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Elevated Risk for Obstructive Sleep Apnea in Patients presenting for Surgeries at a Tertiary Hospital in Nepal: A STOP-BANG Questionnaire Study

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ABSTRACT

Introduction

Obstructive sleep apnea (OSA) can lead to significant perioperative risks like difficult airway management, prolonged hospital stays and increased incidence of morbidity and mortality. We aimed to estimate the proportion of surgical patients with elevated risk for OSA during pre-anesthesia checkup at a tertiary hospital in Nepal.

Methods

This was a cross-sectional study which was conducted among 318 surgical patients presenting for pre-anaesthetic checkup. Two validated screening tools, the snoring, tiredness, observed apnea, high blood pressure, body mass index, age, neck circumference, and gender (STOP-BANG) questionnaire and Epworth Sleepiness Scale (ESS), were used. Data on demographics, comorbidities, and OSA risk factors were collected and analyzed. STOP-BANG score ≥3 was defined as elevated risk for OSA. Those patients who complained of daytime somnolence were further assessed for its severity with ESS. Statistical analysis was done with independent sample t-test, chi-square test and logistic regression.

Results

It was found that 75 (23.58%) of the participants had elevated risk for OSA (STOP-BANG>3). The risk was significantly associated with advancing age, males, obesity, increased neck circumference, hypertension, diabetes and hyperlipidemia. A weak but significant correlation was found between ESS and STOP-BANG scores ($r=0.412$, $p=0.045$).

Conclusion

Proportion of patients with elevated risk for OSA was high in our surgical population. Undiagnosed OSA can have various perioperative complications, hence, we should routinely screen patients using questionnaires like STOP-BANG.

Keywords

Obstructive sleep apnea; perioperative risk; prevalence; STOP-BANG questionnaire

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INTRODUCTION

Obstructive sleep apnea (OSA) is characterized by repeated upper airway collapse when asleep, causing intermittent hypoxemia and sleep fragmentation.[1] These disruptions lead to unwanted systemic consequences, like hypertension, arrhythmias, neurocognitive decline and high degree of daytime sleepiness. OSA is also associated with comorbidities like diabetes and hypertension, increasing perioperative risks.[2]

Globally, OSA prevalence ranges from 6% to 17%.[2] Yet, up to 82% males and 92% females with OSA remain undiagnosed.[3] Surgical patients, particularly those undergoing bariatric surgery, have higher prevalence (70%), compared to 7.2% in general surgical populations.[4,5] Although there has been exponential growth in medical technology, many OSA patients remain undiagnosed.[6] Such patients have increased risk of perioperative complications, including difficult airway management, prolonged hospital stays, and higher mortality rates.[7,8] Early identification is crucial for improving postoperative outcomes.[9] Though polysomnography (PSG) is the gold standard for OSA diagnosis, it is costly and time-intensive, making it impractical for routine preoperative screening. Instead, simple tools like the STOP-BANG questionnaire and Epworth Sleepiness Scale (ESS) are effective for identifying OSA risk.[10,11]

With over 1 billion people affected worldwide, OSA has become a significant public health concern.[12] Its rising prevalence and association with increased perioperative complications underscore the need for early detection and intervention in surgical patients.[13] Anesthesiologists play a critical role in identifying at-risk individuals using accessible screening tools and enabling timely management, thus improving postoperative outcomes. Data regarding such is scarce in our part of the world. Hence, this study aimed to screen for OSA risk and estimate its prevalence in patients presenting for surgery. The secondary objectives were to see the relation between demographic factors and comorbidities with elevated OSA risk and to examine the correlation between ESS and STOP-BANG scores.

