International Journal of Otorhinolaryngology and Head and Neck Surgery
Mohankumar V et al. Int J Otorhinolaryngol Head Neck Surg. 2017 Oct;3(4):861-867
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937

Original Research Article

DOI: http://dx.doi.org/10.18203/issn.2454-5929.ijohns20173689

A study on evaluation of pre and postoperative polysomnography for obstructive sleep apnea patients

Venugopal Mohankumar[1], M. K. Rajasekar[2]*, Narendrakumar Veerasigamani[2], M. Sivaranjani[3]

Department of ENT, [1]Government Vellore Medical College and Hospital, Vellore, [2]Sree Balaji Medical College and Hospital, [3]Madras Medical College, Chennai, India

Received: 23 July 2017
Revised: 07 August 2017
Accepted: 09 August 2017

***Correspondence:**
Dr. M. K. Rajasekar,
E-mail: drnarenkapv@yahoo.com

ABSTRACT

Background: Obstructive sleep apnea is the most common form of sleep-disordered breathing. However, obstructive sleep apnea has been associated with much more insidious conditions, including hypertension, diabetes, heart disease, stroke, and daytime somnolence can lead to a dramatically increased risk of motor vehicle accidents.
Methods: This study was conducted in our institution in 34 OSA patients. After thorough evaluation with PSG, dynamic MRI, DISE patients were treated with various surgeries depending on the level of obstruction. Commonly UPPP, ESP, zetaplasty, tonsillectomy, tongue base reduction were done either alone or in combination.
Results: Pre and postoperative polysomnograhpy for obstructive sleep apnea was evaluated and statistically analyzed. Significant proportion of patients improved both subjectively and objectively as determined by reduction in AHI from 41.73±13.94 to 15.77±9.13, reduction in ESS from 16.41+3.09 to 5.14±3.41 and reduction in snoring.
Conclusions: OSA can be easily treated with proper preoperative investigations, appropriate surgery, prevention of complications and continued lifestyle modifications.

Keywords: Epsworth sleepiness scale, Obstructive sleep apnea syndrome, Apnea hypopnea index, Body mass index

INTRODUCTION

Obstructive sleep apnea, an entity of sleep disordered breathing, which contains repeated episodes of narrowing or collapse of pharyngeal airway during sleep resulting in reduction/ complete cessation of airflow despite ongoing breathing efforts.[1] It is characterized by recurrent sleep induced collapse of the pharyngeal airway leading to hypoxaemia and hypercapnia, with arousal from sleep thus re-establishing patency of airway. It is affecting 2-4% of individuals with serious complications like diabetes, hypertension, stroke, myocardial infarction and neurocognitive effects.[2,3]

Continuous positive airway pressure (CPAP) ventilation is one of the standard therapies for obstructive sleep apnea syndrome. However, majority of the patients abandon CPAP therapy because of refusal or intolerance.[4] Though the OSA patients are classically treated with lifestyle modifications and medical management, compliance is poor in these patients and thus warranting surgical management. Surgical modification of airway has been performed since decades but with inconsistent results. With current knowledge in understanding the pathophysiology and modern investigations surgery has been carried out with the intention of creating more open airway.

Sleep is defined as a "temporary state of unconsciousness that can be interrupted by external stimuli and it is regulated by RAS". Sleep depends on interaction between intrinsic sleep drive, ultradian REM sleep rhythm, adaptive sleep drive and circadian rhythm.[5] In OSA patients; there is collapse of different pharyngeal soft tissue structures especially that of velopharynx, oropharynx, and/or hypopharynx in addition to soft palate vibrations. Based on the different sites of pharyngeal collapse,

"OSA patients are structurally classified as:[6]

Type-1: Narrowing or collapse in the retropalatal (velopharyngeal) region alone.
Type-2: Narrowing or collapse in both retropalatal and retroglossal regions.
Type-3: Narrowing or collapse in the retroglossal region alone".

Our study addresses the postoperative apnea hypopnea index, oxygen saturation and the effectiveness of various surgeries for obstructive sleep apnea. The study was approved by the institutional Ethical Committee, Government General Hospital, Madras Medical College, Chennai and reviewed the experimental design, protocol as well as the letter of information and consent form. Full approval of the board was granted.

Aim of the study

1) To study the pre-operative and post-operative apnea hypopnea index and oxygen saturation.
2) To study clinical improvement post operatively.
3) To study the effectiveness of various surgeries for obstructive sleep apnea.

