ORIGINAL ARTICLE

A clinical study of surgical outcomes in patients with obstructive sleep apnoea syndrome

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Abstract

Introduction: Snoring & Obstructive Sleep Apnea Syndrome (OSAS) is a globally prevalent problem which is increasingly being recognized in recent times. The treatment modalities include medical appliances & surgery. It is mandatory to have a rational approach in the management of obstructive sleep apnoes.Patients are given Continuous Positive Airway Pressure(CPAP) support or advised surgical correction as per the level of obstruction diagnosed by Sleep MRI and the severity as per the Polysomnography. A judicious selection of cases needs to be done for surgical management. Patients unfit for surgery and those who prefer medical treatment are advised CPAP as the primary modality of treatment. A small group of patients need surgical intervention followed by CPAP support.

Objectives: To assess the outcomes of various surgical procedures in the management of OSAS and to define a comprehensive protocol for objective assessment of OSAS with Dynamic MRI andPolysomnography.

Materials & Methods: A cohort of 100 patientsin the age group 27 – 64 years were diagnosed with OSAS and were treated at our institute over a period of one year (January 2010 – January 2011). All patients were evaluated with Epworth sleepiness scale (ESS) and investigated with Dynamic MRI and Polysomnography. As per the management protocols defined in the study, surgeries were performed in 38 patients with severe compromise of the airway, while the other group of 62 patients,and were provided CPAP. The 38 patients selected for surgery were included into this prospective study. Successful outcomes among these 38 patients were analyzed at the end of the study period. Four patients with mixed apnoearequired multimodal therapy which included surgery followed by CPAP support.

Results: Among the 38,patients, surgery proved successful in 34 patients in whom AHI

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reduced from 38.27 to 14.54 (62%) and ESS improved by almost 10 points. FourPatients among the surgical group had persistence of symptoms due to persistence of mixedapnoea& they were given CPAP support. Inferences derived from the above results proved the success of various surgical interventions in the management of OSAS.

Conclusion:A critical analysis of the anatomical & physiological factors inducing obstructive episodes & an appropriate treatment plan is vital, to produce successful outcomesin patients with OSAS. Failure of surgical procedures, are often due to improper case selection. A small group of patients may require multimodal therapy with surgery and CPAP.

Keywords: Obstructive sleep apnea syndrome, Respiratory Distress Index, Polysomnography, Sleep MRI, Epworth sleepiness scale.

Introduction

Obstructive Sleep ApnoeaSyndrome is a common disease of all age groups with a myriad of presentations. It affects 2 - 4% of middle aged adults and 1 - 3 % of children in the general population. Guilleminault, Eldridge and Dement were the first to describe "Sleep Syndrome" in 1973 & they established one of the first sleep clinics in the world.[1]

Significant advances have been made since then in the field of sleep medicine and the present day otolaryngologist must be familiar with the diagnosis and various methods of management of sleep apnoea. Clinically significant OSAS is likely to be present when Apnoea-Hypoapnoea Index (AHI)is >14 events per hour slept, in association with unexplained daytime sleepiness or a minimum of two of the other features of the condition like snoring, irritability, restless sleep and choking episodes. Upper airway resistance syndrome (UARS) is characterized by snoring with increased resistance in the upper airway, resulting in arousals during sleep. This can disturb sleep architecture to the point of causing daytime somnolence. As per recent reports, no distinct diagnostic criteria, exists for this entity.

The treatment modalities include medical appliances & surgery. Opinion regarding the ideal management of OSAS still remains divided, between the choice of surgery and medical therapy. There are two schools of thought; one extreme view completely negates any role for surgery, while the other view advocates surgery in majority of these cases. A rational approach needs to be devised, by analyzing both anatomical & physiological parameters for the optimal management of OSAS. This study proposes a rational approach by clinically correlating the anatomical and physiological factors influencing OSAS, which can help in developing future scientific management strategies for OSAS.

