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INTELLECTUAL FUNCTIONS IN CHILDREN WITH OBSTRUCTIVE SLEEP APNEA

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ABSTRACT

Objective: to evaluate the effect of adenotonsillectomy (AT) on the intelligence of children with Obstructive Sleep Apnea (OSA) due to adenoid hypertrophy.

Patients and Methods: 50 children with obstructive sleep apnea **(OSA)**.They were 24 males (48 %) and 26 females (52%), with a mean age 101.5±15.6 and a range of (72-120) months. All children of study group were subjected to complete history taking preoperative assessment to exclude any other medical problems, full ENT examination, lateral X-ray nasopharyngeal radiographs, tympanometry for cases suspected to have middle ear effusion, routine lab investigations, neuropsychiatric evaluation was performed using Stanford-Binet test Intelligence Scales-Fifth Edition, all children underwent adenotonsillectomy by senior staff, 8 months after adenotonsillectomy neurocognitive testing was followed .

Results: Children with OSAS had lower scores in inteligence quotient indicating impaired neurocognitive function but, 8 months after adenotonsillectomy, the children with OSAS demonstrated significant
improvement in inteligence quotient.

Key Words: Obstructive Sleep Apnea, inteligence quotient, Neurocognitive functions, Adenoid hypertrophy, Adenotonsillectomy.

I- INTRODUCTION

Obstructive sleep apnea (OSA) in children is a disorder characterized by repeated and/or prolonged airway obstructions during sleep, in the form of apneas (complete obstruction of airways resulting in the cessation of breathing) and hypopneas (reduced and labored breathing due to partially blocked airways) throughout the night ***(American Academy of Pediatrics, 2002)***. The most commonly identified risk factor for the childhood obstructive sleep apnea syndrome is adenotonsillar hypertrophy. Thus, the primary treatment is adenotonsillectomy***(Bhattacharyya and Line.,2010)***. Children with SDB due to adenoid hypertrophy have behavior problems, intelligence quotient deficits, deficits of executive function **,**school performance problems, a high prevalence of abnormal neuropsychological diagnosis (***Abdellatif et al.,2014).***The purpose of the present study was to evaluate the effect of adenotonsillectomy (AT) on the intelligence of children with Obstructive Sleep Apnea (OSA) due to adenoid hypertrophy.

II- METHODS

The present study was carried out at Minia University hospital(ENT department, Phoniatric unit), during period from October 2016 to July 2019, and included 50 children aged between 5 to 12 years**.** They were 24 males (48 %) and 26 females (52%), with a mean age 101.5±15.6 of and a range of (72-120) months . This study was approved by the ethics committee in the Faculty of medicine, Minia university hospital, and concents were obtained from subjects.

Inclusion criteria included that 50 children well diagnosed as obstructive sleep apnea (OSA) with polysonography due to adenotonsillar hypertrophy. Exclusion criteria included Children with Previous adenotonsillectomy, Children with craniofacial syndromes, Children with hearing impairment (SNHL) and Obese children (BMI $\geq$ 30).The study group (pre and post-operative) were stastically matched in comparative data age and sex distribution.All patient underwent the following protocol of assessment:

1-Complete history taking including symptoms of OSA.

2-Auditory perceptual assessment of speech (degree of closed nasality) the speech of each case.

3-**Audiological evaluation** included middle ear assessment through immitancemetry (Tympanometry) and hearing assessment through Free field Audiometry , Behavioral Observational Audiomety (BOA), pure tone audiometry, Auditory Brainstem Response "ABR".