METHODS

A prospective study done at upgraded Institute of Otorhinolaryngology, Rajiv Gandhi Government General Hospital, Madras Medical College, Chennai during July 2014 to September 2016. All patients who attend our outpatient department with the complaints of snoring, frequent awakening at night, excessive day time sleepiness, choking in sleep are further evaluated. All the patients underwent clinical examination followed by blood investigations especially thyroid function test and BMI evaluation. Then polysomnography is done with EEG, EOG, ECG, pulse oximetry, oronasal thermistor, thoracoabdominal belts is done to distinguish obstructive or central apnea. Other investigations include CT paranasal sinuses, drug induced sleep endoscopy (DISE) and magnetic resonance imaging.

Inclusion criteria

Inclusion criteria were age>20 years; both sexes (male and female); BMI<40; neck circumference>17 inches for men and >16 inches for women; unsuccessful or refused CPAP therapy.

Exclusion criteria

Exclusion criteria were age below 20 yrs and above 55 yrs; hypothyroidism and other metabolic disorders; BMI >40; associated craniofacial abnormalities.

This study was conducted in our institution in 34 OSA patients. After thorough evaluation with PSG, dynamic MRI, DISE patients were treated with various surgeries depending on the level of obstruction. Commonly UPPP, ESP, zetaplasty, tonsillectomy, tongue base reduction were done either alone or in combination.

All patients were watched for complications like bleeding, pain (VAS score), VPI etc. Patients were given antibiotics, analgesics and mouthwash. Patients were given Ryle's tube feeding and discharged after 1 week. All patients were enquired about reduction in symptoms during subsequent follow up. At 3 months and 5 months polysomnography comprising of ECG, EEG, EOG, oxygen saturation, respiratory effort are done and AHI is calculated. All parameters were compared with pre surgical values and patients were categorized as responders or non-responders. Non-responders were thoroughly evaluated for the cause of failure and managed accordingly.

Statistical analysis

Statistical analysis is done through SPSS 20 software. Descriptive statistical analysis done to summarize the baseline characteristics result. Mean, median and standard deviation has been calculated in descriptive statistics. Paired 't" test is used to compare the values of pre and post op BMI, oxygen saturation, ESS. Annova table is used to compare between baseline AHI and at 3rd, 5th month.

RESULTS

Of the 34 patients 29 (85.3%) were males and 5 (14.7%) patients were females. Mean age of the study population was 37.53±5.2. 8 (23.5%) patients had a history of hypertension and 8 (23.5%) had a history of diabetes. The level of obstruction after confirming with dynamic MRI and DISE were found to be in velum in 18 (52.9%) patients, velum and tongue in 9 (26.5%) patients, velum and nose in 3(8.8%) patients, oropharynx and elongated uvula in 2 (5.9%) patients, velum and uvula in 1 (2.9%) and velum, nose and tongue together in 1 (2.9%) patient.

Mean pre op BMI of these 34 patients were 29.02±2.85. Mean pre-op Epsworth Scale was 16.41±3.09. Mean Friedman score was 2.2±0.76. Average pre op AHI was 41.73±13.94. Average minimum oxygen saturation of 34 patients were 81.44±4.85.

Table 1: Distribution of study participants By BMI.

BMI	Frequency	Percentage (%)
18.5–24.99 (Normal)	3	8.82
25–29.99 (Overweight)	20	58.82
30–34.99 (Obese I)	9	26.47
>35 (Obese II)	2	5.89
Total	34	100.0
Pre-op Mean BMI	29.02±2.85	

Table 2: Distribution of study participants by direction of obstruction.

Direction of obstruction	Frequency	Percentage (%)
Circumferential	14	41.2
Circumferential (Velum) and AP (Tongue)	8	23.5
Lateral wall	10	29.4
Lateral wall (Velum) and AP (Tongue)	2	5.9
Total	34	100.0

Distribution of study participants by BMI and direction of obstruction are tabulated in Table 1 and 2 respectively. The levels of obstruction in the patients are at oropharynx and elongated uvula, velum, velum and elongated uvula, velum and nose, velum and tongue, velum nose and tongue (Figure 1). Among 34 OSA patients 7 (20.6%) patients underwent zetaplasty and ESP each, 5 (14.7%) patients underwent UPPP, 2 (5.9%) patients underwent tonsillectomy with uvuloplasty and 13 patients (38.2%) had surgery done at multiple levels (Figure 2).

