Clinical and polysomnographic features of children evaluated with polysomnography in pediatric sleep laboratory

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Abstract

Aim: Sleep disordered breathing is a common problem in childhood that encompasses a spectrum of disorders extending from primary snoring to obstructive sleep apnea. This study aims to investigate the results of children undergoing evaluation with polysomnography in the sleep laboratory of a tertiary care hospital.

Material and Methods: Demographic and clinical features as well as sleep associated symptoms, scores of pediatric sleep questionnaire and Pittsburgh sleep quality index and polysomnography results are retrospectively evaluated.

Results: Totally 131 patients were evaluated, of which 47.3% (n=62) were females and 52.7% (n=69) were males. Mean age was 101.85±59.15 months at the time of the study. Fifty percent (n=59) of patients complained of snoring and 43.7% (n=52) of patients complained of apnea during sleep. Mean obstructive hypopnea-apnea index was 5.12±11.72. Mean obstructive hypopnea-apnea index of snorers (6.93±13.53) was significantly higher than the mean obstructive hypopnea-apnea index of nonsnorers (2.32±5.43) (p=0.011). Mean obstructive hypopnea-apnea index of patients experiencing apnea during sleep (7.52±14.25) was significantly higher than the mean obstructive hypopnea-apnea index of the children who do not experience apnea (2.61±5.84) (p=0.008). No significant correlation was observed between obstructive hypopnea-apnea index and scores of pediatric sleep questionnaire and Pittsburgh sleep quality index. The prevalence of obstructive sleep apnea was 33.6% (n=44). Forty nine patients (39.8%) were treated after polysomnography. Frequently suggested treatment options were noninvasive mechanical ventilation (n=23, 46.9%), intranasal steroid (n=15, 30.6%), montelukast (n=11, 22.4%) and adenotonsillectomy (n=9, 18.4%).

Conclusions: Polysomnography is the gold standard in the diagnosis of sleep disordered breathing in children. Pediatricians should be able to recognize early signs and symptoms of sleep disordered breathing and refer the patients in risk to centers where evaluation with polysomnography is available. (Turk Pediatr Ars 2017; 52: 23-9)

Keywords: Child, obstructive sleep apnea, polysomnography, sleep disordered breathing

Introduction

Sleep-disordered breathing (SDB) is a common problem in children that occurs in relation with increased resistance in the upper airways during sleep, encompassing conditions ranging from simple snoring to obstructive sleep apnea (OSA) (1, 2). In studies conducted with children of different age groups, the prevalence of primary snoring has been reported to range between 1.5% and 27.6%, and the prevalence of OSA has been reported to range between 1.2% and 5.7% (3). It is known that conditions including adenotonsillar hypertrophy, allergic

rhinitis, obesity, mid-line facial disorders, mandibular hypoplasia, cerebral palsy, Down syndrome, Prader-Willi syndrome, and prematurity constitute a risk in terms of OSA in childhood (4). When SDB is not treated, it may result in severe complications including growth and developmental delay, increased systemic blood pressure, pulmonary hypertension, and cor pulmonale because of recurrent hypoxia. In addition, SDB leads to learning difficulties, behavioral disorders, and hyperactivity by acting on cognitive functions in children (4). Early diagnosis and treatment is very important to avoid all these outcomes. In the diagnosis, polysomnography (PSG) is used

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in addition to detailed history and physical examination. The American Academy of Pediatrics recommends that all children should be interrogated in terms of snoring during routine health controls and examined in terms of OSA findings and assessment with PSG should be performed, if chronic snoring is present and signs of OSA are found (5). In this study, we aimed to retrospectively examine the results of children who were assessed using polysomnography in the Pediatric Sleep Laboratory in our Medical Faculty Hospital.

Material and Methods

The demographic and clinical properties, symptoms related with sleep, the Children's Sleep Habit Questionnaire (CSHQ) scores, Pittsburgh sleep quality Index (PSQI), and PSG results of the children who were evaluated with PSG in the Child Sleep Laboratory between March 2012 and January 2014 were evaluated retrospectively. Ethics committee approval was obtained from the ethics committee of our university (15.07.2016-09.2016.410). Written informed consent was obtained from the parents of the patients.

Demographic and clinical properties

The patient's ages, sexes, reasons for assessment with PSG, underlying diagnoses if present, referral divisions, symptoms including snoring and apnea during sleep, and treatment methods performed were examined.

The Children's Sleep Habit Questionnaire

The Children's Sleep Habit Questionnaire is a questionnaire composed of 22 questions, which was developed by Chervin et al. (16), that is used in evaluation of SDB in children aged between 2 and 18 years. The reliability and validity study of this questionnaire for Turkish children was performed by Yüksel et al. (7). The questions are answered by the families. The score ranges between 0 and 1. It has been found that values above 0.33 are efficient in specifying OSA in children. Therefore, values above 0.33 have been defined as being associated with SDB.

