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Original Research Article

Awake flexible endoscopy in supine position versus drug-induced sleep endoscopy: impact on surgical decision-making in obstructive sleep apnea: experience from a tertiary care centre in Pune, India

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ABSTRACT

Background: Obstructive sleep apnoea (OSA), increasingly prevalent in India due to rising obesity and urbanisation, demands precise preoperative assessment for effective surgical management. This study compares awake flexible nasopharyngolaryngoscopy (FNPLS) and drug-induced sleep endoscopy (DISE) to evaluate their diagnostic contributions and impact on surgical decision-making in a resource-constrained setting.
Methods: A retrospective study at Inamdar Hospital included 177 patients (aged 18–65 years) with OSA (apnoea–hypopnoea index (AHI)>5) diagnosed via Level 2 or 3 polysomnography from January 2019 to July 2025. All underwent FNPLS and DISE to identify airway collapse sites. The study assessed whether DISE provided additional diagnostic information beyond FNPLS and influenced surgical planning. Data were analyzed using SPSS version 26 ($p<0.05$ for significance).
Results: All patients (100%) showed velar and oropharyngeal collapse on FNPLS and DISE. DISE revealed additional sites in 24.3% of cases, mainly tongue base (16.4%) and epiglottic collapse (2.2%), altering the primary diagnosis in 26.0% of patients. Surgical plans remained unchanged in 81.4% of cases. Mean AHI decreased significantly from 17.74±9.25 preoperatively to 9.37±5.91 post-surgery ($p=0.001$). No complications occurred during DISE or surgery.
Conclusions: FNPLS serves as an effective primary tool for OSA surgical planning. DISE offers valuable insights into dynamic airway collapse, enhancing diagnostic precision in select cases. Its role as a complementary investigation supports tailored surgical strategies while optimizing resource allocation.

Keywords: Airway obstruction, Drug induced sleep endoscopy, Flexible nasopharyngolaryngoscopy, Obstructive sleep apnoea, Polysomnography, Surgical planning

INTRODUCTION

Obstructive sleep apnoea (OSA) is a prevalent, yet underdiagnosed sleep-related breathing disorder characterized by recurrent episodes of upper airway obstruction during sleep, leading to intermittent hypoxia, fragmented sleep and significant cardiovascular, metabolic and neurocognitive sequelae.[1] In India, the burden of OSA is rising, attributed to urbanisation, obesity and sedentary lifestyles. A recent study by Goyal

et al estimated its prevalence at nearly 32% in the Indian population, underscoring the magnitude of the problem and the need for early diagnosis and intervention.[2]

Common symptoms include loud snoring, non-refreshing sleep, morning headaches, excessive daytime somnolence and poor concentration, all of which adversely impact quality of life and productivity.[3] While continuous positive airway pressure (CPAP) remains the mainstay of conservative therapy, surgical intervention is often required for patients with predominant anatomical obstruction or CPAP intolerance.[4] Optimal surgical outcomes depend on accurate preoperative evaluation, including clinical assessment, polysomnography, awake flexible nasopharyngolaryngoscopy (FNPLS) and, where appropriate, drug-induced sleep endoscopy (DISE). FNPLS is widely used to assess airway patency and structural contributors to obstruction while the patient is awake. DISE, introduced by Croft and Pringle in 1991, provides dynamic visualisation of upper airway collapse under pharmacologically induced sleep-like conditions, offering a more physiological representation of obstruction and enabling tailored surgical planning.[5,6] However, concerns about standardization, inter-observer variability and the potential influence of sedation on airway dynamics remain.[7] In India, where cost and accessibility are critical considerations, the routine use of DISE must be carefully weighed against its incremental benefit over FNPLS. This study compares the diagnostic findings and clinical utility of FNPLS and DISE in patients undergoing surgical evaluation for OSA, with particular emphasis on their impact on surgical decision-making in a resource-sensitive healthcare setting.

METHODS

Aims and objectives

This retrospective observational study was conducted at Inamdar Hospital. All patients included in the study underwent both awake FNPLS and DISE. The primary objective was to determine whether DISE provided any additional diagnostic findings beyond FNPLS and whether these additional observations resulted in a change in the primary diagnosis or necessitated a modification in the planned surgical treatment strategy.

