Clinical Practice Guidelines on Management of Adult Obstructive Sleep Apnoea

Recommended by

Indian Association of Surgeons for Sleep Apnoea (IASSA)

DECLARATION

This document reflects the consensus opinion of the members of the Indian Association of Surgeons for Sleep Apnoea (IASSA). It is not binding on any individual / individual clinic. However, it is the recommendation of the IASSA that, wherever possible, this document should act as a guideline for clinics performing evaluation and management including surgery for Obstructive Sleep Apnoea in India

IASSA Guidelines Clinical Practice Guidelines on Management of Adult OSA

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Guideline Development

The purposes of this clinical practice guideline are to (1) increase the recognition of OSAS by primary care clinicians to minimize delay in diagnosis and avoid serious sequelae of OSAS; (2) evaluate diagnostic techniques; (3) describe treatment options; (4) provide guidelines for follow-up; and (5) discuss areas requiring further research.

The guidelines have been developed using a robust methodology based on the one utilized by the American Academy of Sleep Medicine (AASM) Guidelines.

Clinical Practice parameters were designated as Standard, Guideline or Option based on the level and amount of scientific evidence available.

The method has been adapted to suit rare conditions where the evidence base is limited, and where expert consensus plays a greater role. The members of the guideline development group are listed below.

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Abbreviations

AASM	American Academy of Sleep Medicine
AHI	Apnoea hypopnea index
APAP	Auto positive airway pressure
ASA	American Society of Anesthesiologists
AUTOPAP	Auto positive airway pressure
BMI	Body mass index
BPAP	Bi-level positive airway pressure
CPAP	Continuous positive airway pressure.
DISE	Drug-induced sleep endoscopy
ECG	Electrocardiography
EDS	Excessive daytime sleepiness
EEG	Electroencephalography
EMG	Electromyography
EOG	Electrooculography
EPAP	Expiratory positive airway pressure
ESS	Epworth sleepiness scale
F-CPAP	Fixed continuous positive airway pressure
FNMM	Fiberoptic nasopharyngoscopy with Müeller's manouvre
GAHM	Genioglossus advancement with hyoid myotomy
GGA	Genioglossus advancement
HDU	High Dependency Unit
HST	Home sleep testing
ICU	Intensive Care Unit
IPAP	Inspiratory positive airway pressure
MAD	Mandibular advancement device
MLS	Multi-level surgery
MRA	Mandibular repositioning appliance
MRI	Magnetic resonance imaging
MSLT	Multiple sleep latency test
MWT	Maintenance of wakefulness test
NCPAP	Nasal continuous positive airway pressure
OA	Oral appliances
OHS	Obesity hypoventilation syndrome
OCST	Out of center sleep testing
OR	Odds ratio
OSA	Obstructive sleep apnoea
OSAS	Obstructive sleep apnoeasyndrome
PAP	Positive airway pressure
PAT	Peripheral arterial tone
PM	Portable monitoring
POSA	Postionalobstructive sleep apnoea
P-SAPS	Perioperative sleep apnoea prediction score
PSG	Polysomnography
QOL	Quality of life
RCT	Randomized controlled trial
RDI	Respiratory disturbance index
REI	Respiratory event index
RERAS	Respiratory effort related arousals
SOREMP	Sleep onset rapid eye movement period
UARS	Upper airways resistance syndrome
ULCT	Unattended limited channel testing
UPPP	Uvulopalatopharyngoplasty
WASM	World Association of Sleep Medicine

Evidence Quality

Evidence Quality	Preponderance of Benefit or Harm	Balance of Benefit and Harm
A. Well designed RCTs or diagnostic studies on relevant population	**Strong Recommendation**	**Option**
B. RCTs or diagnostic studies with minor Limitations;overwhelmingly consistent evidence from observationl studies		
C. Observationl studies (case-control and cohort design)	**Recommendation**	
D. Expert opinion, case reports, reasoning from first principles	**Option**	**No Rec**
X. Exceptionl situations where validating studies cannot be performed and there is a clear preponderance of benifit or harm	**Strong Recommendation** / **Recommendation**	

Level A: Good scientific evidence suggests that the benefits of the clinical service substantially outweigh the potential risks. Clinicians should discuss the service with eligible patients.

Level B: At least fair scientific evidence suggests that the benefit of the clinical service outweighs the potential risks. Clinicians should discuss the service with eligible patients.

