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The epiglottis and obstructive sleep apnoea syndrome

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Abstract

Obstructive sleep apnoea syndrome (OSAS) is caused by obstruction or narrowing of the airway at various levels. The repair of one site only will not alleviate the syndrome if there are obstructions in other sites. Epiglottis prolapse during inspiration is an unusual cause of airway obstruction and a rare cause of OSA.

Twelve cases of OSAS due to an abnormal epiglottis are presented. We present our approach to the diagnosis using fibre-optic examination of the hypopharynx, and our treatment using endoscopic carbon dioxide laser partial epiglottidectomy.

We found in our series that in 11.5 per cent of patients who failed the uvulopalatopharyngoplasty procedure, the reason was a narrow airway at the hypopharyngeal level caused by an abnormal epiglottis. It is our suggestion that in these cases a laser partial epiglottidectomy should be performed. The results of this study show that partial epiglottidectomy can increase the cure rate of patients with obstructive sleep apnoea syndrome by 10–15 per cent.

Key words: Sleep apnoea syndromes; Epiglottis; Laser surgery

Introduction

Sleep apnoea presents a broad spectrum of symptoms that can range from snoring to life-threatening cardiac and pulmonary complications (Thawley, 1995). Three general types of sleep apnoea have been described: central apnoea, obstructive apnoea, and mixed apnoea. The obstructive sleep apnoea syndrome (OSAS) results from any of a large number of pathological conditions that cause total or partial repetitive upper airway obstructions and periodic reductions in air flow during sleep (Simmons, 1993). Its prevalence occurs in about four per cent of middle-aged men, and up to two per cent of middle-aged women (Pillar *et al.*, 1996). Patients with OSAS may have airway obstruction at various levels, including the uvula-soft palate complex, base of tongue, and/or possible other sites (Crumley *et al.*, 1987). Another site of possible obstruction, the nose, is considered to be a relatively minor contributor to significant degrees of OSAS (Simmons, 1993).

Surgical treatment of patients with OSAS must be aimed at the site of the obstruction. In the last two decades since Fujita *et al.* (1981) described the uvulopalatopharyngoplasty (UPPP) procedure, most of the attention was focused on the uvulo-palatal region, since this was considered the site that most often collapsed during sleep. Today UPPP is the most frequent surgical procedure for OSAS (Strollo and Rogers, 1996). Unfortunately, it was found that although the procedures performed to relieve the obstruction at this level (UPPP and laser-assisted uvulopalatoplasty) have been effective in some patients, they have been a complete failure in others. While these procedures were found to be extremely effective (90 per cent or better) in eliminating the snoring component of OSAS, the overall cure rate of the sleep apnoeas was approximately only 50 per cent (Crampette *et al.*, 1992; Launois *et al.*, 1993; Simmons, 1993). This poor outcome suggests that narrowing of the pharyngeal airway at non-palatal sites contributes to the obstructive process in many patients with OSAS. Other procedures designed to relieve the obstruction at other levels were suggested in the last few years, such as inferior sagittal mandibular osteotomy and genioglossal advancement with hyoid myotomy, maxillary and/or mandibular osteotomy and advancement, partial glossectomy, or tracheotomy, but they are usually associated with high morbidity (Woodson and Fujita, 1992).

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Collapse of normal supraglottic structures in adults has rarely been described as a cause of laryngeal obstruction. In newborns, the most common congenital cause of stridor is laryngomalacia. In these patients the epiglottis is usually of abnormal configuration and as a result, on inspiration the flaccid epiglottis collapses into the laryngeal inlet, thereby occluding the airway (Kletzker and Bastian, 1990). Templer *et al.* (1981) described a cause of congenital laryngeal abnormality persisting into adulthood. A lax epiglottis was found to initiate OSAS in a patient by Andersen *et al.* (1987). Person *et al.* (1988) reported on their experience with treatment of redundant aryepiglottic folds as a cause of stridor. Woo (1992) presents eight cases of acquired supraglottic airway collapse as a cause of stridor. The cause of airway obstruction in this series was prolapse of the epiglottis during inspiration. Simmons considered an unusually floppy and redundant epiglottis to be a possible cause of OSAS (Simmons, 1993). Chetty *et al.* (1994) reported a case of an adult patient with an airflow-induced collapse of the epiglottis into the laryngeal inlet causing intermittent obstruction.