The Pittsburgh Sleep Quality Index

The Turkish reliability and validity study of this questionnaire, which was developed by Buysse et al. (8) in 1989, was performed by Ağargün et al. (9). This questionnaire includes 24 questions that evaluate sleep quality and sleep disorder in the last one month. The total score ranges between 0 and 21 and scores above 5 indicate poor sleep quality.

Polysomnographic assessment:

PSG was performed in the Child Sleep Laboratory of our hospital throughout the night (Alice 5, Respirationics, Murrysville, PA). The patients' obstructive hypopnea-apnea indices (OHAI) were recorded as normal, mild/moderate/severe OSA.

Statistical analysis

Analyses of the data were performed using the Statistical Package for the Social Sciences package program 16.0 (SPSS Inc.; Chicago, IL, ABD). The continuous values among descriptive statistics are expressed as mean $\pm$ standard deviation (SS). The frequency analyses are expressed as number (n) and percentage (%). The Mann-Whitney U test was used for comparison of mean values that did not show normal distribution. Correlation analyses were performed using Spearman's correlation analysis. A p value of <0.05 was considered statistically significant.

Results

Sixty-two (47.3%) of the 131 patients who underwent polysomnography between the dates specified were female and 69 (52.7%) were male. The mean age was found as 101.85 $\pm$ 59.15 months. Fifty-nine (50%) of the patients had chronic snoring, 52 (43.7%) had apnea during sleep, and 3 (2.5%) had daytime somnolence. The Division of Pediatric Endocrinology (20.8%) was the second leading division that referred children for sleep studies, followed by the division of Pediatric Chest Diseases (67.7%). The mean CSHQ and PSQI scores of the patients are shown in Table 1 and PSG indications are shown in Table 2. One hundred four of 131 patient answered the CSHQ and 82 answered the PSQI.

The mean obstructive hypopnea-apnea index (OHAI) was found as 5.12 $\pm$ 11.72. The mean OHAI was significantly higher (6.93 $\pm$ 13.53) in patients with symptoms of chronic snoring compared with those with no chronic snoring (2.32 $\pm$ 5.43) (p=0.011) (Table 3). In addition, the mean OHAI was significantly higher in patients who had apnea during sleep (7.52 $\pm$ 14.25) compared with those without sleep apnea (2.61 $\pm$ 5.84) (p=0.008). According to the Children's Sleep Habit Questionnaire, the mean OHAI was higher in subjects who had SDB (5.28 $\pm$ 12.99) compared with those without SDB (2.78 $\pm$ 5.67); however, the difference was not statistically significant (p=0.55). According to the Pittsburgh Sleep Quality Index, the mean OHAI was higher in subjects who had poor sleep quality (7.22 $\pm$ 14.80) compared with subjects with good sleep quality (1.87 $\pm$ 4.65), but the difference was not

statistically significant ($p=0.11$). No correlation was observed between the mean OHAI values and CSHQ and PSQI scores.

The polysomnography results are shown in Table 4. The frequency of obstructive sleep apnea was found as 33.6% ($n=44$). Among the patients who underwent polysomnography because of chronic snoring and apnea, mild OSA was found in five patients, moderate

Table 1. Children's Sleep Habit Questionnaire and Pittsburgh Sleep Quality Index Scores

Children's Sleep Habit Questionnaire (mean±standard deviation)	0.39±0.22
Sleep-disordered breathing (CSHQ >0.33) % (n)	58.7 (61)
Pittsburgh sleep quality index (Mean±Standard Deviation)	5.70±3.47
Poor sleep quality, % (n)	47.6 (39)
Goow sleep quality, % (n)	52.4 (43)

CSHQ: Children's Sleep Habit Questionnaire

Table 2. Polysomnography Indications

Polysomnography indications	% (n)
Chronic snoring and apnea	31.3 (41)
Neuromuscular diseases	10.7 (14)
Skeletal anomalies	10.7 (14)
Congenital lung diseases	9.9 (13)
Obesity	7.6 (10)
Congenital anomalies	6.9 (9)
Pycnodysostosis	4.6 (6)
Noninvasive mechanical ventilation titration	4.6 (6)
Other causes	13.7 (18)

