Sleep, 9(1):232–242

Comparative Polysomnographic Study of Narcolepsy and Idiopathic Central Nervous System Hypersomnia

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Summary: Patients with a primary diagnosis of narcolepsy or idiopathic CNS hypersomnia seen at Stanford University Sleep Disorders Clinic over a 5-year period were studied retrospectively. The two patient groups were compared with respect to blood pressure, Minnesota Multiphasic Personality Inventory (MMPI) psychological profile, nocturnal sleep structure, prevalence and severity of sleep apnea and periodic leg movements in sleep, and daytime sleep tendency. Narcoleptic patients tended to have higher blood pressure, higher prevalence of abnormally elevated MMPI scores, more abbreviated and more disrupted sleep at night, and greater daytime sleep tendency. Sleep apnea and periodic leg movements were more prevalent in narcoleptic patients, but only periodic leg movements in sleep were more prevalent in narcoleptic patients than in the general population. Periodic leg movements during REM sleep were observed in more than one-third of narcoleptic patients, which may be an important pathophysiologic feature of this disorder. **Key Words:** Narcolepsy—Idiopathic central nervous system hypersomnia—Sleep stages—Multiple sleep latency test—Nocturnal myoclonus—Sleep apnea—Minnesota Multiphasic Personality Inventory—Nocturnal polysomnogram.

Narcolepsy and idiopathic central nervous system (CNS) hypersomnia are both disorders characterized by symptoms of excessive daytime sleepiness (EDS) not directly attributable to medical, toxic, or psychiatric factors. These two disorders have many similarities, including age of symptom onset, nonremission of symptoms over the life span, and heredofamilial tendency. The symptoms that differentiate narcolepsy from idiopathic CNS hypersomnia are cataplexy, hypnagogic hallucinations, and sleep paralysis (1).

Bedrich Roth was the first to clearly isolate the idiopathic hypersomnia syndrome, differentiating it from narcolepsy on the basis of comprehensive symptom histories of over 600 cases of hypersomnia (2,3). Both nighttime sleep and daytime naps of idiopathic hypersomnic patients are prolonged and rarely interrupted by awakenings. In contrast, the nocturnal sleep of narcoleptic patients is of normal duration, and in some patients, sleep

Accepted for publication January 1986.
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is periodically interrupted by brief awakenings. Sleep drunkenness and difficulty with awakening in the morning, common in idiopathic hypersomnia, are not common in narcolepsy. During the daytime, narcoleptic patients experience sudden, irresistible "sleep attacks," whereas idiopathic hypersomnic patients complain of constant but more resistible sleepiness. Narcoleptic patients often achieve temporary relief from EDS through brief daytime naps, but idiopathic hypersomnic patients may not feel refreshed despite longer naps.

Nocturnal polysomnographic (NPSG) studies have described two important features of narcolepsy that are not present in idiopathic CNS hypersomnia: the sleep-onset REM period (SOREMP) and disrupted nocturnal sleep (4–13). SOREMPs occur both at night and during daytime naps, and their occurrence on two or more of five consecutive multiple sleep latency test (MSLT) naps is the major polysomnographic criterion used to distinguish narcolepsy from idiopathic CNS hypersomnia (14–16). Despite the distinctions outlined above, the differential diagnosis of narcolepsy and idiopathic CNS hypersomnia remains difficult.

The following is a preliminary report on a retrospective comparative study of 257 narcoleptic and 74 CNS hypersomnic patients who were diagnosed at the Stanford University Sleep Disorders Clinic over a 5-year period. The goal of this investigation was to identify the demographic and polysomnographic features that differentiate narcolepsy from idiopathic CNS hypersomnia, focusing on age, sex, blood pressure, psychological profiles on the Minnesota Multiphasic Personality Inventory (MMPI), nocturnal sleep structure, patterns of daytime sleepiness, and prevalence and severity of pathophysiological events during sleep.

PATIENT POPULATION

All patients assigned a primary diagnosis of narcolepsy or idiopathic CNS hypersomnia at the Stanford Sleep Disorders Clinic between January 1978 and January 1984 were included in this study. Health and sleep symptom history, results of physical examination, and measurement of blood pressure were obtained from the charts of 257 narcoleptic and 74 idiopathic CNS hypersomnic patients. Of the 257 narcoleptic patients, 140 were men (median age 45 years, range 18–75) and 117 were women (median age 44 years, range 10–69); of the 74 idiopathic CNS hypersomnic patients, 40 were men (median age 44 years, range 28–67) and 34 were women (median age 45 years, range 22–62).