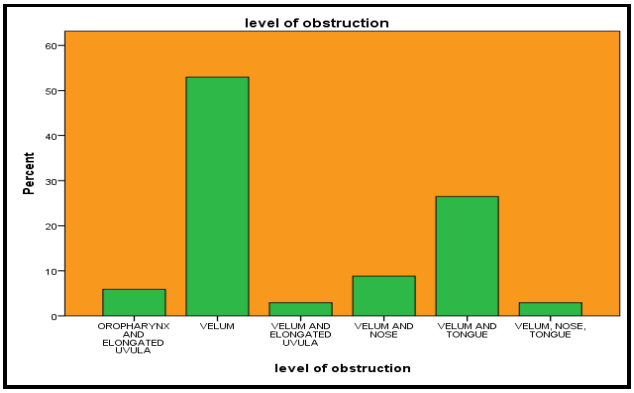

Figure 1: Bar diagram showing distribution of level of obstruction.

Mean BMI before and after surgery was 29.02±2.85 and 27.52±2.96 respectively with mean difference 1.49 which is statistically significant. Mean ESS of 34 OSA patients before and after surgery was 16.41±3.09 and 5.14±3.41 respectively with mean difference of 11.26, which is statistically significant. Average minimum oxygen saturation before and after surgery was 81.44±4.85 and 93.02±4.18, which is also statistically significant with mean difference of 11.58 (Table 3).

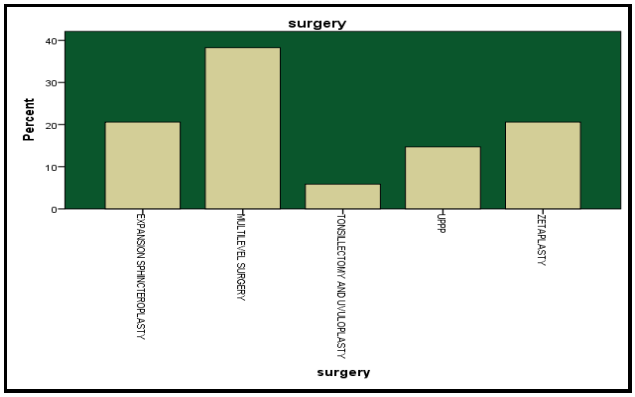

Figure 2: Bar diagram showing various types of surgery in 34 OSA patients.

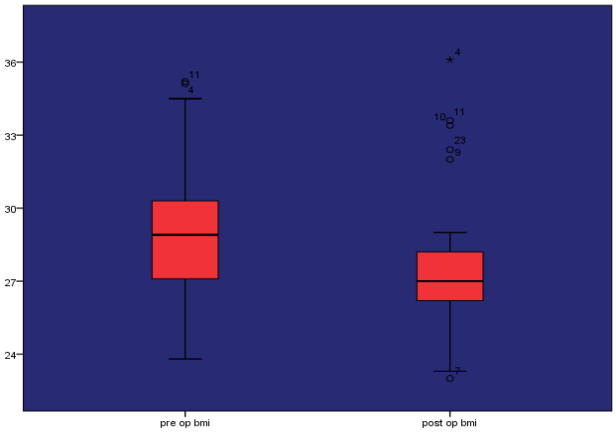

Figure 3: Box-whisker plot showing pre and post–operative BMI.

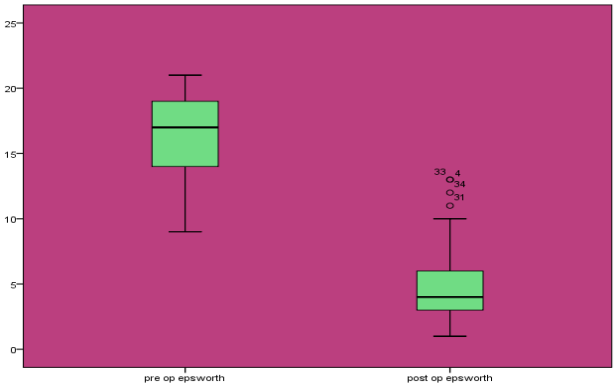

Figure 4: Box-whisker plot showing pre and post-operative difference in Epsworth Sleepiness Scale.

