Preoperative Stop-Bang Questionnaire and Other Difficult Airway Determinants in Prediction and Correlation of Difficult Airway

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Abstract:

Introduction : The most common cause of anesthesia-related morbidity and mortality till date is difficult airway management. Difficult airways are strongly associated with obstructive sleep apnea (OSA) and OSA syndrome (OSAS). Patients with OSA who are anesthetized have a higher risk of problems because of anatomical and physiological alterations in their upper airway. The STOP-Bang Questionnaire is a simple, self-reporting screening tool that consists of four subjective (STOP: Snoring, Tiredness, Observed apnea, and high Blood pressure) and four demographic(BANG: BMI, Age, Neck circumference, Gender) items.

Keywords: STOP-BANG, difficult airway, OSAS, ventilation, upper lip bite test, neck circumference.

Objectives :

1) To evaluate the effectiveness of the STOP-BANG questionnaire in predicting difficult airway.
2) To estimate the diagnostic accuracy of commonly used airway examination tests for assessing difficult airway in adult patients.

Methodology:

In the study, patients posted for elective non- oncological surgery under general anesthesia above the age of 18 years with BMI more than or equal to 25 were selected.

Pre-operative evaluations for all patients included age, gender, height, body weight, BMI, Mallampati score. For anthropometric measurements, thyromental distance, neck circumference, and the upper lip bite test were measured and recorded.

In addition, all patients were asked to answer the STOP-BANG questionnaire.Those patients who scored ≥5 points from this questionnaire were considered to have severe OSAS, whereas those who scored <5 points were considered to have mild-moderate OSAS.

Intraoperatively, any difficult intubation and mask ventilation were recorded along with Cormac-Lehane grading.

Results:

In the study there was significant positive correlation between STOP BANG score and upper lip bite test and neck circumference. There was no significant correlation between thyromental distance and STOP BANG Score. In the study STOP BANG Score >2 had highest sensitivity of 80.95%, Specificity of 86.67%, PPV of 81% and NPV of 86.7% in predicting Difficult Intubation. In the study STOP BANG Score >2 had highest sensitivity of 87.5%, Specificity of 80%, PPV of 66.7% and NPV of 93.3% in predicting Difficult Ventilation.

Conclusion:

According to this study, the use of STOP-BANG questionnaire can be used for predicting difficult mask ventilation and intubation along with the use of other parameters like upper lip bite test and neck circumference.

Background (Introduction)

The most common cause of anesthesia-related morbidity and mortality till date is difficult airway management.

Difficult airways are strongly associated with obstructive sleep apnea (OSA) and OSA syndrome (OSAS). Patients with OSA who are anesthetized have a higher risk of problems because of anatomical and physiological alterations in their upper airway.

The STOP-Bang Questionnaire is a simple, self-reporting screening tool that consists of four subjective (STOP: Snoring, Tiredness, Observed apnea, and

high Blood pressure) and four demographic(BANG: BMI, Age, Neck circumference, Gender) items.

Objectives

1) To evaluate the effectiveness of the STOP-BANG questionnaire in predicting difficult airway.
2) To estimate the diagnostic accuracy of commonly used airway examination tests for assessing difficult airway in adult patients.

Materials& Methods:

Patients above 18 years of age with American Society of Anaesthesiologists (ASA) score of II, III, IV undergoing general anaesthesia and endotracheal intubation will be prospectively included in the study after informed consent is taken.

This study excluded those patients who were unconscious, unoriented, and uncooperative; who may require rapid sequence or awake endotracheal intubation; had a history of upper respiratory tract surgery, burn, trauma, and anomalies in the head-and-neck region; and obstetrics patients.

- Study Design: Observational study
- Sample Size: 51
- Duration of study: 6 months

Study Participants: This study will be conducted on patients posted for elective surgeries under general anesthesia at R.L. Jalappa Hospital and Research Centre, Tamaka, Kolar.

- Sampling Method:

Formula

$$n = [(Z\alpha + Z\beta)/C]\ 2 + 3$$

where $C = 0.5 \log [(1+r)/(1-r)]$

Outcome variable: Correlation between STOP BANG score and difficult airway and mask ventilation

Z-value for 95% CI: 1.96

Z-value for 80% power: 0.84

Correlation (r) : 0.383

Minimum required sample size is n = 51.

Methodology:

1. Detailed history of the patient will be taken.
2. Pre-operative evaluations for all patients will include age, gender, height, body weight, BMI, dental status (whether or not they have natural teeth)