METHODS

The MMPI was completed by 192 narcoleptic patients and 62 idiopathic CNS hypersomnic patients. One hundred seventy-four narcoleptic patients and 37 idiopathic CNS hypersomnic patients, who had been free of stimulant, sedative-hypnotic, or other psychotropic medications for at least 14 days prior to the study, underwent a standard NPSG evaluation, which included electroencephalogram (EEG) (C_3/A_2 and O_1/A_2), electromyogram of the submental and bilateral anterior tibialis, electrocardiogram, nasal and oral airflow determinations (thermistors), thoracic and abdominal strain gauges, and electro-oculogram.

Sleep stages were scored by 30-s epochs according to standard criteria (17), and the data for each consecutive epoch were entered into a computer. A program then calculated 33 sleep-wake variables for each patient, including minutes and proportion of each sleep-wake stage and an analysis by thirds of the night of proportion of wake, NREM sleep, and

REM sleep. Sleep-onset REM periods were scored during the NPSG or MSLT when REM sleep occurred within 10 min of sleep onset.

Respiration was monitored throughout the night in 177 narcoleptic patients and in 34 idiopathic CNS hypersomnic patients. In these patients, all sleep apneic events were counted and classified as obstructive or central by standard criteria (sleep apnea was defined as total cessation of nasal/oral airflow longer than 10 s). Scorers noted the prevailing sleep stage (NREM, REM, or transitional sleep) at the time of occurrence of each apnea. Categorized data on apnea were entered into the computer, and a program calculated 20 sleep apnea variables, including sleep apnea index (SAI, apneic events per hour of sleep) for total sleep and for each sleep stage independently. Hypopneic events, which were episodes of decreased respiratory volume without total cessation of airflow, were tabulated but were not included in the SAI calculation.

Leg movements were recorded throughout the night via bilateral anterior tibialis electromyogram in 193 narcoleptic patients and 30 idiopathic CNS hypersomnic patients, all of whom were stimulant medication–free at the time of the recording. The total number of leg movement events occurring in each sleep stage, number of leg movement series in each stage (episodes of at least five consecutive periodic leg movements; intermovement interval not >60 s) were scored using standard criteria (18). Leg movements were further classified according to presence or absence of sleep-wake stage change immediately following the leg movement or leg movement series, as (a) leg movements not followed by EEG signs of arousal; (b) movements followed by EEG signs of arousal, with duration too brief to score the epoch as wakefulness by standard criteria; or (c) leg movement followed by one or more 30-s epochs of wakefulness. The periodic leg movement data for each patient were entered into the computer, and a program calculated 24 leg-movement variables for each patient, including mean number of movements, mean number of series, and periodic leg movement indices (PLMI, periodic leg movements per hour of sleep) for each type of movement and for each sleep stage.

A standard five-trial MSLT protocol was administered to 222 narcoleptic patients and to 34 idiopathic CNS hypersomnic patients. Mean sleep latency over all tests and total number of naps containing SOREMPs were calculated for each patient. Grand means of sleep latency for each trial and for overall mean sleep latency were calculated for each patient group.

A primary diagnosis of narcolepsy was established if three of the following four criteria were satisfied: (a) definitive history of EDS, (b) mean MSLT sleep latency index <5 min, (c) definitive history of cataplexy, (d) two or more SOREMPs on MSLT, or SOREMP on NPSG and one or more SOREMP on MSLT. Idiopathic CNS hypersomnia was established as the primary sleep disorder diagnosis in patients who had no history of cataplexy and satisfied three of the following four criteria: (a) definitive history of EDS symptoms, (b) mean MSLT sleep latency index <5 min, (c) no history of hypnagogic hallucinations or sleep paralysis, (d) no SOREMPs during MSLT or NPSG. If other sleep disorders, such as sleep apnea syndrome or nocturnal myoclonus, were diagnosed in a narcoleptic or idiopathic CNS hypersomnic patient, they were noted as secondary or tertiary diagnoses. These patients with multiple sleep disorder diagnoses were not excluded from the study.

