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Original Research Article

Evaluation of preoperative and perioperative difficult airway in patients with undiagnosed obstructive sleep apnea undergoing general anaesthesia in ENT and general surgeries: A prospective randomised trial

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Abstract

Background: A common disorder marked by repeated bouts of either partial or total upper airway obstruction during sleep is obstructive sleep apnea (OSA). Undiagnosed OSA increases risks of complex airway management, surgical respiratory failure, and severe cardiovascular events and presents difficulties in perioperative management. This study aimed to assess the frequency and determinants of difficult airways among patients with undiagnosed OSA following general anaesthesia in ENT and general operations.

Materials and Methods: Fifty patients were enrolled and divided into two groups: the OSA group (STOP-BANG score >3) and the Non-OSA group (STOP-BANG score <3). Preoperative assessments included Mallampati classification, blood pressure (BP), oxygen saturation (SpO2), heart rate (HR), body mass index (BMI), mouth opening, sternomental and thyromental distances, and neck circumference. Following administration of the STOP-BANG questionnaire, the number of intubation attempts and the ease of intubation were recorded. Statistical analysis was performed using Chi-square and t-tests to compare outcomes between the two groups.

Results: The OSA group exhibited significantly higher age (42 vs. 36 years, p=0.016), BMI (30.3 vs. 24.7, p<0.001), and neck circumference (38.5 cm vs. 35.3 cm, p<0.001). Blood pressures were notably higher in the OSA group throughout the day (131 mmHg vs. 120 mmHg, p<0.001 for systolic; 83.5 mmHg vs. 78.1 mmHg, p=0.001 for diastolic). Higher STOP-BANG scores correlated with an increased incidence of intubation difficulties and postoperative complications. The Logistic Regression model demonstrated high accuracy, with an accuracy of 85.71%, precision of 91.67%, recall of 84.62%, and a ROC AUC of 95.19%.

Conclusion: This study highlights the elevated risk of perioperative airway complications in patients with undiagnosed OSA. The STOP-BANG questionnaire proves to be an effective screening tool for identifying patients at higher risk of these complications. Early identification and management of OSA in surgical patients could significantly improve postoperative outcomes.

Keywords: Airway management, Intubation, Obstructive sleep apnea (OSA), Respiratory failure.

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1. Introduction

A common disorder marked by repeated bouts of partial or total obstruction of the upper airway during sleep, Obstructive sleep apnea (OSA) causes disturbed sleep and lower oxygen saturation.[1] A considerable number of patients with OSA are thought to remain misdiagnosed, which presents difficulties for perioperative care, especially with general anaesthesia for ENT (Ear, Nose, and throat) and general operations.[2] OSA is linked to a higher risk of perioperative problems, including challenging airway management, postoperative respiratory failure, and severe cardiovascular events.[3,4]

Anaesthesia practice depends critically on the detection and control of a difficult airway. Anaesthesia-related morbidity and mortality[5] are much influenced by complex airway management. Anatomical and functional changes of the upper airway in patients with OSA raise their chance of a problematic airway during induction and anaesthesia

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maintenance.[6] Especially among patients with undiagnosed OSA, the preoperative screening for OSA and subsequent planning for airway control are typically insufficient despite the acknowledged hazards.[7]

Understanding and addressing airway management difficulties in this group is essential, considering the high frequency of undiagnosed OSA in the general population and the related perioperative risks. Patients with undiagnosed Obstructive Sleep Apnea (OSA), identified using a STOP-BANG score greater than 3, have a significantly higher likelihood of experiencing complex airway management, including difficult mask ventilation, difficult laryngoscopy, and difficult intubation, compared to non-OSA patients undergoing general anaesthesia for ENT and general surgeries.

