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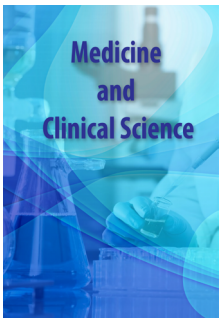

Pre-Operative Electrocardiographic Patterns of Children Who Had Adenotonsillectomy at University of Benin Teaching Hospital, Nigeria

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Abstract

Adenotonsillitis is a relatively common condition among children attending Paediatric Otorhinolaryngology clinics. It is sometimes associated with obstructive sleep apnea (OSA) which can predispose to certain cardiac changes detectable by electrocardiography (ECG). We studied the preoperative electrocardiographic patterns of children surgically managed for adenotonsillitis in our hospital.

This was a one-year retrospective study of children who had adenotonsillectomy at University of Benin Teaching Hospital, Benin-City, Nigeria between January and December 2017. Data was extracted from patients' case files including sociodemographic parameters, clinical features and electrocardiographic profiles. These were analyzed using SPSS version 22.0.

A total of 63 children were studied comprising 40 males (63.5%) and 23 females (36.5%) with a male-to-female (M:F) ratio of 1.74:1. Their ages ranged from 11 months to 192 months with mean age of 53.5±35.9 months. The modal age group of 3 to 4 years comprised 26 children (41.3%). The main presenting complaints were snoring in 58 (92.1%), mouth-breathing in 56 (88.9%), noisy breathing in 52 (82.5%) and OSA in 45 (71.4%). The duration of symptoms ranged from 5 to 96 months. Abnormal ECG was detected in 32 children (50.8%) with the common patterns being T wave abnormalities (9.5%), sinus arrhythmias (7.9%), incomplete bundle branch block (7.9%) and right ventricular hypertrophy (4.8%). There was statistically significant association between presence of OSA and abnormal ECG ($p=0.043$) among the children.

We conclude that ECG abnormalities are relatively common among children with obstructive sleep apnoea due to adenotonsillar hypertrophy in Benin-City, Nigeria.

Introduction

Adenotonsillitis is a relatively common condition among children attending the Paediatric Otorhinolaryngologist's clinics. Adenotonsillar hypertrophy is associated with such symptoms as sleep disordered breathing (snoring and obstructive sleep apnoea), mouth-breathing, recurrent nasal discharge, recurrent upper respiratory tract infections and poor feeding. Perhaps, the most worrisome of these symptoms is obstructive sleep apnoea (OSA). This is typically defined as a 'disorder of breathing during sleep characterized by prolonged partial upper airway obstruction and/or intermittent complete obstruction that disrupts normal ventilation during sleep [1]. Increased upper airway resistance during sleep is an integral feature of OSA. Paediatric OSA is a multifactorial disorder with overlapping contributions from airway narrowing (such as is the case with adenotonsillar hypertrophy), abnormal airway muscle tone and genetics, predisposing children to obstructed breathing during sleep [2]. It is suggested that childhood OSA can jeopardize long-term cardiovascular health with an effect on both cardiac ventricles [3]. Childhood OSA also has an effect on both systolic and diastolic blood pressure as well as to autonomic regulation, brain oxygenation and cerebral blood flow. Some authors have described additional effects including growth problems, pulmonary hypertension and neurocognitive deficits such as poor learning, behavioural aberration and attention deficit hyperactivity disorders [4-6]. The prevalence of OSA in children peaks around 3 to 7 years of age in congruence with the ages of marked adenotonsillar enlargement [7]. Variable prevalence of OSA have been reported in literature with some authors recording as low as 1.2 to 5.7% [9-10], while others found figures as high as 24% [11,12]. Suemy Cioffi Izu et al in Brazil reported a 42% prevalence of OSA among 248 mouth-breathing children [13]. Fasunla et al in Ibadan, western Nigeria reported cessation of breath in 64.4% of 73 children studied [14].

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The gold standard test for the diagnosis of obstructive sleep apnoea syndrome (OSAS) is Polysomnography (PSG). This is useful in differentiating OSAS from primary snoring [15]. There are controversies surrounding the role of PSG in the diagnosis of sleep disordered breathing in children due to lack of standardized interpretation and diagnostic criteria. Furthermore, it is not clear if outcomes are significantly improved in children evaluated with polysomnography compared with those who are not [2]. The relative cost of equipment and by extension, their restricted availability have made PSG of limited use in resource-deprived settings. Electrocardiography (ECG) is one of the simplest and oldest cardiac investigations available, yet it can provide a wealth of useful information and remains an essential part of the assessment of cardiac patients. With modern machines, surface ECGs are quick and easy to obtain at the bedside and are based on relatively simple electrophysiological concepts [15]. Adenoidectomy/adenotonsillectomy remains a major treatment with often appreciable outcomes in children with OSA as it can reduce symptoms and improve growth in affected children [16].

