Research Article

Comparative evaluation of surgical modalities in cases with obstructive sleep apnea syndrome

Manish Sharma, Om Prakash, Mohit Goel

Department of ENT, SMGS Hospital—Government Medical College, Jammu, Jammu & Kashmir, India.
Correspondence to: Manish Sharma, E-mail: maddys654@gmail.com

Received December 17, 2015. Accepted December 23, 2015

Abstract

Background: Sleep apnea is divided into three main types: central sleep apnea syndrome (CSAS), obstructive sleep apnea syndrome (OSAS), and mixed sleep apnea syndrome (MSAS). OSAS is responsible for 80% of cases of sleep apnea.

Objective: To determine the surgical outcome in patients with obstructive sleep apnea (OSA) following classical uvulo-palatopharyngoplasty (UPPP) and modified UPPP and to compare the long-term results of surgery with nasal continuous positive airway pressure (n-CPAP) therapy.

Materials and Methods: Twenty-four diagnosed cases of OSAS were included in this study. These cases were divided into three groups of equal sizes (eight cases each). Cases in group I were subjected to modified UPPP, group II cases were subjected to classical UPPP, and group III were subjected to CPAP therapy.

Results: There were only 2 female patients out of 24 cases (8.33%). All the male patients were alcoholic ($n = 22$), and out of the 24 cases 41.66% ($n = 10$) were smokers. The cephalometry analysis of these patients was as follows: the mean distance from mandibular plane to hyoid bone in group I patient was 22 mm, group II 20.37 mm, and group III 20.87 mm. The mean posterior airway space in group I was 11.37 mm, group II was 11.12 mm, and group III was 11.75 mm. The mean length of soft palate in group I was 47.75 mm, group II was 42.62 mm, and group III was 45.37 mm. Out of the 24 patients in our study 16 underwent surgical treatment.

Conclusion: About 80%–90% of our patients of group I were satisfied subjectively at 1-month follow-up. About 66%–75% of group II patients were also satisfied at 1-month follow-up. About 95%–100% of group III patients were also free of symptoms of OSA who were using CPAP daily.

KEY WORDS: Apnea, cephalometry, continuous positive airway pressure, uvulopalatopharyngoplasty

Introduction

Human beings sleep for one-third of their lives. It may accordingly be said that “quality sleep” and “better life” are synonymous. Insufficient sleep reduces the information controlling capability of the brain and impairs body function.

Access this article online	
Website: http://www.ijmsph.com	Quick Response Code:
DOI: 10.5455/ijmsph.2016.17122015279	

So, sleep disorders lower the quality of life and causes social problems. Sleep apnea syndrome was first described in 1956. Apnea index (AI) is the number of apneic episodes per hour of sleep. Hypopnea is 50% reduction in the thoracoabdominal movements lasting for 10 seconds in the presence of continued air flow and or at least 4% decrease in oxygen saturation (SPO_2). With the better knowledge of this entity, there is abundance of literature regarding redefining the criteria of sleep apnea syndrome, the recent being apnea–hypopnea index >15 (AHI > 15), where AHI is the number of apnea–hypopnea per hour.[1] Apnea is defined as the cessation of breathing for at least 10 seconds. Sleep apnea is divided into three main types: central sleep apnea syndrome, obstructive sleep apnea syndrome (OSAS), and mixed sleep apnea syndrome. OSAS is responsible for 80% of cases of sleep apnea. According to severity of the disease, OSA has been graded into three degrees (mild, moderate, and severe) according to the American Sleep Association.[1] OSA predominantly affects the elderly, obese males, and patients who abuse alcohol and sedatives. There have been changes in management options for OSA, which earlier were medical in the form of weight reduction and nasovent mandibular and tongue positioning prosthesis. The most effective medical treatment is nasal continuous positive airway pressure (n-CPAP) technique. The problems associated with the CPAP are patient compliance and local nasal mucosal irritation. Surgical options for OSA management depend on the levels of obstruction that include septorhinoplasty, palatal surgery, maxillofacial surgery, hyoid suspension, infrahyoid myotomy, mandibular advancement, mandibular osteotomy, midline glossectomy, and tracheostomy. Most effective and common surgical procedure for OSA is uvulopalatopharyngoplasty (UPPP). Classical UPPP is designed to correct upper airway narrowing at three levels, that is, soft palate, the tonsils, and the pharynx. In our study, we performed the modified UPPP (lateral palato pharyngo-glossoplasty, LPPGP) in one of the groups (comprising eight cases) in which in addition to classical UPPP, we removed the lateral part of the base of tongue and compared the surgical outcome of these with eight patients who underwent classical UPPP and eight patients treated by CPAP therapy by doing polysomnography preoperatively and 1 month after the surgery. Successful surgery was defined as AHI reduction by 50% and a postoperative AHI less than 20 or an AI reduction by 50% and a postoperative AI less than 10.[2]

