ORIGINAL RESEASRCH

Comparative Evaluation of Surgical Modalities in Cases with Obstructive Sleep Apnea Syndrome

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ABSTRACT

Introduction- Human beings sleep for one-third of their lives. So, sleep disorders lowers the quality of life and causes social problems. 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. Obstructive sleep apnea predominantly affects the elderly, obese males and patients who abuse alcohol and sedatives.**Material and methods-** Twenty four diagnosed cases of obstructive sleep apnea syndrome were included in this study. These cases were divided into three groups of equal sizes. Cases in group I comprised of 8 cases and were subjected to modified UPPP (uvulopalatopharyngoplasty), group II cases comprised of 8 cases and were subjected to classical UPPP, and 8 cases in group III were subjected to CPAP (continuous positive airway pressure) therapy. The diagnosis of OSA was based upon demographic, subjective and objective criteria. **Results:** There were only 2 female patients out of 24 cases (8.33%). All the males patients were alcoholic (n=22) and out of 24 cases, 41.66 % (n = 10) were smoker. The cephalometry analysis of these patients was as such: The mean distance from mandibular plane to hyoid bone (MP-H) in group I patient was 22 mm, group II, 20.37 mm and group III, 20.87 mm respectively. The mean posterior airway space (PAS) in group I was 11.37 mm, group II was 11.12 mm and group III was 11.75 mm respectively. 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 respectively. The mean FMA angle in group I was 36.87^o, group II, 36.87^o, group III was 36.38^o respectively. The mean SNA angle in group I was 53.75^o group II, 56.62^o and in group III was 53.37^o respectively. Out of 24 patients in our study 16 underwent surgical treatment. Polysomnography analysis: The mean preoperative apnea--hypopnea index (AHI) per hour of group I, II and III pre-operatively 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, 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 pre-operative average oxygen saturation (SaO_2) of group I, II and 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.**Conclusion:** About 80-90% of our patients of group I were satisfied subjectively at one month follow up. About 66-75% of group II patients were also satisfied at one 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 (CPAP) patients were poor compliance, abdominal bloating, nasal mucosal irritation and dryness of mouth. The major postoperative complains 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.

KEYWORDS: 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. So, sleep disorders lower the quality of life and causes social problems. Sleep apnea syndrome was first described in 1956.[1] Earlier sleep apnea syndrome was defined as 30 or more apneic episodes during 7-hours of sleep or an apnea index equal to or greater than 5.[2,3] Apnea index 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 (Apnea-Hypopnea index) is the number of apneas hypopneas per hour.[4] Apnea is defined as the cessation breathing for at least 10 seconds.

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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. Central sleep apnea is the absence of air flow at the level of nostrils or mouth and associated with cessation of all respiratory efforts. Whereas, in obstructive sleep apnea (OSA), there is cessation of air flow at nostrils or mouth in the presence of continued respiratory efforts. Mixed sleep apnea syndrome is defined as when both central, as well as obstructive sleep apnea, is present.

According to severity of the disease, obstructive sleep apnea has been graded into three degrees of severity according to the American Sleep Association.[4]

Mild (5-20 apneic attacks per hour)

Moderate (20-40 apneic attacks per hour)

Severe (>40 apneic attacks per hour)

Obstructive sleep apnea predominantly affects the elderly, obese males and patients who abuse alcohol and sedatives. In a study of almost 6000 population, it was found that about 24% of men and 14% of women were habitual snorers.[5] With respect to age, only 10% of men under 30 yrs of had snoring as compared with 60% of men over 60 yrs of age. It is not fully understood why people snore or develop upper airway obstruction. Male sex, increasing age and obesity are all well recognized association. Both snoring and upper airway obstruction are exacerbated by alcohol and sedative medication. Pathophysiology of snoring and obstructive sleep apnea is determined by a number of interrelated factors. The onset of inspiration triggers a reflex increase in the Electromyogphy (EMG) activity of the pharyngeal dilator muscles that is genioglossus, geniohyoid, palatoglossus, and medial pterygoids.[6] These muscles are activated rhythmically during respiration when the person is awake and hold the airway open, preventing collapse.[7] These muscle like other skeletal muscles become hypotonic during sleep especially REM sleep. In OSA these muscles further become hypotonic during an obstructive episode with the resultant hypoxia and generation of high negative intrathoracic pressure. Hypoxia leads to rise in sympathetic output[8] and catecholamines[9] with resultant peripheral vasoconstriction causing transient pulmonary and systemic hypertension. Negative intrathoracic pressure stimulates arousals and the termination of an obstructive episode.[10] Generation of high negative intrathoracic pressure leads to high cardiac output in presence of high pulmonary & systemic hypertension with resultant cor pulmonale and severe cardiac arrhythmias & sometimes sudden death.[2,3] (Fig 1)

The clinical feature of obstructive sleep apnea syndrome patient are snoring, headache, obstructive episodes, excessive daytime sleepiness, impaired intellectual and social performance, abnormal body movements during sleep, nocturnal enuresis and impotence. OSA results in significant morbidities and mortalities because of loss of alertness and excessive daytime sleepiness.