3. Mallampati score will be recorded by seeing mouth opening.
4. For anthropometric measurements, thyromental distance, neck circumference, and the upper lip bite test will be measured.
5. Thyromental distance will be taken as the distance between the thyroid cartilage and the tip of the jaw with the head in full extension.
6. Neck circumference will be measured at the level of the thyroid cartilage with the head in the neutral position.
7. In an upper lip bite test, the patients will be asked to bite the upper lip with their lower incisors. The patients will be categorized into three classes: class I, patient is able to raise the lower incisors above the vermilion line; class II, patient is able to bite the upper lip below the vermilion line; and class III, patient is unable to bite the upper lip.
8. In addition, all patients will be asked to answer the STOP-BANG questionnaire. It consists of closed-ended questions with a score for each positive answer used as an Obstructive sleep apnea syndrome (OSAS) screening tool.
9. Those patients who scored ≥5 points from this questionnaire were considered to have severe OSAS, whereas those who scored <5 points were considered to have mild-moderate OSAS.
10. In classical laryngoscopy, the glottic view will be evaluated using the Cormack–Lehane (C–L) test.
11. Difficult intubation predictors will include a Mallampati score of III or IV, Class III upper lip bite test, a thyromental distance of <6cm, a neck circumference of >40 cm, a STOP-BANG questionnaire score of ≥5, and a C–L grade of III or IV.
12. Routine investigations will be carried out.
13. In the operating room, after routine monitoring (electrocardiogram, non-invasive blood pressure, and peripheral oxygen saturation), and premedication with Inj. Glycopyrrolate 0.005 mg/kg, 2 mg/kg propofol, and 2 µg/kg fentanyl will be used to induce anaesthesia.
14. Inj. Succinylcholine at 2 mg/kg will be administered intravenously to facilitate endotracheal intubation.
15. After the administration of succinylcholine, laryngoscopy and intubation will be performed in a standard sniffing position.
16. After general anesthesia induction, whether or not mask ventilation and intubation were difficult will be recorded.
17. Difficult mask ventilation will be defined as the inability of an anesthesiologist to provide sufficient oxygen saturation with 100% oxygen during mask ventilation (SpO_2<90%) and the use of other devices, such as laryngeal mask airway or necessity to attempt intubation.

18. Difficult intubation will be defined as three or more unsuccessful attempts with classical laryngoscopy and the procedure lasting longer than 10 min.

When difficult intubation was encountered, the algorithm recommended by ASA was used.

Results:

Table 1: Profile of subjects in the study

		Count	%
	Mean ± SD	45.92 ±16.659	
Age (years)	<30 years	13	25.5%
	31 to 40 years	6	11.8%
	41 to 50 years	9	17.6%
	51 to 60 years	16	31.4%
	>60 years	7	13.7%
Gender	Female	23	45.1%
	Male	28	54.9%
	Male : Female ratio	1.2 : 1	
ASA Grade	1	23	45.1%
	2	26	51.0%
	3	2	3.9%

Table 2: Intubation parameters and scores

		Count	%
Thyromental Distance (Fingers)	2	4	7.8%
	3	47	92.2%
Upper Lip Bite Test	1	25	49.0%
	2	23	45.1%
	3	3	5.9%
Stop Bang Score	0	12	23.5%
	1	5	9.8%
	2	13	25.5%
	3	9	17.6%
	4	7	13.7%
	5	5	9.8%
Difficult Mask Ventilation	NO	35	68.6%

	YES	16	31.4%
Difficult Intubation	NO	30	58.8%
	YES	21	41.2%
CL Grade	1	6	11.8%
	2	23	45.1%
	3	15	29.4%
	4	7	13.7%

Table 3: Correlation between Stop Bang Score and Thyromental Distance, Upper Lip Bite Test, Neck Circumference

		Stop Bang Score	Thyromental Distance (Fingers)	Upper Lip Bite Test	Neck Circumference
Stop Bang Score	Correlation Coefficient	1.000	-0.222	0.542**	0.848**
	P value	.	0.117	<0.001*	<0.001*
	N	51	51	51	51

Spearman's rho
**. Correlation is significant at the 0.01 level (2-tailed).

In the study there was significant positive correlation between STOP BANG score and Upper Lip Bite Test and Neck Circumference i.e. with increase in class of upper lip bite test and neck circumference, STOP BANG score was found to be more.
There was no significant correlation between thyromental distance and STOP BANG Score.