A computer program calculated grand means and standard error, median, range, and frequency distribution for each variable, and statistically compared the two patient populations using Student's t test, Wilcoxon Rank Sum Test, and χ^2 analysis.

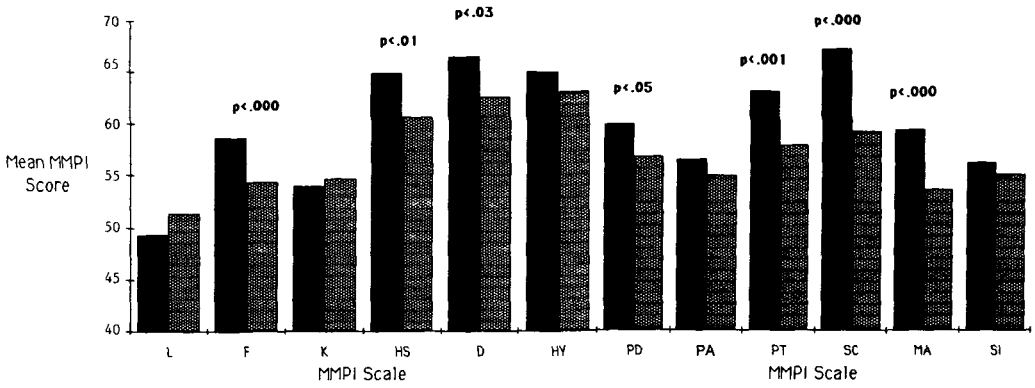

FIG. 1. Mean scores on Minnesota Multiphasic Personality Inventory (MMPI) for narcoleptic (solid bars, n = 192) and idiopathic CNS hypersomnic (stippled bars, n = 62) patients. Intergroup differences indicated ($p < 0.05$, t test). Scales: L, lie; F, frequency or confusion; K, correction; Hs, hypochondriasis; D, depression; Hy, conversion hysteria; Pd, psychopathic deviate; Pa, paranoia; Pt, psychasthenia; Sc, schizophrenia; Ma, hypomania; Si, social introversion.

RESULTS

Blood pressure

Narcoleptic patients (n = 257) had higher blood pressure than CNS hypersomnic patients (n = 74). Mean systolic pressure in narcoleptic patients was 132.6 ± 1.2 mm Hg (median 131, range 90–194); mean systolic pressure in idiopathic CNS hypersomnic patients was 126.9 ± 2.3 mm Hg (median 130, range 89–182) ($t = 2.2$, $p < 0.028$). Mean diastolic pressure in narcoleptic patients was 84.7 ± 0.8 mm Hg (median 84, range 53–127); mean diastolic pressure in idiopathic CNS hypersomnic patients was 80.1 ± 1.5 mm Hg (median 80, range 52–126) ($t = 2.8$, $p < 0.006$). Men had higher blood pressure than women within each patient group. Male narcoleptic patients (n = 140; mean age 44.9 years, median 45, range 18–75) had the highest blood pressures of any group (systolic 136.3 ± 1.5, diastolic 87.8 ± 1.0 mm Hg), followed by male CNS hypersomnic patients (n = 40; mean age 45.4 years, median 44, range 28–67), with a mean blood pressure of 130.9 ± 2.9/82.6 ± 2.0 mm Hg and female narcoleptic patients (n = 117; mean age 43.7 years, median 44, range 10–69) with a mean blood pressure of 128.3 ± 2.0/81.0 ± 1.1 mm Hg. Women with idiopathic CNS hypersomnia (n = 34; mean age 42.2 years, median 45, range 22–62) had the lowest blood pressure (122.1 ± 3.5/77.2 ± 2.1 mm Hg).