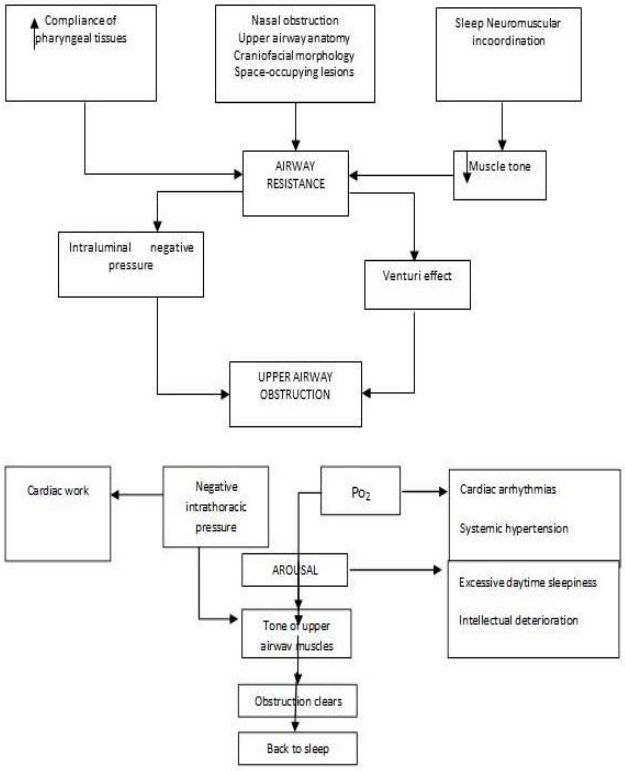


Fig 1: Pathophysiology of Obstructive Sleep Apnea

There have been changes in management options for OSA, which earlier were medical in the form of weight reduction, nasovent mandibular and tongue positioning prosthesis. The most effective medical treatment is nasal continuous positive airway pressure technique (CPAP). The problems associated with the CPAP are patient compliance and local nasal mucosal irritation. Surgical options for OSA management depend upon the levels of obstruction which include septorhinoplasty, palatal surgery, maxillofacial surgery, hyoid suspension, infrayoid 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, i.e., soft palate, the tonsils and the pharynx.

In our study, we performed the modified UPPP (lateral palato pharyngoglossoplasty, LPPGP) in one of the group (comprising of 8 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 8 patients who underwent classical UPPP and 8 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.[11]

MATERIALS AND METHODS

Twenty-four diagnosed cases of obstructive sleep apnea syndrome that had 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. Cases in group I comprised of 8 cases were subjected to modified UPPP, group II cases comprised of 8 cases were subjected to classical UPPP, and 8 cases in group III were subjected to CPAP therapy. The diagnosis of OSA was based on demographic, subjective and objective criteria.

Subjective criteria

1. Snoring
2. Excessive daytime sleepiness affecting the daytime performance
3. Impaired intellectual and social performance.
4. Morning headache.

Objective criteria

1. Apnea – Hypopnea index > 20 (AHI)
2. Polysomnography (PSG)
3. lateral cephalometry
4. Body mass index (BMI)
5. Epworth sleepiness scale (ESS)
6. Modified mallampati (MMP) grading. : To assess the relative size of tongue to oral cavity by asking the patient to open the mouth without the tongue protrusion.

Polysomnography (PSG): Polysomnography is the gold standard investigation for the diagnosis of obstructive sleep apnea and other forms of sleep related disorder. It involves spending night or more in a sleep laboratory connected to variety of monitors. It measures all the standard parameters in overnight PSG which includes electroencephalogram (EEG), submental electromyogram (EMG), electrocculogram (EOG), oxygen saturation (PaO2), electrocardiogram (ECG), nasal and oral airflow, chest and abdominal movement, tracheal microphone, esophageal manometry, anterior tibialis EMG, 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 method of evaluating patients with obstructive sleep apnea. (Fig 2)

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 (MPH) distance, posterior airway space (PAS); which is the distance from the posterior pharyngeal wall to tongue base, soft palate length (PNS – P) which is characteristically increased in OSA.