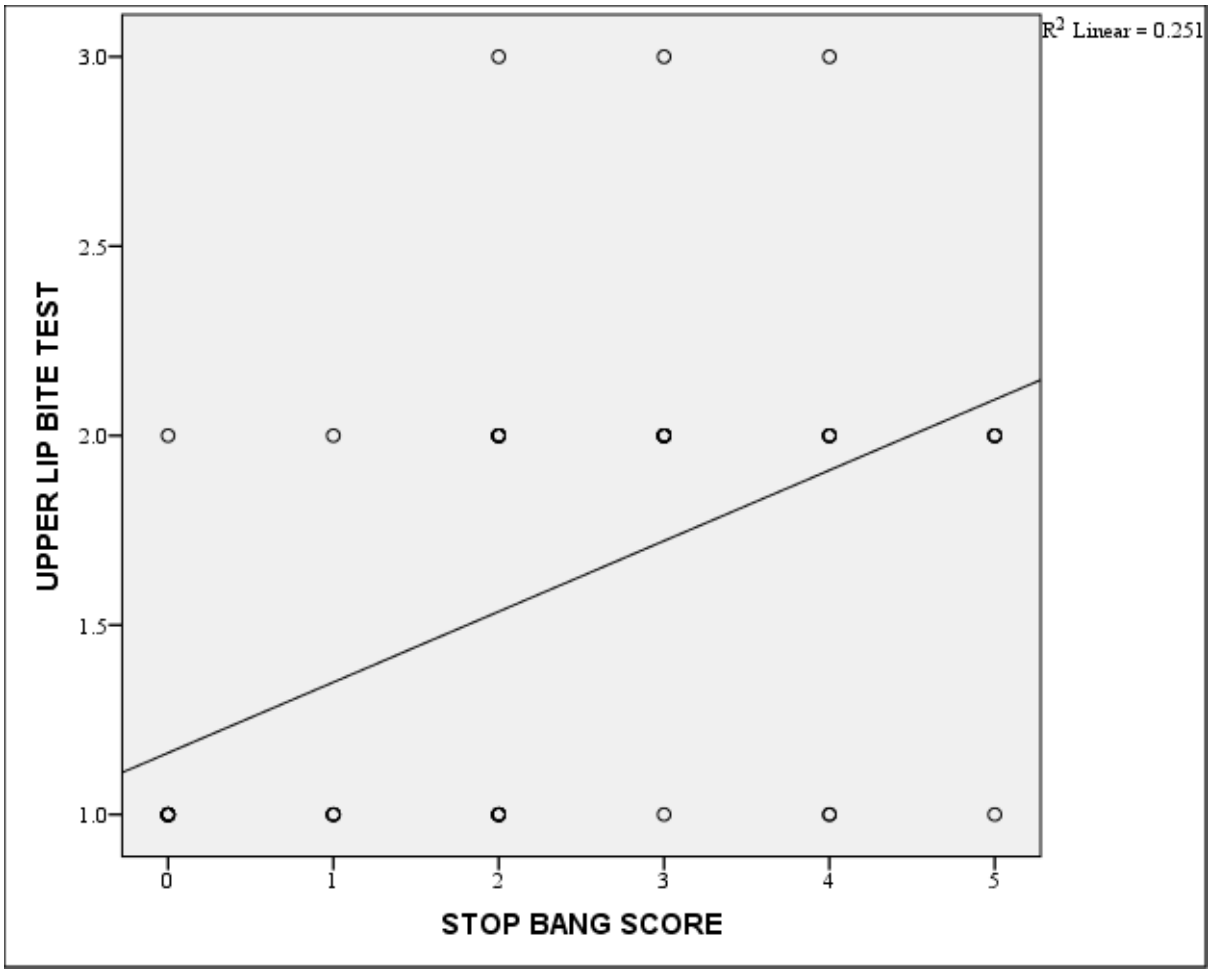

Figure 1: Scatter plot showing positive correlation between STOP BANG Score and Upper Bite test