Level C: At least fair scientific evidence suggests that there are benefits provided by the clinical service, but the balance between benefits and risks are too close for making general recommendations. Clinicians need not offer it unless there are individual considerations.

Level D: At least fair scientific evidence suggests that the risks of the clinical service outweigh potential benefits. Clinicians should not routinely offer the service to asymptomatic patients.

Level X: Scientific evidence is lacking, of poor quality, or conflicting, such that the risk versus benefit balance cannot be assessed. Clinicians should help patients understand the uncertainty surrounding the clinical service.

AASM Levels of Recommendations

Standard: This is a generally accepted patient-care strategy that reflects a high degree of clinical certainty. The term standard generally implies the use of Level 1 evidence, which directly addresses the clinical issue, or overwhelming Level 2 evidence.

Guideline: This is a patient-care strategy that reflects a moderate degree of clinical certainty. The term guideline implies the use of Level 2 evidence or a consensus of Level 3 evidence.

Option: This is a patient-care strategy that reflects uncertain clinical use. The term option implies either inconclusive or conflicting evidence or conflicting expert opinion.

1.1.Obstructive Sleep Apnoea (OSA)

Obstructive sleep apnoea (OSA) is a syndrome characterized by periodic, partial, or complete obstruction of the upper airway during sleep. This, in turn, causes repetitive arousal from sleep to restore airway patency, which may result in daytime hypersomnolence or other day time manifestations of disrupted sleep such as aggressive or distractible behavior in children. The airway obstruction may also cause episodic sleep-associated oxygen desaturation, episodic hypercarbia, and cardiovascular dysfunction.

It is estimated that the adult prevalence of sleep disordered breathing, as measured in a sleep laboratory, is 9% in women and 24% in men, whereas the prevalence of overt OSA has been estimated to be 2% in women and 4% in men. These figures are likely to increase as the population becomes older and more obese. In India, the prevalence of OSAS is 2.4% to 5% in males and 1 to 2% in females and there is no considerable variation in the prevalence of OSAS compared to rest of the world.

1.2. High Risk patients

The demographic characteristics that predispose to development of OSA include older age, male gender, pregnancy and post-menopausal state.

Risk factors that are linked by strong published evidence include obesity, central body fat distribution, increased neck circumference and several anatomical abnormalities of the craniofacial region and upper airway.

Other potential risk factors include genetic predisposition, familial aggregation, tobacco smoking, alcohol use, night-time nasal congestion, endocrine abnormalities (hypothyroidism, acromegaly), polycystic ovarian syndrome, Down's syndrome and drugs (benzodiazepines, muscle relaxants, testosterone therapy).

Sleep-disordered breathing (SDB) has frequently been associated with various forms of cardiovascular disease. Individuals with severe SDB are two- to four-times more likely to develop complex arrhythmias than those without SDB.

Individuals with diagnosed OSA are between two and three times more likely to develop hypertension. JNC7 recognizes OSA as an identifiable cause of hypertension.

The prevalence of OSA in patients with heart failure is estimated at 40 to 70 percent. Individuals with diagnosed OSA are more likely to suffer a stroke than those without OSA.

Type 2 diabetes is more prevalent in patients with sleep-disordered breathing independent of other risk factors.

The American Society of Anesthesiologists (ASA) recommends identifying, monitoring, and treating patients with OSA in the perioperative period.

2.1.Long-term Morbidities Associated With OSAS

2.1.1.Neurobehavioral Consequences

One of the now well-established long-term consequences of OSAS in children is behavioral and neurocognitive morbidities. Behavioral dysregulation is the most commonly encountered comorbidity of OSAS, and the vast majority of studies consistently report some association between OSAS and hyperactivity, attention deficits, impulsivity and attention deficit hyperactivity disorder-like symptoms.

2.1.2.Cardiovascular Consequences

Recurrent hypoxic and hypercapneic episodes of OSAS elevate pulmonary vascular resistance leading to pulmonary hypertension. Such elevations in pulmonary artery pressures may, potentially lead to cor pulmonale. The recurrent episodes of upper airway obstruction that characterize OSAS lead to intermittent hypoxia, hypercapnia and significant swings of intrathoracic pressures, all of which may elicit disturbances in autonomic function.

