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Original Article

Correlation of Severity of Preoperative Stopbang Scores and Incidence of Postoperative Pulmonary Complications in Adults Undergoing Elective Surgeries under General Anesthesia - a Prospective Observational Study

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ABSTRACT

Introduction: Obstructive sleep apnoea (OSA) is a medical disorder and when non-diagnosed precipitates the risk for post-operative pulmonary complications (POPC). STOPBANG score is a questionnaire based screening evaluation method to find our OSA both in general and perioperative population. Hence, we intended to evaluate the association of both severities of STOPBANG score and POPC in postanaesthesia care unit (PACU) in adults undergoing elective non cardiac and non-neurological surgeries under general anaesthesia.
Materials and methods: This double blinded observational study was conducted in 54 patients who underwent elective non-cardiac and non-neurological surgeries under general anaesthesia. Patients were categorized into high risk (≥3) and low risk (<3) of OSA with STOPBANG scores in the Pre-anesthetic clinic and were assessed for POPC in PACU. The POPC such as Upper airway obstruction, hypoxia, signs of respiratory distress, and symptoms and signs of pulmonary aspiration, Reintubation within 24 hours in PACU, post-operative ventilatory support requirement were assessed using a questionnaire.
Results: A total of 50 patients were analyzed in this study since follow up was lost in 4 patients. Demographic parameters were comparable. The incidence of hypoxia in the postoperative period and length of stay in PACU was significantly higher in high risk group ($p<0.001$*). The other POPC was higher in high risk group compared to low risk group, but it was not statistically significant.
Conclusion: Pre-anaesthetic STOP BANG score of ≥3 was associated with increased incidence of POPC in PACU among adults undergoing elective non cardiac and non-neurological surgeries under general anaesthesia.

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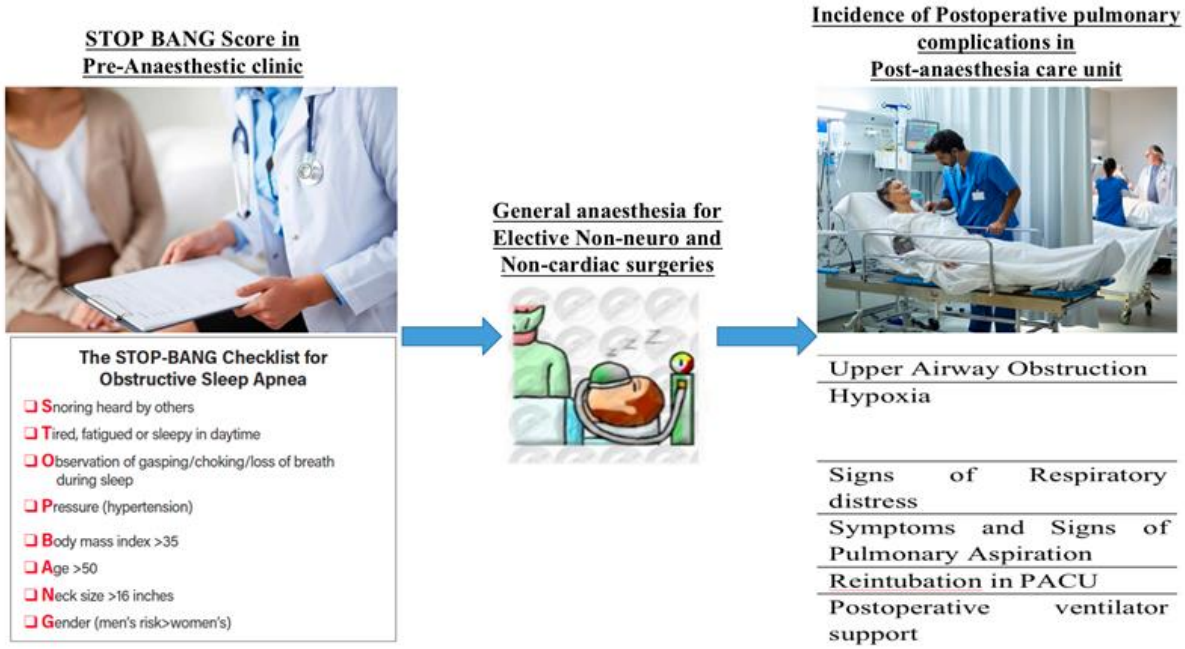
GRAPHICAL ABSTRACT



Introduction

Obstructive sleep apnea (OSA) is a common sleep-related breathing disorder causing sleep arousal. It is characterized by repeated episodes of partial or complete obstruction of upper airway, resulting in reduced airflow (apnoea) or shallow breathing (hypopnoea) [1]. This gives rise to various pathological changes like endothelial dysfunction, increased sympathetic nervous activity and oxidative stress and ultimately, hypoxia [2].