MMPI scores

Narcoleptic patients (n = 192; 108 men, 84 women), as compared with idiopathic CNS hypersomnic patients (n = 62; 33 men, 29 women), showed elevated scores on several MMPI scales, including the F (frequency or confusion: $p < 0.000$, $t = 3.91$), Hs (hypochondriasis: $p < 0.011$, $t = 2.58$), D (depression: $p < 0.031$, $t = 2.19$), Pd (psychopathic deviate: $p < 0.049$, $t = 1.99$), Pt (psychasthenia: $p < 0.001$, $t = 3.49$), Sc (schizophrenia: $p < 0.000$, $t = 5.24$), and Ma (hypomania: $p < 0.000$, $t = 3.88$) scales (Fig. 1). "Marked" elevations (T = ⩾70) on these MMPI scales were more prevalent in the narcoleptic patients than in idiopathic CNS hypersomnic patients: F scale 10.4 > 0% ($\chi^2 = 7.24$, $p < 0.01$), Hs scale 30.7 > 17.7% ($\chi^2 = 4.09$, $p < 0.05$), D scale 39.6 > 33.9% (χ^2 = NS), Pd scale 15.6 > 0% ($\chi^2 = 11.35$, $p < 0.001$), Pt scale 27.1 > 8.1% ($\chi^2 = 10.06$, $p < 0.005$), Sc scale 35.9 > 8.1% ($\chi^2 = 17.63$, $p < 0.001$), Ma scale 17.7 > 4.8% ($\chi^2 = 6.45$, $p < 0.025$).

TABLE 1. *Summary of nocturnal polysomnographic and MSLT data in narcolepsy and idiopathic CNS hypersomnia*

Variable	Narcolepsy	Idiopathic CNS hypersomnia	($p < 0.05$)
Nocturnal sleep			
Total sleep time (min)	369.6 ± 8.7	398.2 ± 9.4	0.028 (*t*)
NREM stage 1 (min)	52.8 ± 2.7	38.9 ± 3.8	0.004 (*t*)
NREM stage 1 (%)	16.4 ± 1.2	10.3 ± 1.1	0.000 (*t*)
Stage 3 and 4 NREM (min)	47.8 ± 2.7	66.9 ± 8.2	0.034 (*t*)
NREM sleep second 3rd of night (min)	11.1 ± 1.1	20.4 ± 3.8	0.023 (*t*)
REM latency (min)	63.1 ± 5.3	105.5 ± 11.7	0.002 (*t*)
No. REM sleep periods	4.2 ± 0.1	3.8 ± 0.2	0.000 (*W*)
Wake after sleep onset (min)	64.8 ± 4.4	49.9 ± 8.8	0.036 (*W*)
Awake (min)			
First 3rd of night	22.3 ± 2.1	15.6 ± 3.2	0.022 (*W*)
Second 3rd of night	27.3 ± 2.2	16.4 ± 3.2	0.007 (*t*)
Longest wake (min)	20.5 ± 1.6	13.0 ± 1.6	0.001 (*t*)
MSLT			
Mean sleep latency, all naps (min)	3.33 ± 0.30	5.10 ± 0.57	0.017 (*t*)
MSLT sleep latency (min)			
1200 h MSLT (nap 2)	3.82 ± 0.66	5.14 ± 0.74	0.001 (*W*)
1400 h MSLT (nap 3)	2.90 ± 0.33	4.08 ± 0.67	0.044 (*W*)
1600 h MSLT (nap 4)	3.40 ± 0.39	4.91 ± 0.84	0.013 (*W*)
1800 h MSLT (nap 5)	4.83 ± 0.46	7.46 ± 1.10	0.022 (*t*)

All values given are means ± SE. Statistical test: (*t*) Student's *t* test, (*W*) Wilcoxon Rank Sum Test. MSLT, multiple sleep latency test.

NPSG variables

Table 1 summarizes a number of nocturnal sleep variables that differed significantly between the 174 narcoleptic patients (96 men, 78 women; mean age 44.4 years) and 37 idiopathic CNS hypersomnic patients (21 men, 16 women; mean age 43.9 years) who were recorded overnight in the sleep laboratory.

Narcoleptic patients exhibited shorter REM sleep latency at night and had significantly more REM sleep periods, although total REM sleep time tended to be slightly greater in the idiopathic CNS hypersomnic group (71.1 ± 2.6 vs. 79.0 ± 3.8 min, $p < 0.091$, $t = 1.71$). Narcoleptic patients also showed less total sleep time, less NREM sleep stages 3 and 4, and more NREM stage 1 than idiopathic CNS hypersomnic patients (Table 1).

Nocturnal sleep was more disrupted in the narcoleptic patients, as indicated by (a) significantly more wakefulness during the first and second thirds of the night, (b) less NREM sleep during the second third of the night, (c) more total wakefulness occurring after sleep onset (WASO), and (d) longer mean duration of the longest waking episode during the night.