2.1.3.Metabolic Consequence**s**

The term 'Metabolic Syndrome', a known risk factor for cardiovascular disease in adults, refers to the clustering of insulin resistance, dyslipidemia, hypertension and obesity.

3.Clinical features of OSA

Obstructive sleep apnea (OSA) symptoms generally begin insidiously and are often present for years before the patient is referred for evaluation.

3.1.Nocturnal symptoms may include the following:

Snoring, usually loud, habitual, and bothersome to others, Witnessed apneas, which often interrupt the snoring and end with a snort, Gasping and choking sensations that arouse the patient from sleep, though in a very low proportion relative to the number of apneas they experience, Nocturia, Insomnia, Restless sleep, with patients often experiencing frequent arousals and tossing or turning during the night.

3.2.Daytime symptoms may include the following:

Nonrestorative sleep (i.e., "waking up as tired as when they went to bed"), Morning headache, dry or sore throat, Excessive daytime sleepiness (EDS) that usually begins during quiet activities (e.g., reading, watching television); as the severity worsens, patients begin to feel sleepy during activities that generally require alertness (e.g.,

school, work, driving). Daytime fatigue / tiredness, Cognitive deficits; memory and intellectual impairment (short-term memory, concentration), Decreased vigilance, Morning confusion, Personality and mood changes, including depression and anxiety, Sexual dysfunction, including impotence and decreased libido, Gastro esophageal reflux, Hypertension, Depression.

EDS is one of the most common and difficult symptoms clinicians treat in patients with OSA. It is one of the most debilitating symptoms because it reduces quality of life, impairs daytime performance, and causes neurocognitive deficits (e.g., memory deficits).

EDS is most frequently assessed by a sleep physician using the Epworth Sleepiness Scale (ESS). This questionnaire is used to help determine how frequently the patient is likely to doze off in 8 frequently encountered situations.

Although patients do not always accurately describe their sleepiness on this scale compared with objective measures, an ESS score greater than 10 is generally considered sleepy. However, a 2003 study showed that an ESS score of 12 is associated with a greater propensity to fall asleep on the Multiple Sleep Latency Test (MSLT), suggesting that 12 would be a better cutoff.

4. Recommended Clinical history and baseline investigations in OSA

4.1. Clinical History

The diagnosis of OSA starts with a sleep history that is typically obtained in one of three settings:

First, as part of routine health maintenance evaluation,

Second, as part of an evaluation of symptoms of obstructive sleep apnoea, and

Third, as part of the comprehensive evaluation of patients at high risk.

High-risk patients include those who are obese, those with congestive heart failure, atrial fibrillation, treatment refractory hypertension, type 2 diabetes, stroke, nocturnal dysrhythmias, pulmonary hypertension, high-risk driving populations (such as commercial truck drivers), and those being evaluated for bariatric surgery (Consensus).

Questions to be asked during a routine health maintenance evaluation should include a history of snoring and daytime sleepiness and an evaluation for the presence of obesity, retrognathia, or hypertension (Consensus).

Positive findings on this OSA screen should lead to a more comprehensive sleep history and physical examination.

A comprehensive sleep history in a patient suspected of OSA should include an evaluation for snoring, witnessed apnoeas, gasping / choking episodes, excessive sleepiness not explained by other factors, including assessment of sleepiness severity by the Epworth Sleepiness Scale, total sleep amount, nocturia, morning headaches, sleep fragmentation / sleep maintenance insomnia, and decreased concentration and memory (Consensus).

An evaluation of secondary conditions that may occur as a result of OSA, including hypertension, stroke, myocardial infarction, corpulmonale, decreased daytime alertness, and motor vehicle accidents, should also be obtained (Consensus).

4.2. Physical Examination

The physical examination can suggest increased risk and should include the respiratory, cardiovascular, and neurologic systems. Particular attention should be paid to the presence of obesity, signs of upper airway narrowing, or the presence of other disorders that can contribute to the development of OSA or to the consequences of OSA. Features to be evaluated that may suggest the presence of OSA include increased neck circumference (> 17 inches in men, > 16 inches in women), body mass index (BMI) > 30 kg/m2, the presence of retrognathia and/or overjet, lateral peritonsillar narrowing, macroglossia, tonsillar hypertrophy, elongated/enlarged uvula, high arched/narrow hard palate, nasal abnormalities (polyps, deviation, valve abnormalities, turbinate hypertrophy) (Consensus).