Pre and post-operative BMI (Figure 3), Epsworth Sleepiness Scale (Figure 4), oxygen saturation (Figure 5) and mean value of AHI at 3rd and 5th month are plotted, which shows improvement in AHI after surgery (Table 4) (Figure 6).

Table 3: Parameters before and after surgery in 34 patients.

Characteristics	Baseline	After 5 months of surgery	Mean difference	P value
BMI	29.02±2.85	27.52±2.96	1.49	<0.001
Epsworth score	16.41±3.09	5.14±3.41	11.26	<0.001
Oxygen saturation	81.44±4.85	93.02±4.18	11.58	<0.001

Table 4: Mean value of AHI before and after surgery at 3 and 5 months.

AHI at baseline	At 3rd month	At 5th month	P value
41.73±13.94	16.92±9.45	15.77±9.13	<0.001

Table 5: Association between different type of surgery and polysomnographic findings.

Surgery	Epsworth Sleep Scale [Mean±SD]		Oxygen saturation [Mean±SD]		AHI [Mean±SD]	
	Baseline	Follow up 5 months	Baseline	Follow up 5 months	Baseline	Follow up 5 months
Expansion sphinteroplasty	13.14±2.91	3.28±1.38	84.43±5.16	95.00±1.16	38.35±11.37	11.14±4.63
Multilevel surgery	17.62±1.76	6.31±3.35	80.08±2.72	91.69±4.29	43.81±9.39	18.39±10.03
Tonsillectomy and uvuloplasty	12.50±0.70	1.00±0.00	84.50±6.36	96.50±0.71	26.25±3.04	5.95±1.20
UPPP	18.20±1.64	7.40±3.21	79.80±7.26	93.80±3.49	38.81±9.46	15.68±8.92
Zetaplasty	17.29±3.45	5.57±4.54	81.29±5.16	92.00±6.00	47.77±23.45	18.43±10.17
Total	16.41±3.09	5.38±3.53	81.44±4.86	93.03±4.19	41.74±13.94	15.77±9.13

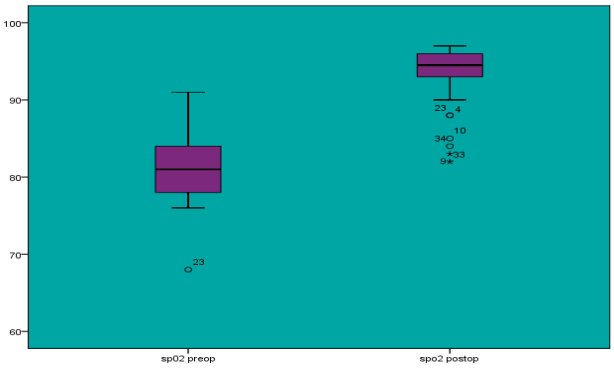

Figure 5: Box-whisker plot showing difference in oxygen saturation before and after surgery.

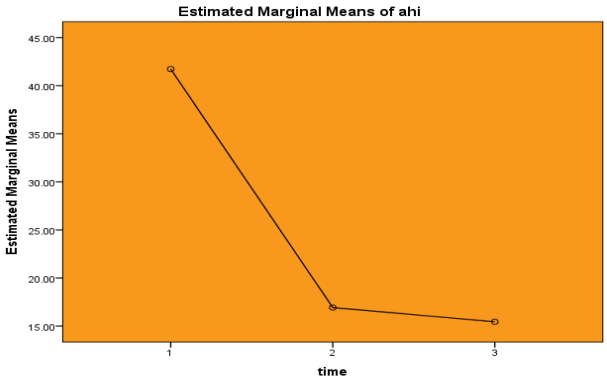

Figure 6: Profile plot showing estimated mean change in AHI over the time after surgery.

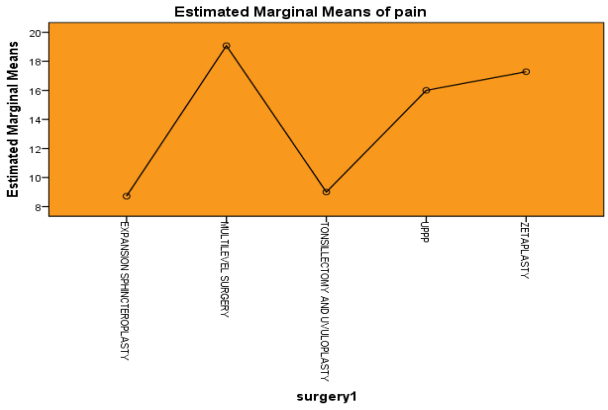

Figure 7: Profile plot showing estimated marginal means of pain duration in various type of surgery.

