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PEDIATRIC OSAS TREATED WITH ADENOIDECTOMY: A COHORT STUDY CONDUCTED AT THE UNIVERSITY HOSPITAL OF PALERMO, ITALY

Donatella Marchese [1], Rosalia Gargano [2], Francesco Dispenza [1], Federico Sireci [1], Carmelo Saraniti [1], Francesco Riggio [1], Francesco Lorusso [1], Marco Pollarolo [2], Riccardo Anzalone [2], Salvatore Gallina [2]

1. Department of Otolaryngology, Head and Neck Surgery, University Hospital of Palermo, Palermo, Italy
2. Section of Otorhinolaryngology, Department of Biomedicine, Neurosciences and Advanced Diagnostic, University of Palermo, Palermo, Italy;

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ABSTRACT

The incidence of Obstructive Sleep Apnea Syndrome (OSAS) in the pediatric population is about 2%. The diagnosis is based on the employment of questionnaires, and polysomnography (PSG) that is the gold standard also among children. The PSG allows to classify OSAS as mild in case of 1< Apnea Hypopnea Index (AHI) ≤5, moderate if 5< AHI ≤10 and severe OSAS when the AHI is >10. If polysomnography is not available, we need alternative diagnostic tests such as nocturnal oximetry studies and respiratory polygraphy. The risk factors identified are different from adults, first tonsillar hypertrophy wins over others. The symptoms and signs described are similar to adult population, but sleep enuresis, neurocognitive impairment and behavioral problems (attention-deficit/hyperactivity disorder, learning problems) are typical of pediatric OSAS.

1. Introduction

Pediatric Obstructive Sleep Apnea Syndrome (OSAS) is defined as a "disorder of breathing during sleep characterized by prolonged partial upper airway obstruction and/or intermittent complete obstruction (obstructive apnea) that disrupts normal ventilation during sleep and normal sleep patterns" (1).
Prevalence is estimated at 1 to 4% in children (2).
The diagnosis is based on the employment of questionnaires, but they are unable to differentiate OSAS from primary snoring. The Polysomnography (PSG) is the Gold Standard to diagnose OSAS. It allows to classify OSAS as mild in case of 1 < AHI ≤ 5, moderate if 5 < AHI ≤ 10 and severe OSAS when the AHI is >10. If polysomnography is not available, we need alternative diagnostic tests such as nocturnal oximetry studies and respiratory polygraphy.
The American Academy of Pediatrics clearly defines the symptoms and risk factors of the disease: symptoms include habitual snoring, sleep disturbances and often also behavioural problems associated with cardiovascular diseases such as hypertension and a general inflammatory state; as regards the risk factors, the most important are adenotonsillar hypertrophy, obesity and neuromuscular diseases (3, 4).
Moreover several genetic syndromes may affect breathing during sleep, particularly those that cause micrognathia, midface hypoplasia, disorders of respiratory control (Arnold-Chiari malformation, Prader- Willi syndrome), as well as miscellaneous and multifactorial disorders (Mucopolysaccharidoses, Down syndrome, sickle cell anaemia) (2, 5).
Although adenotonsillectomy is the most frequently performed intervention for the treatment of pediatric OSAS, one of the topics that is still widely discussed by most authors is the cost-benefit ratio of the removal of the palatine tonsils, which it can cause, especially in children under 3 years of age, post-operative bleeding.
In this context, several authors propose, as a first procedure and in carefully selected patients, an exclusive adenoidectomy intervention that can resolve the obstructive symptoms of the pediatric patient suffering from OSAS (6).
The aim of our study is to evaluate OSAS in pediatric population treated with adenoidectomy only at the University Hospital of Palermo, Italy.

* *Corresponding author*: Marco Pollarolo, *dott.marcopollarolo@gmail.com*
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2. Material and Methods

A prospective cohort study was conducted among patients enrolled attended to the Otolaryngology Unit of the University Hospital of Palermo from June 2015 to July 2017.

The parents signed an informed consent for involvement in this study and they were provided with an information letter for the pediatrics.

The oriented anamnesis was collected, enquiring: frequent snoring (≥3 nights/week), labored breathing during sleep, gasps or snoring noises, episodes of apnea, sleep enuresis (especially secondary enuresis), sleeping in a seated position or with the neck hyperextended, cyanosis, headaches on awakening, neurocognitive impairment and behavioral problems (attention-deficit/hyperactivity disorder, learning problems).

All patients who were included in the study underwent general examination with blood samples, otorhinolaryngology examination with a nasoscopicfiber-optic test (in order to evaluate adenoid tissue) and home sleep test (HST) by *Sibelmed Sleep and Go*. The parameters recorded by the HST are Apnea/Hypopnea index (AHI), number of apneas and hypopneas per hour of sleep; Oxygen desaturation index (ODI), number of desaturation events per hour of sleep; mean of oxygen nocturnal saturation; minimal oxyemoglobin saturation during sleep (NADIR); percentage of sleep with a saturation less than 90%.