Following the history and physical examination, patients can be stratified according to their OSA disease risk. Those patients deemed high risk should have the diagnosis confirmed and severity determined with objective testing in an expedited manner in order to initiate treatment. For other patients, the timing of further testing is determined by the risk of OSA and the presence of daytime impairment or associated morbidity. As part of the initial sleep evaluation, and prior to objective testing, patients should receive education regarding possible diagnoses, diagnostic steps, and the procedure involved in any testing (Consensus).

5. Investigations

The presence or absence of severity of OSA must be determined before initiating treatment in order to identify those patients at risk of developing complications of OSA.

5.1.Evaluation of Severity of Sleep Apnoea

The severity of OSA must be established in order to make an appropriate treatment decision. No clinical model is recommended to predict severity of obstructive sleep apnoea (Option), therefore objective testing is required. A diagnosis of OSA must be established by an acceptable method (Standard). The two accepted methods of objective testing are in-laboratory polysomnography (PSG) and home testing with portable monitors (PM). For specifics on the parameters to be measured with PSG and PM, see the sections below. PSG is routinely indicated for the diagnosis of sleep related

breathing disorders (Standard). PMs may be used to diagnose OSA when utilized as part of a comprehensive sleep evaluation in patients with a high pretest likelihood of moderate to severe OSA (Consensus). PM testing is not indicated in patients with major comorbid conditions including, but not limited to, moderate to severe pulmonary disease, neuromuscular disease, or congestive heart failure, or those suspected of having a comorbid sleep disorder (Consensus).

High-risk patients with nocturnal symptoms of OSA should undergo sleep testing, including those who are obese, those with systolic or diastolic heart failure (Standard), coronary artery disease (Guideline), history of stroke or transient ischemic attacks (Option), or significant tachyarrhythmias or bradyarrhythmias (Guideline). Patients with congestive heart failure who continue to have nocturnal symptoms of sleep related breathing disorders despite optimal medical management are also at risk for OSA and should undergo testing (Standard).

Patients with hypertension should undergo evaluation and testing if they have nocturnal symptoms (disturbed sleep, nocturnal dyspnea, or snoring) suggestive of obstructive sleep apnoea or if they remain hypertensive despite optimal medical management (Consensus).

A preoperative clinical evaluation that includes PSG or PM is routinely indicated to evaluate for the presence of OSA in patients before they undergo upper airway surgery for snoring or OSA (Standard). A preoperative clinical sleep evaluation that includes PSG is recommended to evaluate for the presence of OSA in patients before they undergo bariatric surgery (Consensus). PM testing may also be indicated for the diagnosis of OSA in patients for whom in-laboratory PSG is not possible by virtue of immobility, safety or critical illness and to monitor response to non-CPAP therapies (Consensus).

Follow-up PSG or attended cardiorespiratory (type 3 PM) sleep study is routinely indicated for the assessment of treatment results after surgical treatment for moderate to severe OSA (Standard). To ensure satisfactory therapeutic benefit from oral appliances (OA), patients with OSA should undergo PSG or an attended cardiorespiratory (type 3 PM) sleep study with the OA in place after final adjustments of fit have been performed (Guideline). Also, unattended PM may be in to monitor the response to non-CPAP treatments for OSA, including OAs, upper airway surgery, and weight loss (Consensus). Follow-up PSG or attended cardiorespiratory (type 3 PM) sleep study is routinely indicated to assess treatment results after surgical or dental treatment for sleep related breathing disorders when symptoms return, despite a good initial response to treatment (Standard). Follow-up PSG is routinely indicated in OSA patients for the assessment of treatment results on CPAP after substantial weight loss (e.g., 10% of body weight), substantial weight gain with return of symptoms, when clinical response is insufficient, or symptoms return despite a good initial response to CPAP (Standard). Follow-up PSG or PM is not routinely indicated in patients treated with CPAP whose symptoms continue to be resolved with CPAP treatment (Option).

5.1.1.Polysomnography

The use of PSG for evaluating OSA requires recording the following physiologic signals: electroencephalogram (EEG), electrooculogram (EOG), chin electromyogram, airflow, oxy-gen saturation, respiratory effort, and electrocardiogram (ECG) or heart rate. Additional recommended parameters include body position and leg EMG derivations. Anterior tibialis EMG is useful to assist in detecting movement arousals and may have the added benefit of assessing periodic limb movements, which coexist with sleep related breathing disorders (SRBD) in many patients (Standard). An attended study requires the constant presence of a trained individual who can monitor for technical adequacy, patient compliance, and relevant patient behavior (Guideline). Technical personnel should have appropriate sleep-related training.

