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CLINICAL SIGNIFICANCE OF Q-TC INTERVAL IN CHILDREN WITH SLEEP- DISORDERED BREATHING

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ABSTRACT

Aim. We investigated the usefulness of ECG (Q-Tc interval) in determining the optional treatment modality for pediatric Sleep disordered breathing (SDB).
METHOD: Fifty-six children presenting with snoring and associated symptoms of obstructive SDB had adenotonsillectomy (A&T) as an optional treatment modality. All studied children had ECG as routine preoperative evaluation in the absence of polysomnographic facilities. At 12 weeks post-adenotonsillectomy ECG was repeated. A Q-Tc interval = or >0.43 was regarded as prolonged. Duration of study was 4 years (September 2002 to August 2006).
RESULTS: There was disappearance of symptoms in 98.21 % of children by the second week following A&T. At 12 weeks post-A&T only 26 (46.42%) of patients were available for ECG re-evaluation Mean pre-op versus post-op Q-Tc was 0.4482 and 0.3932 (t -5.484, df 25, p=0.000.) while mean heart rate was 106.15 and 105.19 (t -.179, df 25, p=0.859.). Adenotonsillectomy resulted in a reversal of prolonged Q-Tc to within the normal range. Five (19.23%) of the children with normal Q-Tc 0.39, 0.41, 0.40, 0.41 and 0.35 preoperatively assumed even lower values post operatively (0.37, 0.40, 0.39, 0.406 and 0.32 respectively). There was no statistical correlation between heart rates and Q-Tc intervals in the pre and post adenotonsillectomy patients. (Pearson correlation; -.058, P = 0.389 and -.266, p = .095 respectively).
CONCLUSION: Prolonged Q-Tc interval can be a reasonable pointer to the severity of SDB and its correction is an objective assessment of adenotonsillectomy as an effective treatment option for childhood SDB.

KEYWORDS: Sleep-disordered breathing in children, Q-Tc interval, Adenotonsillectomy.

INTRODUCTION

Sleep disordered breathing is a spectrum of disorders ranging from primary snoring to obstructive apnea/hypopnea syndrome (OSAHS). (Mitchel, 2005). The exact prevalence of Sleep-disordered breathing (SDB) in children in Nigeria is unknown but figures as high as 11% and 28% have been reported in some countries. (Mitchel, 2005; Caulfield, 2004; Ali et al, 1993). The causes are many but chronic adenoid and or tonsil enlargement is the commonest. (Guilleminault et al, 1996; Marcus, 2001).

Delayed diagnosis and optimal treatment often result in significant morbidities such as pulmonary hypertension, cor Pulmonale, right ventricular dysfunction, failure to thrive and poor weight gain. (Kenedy and Waters, 2005; Richard et al, 2004). However, with increased awareness among pediatricians, asymptomatic cardio respiratory, behavioral and neurocognitive deficits are the more recently reported morbidities. (Kenedy and Waters. 2005; Tal et al, 1988).

Adenotonsillectomy is the most appropriate therapy in most children with moderate to severe SDB (Kenedy et al, 2004) but the indications for surgery are now more stringent because of the risk of operative complications. The critical cut-off level for treatment of childhood (OSAHS) is regularly reviewed because recent research reveals that even primary snoring is associated with significant morbidity (Blunden et al, 2000). Therefore, accurate diagnosis of the presence and severity of SDB is essential for early treatment and reduction of complications.

Several studies have shown that primary snoring cannot be confidently distinguished from OSAHS on the basis of clinical history alone. (Carroll et al. 1995; Suen et al, 1995). Clinical symptoms and signs that suggest severe

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Obstructive Sleep Disordered Breathing in children include:

Snoring with

- Struggling to breathe during sleep
- Unusual sleeping position
- Mouth breathing
- Abnormal chest movements during sleep
- Observed apnoea during sleep
- Parents shaking child to prompt breathing during sleep.
- Parental anxiety resulting from observing the child during sleep
- Enlarged adenoids and tonsils

Useful and readily available screening methods such as, lateral neck radiograph and pulse oximetry may suggest severe SDB but not the associated cardiorespiratory complications (Z.Wang et al, 1998; Brouillette et al, 2000; Nixon et al., 2004).

