

Routine Polysomnography before Bariatric Surgery: Is it Necessary or Optional?

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ABSTRACT

Obstructive sleep apnea (OSA) is a condition characterized by episodes of apnea or hypopnea during sleep that result in excessive daytime sleepiness and a range of metabolic disturbances, which adversely affect cardiovascular, metabolic, and psychologic health. The common underlying mechanism for the same is periodic airway closure, which worsens with loss of pharyngeal muscle tone during sleep that results in significant obstruction and episodic apnea. Obesity is one comorbidity that commonly precipitates OSA and also worsens the long-term metabolic sequelae of OSA. With the ever increasing epidemic of obesity that is now starting to affect more developing countries such as India, more patients are undergoing bariatric surgery than before for a range of indications. This population provides a unique set of management issues that shall be the subject of this review.

Keywords: Bariatric surgery, Obstructive sleep apnea, Perioperative management.

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HOW LIKELY IS OSA IN A PATIENT PLANNED FOR BARIATRIC SURGERY?

While obesity occurs in 11.8 to 31.3% of the Indian population, obstructive sleep apnea (OSA) seems to have a prevalence of between 2.5% and 19.5%, which predictably increases to approximately 70% (moderate to severe OSA) in patients undergoing bariatric surgery.¹⁻³ Therefore, 7 out of 10 people scheduled to undergo bariatric surgery would have moderate to severe OSA.

WHY IS IT IMPORTANT TO DIAGNOSE OSA PREOPERATIVELY AND WILL A DIAGNOSIS OF OSA CHANGE PERIOPERATIVE MANAGEMENT?

Obstructive sleep apnea is associated with a higher risk of adverse cardiovascular outcomes including sudden cardiac death that has been shown to have a relative risk of 2.57 during sleeping hours compared with those without it.⁴ Thankfully, this risk has also been shown to reduce with the appropriate use of continuous positive airway pressure (CPAP) over the long-term.⁵ Due to coexistence of various comorbidities, such as metabolic syndrome, pulmonary hypertension, coronary heart disease, etc., patients undergoing bariatric surgery are at a relatively higher risk of complications. Furthermore, different mechanisms at play in the perioperative period worsen OSA and further increase this risk. The use of anesthetic or analgesic drugs, prolonged supine positioning, airway changes secondary to airway manipulation during ventilation, and problems with use of CPAP in the perioperative period contributes to this. Studies have shown that patients with OSA have higher rates of emergent endotracheal intubation, noninvasive mechanical ventilation, and atrial fibrillation.⁶ Obstructive sleep apnea also increases the risk of ICU transfer and prolongation of hospital stay that can contribute significantly to perioperative morbidity in such patients.⁷ Untreated OSA in the perioperative period adversely affect patient health and the management of the same has been shown to improve outcomes.⁷⁻⁹ Because of the adverse effects of untreated OSA in patients undergoing bariatric surgery, routine screening is now recommended for this population.¹⁰⁻¹³

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Once diagnosed, OSA must be managed in the preoperative period depending on the severity of OSA as determined by apnea-hypopnea index (AHI) and the presence of symptoms. The management mentioned is consistent with the American Academy of Sleep Medicine (AASM) guidelines for management of OSA published in 2009.¹⁴

Summary of OSA management as per these guidelines is shown in Table 1.

Table 1: Summary of recommendations from the American Academy of Sleep Medicine

AHI	
<5	Consider other diagnoses
≥5 and ≤14	
With symptoms/sequelae	Treat
Without symptoms/sequelae	Conservative management
≥15	Treat

Symptoms/sequelae—unintentional sleep episodes during wakefulness, daytime sleepiness, unrefreshing 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.

Treatment Modalities

All patients must be educated about their condition with special emphasis on the importance of lifestyle modifications to facilitate

weight reduction and general measures improve symptoms of OSA. The modalities used for treatment include:

Positive Airway Pressure

This maybe provided as CPAP, bi-level PAP (BPAP), or autotitrating PAP (APAP). A split-night study maybe used if AHI ≥ 40 /hour is documented during the first 2 hours of a diagnostic study or AHI 20–40/hour if clinically judged to be requiring PAP. Choice between the modes of application of PAP depend on the nature and severity of the disease. Most patients require CPAP but high pressure requirements can cause difficulty in exhaling and in such cases or those not tolerate CPAP, BPAP may be tried.¹⁴ In such cases, affordability and compliance remain an issue. Preoperatively, patients must be encouraged to use PAP modalities regularly and bring their machines to the hospital during admission to ensure continued use before and after surgery.