Study population

A total of 177 patients diagnosed with OSA on overnight polysomnography (PSG) and considered suitable for surgical management were included. These patients were evaluated between January 2019 and July 2025.

Patients aged 18 to 65 years, diagnosed with OSA (Apnoea–Hypopnoea Index (AHI)>5) on level 2 or Llevel 3 polysomnography, were eligible for inclusion. Only those with complete clinical records and adequate follow-up data were considered for analysis.

Patients were excluded if they had a prior history of upper airway or OSA-related surgeries. A diagnosis of central or mixed sleep apnoea. Pregnancy. Known allergy to propofol. Severe systemic comorbidities contraindicating surgery. Contraindication for DISE or incomplete DISE due to inadequate sedation.

Awake flexible nasopharyngolaryngoscopy

All patients were examined by awake FNPLS. This was performed using a Fujinon 2.7 mm chip-on-tip and Karl Storz 2.7 mm chip-on-tip flexible nasopharyngoscopy to visualize the upper airway and identify the site of collapse during Müller's maneuver. Key anatomical sites assessed included.

Nasal cavity

Evaluated for inferior and middle turbinate hypertrophy and deviated nasal septum (DNS), which may increase nasal resistance.

Soft palate, velum and uvula

Assessed for elongation, redundancy and potential collapse contributing to velopharyngeal obstruction.

Tongue base

Examined for posterior bulk and relative position.

Epiglottis

Assessed for posterior prolapse or supraglottic obstruction.

DISE

DISE was performed in the operation theatre as a day-care procedure. All patients were kept nil per oral for at least 8 hours prior to the procedure and all routine preoperative investigations necessary for general anaesthesia were completed. A topical anaesthetic (4% lignocaine) was applied to the nasal mucosa and 2% xylocaine jelly was used to lubricate the scope. The procedure was performed with the patient in a supine position. Continuous monitoring of oxygen saturation, cardiac rhythm and blood pressure was carried out throughout the procedure. Sleep induction was performed by an anaesthetist using a low dose of propofol (0.01 mg/kg), followed by titration infusion (3 mg/kg/h) until the patient reached an adequate sleep-like state with active snoring. At this point, a video-recorded fibre-optic nasopharyngoscopy was performed to assess the dynamic airway collapse.

Bispectral index (BIS) monitoring was performed in all patients, maintaining a BIS score of 60–80 throughout the procedure. Sites of obstruction visualized on FNPLS and DISE were noted separately and any additional sites

detected on DISE were recorded. The data was analyzed to determine whether DISE revealed any additional sites of obstruction and whether these findings altered the surgical plan.

Surgical procedures

The surgical procedures performed included inferior turbinoplasty, septoplasty and barbed pharyngoplasty. In selected cases with evidence of tongue base obstruction and epiglottic prolapse, targeted interventions such as epiglottoplasty and radiofrequency ablation and/or coblation channeling of the tongue base were undertaken.

Data was tabulated on MS Excel and analyzed using SPSS version 26. Descriptive and inferential statistical tests both parametric (paired t test for before and after comparison) and non-parametric tests (chi square for checking the association of two variables) were applied for analysis of data based on variable type and association checking. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 177 patients with OSA were included in this retrospective study (Diagnosed by PSG level 2 and 3) The mean age of the study population was 37.93±9.55 years, with the 31–40 years age group constituting the largest proportion, comprising 70 participants (39.5%). This was followed by the 41–50 years group with 55 participants (31.1%), the 20–30 years group with 32 participants (18.1%) and the smallest segment, those aged 51 years and above, accounting for 20 participants (11.3%) (Figure 1). The majority of participants were male (83.6%, n=148), with females comprising 16.4% (n=29) of the cohort (Figure 2).