This study aimed to assess the frequency and predictors of problematic airways among patients with undiagnosed OSA having general anaesthesia in ENT and general operations. The aim of the study was to use screening parameters to predict difficult mask ventilation, difficult laryngoscopy, and difficult intubation in patients with undiagnosed OSA. The objectives of the study were to determine whether a STOP-BANG score greater than 3 predicts complex airway management, including difficult mask ventilation, laryngoscopy, and difficult intubation, in patients undergoing general anaesthesia for ENT and general surgeries, and to evaluate the association between clinical parameters such as BMI, neck circumference, Mallampati classification, and other airway assessment measures with the likelihood of complex airway management in patients with undiagnosed OSA .Knowing these elements can help improved preoperative screening, planning, management techniques, improving patient safety, and outcomes.

2. Materials and Methods

This prospective study evaluated whether a high STOP-BANG score (>3) predicts difficult airways in patients undergoing general anaesthesia for ENT and general surgeries. Conducted over six months at a tertiary care hospital in Chennai, India, the study received Institutional Review Board (IRB) approval (SCAHS/ISRB/2024/March/555) and CTRI registration (CTRI/2024/02/0062335). A total of 100 patients undergoing elective ENT and general surgeries were screened, and they were randomly assigned to either the OSA Group (STOP-BANG >3) or the Non-OSA Group (STOP-BANG <3) using computer-generated randomization.

Inclusion criteria included patients aged 18 to 60, classified as ASA I or II, and providing written informed consent. Exclusion criteria included patients with head and neck deformities, obesity, pregnancy, or those unwilling to participate. Preoperative assessments involved Mallampati classification, blood pressure (BP), oxygen saturation (SpO_2), heart rate (HR), body mass index (BMI), mouth opening, sternomental and thyromental distances, and neck circumference.

Airway difficulty was assessed using multiple standardized parameters, including the STOP-BANG questionnaire, Difficult Mask Ventilation (DMV) Score, Cormack-Lehane (CL) grade for laryngoscopic view, and the Intubation Difficulty Score (IDS). The IDS, a comprehensive grading system, evaluates multiple factors influencing intubation difficulty, such as the number of intubation attempts, additional airway maneuvers required, increased lifting force, the use of external laryngeal pressure, and alternative airway techniques. A higher IDS indicates greater intubation complexity. Induction was performed using propofol (2 mg/kg), fentanyl (2 mcg/kg), and rocuronium (0.6 mg/kg) for neuromuscular blockade. In cases of anticipated difficulty, video laryngoscopy was utilized to enhance visualization, and all perioperative airway management details were documented by an independent observer.

Data analysis included Chi-square tests for categorical variables, t-tests for continuous variables, and logistic regression to assess the predictive value of the STOP-BANG score. Results were reported as Odds Ratios (OR), with statistical significance set at $p<0.05$. Sample size calculation, using G*Power software, was based on an expected 20% prevalence of difficult intubation in the OSA group and 5% in the non-OSA group, ensuring 80% power at a 0.05 significance level, which required 50 patients per group.[8]

Sample size calculation

$$n = \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2 . [p_1(1-p_1) + p_2(1-p_2)]}{(p_1 - p_2)^2}$$

n = required sample size per group

p1 = expected proportion in group 1 (e.g., 0.20 for OSA group)

p2 = expected proportion in group 2 (e.g., 0.05 for non-OSA group)

α = significance level (commonly 0.05, so $Z_{1-\alpha/2}=1.96$)

β = probability of Type II error (commonly 0.20, so power = 80%, and $Z_{1-\beta}=0.84$

Randomisation was stratified by age and BMI, with an independent statistician generating the sequence to ensure impartiality. Allocation concealment was ensured by using sealed, opaque envelopes, which were opened only after patient enrollment and baseline assessments. While blinding the anaesthesiologists was not feasible, an independent observer recorded perioperative outcomes, and the statistician analysing the data remained blinded to group assignments to minimize bias.