Both sleep efficiency (SE, total sleep time per total recording time) and sleep maintenance efficiency (SME, total sleep time per total recording time minus latency to first sleep onset) were significantly lower in the narcoleptic group (SE 83.5 ± 0.9 vs. 86.5 ± 2.0, $p < 0.036$; SME 85.9 ± 0.8 vs. 89.1 ± 1.8, $p < 0.016$: Wilcoxon Rank Sum Test).

Sleep apnea

Sleep apnea syndrome (SAS), defined as SAI >5, was present in 23 of 177 narcoleptic patients (22 men, 1 woman) for whom respiration and apnea were measured throughout the NPSG. None of the 34 monitored idiopathic CNS hypersomnic patients had SAI >5.

TABLE 2. *Summary of periodic leg movements (PMS) and sleep apnea in narcolepsy and idiopathic CNS hypersomnia*

Variable	Narcolepsy	Idiopathic CNS hypersomnia	($p < 0.05$)
PMS			
Total mvts/night (NREM)	58.3 ± 8.1	19.6 ± 7.3	0.001 (*t*)
Mvts/night with no arousal (NREM)	36.5 ± 5.7	14.0 ± 5.5	0.005 (*t*)
Mvts/night with arousal but no waking (NREM)	18.8 ± 3.5	4.8 ± 1.8	0.000 (*t*)
Mvts/night with arousal and waking (NREM)	2.6 ± 0.5	0.5 ± 0.2	0.000 (*t*)
SAI (overall)	2.7 ± 0.6	1.1 ± 0.2	0.008 (*t*)
Obstr. sleep apnea			
No. obstr apnea/night	10.4 ± 2.8	1.9 ± 0.8	0.004 (*t*)
Obstr SAI (OSAI)[a]			
OSAI (NREM)	1.6 ± 0.50	0.3 ± 0.11	0.009 (*t*)
OSAI (REM)	2.2 ± 0.56	0.7 ± 0.43	0.031 (*t*)
OSAI (transit)	1.7 ± 0.51	0.3 ± 0.14	0.008 (*t*)
Central sleep apnea			
Central SAI (REM)	6.1 ± 2.9	3.4 ± 1.2	0.007 (*W*)
Hypopnea			
Hypopnea index (REM)	4.2 ± 1.0	2.3 ± 0.9	0.007 (*W*)

All values given are means ± SE. Statistical test: (*t*) Student's *t* test; (*W*) Wilcoxon Rank Sum Test. Mvts, movements; SAI, sleep apnea index; Obstr, obstructive; transit, transitional.
[a]OSAI, apnea/h sleep.

Thus, prevalence estimates for the two patient populations of 13.6 and 0%, respectively, were significantly different ($\chi^2 = 4.96$, $p < 0.05$).

The majority of narcoleptic patients with SAS did not have severe apnea (mean SAI 16.4 ± 11.2, median 12.8, range 5.1–51.3); only three narcoleptic patients, all men, had SAI >25. Mild apnea (SAI > 0 < 5) was observed in 87 (54 male, 33 female) narcoleptic and in 21 (14 male, 7 female) idiopathic CNS hypersomnic patients. Apneic events were absent (SAI = 0) in 67 (35 male, 32 female) narcoleptic and in 12 (3 male, 9 female) idiopathic CNS hypersomnic patients.

Sleep apnea indices for both patient groups were very low, as compared with patient groups with sleep disordered breathing as a primary problem. The overall SAI for all patients (including those with SAI = 0) was slightly higher among narcoleptic (mean SAI 2.74 ± 0.6, median 0.3, range 0–51.3) as compared with idiopathic CNS hypersomnic patients (mean SAI 1.1 ± 0.2, median 0.2, range 0–4.6) (Table 2). As compared with the idiopathic CNS hypersomnic patients, narcoleptic patients had higher mean sleep apnea indices for obstructive apnea in NREM and in REM sleep, and at stage transitions. A noteworthy finding from the perspective of pathophysiological mechanisms was that narcoleptic patients also had significantly higher central apnea indices and hypopnea indices in REM sleep.

