Long-Term Follow-up of Obstructive Sleep Apnea Syndrome Following Surgery in Children and Adults

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SATO, M., SUZUKI, M., OSHIMA, T., OGURA, M., SHIMOMURA, A., SUZUKI, H., TAKASAKA, T. and IKEDA, K. *Long-Term Follow-up of Obstructive Sleep Apnea Syndrome Following Surgery in Children and Adults.* Tohoku J. Exp. Med., **192** (3), 2000, 165–172 — Obstructive sleep apnea syndrome (OSAS) is characterized by recurrent apneas during sleep, resulting in repetitive hypoxemia. The present study retrospectively analyzed subjective and objective assessments of the patients with OSAS in a relatively long-term follow-up. From February 1986 to August 1996, 53 patients received surgical treatment for OSAS and snoring. Thirty-seven (27 males and 10 females) out of 53 patients completed the questionnaire and postoperative sleep study was obtained in 6 patients. In 20 children (<15 years), snoring, sleep apnea, and daytime sleepiness completely disappeared in 12, 19, and 16, and improved in 8, 1, and 4, respectively. These findings confirm that tonsillectomy and/or adenoidectomy in children may be the first selection for treatment. In 17 adults, snoring, sleep apnea, and daytime sleepiness completely disappeared in 2, 5, and 8, improved in 11, 8, and 7, and was unchanged in 4, 4, and 1, respectively. The apnea index in adults was significantly decreased in both early and late postoperative periods. These results suggest that surgery is a satisfactory alternative for adult patients if performed accurate preoperative diagnosis of the localization of the airway collapse and careful long-term follow-up. ————— tonsillectomy; uvulopalatopharyngoplasty; symptomatic improvement; apnea index © 2000 Tohoku University Medical Press

Obstructive sleep apnea syndrome (OSAS) shows snoring, sleep disruption, nocturnal hypoxemia and cardiovascular complications, which may lead to sudden death during sleep (Hung et al. 1990). The modern treatment of OSAS includes drug therapy, nasal continuous positive airway pressure (CPAP), several kinds of upper airway surgery such as tonsillectomy, adenoidectomy, uvulopalatopharyngoplasty (UPPP), and midline glossectomy. Several reports concerning the

Received August 18, 2000; revision accepted for publication October 27, 2000.

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long-term results of surgical procedures on breathing during sleep and sleep quality have been published. For children, tonsillectomy and adenoidectomy have been the most commonly recommended treatment (Gaultier 1992). However, adult patients with OSAS tended to respond poorly to surgical treatment (de Berry Borowiecki and Sassin 1983; Guilleminault et al. 1983; Fujita et al. 1985; de Berry Borowiecki et al. 1985; Conway et al. 1985; Blakley et al. 1986; Regestein et al. 1988; Gislason et al. 1988; Sanders et al. 1990). The success rate of surgical procedures was reported to be from 50 to 70%. He et al. (1988) demonstrated that the cumulative survival of the group treated with UPPP alone was not different from that of untreated patients with an apnea index >20 . Patients with severe OSAS may be effectively treated with nasal CPAP. A recent randomized controlled study of nasal CPAP provided confirmative evidence of the clinical effectiveness of OSAS (Jenkison et al. 1999). However, many patients refuse CPAP and prefer surgery to enlarge the upper airway because of its potential as a long-term essential cure. The compliance of CPAP is reported to be 40~60% (Hoffstein et al. 1992; Kribbs et al. 1993). It is still controversial whether surgery, especially for adult patients with OSAS, offers reliable and long-term benefits. The present study describes the long-term results after surgical procedures for OSAS patients in 20 children and 17 adults.

PATIENTS AND METHODS

From February 1986 to August 1996, consecutive 53 patients with OSAS underwent surgical treatments. A diagnosis of OSAS was made in patients with an apnea index (AI) greater than 10, oxygen desaturation associated with respiratory events, and/or symptoms such as excessive daytime sleepiness and morning headache, loud snoring, abnormal motor activity, and impaired intellectual performance etc. All patients underwent a complete sleep history and a sleep study using portable monitor (Apnomonitor, Chest Co., Tokyo). The surgical modality was determined by the Mueller method, cephalometry, and measurements of the pressure of mesopharynx and esophagus during sleep, which provided the localization of the airway collapse (Ikeda et al. 1998).