Normal value of important cephalometeric measurements include:

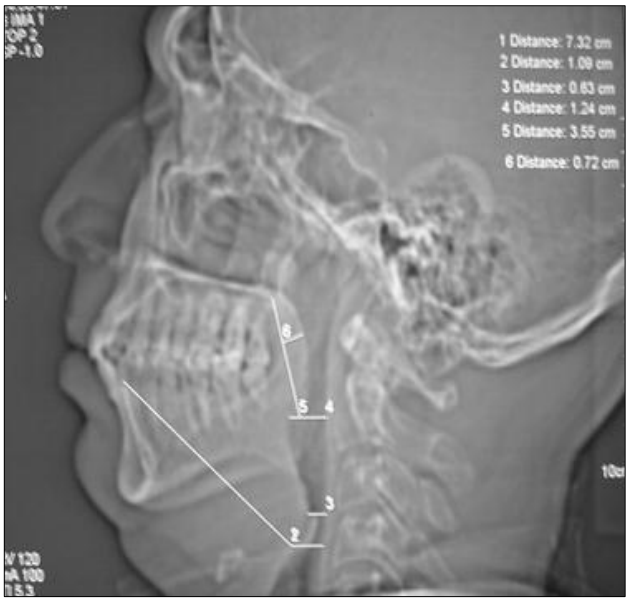


Fig.2. Showing lateral cephalogram.

MPH = 17 ± 6 mm
PAS = 10 ± 3 mm
PNS – P = 42 ± 5 mm.
FMA (Frankfort – Mandibular plane angle) = 24 $\pm$ 5^{o} (increased in OSA)
SNA (Sella to nasion to point A) = 83 $\pm$ 4^{o} (decreased in OSA)
Cephalometry allows assessment of any maxillomandibular hypoplasia and is obviously essential if considering maxillofacial surgery.

Body mass index (BMI): Obesity was found to have a strong association with obstructive sleep apnea. In our study, more than 90% of our patients were obese. Obesity is defined as a body weight which is 20% above the ideal limits and morbid obesity where body weight is 45 kg above ideal or twice the ideal body weight. BMI = weight in kg / height in meter^{2} (kg/m^{2}).

Epworth sleepiness scale (ESS): It's a self-administered questionnaire which provides a measurement of the patient's general level of daytime sleepiness. ESS score increases with the severity of the OSA and is more closely related to the apnea hypopnea index than the degree of hypoxemia. Normal score is taken between 2 and 10. A score of $\geq$ 16 is always associated with moderate to severe OSA, narcolepsy or idiopathic hypersomnia. All the patients in our study groups had ESS score >15.

Modified Mallampati grading

Grade I: Cases where both tonsils, tonsillar pillars, whole length of uvula and posterior pharyngeal wall is visible on mouth opening.

Grade II: Cases where part of tonsils, part of uvula, soft palate and hard palate is visible.

GradeIII:Cases where only a part of soft palate and hard palate is visible.

Grade IV:Cases where only hard palate is visible on mouth opening.

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 biochemistry analysis. They were also subjected to:

- Cephalometry,
- pulmonary Function Test (PFT),
- Arterial blood Gas Analysis (ABG),
- Thyroid function test in suspected cases of hypothyroidism and
- Growth hormones in suspected cases of acromegaly.

Surgical Procedures:

Classical uvulopalatopharyngoplasty (UPPP): 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 nasal tracheal intubation.

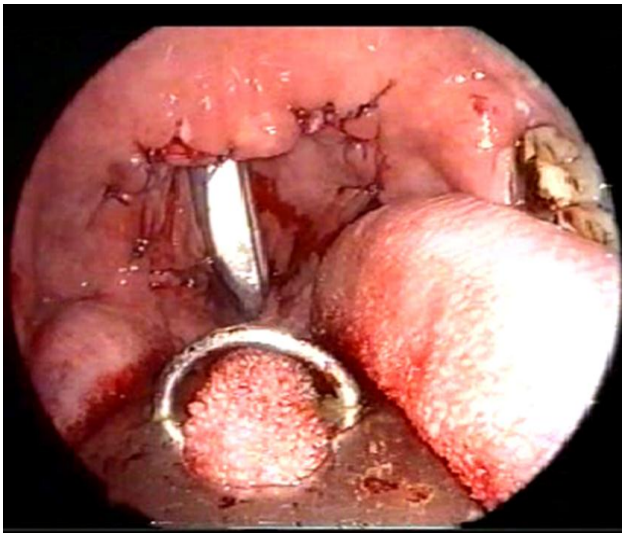
Modified uvulopalatopharyngoplasty (UPPP): In this procedure, we removed the lateral part of base of tongue in addition to the steps of classical uvulopalatopharyngoplasty with the electric cautery and sutured the raw area with 3-0 vicryl sutures.

