Preoperative screening for obstructive sleep apnea in cardiovascular patients – How useful is STOP-BANG questionnaire in the Indian context?

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ABSTRACT

Background: Obstructive sleep apnea (OSA) is reported in a high proportion of cardiac surgical patients, up to 73%. STOP-BANG is a validated questionnaire for screening of outpatients for OSA with high sensitivity. There is sparse literature from India regarding the prevalence of OSA in preoperative cardiovascular patients and the utility of screening tools.

Aims: We sought to study the utility of the STOP-BANG questionnaire as a screening tool for OSA in cardiovascular patients validating it with ambulatory level 3 polysomnography.

Materials and Methods: It was a prospective study where consecutive patients getting admitted for coronary artery bypass surgery (CABG) from August 2017–February 2019 were recruited. All the patients were screened with the STOP-BANG questionnaire. 53 patients underwent overnight level 3 polysomnography using Apnea-Link. Correlations were made between clinical symptoms, STOP-BANG score, and OSA severity, measured using Apnea hypopnea index (AHI).

Results: We had 120 patients(103 males) with a mean age 60 years. Snoring was the most common sleep complaint. Our cohort had a high prevalence of vascular risk factors (DM 72.3%, hypertension 59.2%, dyslipidemia 60%) and 11.7% were obese (BMI >30). The median STOP-BANG score was 3 (IQR 2) with 83 having scores ≥3. Median AHI was 5.6 with AHI 5 in 28 patients and AHI 15 or above in 14 patients. Among the clinical parameters, arousals with respiratory difficulty at night, higher neck circumference, and tonsillar hypertrophy showed a significant association with PSG-proven OSA. STOP-BANG scores 3 or above had a sensitivity of 75% in predicting OSA.

Conclusions: Our study shows that in cardiovascular patients less symptomatic for sleep complaints, the STOP-BANG questionnaire is a useful screening tool for OSA in outpatient settings. Among clinical parameters, airway narrowing and neck circumference can predict OSA.

Keywords: Ambulatory polysomnography, cardiovascular patients, obstructive sleep apnea, screening tool, STOP-BANG questionnaire

INTRODUCTION

Obstructive sleep apnea (OSA) with its metabolic consequences is a well-known risk factor for cardiovascular disease and related mortality.[1] Cardiovascular patients are more likely to have undiagnosed OSA, in comparison to the age-matched population.[2] Several authors have reported the association of OSA with perioperative
pulmonary and cardiac complications. However, OSA remains largely under-recognized in surgical patients. With its implications on perioperative management, recent anesthesia guidelines have recommended OSA screening preoperatively.

Easy-to-use questionnaires are available for OSA screening in outpatient settings, one of the most popular being STOP-BANG. Studies using STOP-BANG have shown a high percentage of patients screened preoperatively are at risk of OSA and have higher rates of perioperative complications. This justifies the use of a bedside screening tool to preoperatively identify those with high-risk for OSA before elective procedures. STOP-BANG have also shown good performance in comparison to polysomnography (PSG) in detecting moderate to severe OSA as well.

The Asian population, especially those with coronary artery disease are younger, have a higher prevalence of risk factors, especially diabetes mellitus, hypertension, and central obesity as compared to the Western population. So whether the STOP-BANG questionnaire performs equally well in our patient group when compared with the gold standard – overnight PSG needs to be studied before recommending it as a preoperative screening tool.

We aimed to study the utility of the STOP-BANG questionnaire for preoperative screening of OSA in a cohort of patients with coronary disease, admitted for coronary artery bypass grafting (CABG) in comparison with ambulatory PSG.

**MATERIALS AND METHODS**

The study was performed at Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum, India. The study design was prospective, where consecutive patients getting admitted for CABG electively were screened for sleep and other medical complaints using a structured proforma, and the STOP-BANG questionnaire was administered after getting informed consent. Recruitment period was from August 2017 till February 2019. The conduct of the study was approved by the Institutional Ethics Committee (IEC/SCT/998/DEC 2016) and was funded by grant from ResMed Foundation, California, USA.