Appropriate interface: A variety of solutions exist with regard to the interface to be used for providing CPAP. Generally, devices may consist of interfaces comprising nasal pillows, nasal cushions, oro-nasal, or full face masks. Recent evidence seems to indicate that oro-nasal implementation might cause higher CPAP requirements by causing mandibular displacement and increasing airway collapsibility because of mouth opening and create higher amounts of leak with reduced patient comfort.^{15–18} The selection of one over the other needs to account for patient- and disease-specific factors with special emphasis on the comfort for the patient, which is imperative in ensuring adherence with long-term therapy.¹⁹ Other factors including cost and availability may further influence the decision regarding appropriate interfaces.²⁰

Autotitrating positive airway pressure: This refers to implementations of CPAP where the amount of airway pressure is adjusted via proprietary algorithms throughout the duration of use to ensure continued airway patency.²¹ This may be used both as a strategy to find adequate levels of CPAP for subsequent usage and for the long-term treatment of such patients. Autotitrating PAP maybe tried in cases intolerant of their high PAP requirements, those with varying requirements through the night because of various builds, sleep, and comorbidity-related factors. Most evidence including recent meta-analyses have failed to show major differences between the use of autotitrating vs fixed PAP for clinically relevant outcomes.^{22,23}

Optimal duration of preoperative usage: The patients diagnosed with OSA should be started on CPAP and surgery deferred until the treatment has been optimized; however, no particular duration of preoperative CPAP therapy has been validated.²⁴

*Behavioral*¹⁴

Weight loss and exercise: Recommended for all OSA patients to target a body mass index (BMI) $< 25 \text{ kg/m}^2$. With ~10% reduction in weight, repeat polysomnography (PSG) maybe needed to assess for ongoing need for PAP. Guidelines differ on the indication of bariatric surgery in these patients with Indian guidelines mentioning a step-wise approach. The recommendations are as follows.²⁵

Body mass index $> 25 \text{ kg/m}^2$ with comorbidities (type II diabetes mellitus, hypertension, dyslipidemia, cardiovascular disease) OR $> 27 \text{ kg/m}^2$: pharmacotherapy apart from lifestyle modifications including dietary changes and exercise.

Body mass index $\geq 32.5 \text{ kg/m}^2$ (with comorbidities) or $\geq 37.5 \text{ kg/m}^2$ even without comorbidities: consideration for bariatric surgery.

Positional therapy: Supine position produces pressure on the airway that can often lead to narrowing/collapse which exacerbates OSA. Devices that keep the patient in the lateral position ensure improvements in airway closure. These can include the use of backpacks, alarms, pillows, tennis balls.

Avoiding sedatives/alcohol before bed: Work by reducing the decreases in pharyngeal muscle tone that underlies the loss of airway patency in OSA patients.

Oral Appliances

Include devices such as mandibular repositioning appliances (MRA)/ tongue retaining devices (TRDs) which work by reducing the airway narrowing by keeping soft tissue away from the oropharynx. These maybe tried in patients with mild to moderate OSA, those not using/ refusing/not tolerating CPAP.

Surgical Procedures

Include a number of nasal, oral, oropharyngeal, nasopharyngeal, hypopharyngeal, and laryngeal procedures. These are considered in the face of anatomical abnormalities precipitating OSA or those in whom other measures have not been beneficial. Strict patient selection is essential.

Adjunctive

Includes workup and management of preexisting conditions such as acromegaly, hypothyroidism. Modafinil maybe tried in patients still having excessive daytime sleepiness (EDS) despite optimal PAP usage.

Patients with Known Obstructive Sleep Apnea

The goal of assessment in these patients is to establish the severity of OSA, the compliance with any treatment instituted for the same and the efficacy of this treatment. These patients may already be using PAP therapies. In such cases, it is essential to document the degree of improvement afforded by these interventions by clinical and, if needed, polysomnographic parameters.