Aims of the study

- To define a comprehensive protocol for objective assessment of OSAS with Dynamic (Sleep) MRI and Polysomnography.
- To assess the outcomes of various surgical procedures in the management of OSAS

Material and methods

Out of the 100 patients who were diagnosed with OSAS, 38patients were selected for surgical treatment (including 33 males and 5 females; age 36 – 64 years Mean avg: 48.5 years), All the 38 patients were included into this study. This prospective studywas conducted over one year period (January 2010 to January 2011), in the Department of Snoring & Sleep Disorders at Madras ENT Research Foundation, Chennai. All 38 patients were selected into this study after a meticulous history to establish a clinical diagnosis of OSAS and confirmed by Epworth Sleepiness Scale (ESS) scores. After approval from the institutional ethics committee, the study group was counseled in detail regarding the surgical procedureand the anticipated outcomes. An informed consent was obtained for participation in this study.Patients were evaluated with Dynamic (Sleep) MRI for assessment of anatomical levels of obstruction and a comprehensive study of physiological parameters during sleep was assessed by Polysomnography.

Inclusion criteria for the study was adult patients who presented with snoring and excessive day time sleepiness, who were having significant airway collapse in Sleep MRI and were ideal cases for surgery under GA. Exclusion criteria werethose patients who had central apnoea, or

were already using CPAP, or were unfit or unwilling for surgery, and patients who were having co-morbid factors (Hypothyroidism/Metabolic disorders/Muscular hypotonia) or were using anti-psychotic medications.

In our study, the Indications for surgery were based on a specific protocol as listed below,

- Respiratory Distress Index (RDI)>20
- Mean O_2 saturation during sleep< 90%
- Excessive day time sleepiness
- No Significant cardiac arrhythmia
- Refused or rejected medical therapy / CPAP

Indications for providing CPAP were -

- Apnoea-Hypoapnoea Index (AHI)> 40
- AHI <40 if patient is Unfit/ unwilling for surgery
- Morbidly obese patients&Mixed apnoea

Clinical Examination of patients in the study included height & weight, BMI (27.8 kg/m^2& 27.3 kg/m^2 were considered normal for a male & female respectively), blood pressure, neck circumference – (17" & 15" were considered normal for a male & female respectively), hyomandibular distance, nasal patency, and, oropharyngeal airway, were measured, respiratory system, cardiovascular, endocrine and neurological system assessment was done to detect any coexisting diseases.

Epworth Sleepiness Scale (ESS) score above 10 (out of 24) with excessive day time sleepiness indicates OSAS. Subjects were given Epworth sleepiness scale questionnaires which included questions on presence of snoring, its intensity and the presence of any choking episode during sleep, recurrent awakening from sleep, excessive day time sleepiness, prior medical and surgical history, smoking and alcohol consumption, diabetes, hypertension, hypo/hyperthyroidism, asthma and exercise.

Sleep MRI (***High Definition GE open 2.0 Tesla***) (fig-1,2) was used in our study for evaluating patients suffering from OSAS, to identity the cause and level of obstruction and to determine ideal patients who would benefit from surgery. Dynamic narrowing is said to be present if the pharyngeal cavity lumen is seen to close in one of the images and if there is more than 50% reduction in the pharyngeal space all through during sleep as compared to maximum area seen in wakeful state. Reduction in airspace up to 50% is considered normal.[2]Based on Fujita et al classification, the level of obstruction identified on the sleep MRI & surgical protocols were decided individually for each patient.

The Polysomnogram (PSG) machine used in our study was ***CleveMed Sleep Scout System P/N 502-0146-1,*** Type III device, 9 channels unit, Cleveland, Ohio, United

Figure1: Dynamic MRI – type I collapse

Figure 2: Dynamic Sleep MRI – type II collapse

States. The Electrodes were placed by international 10 – 20 system. PSG record included overnight monitoring of pulse oximetry, ECG, EEG, anterior tibialis EMG, nasal & oral airflow, chest & abdominal movements, snoring & sleeping position (fig-3). The polysomnographic records were manually scored according to the standard criteria. The main purpose of a sleep study is to confirm physiological factors contributing to decide the management of OSAS and to asses its severity in order to guide the therapeutic choices to offer patients.