Current training pathways include on-the-job training utilizing the Accredited Sleep Technologist Education Program (A-STEP) or college-based training in a sleep technology program accredited by the Commission on Accreditation of Allied Health Education Programs (CAAHEP). The final pathway for demonstration of competency is certification, through the Board of Registered Polysomnographic Technologists (BKPT) or its equivalent. Technologist progression to certification is now required to meet AASM accreditation standards, Center for Medicare and Medicaid Services Independent Diagnostic Testing Facility regulations,11 and multiple state credentialing and licensing regulations.

The parameters, settings, filters, technical specifications, sleep stage scoring and event scoring should be done in accordance with the AASM Manual for the Scoring of Sleep and Associated Events. The frequency of obstructive events is reported as an apnoea + hypopnea index (AHI) or respiratory disturbance index (RDI). The definition of this index has varied over time. When an index is reported in this guideline it was taken directly from the specific practice parameter and the reader is referred to the source document for the definition. Every sleep study should be reviewed and interpreted by a qualified physician, as defined in the AASM Accreditation Standards (Consensus). Interscorer reliability assessment and other quality assurance measures should be performed on a regular basis.

Formal written policies should be in place for all procedures. The most accepted measure of quality is sleep center or laboratory accreditation by the AASM (Consensus). Full night PSG is recommended for the diagnosis of a sleep related breathing disorder but a split-night study (initial diagnostic PSG followed by continuous positive airway pressure titration on the same night) is an alternative to one full night of diagnostic PSG. The split night study may be performed if an AHI > 40/hr is documented during 2 hours of a diagnostic study but may be considered for an AHI of 20-40/hr based on clinical judgment. In patients where there is a strong suspicion of OSA, if other causes for symptoms have been excluded, a second diagnostic overnight PSG may be necessary to diagnose the disorder. The diagnosis of OSA is confirmed if the number of obstructive events (apnoeas, hypopneas + respiratory event related arousals) on PSG is greater than 15 events/hr or greater than 5/ hour in a patient who reports any of the following: unintentional sleep episodes during wakefulness; daytime sleepiness; un-refreshing

sleep; fatigue; insomnia; waking up breath holding, gasping, or choking; or the bed partner describing loud snoring, breathing interruptions, or both during the patient's sleep. OSA severity is defined as mild for RDI > 5 and < 15, moderate for RDI > 15 and < 30, and severe for RDI > 30/hr (Consensus).

5.1.2.Portable Monitors (PM)

PM for the diagnosis of OSA should be performed only in conjunction with a comprehensive sleep evaluation. Clinical sleep evaluations using PM must be supervised by a practitioner with board certification in sleep medicine or an individual who fulfills the eligibility criteria for the sleep medicine certification examination (Consensus). A PM should, at a minimum, record airflow, respiratory effort, and blood oxygenation. The type of biosensors used to monitor these parameters for in-laboratory PSG are recommended for use in PMs and include an oronasal thermal sensor to detect apnoeas, a nasal pressure transducer to measure hypopneas, oximetry, and, ideally, calibrated or uncalibrated inductance plethysmography for respiratory effort. (Consensus).

An experienced sleep technician, sleep technologist, or appropriately trained healthcare practitioner must perform the application of PM sensors or directly educate the patient in the correct application of the sensors (Consensus). PM should be performed under the auspices of an AASM accredited comprehensive sleep medicine program with policies and procedures for sensor application, scoring, and interpretation of the collected data. A quality/performance improvement program for PM including inter-scorer reliability must be in place to assure accuracy and reliability. PMs may be used in the unattended setting as an alternative to PSG for the diagnosis of OSA in patients with a high pretest probability of moderate to severe OSA and no comorbid sleep disorder or major comorbid medical disorders when all of the previous parameters are met (Consensus).