Airway-related Considerations

Usage of PAP

Patients already on PAP or oral appliances should continue to use these during sedation to maintain lung capacity and reduce time to desaturation.¹⁰ Use of 10 cm PEEP with 100% oxygen prior to induction followed by 10 cm positive end expiratory pressure (PEEP) during mask ventilation and after intubation has been shown to reduce atelectasis.^{26,27}

Ramped Position

Due to the high risk of encountering a difficult airway in these patients, apart from having alternative devices and a backup plan, patients should be intubated in the ramped position to increase the likelihood of successful intubation and improve oxygenation.^{28–30}

Video-laryngoscopy

While clear cut evidence for their use in all obese patients in unavailable, it maybe used, when available, due to the expected difficulties in securing the airway.^{31,32}

High Flow Oxygen

Usage can be considered for those who are deemed to be having potentially difficult airways during induction.³¹

Extubation

Advisable only once the patient has regained consciousness and complete reversal of neuromuscular blockade has been established. This can be assessed by sustained head lift >5 seconds, adequate eye opening and coughing. Whenever possible, this should be done in the lateral, semi-upright or other non-supine positions to avoid gravitational effects of soft tissue impinging on the airway. When needed for improving airway patency, use of CPAP and for those retaining CO₂, use of BPAP is recommended and these must be available prior to extubation.^{10,26,31,33}

Anesthesia-related Considerations

Avoidance of Opioids/Sedatives

Due to their tendency to cause respiratory depression and postoperative morbidity, their use should be avoided and if necessary, titrated slowly to minimal required doses.^{10,28}

Analgesics

Multimodal anesthesia refers to the combination of agents such as paracetamol, non-steroidal anti-inflammatory drugs (NSAIDs) and local anesthetics for incisional infiltration/blocks, which can decrease postoperative requirement for opioids and decrease morbidity.^{28,34,35}

Monitoring During Surgery

This is guided primarily by the nature of surgery and comorbidities. Apart from usual operative monitoring, special attention must be paid to capnography and oximetry during surgery which should continue into the postoperative period.^{31,36}

Postoperative

A multitude of factors is at play in the postoperative period which tends to increase the rate of respiratory compromise. These include the OSA itself, usage of drugs such as opioids and sedatives during anesthesia and "REM rebound" on the third to fourth postoperative day worsening apnea.

Recovery after Surgery

Maybe done via the usual institutional policies in post-anesthesia care units (PACUs) and routine management in the ICU is not necessary. Identification of such patients can use objective parameters such as a modified Montefiore Obesity Surgery Score to stratify patients based on risk.³⁷ However, there is a role of extended observation in PACUs to identify patients at high risk of complications. Residual anesthetic/narcotic may contribute to respiratory failure and therefore, care must be taken to monitor the patients for signs of decompensation and ensure continued use of CPAP/oro-/nasopharyngeal airways. Pulse oximetry must continue to be monitored in this period to detect any respiratory failure as treatment is especially indicated for patients with oxygen saturation below 80% for more than a couple of minutes or development of hypercapnia.^{37,38} Patients should preferably be nursed in a lateral position to reduce airway collapse.^{33,39} They are usually provided supplemental oxygen postoperatively with tapering based on maintenance of saturation with some sources advising periodic blood gas evaluation to recognize and treat rising CO₂ levels with reduction in opioids/administration of BPAP.³⁸ However, caution has been advised while using supplemental oxygen because

of concerns regarding increased duration of apneic spells, hindrance in detection of atelectasis, transient apnea, and hypoventilation by pulse oximetry.¹⁰

Therefore, even in the immediate perioperative period, identifying patients with OSA and instituting appropriate measures can prevent numerous life-threatening complications.

HOW WOULD I KNOW IF MY PATIENT HAS OBSTRUCTIVE SLEEP APNEA?

Various screening methods can be used to select patients at high risk of having OSA. These patients can then undergo polysomnographic testing for confirmation. The screening methods include.

Questionnaires

To identify the patients at risk of having OSA, various validated questionnaires exist but usage in a particular setting should be based on the validation of such tests in the population for which it is going to be used. Here, we list a few of these and include evidence from validation studies in the Indian populations.

STOP-BANG

This questionnaire includes the presence of snoring, tiredness, observed apnea, high blood pressure, BMI, age, neck circumference, and male gender (STOP-BANG). Each item is given 1 point and a total of ≥ 3 identifies patients at risk for OSA. Validation in Indian populations have shown a sensitivity of 84–92% and specificity of 50–54.5% with a positive predictive value of 88–92% and negative predictive value of 50–62%.^{40,41}

Modified Berlin Questionnaire

This questionnaire was initially developed to screen for risk factors predicting the presence of OSA by including questions about snoring, excessive daytime sleepiness, presence of hypertension, and obesity in the first part. If a positive response is present to any of these, the subsequent part with a four-point frequency scale is administered to determine the likelihood of OSA. To accommodate those patients in India who do not drive, modifications have been made to this part during the validation study include questions for sleepiness during waiting for appointments, paying bills and watching television. High risk is indicated by two or more answers indicating frequency >3–4/week in questions related to snoring, wake time sleepiness, or presence of hypertension. In India, this questionnaire has been shown to have a sensitivity of 86% and specificity of 95% with a negative predictive value of around 82%.⁴²