Apnea was defined as the absence of nasal airflow for at least 10 seconds, whereas hypopnea was defined as a decrease nasal airflow of 30 % for at least 10 seconds, a 4% decrease in oxygen saturation, or arousal. A decrease of 4% in the mean oxygen desaturation value during sleep was considered to be desaturation, while the mean desaturation value in an hour was represented by ODI.(7)

At the physical examination, the patients appear underweighted or overweighted, with tonsillar hypertrophy, and adenoidal facies, micrognathia/retrognathia and high-arched palate.

We drow up inclusion criteria, as follow:

1. Adenoid hypertrophy: III or IV grade (evaluated by the Cassano-Gelardi Grading Scale)(8)
2. Body Mass Index (BMI) less than 28
3. Absence of skeletal malformations and/or macroglossy
4. Absence of tonsillar hypertrophy more than II grade by Friedman Grading Scale

All selected toddlers underwent adenoydectomy surgery by performing the "cold" dissection technique, under endoscopic control. The hospital discharge occurred 48 hours later. No one was tonsillectomized.

Three months later surgical procedure, all children have been evaluated with a nasoscopicfiber-optic test and HST.

The study was approved by the Palermo Ethical Committee n.1 of the University Hospital of Palermo in the session n.9 of 2015.

3. Results

The study was performed on a sample of 36 patients with a certain diagnosis of OSAS, affected by III-IV grade of adenoid hypertrophy, based on Cassano-Gelardi criteria.

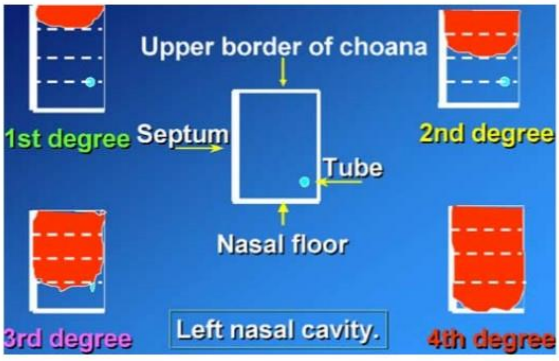

Figure 1. Endoscopic grading of adenoid hypertrophy (left nasal cavity) (8)

Sixteen of them were later excluded because of tonsillar hypertrophy more than II grade ad Friedman Scale at oropharinx. We recruited 20 patients: 9 males and 11 females, aged between 3 and 8 years. Five of them were affected by III grade of adenoid hypertrophy, while fifteen the fourth. All patients who were included in the study underwent adenoidectomy by performing the "cold dissection" technique.

No major surgical complications were recorded during and after the operation.

All data of nocturnal monitoring related to preoperative and three months later conditions are collected in table 1.

The results show a clear improvement in OSAS. Fourteen participants (80%) had mild-moderate OSAS before surgery, while 4 participants (20%) suffered from a severe condition. All patients enrolled in the study showed an improvement in the recorded parameters (Apnea/Hypopnea index (AHI), Oxygen desaturation index (ODI), mean of oxygen nocturnal saturation, minimal oxyemoglobin saturation during sleep (NADIR), percentage of sleep with a saturation less than 90%). In fact, there has been a consistent reduction in pre- and post-operative AHI values (AHI_{pr} = 5,98 ± 3,43; AHI_{po} = 1,45 ± 1,5) and ODI values (ODI_{pr} = 6,4 ± 3,4; ODI_{po} = 1,53 ± 1,48).

Enrollment number	Apnea-Hypopnea Index (AHI)		Oxygen Desaturation Index (ODI)		Average Sat. O_2 (%)		Nadir (%)		Average Sat. O_2 <90% (%)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	2.4	0.8	3.1	0.9	97.6	99.3	89.0	97.6	1.0	0
2	7.1	0.7	7.3	0.8	95.8	99.3	86.0	96.9	2.1	0
3	2.6	0.4	2.7	0.5	97.4	99.4	89.0	97.7	1.2	0
4	11.2	0.9	11.4	0.9	94.3	99.1	84.3	97.9	3.2	0
5	2.8	1.2	2.8	1.3	97.2	98.1	88.0	96.0	1.3	0
6	3.2	0.2	3.3	0.3	97.0	99.7	88.0	98.9	1.4	0
7	8.2	3.1	8.2	3.1	95.7	97.1	85.4	89.0	2.3	1.0
8	11.3	2.9	11.3	3.0	94.2	96.1	84.0	88.0	3.1	2.0
9	4.1	0.4	4.2	0.5	96.9	99.5	87.3	98.8	1.6	0
10	6.9	0.6	7.0	0.8	90.0	99.4	86.0	97.9	1.9	0
11	4.0	0.3	4.1	0.4	97.0	99.6	88.0	98.9	1.5	0
12	12.0	5.9	12.1	5.9	94.6	96.3	85.0	88.0	3.0	2.3
13	2.8	0.8	2.9	0.9	97.3	99.5	90.6	98.7	0	0
14	5.9	0.9	6.0	0.9	96.8	99.5	87.5	97.8	1.8	0
15	3.0	1.2	3.1	1.3	97.2	99.2	88.0	96.1	1.4	0
16	6.4	0.4	6.4	0.5	96.4	99.7	87.2	98.5	1.9	0
17	4.2	0.8	4.4	0.9	96.8	99.4	87.4	98.1	1.8	0
18	12.0	3.9	12.1	4.0	93.9	96.4	84.0	89.0	3.5	1.4
19	2.1	0.7	2.3	0.8	97.9	99.3	90.6	98.2	0	0
20	7.4	2.9	7.5	3.0	96.8	96.9	86.0	88.0	2.0	1.0
Mean	5.98	1.45	6.4	1.53	96.04	98.64	86.9	95.5	1.8	0.38