Among the subjects screened, those consenting underwent overnight ambulatory Level 3 PSG (ApneaLink Air-ResMed Inc) 2 days before the surgery date. During the ambulatory sleep study, physiological parameters recorded were nasal airflow, pulse rate, and blood $O_2$ saturation using a pulse oximeter, chest belt for recording chest excursions during respiration and snoring. Only studies with a minimum of 4 h of sleep record were analyzed, manually reviewed by sleep medicine specialists and report generated. Apneas and hypopneas were defined as per standard American Academy of Sleep Medicine (AASM) guidelines for the scoring of sleep-related respiratory events.

**Statistical analysis**

The analysis was performed using SPSS version 21 software (SPSS Inc, Illinois, Chicago). Comparisons were made between sleep complaints and risk factors and the presence or absence of OSA. Further, different scores and individual components of the STOP-BANG score were separately analyzed for finding sensitivity, specificity, and predictive value in detecting OSA in cardiovascular patients. As per Asian standards of obesity, we also looked into modified STOP-BANG, with body mass index (BMI) >30 taken as abnormal and also made comparisons with clinical and PSG scores.

**RESULTS**

We had 120 patients, predominantly men (M: F 103:17) with a median age of 60 (±11.5) years. Baseline characteristics are shown in Table 1. Baseline characteristics of those undergoing PSG did not differ from those who did not undergo overnight study, other than BMI which was higher in the sleep study group. The majority of our patients had mild-moderate upper airway narrowing.

Around 86 patients (69%) had STOP-BANG scores ≥3 in our cohort (median 3 [interquartile range = IQR 2]) while 53 patients underwent overnight sleep study of which 28 (52.8%) had OSA (apnea-hypopnea index = AHI 5 or above per hour) and 14 (26.4%) had moderate OSA (AHI 15 or above). Median AHI was 5.6.

Bivariate analysis showed that nocturnal arousals with respiratory difficulty, abnormal neck circumference (≥40 cm in male and ≥37 cm in female) ’n male and ≥37 cm), and higher grades of tonsillar hypertrophy had a statistically significant correlation with OSA (Table 2). Subgroup analysis showed a narrow upper airway by Mallampatti score and tobacco smoking as having a significant association with moderate to severe OSA.

At cut-off score 3 or above, STOP-BANG has a high sensitivity of 77.4%, albeit low specificity, making it a good screening tool for OSA in cardiovascular patients.
as well [Table 3]. Raising cutoff scores to 4 or above improved specificity to 59.7% at the expense of sensitivity. Receiver operating characteristic (ROC) curve plotted for sensitivity and specificity of STOP-BANG scores showed an area under the curve of 0.8403 again highlighting the same property of the screening tool as mentioned above [Figure 1]. The predictive value of STOP-BANG increases with higher scores, while a score of less than 3 has a negative predictive value of 66.7% for ruling out OSA [Table 4].

**DISCUSSION**

Over half of our study cohort had OSA, predicted by the STOP-BANG questionnaire, and proven by PSG as well. We could come across only one report from north India, where screening using STOP-BANG alone in general surgical patients had yielded a lower OSA prevalence of 25%.[12] The higher prevalence of OSA in our patients can be partly explained by the fact that being a cardiovascular cohort, they have more modifiable risk factors than the general population, thereby increasing the scores. OSA proven by PSG in our study cohort is comparable to other studies from cardiovascular patients, where prevalence ranged from 13.2–73%.[2,12]

Our cohort was less symptomatic for OSA, in comparison to the usual sleep clinic cohort.[13] Excessive daytime sleepiness and BMI have shown an inconsistent association with OSA in literature, including from our part of Asia.[14,15] Among community dwellers, witnessed apneas increase the odds for having OSA,[16] which was not observed in our cohort. Vascular risk factors have shown a positive correlation with severe OSA across different studies.[17] We also found that diabetics had a trend towards severe OSA, while other vascular risk factors and age failed to show this association.

The question we tried to answer by the study was whether the STOP-BANG score is predictive of OSA in a cardiovascular cohort, more so in the Indian context. With traditional cutoff scores of 3 or above, the questionnaire had a good sensitivity of over 75% with a low specificity,
which makes it a good screening tool. These observations are consistent with previous reports and meta-analysis on STOP-BANG in a sleep clinic and surgical patients.\textsuperscript{[18]} Asian cut-offs of abnormal neck circumference are lower than those reported from West;\textsuperscript{[19]} however, changing BMI cutoff in the score from above 35 to above 30 did not improve upon its performance in predicting OSA in our cohort. However, low scores do not exclude the disease as one-third of patients with low scores turned out to have OSA of some severity, which has been observed in other cardiovascular studies as well.\textsuperscript{[20]}

Shortage of certified sleep laboratories and trained personnel for performing sleep study have to lead the physicians to rely on portable monitoring devices for easy diagnosis of OSA in outpatient settings. Home or out of center sleep testing is getting increasingly utilized nowadays, with the AASM also recommending the use of Level 3 PSG for screening for patients with a high pretest probability of OSA and those with snoring being planned for elective surgeries.\textsuperscript{[21]} We also performed Level 3 PSG in our patients for validating STOP-BANG scores.

