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Psychophysiological correlates of primary insomnia

S. Niemcewicz,
W. Szelenberger

Department of Psychiatry,
Medical University of Warsaw,
Warsaw, Poland

Ψυχοφυσιολογικές συνιστώσες της πρωτοπαθούς αϋπνίας

Περίληψη στο τέλος του άρθρου

OBJECTIVE **Psychophysiological abnormalities indicative of hyperarousal have been observed in insomniacs leading to the hypothesis that primary insomnia is the result of a disorder of a 24-hour/day excessive arousal. The aim of this study was to test this hypothesis.** METHOD **Psychophysiological differences between 16 patients with primary insomnia according to DSM-IV and 16 controls (matched for age, sex and education) were assessed through all-night polysomnography and the Multiple Sleep Latency Tests (MSLT) performed during the day. The Athens Insomnia Scale (AIS) and the Hyperarousal Scale (HS) were utilized to assess subjective severity of insomnia and hyperarousal, respectively. Motor activity was recorded continuously for seven days through wrist actigraphs, and daytime functioning was assessed based on the Selective Reminding Test (SRT) and the Continuous Attention Test (CAT).** RESULTS **In the patient's group motor activity level was found higher during the night, sleep efficiency lower, and the EEG desynchronisation in slow wave sleep was higher. Diurnal measures of arousal were found also to be increased in the patients. The score on the HS was higher in insomniacs than in the controls and it was significantly correlated with the severity of insomnia evaluated with the AIS. Sleep latency in all MSLT sessions was no shorter in patients despite their non-satisfying sleep at night. Impaired daytime functioning in insomniacs was confirmed, as the number of presentations necessary to memorize all items of the SRT was greater in the patient group than in the control group. Further, the degree of learning disturbance correlated with insomnia severity as scored on the AIS. No correlation between the SRT and polysomnographic parameters were observed.** CONCLUSIONS **(a) A 24-hour increase of arousal is confirmed in primary insomnia, (b) poor sleep alone is not the basis of complaints of impaired daytime functioning among insomniacs, (c) the Athens Insomnia Scale is a sensitive clinical tool which can be used to improve the description of insomnia populations.**

Key words

Hyperarousal
Impaired functioning
MSLT
Primary insomnia
Sleep EEG

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Some physiological abnormalities were noticed in insomniacs long ago. Probably the first experimental data were published by Monroe,[1] who observed higher rectal temperature in poor sleepers, a greater number of vasoconstrictions per minute and higher skin resistance. It is interesting that these differences were not limited to sleep but were also observed during waking. Many data confirm the absence of daytime sleepiness.[2] Hyperarousal has also been confirmed in other studies. The whole body metabolic rate is increased.[3] Positive correlation between total time awake and secretion of urinary free cortisol and catecholamines has been found.[4] It has even been proposed that primary insomnia may be just one of many symptoms of another disorder of the 24-hour cycle.[5] This study aimed to verify the hypothesis of 24-hour excessive arousal in primary insomnia.

MATERIAL AND METHOD

Sixteen patients, 7 men and 9 women, aged 21–55 years (mean: 40.8±11.3), with primary insomnia according to DSM-IV_6, lasting 8 months–25 years (mean: 6.4±7 years), were recruited from our Sleep Disorders Clinic. Only those patients

were accepted who were not on drugs or who managed to discontinue medication for at least two weeks before the beginning of the study procedures. The control group consisted of 16 good sleepers chosen from hospital staff and was pair matched according to sex, age and education.

Motor activity was continuously recorded for 7 days with a wrist actigraph monitor (Gaehwiler Electronic). The mean activity level, i.e. the mean number of movements across 5 minute periods, was calculated for diurnal and nocturnal periods.[7] On the evening of the 6th day MMPI, Hamilton and Beck scales were filled in. On the 6th night, apart from polysomnography (PSG), pulsoxymetry was performed. The results of this adaptation night were not further analyzed.