Association between different type of surgery and polysomnographic findings are tabulated (Table 5).

The incidence of temporary VPI is about 17.6% and bleeding is about 11.8%. The mean duration of pain is about 15.33±6.08. The mean pain duration among various surgeries with maximum duration is in multilevel surgery followed by zetaplasty (Figure 7). Success and failure of the surgery was 82.4% and 17.6% respectively.

DISCUSSION

Because of the inconsistent results with various surgeries, Friedman proposed a staging system.[7]

Stage I: Friedman tongue position 1 and 2. Tonsil size 3 and 4. BMI<40.
Stage II: Friedman tongue position 1 and 2. Tonsil size 0, 1 and 2. BMI<40.
Friedman tongue position 3, 4 tonsil size 3 and 4. BMI<40.
Stage III: Friedman tongue position 3 and 4. Tonsil size 0, 1 and 2. BMI<40.
Friedman any tongue position. Any Tonsil size. BMI>40.

OSA patients of stage 2 and 3 have been identified to have obstruction not only at the single level but also simultaneously at multiple levels requiring surgery addressing various levels of airway.[8] Therefore multilevel pharyngeal surgery is usually required to surgically overcome the several sites of obstruction.

Among 34 patients, 7 patients underwent zetaplasty and ESP, 5 patients underwent UPPP, 2 patients underwent tonsillectomy and uvuloplasty and 13 patients underwent multilevel surgery.

On statistical analysis on a study done in our institution, it was found that the study group comprised mainly male (85.3%). This data correlates with the study conducted among 63 patients by Khan et al where the population comprised of 81% men and mean pre op AHI is 62 who underwent UPPP.[9] He concluded that AHI reduced to 50% the previous value in 32 patients with a success rate of 51%". This suggests that incidence of OSA is more common in male population.

The mean age was 37.15±5.8 and the mean AHI was 41.88±15.35. The mean AHI in our study correlated with Janson et al and Pang et al where the mean AHI was 40.1 and 47.3 respectively suggesting that most of the OSA patients falls under severe OSA category.[10,11]

The mean BMI in the study group comprises 29.02 coming under overweight category. This also correlates with Pang et al where the study group had a BMI<30.[11] They found that AHI reduced from 44.2 to 12 and lowest oxygen saturation improved from 78 to 85. This suggests that obesity plays a major causative factor in OSA patients.

The mean preoperative ESS is 16.41±3.09 in our study group. This is similar to study conducted by Pang et al in 487 patients where the mean ESS was 14.5.[11] This suggests that significant proportion of population had symptoms of excessive daytime sleepiness. They reported 7.1% of overall complication. Complications are postoperative desaturation, persistent hypertension, secondary hemorrhage, negative pressure pulmonary edema, and upper airway obstruction requiring reintubation. They concluded that all OSA patients should be monitored in post anesthesia care unit after surgery and based on the outcome in this period; patients should be shifted to general ward.

Almost 100% of individuals had snoring preoperatively which correlates with the study conducted by Whyte KF et al.[12] Snoring gets cured in 30 individuals and reduced in severity in 4 individuals after surgery as witnessed by partners.

The most common site of obstruction in our study group is velum (52.9%) followed by multilevel involving tongue and velum. This study correlates with the study conducted by Herder et al.[13] He reported that, of 127 patients, 63% had single level obstruction while only 37% had multilevel disease. But study conducted by Riley et al shows 93.3% (223 patients) were identified as having multilevel obstruction.[14] Another study by Abdullah et al showed higher incidence of multilevel disease (87% of their 893 patient populations had multilevel obstruction).[15]

On follow up PSG done at 5 months in our study, it was found that post-operative AHI reduced to <50% than the preoperative value in 34 patients which is statistically significant and so the success rate was 82.4%. Whereas in a study conducted by Khan et al and Elshaug et al success rate was 51% and 51.5% respectively.[9,16] This may be because of multilevel surgery done in our study and single airway surgery done in other studies.

