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Sleep apnea in childhood migraine

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Abstract In our previous study we found a high prevalence of disordered sleep breathing in migraine children vs. controls. Since no quantitative studies about sleep respiratory disorders have been carried out in migraine children, we performed a polysomnographic (PSG) study in 10 migraine patients (7 boys, 3 girls; mean age 8.11 years, range, 5.8–14.5) attending the Headache Center of our department, to evaluate the presence of sleep apnea. Mothers completed a headache diary and a sleep diary for at least 1 month and filled out a sleep questionnaire. PSG data showed a normal sleep architecture in 3 cases, an insomnia pattern in 2, a reduction of slow wave sleep

in 3 and a reduction of REM sleep in 2. Respiratory analysis revealed that 2 of 10 patients had obstructive sleep apnea. These 2 patients presented habitual snoring and associated sleep disturbances such as restless sleep and hypnic jerks. Sleep apnea may be a subtle and often undiagnosed symptom in several migraine patients. The report of habitual snoring associated with other sleep disturbances such as restless sleep and other parasomnias may be a sign of sleep apnea in migraine children.

Key words Migraine • Sleep • Sleep apnea • Children

Introduction

In the last years several reports, based on clinical observations and experimental data, highlighted the relationship between sleep and headache: some headaches occur during or after sleep and some migraine syndromes are sleep-phase related. The increase and/or the reduction of sleep time and a poor sleep quality may cause headache or trigger the attacks; on the contrary, sleep may be efficacious to terminate the headache attack [1, 2].

Clinical data showed that headache patients are more liable to sleep disorders: both in adults and in children a strong relationship between headache and specific sleep disorders such as sleepwalking, sleep terror, enuresis and sleep apnea has been demonstrated [3–6]. In a previous study we found a high prevalence of sleep disturbances, especially

concerning the areas of sleep quality, night awakenings, nocturnal symptoms, mainly parasomnias and sleep breathing disorders and daytime sleepiness in headache children [7].

On the other hand, headache may be the presenting symptom of several sleep disorders. Dexter [8] showed that 36%–58% of patients with sleep apnea complaint of morning headache and that headache may be the presenting complaint of sleep apnea syndrome. Kudrow et al. [9] found a 60% prevalence of sleep apnea among ten patients with cluster headache. Paiva et al. [10] demonstrated that in several cases of adult migraine, after a polysomnographic (PSG) study, diagnosis has been changed in half of the patients and the treatment of the underlying clinical condition greatly improved the headache. In this study, 13 of 25 patients were misdiagnosed as primary headache: after the PSG study the diagnosis was changed to periodic sleep limb movement in 4 cases, fibromyalgia syndrome in 6 cases and

obstructive sleep apnea syndrome in 3 cases. This report raised the possibility of similar conditions in pediatric patients. Since periodic limb movements and fibromyalgia syndrome are uncommon in childhood and adolescence, we decided to analyze the respiratory pattern in migraine subjects, also because of the high prevalence of disordered sleep breathing in these children vs. controls: snoring (21.9% vs. 14.7%), sleep breathing difficulties (16.5% vs. 6.8%) and sleep apnea (6.1% vs. 1.0%) [7]. Since no quantitative studies of sleep have been carried out in children and adolescents affected by migraine in order to rule out other diagnoses, we performed a polysomnographic study to evaluate the presence of sleep apnea in migraine patients.

Materials and methods

We investigated 10 migraine patients (7 boys, 3 girls; mean age 8.11 years, range 5.8–14.5 years) attending the Headache Center of our department. The evaluation for all subjects included a complete medical history and a physical examination. A semi-structured interview was used to collect anamnestic and clinical data and information about each child's headache characteristics, such as frequency, intensity, duration and related symptoms.

Laboratory, neurophysiological investigations and neuroimaging, when needed, were used to evaluate the presence of central nervous system diseases. At follow-up, the diagnosis was confirmed according to IHS criteria. The body mass index (BMI) was also evaluated for each child. Mothers and children completed for at least 1 month a headache diary and a sleep diary. Moreover, mothers were asked to fill out a sleep questionnaire.