During the 7th night, standard PSG data[8] as well as electroencephalograms (EEG) from 23 EEG channels were recorded, according to the 10–20 system, with the referential electrode positioned between Cz and Fz. Sleep stages were scored visually. Complexity of EEG (Ω), a global measure of spatial synchronization, was calculated for the whole field of all the EEG channels.[9,10] The next morning a test for the presence of benzodiazepines in urine was performed and was negative in all subjects. Between sessions of the Multiple Sleep Latency Test (MSLT),[11] the Athens Insomnia Scale[12,13] and the Hyperarousal Scale[14] were filled in, and the Selective Reminding Test[15] was performed. The Continuous Attention Test (CAT)[16] was also performed by each subject. The CAT items consist of 240 random presentations of 5×4 squares. The direct repetitions of the same pattern are the target stimuli. The probability of the target appearance is 16%. The subjects were asked to press a button at the moment of detection of the target stimulus and reaction time was measured. The items from the standard CAT test were also used as stimuli in event related potentials recording. The results of the event related potentials study will be reported in a separate paper. Comparison of data was performed using the SPSS package.[17,18]

RESULTS

Patients with insomnia had higher scores on the Athens Insomnia Scale (patients' mean: 12.75±4.09, controls' mean: 3.50±1.63; U=0.5, P<0.00001).

On the MMPI, insomniacs obtained higher scores than the controls for hypochondria (55.93±8.94 vs 49.00±6.65, t=-2.489, df=30, P=0.019), depression (57.31±10.44 vs 45.43±7.79, t=-3.645, df=30, P=0.001), hysteria (58.62±8.77 vs 50.50±6.34, t=-3.001, df=30, P=0.005) and psychasthenia (51.18±9.23 vs 42.50±5.86, t=-2.999, df=30, P=0.005) scales (fig. 1). The Hamilton score was 6.4±2.4 in insomniacs and 0.5±1.0 in controls (U=2.5, P<0.001) and the Beck score was 6.8±4.6 in insomniacs and 2.2±3.6 in controls (U=42.5, P=0.001).

Patients had also higher scores on the Hyperarousal Scale (patients' mean: 65.0±7.54, controls' mean: 55.12±8.74, U=49.0, P=0.003). Scores on the Hyperarousal Scale and the Athens Insomnia Scale were significantly correlated (patients: ρ=0.49, P=0.05, controls: ρ=0.59, P=0.01) (fig. 2). Sleep latency in all MSLT sessions was no shorter in patients than in controls (fig. 3). The mean activity level of patients as recorded by the actigraphs was higher during the night (patients' mean: 2.50±2.56, controls' mean: 1.54±1.02, U=59.5, P=0.04) (fig. 4).

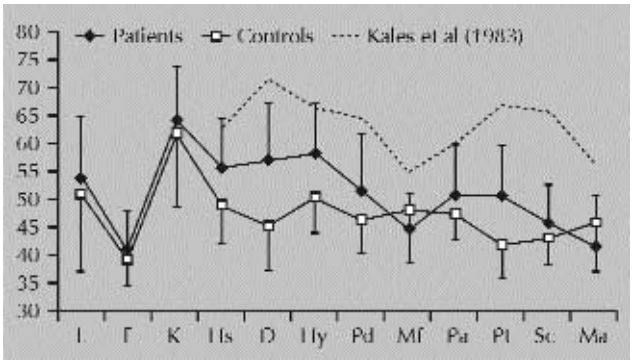

Figure 1. MMPI profile in patients and controls, compared to the data of Kales et al (1983).[19]

Patients did not differ in the number of remembered items during the first presentation of the Selective Reminding Test; the number of presentations necessary to memorize all items, however, was greater in patients than in the control group (patients' mean: 10.06±4.31, controls' mean: 6.56±2.25, U=68.5, P=0.02). The number of repetitions necessary to memorize all items correlated with the

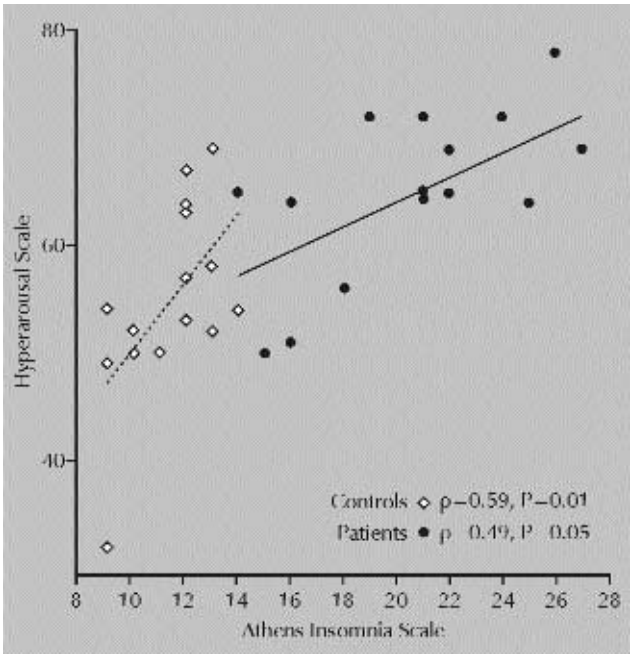

Figure 2. Correlation between the Athens Insomnia Scale and the Hyperarousal Scale.