Table 3. The Mean Obstructive Hypopnea-apnea Index Scores of the Patients

	OHAI	p ^a
Chronic snoring present	6.93±13.53 (0.77; 0.00-8.57)	0.011
Chronic snoring absent	2.32±5.43 (0.00; 0.00-1.57)	
Apnea during sleep present	7.52±14.25 (1.62; 0.00-8.57)	0.008
Apnea during sleep absent	2.61±5.84 (0.00; 0.00-1.54)	
Sleep-disordered breathing according to CSHQ present	5.28±12.99 (0.25; 0.00-3.03)	0.55
Sleep-disordered breathing according to CSHQ absent	2.78±5.67 (0.09; 0.00-2.02)	
Poor sleep quality according to PSQI	7.22±14.80 (0.42; 0.00-9.57)	0.11
Good sleep quality according to PSQI	1.87±4.65 (0.13; 0.00-1.18)	

CSHQ: children's sleep habit questionnaire; PSQI: Pittsburgh sleep quality index; OHAI: obstructive hypopnea-apnea index
OHAI values are expressed as mean±standard deviation (median; 25th percentile-75th percentile).

^aMann-Whitney U test.

OSA was found in six patients, and severe OSA was found in five patients. PSG was found as normal in only one of the children who were obese; severe OSA was found in five of these children, mild OSA was found in one, hypoventilation was found in two, and central apnea was found in one. The detailed diagnoses of the patients who were found to have obstructive sleep apnea are shown in Table 5. Treatment was initiated in 39.8% of the patients ($n=49$) following the study. The most commonly recommended treatment methods included noninvasive mechanical ventilation (NIMV) ($n=23$; 46.9%), nasal steroid ($n=15$; 30.6%), montelukast ($n=11$; 22.4%), and adenotonsillectomy ($n=9$; 18.4%) (Figure 1).

Discussion

In our study, snoring during sleep and apnea were found in approximately half of the patients who were referred to the Child Sleep laboratory for PSG. In pre-

Figure 1. Therapies administered following polysomnography. The percentages inside brackets express the percentages among all patients who received treatment. The total is not added up to 100% because some patients received multiple therapies
NIMV: noninvasive mechanical ventilation

Table 4. Polysomnography Results

Polysomnography results	% (n)
Normal	38.9 (51)
Mild OSA	9.9 (13)
Moderate OSA	6.1 (8)
Severe OSA	17.6 (23)
Primary snoring	6.9 (9)
Hypoventilation	3.1 (4)
Central sleep apnea	2.2 (3)
Hypoxia	6.1 (8)
Inappropriate study	9.2 (12)

OSA: obstructive sleep apnea

Table 5. Diagnoses of Patients with Obstructive Sleep Apnea

Present diagnoses of the patients	Mild OSA (n)	Moderate OSA (n)	Severe OSA (n)
Obesity	1	0	5
Snoring	5	6	5
Chronic lung disease	1	0	0
Neuromuscular disease	0	1	2
Congenital anomaly	1	0	2
Skeletal anomalies	1	0	1
Epiglottitis stenosis	1	0	0
Pyknosis	2	0	2
Prader-Willi syndrome	0	1	2
Mucopolysaccharidoses	0	0	2
Tracheostomy and noninvasive ventilation titration	1	0	1

OSA: obstructive sleep apnea

vious studies conducted in our country, the frequency of snoring was reported as 7% between the ages of 5 and 13 years, and 4% between the ages of 12 and 17 years (10, 11). The reason that this frequency was found higher in our study was related with the fact that most of the children who were referred had chronic diseases because our hospital is a tertiary care hospital, and our study population did not reflect the general pediatric population. Snoring may be the earliest sign of OSA syndrome. All children should be interrogated in terms of snoring during routine healthcare visits. In addition, presence of symptoms including apnea during sleep, secondary enuresis, cyanosis, daytime somnolence, and learning difficulties, and physical examination findings including obesity, tonsillar hypertrophy, adenoid

facies, micrognathia or retrognathia, highly arched palate, growth and developmental delay, and hypertension should warn pediatricians in terms of OSA syndrome. The American Academy of Pediatrics recommends that patients with these signs and symptoms should be evaluated with PSG (5). Therefore, awareness of pediatricians in terms of the signs and symptoms of OSA syndrome actually constitutes the first step in the management of these patients.

Polysomnography is considered gold standard in the diagnosis of SDB (1, 3, 12). However, other diagnostic methods are being investigated because PSG can only be performed in a limited number of centers. Although none of the other diagnostic methods replaces PSG, these methods may be used when opportunities are limited (4). In a study conducted by Preutthipan et al. (13), in which various symptoms were interrogated, it was shown that history alone was insufficient for making the diagnosis of OSA syndrome. It has been reported that CSHQ developed by Chervin et al. (14) could predict the diagnosis of OSA syndrome. In a study conducted by Kang et al. (15), it was reported that evaluation of history in association with physical examination findings including tonsillar and adenoid size and anatomic features including obesity would be useful in the diagnosis of OSA. However, use of history, physical examination findings, and questionnaires have been recommended as a screening tool rather than a diagnostic tool (3). The scores of CSHQ and PSQI, which we used in our study, were not found correlated with the patients' OHAI values.