The distribution of BMI was categorized across different age groups. In terms of Body Mass Index (BMI), 52.5% (n=93) were categorized as overweight, 27.7% (n=49) had a normal BMI and 19.8% (n=35) were obese, indicating that most of the study population had elevated BMI levels. The mean BMI was 26.92±3.69 kg/m². There was no statistically significant association between age groups and BMI categories (p=0.057) (Table 1). The highest proportion of overweight individuals (44.1%) belonged to the 31–40 years age group. The 41–50 years group also had a notable share across all BMI categories, especially in the obese category (34.3%). Younger participants (20–30 years) predominantly fell into the normal BMI category (32.7%). Participants aged 51 and above had relatively higher proportions in the obese category (17.1%). The p value of 0.057 indicates that the observed differences in BMI distribution across age groups are not statistically significant (NS) at the 5% level. The mean lowest oxygen saturation (LOS) was 76.04±9.61%, with a range from 52% to 89%, reflecting considerable inter-individual variability in oxygenation levels, which may influence clinical decision-making and postoperative outcomes patients.

All participants in the study (100%, n=177) were found to have vellum collapse during the diagnostic evaluation. oropharyngeal (100%, n=177) levels during diagnostic evaluation, highlighting it as a common and consistent site of airway obstruction in patients undergoing evaluation for sleep-disordered breathing. Tongue base collapse was less frequent, present in approximately 22.5% of participants (16.9% complete collapse, 5.6% partial collapse) suggesting it is a less frequent site of obstruction compared to vellum or oropharyngeal regions, but still a relevant contributor to airway compromise in a subset of patients (Table 2).

Epiglottic collapse was observed in only 4 patients (2.2%) of the participants while only 2 (1.12%) showed anterior collapse and another 2 (1.12%) demonstrated the trapdoor type of collapse (Table 3). When comparing DISE findings to awake examination, 43 individuals (24.3%) had additional findings observed during DISE that were not evident in the awake state.

These additional findings included tongue collapse (16.4%), partial collapse (5.6%) and a small percentage of BOT+ epiglottic or trapdoor patterns (1.1% each). However, it is critical to note that 134 participants (75.7%) showed no additional findings during DISE compared to their awake examination (Table 4). 134 (75.7%) had no additional findings, 29 (16.4%) showed tongue collapse, 10 (5.6%) showed partial collapse, 2 (1.1%) each showed BOT+ epiglottic collapse and trapdoor epiglottic pattern.

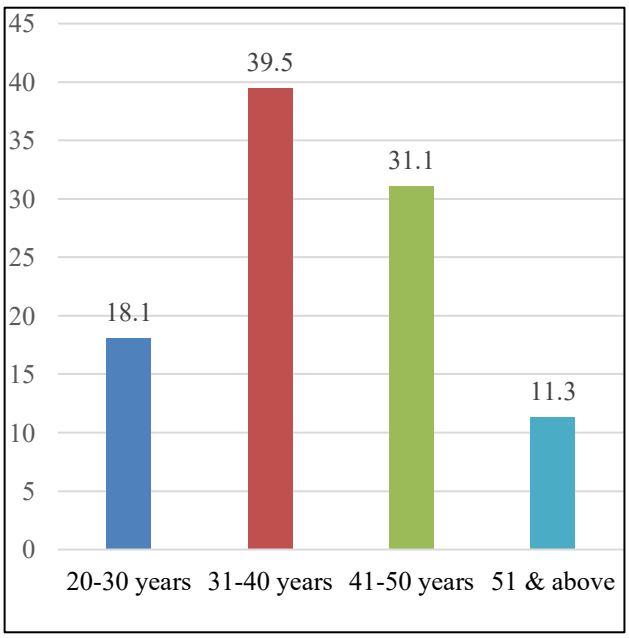

Figure 1: Distribution of study participants by age group.

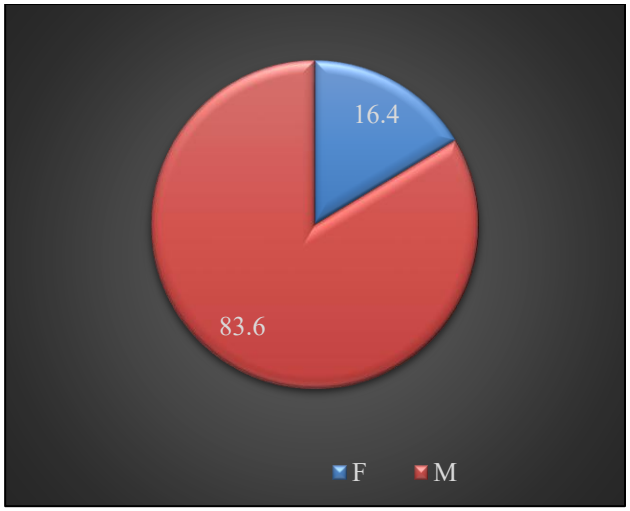

Figure 2: Gender distribution of study participants.