METHODS

A cross-sectional study with descriptive and analytical components was conducted in the Pre-anesthesia Checkup (PAC) Clinic of Kathmandu Medical College Teaching Hospital from October 2023 to January 2024. Following the Institutional Review Committee approval (Ref: 29092023/05), the patients (18 years and above) attending the PAC clinic were explained about the study, and informed consent was taken. Children, pregnant ladies and people not willing to consent were excluded. The interview was taken in the presence of their partner or a reliable informant. For calculation of the sample size, a previous study where 24.5% of patients had a high risk for OSA (STOP-BANG> 3) was taken.[3] Utilizing the formula, $n=z^2*pq/e^2$, where n=sample size, z is the z score at 95% confidence interval, CI (1.96), p is the proportion of patients who had high risk for development of OSA (0.245), q is 1-p (0.755) and e is the allowable error at 5%. A sample size of 285 was calculated. If we consider a drop out of 10%, a sample size of 315 would be enough. Convenience sampling technique was used.

Demographic details and comorbidities like diabetes mellitus (DM), hypothyroidism and Chronic obstructive pulmonary disease (COPD) was enquired. Screening for OSA was then done with STOP-BANG questionnaire.[14] Approval was sought and received from the author of the questionnaire for use in this study. STOP-BANG questionnaire comprises of eight items: four related to medical history- snoring, daytime tiredness, observed apnea while sleeping and history of hypertension and four to physical examination- Body Mass Index (BMI> 35 kg/m^2, age>50 years, neck circumference>40 cm and male gender. Each variable is scored as 1, if the characteristic is present and 0 if it is absent. Scores of 0-2, 3-4 and >4 are considered low risk, intermediate risk, and high risk for OSA respectively. The patients are also considered to be high risk if they answered positively to any two of STOP questions and met at least one of the following three criteria: male gender, neck circumference more than 40 cm or BMI >35 kg/m^2. If the patient gave a positive history of daytime tiredness or somnolence, they were further enquired about the details with the Epworth Sleepiness Scale (ESS). Approval was also sought and received from the author of ESS. This scale consists of eight daily situations which assesses a person's sleepiness in the scale of 0 to 3, with 0, 1, 2 and 3 meaning no, slight, moderate and high chance of dozing respectively. A score of 0-7 is normal. A score of 8-9 suggests an average level of daytime sleepiness; 10-15 indicates one may be excessively sleepy and should consider consulting a doctor while a score of 16-24 means you are excessively sleepy and should seek medical attention.[11]

For physical examination, the patients were weighed in kilograms (kg) using a calibrated spring scale. Measurement of height was done in meters (m) using a stadiometer after footwear removal. BMI was calculated using the formula: Weight/(Height)^2. For neck circumference, the patient was asked to sit upright and look forward. The measurement was done at the midway of the neck, between mid-cervical spine and mid anterior neck, at cricothyroid level, using a non-elastic tape. The landmark for males with a laryngeal prominence (Adam's apple) was just below the prominence.

Care was taken not to involve the shoulder or neck muscles (trapezius) in the measurement.[15] If any patient who took the STOP-BANG questionnaire and the ESS provided high scores on both or either of the questionnaires, they were advised for further work-up before elective surgery.

The Statistical Package for the Social Sciences, version 20 (SPSS Inc; Chicago, IL, USA) was used. Normality of the continuous variables was assessed using Shapiro-Wilk and Kolmogorov-Smirnov tests. Descriptive statistics were presented as mean±standard deviation (SD) for continuous variables, which were normally distributed and as median (IQR) for non-normally distributed data. Frequencies and percentages for used for categorical variables. Comparison between low-risk and high-risk groups were done using independent samples' t-test for continuous data with normal distribution and Mann-Whitney U test for continuous data which were not distributed normally. Chi square/ Fisher exact test for categorical variables. Logistic regression models were developed to test the risk of OSA from age, gender, neck circumference, presence of hypertension, diabetes mellitus, hyperlipidemia, hypothyroidism and COPD. Odds ratio (OR) and its 95% Confidence Interval (C.I.) was used to interpret the results. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 318 patients were included in this study. Female preponderance was seen (54.4%, n=173). The mean age of the sample population was 44.94±15.803 years and mean BMI was 26.25±4.57 kg/m^2. Maximum number of patients were in the age group of 30-39 years followed by 40-49 and then 50-59. Majority of the patients presented for general surgery (44%, n=140), followed by urosurgery (26.4%, n=84) and orthopedic surgery (10.4%, n=33). Other specialties included neurosurgery, gynaecology, plastic surgery, ENT and dentistry. Among the high-risk group for OSA, general surgery patients again constituted the majority, presenting for laparoscopic cholecystectomy (46.67%, n=35) followed by urosurgery (29.3%, n=22) and gynecological surgery (8%, n=6). Hypertension (HTN) and DM were seen in 60 (18.9%) and 26 (8.2%) of patients. COPD was seen in 9 (2.8%) while hypothyroidism was present in 23 (7.2%). Hyperlipidemia was seen in 15 patients (4.7%).