One of the strengths of our study is the homogeneity of the cohort – all our patients were admitted for coronary bypass grafting electively and had a high prevalence of vascular risk factors-of the tune of 60–70%. Other than snoring, other symptoms of OSA were infrequent in our cohort. Ours being a prospective study design, we could meticulously collect all the clinical data and do STOP-BANG scoring which adds to the strength of the study. Also, we could validate the questionnaire with Level 3 PSG. Ours is the first study from India where STOP-BANG questionnaire scores were compared with PSG results in preoperative cardiovascular patients.

Nevertheless, our study is not without limitations. We could recruit only 120 patients and only a little over one-third consented for a sleep study, which reduces the overall effect size. Also, ambulatory level 3 PSG without sleep stage scoring cannot rule out sleep disorders absolutely due to technical factors like data loss; however, this has been minimized by the application of sensors by a sleep technologist and including only those patients who had at least 4 h night sleep on the study night for analysis, which reduces the chance of underdiagnosing OSA further. Though there is some emerging literature regarding poor perioperative outcomes in patients with OSA, especially untreated OSA, with a higher incidence of emergent intubation, aspiration pneumonia, and prolonged hospital stay, we did not look into the impact of OSA on postoperative outcome of our patient cohort, which is another limitation of our study.\textsuperscript{[22,23]}

Despite these limitations, which are minor considering manpower and technical resources required for performing fully supervised PSG, our study adds to our understanding of OSA and the utility of screening tools in Asian, especially the Indian population, with a higher prevalence of diabetes and premature cardiovascular diseases. We found that nearly 50% of our screened cardiovascular patients without overt sleep symptoms like excessive daytime sleepiness had OSA of varying severity. STOP-BANG questionnaire performed well as a screening tool, with a sensitivity of over 75% Predictive value of STOP-BANG showed a graded increment with an increase in cutoff scores as well, which again reaffirms its utility as a screening tool in preoperative cardiovascular patients as well.

**CONCLUSIONS**

Our study shows that the prevalence of OSA is high in our cohort of patients undergoing cardiovascular surgery. In cardiovascular patients less symptomatic for sleep complaints, the STOP-BANG questionnaire performs well as a screening tool for OSA detection. Assessment of neck circumference and airway narrowing preoperatively can predict patients at risk of OSA.

**Ethical approval**

The study has been conducted after approval from the Institutional Ethics committee following the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. Informed consent was obtained from all individual participants included in the study.

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### Table 3: Sensitivity and specificity of the STOP-BANG questionnaire in comparison to Level 3 - PSG

| STOP-BANG Scores | PSG proved OSA | Odd’s ratio | P-value |
|------------------|----------------|-------------|--------|
| Positive         | Negative       |             |        |
| <3               | 12 (22.6)      | 24 (35.8)   | 1.91   |
|                  | (0.85–4.26)    | (0.93–3.99) | 0.12   |
| ≥3               | 41 (77.4%)     | 43 (64.2%)  | 0.52   |
| ≥4               | 50 (85.7%)     | 47 (69.2%)  | 0.66   |
| ≥5               | 10 (17.2%)     | 6 (9.0)     | 0.66   |

### Table 4: Positive and negative predictive value of STOP-BANG scores for OSA screening

| STOP-BANG scores | <3 | ≥3 | ≥4 | ≥5 | ≥6 | ≥7 |
|------------------|----|----|----|----|----|----|
| Positive predictive value | 12 (33.3) | 41 (48.8) | 30 (52.6) | 11 (64.7) | 4 (80.0) | 2 (100.0) |
| Negative predictive value | 24 (66.7) | 43 (51.2) | 27 (47.4) | 6 (35.3) | 1 (20.0) | 0 (0.0) |
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Conflicts of interest
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