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Safety and efficacy of adenotonsillectomy for obstructive sleep apnea in infants, toddlers and preschool children

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ABSTRACT

Objective: To investigate and compare the safety and efficacy of adenotonsillectomy (AT) on obstructive sleep apnea (OSA) in infants and toddlers (IT) with preschool children (PS), and charts of 147 children between the ages of 11 months and 6 years were reviewed.
Methods: Harmonic Scalpel (HS) was introduced into AT to reduce the operative duration and intraoperative hemorrhage. Preoperative and postoperative apnea–hypopnea indices (AHI) values obtained by the type 3 portable monitoring device, and the change achieved by AT were statistically compared between IT group ($N = 50$) and PS group ($N = 97$). The mean operative duration, the mean amount of intraoperative hemorrhage, the incidence of postoperative hemorrhage, the frequency of abnormal postoperative chest X-ray findings, and the length of hospital stay were also compared between the two groups. All statistical analyses were conducted using either the Student's t test or Fischer's exact test, and p-values <0.05 were considered statistically significant.
Results: In the IT group, the mean preoperative AHI value was 13.5 ± 7.1 and decreased to 4.7 ± 3.4 postoperatively. In the PS group, the mean AHI value changed from 16.0 ± 10.2 to 4.4 ± 2.4. There were statistically significant differences between the preoperative and postoperative AHI values in both the IT and PS groups, but there were no statistically significant differences between the IT and PS groups. The mean operative durations in the IT group for tonsillectomy and adenoidectomy were 12.8 ± 6.7 min and 19.5 ± 8.1 min, respectively. The corresponding values in the PS group were 14.5 ± 6.6 min and 22.9 ± 9.7 min, respectively. The mean tonsillectomy durations were comparable, but the adenoidectomy duration was statistically shorter in the IT group. In the IT group, the mean amounts of intraoperative hemorrhage during tonsillectomy and during adenoidectomy were 6.0 ± 5.1 and 18.9 ± 10.6 g, respectively. The corresponding values in the PS group were 6.4 ± 5.4 g and 26.2 ± 13.4 g, respectively. The mean tonsillectomy blood loss was comparable between the groups but was statistically less during adenoidectomy in the IT group. There were no statistical differences between the two groups in the incidence of postoperative hemorrhage and of abnormal findings in the postoperative chest X-ray, and in the length of hospital stay.
Conclusion: AT in IT can be performed without major perioperative complications and should be considered the primary treatment of OSA from infancy to early childhood. Ultrasonic devices may contribute to increasing the safety of this surgical treatment.

1. Introduction

Obstructive sleep apnea (OSA) in children is known to disturb physical and mental development [1], and children with severe OSA generally need medical intervention. Because the efficacy of adenotonsillectomy (AT) on OSA in children has widely been

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reported [2–4], this operative procedure is now considered to be the first line of treatment [5]. In contrast, little attention has been paid to its safety, particularly in infants and toddlers, resulting in hesitations to operate.

Since 2004, we have introduced an ultrasonically activated scalpel into AT with the aim of reducing both the operating time and intraoperative hemorrhage. The use of the Harmonic Scalpel™ (HS; Ethicon Endosurgery, Cincinnati, OH, USA) has enabled us to more easily achieve hemostasis during AT and therefore to reduce the operation time [6,7]. We believe that the shorter operative duration and the reduction in bleeding obtained by HS use would reduce the frequency of postoperative complications in children with OSA.

In the present study, we retrospectively investigated the operative duration, the amount of intraoperative hemorrhage, and the incidence of postoperative hemorrhage and respiratory complications. We aimed to determine if there was higher risk of AT performed in infants and toddlers compared with that in preschool children. In addition, the efficacy of ultrasonic AT on pediatric OSA was assessed and compared between these groups using a type 3 portable monitoring (PM) device [8].