Epsworth Sleepiness Score

This questionnaire quantifies daytime sleepiness using points given for the likelihood of falling asleep (0 = no chance and 3 = high chance) in various situations. The final score is a sum of these points with scores ≥ 10 , indicating the possible presence of excessive sleepiness. Validation studies exist for Hindi translations of the same, which show good agreement with English versions.^{43,44} A study comparing ESS and STOP-BANG in India reported a sensitivity of 100%, specificity of 55.6%, PPV 45.7% and NPV of 100% for ESS.⁴⁰ However, Western literature seems to indicate that ESS has a sensitivity that is much lower than that of STOP-BANG, Berlin questionnaire (BQ) and advice against using ESS for screening patients.^{45,46}

Comparison

Western literature, on comparison of questionnaires, shows the highest sensitivities with STOP-BANG followed by BQ and then

ESS. A study comparing ESS and BQ with level I PSG as the gold standard ($n = 72$) showed better sensitivity of BQ compared with ESS (71.11 vs 31%). Similar comparison of ESS and STOP-BANG, unlike other published data, showed higher sensitivity of ESS vs STOP BANG (100% vs 84.6%) using level III PSG as gold standard but was again, limited by a small sample size ($n = 50$). In general, guidelines advise again using ESS and instead using STOP-BANG and BQ for determining which patients should be further tested for OSA.³¹

PSG

While providing the best way of diagnosing OSA, PSG has limitations with regard to availability, adequate technical expertise and costs that are especially important in a resource-constrained setting. These issues are partially addressed using a questionnaire based algorithms to stratify patients based on risk with those identified as high risk undergoing a sleep study while those at low risk are managed with usual perioperative care.¹³

Screening for Obesity Hypoventilation Syndrome (OHS)

OHS often coexists with OSA and independently affects outcomes by causing an increase (as compared with OSA

without OHS) in the postoperative respiratory failure, heart failure, prolonged intubation, ICU transfer, and longer ICU/hospital stay.⁷

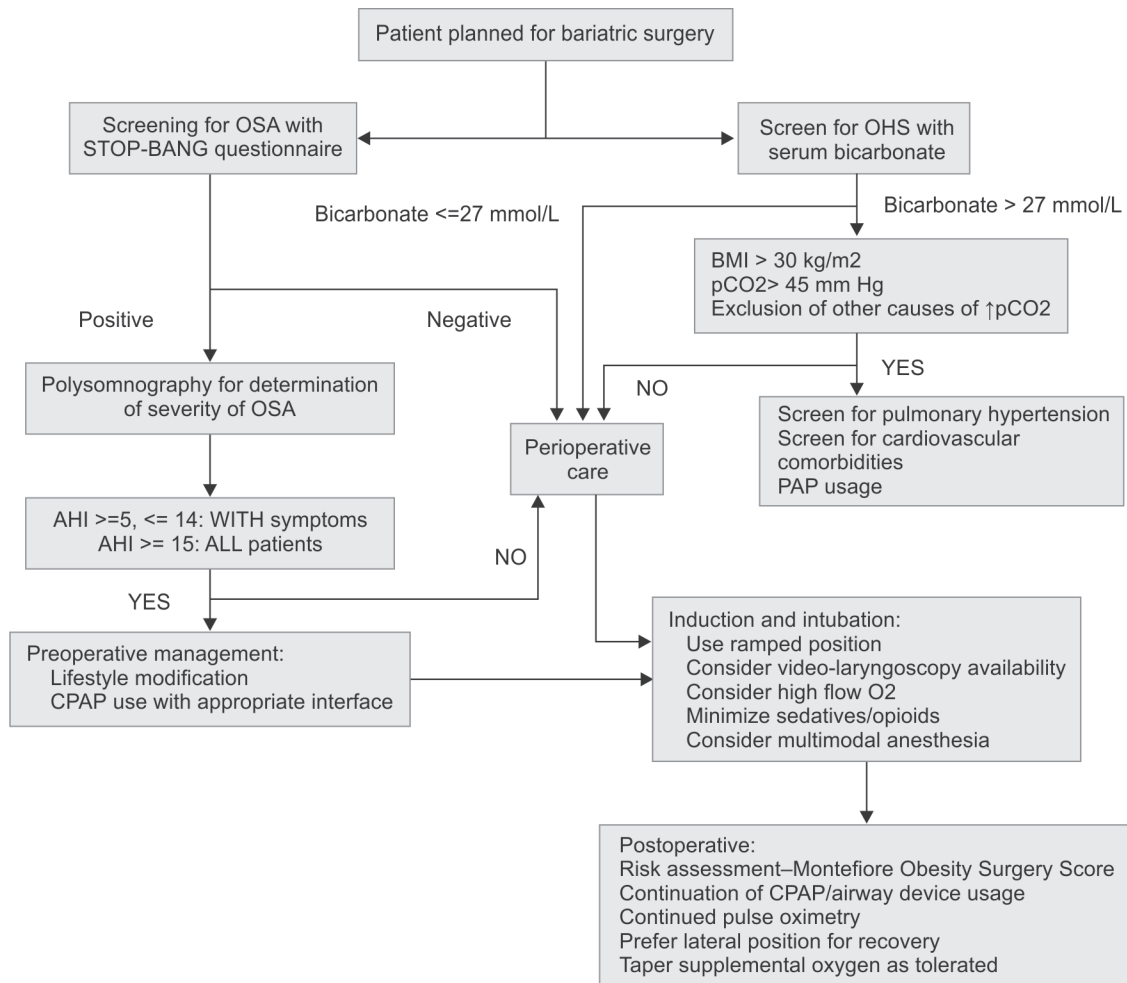
Because of this, screening via blood bicarbonate level testing is recommended as a part of preoperative assessment. Levels >27 mmol/L have a sensitivity of 76.6–92% and specificity of 50–89.5% for the diagnosis of OHS.^{47–49}