Then, the patients underwent a PSG study in the Sleep Laboratory of our department after a one-night adaptation in order to avoid the "first night effect".

Two channel (C3-A2 and O2-A1) electroencephalography, left and right electro-oculography, chin electromyography (EMG), electrocardiography (ECG), respiratory flow, abdominal respiratory effort and oxygen saturation were used for scoring sleep and analyzing respiratory disorders. Gold-plated surface electrodes were applied to the scalp using the collodium technique according to the International 10-20 System. Sleep recordings started at the patient's habitual bedtime and continued until spontaneous awakening. Records were visually scored in 30 seconds time according to the standard criteria of Rechtschaffen and Kales [11].

Sleep histograms and sleep/wake statistics including total sleep time, sleep efficiency, sleep latency, REM latency, number of awakenings and the percentage of time spent in each stage of sleep were carried out by computer based on visual scoring.

Apnea was defined as the cessation of airflow for at least 10 seconds. Apnea count was made by direct observation and sleep apnea was classified as either obstructive, central or mixed: (a) obstructive apnea, absence of oronasal airflow with continued respiratory effort lasting longer than two respiratory cycle times; (b) central apnea, the cessation of respiratory effort lasting at least two respiratory cycle

times; and (c) mixed apnea, starts as central apnea but then compares respiratory effort in absence of airflow. The minimum criteria for definition of obstructive sleep apnea syndrome was the presence of at least 5 apnea events per hour, corresponding to an apnea index (number of apneas per hour) > 5 , whereas some authors consider an apnea index < 10 to be normal [12, 13]. However in children criteria are different: the 10-second duration criteria is not applicable and even one obstructive apnea event per hour is considered a pathologic condition [14]. For this study, we scored as obstructive apnea any event of cessation of airflow lasting at least 5 seconds and we considered an obstructive apnea index higher than 1 to be pathologic according to Marcus et al.'s criteria [15].

Regarding central apneas, few studies have been carried out in children and adolescents, and the normality criteria are difficult to define. Carskadon et al. [16] studied 22 children aged 9-13 years and showed that central apneas of more than 5-s duration occur frequently while those lasting more than 15 s are rare; fewer than three central apneas were seen per hour of sleep. Marcus et al. suggested to consider them abnormal when they are associated with desaturation below 90%, irrespective of the length of the apnea. However, in this study central apneas rarely appeared to cause desaturation [15]. Therefore, due to the lack of clearly defined normal criteria, for the purpose of this study we did not consider central apneas.

Results

Headache diaries showed, in the last month, at least one migraine attack per week in 9 patients and at least one migraine attack per month in 1 patient. Sleep diaries showed a bedtime later than 11 p.m. in 5 cases, daytime napping in 3 subjects and an irregular schedule (bedtime and wake-up time that changed more than one hour during school days) in 6 subjects. Sleep questionnaires showed the presence of snoring in 4 subjects; associated sleep disturbances were restless sleep, sleepwalking, enuresis and hypnic jerks.

None of the subjects had migraine attacks in the 2 preceding days and during the night of the PSG study. The patient characteristics and the polysomnographic data are shown in Table 1. Among the 10 patients, 3 had a normal sleep architecture, 2 showed an insomnia pattern (increase of awakenings and wake after sleep onset), 3 had a reduction of slow wave sleep, and 2 showed a reduction of REM sleep without the first REM period and an increased REM latency.

Respiratory analysis revealed that 2 of 10 patients had obstructive sleep apnea. These 2 patients reported to have habitual snoring and also showed associated sleep disturbances such as restless sleep and hypnic jerks. At the PSG evaluation, both patients showed an increase in number of stage shifts, indicating an alteration of sleep continuity. All patients did not show significant desaturations during PSG.

The BMI was normal for all the children and in particular for the 2 migraineurs presenting sleep apnea.