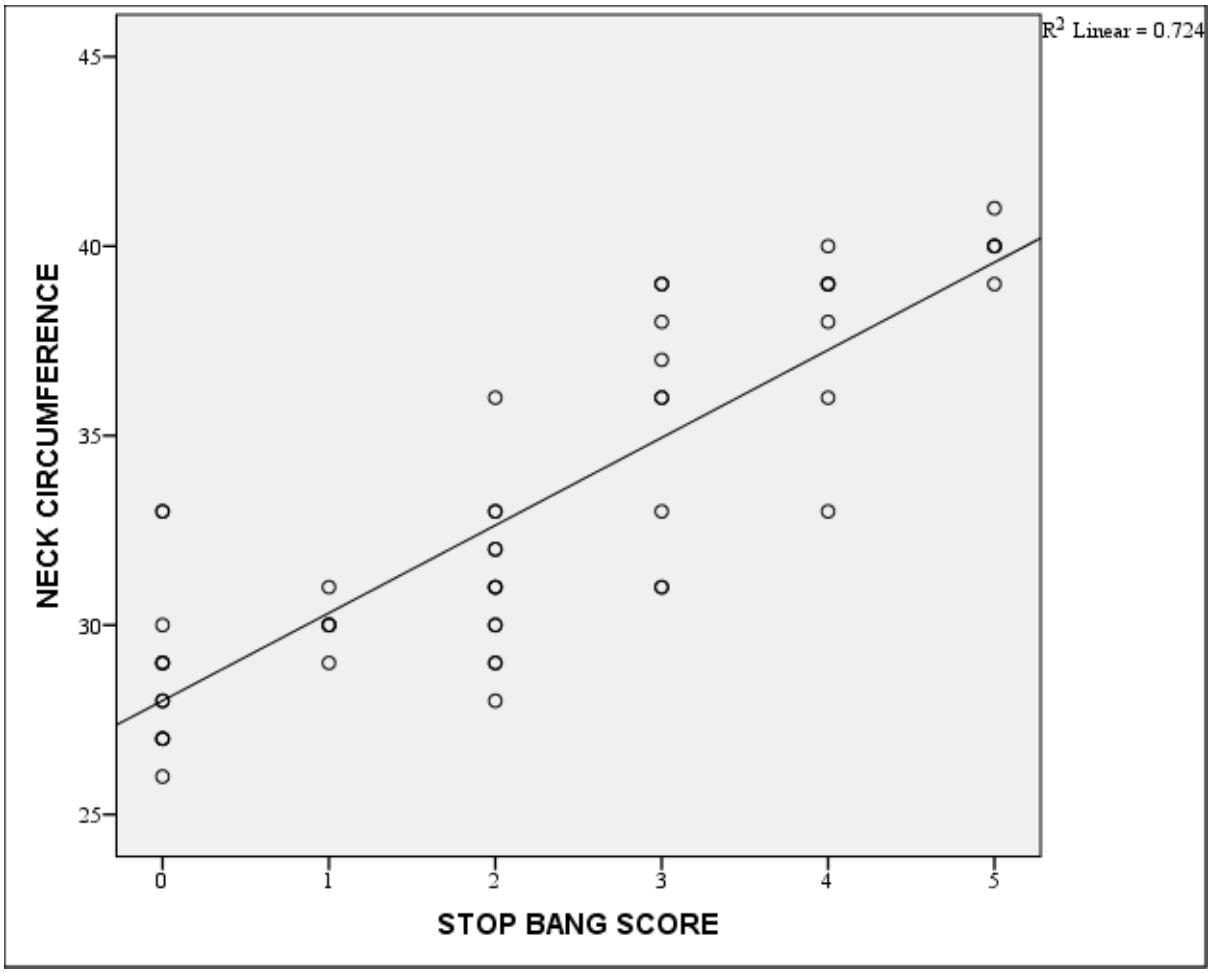

Figure 2: Scatter plot showing positive correlation between Stop Bang Score and Neck Circumference

Table 4: Correlation between Stop Bang Score and CL Grade

		Stop Bang Score	CL Grade
Stop Bang Score	Correlation Coefficient	1.000	0.670**
	P value	.	<0.001*
	N	51	51
**. Correlation is significant at the 0.01 level (2-tailed).			

In the study with increase in CL Grade there was significant increase in STOP BANG score and vice versa.

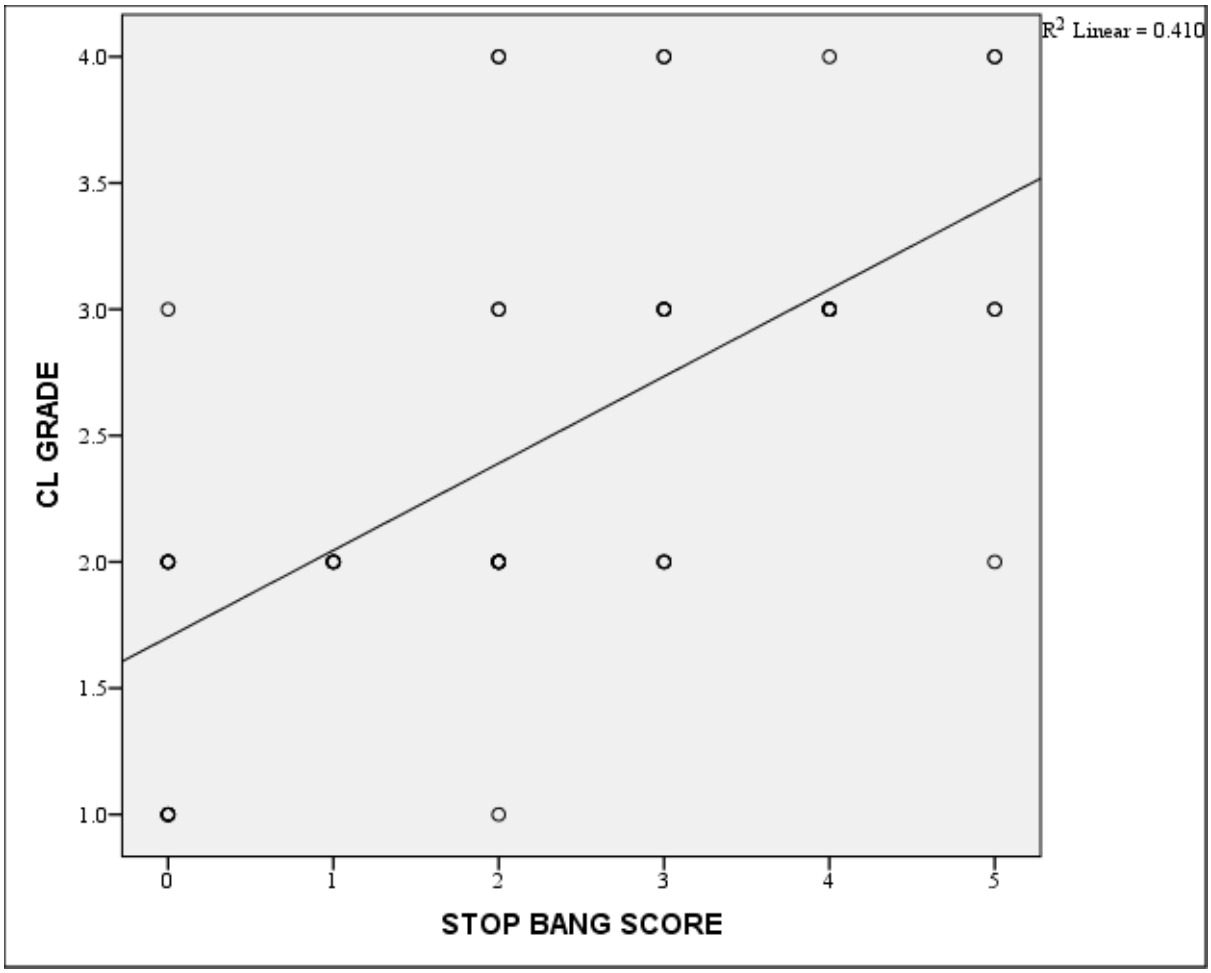

Figure 3: Scatter plot showing positive correlation between Stop Bang Score and CL Grade