A correlation of dynamic sleep MRI with polysomnography was performed to plan the appropriate plan of management (surgery or CPAP) and the treatment

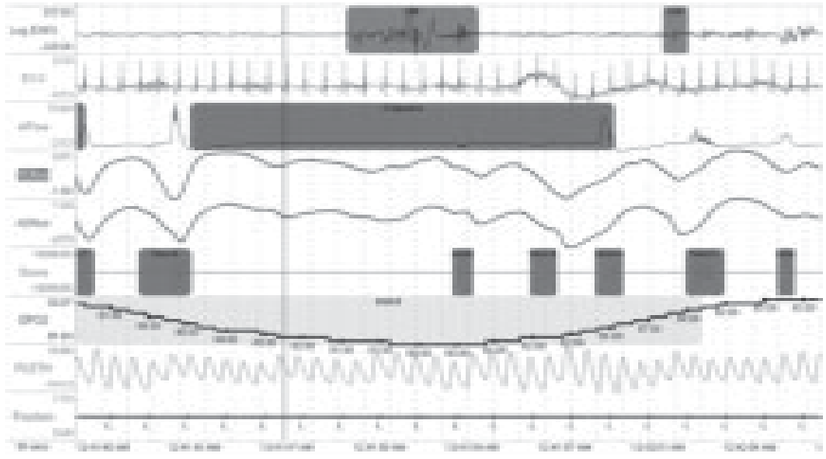

Figure 3: Polysomnography

outcomes were assessed at six months postoperatively with CPAP, polysomnography and ESS scores.

The success of surgical treatment for OSAS was categorized by the criteria used by Sher et al in their 1996 review.[3]In this studysuccess as defined as 50% improvement in respiratory distress index (RDI), with a significant decrease in the RDI to below 20, or the apnea index to below 10 from the pre operative level.

Results

Among the 100 patients who were diagnosed to have OSAS, 40 patients had retro-palatal (Level I) collapse out of which 18 preferred to have CPAP and 22 patients underwent surgery. Of these 22 patients selected for surgery, 2 patients had nasal polypi, 2 had gross turbinate hypertrophy, 2 had marked septal deviation along with retro-palatal (Level I) collapse and hence, they underwent Laser assisted Uvulo-palato-pharyngoplasty (LAUP) (fig-4)along with Nasal procedures accordingly (FESS / turbinoplasty / septoplasty). LAUP alone was done for 16 patients. Among the 22 patients with level I collapse who underwent surgery, 1 patient had persistence of symptoms due to a co-existent mixed apnoea.

Both retro-palatal & retro-lingual collapse (Level II) were noted in 52 patients.Out of them,38 patientsprefered CPAP and 14 patients underwent surgery. In this group, 10 patients hadlaser assisted uvulo-palato-pharyngoplasty (LAUP)with genioglossus advancement procedure (GGA)(fig-5).For GGA, osteotomies were done in the mandible at the geniotubercle, thus advancing the insertion of genioglossus & geniohyoid by 10-14 mm & rotating it by 90%. This increases the tension placed on the tongue.Three patients had narrowed nasopharyngeal airway with retro-gnathia, andhence underwent Maxillo-

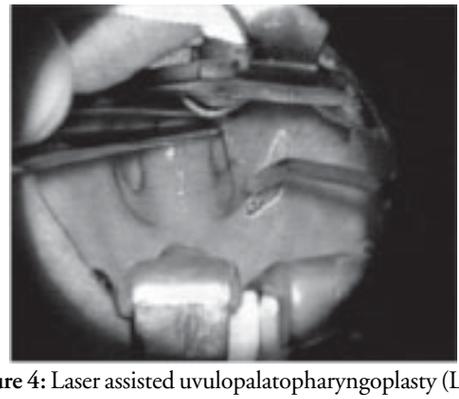

Figure 4: Laser assisted uvulopalatopharyngoplasty (LAUP)

Figure 5: Genioglossus Advancement Procedure (GGA)

mandibular osteototomy and advancement procedure (MMA). One morbidly obese patient in this group neededa tracheostomy.