Table 1. Pre-Post operative results of cardio-respiratory monitoring

4. Discussion

OSAS represents a pathology characterized by nocturnal collapse of the mucous membrane of the upper respiratory tract. Collapse occurs in particular at the level of the oropharynx and hypopharynx, sites characterized by a more easily collapsible mucous lining.

In this sense, nasal respiratory obstruction would seem to play a secondary role in the determinism of the disease. However, nocturnal oral breathing can favor, through multiple mechanisms, the oro-hypopharyngeal collapse.

In fact, the increase in nasal resistance causes a greater contraction of the inspiratory muscles with consequent growth of the negative pressure on the walls of the collapsible area of the upper airways. This often forces the patient to sleep with the mouth open with retroposition of the base of the tongue.(9)

Opening the mouth also determines an unfavorable position of the genioglossus which reduces its efficiency.

Again, the reduction or disappearance of nasal reflexes affects the contractility of the diaphragm and pharyngeal dilator muscles.

In recent years, the role of nitric oxide produced in significant quantities at the level of the nose and paranasal sinuses has been greatly investigated. Its action is expressed not only as an important vasodilator, but also at the level of the pharynx dilator muscles, increasing muscle tone. In this regard, it seems that nasal respiratory obstruction may be associated with a reduction in the production of this substance with a consequent decrease in the tone of the pharyngeal muscles.(10)·(11)

Therefore, a surgical treatment of OSAS aimed exclusively at resolving the nasal obstruction with consequent nocturnal oral breathing is conceivable.

Several studies have been conducted to clarify the effectiveness of adenoidectomy alone in a pediatric patient suffering from OSAS.

Joshua et al performed a cross-sectional study to evaluate the long-term efficacy of adenoidectomy surgery and found 3% adenoid regrowth at 3-5 years and symptom improvement in 74-87% of patients selected in the study.(12)

Some papers have assessed the risk of tonsillectomy surgery following a previous adenoidectomy to treat OSAS. In a retrospective cohort study, Kay et al found that within 5.4 years of the first adenoidectomy, 108 children underwent tonsillectomy. The authors also highlighted how the relative risk of undergoing the second surgery was reduced by 0.83 each year after the adenoidectomy: the probability of undergoing tonsillectomy was higher for children who had undergone adenoidectomy within first 2 years.(13)

Other works have evaluated the effectiveness of adenoidectomy alone to solve obstructive problems and related symptoms of pediatric patients suffering from OSAS.

Reckley et al carried out a systematic review and analysis of the literature to assess whether adenoidectomy can improve obstructive apnea in pediatric patients.(14) Only three selected papers analyzed pre- and post-adenoidectomy outcomes.

Shatz et al reported a 94.9% decrease in AHI values for 15 patients in the 5-12 month age group, while Shintani et al reported a 66.7% decrease in AHI values in 13 pediatric patients.(15)·(16) Robinson et al instead evaluated 19 pediatric patients and showed a reduction in AHI in the age group 3-5 months and 6-11 months of 86.3% and 56.6% respectively.(17) Moreover Shintani et al observed a preoperative O2 saturation level of 80.0% ± 9.5% against a postoperative saturation value of 85.5% ± 6.0%.(16)

The results of our work, as can be seen from the analysis of the previously mentioned works, are in line with what is stated in the literature. The pre- and postoperative results of cardio-respiratory monitoring show that adenoidectomy surgery can lead to a real improvement of the disease.

5. Conclusions

These works show that isolated adenoidectomy surgery can improve the symptoms of pediatric patients suffering from OSAS as measured by the postoperative reduction in AHI values and mean oxygen saturation.

The results we obtained show that in carefully selected patients the intervention of adenoidectomy with preservation of the palatine tonsils can be decisive.

Therefore, in these patients, with an objective examination characterized by exclusive nasopharyngeal pathology, a preoperative sleep endoscopy (DISE) is proposed in order to highlight any other obstructive sites that cannot be viewed with standard methods.

Further studies are certainly needed to analyze a larger number of cases and to compare the different surgical techniques of adenoidectomy in relation to an improvement in the symptoms of pediatric patients with OSAS.

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