3. Results

In several parameters, the baseline characteristics reveal significant differences between the NON-OSA and OSA groups (**Table 1**). The OSA group had a higher mean age (42 years) than the NON-OSA group (36 years), with a p-value of 0.016, indicating a significant difference. Gender distribution did not differ significantly between the groups (p=0.686). The ASA grade showed a significant difference (p=0.001) with a higher percentage of ASA grade II in the OSA group (74%) compared to the NON-OSA group (36%). Similarly, BMI and neck circumference were significantly higher in the OSA group (BMI: 30.3 vs. 24.7, p=0.001; Neck circumference: 38.5 cm vs. 35.3 cm, p=0.001).

Table 1: Baseline characteristics

Parameter	**Non-OSA n= 50 (%)**	**OSA n=50 (%)**	**p-value**
Age in years (Mean [SD])	36 [12.2]	42 [12.3]	0.016
Gender			0.686
Male	30 (60)	27 (54)	
Female	20 (40)	23 (46)	
ASA grade			0.001
I	32 (64)	13 (26)	
II	18 (36)	37 (74)	
BMI (Mean [SD])	24.7 [5.00]	30.3 [5.46]	0.001
Neck circumference in cm (Mean [SD])	35.3 [3.15]	38.5 [3.47]	0.001

Table 2: Hemodynamic parameters

Hemodynamic Parameter	**Non-OSA n= 50 (Mean [SD])**	**OSA n=50 (Mean [SD])**	**p-value**
Heart rate in bpm	79.8 [11]	80.3 [12.3]	0.830
Systolic Blood pressure in mmHg	120 [11.8	131 [14.6]	0.001
Diastolic Blood pressure in mmHg	78.1 [8.04]	83.5 [7.84]	0.001

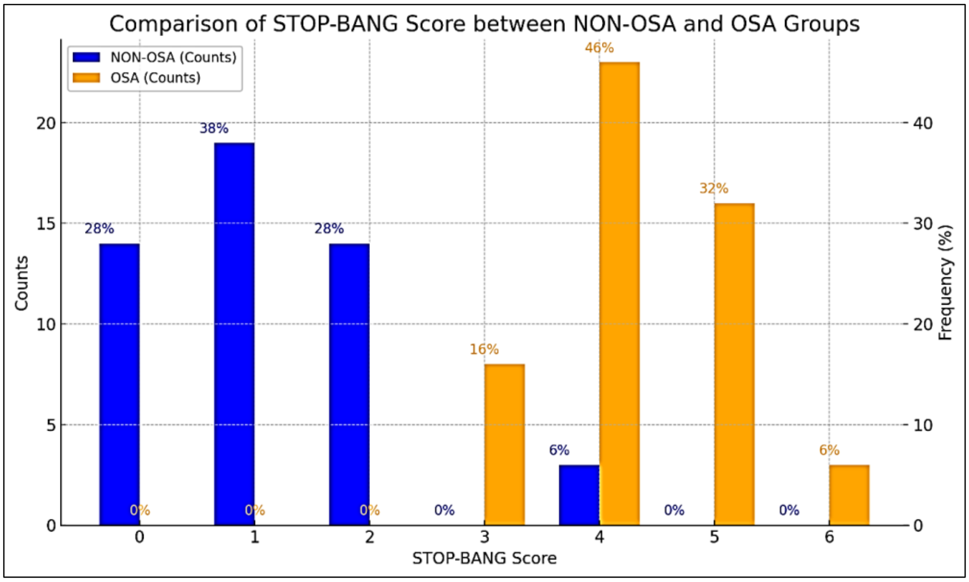

Figure 1: Comparison of STOP BANG Score between NON OSA and OSA groups

The hemodynamic parameters indicate that heart rate was similar between the groups (p=0.830). However, systolic and diastolic blood pressures were significantly higher in the OSA group (Systolic: 131 mmHg vs. 120 mmHg, p=0.001; Diastolic: 83.5 mmHg vs. 78.1 mmHg, p=0.001), suggesting that OSA patients may have higher blood pressure levels (**Table 2**).

