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Original Research Article

Evaluation of STOP BANG Questionnaire in Predicting the Difficult Mask Ventilation and Difficult Intubation in Obese Patients

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Abstract:
Introduction: Airway is still the most challenging entity for anaesthesiologist even after invention of wide variety of airway gadgets. Unanticipated difficult airway is most difficult to manage, so anticipation of difficult airway is most crucial for anaesthesiologist which can be done by pre-operative assessment. The morbidity and mortality associated with unanticipated difficult airway is very high especially in obese patient as obesity affects multiple organs. By correct anticipation and taking appropriate measures we can reduce it significantly.
Objective: To evaluate STOP-Bang score as a tool for predicting difficult mask ventilation and difficult intubation in obese patients.
Methodology: 150 obese patients (BMI ≥ 30) with ASA physical status II and III aged 18 years or older undergoing various surgeries under general anaesthesia with endotracheal tube placement were enrolled for the study after taking informed written consent. Preoperatively, these patients were given STOP-Bang questionnaire. Based on questionnaire response and examination, STOP-Bang scoring was done. Score was used to classify obese patients as high risk (≥3) or low risk (<3) for OSA. After attaching standard ASA monitors i.e. electrocardiogram, heart rate, pulse oximeter and non-invasive blood pressure, baseline values were recorded. Mask ventilation grade, Modified Cormack-Lehane Grade, number of attempts of intubation and use of rescue measures were also evaluated in each patient. The collected data was analysed using SPSS version 21, whereas P<0.05 was considered significant. Quantitative data were described using mean ± standard deviation. Comparison between the quantitative variables were done by using t test and ANOVA.
Results: In our study we found that the mask ventilation grade was significantly associated with STOP-Bang score (p<0.01). It showed that higher the STOP-Bang score, greater the difficulty in mask ventilation. The laryngoscopy grade (Cormack-Lehane grading) was not significantly associated with STOP-Bang score (p=0.125). The patients with high STOP-Bang score required more intubation attempts in comparison to low STOP-Bang score (p value 0.353, statistically not significant).
Conclusion: High STOP-Bang score is a good predictor of difficult mask ventilation rather than difficult laryngoscopy however one criterion of STOP-Bang score i.e; neck circumference has direct correlation in predicting difficult airway (mask ventilation and laryngoscopy).
Keywords: STOP BANG, Mask Ventilation, Intubation, Obese.

Introduction

The airway management in obese patients is a relatively arduous task because of accompanying anatomical and physiological changes. In addition to this, obesity is also found to be associated with various cardiovascular and metabolic aberrations, which makes anaesthetic management even more difficult. [1] World Health Organization (WHO) defines obesity as Body Mass Index (BMI) of 30 or more, calculated after taking weight in kilograms and height in metres (kg/m^2). [2] Obesity is a growing concern worldwide including India. Obese individuals are found to be vulnerable to multiple conditions like biliary stones (or associated complications), nerve entrapment syndromes or fractures. In the present time, the number of obese individuals requiring elective or emergency surgeries have been increasing constantly. Hence, the anaesthesiologist has to be well prepared for assessing the risk of complications and predict any difficulty in anaesthetic management of such patients. In obese individuals, due to extra fat deposition in the areas of oral cavity, pharynx and submandibular regions, there is narrowing in the airway region, which further makes laryngoscopy difficult. Moreover, obesity is also commonly associated with sleep breathing related disorder called Obstructive Sleep Apnoea (OSA). In this disorder, there is partial or complete collapse of the upper airway during sleep and can cause hypoxia or long-term cardiovascular changes in patients. So, in obese patient, with associated obstructive sleep apnoea, intubation becomes even more complicated procedure. [3] Post operative management of such patients (obese with OSA) is again challenging due to risk of associated pulmonary complications.

Anaesthesiologist has to assess the airway of patients in pre operative period to devise an airway management plan. The standard procedure of assessment involves mouth opening, neck extension, modified Mallampati grading & thyromental distances. To assess the difficulty level of endotracheal intubation, many risk scores such as: Wilson risk score, [4] modified Mallampati grading, [5] Benumof's score and Intubation difficulty score (IDS) [6] have been evaluated, but none of these include Obstructive sleep apnoea as a predicting factor of difficult airway. We planned this study to evaluate if STOP-Bang score can be used to predict risk of difficult mask ventilation and difficult intubation in obese patients in addition to conventional airway assessment tools.