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2- Otolaryngologic examination.
The oropharynx (lips,teeth,tongue,hard and soft palates, uvula, tonsillar pillars,tonsils,lateral and posterior pharyngeal walls) was examined with a tongue blade and a good light. Examination of the nasopharynx through nasopharyngoscopy.
3- X-ray (nasopharynx) (lateral view) for Adenoid assessment.
4-Polysomonography test: a full polysomnography (PSG) study using standard clinical pediatric techniques and a commercially available sleep system for diagnosis of OSA.
4-Psychometric evaluation by Intelligence Quotient "IQ" using Stanford Binet Intillegence Scale (5th edition). The Stanford-Binet scale tests intelligence across four areas: verbal reasoning, quantitative reasoning, abstract /visual reasoning, and short-term memory. The areas are covered by 15 subtests, including vocabulary, comprehension, verbal absurdities, pattern analysis, matrices, paper folding and cutting, copying, quantitative, number series, equation building, memory for sentences, memory for digits, memory for objects, and bead memory.
Mental age was determinded for each child :I.Q = Mental age÷chronological age ×100. Then all patients underwent to Adenotonsillectomy (AT):Adenotonsillectomy was done by the same surgeon, tools and at the same place. Routine lab investigations were done before the operation. Finally after (8 months) of adenotonsillectomy the patients were followed by:APA of speech, IQ test and mental age,Tympanogram.

III- RESULTS

(1) Demographic data:

Table (1): demographic data.

		N=50
Age	*Range*	(72-120)
	Mean ± SD	101.5±15.6
Sex	*Male*	24(48%)
	Female	26(52%)

The children in this study included 50 children with obstructive sleep apnea (OSA).They were 24 males (48%) and 26 females (52 %), with a mean age 101.5±15.6 months and a range of (72-120) months.

Table (2): Comparison between preoperative and postoperative state as regard to APA

		Preoprative	Postoperative	P value
		N=50	N=50	
APA	*No degree*	0(0%)	50(100%)	***<0.001****
	Mild	0(0%)	0(0%)	
	Moderate	20(40%)	0(0%)	
	Severe	30(60%)	0(0%)	

A statistical highly significant differences were obtained between preoperative and postoperative examination of the study group as regard the auditory perceptual assessment (APA) . (p <0.001)

Table (3): Comparison between preoperative and postoperative state as regard to tympanogram

		Preoprative	Postoperative	P value
		N=50	N=50	
tympanogram (preoperative)	*Type A*	16(32%)	47(94%)	***<0.001****
	Type B	15(30%)	0(0%)	
	Type C	19(38%)	3(6%)	

A statistical highly significant differences were obtained between preoperative and postoperative examination of the study group as regard the tympanogram. (p <0.001)

Table (4): Comparison between preoperative and postoperative state as regard to symptoms of OSA.

Symptoms of OSA		Preoprative	Postoperative	P value
		N=50	N=50	
Snoring	*Yes*	50(100%)	0(0%)	***<0.001****
	No	0(0%)	50(100%)	

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Mouth Breathing	*Yes*	50(100%)	0(0%)	***<0.001****
	No	0(0%)	50(100%)	
Nasal Obstruction	*Yes*	50(100%)	5(10%)	***<0.001****
	No	0(0%)	45(90%)	
Excessive Daytime Somnolence	*Yes*	30(60%)	3(6%)	***<0.001****
	No	20(40)	47(94)	
Nighttime Awakening	*Yes*	40(80%)	0(0%)	***<0.001****
	No	10(20)	50(100%)	

A statistical highly significant differences were obtained between preoperative and postoperative examination of the study group as regard the symptoms of OSA .**(p<0.001)**

Table (5): Comparison between preoperative and postoperative state as regard the IQ and mental age.

		Preoprative	**Postoperative**	**P value**
		N=50	**N=50**	
IQ	*Range*	(70-91)	(78-95)	***<0.001****
	Mean ± SD	80.9±5.9	84.1±5.6	
Mental age	*Range*	(54-132)	(61-133)	***<0.001****
	Mean ± SD	87.3±20.1	94.9±19.6	

A statistical highly significant differences were obtained between preoperative and postoperative examination of the study group as regard the IQ.(p<0.001)

IV- DISCISSION

Obstructive sleep apnea (OSA) in children is a disorder characterized by repeated and/or prolonged airway obstructions during sleep, in the form of apneas and hypopneas throughout the night ***(American Academy of Pediatrics, 2002)***.