The STOP-BANG scores show significant differences between the NON-OSA and OSA groups (p=0.000). Higher scores were predominantly seen in the OSA group, with 46% having a score of 4 and 32% having a score of 5. In contrast, the NON-OSA group had the most participants, scoring between 0 and 2 (**Figure 1**).

There were significant differences in DMV scores between the groups (p=0.001). Most NON-OSA participants scored 1 (56%), whereas most OSA participants scored 2 or 3 (50% and 48%) as shown in **Figure 2**.

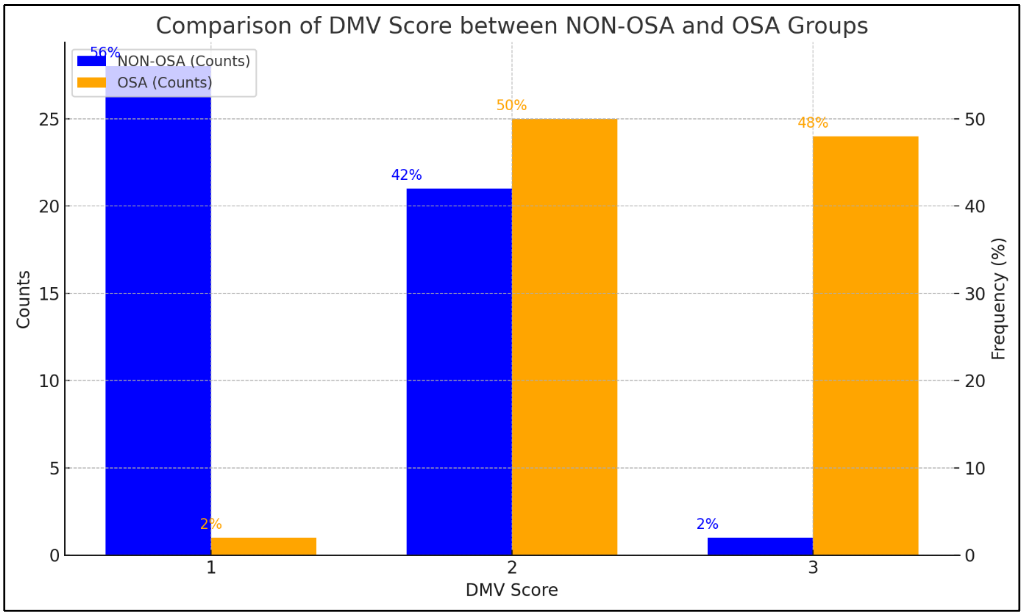

Figure 2: Comparison of DMV Score between NON OSA and OSA groups

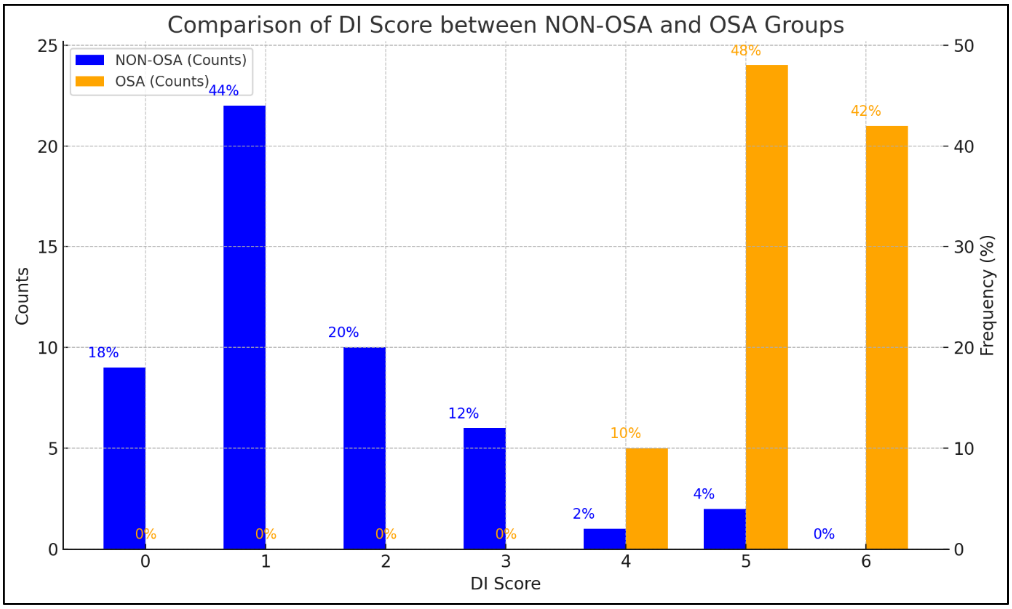

Figure 3: Comparison of DI score between non-OSA and OSA groups

Table 3: Comparison of CL grade between the two groups

CL Grade	NON-OSA		OSA		p-value
	Count	Frequency	Count	Frequency	
1	28	56%	0	0%	0.001
2a	17	34%	4	8%	
2b	5	10%	29	58%	
3	0	0%	17	34%	

CL grades differed significantly between the groups (p=0.001). The NON-OSA group had a higher frequency of CL grade 1 (56%), while the OSA group had higher frequencies in CL grades 2b (58%) and 3 (34%) as shown in **Table 3**.

The DI scores showed a significant difference (p=0.001). Higher DI scores were more common in the OSA group, with 48% scoring 5 and 42% scoring 6, compared to the NON-OSA group, where most scores were between 0 and 2. As shown in **Figure 3**.