In our study group AHI 8.82% of patients had 50-60% improvement in AHI, 29.4% patients had improvement in the AHI upto 60-70% of preoperative value and 38.23% of individuals had 70- 80% improvement in post op AHI.

In a study conducted by Lin et al success rate after multilevel surgery was 66.4% and in our study it is 82.4%.[17]

On statistical analysis, two patients in our study underwent tonsillectomy with uvuloplasty as a sole surgical treatment for OSA. And these two patients improved well without any complications accounting a success rate of 100%. This result correlates with the study conducted by Verse et al where the result was 100% in mild group and 80.8% in severe OSA group.[18] In our study the study population had a BMI of average 25, therefore patients with moderate OSA also responds to tonsillectomy if the obstruction is due to enlarged tonsil alone. But the disadvantage is lack of adequate population group.

Of the 34 patients, (17.6%) patients had VPI and 4 (11.9%) patients had bleeding as a complication. This correlates with study conducted by Esclamado et al, but in a study conducted by Vieira et al only one patient had bleeding.[19,20]

In a study conducted by Esclamado et al serious complication like death had occurred. In our study there was no case of mortality.[19] Death in above study was mainly due to postoperative airway edema.

Among 34 patients, 28 (82.4) patients had a postop oxygen saturation >90%, snoring reduced in 30 patients and ESS normalized (<10) in 27 patients. This suggests that after surgery there is both subjective and objective improvement. Incidence of hypertension and diabetes in our study population is about 23.5% (8 patients) each.

In those 6 patients who had failure, average BMI index was31.4 and there is no significant change between pre-operative and post op BMI and thus suggesting weight reduction has a major role in the outcome of surgery.

The mean duration of pain in our study according to visual analogue scale is about 15.53±6.08, which also correlates with study by Vieira et al.[20] The duration of pain varies with each surgery and it is more in surgery involving tongue base followed by zetaplasty.

Staurt et al conducted a study in 48 patients. He compared surgical outcomes of efficacy of modified UPPP with coblation channeling of tongue.[21] Patients were followed up for 3 months. At the end of 3 months PSG was taken. Post op clinical assessment, sleep questionnaire and BMI were compared. AHI reduced from 23.1 to 5.6 and ESS reduced to 5 from pre op value of 10.5.

Tschopp et al conducted a similar study and reported that AHI and tonsillectomy were the most important predictive factors.[4] Multilevel surgery provides a valuable alternative to CPAP therapy especially if conducted in combination with tonsillectomy. When comparing studies on multilevel surgery, special attention should be paid to the rate of tonsillectomy in the patient population.

