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Study of Overnight Pulse Oximetry in Children Posted for Adenotonsillectomy for the Diagnosis of Obstructive Sleep Apnea Syndrome

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ABSTRACT

Loud, frequent and disruptive snoring is the most common nocturnal manifestation of OSAS in children and adolescents. Pulse oximetry has been proposed as an alternative for diagnosing OSAS in children. Present study was aimed to study overnight pulse oximetry in children posted for Adenotonsillectomy, for the diagnosis of obstructive sleep apnea syndrome. Present study was cross-sectional descriptive study conducted in children below 18 years of age admitted with clinically confirmed adenotonsillar enlargement and posted for Adenotonsillectomy. McGill Oximetry Scoring was done to classify the severity of OSA and the need for surgery. A total of 55 children were studied, out of which 33 (60%) were in the age group of 6-10 years. Among 55 children studied, 33 (60%) were males and 22 (40%) were females. Twenty Five children (45%) were obese and 30 children (55%) had normal BMI. Among 55 children, Adenoid facies were present in 28 (51%) cases, 24 (44%) had grade 3 tonsillar hypertrophy and 31 (56 %) had grade 4 tonsillar hypertrophy. Mouth breathing was present in 28 (51%) cases, snoring was present in 35 (74%) cases and frequent awakenings were present in 43(78%). Mean number of desaturations in obese children with adenotonsillar hypertrophy (17.40±1.66) was more than children with normal BMI (13.03±1.52), difference was statistically significant ($p<0.001$). Statistical Analysis shows statistically significant association of Obesity ($p<0.001$), Adenoid facies ($p<0.001$), grade 3 and grade 4 tonsillar hypertrophy ($p>0.002$), Mouth breathing, snoring and frequent awakenings ($p<0.001$) with severity of OSA. Overnight pulse oximetry is a low cost tool which can be used as an alternative to Polysomnography for the diagnosis and assessment of severity of OSA in children with Adenotonsillar hypertrophy.

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Key Words

Overnight pulse oximetry, mcGill oximetry, Obstructive sleep apnea syndrome, adenotonsillar hypertrophy

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INTRODUCTION

Obstructive sleep apnea syndrome (OSAS) is identified by repeated episodes of upper airway obstruction during sleep, despite continued or increased respiratory effort, resulting in complete (apnea) or partial (hypopnea ≥30% reduction in airflow accompanied by ≥3% O_2 desaturation and/or arousal) cessation of airflow at the nose and/or mouth, as well as sleep disruption[1].

Loud, frequent and disruptive snoring is the most common nocturnal manifestation of OSAS in children and adolescents. Mouth breathing and dry mouth are common daytime symptoms of OSAS, as are chronic nasal congestion or rhinorrhea, morning headaches, hyponasal speech, difficulty swallowing, and poor appetite[2]. Adenotonsillar hypertrophy is the most common cause of upper airway obstruction, which can vary in severity and site (nose, nasopharynx/oropharynx, hypopharynx)[1].

Polysomnography is the gold standard diagnostic procedure for OSAS, but it requires an expensive equipment, involves the expertise of a highly specialized technician and doctor and takes a long time to do, making it a difficult procedure, especially in a hospital setting. Pulse oximetry has been proposed as an alternative for diagnosing OSAS in children[3,4]. Present study was aimed to study overnight pulse oximetry in children posted for Adenotonsillectomy, for the diagnosis of Obstructive Sleep Apnea Syndrome.

MATERIALS AND METHODS

Present study was cross-sectional descriptive study conducted in department of Paediatrics, at Vydehi institute of Medical Sciences and Research Centre, Bangalore, Karnataka, India. Study duration was of one year and six months (January 2020 to June 2021). Study approval was obtained from the Institutional Ethics Committee.

Inclusion criteria: All children below 18 years of age admitted with clinically confirmed adenotonsillar enlargement and posted for adenotonsillectomy, with parents willing to give written consent to participate in the present study.

Exclusion criteria:

- Those children in whom overnight pulse oximetry was not possible due to logistic reasons like overnight stay/hospitalization
- Children with other co-morbid illnesses like cyanotic congenital heart disease, very sick children in whom pulse oximetry values may vary due to systemic illness

Study was explained to parents in local language and written consent was taken from parents for participation and study. Data regarding socio demographic profile and clinical history was collected by pretested questionnaire/proforma. All children clinically diagnosed with Adenotonsillar hypertrophy and posted for adenotonsillectomy, were subjected to 6 or more hours of overnight oximetry. SPO2 values were recorded with a Philips pulse oximeter (Model number M3535A) which displays the SPO2 recordings on a monitor. McGill Oximetry Scoring (severity of Obstructive Sleep Apnea is determined by the SPO2 nadir and by the number of these episodes during nocturnal oximetry) was done to classify the severity of OSA and the need for surgery.