The diagnosis of OSA is confirmed and severity determined using the same criteria as used for PSG. Scoring criteria should be consistent with the current published AASM standards for scoring of apnoeas and hypopneas (Consensus). The term RDI has been defined differently when used with PMs than when used with PSG. RDI PM is the number of apnoeas + hypopneas / total recording time rather than total sleep time. As a result, PMs are likely to underestimate the severity of events compared to the AHI by PSG. Due to the known rate of false negative PM tests, in-laboratory PSG should be performed in cases where PM is technically inadequate or fails to establish the diagnosis of OSA in patients with a high pretest probability (Consensus).

5.2.Evaluation of Site of Obstruction

Opinion regarding the ideal management of OSAS still remains divided, between the choice of surgery and medical therapy and it mainly depends upon the identification of level & pattern of obstruction in the upper airway.

As the interest in Sleep-Disordered Breathing (SDB) has increased, various attempts have been made to assess upper airway anatomy in patients with this relatively frequent disorder. From the very beginning, researchers and clinicians used a multitude of

different techniques like Cephalometry, Fibreoptic Nasendoscopy – Muller's maneuver / End Expiratory, Dynamic Sleep MRI and Drug Induced Sleep Endoscopy (DISE), not only to reveal potential differences in upper airway anatomy to understand the origin and the pathophysiology of the disease but also to improve patient management and treatment success.

5.2.1. *Drug-Induced Sleep Endoscopy (DISE)*

DISE is a visual inspection of the upper airway during a drug-induced sleep that has been proposed as a method for identifying likely sites of obstruction during sleep. Furthermore, palatal surgery may be effective in up to 75% of patients selected for the procedure after DISE compared to a 40% success rate in unselected SDB patients. It is performed widely and its validity has been demonstrated by several studies; in fact, it provides clinical information which is not available by routine clinical inspection alone. Even though sleep endoscopy during natural sleep is an ideal test, it may disturb the sleeping patient. For these reasons, in 1991 Croft and Pringle introduced drug-induced sleep nasendoscopy, which provides direct visualization of structural collapses of the upper airway under anaesthesia.

5.2.1.1. DISE protocol

Prerequisites

Performing Place - operating room / endoscopy suite / similar place equipped with facility for resuscitation. (Consensus)

Personnel - Anesthetist well versed with difficult intubation, ENT surgeon

Equipment - Facility for intubation, LMA, emergency Tracheostomy - if required, cardio respiratory monitoring, flexible endoscope, recording system

DISE /dynamic MRI findings should be the basis for selection of the surgical procedure to be performed on the soft palate, base tongue or epiglottis. (Consensus)

It is recommended to follow a universal scoring pattern either DISE Index or VOTE Index at the end of the procedure. (Consensus)

5.2.2.Sleep MRI

It helps in the identification of the cause and site of obstruction of the upper airway during natural sleep. Thanks to its panoramicity, possibility to visualize anatomical structures in any plane of the space and highest contrast resolution combined with a more than satisfactory spatial resolution, and it allows us to evaluate the entire pharyngeal airway and the surrounding soft tissues and skeletal structures. It emerged as a highly reliable imaging technique in identifying craniometric landmarks and in measuring linear, angular, cross sectional and volumetric indices.

Identification of the site and pattern of obstruction of upper airway during sleep is an essential point in choosing the therapeutic approaches of OSAS patients. Several studies have demonstrated that DISE / Sleep MRI may help to specify therapy individually, leading to an increased surgical success rate (Guideline).

6.Management Protocol

- Patient has to be explained about life style modification and the potential benefits out of doing regular exercise and reducing weight. (Guideline)
- CPAP trial has to be offered to all patients with OSA. (Guideline) and the efficacy and compliance of CPAP has to be assessed. (Consensus)
- If the pressure is too high (10 and above) and patient couldn't tolerate, BIPAP trial can be given and option of surgery can be explained to the patient. (Option)
- If the BMI is more than 35, it is recommended to go for bariatric surgery and to use CPAP before and after the surgery. (Option)
- Patients with severe AHI who are not comfortable with CPAP have to be explained about the outcome of surgery and possibility of using CPAP after the surgery which may improve the compliance by reducing the upper airway resistance. (Consensus)
- Patients with morbid obesity with cardiac complications who may not be fit for multilevel surgery have to be explained the need for Temporary / Permanent Tracheosotomy. (Consensus)
- Efficacy may be assessed by reduction in AHI / AI, improvement in SaO2, Sleep Efficiency, and improvement in ESS score & Quality of Life after a period of 6 months. (Consensus)
- Compliance is assessed by duration of CPAP usage - > 4hrs acceptable. (Guideline)