Among the 14 patients with level II collapse who underwent surgery, 3 had persistence of their symptoms either due to co-existent central apnoea, or glossoptosis at sleep or pharyngeal muscle hypotonia. These patients required CPAP support.8 patients had retro-lingual (level III) collapse and among them 2 patients underwent genioglossus advancement surgery, while remaining 6 patients preferred CPAP support.

Twelve other patients, who had initially preferred CPAP, were not comfortable with CPAP and subsequently underwent surgery. Eight of them had retro-palatal (Level I) collapse and underwent LAUP and 4 had both retro-palatal & retro-lingual collapse (level II). Two of these patients had a LAUP along with genioglossus advancement procedure & maxillo-mandibular osteototomy/ advancement was done in 2 other patients.

The data collected was analyzed using SPSS 2.0 software with the application of student 'T' test for numerical values and the Carl Pearson method for correlation. At follow up after surgery, the significant decrease of mean average scores in AHI and ESS proved that there is significant relief in the obstructive sleep apnea features with surgical intervention. A rationale exists in the meticulous selection of ideal cases for surgery and others who need to be given CPAP therapy and this needs to be judiciously applied in selection of management porotocols for each patient with OSAS.

Overall analysis of results showed that Level II obstruction was found to be the commonest (52%) in the entire cohort. Overall CPAP was found to be the treatment, most preferred by patients (62%), and in selected cases surgery was performed (38%)(Table-1). For patients who were having retro-lingual - level III obstruction (8%), CPAP was found to be a better choice (75.0%), while 2 patients underwent successful surgery (25.0%).The mean average AHI score in our group was 38.268 before surgery and it reduced to 14.54 after surgical intervention. The Mean Average ESS reduced from 17 to 7 respectively.(fig-6,7,8,9). Overall outcomes of surgery, showed a significant positive correlation factor of r = *0.604* with $p < 0.01$ observed between AHI and ESS prior to surgery& the post op AHI vs ESS correlation was *r=0.840* significant at the level of $p<0.01$. (Table-2).

Table 1: Correlation between AHI, ESS before Surgery and after Surgery

Surgery	No of patients (n=38)	Pre op (Average)		Post op (Average) 6mth later	
		AHI	ESS	AHI	ESS
LAUP	16	30.01	15.63	14.41	6.87
LAUP + FESS	2	38.1	14	12.4	7
LAUP + Septoplasty	2	32.5	17	12.5	5
LAUP + Turbinoplasty	2	31.7	16	12.8	6
LAUP + GGA	10	35.32	18	18.1	8
MMA	2	77.6	20	14.3	9
Tracheostomy	2	89.2	22	03.2	4
GGA	2	41.3	19	15.4	8

Table 2: Correlation between Pre-surgical AHI, ESS vs. Post-surgical AHI, ESS

No of patients	Pre OP (average)		Post OP (average)	
	AHI	ESS	AHI	ESS
38	38.27	17	14.54	7

r= 0.604 (Pre-op AHI vs ESS)
r= 0.840 (Post-op AHI vs ESS)
Positive Correlation is at the level of 0.01(2 tailed)

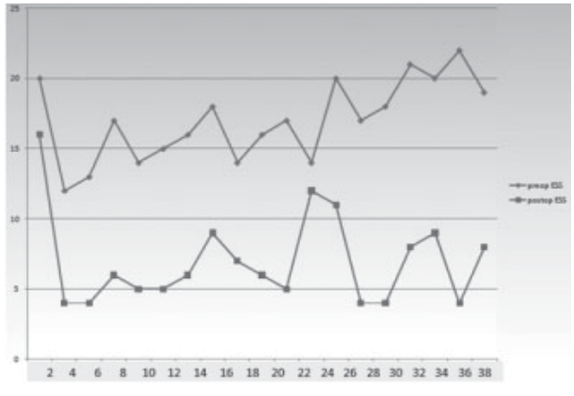

Figure 6: Trends in ESS score

Discussion

Obstructive sleep apnea syndrome requires a rational management with correction of both physiological factors