Table 5: Area under the ROC curve (AUC) for Stop Bang Score in predicting Difficult Intubation

Criterion values and coordinates of the ROC curve

Criterion	Sensitivity	95% CI	Specificity	95% CI	+PV	-PV
≥0	100.00	83.9 - 100.0	0.00	0.0 - 11.6	41.2	
>1	100.00	83.9 - 100.0	56.67	37.4 - 74.5	61.8	100.0
>2	**80.95**	**58.1 - 94.6**	**86.67**	**69.3 - 96.2**	**81.0**	**86.7**
>3	52.38	29.8 - 74.3	96.67	82.8 - 99.9	91.7	74.4
>4	19.05	5.4 - 41.9	96.67	82.8 - 99.9	80.0	63.0
>5	0.00	0.0 - 16.1	100.00	88.4 - 100.0		58.8

In the study STOP BANG Score >2 had highest sensitivity of 80.95%, Specificity of 86.67%, PPV of 81% and NPV of 86.7% in predicting Difficult Intubation.

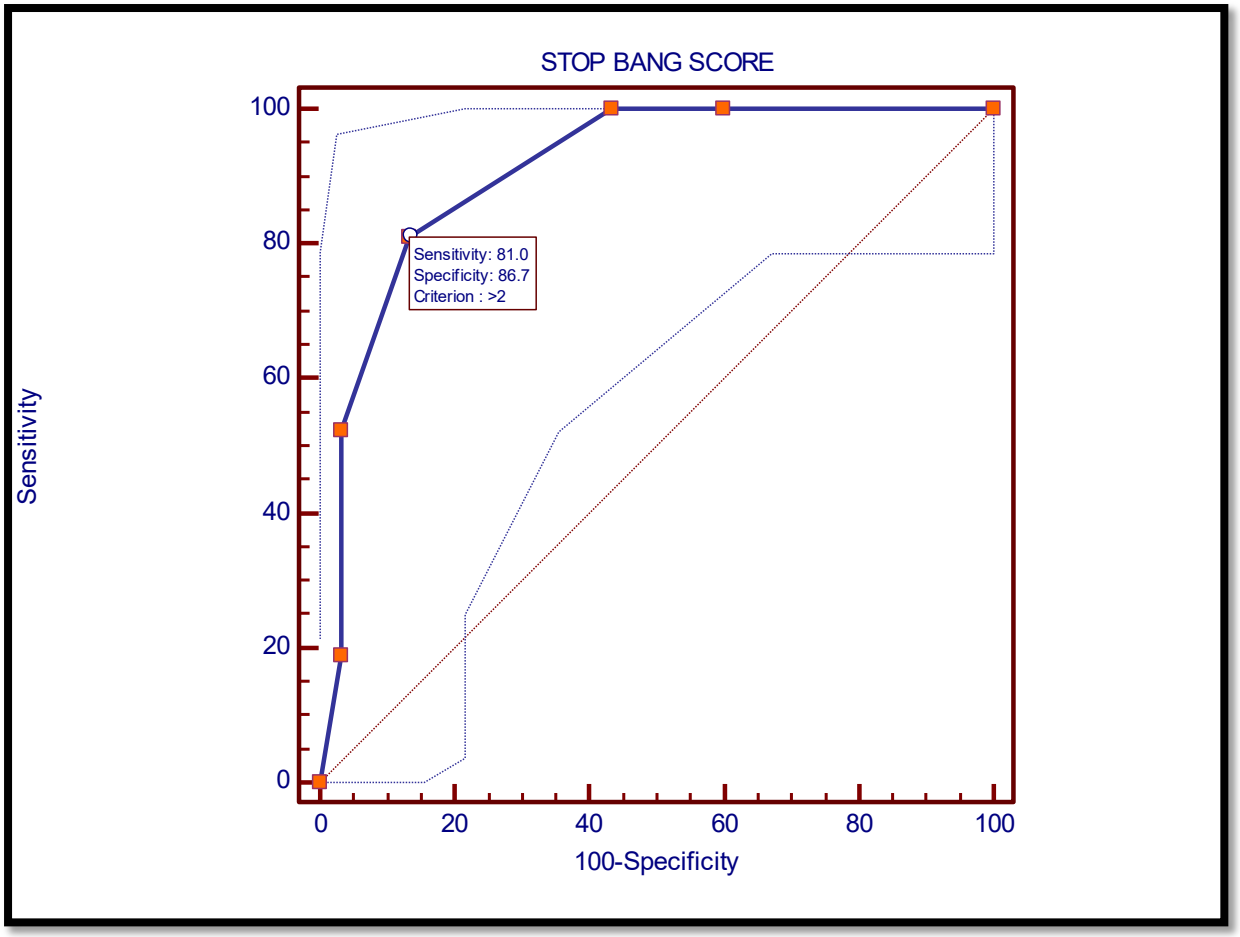

Figure 4: Area under the ROC curve (AUC) for Stop Bang Score in predicting Difficult Intubation