TABLE 1. *Surgical modality of the patients with sleep apnea syndrome*

Procedures	Children ($n=20$)	Adults ($n=17$)
Uvulopalatopharyngoplasty (UPPP) + tonsillectomy	0	12
Tonsillectomy and adenoidectomy	12	0
Tonsillectomy	3	1
Adenoidectomy	5	0
UPPP + midline glossectomy	0	2
UPPP + inferior turbinectomy	0	1
Midline glossectomy	0	1

Thirty-seven out of 53 patients, bed partners and observers completed the questionnaire. The patients consisted of 27 males and 10 females with a mean age of 23 years (range, 1 to 61 years). There were 20 children (<15 years) and 17 adults. The surgery included UPPP, tonsillectomy, adenoidectomy, and laser midline glossectomy, and inferior turbinectomy (Table 1), which were determined by the localization of the airway collapse. The duration of follow-up averaged 92 months (range, 37 to 150 months). The questionnaire included the present height and body weight, the presence or absence of snoring, of sleep apnea, of daytime sleepiness, and of late postoperative complications, and the subjective outcome of surgery. Late postoperative sleep studies measured by portable monitor at home were obtained in 6 patients.

Body mass index (BMI) and AI data were analysed by Student's *t*-test. A *p* value of <0.05 was considered statistically significant.

RESULTS

A significant increase in BMI at questionnaire as compared with that before surgery was observed in children, which may be due to normal growth with age (Fig. 1). On the other hand, there was no significant difference of BMI between preoperative and postoperative periods in the adults.

The changes in snoring were evaluated by the patient's bed partners (Fig. 2). All of the children showed an absence or marked decrease of snoring after surgery. Although most of the adult patients showed an improvement of snoring, 4 patients were found to be unchanged. However, these 4 patients replied that snoring was improved immediately after operation as compared with preoperatively and that snoring became worse with time. This finding suggests that all patients can be

Fig. 1. Changes in body mass index (mean $\pm$ s.d.). $\square$, preoperative period; $\blacksquare$, at questionnaire. *a*, *p* < 0.01; *b*, not significant.

Fig. 2. Changes in snoring obtained by questionnaire. □, absence; ▒, decrease; ■, no change.

Fig. 3. Changes in sleep apnea obtained by questionnaire. □, absence; ▒, decrease; ■, no change.

defined as responders immediately after surgery.

The outcome of apnea symptoms was examined (Fig. 3). Similarly to snoring, sleep apnea totally disappeared in child patients. In adults, 4 patients showed no change in sleep apnea in the late postoperative period, two of whom were transiently improved immediately after surgery. The symptomatic response of daytime sleepiness was analysed (Fig. 4). A complete elimination was observed in 16 patients and a moderate improvement in 4 child patient. In adults, daytime sleepiness disappeared in 8 patients and 4 patients showed a moderate

Fig. 4. Changes in daytime sleepiness obtained by questionnaire. □, absence; ▨, decrease; ■, no change.

Fig. 5. Changes in apnea index (mean $\pm$ S.D.). □, preoperative period; ▨, postoperative period immediately after surgery; ■, postoperative period long-term after surgery. a, not significant; b, $p < 0.01$.

improvement, but one patient complained of daytime sleepiness, who was the same patient with unchanged snoring and sleep apnea.

There were 2 children and 8 adults with late complications. Two children complained of rhinolalia. In adults, 6 patients sometimes complained of nasal regurgitation due to velopharyngeal incompetence and 2 patients felt an unpleasantness in the throat.

Based on symptomatic success and the presence of complications, the surgical

outcome was evaluated by the questionnaires. All child patients except one showed a satisfactory outcome after surgery. One patient receiving surgery in childhood made no opinion concerning the outcome despite the absence of snoring, sleep apnea and postoperative complications. Among adults, 4 patients complained of unsatisfactory outcomes and one gave no opinion.