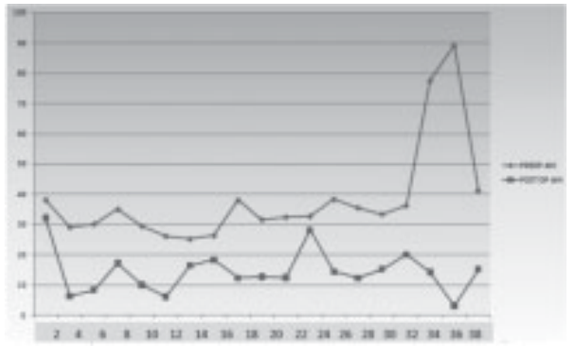

Figure 7: Trends in AHI score

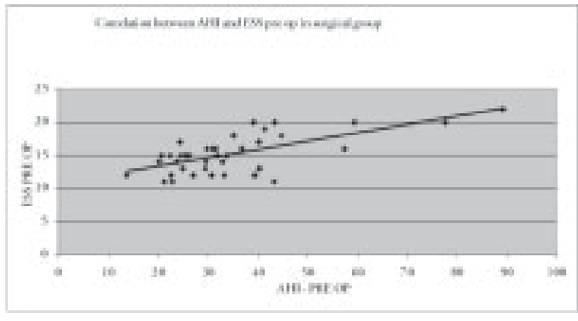

Figure 8

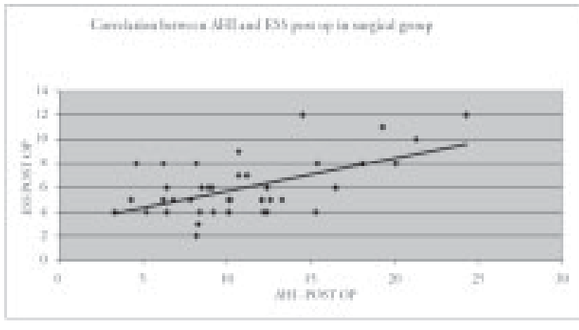

Figure 9

influencing collapse of airway and mechanical obstruction compromising the airflow. Traditionally treatment for snoring has focused on subjective assessment by Epworth sleepiness scale and treatment resolving only the mechanical obstruction in order to relieve patients from snoring. Current concept focuses on meticulous assessment of both anatomical and physiological parameters attributed to causation of OSAS. Objective assessment is done through apnea hypopnoea index score and symptomatic assessment is done through ESS. This study has focused on devising a rationale based on the above two parameters for ideal management of OSAS.

This study has documented definitive improvement in ESS and AHI scores by intervention with surgery and or CPAP.

The Fujita classification of airway obstruction divides the velohypopharynx into descriptive levels:

– Type I is Retropalatal,

– Type II is both Retropalatal and Retrolingual,

– Type III is Retrolingual

Literature analysis as per level of obstruction -

A - Level I collapse

Kamami in his study of 63 patients reported with 50% of patients being cured of their obstructive sleep apnea and a significant reduction occurring in an additional 25% of patients with LAUP.[4]In a study by Walker R P et al[5] in a case series of 43 patients, RDI decreased from 24.6 to 16.2. In our study of 100 patients, 40 patients were having level I airway collapse.LAUP was done alone in 16 patients and 6 patients underwent combined LAUP with nasal and other procedures. In patients with LAUP alone, in 2 patients AHI was reduced by only 25% but in others there was significant improvement over 50% in AHI. Post operatively AHI was significantly improved in all patients who underwent various nasal procedures along with LAUP. In this study success rate by LAUP alone is 87%. Average AHI reduced from 30.01 to 14.41 and ESS score improved from 15.6 to 6.8(Table-2).