Follow-up: These patients were followed up at weekly interval for one month and then repeat polysomnography were done after one month of surgery.

OBSERVATIONS

The present study was conducted on 24 cases of obstructive sleep apnea (OSA).Various demographic parameters included were age, sex, body mass index (BMI Kg/m^2), Epworth sleepiness scale (ESS) score, modified mallampati (MMP) grade, tonsil grade, alcoholics, and smoking. There were only 2 female patients out of 24 cases (8.33%). All the males patients were alcoholic (n=22) and out of 24 cases, 41.66 % (n = 10) were smoker. All of these 24 cases, patients were grouped into three groups randomly depending upon the type of treatment option these patients received. Each group comprised of 8 patients. Group I (Modified UPPP) consisted of 8 patients. Group II (classical UPPP) consisted of 8 patients (Fig 3). Group III (CPAP) consisted of 8 patients also.

Mean age of group I patient was 49.50 yrs (n = 8) Group II was 42.87 yrs. (n = 8) and Group III was 49.50 yrs. (n = 8) with no statistical significance difference among the age of three groups (p> 0.10). The mean body mass index (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 respectively with no statistically significant difference (p> 0.10). The mean Epworth sleepiness scale (ESS) score of Group I was 20, Group II was 22.5 and Group III was 19.12 respectively with no statistically significant difference (p> 0.10). The mean



Fig, 3. Operative photograph following classical UPPP.

grade of tonsillar hypertrophy was grade II in all the groups. Modified Mallampati (MMP) grade of Group I, II, III was 2.75, 3.0 and 2.62 respectively. [Table 1]

	Mean Age (yrs)	Mean BMI (Kg/m^2)	Mean ESS Score	Mean MMP Grade	Mean Tonsil Grade
Group 1 (Modified UPPP)	49.50	29.21	20	2.75	2
Group 2 (Classical UPPP)	42.87	30.27	22.5	3	2
Group 3 (n-CPAP)	49.50	31.60	19.12	2.62	2

Table 1: Demographic analysis

The cephalometry analysis of these patients was as such: The mean distance from mandibular plane to hyoid bone (MP-H) in group I patient was 22 mm, group II, 20.37 mm and group III, 20.87 mm respectively. The mean posterior airway space (PAS) in group I was 11.37 mm, group II was 11.12 mm, and group III was 11.75 mm respectively. 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 respectively. The mean FMA angle in group I was 36.87^o, group II, 36.87^o, group III was 36.38^o respectively. The mean SNA angle in group I was 53.75^o group II, 56.62^o and in group III was 53.37^o respectively. Out of 24 patients in our study 16 underwent surgical treatment. [Table 2][Figure 4]

	Mean MP-H (mms)	Mean PAS (mms)	Mean PNS – P (mms)	Mean FMA (Degree)	Mean SNA (Degree)
Group 1 (Modified UPPP)	22	11.37	47.75	36.87	53.75
Group 2 (Classical UPPP)	20.37	11.12	42.62	36.87	56.62
Group 3 (n-CPAP)	20.87	11.75	45.37	36.38	53.37

Table 2: Cephalometry analysis

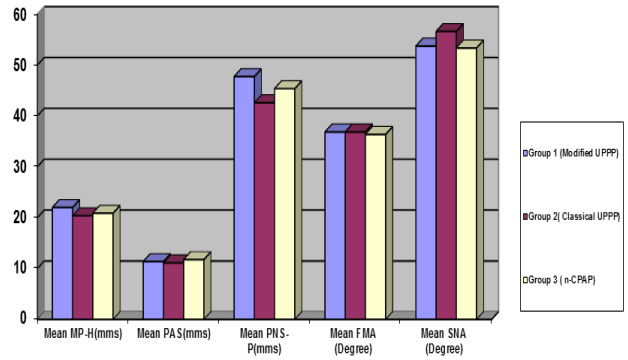


Fig 4: Cephalometry Analysis

Polysomnography analysis: The mean preoperative apnea--hypopnea index (AHI) per hour of group I, II and III pre-operatively 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, 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 pre-operative average oxygen saturation (SaO_2) of group I, II and 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.