Materials and Methods

Twenty-four diagnosed cases of OSAS presented to the outdoor services of Department of Otolaryngology, Head and Neck surgery, Government Medical College, Jammu, India, between July 2013 and July 2014 were included in this study. These cases were divided into three groups of equal size on the basis of computerized randomization table. Group I comprised 8 cases that were subjected to modified UPPP, group II comprised 8 cases subjected to classical UPPP, and group III comprised 8 cases subjected to CPAP therapy. The diagnosis of OSA was based on demographic, subjective (snoring, excessive daytime sleepiness, impaired intellectual and social performance), and objective criteria (AHI > 20, polysomnography [PSG], lateral cephalometry, body mass index [BMI], Epworth sleepiness scale [ESS], modified Mallampati grading [MMP]).

Polysomnography

It involves spending a night or more in a sleep laboratory connected to variety of monitors. It measures all the standard parameters in overnight PSG, which includes electroencephalogram, submental electromyogram (EMG), electrocculogram, oxygen saturation (PaO_2), electrocardiogram, nasal and oral airflow, chest and abdominal movement, tracheal microphone, esophageal manometry, anterior tibialis EMG, and sleep position detector.

Lateral cephalometry

Cephalometry is a standardized lateral radiograph of the head and neck showing upper airway bony and soft-tissue structures. Cephalometry analysis is among the most commonly used methods of evaluating patients with OSA. Cepahlometric study identifies several specific hard and soft-tissue structures that can help in the diagnosis of OSA. Important measurements include mandibular plane to hyoid (MP-H) distance; posterior airway space (PAS), which is the distance from the posterior pharyngeal wall to tongue base; and soft palate length (PNS – P), which is characteristically increased in OSA. Normal value of important cephalometeric measurements include MP-H (17 ± 6 mm), PAS (10 ± 3 mm), PNS – P (42 ± 5 mm), FMA (Frankfort Mandibular plane angle) (24 + 5°), and SNA (Sella to nasion to point A) (83 + 4°). Cephalometry allows assessment of any maxillomandibular hypoplasia and is obviously essential if considering maxillofacial surgery.

Body mass index

Obesity was found to have a strong association with OSA. In our study, more than 90% of our patients were obese.

BMI = weight in kilogram/ height in meter^2 (kg/m^2).

Epworth sleepiness scale

It is a self-administered questionnaire that provides a measurement of the patient's general level of daytime sleepiness. ESS score increases with the severity of OSA and is more closely related to AHI than the degree of hypoxemia. Normal score is taken between 2 and 10. A score ≥16 is always associated with moderate to severe OSA, narcolepsy or idiopathic hypersomnia. All patients in our study groups had ESS score >15.

All patients with polysomnographic evidence of OSA were included in this study. The cases in group I and group II were admitted a day prior to surgery. They were evaluated with detailed history, clinical examination, routine hematology, and biochemical analysis.