Children with SDB due to adenoid hypertrophy have behavior problems, intelligence quotient deficits, deficits of executive function **,**school performance problems, a high prevalence of abnormal neuropsychological diagnosis (***Abdellatif et al.,2014).***The main risk factors include adenotonsillar hypertrophy, obesity, race, craniofacial deformity and neuromuscular diseases ***(Marcus et al.,2012)*** .The purpose of the present study was to evaluate the effect of adenotonsillectomy (AT) on the intelligence of children with Obstructive Sleep Apnea (OSA) due to adenoid hypertrophy.

Adenotonsillectomy is thought to benefit children with OSA in additional ways beyond those demonstrable with PSG. Parents frequently report noticeable improvement in obstructive symptoms such as snoring, mouth breathing, or hyperhidrosis during sleep. Quality or continuity of nighttime sleep also may benefit***(Mitchell et al.,2004)***. 60% of patients in this study had severe degree of hyponasal speech and 40% had moderate degree of hyponasal speech pre adenotonsillectomy but 8 months post AT only 4 % of the patients had moderate hyponasal speech and 12 % had mild degree of hyponasal speech This improvement of the auditory perceptual assessment can be attributed to the get riding of the obstructive effect of adenoid on the posterior choana.

prevalence of ETD to be significantly higher among infants with OSA, and also concluded that surgical interventions can effectively reduce the need for further tympanostomy tube placement***(Robison et al., 2012)***. In this study there were improvement in the ETD demonstrated from the results of tympanogram (30% had type B and 38 % had type C pre AT but 8 months post AT 6 % had type B and 28 % had type C) post adenotonsillectomy. This improvement in the ETD in our patients may be attributed to get ridding of the chronic adenoid infection which causing chronic persistent or recurrent ear disease post adenotonsillectomy so after AT there were good aeration of the middle ear and Maintenance of its normal middle ear pressure.

Caregivers report an improvement in sleep disturbance, physical suffering, emotional distress, and daytime problems in their children with OSA after adenotonsillectomy. Adenotonsillectomy improved upper airway obstruction to levels equivalent to controls, with a significant mean pre- to post-operative reduction in OAHI of 5.8 to 0.8 ***(Kohler et al.,2009).*** significant improvements in OSA symptoms(nasal obstruction,mouth breating, sleep symptoms) postAdenotonsillectomy than preoperative***(Abd-Allatif et al.,2014)***.In our study there were improvement of almost OSA symptoms post adenotonsillectomy like snoring,mouthbreathing , nasal obstruction, excessive daytime

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somnolence and nighttime awakening . Improvement of almost OSA symptoms in our study may be attributed to removal of the upper airway after adenotonsillectomy.

psychological evaluations were carried out before and after Adenotonsillectomy, found that significant improvements in the intellectual performance test and in the writing, arithmetic's and reading tests, so proper treatment of such conditions may bring about benefits for the child's intellectual and school performances***(Ikedia et al.,2012)***. The mean IQ of children in this study was raised from 80.9±5.9 pre AT to be 84.1±5.6 post AT. This improvement of IQ in our patients can be attributed to get ridding of the upper airway obstruction during sleep, intermittent hypoxemia, disruption of normal ventilation and long duration (eight months) post AT giving enough duration to raise intellectual functions so improvement in IQ results post AT. These results match most of published data about improvement of IQ after adenotonsillectomy in children with OSA.

From our study we conclude that children with OSA due to adenotonsillar hypertrophy had poor IQ owing to obstructive symptoms of upper respiratory tract leading to nocturnal hypoxemia, intruptive sleep,Eustachian tube dysfunction but eight months after AT there were increase in the academic achievement as a result of improvement of all previously mentioned factors.

V- CONCLUSION

Children with OSA due to adenotonsillar hypertrophy had poor IQ owing to obstructive symptoms of upper respiratory tract leading to nocturnal hypoxemia, intruptive sleep,Eustachian tube dysfunction but eight months after AT there were increase in the academic achievement as a result of improvement of all previously mentioned factors.

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