There is sometimes precautionary skepticism among anaesthetists, of the adequacy of ECG alone in determining the safety of general anaesthesia in children with OSA in our setting. Paediatric echocardiography and Cardiologist's evaluation have been advocated in children with suspected structural and functional abnormalities. This practice should yield better outcomes especially with concerted co-operation between Otorhinolaryngologists, Paediatric Cardiologists and Anesthesiologists.

The aim of this study was to describe the ECG patterns of children prepared for adenotonsillectomy in our centre, to evaluate the impact of OSA on cardiac function as well as identify the subset that may require further specialized assessment in the quest for safe general anaesthesia and surgery.

Patients and methods

This study included patients who were diagnosed with adenotonsillar hypertrophy/adenotonsillitis, who underwent adenotonsillectomy/adenoidectomy at the Otorhinolaryngology clinic of the University of Benin Teaching Hospital, Nigeria over a one-year period (between January 2017 and December 2017). Data was extracted from patients' case notes. These include sociodemographic characteristics, presenting complaints, duration of symptoms and electrocardiographic results. Patients with abnormal ECG findings had Paediatric Cardiology review and in some instances, echocardiography to ascertain cardiac fitness for surgery. Data analysis was done using SPSS version 22.0. Chi-square test was used to test for associations while statistical significance was set at $p < 0.05$.

Results

A total of 63 children had complete data and were included in the study. There were 40 males (63.5%) and 23 females (36.5%) with a male-to-female ratio of 1.74:1. Their ages ranged from 11 to 192 months with mean age of 53.5 ± 35.9 months. The modal group was 3-4 years age group which accounted for 41.3% of all participants.

The chief presenting complaints were snoring in 58 patients (92.1%), noisy breathing in 52 patients (82.5%), mouth-breathing in 56 patients (88.9%), recurrent nasal discharge in 51 patients (80.9%) and OSA in 35 patients (55.6%). Duration of symptoms ranged from 5 to 96 months. Majority (38.1%) had symptoms for 12-24 months.

Table 1. *Age classification of study participants.*

Age	Number	(%)
0-2 years	12	19.0
3-4 years	26	41.3
5-6 years	11	17.5
7-8 years	7	11.1
9-10 years	2	3.2
11-12 years	2	3.2
13-14 years	1	1.6
15-16 years	2	3.1
Total	63	100

Table 2. *Sleep apnoea among study participants.*

	Number	(%)
YES	35	55.6
NO	28	44.4
TOTAL	63	100

Table 3*. Electrocardiography results among study participants.*

ECG pattern	Frequency	(%)
Abnormal results	32	50.8
Normal results	31	49.2
Total	63	100

Table 4*. Pattern of ECG abnormalities*

ECG abnormalities	Frequency	(%)
No abnormality	31	49.2
Ventricular premature complexes	1	1.6
Right axis deviation	1	1.6
Short P-R interval	1	1.6
T wave abnormalities	6	9.4
Pacemaker spikes	1	1.6
High ventricular voltage	1	1.6
Right ventricular hypertrophy	3	4.8
Sinus arrhythmia	5	7.9
Atrial abnormality	2	3.2
ST-T abnormality	3	4.8
Left ventricular hypertrophy	2	3.2
Incomplete bundle branch block	5	7.9
Left axis deviation	1	1.6
Total	63	100

***Table 5**. ECG pattern of children with OSA.*

	Abnormal ECG (%)	Normal ECG (%)	Total (%)
OSA present	17 (48.6)	18 (51.4)	35 (100.0)
OSA absent	15 (53.6)	13 (46.4)	28 (100.0)
Subtotal	32 (50.8)	31 (49.2)	63 (100.0)

Obstructive sleep apnoea was observed in 35 children (55.6%).

Abnormal ECG was detected in 32 patients (50.8%). The frequencies of the abnormalities detected are as shown in table 3.

The commoner ECG abnormalities detected were T wave abnormalities (9.5%), sinus arrhythmias (7.9%), incomplete bundle branch block (7.9%), right ventricular hypertrophy (4.8%), ST-T segment abnormality (4.8%), left ventricular hypertrophy (3.2%) and atrial abnormality (3.2%).

Discussion

Adenotonsillar hypertrophy is a major cause of airway narrowing in children alongside craniofacial abnormalities from syndromic and neuromuscular diseases. Breathing patterns due to airway narrowing are highly variable, including obstructive cycling, increased respiratory effort, flow limitation, tachypnoea, and/or gas exchange abnormalities and as a consequence, sleep homeostasis may be disturbed. Increased upper airway resistance is an essential component of OSA, including any combination of narrowing/retro-positioning of the maxilla/mandible and/or adenotonsillar hypertrophy. In addition to anatomical factors, the stability of the upper airway is impacted on by neuromuscular activation, ventilatory control, and arousal threshold [17,18]. These components can result in the cardiac changes often seen in children with OSA which we also observed in our study population.