Data analysis: Data was collected and compiled using Microsoft Excel, analysed using SPSS version 27. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi-square test or Fisher exact test as applicable. $p>0.05$ was considered as statistically significant.

RESULTS

A total of 55 children were studied, out of which 33 (60 %) were in the age group of 6 to 10 years. Among 55 children studied, 33(60 %) were males and 22 (40 %) were females. 25 children (45%) were obese and 30 children (55%) had normal BMI.

Among 55 children, Adenoid facies were present in 28 (51%) cases, 24 (44%) had grade 3 tonsillar hypertrophy and 31 (56%) had grade 4 tonsillar hypertrophy. Mouth breathing was present in 28 (51%) cases, snoring was present in 35 (74%) cases and frequent awakenings were present in 43(78%). Overnight pulse oximetry study was done for 6 hrs in 23 (42%) cases,7 hrs in 18 (33%) cases and 8 hrs in 14 (25%) cases. Mean number of desaturations were 15.02±2.69, mean McGill Oximetry score was 3.49±0.50. 28 (51%) cases had moderate OSA and 27 (49%) cases had severe OSA.

Mean number of desaturations in obese children with adenotonsillar hypertrophy (17.40±1.66) was more than children with normal BMI (13.03±1.52), difference was statistically significant ($p<0.001$). Mean number of desaturations in children with Adenoid facies was 17.40±1.66 and in children without Adenoid facies was 13.03±1.52, difference was statistically significant ($p<0.001$). Mean number of desaturations in children with grade 3 tonsillar hypertrophy was 13.46±2.36 and in children with grade 4 tonsillar hypertrophy was 16.23±2.32, difference was statistically significant ($p<0.001$).

Table 1: McGill oximetry scoring

		No. of episodes		
Oximetry Score	OSA classification	SPO2<90%	SPO2<85%	SPO2<80%
1	Inconclusive for OSA	<3	0	0
2	Mild OSA	≤3	≥3	0
3	Moderate OSA	≤3	>3	≥3
4	Severe OSA	≤3	>3	>3

Table 2: General characteristics

Characteristics	No. of patients	Percentage
Age groups (years)		
≤5	5	9.09
6-10	33	60.00
11-15	17	30.91
Mean Age	9.07±2.86	
Mean height	132.31±16.68	
Mean weight	36±12.46	
Gender		
Male	33	60
Female	22	40
BMI		
Obese	25	45
Not-obese	30	55

Table 3: Patients characteristics

Characteristics	No. of patients	Percentage
Adenoid facies	28	51
Tonsillar hypertrophy		
Grade III	24	44
Grade IV	31	56
Mouth breathing	28	51
Snoring	35	74
Frequent awakenings	43	78
Recurrent Infections	55	100
Hours of Study		
6	23	42
7	18	33
8	14	25
Total number of desaturations	15.02±2.69	
SpO2<90%	6.49±0.99	
SpO2<85%	4.78±0.89	
SpO2<80%	3.75±1.06	
Mc Gill Oximetry Score	3.49±0.50	
Grading of OSA		
Moderate	28	51
Severe	27	49

Table 4: Total number of desaturations

Variable	Total no. of desaturations	p-value
BMI		
Obese	17.40±1.66	<0.001
Not obese	13.03±1.52	
Adenoid facies		
Present	17.40±1.66	<0.001
Absent	13.03±1.52	
Tonsillar hypertrophy		
Grade III	13.46±2.36	<0.001
Grade IV	16.23±2.32	

Statistical Analysis shows statistically significant association of Obesity ($p<0.001$), Adenoid facies ($p<0.001$), grade 3 and grade 4 tonsillar hypertrophy ($p>0.002$), Mouth breathing, snoring and frequent awakenings ($p<0.001$) with severity of OSA.

DISCUSSIONS

Intermittent hypoxia, as well as the numerous arousals caused by these obstructive events, are likely to cause considerable cardiovascular, metabolic and neurocognitive-neurobehavioral morbidity[1]. OSAS is caused by a narrowed upper airway, either anatomically or functionally. A total of 55 children below 18 years of age were studied. All children had adenotonsillar hypertrophy on clinical examination. We observed that out of 55 children,60% of cases (33) were males and 40% of cases (22) were females in our study. Similar findings were noticed by Zampoli *et al.*[3] out of 137 children, 64.2% were males and 34.8% were females and by Merin Bobby *et al.*[5] out of the 60 study population, 36 (60%) were males and 24 (40%) were females.