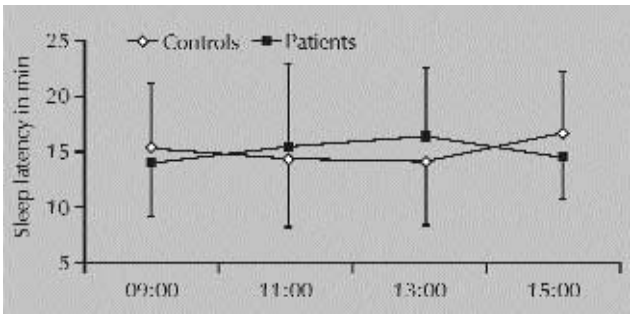

Figure 3. Multiple Sleep Latency Test (MSLT) in patients and controls.

results of the Athens Insomnia Scale in patients (ρ=0.57, P=0.02), but not in controls (ρ=-0.01, not significant). No correlations were observed between results of the Selective Reminding Test and results of the PSG. Patients had no more omissions in the CAT than controls, but their score of false target detections was greater and this difference was close to significance level (patients' mean: 2.81± 3.10, controls' mean: 2.16±4.19, U=80.5, P= 0.07). The patients' reaction time was shorter than that of the controls (patients' mean: 514.60±69.24 msec, controls' mean: 577.44±78.25 msec, U=65.0, P=0.02).

The PSG data are shown in table 1. Wake time after sleep onset was higher and the sleep efficiency index was lower in the insomniac group. In the insomniac group the complexity of the EEG (Ω) was greater in slow wave sleep (stage 3+4) (3.348±0.308 in insomniacs and 3.171± 0.304 in controls, U=76.0, P=0.05).

DISCUSSION

The MMPI profile in the insomniac group of this study was similar to the findings of Kales et al.[19] The most significant difference concerned the depression score, apparently because the patients in this study did not meet the clinical criteria of depression: all their scores in MMPI were below 70 points, their mean Hamilton score was 6.4±2.4 and their mean Beck score was 6.8±4.6.

The motor activity level of patients was higher during the night and sleep efficiency was lower. In slow wave sleep the linear descriptor of EEG complexity (Ω) was higher in the patients' group, which means that their slow wave sleep EEG was more desynchronized. Diurnal measures of arousal were also increased. The score on the Hyperarousal Scale was higher in insomniacs and it significantly correlated with the score on the Athens Insomnia Scale. Sleep latency in all MSLT sessions was no shorter in patients, so that in the day they were not more sleepy than healthy subjects, in spite of nonsatisfying sleep at night.

Impaired functioning in many areas is among the diagnostic criteria of primary insomnia; research data, however, concerning daytime performance are inconsistent. For example, Adam et al[20] reported no difference in