The patient suffering from this medical disorder is often seen having persistent daytime drowsiness which is the most common feature of OSA. The other risk factors responsible for the OSA development include male gender, older age, neck circumference more than 40 cm, snoring, smoking, and alcohol intake [3]. The OSA incidence is high in men when compared with women [3]. OSA occurs when the tongue and palate muscles supporting the soft tissues in the throat relax, and then breathing is momentarily cut-off as the airway has been narrowed or closed. It was shown that mortality rates are higher among patients with OSA. Patients with OSA are at greater risk for developing airway obstruction, congestive cardiac failure, stroke, and desaturation post operatively [4].

OSA has a higher chance of prevalence in surgical population than in general population. The general anaesthesia given to patients undergoing surgery worsens the sleep apnea and increases the risk of post-operative pulmonary complications (POPC) [5]. To assess the chances for POPC development, an adequate pre-operative evaluation should be done which reduces the risk of occurrence of such complications, and also the length of hospital stay [6]. The standard method used to diagnose OSA is STOP BANG questionnaire. This is a highly recommended test by the American society of anesthesiologists (ASA) for screening OSA pre-operatively, yet remains undiagnosed sometimes, and thus increasing the POPC risk including reintubation, pneumonia, atelectasis, and respiratory failure [7]. The acronym STOPBANG stands for Snoring loudly, Tiredness during daytime, Observed apnea during sleep, high blood pressure, body mass index (BMI: >35 kg/m^2), age (>50 years), neck circumference (>40 cm), gender (male gender). The STOPBANG assessment is done pre-operatively based on an 8-point scoring system.

Studies have shown that patients with a score <3 are at a lower risk of POPC than those with a score of ≥3. STOPBANG score is considered as the most effective method for screening OSA [8].

Although there is literature regarding STOPBANG score and POPC available for western population, there is paucity for literature among Asian population. Hence, we conducted this prospective double blinded observational study to evaluate the incidence of post-operative pulmonary complications in correlation with pre-anaesthetic assessment of STOPBANG score in patients posted for elective non cardiac and non-neurological surgeries under general anaesthesia.

Materials and Methods

After getting ethical committee approval, written informed consent was obtained from all participants. This prospective double blinded observational study was conducted in 54 patients undergoing elective non-cardiac and non-neurological surgeries under general anaesthesia in Saveetha Medical College and hospital in kanchipuram District, Tamilnadu, India from April 2022 to September 2022 for 6 months. This study was conducted in agreement with the principles of declaration of Helsinki.

Exclusion criteria were patient refusal, age less than 18, known neuromuscular disease, urgent/emergent surgeries, cardiac surgery, neurosurgery, or other procedures that required therapeutic hypothermia. All patients were asked questions from STOP BANG questionnaire preoperatively in pre-anaesthetic assessment clinic and scoring was done accordingly. The STOPBANG score was based on a "yes or no" response to the following questions and examinations such as snoring loudly, tiredness during daytime, observed apnea during sleep, high blood pressure, Body Mass Index (BMI: >35 kg/m^2), age (>50 years), neck circumference (>40 cm), gender (male gender). Each option had a score of 1 with a total score of 8. STOPBANG scores were collected by a postgraduate posted in patient assessment clinic. Patients were then classified based on the STOPBANG score as high risk of OSA if score is ≥3 and low risk of OSA if score is <3. Anaesthesia was provided and monitored according to the anaesthesiologist in charge for patient as per standard protocol (Induction - Propofol + Fentanyl and Maintenance - Sevoflurane + Oxygen + Medical Air). Neuromuscular blocking agents were used in all patients initially as loading dose prior to tracheal intubation followed by incremental dose, if necessary. The reversal of neuromuscular blockade using neostigmine and dosage was decided by the same anaesthesiologist.

Based on the standard extubation criteria, patients were extubated in the operating room and shifted to PACU for further observation. All patients were administered 100% oxygen (4 L of Oxygen) using face mask after tracheal extubation. On arrival at PACU, all patients received 4L of oxygen using a face mask. A standardized data collection sheet was completed for each patient containing age, sex, height, weight, body mass index, ASA class, diagnosis, surgical procedures, comorbidities, duration of nil per oral, type of anaesthesia, duration of surgery, duration of anaesthesia, temperature on admission, length of PACU stay, intraoperative muscle relaxants, and evidence of neuromuscular damage. Postoperative pulmonary complications observed in PACU which included upper airway obstruction requiring intervention (jaw thrust, oropharyngeal/nasopharyngeal airway), hypoxia in post-operative period not responding to 4 L of oxygen by face mask, non-rebreathing mask with high flow oxygen in room air (mild-94, moderate-90 to 93, and severe <90), signs of respiratory distress (RR <8/>35/min or accessory muscle use or tracheal tug), and symptoms and signs of pulmonary aspiration-evidence of gastric contents in the oropharyngeal structure. Reintubation in PACU, post-operative ventilatory supports requirement. The PACU nurse/post graduate resident observed patients continuously during their PACU stay and contacted the study investigator immediately if observed any of the above-mentioned complications. The patients involved in the study and the study investigator in the postoperative period were blinded to the patient's STOPBANG scores in the preoperative period to ensure double blinding.