Table 6: Area under the ROC curve (AUC) for Stop Bang Score in predicting Difficult Ventilation

Criterion values and coordinates of the ROC curve

Criterion	Sensitivity	95% CI	Specificity	95% CI	+PV	-PV
≥0	100.00	79.4 - 100.0	0.00	0.0 - 10.0	31.4	
>1	100.00	79.4 - 100.0	48.57	31.4 - 66.0	47.1	100.0
>2	**87.50**	**61.7 - 98.4**	**80.00**	**63.1 - 91.6**	**66.7**	**93.3**
>3	62.50	35.4 - 84.8	94.29	80.8 - 99.3	83.3	84.6
>4	31.25	11.0 - 58.7	100.00	90.0 - 100.0	100.0	76.1
>5	0.00	0.0 - 20.6	100.00	90.0 - 100.0		68.6

In the study STOP BANG Score >2 had highest sensitivity of 87.5%, Specificity of 80%, PPV of 66.7% and NPV of 93.3% in predicting Difficult Ventilation.

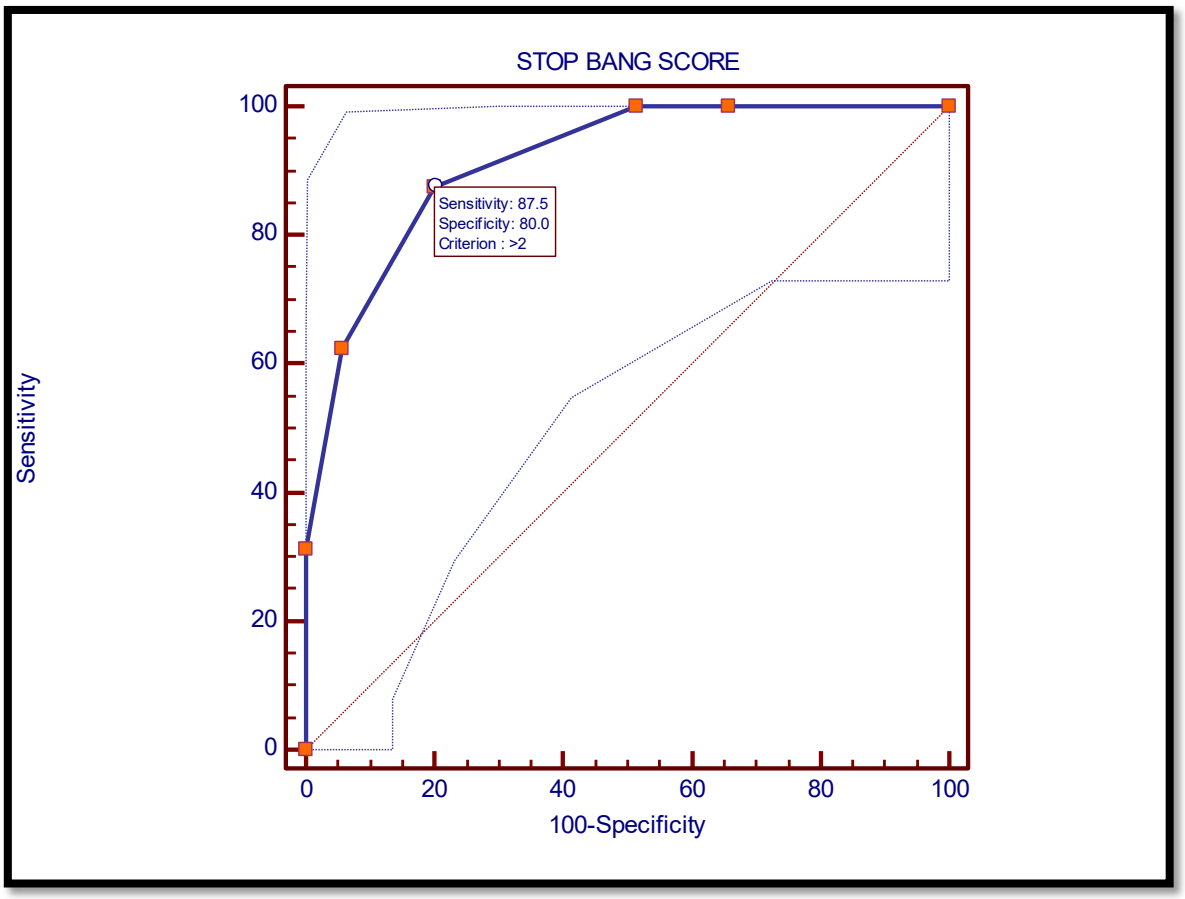

Figure 5: ROC Curve showing Area under the ROC curve (AUC) for Stop Bang Score in predicting Difficult Ventilation