The prevalence of risk for OSA, as assessed by STOP-BANG questionnaire is presented in Table 1. Though the scoring of STOP-BANG questionnaire categorizes the results into three categories, for study purposes, we have categorized them into low risk (STOP-BANG 0-2) and elevated risk (STOP-BANG 3-8).[3] The two groups, intermediate and high risk were combined into "elevated risk" as both groups had small number of participants and categorizing them into two groups may improve statistical power. Combining the two groups we found that 75 (23.58%) patients in this sample had elevated risk for OSA with STOP-BANG score ≥3.

Table 1. Prevalence of risk for OSA as per STOP-BANG questionnaire

Risk	Number (%)	
Low	243 (76.4%)	
Intermediate	43 (13.5%)	75 (23.58%)
High	32 (10.1%)	

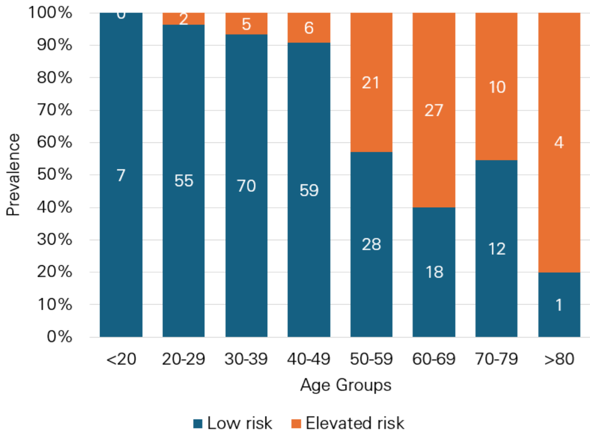

Table 1. Risk of OSA according to age groups

Figure 1 illustrates the distribution of the sample across age groups. We can see that with increase in age, the risk for OSA also increases. A Chi-square test for trend was done which showed a significant increase in OSA risk with age ($\chi^2 = 72.62$, $p < 0.001$). Pearson and Likelihood Ratio tests also supported this association (both $p < 0.001$).

The baseline demographic data and clinical characteristics have been compared between low risk and elevated risk groups which is shown in Table 2. It was seen that individuals with elevated risk to OSA were significantly elderly and had higher BMI and larger neck circumference. Males were more vulnerable to OSA while grades of obesity showed no significant association. As for comorbidities, elevated OSA risk was significantly associated with HTN, DM and hyperlipidemia but not with COPD or hypothyroidism and smoking.