The statistical analysis was done using SPSS software. For qualitative data, the frequency and percentages were calculated. For quantitative data, mean and standard deviation was calculated using Chi-square test.

Results and Discussion

54 patients were recruited for the study. However, we lost follow-up for 4 patients in the postoperative ward. Hence, 50 patients were analyzed for statistical analysis. Among 50 participants, females were 44% and males were 66%. Age group of the participants was observed to be as follows: 26% were 31-40, 28% were 41-50, and 46% were 51-60. Comorbidities were observed to be systemic hypertension in 10%, diabetes in 36%, both systemic hypertension and diabetes in 14% of the patients and others had no comorbidities. Surgical procedures involved were Truncal vagotomy, total abdominal hystrectomy, Vaginal Hystrectomy, open hernioplasty, Humerus fixation, shoulder arthroscopy, and Staging laparotomy. The general demographic parameters and other associated parameters are listed in Table 1. Distribution of severity of STOPBANG scores among the 50 patients is presented in Table 2. The overall incidence of POPC among the 50 patients is provided in Table 3.

The Overall association of STOPBANG scores with demographic parameters and POPC were observed as described in Tables 4 and 5, respectively. The incidence of Hypoxia was significantly higher in patients belonging to high risk group when compared with Low risk group ($p<0.001$*).

The other POPC was higher in high risk group when compared to low risk group, but it did not have statistical significance. The length of stay in PACU observed in High risk group was 61.56±15.5 minutes and Low risk group was 42.65±7.6 minutes. It was significantly higher in high risk group when compared with low risk group ($p<0.001$*).

OSA is a common chronic multisystem disorder that has been associated with cardiovascular diseases, ischaemic heart disease, heart failure, arrhythmias, cerebrovascular diseases, and endocrine disorders.

Table 1: General demographic and other associated parameters of all the patients

Serial No.	Variables (n=50)	Values
1	Age (years)	48.62 ± 8.767
2	Height (centimeter)	161.42 ± 6.670
3	Weight (kilogram)	76.14 ± 11.763
4	Body Mass Index (kg per square meter)	29.67 ± 6.172
5	American society of Anaesthesiologist (ASA) grade 1/2 (%)	1 (40%) / 2 (60%)
6	Duration of Nil per oral (minutes)	429.40 ± 42.781
7	Duration of Surgery (minutes)	129.42 ± 26.309
8	Duration of Anaesthesia (minutes)	142.96 ± 26.566
9	Temperature on admission (Celsius)	37.50 ± 0.735
10	Length of stay in PACU (minutes)	48.70 ± 13.844

Table 2: Distribution of severity of STOPBANG scores among the study population

STOPBANG Score (Low Risk <3 & High Risk ≥ 3)	Number of patients (n=50)
0	6 (12%)
1	12 (24%)
2	16 (32%)
3	1 (2%)
4	6 (12%)
5	7 (14%)
6	2 (4%)

Table 3: Over all incidence of postoperative pulmonary complications among the study population

Serial No.	Postoperative Pulmonary Complications (POPC)	Number of patients with POPC (percentage)	Number of patients without POPC (percentage)
1	Upper Airway Obstruction	1 (2%)	49 (98%)
2	Hypoxia	Mild - 11 (22%) Moderate - 4 (8%) Severe - 1 (2%)	34 (68%)
3	Signs of Respiratory distress	1 (2%)	49 (98%)
4	Symptoms and Signs of Pulmonary Aspiration	1 (2%)	49 (98%)
5	Reintubation in PACU	1 (2%)	49 (98%)
6	Postoperative ventilator support	1 (2%)	49 (98%)

Table 4: Association of STOPBANG scores and demographic parameter

Serial No.	Variables	Number of patients with STOPBANG Score <3 (Low risk)	Number of patients with STOPBANG Score ≥ 3(High Risk)	P-value
1	Distribution of patients	34 (68%)	16 (32%)	0.06
2	Age-31 to 40 years	12 (24%)	1 (2%)	0.06
3	Age-41 to 50 years	11 (22%)	3 (6%)	
4	Age-51 to 60 years	11 (22%)	12 (24%)	
5	Sex M/F	15 (30%) /19 (38%)	13 (26%) /3 (6%)	0.06
6	ASA 1/2	19(38%) / 15 (30%)	0 (0%) /16 (32%)	0.09

Table 5: Association of STOPBANG scores with incidence of postoperative pulmonary complications