$$\% \text{ change} = \frac{\text{Pre-operative} - \text{post-operative}}{\text{Pre-operation}} \times 100$$

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

The mean AHI/Hr postoperative 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 are of the important variable are displayed in the table and bar diagrams. [Table 3,4,5,6,7]

	Mean AHI /Hr.		Mean SaO_2 average %		Mean Sa_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.
Group1 (Modified UPPP)	63.7	26.29	92.68	95.50	64.37	80.75	91.76	78.25	14.12	6.12
Group2 (Classical UPPP)	70.60	46.93	88.61	92.75	61.00	77.12	97.58	75.37	15.25	8.50
Group3 (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 one month surgery (% Change, Efficacy)

	Mean	Standard Deviation	Standard Error Mean	P - value
AHI (per hr)	37.68	32.94	10.98	0.002
SaO2 ave. %	–3.17	2.31	0.77	0.003
SaO2 worst %	–17.44	12.30	4.10	0.003
Longest Apnea seconds	19.23	28.15	9.38	0.75
Ave. SaO2 Desaturation	7.88	2.71	0.90	0.000

Table 5: Polysomnographic variables after one month follow up. (Group 1)

	Mean	Standard Deviation	Standard Error Mean	P - value
AHI (per hr)	23.66	8.14	2.88	0.001
SaO2 ave. %	– 4 .13	2.35	2.88	0.002
SaO2 worst %	– 16.12	7.60	0.83	0.001
Longest Apnea seconds	22.21	25.16	2.68	0.041
Ave. SaO2 Desaturation	6.74	3.84	1.359	0.002

Table 6: polysomnographic variables after one month follow up. (Group 2)

	Mean	Standard Deviation	Standard Error Mean	P - value
AHI (per hr)	59.30	31.75	11.22	0.001
SaO2 ave. %	– 19.62	13.08	4.62	0.004
SaO2 worst %	– 46.25	23.96	8.47	0.001
Longest Apnea seconds	46.92	9.66	3.41	0.000
Ave. SaO2 Desaturation	8.75	1.83	0.64	0.000

Table 7: Polysomnographic variables after one month follow up. (Group 3)

DISCUSSION

Obstructive sleep apnea (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 several years. The advances in the treatment of obstructive sleep apnea are aimed at reducing the number of episodes of apnea-hypopnea, 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.[12] The mainstay of therapy for OSA syndrome is nasal continuous positive airway pressure (CPAP) therapy which maintains a patent airway during sleep, thereby avoiding apnea.[10] 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, uvulopalatopharyngoplasty

(UPPP), was 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.[13] More aggressive surgical options such as UPPP with genioglossus advancement, hyoid suspension, and hyoidthyroidpexia have also been reported with decrease in AHI ranged from 10%-60%.[14-18] However, most patients in these series had mild or moderate OSA, and follow-up was short.[14] Classical uvulopalatopharyngoplasty 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.[19] 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.[11] Subjective response after these three treatment modalities in our study was also analyzed using the various parameters like improvement in daytime sleepiness, e.g., 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 a previous study in which the rate of success ranged between 25%-55% using UPPP in addition to other surgical techniques.[14] Another important finding in our study was negative correlation between the pre surgery body mass index (BMI) and the post surgery AHI. The more obese patients (e.g. BMI >33 Kg/M^2) where those who had lower decrease in the post surgical AHI. It is feasible that increase in the intraluminal pharyngeal pressure in these patients was not overcome by the 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.[20]

There has been a long-term study on OSA, which is very close to our modified UPPP, that is 8 years of follow up uvulopalatopharyngoplasty combined with midline glossectomy as a treatment for OSA.[21] In this study of 22 cases of OSA, uvulopalatopharyngoplasty was combined with the midline glossectomy of the dorsum of tongue. The body mass index (BMI) was normal in 13 cases and abnormal in 9 cases of that study. The apnea index (AI) was reduced in 82% of the cases 12 months post operatively, 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 post operative complications in any of the patient and only minor long term problems. No relationship was found between BMI and surgical outcome in this study.

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 above mentioned previous long term study i.e. uvulopalatopharyngoplasty 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's 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 one month follow up with 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 one 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, and nasal mucosal irritation and dryness of mouth. The major postoperative complains 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 effective therapy for patients with OSA syndrome. Specifically, a statistically significant improvement was noted for the mean change in polysomnography parameters; AHI per hour of sleep, average SaO_2 saturation and average SaO_2 desaturation rates ($p<0.05$), OSA related quality of life and daytime sleepiness.

CONCLUSION

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