The number of intubation attempts was significantly higher in the OSA group (p=0.001). Most NON-OSA participants required only one attempt (92%), while the OSA group had more participants requiring two or three attempts (56% and 34%, respectively) and Postoperative complications were significantly more frequent in the OSA group (p=0.001). In the NON-OSA group, 74% had no complications, whereas 68% of the OSA group experienced complications.

The correlation analysis shows strong positive correlations between the STOP-BANG score and several parameters, including DMV score (r=0.679, p=0.001), DI score (r=0.778, p=0.001), and attempts of intubation (r=0.641, p=0.001). There were also moderate to strong correlations between DMV score and DI score (r=0.701, p=0.001), CL grade and DI score (r=0.740, p=0.001), and DI score and attempts of intubation (r=0.811, p=0.001), indicating interdependencies between these clinical metrics, as shown in **Table 4**.

Table 4: Correlation analysis

Metric	Correlation coefficient	p-value	Description
STOP-BANG Score vs.			
DMV Score	0.679	0.001	Strong positive correlation
CL Grade	0.493	0.001	Moderate positive correlation
DI Score	0.778	0.001	Strong positive correlation
Attempts of Intubation	0.641	0.001	Strong positive correlation
DMV Score vs			
CL Grade	0.296	0.003	Weak positive correlation
DI Score	0.701	0.001	Strong positive correlation
Attempts of Intubation	0.524	0.001	Moderate positive correlation
CL Grade vs			
DI Score	0.740	0.001	Strong positive correlation
Attempts of Intubation	0.713	0.001	Strong positive correlation
DI Score vs			
Attempts of Intubation	0.811	0.001	Robust positive correlation