Polysomnography is the gold standard for assessing the severity and prioritizing treatment in SDB as well as evaluating the risk of complications of adenotonsillectomy (American Thoracic Society, 1996). However, it is very expensive and unavailable in most centers especially in the developing countries like Nigeria.

Hence in the absence of polysomnography, asymptomatic but potential fatal morbidities may be ignored in these children. This has necessitated the search for a cheap but reliable method of assessing severity and prioritizing treatment in such settings.

In a previous study in this centre, prolonged Q-Tc interval suggesting asymptomatic right ventricular strain was common among our children with SDB (Umana et al, 2006).

We therefore investigated the possible usefulness of Prolonged Q-Tc interval in children with SDB as a tool for evaluation illness and treatment in a centre where polysomnography facility is lacking.

PATIENTS AND METHODS

This was a prospective study of 56 children referred to our Ear, Nose and Throat (ENT) clinic with clinical diagnosis of sleep - disordered breathing (SDB) due to chronic adenotonsillar hypertrophy. The study which was conducted in the University of Calabar Teaching Hospital, Calabar, Nigeria between September, 2002 and August, 2006 was limited by lack of facilities for Polysomnography and assessment of blood gas levels as well as refusal of some of the parents in the study group to continue follow up clinics. All the children were examined by the pediatricians. Pre-adenotonsillectomy evaluation included a 12-lead electrocardiogram (ECG), in addition to routine complete blood count, lateral neck plain radiographs and urinalysis. With the informed consent of a parent adenotonsillectomy was carried out as the treatment option. Post-adenotonsillectomy (A&T) ECG evaluation was advised after 12 weeks. The same consultant pediatrician read the ECG tracings but was blinded to the preoperative ECG readings. The QT interval was corrected for the heart rate according to Bazet's formula: Q-Tc=Q-T interval/√RR interval. The normal value was taken as < 0.43 seconds and prolonged duration as = or > 0 .43seconds

Children with cardiac disease, sickle cell anemia or hemoglobin ≤10 g/dl were excluded. The data were analyzed using SPSS Windows 2000 statistical package.

RESULTS

There was clinical symptom resolution in 98.2% of patients by the second week following A&T. At 12 weeks post adenotonsillectomy only 26 (46.42%) of patients were available for ECG re-evaluation and their mean pre-op versus post-op Q-Tc was 0.4482 and 0.3932 (t -5.484, df 25, p=0.000.) while mean heart rate was 106.15 and 105.19 (t -.179, df 25, p=0.859.). (-Table I1) Adenotonsillectomy caused significant reduction of prolonged Q-Tc to within normal range in 19 out of 20 (95%) cases. Five (19.23%) of the children (Patient nos. 3, 11,16, 18 and 25) with normal Q-Tc 0.39, 0.41, 0.40, 0.41 and 0.35 preoperatively assumed even lower values post operatively (0.37, 0.40, 0.39, 0.406 and 0.32 respectively). (-Table I) There was no statistical correlation between heart rates and Q-Tc intervals in the pre and post adenotonsillectomy patients. (Pearson correlation; -.058, P = 0.389 and -.266, p = .095 respectively).

Table I: Q-Tc Interval pre and post Adenotonsillectomy

Patients	Q-Tc Intervals			
	Pre-op	Post-op	Reduction	%Relative fall
1	0.44	0.425	0.015	3.5
2	0.53	0.43	0.10	23.25
3	0.39	0.37	0.02	4.65
4	0.45	0.43	0.02	4.65
5	0.44	0.41	0.03	6.98
6	0.44	0.43	0.01	2.33
7	0.53	0.46	0.07	16.28
8	0.53	0.33	0.20	46.51
9	0.46	0.33	0.13	30.23
10	0.45	0.40	0.05	11.63
11	0.41	0.40	0.01	2.33
12	0.44	0.393	0.05	11.63
13	0.46	0.388	0.08	18.61
14	0.48	0.333	0.15	32.61
15	0.444	0.40	0.01	2.33
16	0.41	0.39	0.02	4.65
17	0.50	0.413	0.09	17.40
18	0.413	0.406	0.007	1.70
19	0.48	0.375	0.15	31.25
20	0.43	0.388	0.04	9.41
21	0.45	0.358	0.09	20.00
22	0.43	0.416	0.014	3.26
23	0.43	0.42	0.01	2.33
24	0.50	0.42	0.08	16.00
25	0.35	0.32	0.03	8.57
26	0.45	0.40	0.05	11.63
Mean values	0.4482	0.3932	0.065	12.59