Twenty-four patients among 318 had history of daytime somnolence with tiredness, for which Epworth Sleepiness Scale (ESS) was calculated. Among those 24, five patients had ESS score 10 and above. The one with the highest ESS score (17) was a diagnosed case of OSA, who was under

Table 2. Demographic and clinical characteristics comparison across low risk and elevated risk

Parameters	Low risk	Elevated risk	p-value	Test statistic (U) for non-parametric test	95% Confidence Interval for mean difference/ Effect size (r) [for non-parametric test]
Age in years, median [IQR]	42 [30-52]	58 [50-65]	<0.001	14741.5	0.45
BMI* (kg/m^2), mean±SD	25.76±4.53	27.80±2.33	0.001		(-3.20, -0.87)
Neck circumference (cm), median [IQR]	34 [32-36]	38 [35-40]	<0.001	13447	0.35
Gender, N (%)					
Male	90 (37.03%)	55 (73.33%)	<0.001		
Female	153 (62.9%)	20 (26.6%)			
BMI Categories N (%)					
Underweight (BMI<18.9)	11 (4.52)	2 (2.67)	0.07		
Normal (BMI:19-24.9)	101 (41.5)	14 (18.6)			
Overweight (BMI:25-29.9)	83 (34.25)	37 (49.33)			
Obesity Class I (BMI:30-34.9)	45 (18.5)	19 (25.3)			
Obesity Class II (BMI:35-39.9)	2 (0.82)	2 (2.66)			
Obesity Class III (BMI>40)	1 (0.41)	1 (1.33)			
Co-morbidities N (%)	18 (7.4%)	42 (56%)	<0.001		
HTN†					
DM‡	13 (5.34%)	13 (17.33%)	0.002		
COPD**	6 (2.47%)	3 (4%)	0.45		
Hypothyroidism	16 (6.58%)	7 (9.3%)	0.45		
Hyperlipidemia	5 (2.05%)	10 (13.3%)	<0.001		
Smoker, N (%)	44 (18.1)	19 (25.33)	0.19		

*Note: Data are presented as mean±SD / median [IQR]for quantitative and N (%) for qualitative variables and p-value calculated via Independent sample t-test (normally distributed data)/ Mann-Whitney U test (non-normally distributed data) or chi-square/ Fisher's exact test respectively. Abbreviations: *Body Mass Index; † Hypertension; ‡DM, Diabetes Mellitus, **Chronic Obstructive Pulmonary Disease.*

CPAP therapy since last 35 days. He was evaluated for OSA when his STOP-BANG score was found to be high in a previous PAC. A statistically significant positive relation was found between ESS and STOP-BANG scores using Pearson correlation analysis (r = 0.412, p = 0.045), indicating that as ESS scores increase, STOP-BANG scores tend to increase as well.

Logistic regression analysis (Table 3), identified age, male gender, neck circumference and presence of hypertension as significant predictors of elevated OSA risk. The odds ratio for age was 1.101 (95% CI:1.064–1.140, p < 0.001), indicating a 10.1% increase in OSA risk per year of age. Male gender had an odds ratio of 3.805 (95% CI: 1.435–10.084, p = 0.007), and neck circumference had an odds ratio of 1.321 (95 CI:1.126–1.555, p = 0.001). Significantly, presence of HTN had an odds ratio of 32.251.

Table 3. Logistic regression analysis of variables

Risk	Odds ratio [Exp (B)]	95% CI Upper, Lower	p-value
Age	1.101	1.064, 1.140	<0.001
Male gender	3.805	1.435, 10.084	0.007
Neck circumference	1.321	1.126, 1.555	0.001
Hypertension	32.251	7.61, 136.643	<0.001

DISCUSSION

We aimed to determine the prevalence of obstructive sleep apnea (OSA) risk in surgical patients at a tertiary hospital in Nepal using the STOP-BANG questionnaire and we found that 23.58% of the study population had an elevated risk for OSA. There were significant associations with advancing age, male gender, increased neck circumference, hypertension, diabetes, and hyperlipidemia. These results demonstrate a high burden of undiagnosed OSA in surgical populations and emphasize the need to address these risk factors in perioperative care.