Zampoli *et al.*[3] observed that obesity, a known risk factor for OSA, was not an important association in their study but obesity was seen to be associated with increased number of desaturations and hence, increased severity of OSA in our study. In our study, Adenoid facies were present in 51% cases. Grade 3 Tonsillar hypertrophy was present in 44 % cases and grade 4 hypertrophy in 56% cases. In the study conducted by Merin Bobby *et al.*[5] majority of study population (58.3%) had grade III tonsils and 50% had Grade III adenoids. Mbam *et al.*[6] noted that grade 3 tonsillar hypertrophy was seen in 50% of cases and grade 4 tonsillar hypertrophy was seen in 41.7% of cases. In study by Zampoli *et al.*[3] adenotonsillar hypertrophy was present in 61.6% of cases with moderate OSA and 83.1% of cases with severe OSA. Similar findings were noted in present study.

In the study conducted by Jonas *et al.*[7] out of 110 patients, 61 children (56 %) had normal oximetry whereas 30 children (27%) had McGill grade 2 and 19 children (17%) had Mc Gill score 3 and 4. Seventy percent (70%) of children with McGill 2 had either a normal or mild OSA on PSG. All the children with McGill 3 and 4 had moderate/severe OSA by PSG. It was concluded that a normal or McGill score 2 does not rule out OSA and a PSG is required for diagnosis. In study by Suarez *et al.*[8] mean age was 6.75 years old. PSG showed OSAS in 75 children (45%) and simple snoring in 92. Sixty five oximetries were considered pathological and in agreement with the PSG in relation to OSAS, 10 children with mild OSAS in the PSGs had normal oximetries. The study concluded that overnight oximetry is highly sensitive and specific for diagnosis of OSAS in children with Adenotonsillar hypertrophy and clinically suspected OSAS.

In the study conducted by Merin Bobby *et al.*[5] there was a positive correlation between grade of Adenotonsillar hypertrophy and oxygen desaturation index. The pulse oximetric parameters were seen to improve after adenotonsillectomy in this study ($p<0.05$). The strength of our study was that a detailed evaluation of clinical signs and symptoms of each child was done prior to starting the study since it is a cross-sectional study. In the study by Mbam *et al.*[6] mean

Table 5: Patient characteristics and severity of OSA

Characteristics	Moderate OSA (%)	Severe OSA (%)	p-value
Age	9.68±3.25	8.44±2.26	0.109
Gender			
Male	13 (46)	20 (74)	0.036
Female	15 (54)	7 (26)	
Obese	2 (7)	23 (85)	<0.001
Adenoid facies	2 (7)	26 (96)	<0.001
Tonsillar hypertrophy			
Grade III	18 (64)	6 (22)	0.002
Grade IV	10 (36)	21 (78)	
Clinical Symptoms	28(100)	27(100)	--
Mouth Breathing	2 (7%)	26 (96)	<0.001
Snoring	10 (36)	25 (95)	<0.001
Frequent awakenings	16 (57)	27(100)	<0.001
Recurrent Infections	28(100)	27(100)	--

nocturnal SPO2 (peripheral saturation of oxygen) profiles of children with adenotonsillar enlargement were compared with normal children. The conclusion of the study was that children with adenotonsillar hypertrophy had lower nocturnal oximetric profiles as compared to normal children. Our study was similar as children with adenotonsillar hypertrophy and significant clinical symptoms had increased severity of OSA as per Mc Gill oximetry score.

The limitations of our study were children with various risk factors for OSA other than Adenotonsillar hypertrophy were not studied and hence the results are not representative of children with other causes of OSA. Polysomnography, which is the gold standard diagnostic test for OSA could not be done as it requires expensive equipment and is time-consuming and cannot be done routinely and hence, results of overnight pulse oximetry could not be compared with polysomnography.

CONCLUSION

Overnight pulse oximetry and McGill oximetry score is a useful combination for diagnosing OSA and determining its severity in children with Adenotonsillar hypertrophy. Overnight pulse oximetry is a low cost tool which can be used as an alternative to Polysomnography for the diagnosis and assessment of severity of OSA in children with Adenotonsillar hypertrophy and hence, prioritize for surgery in children.

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