Surgical procedures

Classical uvulopalatopharyngoplasty

In the procedure we removed the tonsils, uvula, and part of soft palate and then sutured the raw area with 3-0 vicryl sutures. The procedure was done under general anesthesia with nasotracheal intubation.

Modified uvulopalatopharyngoplasty

In this procedure, we removed the lateral part of the base of tongue in addition to the steps of classical uvulopalatopharyngoplasty with electric cautery and sutured the raw area with 3-0 vicryl sutures.

Follow-up

These patients were followed up at weekly interval for 1 month and then repeat polysomnography were done.

Results

This study was conducted on 24 cases of OSA. The demographic parameters included were age, sex, BMI (kg/m^2), ESS score, MMP grade, tonsil grade, alcoholism, and smoking. There were only 2 female patients out of 24 cases (8.33%). All the male patients were alcoholic (n = 22) and out of 24 cases, 41.66% (n = 10) were smokers. All of these 24 patients were randomly grouped into three groups depending on the type of treatment option these patients received. Each group—group I (modified UPPP), group II (classical UPPP) (Figure 3), and group III (n-CPAP)—comprised 8 patients.

Mean age of patients in group I was 49.50 years (n = 8), group II was 42.87 years (n = 8), and group III was 49.50 years (n = 8) with no statistically significant difference among the age of three groups (P > 0.10). The mean BMI (kg/m^2) of group I (modified UPPP) was 29.21, of group II (classical UPPP) was 30.27, and group III (n-CPAP) was 31.60 with no statistically significant difference (P > 0.10). The mean ESS score of group I was 20, group II was 22.5, and group III was 19.12 with no statistically significant difference (P > 0.10). The mean grade of tonsillar hypertrophy was grade II in all the groups. MMP grade of Groups I, II, and III was 2.75, 3.0, and 2.62, respectively (Table 1).

The cephalometry analysis of these patients was as follows: the mean distance from MP-H in group I, group II, and group II was 22, 20.37, and 20.87 mm, respectively. The mean PAS in group I, group II, and group III was 11.37, 11.12, and 11.75 mm, respectively. The mean length of soft palate in group I, group II, and group III was 47.75, 42.62, and 45.37 mm, respectively. The mean FMA angle in group I was 36.87°, in group II was 36.87°, and group III was 36.38°, respectively. The mean SNA angle in group I was 53.75° in group II was 56.62°, and in group III was 53.37°, respectively. Of the 24 patients in our study, 16 underwent surgical treatment (Table 2).

Polysomnography analysis

The mean preoperative AHI per hour of group I, II, and III preoperatively was 63.79 (n = 8, S.D = 28.15), 70.60 (n = 8, S.D = 14.19), and 59.30 (n = 8, S.D= 31.75), respectively. The mean AHI per hour postoperatively of group I, group II, and group III was 26.29 (S.D = 14.41), 46.93 (S.D = 9.58), and 0.00 (S.D = 0.00), respectively. The mean preoperative average oxygen saturation (SaO_2) of group I, group II, and group III was 92.68 (n = 8, S.D = 3.04), 88.61 (n = 8.5 D = 4.65), and 79.12 (n = 8, S.D = 13.09), respectively.

$$\%\text{Change} = \frac{\text{pre-operative} - \text{postoperative}}{\text{pre-operative}} \times 100$$

From this study, the %change in AHI/hour in group I, II, and group III was 58.78%, 33.11%, and 100.00%, respectively. All these data were statistically analyzed. Polysomnographic variables after 1-month follow-up were further analyzed as below.

The mean postoperative AHI/hour of group I (modified UPPP), group II (classical UPPP), and group III (n-CPAP) was 26.29 (S.D = 32.94, SEM = 10.98, p < 0.002), 46.93 (S.D = 8.14, SEM = 2.88, p < 0.001), and 0.00 (S.D = 31.75, SEM = 11.22, p < 0.001), respectively (Tables 3–7).