DISE led to a change in the primary diagnosis in 26.0% (n=46) of patients. In contrast, in 74.0% (n=131) of cases, DISE did not change the primary diagnosis (Table 5). Out of 177 patients assessed 134 (75.7%) did not undergo a change in surgical decision after DISE (Table 6). The surgical procedures performed included inferior turbinoplasty, septoplasty and barbed pharyngoplasty.

In selected cases with evidence of tongue base obstruction and epiglottic prolapse, targeted interventions such as epiglottoplasty and radiofrequency ablation and/or coblation channeling of the tongue base were undertaken. All surgical interventions were performed uneventfully, with no significant postoperative complications. No complications were reported following DISE, affirming its safety as a diagnostic tool in clinical practice

The mean preoperative AHI (apnea-hypopnea index) was 17.74±9.25, which reduced significantly to 9.37±5.91 postoperatively. This reflects a statistically and clinically significant improvement. A paired t-test was applied, yielding a p value of 0.001, which is statistically highly significant ($p<0.01$) indicating that the surgical intervention had a positive impact on reducing the severity of obstructive sleep apnea in the study population.

Table 1: Association between age groups and BMI categories (n=177).

Chi square test			BMI categories			Total	P value
			Normal	Overweight	Obese		
Age gap (in years)	20-30	Count	16	13	3	32	0.057(NS)
		% within BMI	32.7%	14.0%	8.6%	18.1%	
	31-40	Count	15	41	14	70	
		% within BMI	30.6%	44.1%	40.0%	39.5%	
	41-50	Count	15	28	12	55	
		% within BMI	30.6%	30.1%	34.3%	31.1%	
	51 & above	Count	3	11	6	20	
		% within BMI	6.1%	11.8%	17.1%	11.3%	
Total		Count	49	93	35	177	
		% within BMI	100.0%	100.0%	100.0%	100.0%	

Chi square non parametric test of significance applied, *p<0.05 is statistically significant, **p<0.01 is statistically highly significant.

Table 2: Tongue base collapse among study participants (n=177).

Tongue base collapse		Frequency	%
Options	No	137	77.40
	Partial	10	5.6
	Yes	30	16.9
	Total	177	100.0

Table 3: Pattern of epiglottic (Ottis) collapse among study participants (n=177).

Epiglottis collapse		Frequency	%
Options	Anterior	2	1.12
	No	173	97.7
	Trapdoor	2	1.12
	Total	177	100

Table 4: Type of additional findings detected during DISE (n=177).

Types mentioned		Frequency	%
Options	-	134	75.7
	BOT+Epiglottis	2	1.1
	Partial	10	5.6
	Tongue collapse	29	16.4
	Trapdoor epiglottis	2	1.1
	Total	177	100.0

Table 5: Did DISE change the primary diagnosis? (n=177).

Did DISE change the primary diagnosis?		Frequency	%
Options	No	131	74.0
	Yes	46	26.0
	Total	177	100.0

Table 6: Change in the final surgical decision based on DISE (n=177).

Final surgical decision		Frequency	%
Valid	No	134	75.7
	Yes	43	24.3
	Total	177	100.0

DISCUSSION

OSA is a multifactorial disorder with anatomical, neuromuscular and functional contributors to upper airway collapse during sleep.[8] Precise identification of obstruction sites is crucial for successful surgical intervention. Both awake nasopharyngolaryngoscopy Although both awake FNPLS and DISE are well-established preoperative assessment tools, their comparative efficacy in guiding surgical planning needs critical evaluation, particularly within the constraints of resource-limited Indian healthcare settings.