B – Level II collapse

Johnson and Chin revealed a mean reduction in the AHI by 44.1, from a pre op value of 58.7 to post op value of 10.5 in patients undergoing UPPP and GGA[6].For tracheostomy two studies reports the role of temporary tracheostomy in management of OSAS[7,8].In our study, 52 patients were found to be having level II airway collapse. In this group LAUP was done along with GGA in 10 patients. In 8 patients AHI was reduced by more than 50%. Success rate of this procedure is 80%. AHI reduced from 35.3 to 18.1 and improvement in ESS score is of 10 points (Table-2). Maxillo-mandibular advancement (MMA) was done for 2 patients while 2 patients underwent tracheostomy because of severe respiratory distress, in both patients AHI was reduced significantly.

C – Level III collapse

In our study 8 patients were having level III obstruction. All patients have shown good improvement on subjective

assessment after treatment. For 2 patients in whom GGA was done, there was 62% improvement in AHI. The success rates of the procedures have been variable, ranging from 23% to 77%[9,10]. The other6 patients benefitted by CPAP support.

Overall, in 4 patients after surgery CPAP support was given to relieve the obstruction. The probable reason for this collapse inspite of surgical clearance may be attributed to musclehypotonia, soft tissue edema, anatomically narrow oropharynx or subclinical central apnoea. None of the patient had post-surgical nasopharyngeal regurgitance, velopharyngeal incompetence, or aspiration syndrome.

Conclusion

Management of a patient with sleep disordered breathing requires a multidisciplinary team approach. A systematic evaluation of each patient with a rationale protocol is necessary to produce the best outcomes. A detailed history, clinical examination & simple overnight observation will usually help to clinch the diagnosis of obstructive sleep apnea syndrome. Polysomnography is the gold standard investigation to help diagnose the type and severity of sleep apnea. Sleep MRI (Dynamic MRI) with sleep nasal endoscopy has obviated the need for cumbersome cephalometric measures to establish the site of obstruction. Patients need to be counseled regarding all medical and surgical treatments that are available.

CPAP therapy is considered as the first line treatment, however surgery should be offered to patients, in selected and indicated cases and also those struggling to tolerate nasal CPAP. CPAP titration should be tailor made for each individual and calibrated over period of time, during which patients need to be symptomatically judged based on a comfort questionnaire. Many patients select surgical treatment because of intolerance to non-surgical treatments; while some may consider surgery to improve their ability to tolerate nonsurgical treatments, such as the reduction of therapeutic CPAP pressure or improvement of nasal symptoms caused by CPAP use.The surgeon must possess wisdom and experience in order to adjudge the best cases for surgery in which he can provide the optimal outcomes and he should also educate the patient regarding the surgical procedure & its complications and expected outcomes. The patients should be offered all the treatment options available and choice of treatment must be left to them. Their contribution to relief of symptoms by indulging in a healthy life style with diet control and weight reduction also needs to be over emphasized, since the management of OSAS is a team effort by the physician and the individual needing treatment.

Our study has highlighted the successful outcomes of surgery in patients with obstructive sleep apnoea syndrome, as noted by the significant positive correlation factors obtained in AHI & ESS scores. These results have been similar to those reported in world literature. Patients have expressed relief from their OSAS symptoms after surgery which proves that surgical intervention has a definitive role in the management of selective cases of obstructive sleep apnoea. At present a clinical study is underway at our institute in order to assess the long term surgical outcomes in a larger cohort in comparison with CPAP support.

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Abbreviations:

AHI= Apnoea-Hypoapnoea Index

ESS= Epworthj Sleepiness Scale

RDI = Respiratorty Distress Index

LAUP= Laser assisted Uvulo-palato-pharyngoplasty

FESS= Functional Endoscopic Sinus Surgery

GGA= Genioglossus Advancement

MMA = Maxillo-mandibular Osteotomy & Advancement

PSG = Polysomnography