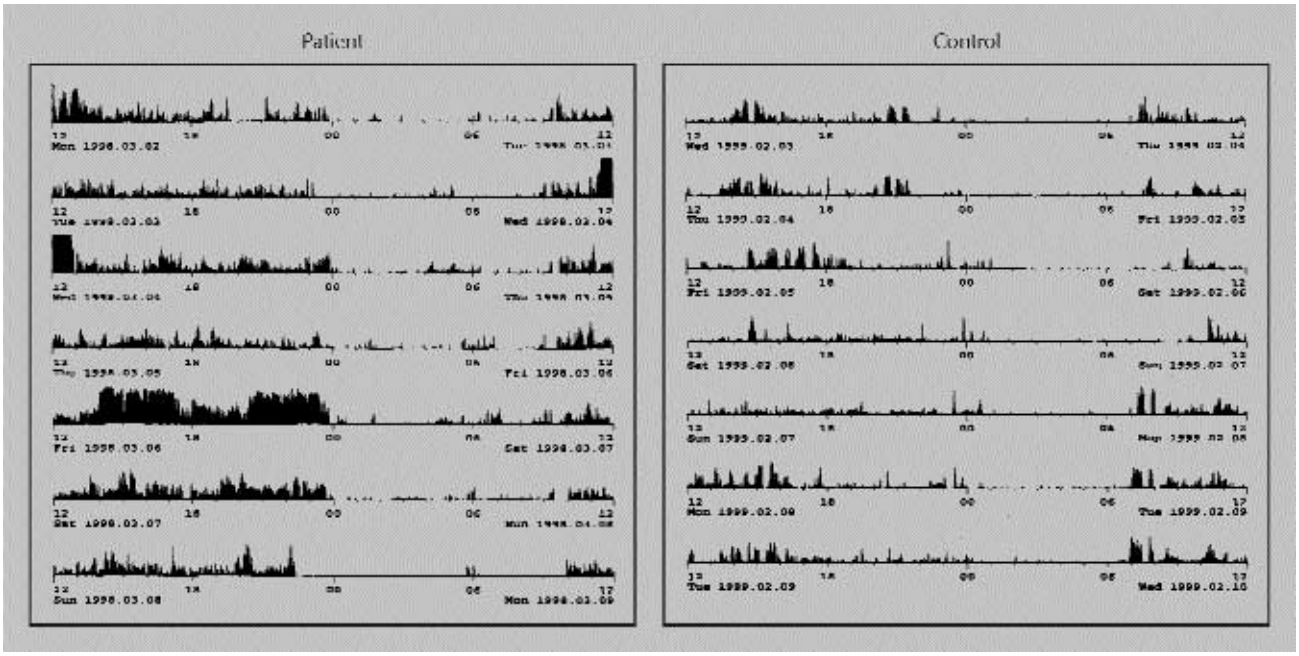

Figure 4. Examples of a week's actigraphy of one patient and one control subject. In each row a 24-hour period of motor activity is plotted. The circadian decrease of motor activity is clearly visible. The patient's motor activity is greater during both the night and the day.

Table 1. Sleep parameters in insomniacs and controls.

Sleep parameters	Insomniacs (n=16)			Controls (n=16)		
	Mean	±	SD	Mean	±	SD
Total dark time (min)	470.47	±	28.82	455.37	±	35.77
Sleep period time (min)	391.16	±	48.93	412.56	±	37.97
Total sleep time (min)	433.43	±	36.50	436.14	±	44.60
Sleep efficiency index	90.06	±	6.88***	94.73	±	4.85
Sleep latency (min)	24.31	±	16.38	18.04	±	12.89
Latency of REM (min)	93.97	±	19.23	98.20	±	42.28
Latency of stage 3 (min)	47.08	±	24.99	37.54	±	21.73
Latency of stage 4 (min)	76.37	±	49.06	69.68	±	63.13
Total duration of stage 1 (%)	5.80	±	3.26	4.17	±	2.73
Total duration of stage 2 (%)	48.97	±	8.11	50.76	±	4.67
Total duration of stages 3+4 (%)	15.08	±	4.53	17.40	±	6.41
Total duration of REM (%)	20.19	±	4.64	22.39	±	5.57
Wake time after sleep onset (%)	7.63	±	7.11**	3.10	±	4.94
Wake time after final awakening (min)	12.72	±	15.92*	1.18	±	12.13

* U=73.5, P=0.04, ** U=68.5, P=0.025, *** U=64.5, P=0.015

reaction time between good and poor sleepers, but in the study of Hauri[21] insomniacs performed worse than controls on reaction time and in the insomniac group in this study the reaction time was shorter than in controls. Perhaps the scoring of insomnia severity with a valid scale is needed for comparison of data from different centers. The mean number of presentations necessary to memorize all items of the Selective Reminding Test was greater in patients than in the control group, indicating that their learning ability was disturbed. The degree of learning disturbance correlated with the score on the Athens Insomnia Scale but no association between the Selective Reminding Test and the results of PSG was observed.

The hypothesis on 24-hour hyperarousal in primary insomnia was confirmed in the present study. It can be also concluded that poor sleep alone is not the basis of such secondary manifestations as impaired daytime functioning. Moreover, the Athens Insomnia Scale was judged to be a sensitive clinical psychometric tool which can be used to refine the description of insomnia populations.