Predictably, male narcoleptic patients had higher SAI than female patients (men: mean SAI 4.6 ± 0.8, median 1.6, range 0–51.3; women: mean SAI 0.8 ± 0.1, median 0.1, range 0–23.9). The mean OSAI-REM in the male narcoleptic (6.1 ± 2.9 obstructive apnea per hour of REM sleep) patients was greater than the mean OSAI-NREM (1.6 ± 0.5).

Periodic leg movements during sleep

Periodic leg movements during sleep (nonzero PLMI, i.e., at least one series of ≥5 periodic leg movements) were recorded in 63.2% of the narcoleptic patients (67 of 109

men, 55 of 84 women) and in 30% of idiopathic CNS hypersomnic patients (7 of 15 men, 2 of 15 women). Thus, prevalence of nonzero PLMI differed significantly between the two diagnostic groups ($\chi^2 = 11.82$, $p < 0.01$).

Narcoleptic patients had more leg movements per night (mean 72.4 ± 9.8, median 24, range 0–515) than idiopathic CNS hypersomnic patients (mean 19.8 ± 7.6, median 0, range 0–154). Narcoleptic patients also had more leg movement series (mean 4.1 ± 0.6, median 3, range 0–56 vs. mean 1.1 ± 0.3, median 0, range 0–8). The frequency of occurrence of arousal and awakening events in association with leg movements was the same regardless of patient diagnostic group or sleep state: Periodic leg movements not associated with arousal constituted 60–62% of all leg movements, those with arousal but no awakening, 31–32%, and those associated with awakening, 6–9%. The majority of patients with nonzero PLMI (>70% in either diagnostic group) showed at least one awakening from nocturnal sleep that was associated with periodic leg movement.

Periodic leg movements (≥5 leg movements in a series) occurred during NREM sleep in 60.1% (62 men, 54 women) of narcoleptic and 30% (7 men, 2 women) of idiopathic CNS hypersomnic patients. In contrast, periodic leg movements in REM sleep (at least one series ≥5 movements) were recorded in 38.3% (43 men, 31 women) of narcoleptic patients, but in only one male idiopathic CNS hypersomnic patient, who showed a single series of nine leg movements. Therefore, only the NREM sleep leg movement variables could be statistically compared (Table 2). The mean number of NREM sleep leg movements in all categories (those not accompanied by arousal, those with arousal but no awakening, and those associated with complete awakening) was significantly higher in narcoleptic patients (Table 2). Significantly more narcoleptic patients had PLMI-NREM ≥5 (≥5 leg movements per hour of NREM sleep); 45.6% (51 men, 37 women) of narcoleptic versus 20% (4 men, 2 women) of idiopathic CNS hypersomnic patients ($\chi^2 = 8.94$, $p < 0.005$). Differences in the prevalence of PMLI-REM (≥5 leg movements per hour of REM sleep) were even more marked: 34.7% (37 men, 30 women) of narcoleptic patients versus 3.3% (1 man) of idiopathic CNS hypersomnic patients ($\chi^2 = 12.06$, $p < 0.001$).

The prevalence of periodic leg movement syndrome (PMS), using the criterion of 40 periodic leg movements per night (18), was significantly higher in narcoleptic (46%; 51 men, 38 women) than in idiopathic CNS hypersomnic (13.3%; 3 men, 1 woman) patients ($\chi^2 = 11.48$, $p < 0.01$). Among these patients, the mean PLMI-NREM was comparable in narcolepsy (24.0 ± 2.8) and idiopathic CNS hypersomnia (19.3 ± 4.2). The mean PLMI-REM in patients with ≥40 leg movements per night was 28.5 ± 8.7.

To compare the prevalence of PMS among narcoleptic patients with prevalence estimates reported in other studies (12,13), we determined the number of patients who had ≥100 periodic leg movements per night. In this study, 51 of 193 narcoleptic patients (26.4%; 27 men, 24 women) had ≥100 leg movements per night.