Mean pre-op versus post-op Q-Tc interval 0.4482 and 0.3932 (t -5.484, df 25, p=0.000).

Table II: Heart Rate pre and post Adenotonsillectomy.

Patients	Heart Rate	
	Preoperative	Postoperative
1	100	107
2	107	107
3	115	107
4	120	80
5	104	100
6	115	107
7	100	100
8	125	115
9	125	150
10	115	125
11	94	136
12	100	83
13	100	88
14	107	100
15	107	107
16	100	128
17	88	97
18	90	62
19	136	93
20	110	113
21	150	143
22	120	117
23	107	116
24	107	86
25	96	86
26	88	82
Mean	106 15	105.19

Mean pre-op versus post-op heart rates 106.15 and 105.19 (t -.179, df 25, p=. 859)

DISCUSSION

In our study, prolonged Q-Tc, a significant indicator of asymptomatic cardiac morbidity in these children was correctable by adenotonsillectomy. Our finding suggests that Prolonged Q-Tc interval could be used as a reasonable pointer to the severity of SDB in children and an indication for early adenotonsillectomy.

Several studies show that primary snoring cannot be confidently distinguished from OSAS on the basis of clinical history alone (Carroll et al, 1995; Suen et al, 1995). Also, correlation between tonsil size and severity of SDB is still controversial (Z. Wang et al, 1998) because a large tonsil in a child is not prima facie evidence of significant upper airway obstruction during sleep. In addition, a more potent postnasal space seen on Lateral radiograph of the neck while awake may diminish significantly during sleep, especially during rapid-eye-movement sleep when muscle tone is at its nadir. Furthermore overnight oximetry has a positive predictive value of greater than 90% (Brouillette et al, 2000; Nixon et al, 2004) but a negative oximetry test does not exclude OSAHS so it is best used in conjunction with polysomnography.

A normal Q-Tc interval in children is 0.39-0.425 and prolonged intervals (> 0.43) suggest ventricular strain. Q-Tc interval is a marker for ventricular repolarisation and prolongation of this interval points to reduced cardiac stability favoring susceptibility to potentially lethal ventricular fibrillation (Chameides, 1984). This is associated with death in some clinical conditions (Schwartz. 1995) and in apparently healthy people (Schouten,1991). It is a rare cause of collapse, loss of consciousness and seizures in the prolonged Q-Tc syndrome.

Hence, in the absence of polysomnography, reliance on clinicoradiological findings and overnight oximetry done (where available and functional), may cause asymptomatic but potentially fatal morbidity and adenotonsillectomy therefore delayed in these children.

Our study also showed a further lowering of Q-Tc value following A&T even when the Q-Tc interval was within normal range. Therefore Q-Tc interval may be used as a cheap, readily available and objective assessment of the effectiveness of therapy in SDB.

Our findings also affirm the effectiveness of adenotonsillectomy as an early and appropriate treatment in children with SDB (Kenedy et al, 2004). Most of the parents of our patients did not see the need for prolonged follow up with clinical and laboratory assessment to evaluate outcome of treatment, because resolution of signs and symptoms was satisfactory within a few weeks of A&T. This attitude is not surprising because it is reported that following A&T symptoms disappear and overnight respiratory parameters are corrected in about 80% of children (Kenedy et al, 2005).

