

DIURNAL RHYTHM OF WAKING AND SLEEP IN NARCOLEPSY

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UDC 616.8-009.836.12-092"52"

A polygraphic investigation throughout the 24-h period on 3 patients with narcolepsy revealed an increase in the duration of sleep, more especially in the patient with a monosymptomatic form of the disease, as a result of excessive sleep during the day. In patients with a polysymptomatic form of the disease, the stages of drowsiness were more marked. All patients were deficient in certain stages of slow sleep, but had more than the normal number of phases of fast sleep in the first half of the day and of "delta" sleep in the evening and at night. An increase in the phasic activity of fast sleep was found in patients with the polysymptomatic form of narcolepsy. The phenomenon of a premature onset of fast sleep was observed in these patients much more frequently.

A study of the diurnal rhythm of waking and sleep is of the greatest importance to the understanding of the physiological mechanisms of sleep and the pathogenesis of its disorders. Investigations of healthy persons have revealed rhythmic fluctuations in the psychophysiological indices during the 24-h period, with a period corresponding to the slow sleep-fast sleep cycle [2].

The object of the present investigation was to study this diurnal rhythm in patients with paroxysmal narcolepsy, as a possible means of obtaining additional information to help toward elucidating its role in the organization of physiological process in the body.

EXPERIMENTAL METHOD AND RESULTS

Tests were carried out on 3 men aged 17, 23, and 27 years with narcolepsy. Two patients had a polysymptomatic form of the disease in which, besides attacks of uncontrollable sleepiness during the day, they exhibited paroxysms of loss of muscle tone (cataplexy) and disturbances of nocturnal sleep, in the form of hypnagogic hallucinations. The third patient had only this tendency to sleep during the daytime (monosymptomatic form).

A polygraphic investigation was carried out continuously over the 24-h period on all these patients, with simultaneous recordings of the EEG (frontal, parietal, and occipital leads), the electrooculogram, the electromyogram of the muscles of the oral diaphragm, and the ECG. The polygraphic recordings were obtained continuously through the night. During the day interruptions were allowed for eating, toilet purposes, and so on. Together with the polygraphic recording, visual observations were made on the patients, especially during the interruptions in the polygraphic investigations. None of the patients fell asleep during interruptions in the polygraphic recording. The patients could go to bed, sit in a chair, read or listen to the radio as they pleased. The conditions of illumination were normal. The subjects were adapted to the experimental conditions, because before the 24-h investigation, frequent polygraphic studies of nocturnal sleep and of the paroxysms of sleep during the day were carried out on each of them. Every 40-sec interval of the record was analyzed using the classification of the stages of sleep proposed by Davis et al. [1], with the addition of a phase of fast sleep.

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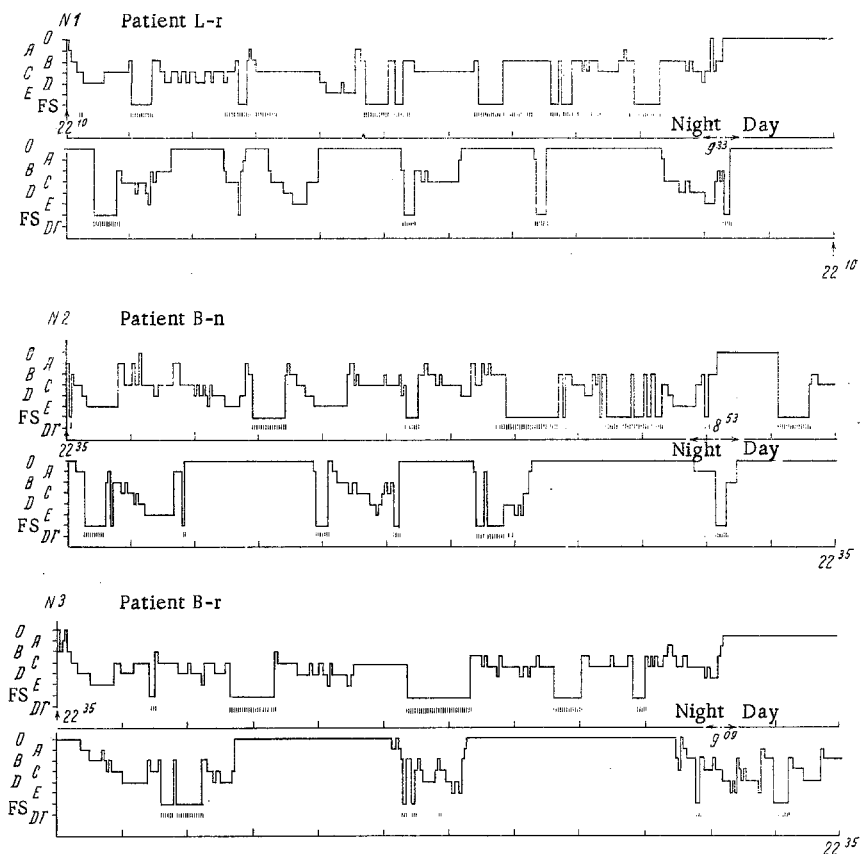


Fig. 1. Graph of diurnal cycle of waking and sleep in patients with narcolepsy. Nos. 1 and 2) Patients with a polysymptomatic form of the disease; No. 3) monosymptomatic form; 0 denotes waking; the letters A, B, C, D, E, and FS (fast sleep) denote stages of sleep. Nocturnal and diurnal parts of investigations demarcated by the time of awakening in the morning.