OSA was found in about one third of the participants in our study. This rate is substantially higher compared with previous studies (3). However, the children included in our study do not reflect the general pediatric population as mentioned earlier. The presence of underlying chronic conditions including lung diseases, skeletal malformations, obesity, and congenital anomalies in the children in our study was the reason for the higher rate of OSA compared with rates found in the general pediatric population, which ranged between 1.2% and 5.7%. The previous studies in the literature that showed increased prevalence of OSA in children with various chronic diseases supports this view. For example, the prevalence of OSA has been found as 40% in children with chronic renal failure (16). The prevalence of OSA has been reported as 52% in patients with primary ciliary dyskinesia and 19% in patients with bronchiolitis obliterans (17, 18). In the

follow-up of children with chronic diseases, accompanying sleep-related symptoms may be missed by both families and physicians while the attention is focused on the primary disease. Undiagnosed OSA may further impair the quality of life in children whose quality of life is already impaired because of chronic disease or may lead to occurrence of complications related with OSA. Therefore, interrogation of symptoms including snoring and apnea during sleep, which might suggest SDB, is very important in the follow-up of these patients, as in the follow-up of healthy children.

It is known that SDB is related with epilepsy, asthma, and obesity, which are observed commonly in childhood. Obstructive sleep apnea is observed more commonly in children with severe resistant epilepsy compared with those with mild epilepsy, and treatment of OSA enables better control of seizures (19, 20). The prevalence of OSA is higher in children with poorly controlled asthma and adenotonsillectomy provides control of asthma attacks (21). It has been shown that both SDB and short sleep period increase the risk of obesity in children (22, 23). In contrast, some publications have shown that obesity is a risk factor for development of OSA (24, 25). In our study, PSG was found normal in only one of the children who had obesity, and SDB was found in the other children. In children with obesity who had undergone tonsillectomy for treatment of OSA syndrome, assessment after tonsillectomy revealed that the signs of OSA improved, but less improvement was observed compared with non-obese children (26). In addition, hypertension, which is one of the complications of OSA, showed less improvement after tonsillectomy in obese patients compared with non-obese patients (27). These studies show that adenotonsillectomy alone may not be sufficient in the treatment of OSA-related complications in obese children. Weight reduction may substantially decrease the findings of OSA in these patients. In a study conducted by Kalra et al. (28), a marked improvement occurred in the findings of OSA after surgery with weight reduction in obese adolescents who underwent bariatric surgery.

Treatment was administered in approximately 40% of the patients who were assessed with polysomnography. In our study, NIMV was the most commonly used treatment method. This was followed by nasal steroid, montelukast, and adenotonsillectomy. Adenotonsillectomy is recommended as the first-line therapy in children with OSA and adenotonsillar hypertrophy (3). However, other treatment methods including NIMV, montelukast, and nasal steroid are recommended in children who do not

have adenotonsillar hypertrophy or who are risky in terms of surgery (3). The most commonly used method in this study was NIMV instead of adenotonsillectomy, because most of the included patients had chronic problems. Adherence to treatment is very important in terms of treatment success in noninvasive mechanical ventilation. Therefore, NIMV should not be recommended in cases where adenotonsillectomy is the first option, although its success in the treatment of OSA syndrome has been demonstrated (3). In patients in whom adenotonsillectomy is unsuccessful, NIMV is an efficient method in the treatment of OSA (29). In addition, it has been used efficiently in children with obesity, facial and skull deformities, and trisomy 21 (30). Among other treatment methods, nasal steroid and montelukast have been shown to be efficient, especially in non-obese children with mild OSA syndrome and recommended as an alternative to adenotonsillectomy (31, 32).

The patients' long-term responses to treatment and the prevalence of complications could not be evaluated because our study was a retrospective study. In addition, the criteria for different treatment options could not be demonstrated clearly because the diagnoses were variable and the number of patients for each diagnosis was low. Elucidation of these limitations is targeted with prospective studies.

When obstructive sleep apnea is not treated, it may result in severe complications including growth and developmental delay, disturbance in cognitive functions, hypertension, right heart failure, and even cor pulmonale (33). In a recent study, it was shown that psychosocial disturbances could continue in these children even if OSA was treated (34). Therefore, early diagnosis and treatment of OSA is very important.

In conclusion, SDB may be frequently observed in childhood, especially in children with chronic diseases. Pediatricians should be aware of the signs and symptoms indicating OSA, interrogate children in this regard during routine follow-up visits, and refer patients to centers where PSG can be performed in suspicious cases.

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Informed Consent: Written informed consent was obtained from parents for polysomnography.

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Kaynaklar

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