CONCLUSION

Obstructive sleep apnea, which is an entity of sleep, disordered breathing leads on to various systemic consequences, if left untreated. Thus in the study conducted in our institution patients of OSA who refused CPAP or failed after CPAP trail were vigorously investigated. After identifying the site of obstruction, patients were channelized to different surgeries addressing velum, tongue, tonsil and uvula. Significant proportion of patients improved both subjectively and objectively as determined by reduction in AHI from 41.73±13.94 to 15.77±9.13, reduction in ESS from 16.41+3.09 to 5.14±3.41 and reduction in snoring. Since the complications of surgeries were anticipated preoperatively and managed accordingly, serious sequlae like airway compromise and deaths were avoided. Thus all surgeries were equally effective with proper preoperative investigations, appropriate surgery, anticipation and management of complications and continued lifestyle modifications.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Remmers JE, deGroot WJ, Sauerland EK, Anch AM. Pathogenesis of upper airway occlusion during sleep. J Appl Physiol. 1978;44:931.
2. Young T, Palta M, Dempsey J, Skatrud J, Weber S, Badr S. The occurrence of sleep-disordered breathing among middle-aged adults. N Engl J Med. 1993;32:1230–5.
3. Marshall NS, Wong KK, Liu PY, Cullen SR, Knuiman MW, Grunstein RR. Sleep apnea as an independent risk factor for all-cause mortality:the Busselton Health Study. Sleep. 2008;31:1079-85.
4. Tschopp K, Zumbrunn T, Knaus C, Thomaser E, Fabbro T. Statistical model for postoperative apnea–hypopnea index after multilevel surgery for sleep-disordered breathing. Eur Arch Otorhinolaryngol. 2011;268(11):1679-1685.
5. Browning GG, Gleeson M, Burton MJ, Clarke R, John H, Jones NS, et al. Scott-Brown's otolaryngology head and neck surgery. 7th ed. Vol. 2. London: Hodder Arnold; 2008: 2305-2312.
6. Suto Y, Matsuo T, Kato T, Hori I, Inoue Y, Ogawa S, et al. Evaluation of the pharyngeal airway in patients with sleep apnea:value of ultrafast MR imaging. AJR Am J Roentgenol. 1993;160:311-4.
7. Friedman M, Ibrahim H, Bass L. Clinical staging for sleep-disordered breathing. Otolaryngol Head Neck Surg. 2002;127 (1):13-21.
8. Vanderveken OM, Maurer JT, Hohenhorst W, Hamans E, Lin HS, Vroegop AV, et al. Evaluation of drug-induced sleep endoscopy as a patient selection tool for implanted upper airway stimulation for obstructive sleep apnea. J Clin Sleep Med. 2013;9(5):433-8.
9. Khan A, Ramar K, Maddirala S, Friedman O, Pallanch JF, Olson EJ.. Uvulopalatopharyngoplasty in the Management of Obstructive Sleep Apnea. Mayo Clin Proc. 2009;84(9):795-800.
10. Janson C, Gislason T, Bengtsson H, Eriksson G, Lindberg E, Lindholm CE, et al. Long-term follow-up of patients with obstructive sleep apnea treated with uvulopalatopharyngoplasty. Arch Otolaryngol Head Neck Surg. 1997;123(3):257-62.
11. Pang KP, Woodson BT. Expansion sphincter pharyngoplasty:a new technique for the treatment of obstructive sleep apnea. Otolaryngol Head Neck Surg. 2007;137(1):110-4.
12. Whyte KF, Allen MB, Jeffrey AA, Gould GA, Douglas NJ. Clinical features of the sleep apnoea/ hypopnoea syndrome. Q J Med. 1989;72:659–66.
13. Den Herder C, Van Tinteren H, De Vries. Sleep endoscopy versus modified Mallampati score in sleep apnea and snoring. Laryngoscope. 2005;115:735-39.
14. Riley RW, Powell NB, Guilleminault C. Obstructive sleep apnea syndrome:a review of 306 consecutively treated surgical patients. Otolaryngol Head Neck Surg. 1993;108(2):117-25.

15. Abdullah VJ, Van Hasselt CA. Video Sleep Nasendoscopy. Surgical Management of Sleep Apnea and Snoring. In: Terris DJ, Goode RL, eds. Boca Raton, FL: Taylor & Francis; 2005: 143–154.
16. Elshaug AG, Moss JR, Southcott AM, Hiller JE. Redefining success in airway surgery for obstructive sleep apnea:a Meta-analysis and synthesis of the evidence. Sleep. 2007;30(4):461-7.
17. Lin HC, Friedman M, Chang HW, Gurpinar B. The efficacy of multilevel surgery of the upper airway in adults with obstructive sleep apnea/hypopnea syndrome. Laryngoscope. 2008;118(5):902-8.
18. Verse T, Kroker BA, Pirsig W, Brosch S. Tonsillectomy as a Treatment of Obstructive Sleep Apnea in adults with tonsillar hypertrophy. Laryngoscope. 2000;110:1556-9.
19. Esclamado RM, Glenn MG, McCulloch TM, Cummings CW. Perioperative complications and risk factors in the surgical treatment of obstructive sleep apnea syndrome. Laryngoscope. 1989;99(11):1125-9.
20. Vieira MBM, Leite SHP, Cunha FC. Zetapalatopharyngoplasty (ZPPP): New Surgical Tecnique for Snoring and Sleep Apnea Treatment. Braz J Otolaryngol. 2001: 1-8.
21. MacKay SG, Carney AS, Woods C, Antic N, McEvoy RD, Chia M, et al. Modified Uvulopalato-pharyngoplasty and Coblation Channeling of the Tongue for Obstructive Sleep Apnea:A Multi-Centre Australian Trial. J Clin Sleep Med. 2013;9(2):117-24.

Cite this article as: Mohankumar V, Rajasekar MK, Veerasigamani N, Sivaranjani M. A study on evaluation of pre and postoperative polysomnography for obstructive sleep apnea patients. Int J Otorhinolaryngol Head Neck Surg 2017;3:861-7.