The terms 'epiglottoplasty', 'supraglottic trimming', and 'anterior epiglottopexy' have been used to describe surgical procedures that excise obstructing supraglottic tissues (Marcus *et al.*, 1990). The exact site and extent of the resection are individualized for each patient according to the anatomic abnormality causing the obstruction. Woo (1992) used carbon dioxide laser through a laryngoscope to trim the top half of the suprahyoid epiglottis. Mickelson and Rosenthal (1997) recently presented 12 patients with OSAS whose syndromes were resolved following midline glossectomy and epiglottidectomy. This study presents our experience with 12 patients who, following UPPP procedure, still suffered from airway obstruction which was related to an abnormal epiglottic position and configuration.

We present the diagnostic work-up of this condition and the surgical procedure designed for its alleviation.

Materials and methods

One hundred and four patients with obstructive sleep apnoea syndrome were evaluated using fibre-optic endoscopy. All of the patients had undergone the UPPP procedure at least two years before the endoscopic evaluation but still had clinical and polysomnographic (PSG) evidence of OSAS.

The patient population was comprised of 86 males and 18 females ranging in age between 19 and 67 years with a mean age of 42.3 ± 14.6 years. Body mass index (BMI) ranged from 20.1 to 57.6 kg/m^2 (mean = 38.2 ± 9.6 kg/m^2).

All of the patients had PSG studies showing a decrease in oxygen blood saturation down to 33-84 per cent (mean = 68 ± 8.6 per cent) and a sleep apnoea index of 27-87 (mean = 42 ± 16.4), each lasting a mean of 23 ± 14.3 seconds. Only nine patients were still snoring, but to a lesser degree than prior to the UPPP procedure.

Twenty-two patients had used the continuous positive airway pressure (CPAP) device. Nineteen patients experienced the feeling of being suffocated, and three patients simply had resistance to the notion of wearing a night-time mask indefinitely.

The fibre-optic examination of the hypopharynx was performed using a Machida fibre-optic scope, 3.3 mm or 4.0 mm. The fibre-optic laryngoscope was attached to a video system for magnification and documentation so that all of the fibre-optic evaluations could be videotaped, thus enabling subsequent review and evaluation by other independent otolaryngologists.

All patients were locally anaesthetized using two per cent lidocaine spray to the nasal cavities and the throat. After a three-minute wait, Cetacaine™ was sprayed once in each nasal chamber and once through the mouth when the patient was inhaling. All procedures were performed in an office setting with the patient in the sitting position first, and then reclining with the head and neck hyperextended. By examining the patients in the supine position we did not find any differences regarding the position of the epiglottis. Although sleep endoscopy is considered to be a gold standard procedure, unfortunately we lack the facilities to perform this important diagnostic procedure, and, therefore, we were unable to examine these patients fibre-optically during sleep.

All patients were asked to pant with deep oral or nasal inspiration and expiration during the fibre-optic examination, at a rate of one pant per second. We have found that the effect on the epiglottis is a constant effect either with nasal or with oral inspiration. The patients were rested between every six pants, and tested for a total of 24 pants.

The entire upper airway was examined thoroughly regarding the degree of obstruction caused by the epiglottis at the supraglottis and hypopharyngeal level. A rating scale was created for the purpose of identifying stages of the position of the epiglottis with respect to the base of the tongue during deep inspiration.