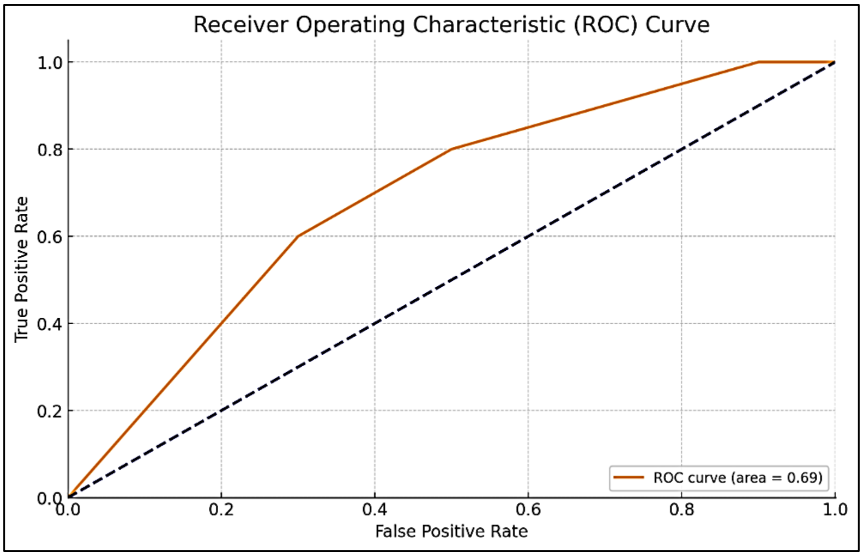

Figure 4: Receiver operating characteristic curve

The logistic regression model demonstrated strong performance in predicting outcomes, achieving an accuracy of 85.71%. It exhibited a high precision of 91.67%, indicating a low false positive rate, while maintaining a recall of 84.62%, reflecting its ability to correctly identify positive cases. Additionally, the model achieved an impressive ROC AUC of 95.19%, signifying excellent overall discriminatory power in distinguishing between classes.

The ROC curve shows a strong predictive capability of the model, with an area under the curve (AUC) of 95.19%, indicating that the model is effective at distinguishing between patients with difficult intubation and those without, as shown in **Figure 4**.

Postoperative complications were significantly higher in the OSA group compared to the non-OSA group. The most frequent complications included airway obstruction (16%), hypoxia (24%), unplanned ICU admission (10%), and reintubation (12%) in the OSA group, with statistically significant differences ($p < 0.05$) compared to the Non-OSA group. These findings highlight the need for enhanced perioperative airway management in undiagnosed OSA patients.

OSA patients had significantly lower sternomental and thyromental distances than non-OSA patients ($p < 0.01$). This suggests that reduced airway dimensions in OSA patients contribute to the increased difficulty in intubation and ventilation.

4. Discussion

Obstructive Sleep Apnea (OSA) remains a critical and often underdiagnosed condition with substantial perioperative implications, especially in patients undergoing general anesthesia. Given the anatomical and physiological changes associated with OSA, these individuals frequently pose significant challenges in airway management. This study aimed to evaluate whether the STOP-BANG score—a simple and widely used screening tool—can effectively predict airway difficulties and postoperative complications in elective surgical patients. Our findings not only reinforce the clinical utility of STOP-BANG but also contribute valuable evidence supporting its role in preoperative risk stratification.

The study results show that the NON-OSA and OSA groups significantly differ in several areas. The average age of the OSA group was 42 years, while the average age in the NON-OSA group was 36 years. This difference was statistically significant (p=0.016). There were no essential changes between the genders in the distribution (p=0.686). However, the ASA grade, BMI, and neck size were significantly higher in the OSA group. The p-values were all 0.000, which means they were very statistically significant. The OSA group had a higher mean BMI (30.3 vs. 24.7) and a more considerable mean neck girth (38.5 cm vs. 35.3 cm). Also, 74% of the OSA group had an ASA grade II compared to 36% of the NON-OSA group.

Regarding hemodynamics, the heart rate did not vary much between the groups (p=0.830). The OSA group had significantly higher systolic and diastolic blood pressures than the NON-OSA group. The OSA group had 131 mmHg of systolic blood pressure compared to 120 mmHg in the NON-OSA group (p=0.000) and 83.5 mmHg of diastolic blood pressure compared to 78.1 mmHg (p=0.001). Based on these results, people with OSA may be more likely to have high blood pressure.