Preoperative and postoperative results of sleep studies obtained by portable monitor are shown in Fig. 5. Eleven out of 20 children underwent a preoperative sleep study, in which the mean AI was 14 per hour. A sleep study was performed in only two patients in the early postoperative period. The AI returned to the normal range in both patients. All of the adult patients underwent a sleep study before the operation, and the mean AI was 40 per hour. Immediately after operation, the AI was significantly decreased to 4 per hour ($n=8$), which remained within a normal range in the late postoperative period ($n=6$). However, we could obtain a long-term result of the sleep study in only one out of 4 patients with an unsatisfactory outcome. The AI of this patient changed from 51 per hour preoperatively to 16 per hour late postoperatively, which is considered to be satisfactory result.

DISCUSSION

The gold standard for treatment of OSAS in infants and children is tonsillectomy and/or adenoidectomy (Gaultier 1992). Although associated problems such as an abnormally long soft palate, retroposition of the mandibule, or soft tissue infiltration behind the base of the tongue can occur after operation, none of our patients had residual problems after operation. It is also reported that OSAS may recur after puberty, especially in men (Guilleminault et al. 1989), however, no apparent recurrence of sleep-related symptoms in our child patients was observed in spite of the increased BMI. Although one patient did not reply to the question on the surgical outcome, the symptomatic improvement without late postoperative complications suggests the successful result of surgery in this patient. In this study, postoperative sleep results were obtained from only 2 patients. Objective assessment of sleep condition would further support improvement in surgical treatment. Thus, these findings confirmed that tonsillectomy and/or adenoidectomy for infants and children with OSAS should be the first modality for treatment.

Analysis of surgical success or failure in UPPP in adult patients with OSAS involves several different aspects. The long-term results of surgery on breathing during sleep and on sleep quality have been extensively investigated. Conway et al. (1985) concluded that, after 1 year-follow-up, 20 of 33 patients could be defined as responders. However, weight gain after surgery jeopardizes the good surgical results. Guilleminault and coworkers (1983) reported that weight increase after surgery was also associated with poor objective results. In the present study, there was no significant difference between preoperative and postoperative average

BMI. Moreover, the patients with unsatisfactory symptomatic results showed no significant changes in BMI. Various papers have indicated a discrepancy between subjective improvement and absence of objective favorable changes (Blakley et al. 1986; Gislason et al. 1988; Regestein et al. 1988). Namely, the results obtained by questionnaire tend to be better in most patients after UPPP, irrespective of the poor results of postsurgical sleep monitoring. Although about half of the adult patients underwent sleep studies postoperatively immediately and late after surgery, AI returned to the normal range in all patients examined. The postsurgical signs of our cases were well consistent with the subjective improvement, which would suggest an appropriate preoperative assessment of the localization of the airway obstruction. We could obtain the AI in only one patient with a unsatisfactory symptomatic outcome, in whom the AI had declined from 51 to 16 after UPPP. The other 3 patients with unsatisfactory subjective outcomes could be expected to have poor objective results. The possibility of weight gain after surgery can be neglected as a cause of the poor subjective results because there was no change in BMI. Another possibility as a causative factor for the failure of late postoperative improvements after surgery in adult non-responders is inadequate selection of the surgical procedure due to insufficient assessment of the localization of obstruction of the airway (Skatvedt 1995; Ikeda et al. 1998). Recently, we introduced the dynamic magnetic resonance imaging (MRI) during awake and asleep conditions to assess the airway collapse (Ikeda et al. 2000). Last, airway collapse of unknown origin may have occurred, presumably due to the local deposit of flaccid tissue in the collapsible part of airways. A combination of surgical options and nasal CPAP may be effective for patients with poor surgical responders.

In conclusion, long-term follow-up of OSAS after surgery including questionnaire and sleep study was performed in order to evaluate effectiveness of surgery for OSAS. Tonsillectomy and/or adenoidectomy were proved to be quite effective in children with OSAS. Approximately 80% of adults with OSAS showed satisfactory results with UPPP plus tonsillectomy. The current strategy for improving the success rate of surgical treatment for OSAS is to perform preoperative localization of the obstruction in the airway including the Mueller maneuver, continuous pressure measurement of the upper airway, and dynamic MRI.

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