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ΠΕΡΙΛΗΨΗ

Ψυχοφυσιολογικές συνιστώσες της πρωτοπαθούς αϋπνίας

S. NIEMCEWICZ, W. SZELENBERGER

Department of Psychiatry, Medical University of Warsaw, Warsaw, Poland

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ΣΚΟΠΟΣ Σε αϋπνικούς ασθενείς έχουν παρατηρηθεί ψυχοφυσιολογικές ανωμαλίες ενδεικτικές υπερεγρήγορσης. Τα ευρήματα αυτά έχουν οδηγήσει στην υπόθεση ότι η πρωτοπαθής αϋπνία είναι αποτέλεσμα 24ωρης διαταραχής της εγρήγορσης. Η παρούσα μελέτη αποσκοπεί στον έλεγχο της υπόθεσης αυτής. **ΥΛΙΚΟ-ΜΕΘΟΔΟΣ** Εξετάστηκαν οι διαφορές σε ψυχοφυσιολογικές δοκιμασίες μεταξύ 16 ασθενών με πρωτοπαθή αϋπνία και 16 μαρτύρων αντίστοιχης ηλικίας, φύλου και εκπαίδευσης προς τους ασθενείς. Ασθενείς και μάρτυρες υποβλήθησαν σε υπνοπολυγραφική μελέτη καθόλη τη διάρκεια της νύκτας και πολλαπλή δοκιμασία λανθάνοντος χρόνου του ύπνου (MSLT) κατά τη διάρκεια της ημέρας. Η εκτίμηση του υποκειμενικού βαθμού της αϋπνίας και της υπερεγρήγορσης έγινε μέσω της Κλίμακας Αϋπνίας Αθηνών (AIS) και της Κλίμακας Υπερεγρήγορσης (HS), αντίστοιχα. Για την επί επτά ημέρες συνεχή καταγραφή της σωματικής κινητικότητας χρησιμοποιήθηκαν

ακτιγράφοι καρπού. Το επίπεδο ημερήσιας λειτουργικότητας μετρήθηκε με τη Δοκιμασία Επιλεκτικής Μνημονικής Ανάκλησης (SRT) και τη Δοκιμασία Συνεχούς Προσοχής (CAT). **ΑΠΟΤΕΛΕΣΜΑΤΑ** Οι πάσχοντες από αϋπνία, σε σύγκριση με τους μάρτυρες, εμφάνισαν κατά τη διάρκεια της νύκτας αυξημένη κινητική δραστηριότητα, μειωμένη επάρκεια του ύπνου και εντονότερο ηλεκτροεγκεφαλογραφικό αποσυγχρονισμό κατά τον ύπνο βραδέων κυμάτων. Ο βαθμός εγρήγορσης των ασθενών βρέθηκε αυξημένος και κατά τη διάρκεια της ημέρας. Η βαθμολογία της Κλίμακας Υπερεγρήγορσης ήταν υψηλότερη στην ομάδα των ασθενών και παρουσίαζε στατιστικώς σημαντική συσχέτιση με τη βαθμολογία της Κλίμακας Αϋπνίας Αθηνών στο σύνολο του δείγματος. Ο λανθάνων χρόνος του ύπνου σε όλες τις δοκιμασίες MSLT δεν διέφερε μεταξύ ασθενών και μαρτύρων, μολονότι οι ασθενείς ανέφεραν ότι δεν ήταν ικανοποιημένοι από το νυκτερινό ύπνο τους. Η ημερήσια λειτουργικότητα των ασθενών ήταν μειωμένη, όπως έδειξε η Δοκιμασία Επιλεκτικής Μνημονικής Ανάκλησης, ο βαθμός δε της μείωσης αυτής παρουσίαζε συσχέτιση με τη βαθμολογία της Κλίμακας Αϋπνίας Αθηνών, όχι όμως με την επάρκεια του ύπνου και τις άλλες υπνοπολυγραφικές παραμέτρους. **ΣΥΜΠΕΡΑΣΜΑΤΑ** (α) Τα αποτελέσματα επιβεβαιώνουν ύπαρξη ψυχοφυσιολογικής υπερεγρήγορσης καθόλο το 24ωρο στην πρωτοπαθή αϋπνία, (β) η διαταραχή του νυκτερινού ύπνου καθεαυτή δεν αποτελεί την αιτία για μειωμένη ημερήσια λειτουργικότητα, (γ) η Κλίμακα Αϋπνίας Αθηνών είναι ευαίσθητο κλινικό ψυχομετρικό εργαλείο και μπορεί να χρησιμοποιηθεί ευχερώς για την καλύτερη κατανόηση των χαρακτηριστικών του πληθυσμού των ασθενών με αϋπνία.

Λέξεις ευρετηρίου: Διαταραχή λειτουργικότητας, Εγκεφαλογράφημα ύπνου, Πολλαπλή δοκιμασία λανθάνοντος χρόνου ύπνου, Πρωτοπαθής αϋπνία, Υπερεγρήγορση

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Corresponding author:

W. Szelenberger, Department of Psychiatry, Medical University of Warsaw, Nowowiejska 27, 00–665 Warsaw, Poland