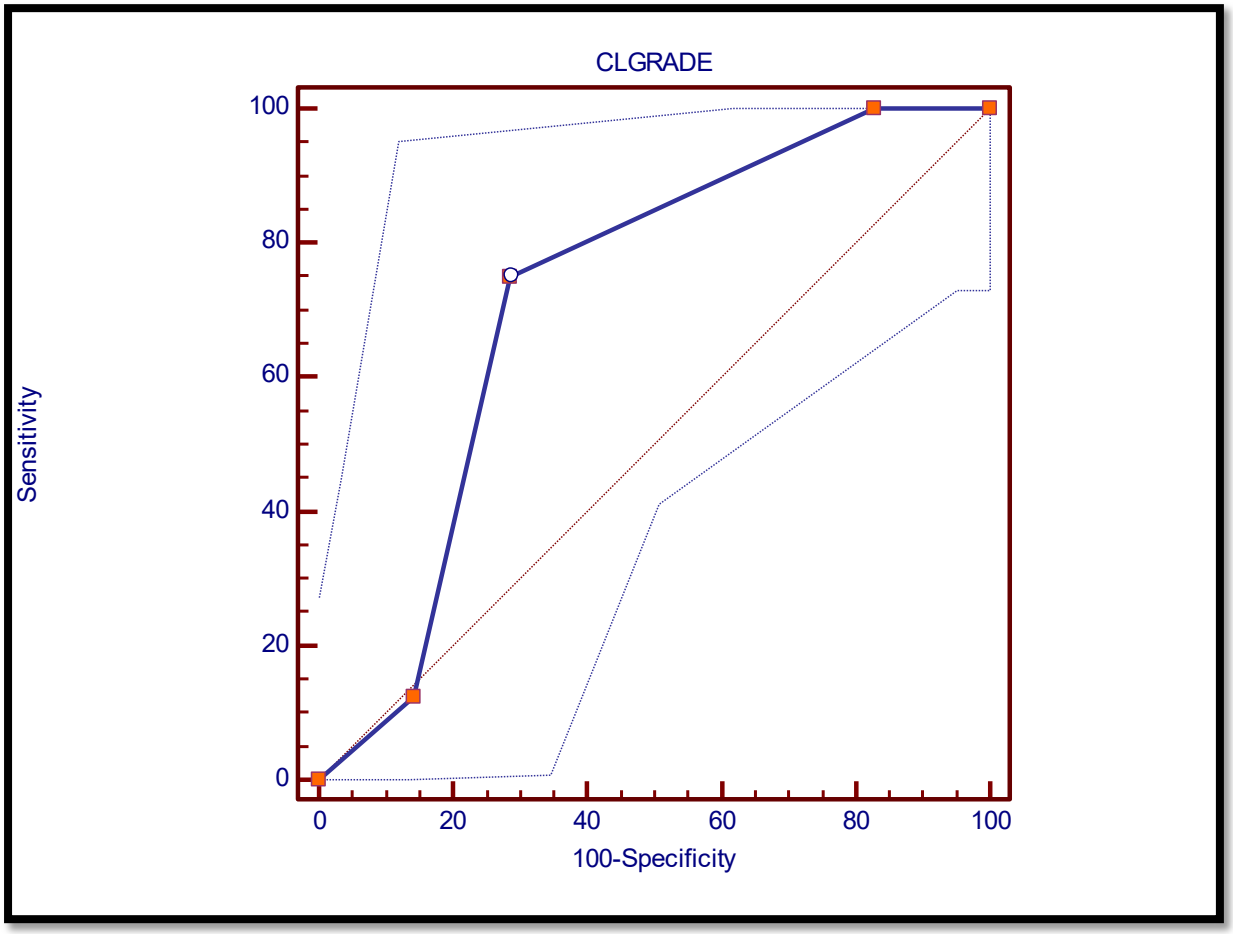

Figure 7: ROC Curve showing Area under the ROC curve (AUC) for CL Grade in predicting Difficult Ventilation

Conflict of Interest- Nil

Discussion:

In anaesthesia, maintaining the airway is crucial, and failing to do so can have detrimental effects. In order to predict a challenging airway before the intervention, patients should be evaluated using a variety of anatomical features, relevant tests, and criteria.[1,2]

OSAS is associated with narrowing of the upper airway due to the fat deposition on the pharyngeal wall and loss of pharyngeal dilator activity during sleep.The collapse of the upper respiratory tract is likely the cause of the considerable increase in difficult face mask ventilation, and it may therefore be considered an independent risk factor.[2,3]In this particular study, patients with a STOPBANG score of ≥3, who are at risk of developing severe OSAS, experienced difficult airway more frequently and significantly more often than patients with a low score (p=0.02). A moderately positive

association was seen between STOP-BANG and difficult airways. The rates of difficult mask ventilation were 31.4% and difficult intubation was 41.2%.
Since patients with severe OSAS may experience serious perioperative problems, anaesthesiologists must have access to a valid and reliable screening test in order to identify patients with OSAS. As a result, the STOP-BANG questionnaire can help identify patients who have undiagnosed OSAS and predict whether or not they will havedifficult airway.[3]

Additionally, the following outcomes were noted: (1) Two criteria (upper lip bite test, neck circumference >35 cm) were independent risk factors for difficult mask ventilation; (2) difficult mask ventilation was more frequent when intubation was difficult; and (3) Cormac Lehane grade >2, was an independent risk factors for difficult intubation; (4) significant positive correlation between STOP BANG score and Upper Lip Bite Test and Neck Circumference i.e. with increase in class of upper lip bite test and neck circumference >35cm, there was an increased STOP BANG score.