The ages of the children we studied ranged from 10 months to 192 months with a mean age of 53.5 months (S.D ± 35.9 months). This is comparable with similar studies previously conducted in the Nigerian cities of Ibadan, Kano and Ekiti [13,19-21]. Majority of the children were below 6 years of age corresponding with the typical ages of accelerated adenoidal and tonsillar growth. It is thought that daycare and school attendance may be a predisposing factor to repetitious upper airway infection, with further impact on the respiratory status of the children in this age group [13].

Our study found male preponderance of 1.74:1 which compares considerably with similar previous studies [19,21-23]. In Kano, Ibrahim et al found equal distribution between the sexes [20]. The reason for male preponderance is not exactly clear even though attempts at physiologic explanation has identified a role for the influence of sex hormones on respiration and body fat distribution [24].

The commonest presenting complaints seen in this study mirror the findings in similar studies in Nigeria [19-21]. A vivid account of the signs and symptoms of OSA which was published in a 19th century issue of British Medical Journal described inter alia 'the stupid-lazy child who frequently suffers from headaches at school, breathes through his mouth instead of his nose, snores and is restless at night, and wakes up with a dry mouth in the morning, is well-worthy of the solicitous attention of the school medical officer' [25]. This description is perhaps still apt two centuries later though with better understanding of the underlying pathology. In our study, 55.6% of the children had witnessed sleep apnoea reported. This figure may understandably be below actual figures as parents have to be awake to witness number and duration of apnoeic episodes therefore it may be safe to assume that a number of episodes may have be missed by the parents. Our figures compare well with earlier reports [13,14].

Sleep apnoea can be a result of chronic upper airway obstruction which is an established factor in the development of cardiac changes in children. In this study the duration of obstructive symptoms ranged from 5 months to 8 years with the majority of patients suffering it between 1 and 2 years. This is again comparable to previous studies [19,20].

Abnormal ECG findings were detected in 32 (50.8%) of 63 children studied with the commonest abnormalities being T wave abnormalities (9.5%), sinus arrhythmias (7.9%), incomplete bundle branch block (7.9%), ST-T abnormalities (4.8%) and right ventricular hypertrophy (4.8%). Similar findings were made in other studies in Nigeria with T wave abnormality being a prominent finding [19,20]. O'Brien and Gozal [26] found evidence of altered autonomic nervous system regulation with increased sympathetic vascular reactivity during wakefulness in children. It is known that OSAS can exert stress on the autonomic nervous system as well as lead to cardiac changes that may involve both right and left ventricles [27,28]. In addition, OSAS in childhood can affect blood pressure and cerebral blood flow thereby jeopardizing long-term cerebral and cardiovascular health [4]. Shamsuzzaman et al [29] described the relationship between QT-interval abnormalities, ventricular activity and cardiac arrhythmias as they relate to OSA. The observed association between left ventricular remodeling and abnormal 24-hour blood pressure monitoring outcomes underscores a role for sleep disordered breathing in increasing cardiovascular morbidity. To lend further credence to this assertion is the observation that clinical features and ECG patterns have been reported to reverse, months following adenotonsillectomy [14,27,28]. Worthy of note though, that some authors believe the benefit is minimal [30].

Testing for association between OSA and abnormal ECG tracings in our study, we found a statistically significant relationship (p=0.043). Cor-pulmonale has been reported in literature to result from chronic upper airway obstruction with considerable morbidity and sometimes, mortality [23,27]. It is probably better appreciated by carrying out echocardiography on the patients as this will show better, the functionality of the chambers of the heart [14]. Echocardiographic study is beyond the scope of our retrospective study. All patients with abnormal ECG results were referred for Paediatric Cardiology review for assessment of fitness for general anaesthesia and surgery. Of these, only five children required echocardiographic assessment with acceptable cardiac function recorded. All the children had adenotonsillectomy with satisfactory outcome.

Conclusion

Abnormal ECG tracings are relatively common among children with symptomatic adenotonsillar hypertrophy requiring surgical intervention in our setting, particularly those with OSA. Interdisciplinary co-operation is advocated in the management of these children.

Recommendations

Children suffering from chronic upper airway obstruction due to adenotonsillar hypertrophy are at risk of obstructive sleep apnea with possibility of development of adverse cardiac changes, hence electrocardiographic evaluation should be considered routinely in children with OSA. Adenoidectomy/ adenotonsillectomy may be indicated in these children.

Conflict of interest

The authors declare no conflict of interest.

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