CONCLUSION

Prolonged Q-Tc interval is a useful indicator of the severity of SDB and associated cardiac morbidity in children. It is also a cheap and objective assessment of the effectiveness of therapy. In centers that lack facilities for polysomnography, Prolonged Q-Tc interval should be considered an added indication for adenotonsillectomy where clinical symptoms and signs suggest OSAS. Although the sample size in the present study is small, our findings are clear and unambiguous and calls for further evaluation with a larger sample size.

REFERENCES

Ali, N. J, Pitson, D. J. and Stradling, J. R., 1993. Snoring, sleep disturbance, and behavior in 4–5 year olds. Arch Dis Child., 68:360–366.

American Thoracic Society. 1996. Standards and indications for cardiopulmonary sleep studies in children. Am J Respir Crit Care Med. 153: 866-878.

Blunden, S, Lushington, K, and Kennedy, D, et al., 2000. Behaviour and neurocognitive performance in children aged 5-10 years who snore compared with controls. J Clin Exp Neuropsychol, 22: 554-568.

Brouillette, R. T., Morielli, A., Leimanis, A, et al., 2000. Nocturnal pulse oximetry as an abbreviated testing modality for pediatric obstructive sleep apnea. Pediatr. 105: 405-412.

Carroll, J. L, McColley, S. A, and Marcus, C. L., 1995. Inability of clinical history to distinguish primary snoring from obstructive sleep apnea syndrome in children. Chest 108: 610-618.

Chameides, L., 1984. Reading a child's ECG. Emerg. Med. 16 (2): 79-111.

Guilleminault, C., Pelayo, R. and Leger, D., 1996. Recognition of sleep-disordered breathing in children. Pediatr., 98: 871–882.

Hellen, Caulfield, 2004. Sleep Disordered Breathing in Children. ENT News. 12, (4): 55-58.

Kennedy, J.D, Blunden, S, and Hirte, C, et al., 2004. Reduced neurocognition in children who snore. Pediatr Pulmonol 37: 330-337.

Kennedy, J. D, and Waters, K. A., 2005. Investigation and treatment of upper-airway obstruction: childhood sleep disorders I. MJA., 182 (8): 419-423.

Marcus, C. L., 2001. Sleep-disordered breathing in children. Am J Respir Crit Care Med., 164: 16-30.

Mitchell, R. B., 2005. Sleep-disordered breathing in children: are we underestimating the problem? Eur Respir J., 25:216-217.

Nixon, G. M., Kermack, A. S., and Davis, G. M, et al. 2004. Planning adenotonsillectomy in children with obstructive sleep apnea: the role of overnight oximetry. Pediatr. 113 (1 Pt 1): e19-25.

Richard H. Blum MD, MSE and Francis X. McGowan Jr MD., 2004. Chronic upper airway obstruction and cardiac dysfunction: anatomy, pathophysiology and anesthetic implications. Pediatr. Anesth. January, 14 (1): 75.

Schouten, E. G., Dekker, J. M., and Meppelink, P., et al. 1991. QT interval prolongation predicts cardiovascular mortality in an apparently healthy population. Circulation, 814:1516-1523.

Schwartz, P. J, Locati, E., Napolitana, C. and Prior, S. G., 1995. The long QT syndrome. In: Zipes DP, Jalife J, eds. Cardiac electrophysiology: from cell to bedside. 2nd ed. Philadelphia: WB Saunders, 788-811.

Suen, J. S., Arnold, J. E., and Brooks, L. J., 1995. Adenotonsillectomy for treatment of obstructive sleep apnea in children. Arch Otolaryngol Head Neck Surg., 121: 525-530.

Tal, A., A. Leiberman, G. Margulis, and S. Sofer., 1988. Ventricular dysfunction in children with obstructive sleep apnea: radionuclide assessment. Pediatr. Pulmonol. 4: 139-143.

Umana AN, Bassey D, and Anah M. et al., 2006. Right ventricular strain in Children with Sleep disordered breathing in University of Calabar Teaching Hospital, Nigeria. Mary Slessor Journal of Med. 6(1): 75-79.

Wang RC, Z. Elkins TP, and Keech D., 1998. Accuracy of clinical evaluation in pediatric obstructive sleep apnea. Otolaryngol Head Neck Surg. 118: 69-73.