6.1. Oral appliances (OA)

OA's will be helpful in patients with mild to moderate OSA who prefer oral appliances to CPAP, orwho do not respond to CPAP or who fail treatment attempts with CPAP. The option and availability of oral appliances has to be discussed with the patient. (Guideline)

6.2. *Preoperative Evaluation*

- As per routine pre op investigations
- Coagulation Profile
- Blood Grouping & Typing
- Thyroid Function Test
- ElectroCardioGram
- 2D Echocardiogram

- Pulmonary Function Test (if needed)
- Any other investigations as and when indicated for anaesthesia and surgical safety

6.3.Surgical Protocol

Surgical treatment is recommended in patients who have failed or intolerant to PAP therapy or patients who refuse CPAP therapy. (Guideline)

Static obstruction, if present, may be surgically intervened in proven OSA and UARS patients, where PAP therapy is either ineffective or patient is non compliant. (Consensus)

BMI 40 and above is a relative contraindication for surgery for dynamic obstruction of the upper airway, and bariatric surgery should be recommended in cases of failure of PAP therapy. In selected cases of lymphoid tissue hypertrophy of the upper airway, surgery for dynamic obstruction can be performed, when both PAP therapy and bariatric surgery are not a viable option. (Consensus)

6.4.Nasal surgery

Nasal surgery as a standalone procedure in the treatment of OSA has been found to be ineffective. It improves the quality of sleep and compliance with CPAP therapy and improves its efficacy in patients who have static nasal obstructions like Grade 2 or 3 deviated nasal septum, Grade 2 or 3 inferior turbinate hypertrophy, concha bullosa, sinonasal polyposis, Grade 3 or 4 adenoidal hypertrophy, or any tumour of nose or upper airway. Dynamic collapse at the level of nasal valve can be surgically corrected. (Guideline)

6.5.Surgery on soft palate

Classical UPPP or one of its variants, such as zeta palatoplasty, expansion sphincter palatoplasty, lateral pharyngoplasty, etc can be performed according to the observation (Level and pattern of collapse) and preference of the surgeon. (Consensus)

6.6.Base of tongue surgery

Prerequisites

Personnel - Anesthetist well versed with difficult intubation, ENT surgeon

Equipment - Facility for intubation, Laryngeal Mask Airway, LMA, emergency Tracheostomy - if required, cardio respiratory monitoring and resuscitation (Consensus)

Midline glossectomy, coblation assisted excision of tongue base / lingual tonsil, Trans Oral Robotic Surgery etc can be performed according to the observation (Level and pattern of collapse) and preference of the surgeon. It is recommended to do first few cases under the guidance of experienced Sleep Apnoea surgeon. (Consensus)

6.7.Multilevel surgeries on nose, palate, base of tongue and epiglottis

Multilevel surgery can be performed in a single stage or as a staged procedure depending upon the surgeon's expertise and the intensive care facilities of the hospital in which the procedure is conducted. When done in a single stage it is recommended not to pack the nose.

In staged multilevel surgery, nasal & nasopharyngeal surgery can be done as a first stage followed by oropharyngeal & Endoluminal hypopharyngeal surgery separated by atleast few weeks in case of a large base tongue as nasal packing makes the process of extubation much more difficult. (Consensus)

Palatal surgery can be combined with major nasal surgery requiring nasal packing, only if the base tongue is not large enough to cause complete airway obstruction. So, patients showing partial / incomplete collapse at tongue base during DISE / Sleep MRI shouldn't be taken for major nasal surgery in combination with palatal surgery. If at all taken, nose has to be packed with the nasopharyngeal airway or have to be extubated after 24 hrs of monitoring in ICU. (Consensus)

Palatal surgery can be combined with base of tongue surgery, only if following precautions are taken.