It will be clear from the graphs in Fig. 1 and from Table 1 that in all patients the total duration of sleep during the 24-h period was increased, mainly due to an increase in diurnal sleep. The duration of nocturnal sleep was increased only to a moderate degree. The longest duration of nocturnal sleep was observed in the patient with the monosymptomatic form. The total contribution of the phase of slow sleep was greatest in the same patient, and as well as an increase in the C and D stages, he also was deficient in stage E. Patients with the polysymptomatic form were distinguished by the greater severity of their stages of drowsiness, which in all 3 patients were dominant during the day. One patient was deficient in stages D and E during both night and day. The second patient was deficient in stage C. The number of phases of fast sleep was increased in all patients. Only the second patient showed an increase in the relative percentage of phases of fast sleep relative to the total duration of sleep in the 24-h period, indicating an absolute increase in the production of fast sleep unconnected with the total duration of sleep. Comparison of the distribution of the phase of fast sleep during the 24-h period showed that the first half (from 0 to 12 h) accounted for 74.4, 78.6, and 67% respectively of its total duration. The latent period of the episodes of fast sleep was shortened and the duration of the episodes themselves was lengthened in the first half of the 24-h period (Table 2).

The differences with respect to both indices (disregarding the first, premature episode of fast sleep at night in the second patient) are statistically significant; $P = 0.05$ (by the Wilcoxon-Mann-Whitney criterion).

Fluctuations in the distribution of "delta" sleep (stages D and E) during the 24-h period were most marked when the periods from 18 to 6 h and from 6 to 18 h were compared. Occurrence of deep slow sleep reached a maximum during the evening and at night, 79.66 and 71.4% respectively, indicating that this type is more closely bound with the periodicity of daylight.

TABLE 1. Comparison of Duration of Waking and Sleep in Patients with Narcolepsy and Healthy Subjects

	Patient	Waking	Duration of sleep	Stage of sleep (in percent)					
				A	B	C	D	E	BC
I	Polysymptomatic form 1. P-v	553 min	887 min	0,8	13,8	24,8	5,9	4,1	12,2
		38,4%	61,6%	(1,6)	(1,8)	(11,0)	(4,1)	(3,6)	(6,9)
II		—	887 min	1,2	22,4	40,2	9,7	6,7	19,8
III		—	561 min	0,9	21,7	40,7	8,9	5,5	22,3
IV		—	326 min	(5,6)	(6,1)	(38,1)	(14,2)	(12,3)	(23,6)
				1,8	23,5	39,5	11,0	8,6	15,6
I	2. B-n	498 min	942 min	5,7	9,4	15,4	7,8	9,3	17,8
		65,4%	65,4%						
II		—	942 min	9,0	14,2	23,4	11,7	14,1	27,3
III		—	602 min	5,8	15,1	26,5	11,7	15,9	25,0
IV		—	304 min	14,6	12,9	18,2	12,0	10,9	31,4
I	Monosymptomatic form 3. B-r	488 min	952 min	2,1	8,8	23,7	14,6	2,9	14,1
		33,8%	66,2%						
II		—	952 min	3,1	13,4	35,9	22,1	4,2	21,3
III		—	537 min	0,3	8,0	41,0	19	5,6	26,1
IV		—	415 min	6,8	20,2	29,1	26,3	2,4	15,2

Note. 1) Occurrence of waking and sleep (stages and phases of sleep) during 24-h period; II) occurrence of stages of sleep relative to its total duration in 24-h period; III) occurrence of stages of sleep relative to duration of nocturnal sleep; IV) occurrence of stages of sleep relative to duration of diurnal sleep. Normal values obtained in studies of nocturnal sleep of 10 healthy subjects given in parentheses.

TABLE 2. Duration of Latent Period and Episodes of Phase of Fast Sleep in First and Second Halves of 24-h Period

	0—12 h	12—24 h
Mean duration of latent period of episodes of fast sleep	90,3 min (45—100) 75,4 min (29—167) 79 min (50—118)	127 min (65—167) 104 min (62—197) 172 min (68—287)
Mean duration of episodes of fast sleep	21,3 min (9—33) 23,5 min (5—53) 43,7 min (11—56)	9,8 min (40 sec) 19 min 9,5 min (3—24) 13,6 min (5—38)

Note. Extreme values given in parentheses.

The graph of the diurnal cycle of the first patient shows that rapid movements of the eyes, which normally appear only during fast sleep, were recorded at other times also, usually before the beginning and after the end of an ordinary episode of this phase of sleep. This may indicate a high intensity of oculomotor activity during narcolepsy. In the second patient, hyperproduction of the phasic and tonic components of fast sleep took place parallel with each other, as reflected in the general increase in the proportion of the 24-h period occupied by this phase of sleep. In patients with the polysymptomatic form of the disease, of 12 episodes of fast sleep occurring during the daytime, 9 began immediately after awakening or after stage A with a latent period of more than 1 min. This difference from the monosymptomatic form is not absolute, for in 2 cases in the third patient a phase of fast sleep also appeared prematurely, but it was shorter in duration, had a longer latent period, and was accompanied by weak phasic activity, in the form of single eye movements.

No connection was found between the duration of the individual episodes of fast sleep and the latent period preceding them. No distinct cyclic pattern of appearance of fast sleep was observed during the 24-h period, as other workers have described in patients with narcolepsy [3]. This may perhaps be due to the small number of cases in the present series.

LITERATURE CITED

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