Four stages have been formulated:

Stage 0 - epiglottis hugs the tongue
Stage 1 – epiglottis between 0 and 45 degrees
Stage 2 – epiglottis between 45 and 90 degrees
Stage 3 – epiglottis over 90 degrees.

We used the term 'epiglottic entrapment' to describe the apparent obstruction of the glottis by the epiglottis during inspiration. An audible slapping sound can be heard at times when this occurs.

Partial epiglottidectomy was the procedure of choice for the alleviation of the obstructions caused by the epiglottis when it was in the stage 2 and stage 3 positions. The procedure was performed by means of an intraoral approach, under general anaesthesia, delivered through a laser-safe endotracheal tube. The patient was placed in Rose's position and Dedo's laryngoscope was used to expose the upper part of the epiglottis. A Sharplan CO_2 laser attached to a Zeiss surgical microscope at a power of 20-30 watts was then used in a continuous or superpulsated mode.

The upper middle one third to a half of the epiglottis was resected using a 'U' shaped incision with its convexity inferiorly. The sides of the epiglottis were left intact to avoid exceptional bleeding and to act as lateral stilts, which allow normal epiglottic function post-operatively. The resected epiglottic specimens were sent for pathological evaluation.

All patients were administered 10 to 15 mg of intravenous dexamethazone sodium intra-operatively, and in the post-operative period. No patients required post-operative intubation or tracheotomy. Peri-operative antibiotics were also administered to all patients. Liquid diet was begun on the first post-operative day, and patients were discharged when adequate oral intake was tolerated, usually two to five days.

Evaluation of the surgical success (or failure) was performed on the basis of:

(1) Post-operative oxygen saturation levels as measured in the recovery room and during the patients' stay in the hospital.

(2) Personal questionnaires: the patients reported whether the operation was successful, partially successful or not successful with respect to their pre-operative complaints.

(3) Nocturnal PSG studies performed at least one year following surgery.

Values before and following surgery were compared by the paired Student *t*-test. *P* values less than 0.05 were considered significant.

Results

The fibre-optic findings demonstrated that in 11.5 per cent of the patients (12 patients) the epiglottis was in Stage 2 (nine patients) or Stage 3 (three patients), in which it was sucked backwards during inspiration against the posterior wall of the hypopharynx. Partial epiglottidectomy was performed on these 12 patients.

There were no serious complications associated with any of these procedures, including no significant post-operative bleeding or infection, no voice change or speech impairment, no regurgitation of fluids to the nasopharynx, and no aspirations.

Post-operative oxygen saturation levels increased from an average of 82 per cent prior to surgery to an average of 93 per cent post-operatively (statistically significant). All of the patients responded to the questionnaires. Seven patients (58.3 per cent) considered the operation to be a success, two patients (16.6 per cent) considered the operation to be partially successful, and three patients (25 per cent) did not consider the surgery to be successful in alleviating their symptoms. The overall successful rate, following the questionnaires, was therefore, 75 per cent.

Nocturnal PSG studies were performed at least one year post-operatively on nine patients. There was resistance on the part of the remaining patients to have a repeat study, mostly because they felt clinically improved and claimed that there was no need for them to subject themselves to further testing or its financial burden. Comparing the results of the PSG studies performed pre-operatively to those which were performed following the operations, we found a dramatic increase in the oxygen blood saturation from 68 per cent ± 8.6 per cent pre-operatively to 94 per cent ± 3.8 per cent following surgery. The sleep apnoea index decreased from 42 ± 16.4 to 8 ± 3.2 (range 2 to 38) post-operatively, and the duration of the apnoeas decreased also from 23 ± 14.3 seconds to 12 ± 4.6 seconds (statistically significant).

Discussion

Obstructive sleep apnoea syndrome (OSAS) is a disorder characterized by repetitive collapse of the upper airway causing periodic cessation of breathing during sleep (Woodson and Fujita, 1992; Fujita *et al.*, 1985). Patients with OSAS may have airway obstruction at various levels. The site or sites of airway narrowing or obstruction must be accurately diagnosed prior to any surgical procedure in order to achieve the best results.