2. Subjects and methods

Charts of 147 children between the ages of 11 months and 6 years (102 boys and 45 girls) were retrospectively reviewed. All children had undergone AT through HS between 2004 and 2008 at Kochi Medical School Hospital for complaints of snoring, sleep apnea, and restless sleep. Each participant had undergone preoperative nocturnal breathing monitoring with type 3 PM at home, using the Sleeptester™ (Fukuda Lifetech Inc., Tokyo, Japan), which was equipped with five channels for oronasal airflow, thoracoabdominal effort, snoring, body position, and oximetry (SpO_2) [8]. The sensors were set by their guardians, and five recordings were taken each night. Results were manually analyzed by sleep technologists using specific software (SAS-100). The home monitoring was repeated 3–6 months postoperatively. The apnea–hypopnea index (AHI) values were used to indicate OSA: apnea was defined as cessation (>90% reduction) of oronasal airflow lasting for more than 2 breaths and hypopnea was defined as a >50% reduction of oronasal airflow with >3% desaturation for more than 2 breaths. These parameters were consistent with the 2007 guidelines of the American Academy of Sleep Medicine (AASM) [9].

Subjects were divided into two groups on the basis of their age at the time of operation: 0–3-year-old, infants and toddlers (IT group) and 4–6-year-old, preschool children (PS group) (Table 1). Preoperative and postoperative AHI values were compared between these groups. To investigate safety, the mean operative duration and the mean amount of intraoperative hemorrhage were statistically compared between the IT and PS groups. During both adenoidectomy and tonsillectomy, a suction tube was never used, and the intraoperative hemorrhage was absorbed in fixed-sized cotton ball throughout the procedures. They were weighed on the accurate scale. In addition, the incidence of postoperative hemorrhage and the frequency of abnormal postoperative chest X-ray findings were investigated and compared statistically. Postoperative hemorrhage was defined as any bleeding at the operative site, regardless of its amount and timing. Such a tiny bleeding as hemosputum found by guardians or nurses was included. Chest X-rays were taken on the day after surgery and any abnormalities were noted by pediatricians and radiologists. The length of hospital stay was also compared between the IT and PS groups based on the incidence of variance from the clinical pathway for pediatric AT. All statistical analyses were conducted using either the Student's *t* test or Fischer's exact test, and *p*-values <0.05 were considered statistically significant.

Size of tonsils was assessed according to the palatine tonsil grading in Friedman's staging [10] and that of adenoids was assessed based on Parikh's nasopharyngoscopic grading system [11]. Children with any evident history of congenital craniofacial deformity, tracheolaryngomalacia, metabolic disorder, cerebral palsy, or mental retardation were excluded from this study following overnight polysomnography. Written informed consent was required from the guardians of all children and was taken preoperatively for AT through HS and prior to the use of the above mentioned home monitoring. This study was approved by the institutional ethics committee of our hospital.

3. Surgical procedures

After endotracheal intubation, a Davis mouth gag was applied. A cold knife was initially used to expose the capsule before introducing curved shears (CS 14C) for extracapsular dissection (Fig. 1A). Coagulation and dissection were achieved with this probe alone to the tonsillar hilus. These procedures were performed with the HS at a power level of 3. After bilateral tonsillectomy, rubber catheters were passed transnasally to retract the soft palate and a 4 mm 70° rigid endoscope was inserted to visualize the nasopharynx. First, curette adenoidectomy (Beckmann) was applied, and then, a ball coagulator (HBC 05) was used to eliminate the residual adenoid and to complete hemostasis (Fig. 1B). During adenoidectomy, the HS was used at a power level of either 1 or 2.

Table 1
Profiles of children and summary of results in each group.

	IT ($N=50$)		PS ($N=97$)		*p*-Value
Age distribution	≦1	5	≦4	40	NA
	≦2	14	≦5	34	
	≦3	31	≦6	23	
Tonsil size*	I 0	II 3	I 0	II 3	0.1
	III 30	IV 17	III 43	IV 51	
Adenoid size**	I 0	II 0	I 0	II 5	0.13
	III 18	IV 32	III 36	IV 56	
Pre. and post. type 3 PM both completed	37 (74.0%)		71 (73.2%)		0.92
Preoperative AHI ≧ 5	32 (86.5%)		66 (93.0%)		0.27
Postoperative AHI < 5	24 (64.9%)		45 (63.4%)		0.88
Postoperative hemorrhage	4 (8.0%)		4 (4.1%)		0.33
Abnormal findings in the chest X-ray	9 (18.0%)		11 (11.3%)		0.26
Variance of hospitalization	11 (22.0%)		17 (17.5%)		0.51

Size of tonsils* was assessed according to palatine tonsil grading in Friedman's staging and that of adenoids** was assessed based on Parikh's nasopharyngoscopic grading system.