Discussion

OSA happens as a result of structurally and abnormally collapsible airway. Significant advances have been made in the evaluation and management of sleep disordered breathing in the past. Advances in the treatment of OSA are aimed to reduce the number of episodes of apnea–hypopnea, reduce the number of arousals, and to normalize the oxyhemoglobin saturation levels. These changes have been correlated with an improvement in daytime alertness and quality of life.[3] The mainstay of therapy for OSA syndrome is n-CPAP therapy, which maintains a patent airway during sleep, thereby avoiding apnea. However, although CPAP is highly effective, compliance and acceptance with the treatment is a problem. The other treatment options include surgical management. The most widely used surgical therapy, UPPP, described in 1981 with only 41% of the patients undergoing UPPP, obtain an AHI of fewer than 20 events per hour of sleep, which is not labeled as an adequate surgical outcome. More aggressive surgical

Table 1: Demographic analysis

	Mean age (years)	Mean BMI (Kg/m^2)	Mean ESS score	Mean MMP grade	Mean tonsil grade
Group I (modified UPPP)	49.50	29.21	20	2.75	2
Group II (classical UPPP)	42.87	30.27	22.5	3	2
Group III (n-CPAP)	49.50	31.60	19.12	2.62	2

Table 2: Cephalometry analysis

	Mean MP-H (mms)	Mean PAS (mms)	Mean PNS – P (mms)	Mean FMA (degree)	Mean SNA (degree)
Group I (modified UPPP)	22	11.37	47.75	36.87	53.75
Group II (classical UPPP)	20.37	11.12	42.62	36.87	56.62
Group II (n-CPAP)	20.87	11.75	45.37	36.38	53.37

Table 3: Polysomnography analysis

	Mean AHI/Hour		Mean SaO_2 average %		Mean SaO_2 worst %		Mean longest apnea (seconds)		Mean average SaO_2 de-saturation %	
	Pre-op.	Post-op.	Pre-op.	Post-op.	Pre-op.	Post-op.	Pre-op.	Post-op.	Pre-op.	Post-op.
Group I (modified UPPP)	63.7	26.29	92.68	95.50	64.37	80.75	91.76	78.25	14.12	6.12
Group II (classical UPPP)	70.60	46.93	88.61	92.75	61.00	77.12	97.58	75.37	15.25	8.50
Group III (n-CPAP)	59.30	0.00	79.12	98.75	50.37	96.62	58.17	11.25	10.25	1.50

Table 4: Polysomnography analysis after 1-month surgery (% change, efficacy)

	Mean % change in AHI/hour	Mean % change in SAO_2 average	Mean % change SAO_2 worst	Mean % change in longest apnea	Mean % change in average SAO_2 desaturation
Group I (modified UPPP)	58.78	2.96	19.77	11.55	55.97
Group II (classical UPPP)	33.13	4.49	21.23	17.70	43.15
Group III (n-CPAP)	100.00	19.87	47.91	82.48	84.89

Table 5: Polysomnographic variables after 1-month follow-up (group I)

	Mean	Standard deviation	Standard error mean	*P*-value
AHI (per hour)	37.68	32.94	10.98	0.002
SaO_2 ave. %	−3.17	2.31	0.77	0.003
SaO_2 worst %	−17.44	12.30	4.10	0.003
Longest apnea seconds	19.23	28.15	9.38	0.75
Ave. SaO_2 desaturation	7.88	2.71	0.90	0.000

Table 6: Polysomnographic variables after 1-month follow-up (group II)

	Mean	Standard deviation	Standard error mean	*P*-value
AHI (per hour)	23.66	8.14	2.88	0.001
SaO_2 ave. %	−4 .13	2.35	2.88	0.002
SaO_2 worst %	−16.12	7.60	0.83	0.001
Longest apnea seconds	22.21	25.16	2.68	0.041
Ave. SaO_2 desaturation	6.74	3.84	1.359	0.002