The prevalence of OSA in our study aligns with previous research in surgical populations, which report a range of 9-38% in Asian cohorts.[2] Our results is also in concordance with Agrawal et al., who found a 24.5% incidence of OSA in Indian surgical patients using similar methodology.[3] However, Elkouny et al found a higher prevalence of 47.3%, likely due to differences in STOP-BANG scoring criteria as they used the updated STOP-BANG version.[16] An even higher prevalence of 55% was reported by Chudeau et al in emergency surgeries. [17] In Nepalese context, Pokharel et al. reported a 47.05% prevalence of severe OSA using polysomnography (PSG), but their sample size was small and hence, may not reflect the general population.[18] While PSG remains the gold standard for OSA diagnosis, it may not always be feasible or accessible in pre-operative settings.[19] Hence, the STOP-BANG questionnaire is a practical alternative for preoperative screening, especially as it has a strong correlation with perioperative complications.[20]

Our study found that older age and male gender were significant predictors of elevated OSA risk, consistent with global trends.[3,21] OSA increases with age as visceral fat increases with age, which is why the prevalence of sleep apnea may increase in middle-aged and elderly males and post-menopausal females.[22] Even though there was a female majority of 54.4% in our sample, males accounted for 73.3% of high-risk group, suggesting gender-specific vulnerability. This may be attributed to hormonal differences, as androgens in males can increase tongue muscle mass, predisposing to airway obstruction. On the other hand, progesterone in premenopausal women may have a protective effect.[23] As such, postmenopausal women may experience increased OSA risk, likely due to the absence of modulating effects of sex hormones.[24,25]

Obesity is a well-established risk factor for OSA, and in our study, overweight (BMI 25–29.9 kg/m²) and Class I obese (BMI 30–34.9 kg/m²) patients accounted for 74.6% of the high-risk group. Interestingly, 49.3% of high-risk patients had a BMI <30 kg/m², suggesting that in our population, OSA may develop at lower BMI thresholds. This may be due to ethnic variations in body composition and fat distribution. This aligns with studies highlighting craniofacial morphology as a contributing factor in Asians, emphasizing the need for region-specific screening protocols.[7,21,26]

Cardiovascular risk factors, including hypertension, hyperlipidemia, and diabetes, were frequently seen in high-risk OSA patients, similar to Agrawal et al.[3] As per the logistic regression analysis, hypertension was the strongest predictor, with an odds ratio of 32.251. HTN is a well-established consequence of OSA due to recurrent hypoxia and sympathetic activation that occurs as a result of sleep fragmentation. Hypothyroidism, often linked to OSA due to weight gain, was not significant in our study, possibly due to the small sample size.

A weak but significant correlation was found between the Epworth Sleepiness Scale (ESS) and STOP-BANG scores, suggesting that excessive daytime sleepiness can be a clinical marker for OSA risk. However, ESS alone is insufficient for screening. While PSG remains the diagnostic gold standard, subjecting every patient to PSG in pre-operative period would lead to unnecessary drain on the resources. Tools like STOP-BANG and ESS provide a practical alternative for risk stratification. This also aligns with study by Chung et al, which have shown the utility of ESS in screening of OSA.[27]

This study has limitations, including the use of STOP-BANG as a screening tool rather than a diagnostic test, which may overestimate OSA risk. Additionally, the study population was limited to surgical patients, which may not be representative of the general population. Future studies should aim to incorporate diagnostic tests, especially in those with identified risk factors.

CONCLUSION

This study demonstrates a high prevalence of OSA risk in a surgical population, with significant associations with age, obesity, neck circumference, and comorbidities such as hypertension and diabetes. The findings stress on routine screening of OSA in preoperative assessments highlighting the need for integrated management of OSA and its associated conditions. By identifying and managing high-risk patients, we can improve perioperative outcomes and reduce OSA-related complications.

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CONFLICT OF INTEREST

The author(s) declare that they do not have any conflicts of interest with respect to the research, authorship, and/or publication of this article.

AUTHOR CONTRIBUTIONS

US: Research concept, design, literature review, data collection, data analysis, statistical analysis, manuscript preparation

PK: Literature review, Data collection, data analysis, statistical analysis, manuscript review

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