Multiple sleep latency test

Narcoleptic patients (125 men, 97 women) exhibited shorter sleep latency on the MSLT as compared with idiopathic CNS hypersomnic patients (18 men, 16 women) [mean 3.33 ± 0.3 min, median 2.1, range 0.1–17.5 vs. mean 5.10 ± 0.57 min, median 4.0, range 0.2–15, respectively (Table 1)]. Between-group comparisons for individual nap tests revealed that narcoleptic patients had a shorter mean sleep latency on all MSLT trials except the 10 a.m. test (Table 1). The overall proportion of MSLT naps showing SOREMPs was predictably much higher in narcoleptic patients (54.1 vs. 4.7%). Twenty (9.0%) narcoleptic and 27 (79.4%) idiopathic CNS hypersomnic patients had no SOREMPs during

MSLT. Thirty (13.5%) narcoleptic and six (17.6%) idiopathic CNS hypersomnic patients had one SOREMP in five trials. Fifty-seven (25.7%) narcoleptic patients and one idiopathic CNS hypersomnic patient had two SOREMPS. Thirty-five (15.8%) narcoleptic patients had three SOREMPs, 49 (22.1%) had four SOREMPs, and 31 (14%) had five SOREMPs. Four of 20 narcoleptic patients showed no SOREMPs and five of 30 narcoleptic patients who showed one SOREMP during MSLT also had no SOREMPs during NPSG. None of the idiopathic CNS hypersomnic patients had a SOREMP during NPSG.

DISCUSSION

In current clinical practice, it is often difficult to differentiate between narcolepsy and idiopathic CNS hypersomnia. Cataplexy, the pathognomonic symptom of narcolepsy, is highly variable in frequency of occurrence, severity, and age of onset. There are unresolved differences of opinion as to whether a definitive history of cataplexy is a necessary component of the narcolepsy syndrome.

Using SOREMPs as a polysomnographic indicator of narcolepsy has greatly facilitated accurate diagnosis. However, narcoleptic patients may not exhibit the standard criterion of two SOREMPs during five MSLT naps, and the occurrence of one SOREMP does not definitively rule out other diagnoses.

Polysomnographic studies comparing narcolepsy and idiopathic CNS hypersomnia have not differentiated the sleep structure in these two disorders (19–25). Distinguishing between narcolepsy and idiopathic CNS hypersomnia on the basis of monoamine metabolite levels measured in cerebrospinal fluid has not been successful to date (26,27). The retrospective comparison of narcoleptic and idiopathic CNS hypersomnic patients reported here is a further attempt to construct a profile of demographic, psychological, an polysomnographic features that differentiate these two hypersomnolence disorders. The ratio of narcoleptic patients to idiopathic CNS hypersomnic patients in this study, 4.6/1, is markedly higher than the estimates of relative prevalence from other case series studies: 1.73/1 (2,3), 2.71/1 (4), 2.83/1 (28). This discrepancy may reflect the application of more lenient diagnostic criteria for narcolepsy, such as relaxation of the requirement that SOREMPs occur in at least two of five MSLT naps, or it may reflect a trend toward more stringent criteria for diagnosis of idiopathic CNS hypersomnia, a more likely explanation.

The finding of higher blood pressure in the narcoleptic group is difficult to interpret because of a host of confounding variables. A multifactorial analysis of these data, which takes into account such factors as age, prior use of stimulant medication, and history of peripheral vascular disease and sleep apnea has not been attempted.

Results of the MMPI strongly suggest a greater prevalence of psychopathology in narcoleptic patients. Elevated hypochondriasis, depression, and hypomania scales among a high proportion of narcoleptic patients may reflect their greater difficulty in coping with debilitating hypersomnolence symptoms. Elevation on the schizophrenia scales may be more directly related to hypnagogic imagery, cataplexy, or other distinctive symptoms of narcolepsy. Prior use of stimulants may have affected the MMPI data of either group. More thorough interpretation of these results is beyond the scope of the present report.

The polysomnographic data reported here underscore several differences between narcolepsy and idiopathic hypersomnia with respect to duration of sleep, proportion of sleep stages, REM sleep latency, sleep efficiency, and severity of daytime sleepiness. Idiopathic CNS hypersomnic patients have longer and more consolidated sleep at night. As compared with narcoleptic patients, they have longer total sleep time, less stage 1 NREM sleep, more

total NREM sleep in the second third of the night, more stage 3 and 4 NREM sleep, less wakefulness in the first and second thirds of the night, less total wake after sleep onset, and shorter mean duration of the longest intrasleep waking period of the night. Sleep patterns and distribution of sleep stages of the idiopathic CNS hypersomnic patients in this study did not appear to be strikingly different from those in normal subjects. However, first-night effect and the disruptive environment of the laboratory may have masked more subtle differences.

