night and Waking Response in the Process of Treatment with Enuresis Alarm

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ABSTRACT: A total of 257 enuretic patients aged 5.5-16 years were treated with an enuresis alarm. There were 4,796 enuretic episodes recorded by parents during treatment. Records included time of episode, reflex response to conditioning (judged by measuring the size of the urine spot on the bed) and waking response. Results showed peak wetting time occurred at around 2 A.M. Treatment did not alter the peak wetting time but decreased the percentage of nights during which enuretic episodes occurred. Analysis was made according to each of the following variables: sex, age, diagnosis, developmental history, enuresis frequency before treatment, type of enuresis (primary or secondary) and treatment outcome. Females wet more than males during the first third of the night. This trend was reversed during the rest of the night. Older patients responded better than younger patients. Older females reached 100% waking response in some segments of the night. Patients with idiopathic enuresis responded better to treatment with a sharp decline in percentage of wet nights compared with patients with psychological problems. In the latter only a moderate decline was observed. Patients with developmental delay wet more than patients with normal development. Patients with high frequency enuresis prior to treatment showed a greater decrease in enuretic episodes than those with low frequency only during the first third of treatment. No changes with respect to wetting time were observed during the rest of the treatment. Importantly, no differences with respect to wetting time were observed between primary and secondary enuresis and between ages. The frequency of the waking response was a function of time of night: 33% occurred in the first two hours of sleep. The frequency however, gradually increased as the night progressed, up to 78% response in the last two hours. Treatment did not alter the temporal pattern of response which remained consistent. Patients with successful outcome to treatment showed better waking response than unsuccessful patients. Females responded better than males at all times. Few or no changes were observed with respect to the other variables. Importantly, the reflex response to alarm was related to but did not depend upon waking response. The trend of waking response was preserved in all sub groups.

INTRODUCTION

Enuresis is defined as involuntary micturition after age 5 years and may be either nocturnal, diurnal, or both. Many etiologies have been proposed for enuresis including psychologic factors, environmental stress, maturational factors, decreased bladder capacity and organic pathology among others. The majority of enuretics, however, have neither anatomic nor psychological problems and are, therefore, classified as idiopathic enuretics (1).

One of the most widely propagated theories concerning enuresis is that the basic fault is a poor arousal response to bodily or environmental stimuli due to un-

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usually deep sleep. Only a few E.E.G. studies with enuretics have been conducted, and they have yielded contradictory results. Some suggested that enuretic episodes occurred in deep sleep (2), while others suggested that enuresis may occur in all stages of sleep (3).

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Pierce (4) theorized that enuretic events were "dream equivalents." Broughton (5) developed a new concept of enuresis as a disorder of arousal, similar to somnambulism and night terrors. Ritvo (6) found different arousal responses with non-disturbed children compared with those who were psychiatrically disturbed.

When time of night was also considered most studies reported that enuretic episodes occurred in the first half, or third, of the night. The purpose of this study was to examine the relationship between nocturnal enuresis, time of night and waking response in the process of treatment with enuresis alarm.

METHODS

A total of 257 enuretic patients age 5.5-16 were treated with an enuresis alarm. There were 4976 enuretic episodes recorded by patients and parents during treatment. Records included time of episode, the size of the spot of urine in the bed (this was used as an indicator of the reflex response to conditioning), waking response to the alarm and whether the patient woke up by him or herself or was aroused by a parent. Analysis was made in two ways: by subjects (257) and by enuretic episodes (4976). Treatment was divided into 3 phases (weeks 1 and 2, weeks 3 and 4, weeks 5-7). Each night was divided into five equal parts starting at 9 P.M. ending at 7 A.M.

To determine the response to the enuresis alarm, the data were analyzed according to the following variables: sex, age, diagnosis, developmental history, enuresis frequency before treatment, type of enuresis (primary — never had a dry period, secondary — was dry for 6 months or more) and treatment outcome.

RESULTS

The peak time for enuresis episodes was about 2 am. This remained true throughout the 7 weeks period of the study, despite the fact that the percentage of nights during which wetting occurred decreased from 84% during weeks 1 and 2 to 62% during weeks 3 and 4 and 53% during weeks 5 through 7.

Patients with idiopathic enuresis responded better to treatment showing a sharp decline in frequency of wetting compared with patients with psychological problems. In the latter only a moderate decline was observed. Females wet more than males during the first third of the night. This trend was reversed during the rest of the night. Patients with developmental delay wet more than normally developed patients during the entire treatment. Patients who wet every night prior to treatment had a greater decrease in number of wet nights than those who started off with less frequent wetting (1-6 nights per week) only during the first third of

the treatment. Patients with successful outcome to treatment showed a sharp decline in wetting frequency in the second third of treatment compared with patients with unsuccessful outcome where only a very slight decline was observed whether the enuresis was primary or secondary enuresis and regardless of the age of the patients. The peak time of wetting remained the same in all subgroups during all phases of treatment.

Waking response: The frequency of the waking response to the auditory stimulus of the alarm, was a function of time of night: 33% of enuretic episodes were associated with a waking response in the first 2 hours of sleep; the percentage gradually increased as the night progressed, to reach 78% of enuretic episodes associated with a waking response in the last 2 hours. Treatment did not alter this pattern of response which remained consistent throughout. Analysis in both ways (subjects and episodes) revealed the same results.

Patients with successful outcome to treatment showed better waking response (from 40% of enuretic episodes during the first 2 hours up to 80%), compared with unsuccessful patients (20%- 55%). Females woke more often than males at all times (45%-90% compared with 25%-70% for males). Older patients (age 10-16 years) woke more often than younger patients (age 5.5-10 years), particularly during the first third of the night (55%-70% compared with 28%-48% waking response). Combined analysis was made for age and sex. Females continued to show better waking response, in all age groups. Older females (age 10-16) reached 100% waking response in some segments of the night during the entire treatment period. Little or no change was observed with respect to the other variables.

The reflex response as estimated by the size of the spot of urine in the bed improved in proportion to the number of times the alarm went off, but did not depend upon waking response ($p < .001$) i.e. there was some decrease in the amount of urine voided even if the child did not wake up. The trend of waking response was preserved in all sub-groups.

DISCUSSION

These results tend to support the assertion that enuretic episodes are not a function of sleep stages but a function of time of night. The preservation of the peak time of wetting throughout the treatment process supports Graham's (7) claim that the enuresis alarm does not alter sleep pattern but causes a conditioning act in relation to bladder filling. Therefore enuresis does not appear to be a disorder of arousal as suggested by Broughton (5). As the night progresses better waking response is observed. This phenomenon can be explained by two factors:

- A. Sleep during the first third of night is predominantly delta sleep, the deepest stage of sleep and later sleep is lighter.
- B. As the night progresses the intravesical pressure increases and a signal of bladder activity can reach cortical levels with sufficient intensity to cause arousal (6).

The fact that males wet more than females (2:1) is stressed in many epidemiological studies. The reason is still unknown. The present results offer a new explanation for this observation by relating it to the differences in waking response.

The findings of this research can assist in developing a tool for prognosis before and during the treatment of enuresis. Further research in that direction is, obviously, needed.

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