Serial No.	Postoperative Pulmonary complications	Number of patients with STOPBANG Score <3 (Low risk)	Number of patients with STOPBANG Score ≥ 3(High Risk)	P-value
1	Hypoxia	Mild-5 (14.7%) Moderate-0 (0%) Severe-0 (0%) None-28 (82.3%)	Mild-6 (37.5%) Moderate-4 (25%) Severe-1 (6.2%) None-5 (31.3%)	<0.001*
2	Upper airway obstruction	0 (0%)	1 (6.2%)	0.123
3	Signs of Respiratory distress	0 (0%)	1 (6.2%)	0.123
4	Symptoms and Signs of Pulmonary Aspiration	0 (%)	1 (6.2%)	0.123
5	Reintubation in PACU	0 (0%)	1 (6.2%)	0.123
6	Postoperative ventilator support	0 (0%)	1 (6.2%)	0.123

These comorbidities together with pathophysiological effects of sedatives, analgesics and anaesthetic agents may aggravate symptoms of OSA by reducing pharyngeal tone, ventilatory reflexes, and arousal responses. It affects about 2-4% of the adult population. Higher STOPBANG scores were shown to be correlated to higher rates of postoperative respiratory and cardiovascular complications [9, 10]. In this study, we investigated relationship between STOPBANG score and POPC in Asian population in our center. Demographic details respect to age, height, weight, and BMI were comparable (Tables 1 and 4). Comorbid conditions like hypertension were seen in 10% of patients, Diabetes mellitus in 30% of patients, and both in 14% of patients.

Among the 50 patients, 32% belonged to high risk for OSA and 68% belonged to low risk for OSA according to STOPBANG scoring. Our results showed that high risk for OSA patients had higher incidence of POPC compared with low risk for OSA according to STOPBANG scores (Table 5). Among the POPC, most of the patients had hypoxia with varying severity (Mild to severe). Incidence of hypoxia was significantly higher with 11 patients in high risk for OSA group and 5 patients in low risk for OSA group ($p<0.001$*). In studies conducted by pereria *et al.* [1] and sangkum *et al.* [2], the incidence of hypoxia was comparatively higher in patients with STOPBANG score of more than 3. Hence, it is obvious that that postoperative care in terms of adequate oxygen support with appropriate oxygen delivery devices and recruitment manoeuvre for the lungs are prudent to avoid such adverse outcomes. The Incidence of other POPC like upper airway obstruction, signs and symptoms of pulmonary aspiration, signs of respiratory distress, reintubation in PACU and postoperative ventilatory support were clinically higher, but were not statistically significant. These findings were similar to that of Pereria *et al.* [1] and Sangkum *et al.* [2]. One patient in high risk OSA developed pulmonary aspiration requiring reintubation and post-operative ventilation (Table 5). It was a case of ventral hernia repair, the patient had a delayed recovery from anaesthesia and trial extubation was done, but it eventually failed in PACU. Since all other causes of delayed recovery were ruled out, we presume that it might be because of the undiagnosed obstructive sleep apnoea syndrome which the patient was suffering from. We had followed up the patient in the entire postoperative period and later, after extubation in the critical care unit after two days, polysomnography confirmed OSA for the patient. The patient was discharged with home bipap machine as advised by the pulmonologist. We also found that length of PACU stay was higher in patients with high risk for OSA with mean of 61.5 minutes compared with low risk OSA with mean of 42.6 minutes ($p<0.001$*). This may be due to intensive monitoring or any associated adverse outcomes which may lead to longer hospital stay in high risk for OSA. In study by Edwin *et al.* [7], they found that STOP BANG score was useful for stratifying patients who are at risk of unexpected intraoperative and early postoperative adverse events. Our study was not devoid of Limitations. Firstly, it was not possible to compare the results of STOPBANG questionnaire with a definite polysomnographic diagnosis. Hence, the high risk for post-operative events may not be due to obstructive sleep apnea. Secondly, the sample size was meager to conclude that incidence of POPC is higher in patients with STOPBANG scores of ≥ 3. Hence, studies with higher sample size comparing patients belonging to different ethnicity are warranted in future to find out true association. Thirdly, the patients were not followed once they get discharged from PACU. Hence, respiratory events were not registered after PACU discharge.

Conclusion

Preoperative STOP BANG score of ≥ 3 was associated with significantly increased incidence of post-operative pulmonary complications and prolonged stay in post anaesthesia care unit in patients undergoing elective non-cardiac and non-neurological surgeries under general anaesthesia. Hence, STOPBANG score may be used as preoperative risk stratification tool in the pre anaesthetic clinics to predict the postoperative pulmonary complications.

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No potential conflict of interest was reported by the authors.

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Authors' Contributions

All authors contributed to data analysis, drafting, and revising of the paper and agreed to be responsible for all the aspects of this work.

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