Narcoleptic patients have shorter latency to REM sleep at night than idiopathic CNS hypersomnic patients, which was an expected outcome, since the presence of nocturnal SOREMPs was one of the diagnostic criteria. Narcoleptic patients also tend to have more REM cycles per night, but total REM sleep did not differ significantly.

Sleep apnea syndrome (SAI >5) was found in only 13% of narcoleptic patients and in none of the idiopathic CNS hypersomnic patients. This prevalence in narcoleptic patients is no greater than that among patients presenting at sleep disorders clinics with variable sleep/wake complaints (28), or among normal adult subjects with no sleep-wake complaint (29). This suggests that increased prevalence or severity of sleep apnea is not a concomitant of the narcolepsy syndrome. Rather, sleep apnea probably occurs coincidentally in the middle-aged and elderly male narcoleptic population, which may further disrupt nocturnal sleep and increase daytime hypersomnolence (12). The absence of SAS in the idiopathic CNS hypersomnia patients is probably an artifact of diagnostic practices, since this diagnosis is typically made by exclusion of potential pathophysiological etiologies. However, differences in mean number of central apnea and hypopnic events during REM sleep may indicate that respiratory control in this sleep stage is more labile in narcoleptic patients.

In this study, narcoleptic patients had significantly more leg movements per night and more movements associated with arousal or awakening. Estimates of the prevalence of PMS syndrome in narcolepsy have varied tremendously: 9% (30), 24.6% (12), 48.9% (13), 54% (31).

When we used the criterion of ≥ 100 leg movements per night, which is more consistent with earlier studies, the prevalence of PMS in narcoleptic patients is 26.4%, which agrees most closely with the 24.6% prevalence reported by Wittig et al. (12). These estimates are approximately double the 10–13% prevalence in the total population of several thousand patients seen at sleep disorders clinics (28), or the 11% prevalence noted both in adults with no sleep/wake complaints (32) and in insomniacs (33).

The 13.3% prevalence of PMS in idiopathic CNS hypersomnic patients is comparable to the prevalence among adults with no sleep-wake complaint (32), suggesting that PMS is not abnormally prevalent in idiopathic CNS hypersomnic patients. Diagnostic practices may have lowered the estimate, since patients who show abnormally high PLMI but no SOREMPs are often assigned a primary diagnosis of hypersomnolence secondary to periodic leg movements in sleep (nocturnal myoclonus).

Finally, narcoleptic patients exhibited significantly greater sleep tendency on MSLT. On average, they fell asleep faster than idiopathic CNS hypersomnic patients on all MSLT naps except the first (10:00 a.m.). Idiopathic CNS hypersomnic patients exhibited significantly longer mean sleep latency on the last nap, which immediately precedes termination of testing and departure from the laboratory. This finding supports the assumption that these patients, when motivated to do so, are able to resist sleep better than narcoleptic patients. Interestingly, 41 (18.5%) of the diagnosed narcoleptic patients with cataplexy did not show two SOREMPS on MSLT or NPSG; 16 patients (7.2%) did not have a SOREMP on either test.

The findings reported here support the hypothesis that narcolepsy and idiopathic CNS hypersomnia are distinct syndromes with characteristic sleep/wake patterns, EDS symptoms, REM sleep abnormality, and associated pathophysiological events. The narcoleptic and idiopathic CNS hypersomnic patients may also present different MMPI psychological profiles. Idiopathic CNS hypersomnic patients sleep longer than narcoleptic patients; they enter REM sleep later at night and after the usual 90–120-min progression through NREM stages of sleep: they have more NREM stages 3 and 4 sleep and experience fewer and briefer awakenings from sleep at night, and they are not as sleepy during the daytime. Sleep apnea may coexist with narcolepsy syndrome, although this study indicates that it is no more prevalent in narcoleptic patients than in the general population. In cases where it does occur, the apnea may disrupt nighttime sleep and further impair daytime alertness. Periodic leg movements during sleep are more prevalent in narcoleptic patients, which may be an important factor contributing to their disturbed sleep. The occurrence of periodic leg movements during REM sleep may be a distinctive phenomenon that differentiates narcolepsy from idiopathic CNS hypersomnia or other sleep disorders.

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