In our study, the participant population was predominantly middle-aged, with the majority of patients falling within the 31–50 years age range (70.6%). The most common age group affected was 31–40 years, followed by the 41–50 years group. This distribution aligns with global epidemiological trends, wherein OSA is known to peak in middle age due to age-related changes in upper airway collapsibility, fat distribution and neuromuscular control. Indian studies conducted in different centers have reported a similar age profile among patients diagnosed with moderate to severe OSA.[9,10] In the present study males were affected more than females comprising 78.3% of the study population, resulting in a male-to-female ratio of approximately 5:1. This male predominance is a well-established finding across global and Indian literature, often attributed to differences in upper airway anatomy, fat deposition patterns and hormonal influences such as the protective role of oestrogen in pre-menopausal women.[11] In the study, all the female participants were below 45 years of age and were pre-menopausal. Authors did not encounter any post-menopausal women. This observation supports existing literature suggesting that hormonal factors before menopause may have a protective role against OSA. This could partly explain the lower proportion of female patients in our series, as OSA is known to become more common after menopause. It may also indicate that older women with OSA are either being under-diagnosed or under-referred for evaluation.

More than half of the participants were overweight (52.5%) and 19.8% were obese, with a mean BMI of 26.92±3.69 kg/m². Although the association between BMI and age was not statistically significant (p=0.057), a clear trend was noted where participants aged 31–50 years had higher BMI values. Similar findings have been reported in earlier Indian studies and NFHS 2020 data, which show an increased prevalence of overweight individuals in this age group.[12-14] Most younger patients had a normal BMI, whereas obesity was more frequently seen among participants over 50 years. While overweight and obesity appear more common in the middle-aged groups (31–50 years), the association between age and BMI category was not statistically significant in this study. Nonetheless, trends suggest a possible age-related increase in BMI, warranting further investigation with a larger sample.

In the study, most younger individuals (aged 20–30 years) had a normal BMI, while a higher number of participants above 50 years were found to be obese. Although the association between age and BMI was not statistically significant, this trend suggests that prolonged exposure to increased body weight may worsen the severity of OSA with age. These findings highlight the

importance of considering both body weight and fat distribution during OSA evaluation, particularly in Indian patients, where obesity often interacts with craniofacial anatomical factors.

The lack of statistical significance in our study may be due to the sample size; however, the overall pattern supports existing literature indicating that age and BMI act together as important risk factors for OSA, Obesity leads to fat deposition around the airway, increased upper airway collapsibility and changes in airway mechanics, thereby increasing the risk of airway collapse.[15-17] While BMI alone does not determine OSA severity, its interplay with age-related muscle tone reduction and craniofacial anatomy underscores its clinical relevance. Future research with a larger cohort may further clarify the statistical significance of this observed trend.

In our study, the mean LOS was 76.04±9.61%, with values ranging from 52% to 89%. This wide variation reflects the diverse physiological impact of OSA among patients and may influence both symptom severity and long-term health risks. Previous studies have shown that lower oxygen saturation levels during sleep are closely linked to OSA severity and are strongly associated with cardiovascular disease, neurocognitive impairment and systemic inflammation.[18,19] LOS is widely regarded as a reliable marker of hypoxic burden. Levels below 80% are often related to increased oxidative stress and endothelial dysfunction, which may contribute to the development of hypertension, cardiac arrhythmias and metabolic disturbances.[20] The significance of LOS extends beyond diagnosis; it also plays an important role in risk stratification and surgical planning. Patients with marked nocturnal desaturation often require more extensive or multi-level surgical interventions and closer perioperative monitoring, particularly when additional comorbidities are present.