Evaluation must begin if screening is positive—diagnosis requires BMI >30 kg/m², pCO₂ >45 mm Hg and a workup that excludes alternate causes of an increased pCO₂ including COPD and asthma. Once a diagnosis of OHS is established, screening is also required for pulmonary hypertension (usually echocardiography) as well as other cardiovascular comorbidities to optimize the preoperative characteristics.⁵⁰ Management in parallel with that of OSA with application of PAP helps offset part of the increased morbidity and improves outcomes.^{9,51}

So, screening for OSA should be done with questionnaires. STOP-BANG questionnaire performs better compared with other questionnaires in the perioperative period for detecting OSA, which needs to be confirmed by a PSG. It is also prudent to screen for OHS with a serum bicarbonate levels.

Flowchart 1 highlights the approach to the management of OSA in patients undergoing bariatric surgery.

Flowchart 1: Approach to the management of OSA in patients undergoing bariatric surgery. AHI, apnea–hypopnea index; BMI, body mass index; CPAP, continuous positive airway pressure; OHS, obesity hypoventilation syndrome; OSA, obstructive sleep apnea



WILL A PATIENT DIAGNOSED WITH OBSTRUCTIVE SLEEP APNEA PREOPERATIVELY STILL REQUIRE OBSTRUCTIVE SLEEP APNEA TREATMENT POST-BARIATRIC SURGERY?

While the exact amount of weight loss is dependent on the type of surgery, studies including those from India indicate significant reduction of weight as well as OSA (measured by AHI) after surgery.³ The amount of weight loss rather than the type of surgery seems to influence this improvement⁵² with results from patients undergoing Roux-en-Y gastric bypass and sleeve gastrectomy indicating that close to 55% patients experience improvement or resolution of OSA after surgery.⁵³ Evaluation of OSA over longer periods of time has also demonstrated sustained cure in 45% patients and improvement in 78% of patients after bariatric surgery. Many patients (62%) who undergo bariatric surgery will have residual OSA despite dramatic weight loss. Only 25% of patients postoperatively will have AHI <5/hour and 44% will have AHI <10/hour. However, close to 20% may have the persistence of moderate to severe OSA which may need aggressive management.⁵⁴ It is advisable that patients with OSA diagnosed preoperatively should undergo repeat PSG after surgical weight loss even if they lack symptoms of excessive sleepiness.

A significant proportion of patients undergoing bariatric surgery will have residual OSA severe enough to necessitate treatment. Patients having significant weight loss (>10%) should undergo repeat PSG postoperatively so to diagnose the presence of OSA, which should be managed as per indications.

CONCLUSION

It is important to screen for OSA in patients awaiting bariatric surgery because they have a higher incidence of having OSA and higher chances of developing perioperative complications than those undergoing other surgeries. The majority of people would have remnant OSA post-bariatric surgery, requiring one, or other modalities of treatment.

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