There were also significant changes between the groups in the STOP-BANG scores (p=0.000). Most people in the OSA group had higher scores—46% had a score of 4 or higher, and 32% had a score of 5—than those in the NON-OSA group, who mostly scored between 0 and 2. The STOP-BANG scores show that this trend indicates that the risk and severity of OSA are higher.

Also, the DMV results were very different (p=0.000). Most people who did not have OSA scored 1 (56%), while most who did have OSA scored 2 or 3 (50% and 48%, respectively). The CL grades were also very different (p=0.000). The NON-OSA group had a higher frequency of CL grade 1 (56%), while the OSA group had higher rates of CL grades 2b (58%) and 3 (34%).

There was a significant difference between the DI scores (p=0.000), with more people in the OSA group getting better scores (48% scored 5 and 42% scored 6). The NON-OSA group, on the other hand, had most of their results between 0 and 2. These differences make it clear that the OSA group has a more challenging time with intubation.

There were many more tries to intubate people in the OSA group (p=0.000). Most people in the NON-OSA group only needed one try (92%), but more people in the OSA group required two or three tries (56% and 34%, respectively). This shows that managing the airways of OSA patients is more complicated.

Complications after surgery happened a lot more often in the OSA group (p=0.000). 74% of people in the NON-OSA group did not have any problems, while 68% of people in the OSA group did. This shows that OSA patients have a higher chance of having bad results after surgery.

The correlation study showed that the STOP-BANG score was strongly linked to several factors, such as the DMV score (r=0.679), the DI score (r=0.778), and the number of attempts at intubation (r=0.641). All of these relationships had p-values of 0.000. There were also moderate to strong links between the DMV score and the DI score (r=0.701), the CL grade and the DI score (r=0.740), and the DI score and the number of tries to intubate (r=0.811), showing that these clinical measures are connected.

The Logistic Regression model did very well; it was accurate 85.71% of the time, precise 91.67% of the time, remembered 84.62% of the time, and had an ROC AUC of 95.19%. The ROC curve shows that the model is very good at making predictions, showing that it can tell the difference between people who have trouble with intubation and those who don't.

The results of this study agree with those of several other studies that found similar links between OSA and problems during surgery. For example, Chung et al.'s study found that higher STOP-BANG scores were linked to higher risks during surgery, such as having trouble intubating and problems after surgery. Their study also showed that OSA patients are more likely to have high blood pressure, which aligns with our findings that the OSA group had significantly higher systolic and diastolic blood pressures. Chung et al. found that patients with higher STOP-BANG scores had a 2.5 times higher chance of having problems during surgery, which matches our observation of a higher risk.[9]

A study by Vasu et al. supported our results by showing that people with OSA had higher BMI and neck circumference measurements, which were strong indicators of having a hard time managing their airways and more tries to intubate them. In a study by Vasu et al., a BMI of 30 or more and a neck circumference of 40 cm or more were strong indicators of difficult breathing. Our results showed that people with OSA had higher BMI (30.3 vs. 24.7) and neck circumference (38.5 cm vs. 35.3 cm).[10]

However, some studies have found that there aren't as big of differences between the OSA and NON-OSA groups when it comes to gender distribution and ASA grades. For example, Memtsoudis et al. found no significant differences between the sexes in their group, with 55% men in the OSA group and 52% men in the NON-OSA group. This differs from our study, which found more significant differences (p=0.686).[3] Also, even though our study found a big difference in ASA grades, other studies have shown that ASA grades are subjective and can change based on the doctor's evaluation.