Compared to STOP-BANG, neck circumference and C-L displayed a stronger positive association in this current study. Even though the STOPBANG questionnaire included the neck circumference criterion, when used alone, it was more strongly associated with difficult intubation. A short, wide neck increases the chance of having a difficult airway. A prior study discovered a statistically significant relationship between neck circumference and challenging intubation.[5,6] It might be due to the limited extension needed for intubation. The current study found a correlation between difficult airway and neck circumference. The STOP BANG score and thyromental distance did not have significant correlation.
The upper lip bite test was proven to be a sensitive indicator of difficult airway in a prior study, however no statistically significant link was discovered in this investigation.[7] The test's accuracy and reliability may differ based on the patients' gender and ethnicity. This outcome could be explained by the variety of people's craniofacial features, their inability to comprehend the instructions, and their disparate dental and lip structures. There was however positive association between upper lip bite test and STOP BANG score >2.
According to a prior study, people with a C–L grade of 3 or 4 have a higher risk of difficult intubation.High C-L grades and difficult airway were shown to be significantly associated in our study ($p<0.001$). The main drawback of difficult intubation, notwithstanding the substantial association between it and C-L grade, is that it can only be performed after the patient has undergone general anaesthesia. As a result, we ought to employ additional examinations that can reveal difficulty beforehand.

Conclusion:

According to this study, the use of STOP-BANG questionnaire can be used for predicting difficult mask ventilation and intubation. Parameters like upper lip bite test and neck circumference can be used as an additional tool to aid in prediction.

Limitations:

- The sample size of the study was small. It could have been better with larger population size.

Abbreviations:

- OSAS – Obstructive sleep apnea syndrome
- CL – Cormac-Lehane
- BMI – Body Mass Index
- PPV – Positive predictive value
- NPV – Negative predictive value

References:

1. Bilge A, Erol A, Arıcan Ş, Tuncer Uzun S. The use of STOP-BANG questionnaire and other difficult airway determinants in difficult airway prediction and correlation. Ulus Travma Acil CerrahiDerg 2022;28:1277-1284.
2. Thammaiah SH, Sreenath RH, Kumararadhya GB, Babu N, Archana KN. Preoperative STOP-BANG questionnaire to predict difficult airway in undiagnosed obstructive sleep apnea patients undergoing elective gynecological surgeries under general endotracheal anesthesia: A prospective observational study. Ann Afr Med 2023;22:520-5
3. Shetty K, Soori R. Stop-bang questionnaire as a screening tool for obstructive sleep apnoea in the surgical population: a prospective observational study. Biomedicine.2023 Feb. 26 2023 ;43:236-42.
4. I.D. Alp, B.G. Koksal, K. Bollucuoglu et al., Evaluation of the relationship between the stop-bang score with oxygen reserve index and difficult airway: a prospective observational study, Brazilian Journal of Anesthesiology 2023
5. Lauren C. Berkow, Promise Ariyo,Preoperative assessment of the airway,Trends in Anaesthesia and Critical Care, 2015;5;28-35
6. Chung F, Yegneswaran B, Liao P, Chung SA, Vairavanathan S, Islam S, et al. STOP questionnaire: A tool to screen patients for obstructive sleep apnea. Anesthesiology 2008;108:812-21

7. Langeron O, Masso E, Huraux C, Guggiari M, Bianchi A, Coriat P, et al. Prediction of difficult mask ventilation. Anesthesiology 2000;92:1229-36
8. Han R, Tremper KK, Kheterpal S, O'Reilly M. Grading scale for mask ventilation. Anesthesiology 2004;101:267
9. Hsia JC. Anatomy and physiology of the upper airway in obstructive sleep apnea. Oper Tech Otolaryngol Head Neck Surg 2015;26:74-7
10. Mathangi K, Mathews J, Mathangi CD. Assessment of perioperative difficult airway among undiagnosed obstructive sleep apnoea patients undergoing elective surgery: A prospective cohort study. Indian J Anaesth 2018;62:538-44.
11. . Magalhães E, Oliveira Marques F, Sousa Govêia C, Araújo Ladeira LC, Lagares J. Use of simple clinical predictors on preoperative diagnosis of difficult endotracheal intubation in obese patients. Braz J Anesthesiol 2013;63:262-6
12. Chia P, Seet E, Macachor JD, Iyer US, Wu D. The association of pre-operative STOP-BANG scores with postoperative critical care admission. Anaesthesia 2013;68:950-2.