Table 7: Polysomnographic variables after 1-month follow-up (group III)

	Mean	Standard deviation	Standard error mean	*P*-value
AHI (per hour)	59.30	31.75	11.22	0.001
SaO_2 ave. %	−19.62	13.08	4.62	0.004
SaO_2 worst %	−46.25	23.96	8.47	0.001
Longest apnea seconds	46.92	9.66	3.41	0.000
Ave. SaO_2 desaturation	8.75	1.83	0.64	0.000

options such as UPPP with genioglossus advancement, hyoid suspension, and hyoidthyroidpexia have also been reported with decrease in AHI ranging from 10%–60%.[4–8] However, most patients in these series had mild or moderate OSA, and follow-up was short.[4] Classical UPPP is a surgery designed to correct upper airway narrowing at three levels: the soft palate, the tonsils, and the nasopharynx. The most common short-term morbidities with classical UPPP include pain in the throat, dry throat, valopharyngeal insufficiency (VPI), and difficulty in swallowing. The most common long term morbidity is classified as "abnormal sensation" in the throat, described in various ways by the patients including complaints of a "lump" in the throat and difficulty in swallowing. Definition of surgical success has been widely variable. In most of the reports, success has been considered when there was a reduction of AHI score below 20 events per hour or when there was a decrease of 50% in the AHI per hour after surgery.[2] Subjective response after these three treatment modalities in our study was also analyzed using the various parameters such as improvement in daytime sleepiness, for example, reduction in ESS score <10. Our definition of surgical success included improvement in variables, AHI, and ESS score.

Our study included 24 patients having moderate to severe OSA. This study showed that modified UPPP was effective in reducing the AHI per hour by 59%. The classical UPPP was effective in reducing the AHI per hour by 33% in this study. The gold standard therapy, CPAP, was effective in reducing AHI per hour by 100% in this study. This study showed that the success rate of modified UPPP is higher than that in a previous study in which the rate of success ranged between 25% and 55% using UPPP in addition to other surgical techniques.[4] Another important finding in our study was negative correlation between the pre-surgery BMI and the postsurgery AHI. The more obese patients (e.g., BMI > 33 kg/m^2) had lower decrease in the postsurgical AHI. It is feasible that increase in the intraluminal pharyngeal pressure in these patients was not overcome by surgery, we will need to investigate the cause for the poor response in very obese patients. Possible mechanism by which obesity could increase the upper airway resistance includes airway narrowing as a result of fatty deposits in the pharynx and others soft tissues and a decrease in the diaphragmatic compliance caused by accumulation of fat in the abdominal wall.[9] There has been a long-term study on OSA, which is very close to our modified UPPP, that is 8 years of follow-up of UPPP combined with midline glossectomy as a treatment for OSA.[10] In this study of 22 cases of OSA, UPPP was combined with the midline glossectomy of the dorsum of tongue. The BMI was normal in 13 cases and abnormal in 9 cases of that study. The AI was reduced in 82% of the cases 12 months postoperatively, being reduced by 50% in 59% of the cases and normalized in 32%. After 8.4 years of follow-up, reduction in AI was 75% and normal AI in 25% of the patients. On subjective rating scale, 95% of the patients were satisfied with the results at the first follow-up, and the figure was 86% at the fourth follow-up; 64% did not suffer from sleep apnea at the first follow-up as compared with 46% at 6-monthly follow-up. There were no immediate postoperative complications in any of the patient and only minor long-term problems. No relationship was found between BMI and surgical outcome in this study. Our study matched with a study conducted in pediatric population suffering from OSA.[11]

In our study, the results of modified UPPP group in terms of subjective improvement in snoring and daytime sleepiness are very encouraging. We found a statistically significant decrease in AHI per hour of sleep to 59% ($p < 0.05$) which has a very close resemblance to the abovementioned previous long-term study, that is, UPPP combined with dorsal midline glossectomy. This significant improvement should be viewed with caution because of the relatively short-term follow-up. Because of the short-term follow-up and the small patient population, it is difficult to compare this treatment modality (modified UPPP) to other modalities. We found the procedure safe and fairly easy to perform. Initial improvement in subjective and objective sleep parameters is encouraging. Long-term follow-up, and a more controlled study is necessary to further prove the efficacy.