Table 1 Subjects' characteristics, polysomnographic (PSG) data and sleep apnea diagnosis

Patient	Sex	Age (years)	BMI (kg/m ²)	Migraine frequency	Snoring	Associated sleep disturbances	PSG	Apnea index
1	M	6.1	20.3	1 per week	Yes	Restless sleep	↓ REM, ↑ MT	0.5
2	M	6.5	19.7	1 per month	No	Sleepwalking	Normal	0.8
3	M	8.8	20.4	1 per week	No	–	Normal	0.4
4	F	11.4	19.9	1 per week	Yes	Restless sleep, sleeptalking	↓ REM, ↑ stage shifts	1.8
5	M	5.8	13.3	1 per week	Yes	Hypnic jerks, restless sleep, enuresis	↑ Stage shifts, ↓ SWS	5.5
6	F	14.5	22.4	1 per week	No	–	↓ SWS	0.3
7	M	9.4	21.2	1 per week	No	Nightwakings, restless sleep	Insomnia	0
8	M	10.3	19.4	1 per week	No	Confusional arousals	↓ SWS	0
9	M	9.5	15.2	1 per week	No	–	Normal	0.7
10	F	7.9	20.3	1 per week	Yes	Sleepwalking	Insomnia, ↑ NREM	0.8

BMI, body mass index; SWS, slow wave sleep; MT, movement time

Discussion

Our study represents the first attempt to evaluate the presence of sleep apnea as a causative or associated factor of migraine in children. Some limitations of the study should be noted. Due to the small sample size we cannot clearly evaluate this relationship and we can only suggest that some clinical signs be taken into account and may indicate the possibility of sleep apnea in a migraine child. Also the gender distribution, with an over-representation of boys, may represent a bias of the study. Nevertheless, we should consider that, while the prevalence of sleep apnea in adults showed a M:F ratio of 8:1, in children this ratio is 1:1. Therefore gender is not a factor affecting the results of our study [17].

BMI was within normal range in our patients; we should consider that associated obesity is not a main feature of sleep apnea in children while it is present in the majority of sleep apneic adults [17].

These preliminary data suggest that sleep apnea is a subtle and often undiagnosed symptom in several migraine patients; the apnea index in our sample was not very high, but it was sufficient for the diagnosis in children [15]. Although parents could not be aware of this symptom in their children, the report of habitual snoring associated with other sleep disturbances such as restless sleep and other parasomnias could be a reliable marker of sleep apnea in migraine children.

Several reports have linked sleep apnea with the occurrence of morning headache: in the study by Guilleminault [18] 36% of patients with sleep apnea complained of morning headache that appeared gradually over years, while in the study by Dexter [8] headache was the presenting complaint of sleep apnea. In this report symptoms associated with sleep apnea were snoring (72%), severe to moderate obesity (54%), excessive daytime sleepiness (36%), enuresis

(18%) and restless sleep (100%). In all our patients with sleep apnea, we found an association with restless sleep and snoring; excessive daytime sleepiness was not the main complaint because children affected by sleep breathing difficulties often showed hyperactivity or attention deficit [19].

Other studies reported the presence of sleep apnea in 22% of cases of chronic recurring mixed type headaches and in 25% of cluster headaches [4].

In migraine patients, either obstructive or central sleep apnea has been found. In Paiva et al.'s [10] study, 3 patients had obstructive sleep apnea syndrome among 13 migrainous patients. Kudrow et al. showed evidence of sleep apnea in 6 of 10 cluster headache patients: 4 of these patients had central apnea, and 2 obstructive apnea [9].

Several reports showed that migraine attacks in sleep apnea patients occur usually during nighttime or early morning [18, 20, 21]. There is a variety of proposed mechanisms to explain the increased incidence of headache in sleep apnea patients: hypercarbia, hypoxemia, altered cerebral blood flow, increased intracranial pressure, alterations in sympathetic nerve activity and increases in blood pressure secondary to multiple arousals [22]. However, it seems that early-morning headache is not a specific symptom to sleep apnea [21]. In fact, patients with abnormal sleep complained of early morning headache even more frequently than patients with sleep apnea. These data confirm the hypothesis that migraine attacks are secondary to sleep disruption rather than due to sleep apnea by itself. Due to the multifactorial genesis of migraine in children, the pathogenetic mechanism is difficult to clarify. Future studies may elucidate the character of headache in these patients and address the question if sleep apnea is the primary event leading to headache or if sleep disruption (that could be linked to several other sleep disorders) is the main pathogenetic factor for migraine.

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