Awake FNPLS remains a cornerstone for upper airway assessment in patients with OSA. FNPLS provides reliable identification of anatomical contributors to obstruction, especially in cooperative patients.[21] In the study, FNPLS was carried out in all 177 participants. It enabled comprehensive assessment of nasal patency, turbinate hypertrophy, septal deviation, soft palate redundancy, pharyngeal crowding, tongue base bulk and epiglottic configuration, guiding the surgical plan. Velar and oropharyngeal collapse were observed in all cases (100%), whereas tongue base and epiglottic collapse were identified in 22.5% and 2.2% of patients, respectively. These findings are comparable to those reported by Joy et al, who also noted that retropalatal collapse is the most common site identified on both awake FNPLS and DISE, whereas hypopharyngeal collapse is more accurately visualised under sedation.[22] These results highlight that FNPLS is highly effective for evaluating proximal airway structures but may have limitations in detecting dynamic distal airway collapse. Nevertheless, its advantages in the Indian context are significant: it is cost-effective, safe and easily performed in the outpatient setting without sedation. Current literature supports its role as a valuable tool for airway evaluation and surgical planning, making it an appropriate first-line assessment in most OSA patients. The role of DISE is a diagnostic method in the comprehensive assessment and surgical management of OSA continues to evolve.[23,24] In our series, DISE revealed additional findings in 24.3% of cases, primarily involving the tongue base and epiglottis. However, in 75.7% of patients, no new sites were identified beyond those seen on FNPLS. Even when additional findings or a change in primary diagnosis were noted (26.0%), the surgical plan remained unchanged in 75.7 % of cases. Similar findings have been reported by Campanini et al and Rodríguez-Bruno et al indicating that DISE alters surgical decisions in only a minority of patients.[25-27]

These findings have important implications for healthcare resource optimisation. DISE involves additional cost, time and potential risks and its routine use may not be justified if surgical planning and outcomes remain largely unchanged. Certal et al in a systematic review, reported no clear consensus on the superiority of DISE over awake endoscopic techniques such as FNPLS for surgical planning. They further highlighted that addressing every obstruction site seen on DISE does not necessarily improve outcomes and may lead to overtreatment in some cases.[28] The identification of additional sites during DISE may also be influenced by higher sedative doses, longer procedural duration, observer bias or secondary collapse patterns induced during sedation, which may not correlate with clinically significant obstruction.

The findings align with published evidence suggesting that the influence of DISE on surgical outcomes may vary depending on patient selection and clinical context. While numerous studies have demonstrated the diagnostic advantage of DISE in delineating multi-level sites of airway collapse, our results indicate that such additional information does not invariably result in changes to the surgical plan or lead to measurably superior outcomes for every patient. The value of DISE is likely maximised in well-selected, complex or diagnostically challenging cases, particularly when certain collapse patterns are not apparent during awake assessment, rather than as a mandatory preoperative investigation for all candidates. This interpretation is supported by the multicentre study conducted by Pang et al, involving 326 patients with OSA. The study reported that preoperative DISE was not consistently associated with improved surgical success rates.[29]

Concerns about standardization, reproducibility and inter-observer variability have also been raised by several authors.[30-32] Hence, DISE may be most beneficial in cases with diagnostic ambiguity or suspected occult multilevel collapse, rather than as a universal preoperative requirement. In the present study, a significant post-operative improvement in AHI was observed (p=0.001). This reflects the well-established effectiveness of surgical

interventions for OSA. Surgical intervention remains an important option, particularly for patients with anatomical obstruction or those intolerant to conservative therapies. The present study has a few limitations. As it is retrospective and conducted in a single centre, the possibility of selection bias and restricted external validity cannot be completely excluded. Long-term outcomes beyond subjective improvement, as well as a more detailed stratification of surgical sub-procedures, were not evaluated. Nonetheless, these are relatively minor constraints and do not diminish the overall strength of the study. The sizeable sample and the use of uniform preoperative assessment in all patients enhance the reliability of the observations. These findings provide a valuable foundation and highlight the need for larger multicentre prospective studies to further substantiate the role of DISE in surgical planning for OSA.

CONCLUSION

This study demonstrates that DISE, though capable of identifying additional sites of obstruction, does not always alter the final surgical plan or outcomes in most OSA patients. Awake FNPLS was sufficient for effective surgical decision-making in the majority of cases. In resource-constrained healthcare settings, routine DISE for all surgical candidates may not be warranted and its selective use appears to be a more pragmatic and cost-effective approach. Future multicenter prospective studies with long-term follow-up are essential to define the subset of patients who truly benefit from DISE-guided surgical planning, thereby optimizing its role in OSA management.

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