Conclusion

About 80%–90% of our patients of group I were satisfied subjectively at 1-month follow-up with a history of decreasing loudness of snoring, decreasing episodes of repeated arousals during night and improvement in the daytime intellectual and social performance. About 66%–75% of group II patients were also satisfied at 1-month follow-up like above. About 95%–100 % of group III patients were also free of symptoms of OSA, who were using the CPAP daily. The major complaints of the group III (n-CPAP) patients were poor compliance, abdominal bloating, nasal mucosal irritation, and dryness of mouth. The major postoperative complaints of those patients who underwent surgical treatment were in the form of dysphagia, foreign body sensation in the throat, and difficulty in clearing the throat. The results of this study demonstrate that modified UPPP is an effective therapy for patients with OSA syndrome.

References

1. American Academy of Sleep Medicine Task Force. Sleep-related breathing disorders in adults: recommendation for syndrome definition and measurement techniques in clinical research. The report of an American Academy of Sleep Medicine Task Force. Sleep 1999;22:667–89.
2. Sher AE, Schechtman KB. Picurilloz F. The efficacy of surgical modification of upper airway in adults with obstructive sleep apnea syndrome. Sleep 1996;19:156–77.
3. Eugenio V, José MM, Carrizo S, Naya MJ. Tongue–base suspension in conjunction with uvulopalatopharyngoplasty for treatment of obstructive sleep apnea; long-term follow-up results. Laryngoscope 2006;116:1223–7.

4. Johnson NT, Chinn NJ. Uvulopalatopharyngoplasty and inferior sagittal mandibular osteotomy with genioglossus advancement for treatment of obstructive sleep apnea. Chest 1994;105: 278–83.
5. DeRowe A, Gunther E, Fibbi A, Lehtimaki K, Vahatalo K, Maurer J, et al. Tongue–base suspension with a soft tissue to bone anchor for OSA. Otolaryngol Head Neck Surg 2000;122:100–3.
6. Woodson BT. A tongue suspension suture for obstructive sleep apnea and snorers. Otolaryngol Head Neck Surg 2001;124: 297–303.
7. Rilley RW, Powell NB, Guilleminault C. Obstructive sleep apnea syndrome: a review of 306 consecutively treated surgical patients. Otolaryngol Head Neck Surg 1993;108:117–25.
8. den Herder C, van Tinteren H, de Vries N. Hyoidthyroidpexia: a surgical treatment for sleep apnea syndrome. Laryngoscope. 2005;115(4):740-5.
9. Nishimura Y, Nishimura T, Hattori H, Hattori C, Yonekura A, Suzuki K. Obesity and obstructive sleep apnea syndrome. Acta Otolaryngol Suppl. 2003;(550):22–4.
10. Adsberg U, Jessen M. Eight years of follow-up—uvulopalatopharyngoplasty combined with midline glossectomy as a treatment for obstructive sleep apnea syndrome. Acta Otolaryngol Suppl 2000; 543:175–8.
11. Guilleminault C, Lee JH, Chan A. Pediatric obstructive sleep apnea syndrome. Arch Pediatr Adolesc Med 2005;159(8):775–85.

How to cite this article: Sharma M, Prakash O, Goel M. Comparative evaluation of surgical modalities in cases with obstructive sleep apnea syndrome. Int J Med Sci Public Health 2016;5:785-790

Source of Support: Nil, **Conflict of Interest:** None declared.