Other studies have also found strong links between STOP-BANG scores and other clinical measures used in our research, like the DMV and DI scores. Similar associations were found in a survey by Nagappa et al., which suggests that higher STOP-BANG scores can predict several problems that may arise during and after surgery, such as difficulties with intubation and more complications. According to Nagappa et al., there is a strong association (r=0.771) between STOP-BANG scores and DI scores, similar to what we found (r=0.778).[11]

Many studies have reported findings consistent with our results. For instance, a study by Hwang et al. demonstrated that patients with Obstructive Sleep Apnea (OSA) experienced significantly more difficulty with breathing and postoperative complications. Hwang et al. reported that 45% of OSA patients faced postoperative issues, compared to only 22% of non-OSA patients.[12] Similarly, Kaw et al. identified that OSA patients had a higher risk of perioperative complications, such as cardiovascular events and respiratory failure, with an odds ratio (OR) of 3.1 for respiratory failure. This aligns with our findings regarding postoperative complications.[13]

Thammaiah SH et al. found that the STOP-BANG questionnaire effectively predicts unanticipated difficult airways and perioperative complications in patients with undiagnosed OSA. In a study of 250 patients, those with STOP-BANG scores ≥3 had significantly higher rates of difficult mask ventilation (59.8% vs. 4.05%), difficult intubation (56.9% vs. 11.5%), and airway complications ($P < 0.001$). These findings highlight its utility as a preoperative screening tool.[14]

Mathangi K et al. stated that undiagnosed OSA is linked to increased airway management challenges, including difficult mask ventilation (DMV) and intubation (DIT). In a study of 100 patients, the OSA group (STOP-BANG >3) showed significantly higher rates of DMV (77.7%), DIT (22.2%), and difficult laryngoscopy (33.3%). The STOP-BANG score emerged as the strongest predictor of DMV (OR 3.15, CI 2.06–4.8), emphasizing its utility as a preoperative screening tool.[15]

Fernandez-Bustamante A et al. described that patients screened as moderate/high risk for OSA (S-OSA) had similar rates of adverse respiratory events (AREs) to diagnosed OSA (D-OSA) patients but experienced worse postoperative outcomes, including higher rates of reintubation, ICU admission, and 30-day mortality and compared to No-OSA patients, both OSA groups had significantly more AREs ($P < .001$), with S-OSA outcomes likely worsened by lack of management post-PACU. Multidisciplinary strategies are essential to improve care for S-OSA patients.[16]

Thammaiah in their study emphasized that the STOP-BANG questionnaire effectively identified severe OSA in ENT patients but did not predict difficult airway or mild/moderate OSA. Among 48 patients, 18.7% had difficult airways, all with moderate/severe OSA, characterized by older age, BMI >35, cervical circumference >40 cm, and Cormack III/IV. BMI and Cormack grades were strong predictors of OSA and difficult airway, respectively.

Even though this study had some significant results, it also had some limitations that need to be pointed out. First, the sample size was small, so the results might not apply to bigger and more diverse groups of people. Second, the study only took place in one centre, which could have caused selection bias and made it harder to use the results in other clinical situations. The study may also have been affected by information bias because the data came from medical records that were already in existence. The subjective nature of some factors, like ASA grades, may also cause the results to differ. Future studies should try to include bigger, multi-centre cohorts to make the results more applicable to a broader range of people. Prospective research should use standard methods to check clinical parameters to make the results more reliable. This would help reduce bias. Also, looking into the underlying processes that connect OSA with complications during surgery could help design targeted interventions. It would be helpful to find out if optimizing patients before surgery, such as by losing weight or starting CPAP treatment, lowers the risks of surgery in people with OSA.

5. Conclusion

This study highlights the association between undiagnosed Obstructive sleep apnea (OSA) and an increased risk of difficult mask ventilation, laryngoscopy, and intubation during the perioperative period. Tools such as the STOP-BANG questionnaire, along with clinical parameters like BMI, neck circumference, and airway assessment scores, serve as effective predictors of perioperative airway challenges. Higher STOP-BANG scores correlate with more complex airway management and a greater number of intubation attempts. Logistic regression analysis confirms the predictive value of these variables. Incorporating routine OSA screening and proactive airway management strategies enhances patient safety and improves perioperative outcomes.

6. Source of Funding

None.

7. Conflict of Interest

None.

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