- If extubated on the table, patient should be fully awake and complete hemostasis have been ensured or to be extubated after 24 hrs in the ICU
- Nasopharyngeal airway has to be secured if the patient is extubated immediately.
- Sedatives and narcotics to be avoided
- Facility for reintubation / tracheostomy should be available
- Availability of Non invasive ventilation / Auto CPAP in the ICU / HDU / Post OP ward (Consensus)

In morbidly obese patients or with cardiac complications, preliminary / Temporary tracheostomy should be considered. (Guideline)

It is recommended to combine 2 minor procedures with 1 major procedure or 1 minor procedure with 2 major procedures with necessary precautions. It is not recommended to combine 3 major procedures. (Consensus)

Minor Procedure	Major Procedure
Nasal valve surgery	Endoscopic sinus surgery
Inferior Turbinate channeling	Septoplasty / Turbinectomy / Turbinoplasty
Palatal & Tonsil channeling	Adenoidectomy
Tongue base channeling	UPPP & Various modifications
Septal Spur excision	Midline Glossectomy / Lingual tonsil excision / genioglossus advancement / Hyoid advancement / Mandibular or Maxillomandibular advancement / Trans Oral Robotic surgery

6.8.External Frame work Surgery

Prerequisites

Patient with multilevel obstruction with hypoplastic maxilla / retrognathia / mandibular retrusion

Personnel - Anesthetist well versed with difficult intubation, ENT surgeon, Faciomaxillary surgeon

Equipment - Facility for intubation, Laryngeal Mask Airway, LMA, emergency Tracheostomy - if required, cardio respiratory monitoring and resuscitation

6.9.Multi – Staged Surgery

Multilevel treatment can be performed in a single stage or in multiple stages. Since palatal surgery and Tongue base surgery / genioglossus / hyoid advancement are all rather limited procedures without significant surgical morbidity, these procedures are usually first to be attempted to improve obstructive sleep apnea. After a healing period of six months, a post-operative polysomnogram is to be obtained to evaluate the outcome. In patients with persistent obstructive sleep apnea, maxillomandibular advancement can then be performed. Palatal surgery in combination with genioglossus / hyoid advancement is usually considered as phase I operation, in which these procedures are often performed as a Single Multi level operation. Usually Maxillomandibular advancement is considered as phase II operation.

However, the staged approach may actually increase unnecessary surgical manipulation for some patients. Patients with factors that can negatively influence the outcome may have a low chance of success with phase I operation. Therefore, patients with severe obstructive sleep apnea, morbid obesity, significant maxillomandibular deficiency or patients who wish to have the best chance for a cure with a single operation can certainly be considered as candidates for maxillomandibular advancement as a primary surgical treatment option.

7. Perioperative Management of Patients with Obstructive Sleep Apnea

Preop evaluation may be initiated in a preanesthesia clinic (if available) or by direct consultation from the operating surgeon to the anesthesiologist. (Option)

The severity of the patient's OSA, the invasiveness of the diagnostic or therapeutic procedure, and the requirement for postoperative analgesics should be taken into account in determining whether a patient is at increased perioperative risk from OSA.

The patient and his or her family should be informed of the potential implications of OSA on the patient's perioperative course.

General anesthesia with a secure airway is preferable to deep sedation without a secure airway, particularly for procedures that may mechanically compromise the airway and patients at increased perioperative risk from OSA should be extubated while awake and full reversal of neuromuscular block should be verified before extubation. (Guideline)

When possible, extubation and recovery should be carried out in the lateral, semiupright, or other nonsupine positions.(Guideline)

Risk factors for postoperative respiratory depression may include the underlying severity of the sleep apnea, systemic administration of opioids, use of sedatives, site and invasiveness of surgical procedure, and the potential for apnea during rapid eye movement (REM) sleep on the third or fourth postoperative day (i.e., "REM rebound"), as sleep patterns are reestablished.

- Postoperative Analgesia – Sedatives and narcotics to be avoided
- Postoperative supplemental oxygen administration should be considered
- Postoperative CPAP will improve ventilatory function in these patients should be considered
- If possible, patients should be placed in nonsupine positions throughout the recovery process
- Should have continuous pulse oximetry monitoring after discharge from the recovery room
- Because of their propensity to develop airway obstruction or central respiratory depression, they may require a longer stay in HDU
- To establish that patients are able to maintain adequate oxygen saturation levels while breathing room air, respiratory function may be determined by observing patients in an unstimulated environment, preferably while asleep

8. Conclusion:

Clearly, it is important to review all possible treatment options and explain the rationale for sleep apnea surgery. Successful surgical outcome depends on proper patient selection based on diagnostics, selection and execution of the procedure.

The management has to be individualized for each patient and the disease. The adaptation of a logical and systematic approach to clinical evaluation, treatment planning and surgical execution is necessary in order to maximize safety and improve surgical results.