With the use of the flexible fibre-optic laryngoscope, more accurate information was obtained regarding obstruction sites in awake and sleeping patients (Guilleminault *et al.*, 1978). Crumley *et al.* (1987) demonstrated that fibre-optic endoscopy of the upper airway in the sitting and supine positions was helpful in confirming airway sites with smaller diameters in awake patients.

Reports in the literature describe attempts at elucidating the relative importance of the various sites of obstruction in sleep apnoea patients (Wilms *et al.*, 1982). With regard to the voluminous studies which were published since OSAS was introduced in the 1970's, only a few reports related OSAS to a pathologically large and lax epiglottis (Templer *et al.*, 1981; Andersen *et al.*, 1987; Person *et al.*, 1988; Woo, 1992; Simmons, 1993; Chetty *et al.*, 1994; Mickelson and Rosenthal, 1997).

The surgical treatment of OSAS has evolved from crude but effective tracheostomy to a variety of site-specific procedures directed at collapsible areas of the upper airway. These areas have been described as having disproportionate anatomy (Fujita *et al.*, 1991). However, most of the surgical procedures such as UPPP, maxillary and/or mandibular advancements, lingualplasty or partial glossectomy, are associated with only 50 per cent relief of the syndrome or with high morbidity to the patients (Crampette *et al.*, 1992; Woodson and Fujita, 1992; Launois *et al.*, 1993; Simmons, 1993).

Hypopharyngeal obstruction is postulated to explain persistent OSAS in many patients who did not obtain sufficient benefit from UPPP (Crumley *et al.*, 1987). Studies of closing pressures during sleep indicate that up to 50 per cent of OSAS subjects may have significant hypopharyngeal collapse (Shepard and Thawley, 1990). In view of this information and considering the epiglottis to be one of the obstructive elements in the hypopharynx, we conducted this study.

Using the flexible fibre-optic pharyngoscope we have observed and documented the fact that the epiglottis may contribute to hypopharyngeal obstruction to various degrees depending on its position in relation to the base of the tongue and the posterior wall of the hypopharynx. Partial or nearly total obstruction by the epiglottis at the supraglottic level was found in 11.5 per cent of the patients who had already undergone the UPPP procedure.

Comparing the results of the PSG studies obtained from our patients to the findings of the fibre-optic evaluations, we have found a direct correlation between the degree of the OSAS (oxygen saturation, apnoea index, mean duration of apnoeas) and the position of the epiglottis. In the most severe cases, the epiglottis was sucked backwards and downwards during inspiration into apposition with the posterior pharyngeal wall until total obstruction of the laryngeal inlet occurred (stage 3). In the least severe cases, the epiglottis was found to be in stage 2 position.

By cutting out the upper middle one third to a half of the epiglottis in those cases where its position was in stage 2 or 3, the entire aerodynamic shape of the hypopharynx was changed, and the obstruction caused by the epiglottis was relieved.

The PSG studies performed post-operatively, together with post-operative oxygen saturation levels and the patients' responses, show clearly that by performing partial epiglottidectomy with other procedures such as UPPP or partial glossectomy, the cure rate of OSAS raises from 50 per cent to about 60-65 per cent.

Conclusion

Fibre-optic evaluation of the oropharynx and hypopharynx should be performed in all patients prior to any surgical procedure because it enables the surgeon to directly view the airway and compare the airway diameters at any level, and to visualize any unforeseen pathology.

Using this technique, our findings revealed that partial or total hypopharyngeal obstruction by the epiglottis may contribute to OSAS, and in cases where the epiglottis is in Stage 2 or 3, this may be the major contributing factor for the OSAS. Our experience with laser partial epiglottectomy clearly indicates that such surgery can play a significant role in the surgical management of OSAS, especially in those patients for whom the UPPP procedure did not alleviate the obstruction.

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