OSA can be screened pre-operatively by a simple STOP-Bang [i.e. acronym for Snoring, Tiredness, Observed apnoea, Pressure (BP > 140/90), Body mass index, Age, Neck circumference and Gender] questionnaire. The STOP-Bang Score may be used to classify obese patients as high risk or low risk for OSA. Compared to other questionnaire like Berlin questionnaire, sleep apnoea clinical score and American society of anaesthesiologist (ASA) checklist, STOP-Bang is simple to administer and requires only 5th grade education level. STOP-Bang requires only 3 simple measurements i.e. height, weight & neck circumference. [7]

Material and Methodology:

This was a prospective study conducted after obtaining approval from the Institutional ethics committee. The sample size was calculated on the basis of a previous study which recorded prevalence of difficulty in intubation among obese patients in India as 11%. [8] Taking 95% confidence limit and absolute error of 5%, total sample size was calculated as follows: $N = Z\alpha^2 x P x Q / L^2 = 150$, where N = sample size; $Z\alpha = 1.96$, value of the standard normal variate corresponding to level of significance alpha 5%; P = prevalence of difficulty in intubation among obese patients in India as 11% (0.11); Q = 1 – P = 1 –0.11= 0.89; L = Absolute error = 5% (0.05).

We enrolled 150 obese patients (BMI ≥ 30) with ASA physical status II and III aged 18 years or older undergoing various surgeries under general anaesthesia with endotracheal tube placement after informed written consent. Patients with history of difficult airway in past, pregnant females, patients with known allergies to drugs (used in study), patients with known psychiatric disorders, patients already intubated with another advanced airway device were excluded from study.

Pre-operative anaesthesia check-up was done of all the consented patients. Detailed history was elicited including history of any major illness or disease in the past. General physical examination and airway examination (mouth opening, modified Mallampati grading, thyromental distance and neck movements) of each patient was performed and parameters were noted. All relevant investigations were done at the time of check-up. After obtaining written informed consent, patients were given STOP-Bang questionnaire (Table 1) preoperatively. Based on questionnaire response and examination, STOP-Bang scoring was done. Score was used to classify obese patients as high risk (≥3) or low risk (<3) for OSA. The anaesthesia provider (all anaesthesia providers involved in this study had performed at least 100 intubations in obese patients with BMI≥30) performing the laryngoscopy and intubation were blinded for the STOP-Bang score. Routine pre-operative preparation consisted of fasting of 6-8 hours for solids prior to surgery. Premedication with Tablet Ranitidine 150mg night before surgery was also done. On arrival in operating room, patients were positioned on operation table in ramped up position in such a way that the external auditory meatus is horizontally aligned with the sternal notch. After attaching standard ASA monitors i.e. electrocardiogram, heart rate, pulse oximeter and non-invasive blood pressure, baseline values were recorded. Patients were pre-oxygenated for at least three minutes with 100% oxygen and given injection Fentanyl 2mcg/kg. After 3 minutes, anaesthesia was induced with injection Propofol 2mg/kg. Once the patient attained jaw relaxation, 2 manual breaths were given with bag and mask. Adequacy of mask ventilation was assessed by chest rise and capnogram. If not adequate, oral or nasopharyngeal airway or both were used to improve mask ventilation. After first two breaths, injection Succinylcholine 1.5 mg/kg was administered. Bag and mask ventilation was done for 60 seconds. Adequacy of mask ventilation was again assessed by chest raise and capnogram and mask ventilation grade noted. Laryngoscopy and intubation were done using video laryngoscope C Mac c blade (Storz Inc.) (equivalent to Laryngoscope McIntosh blades size 3 and 4) [9,10] as conventional laryngoscope. The laryngoscopist who performed conventional laryngoscopy was blinded for the monitor. Second anaesthetist looking at the monitor videotaped the laryngoscopy and the modified Cormack-Lehane grading [11,12] showed by the video image was correlated with the modified Cormack-Lehane grading commented by the laryngoscopist. Modified Cormack-Lehane grade 3 and 4 images were captured for objectivity and validation. Number of attempts of laryngoscopy, use of rescue measures like Bougie, stylette, videolaryngoscope C and D blade, fibreoptic intubation or supraglottic airway device were noted. Correct placement of endotracheal tube was confirmed by bilateral air entry and capnograph for more than 5 successive breaths.

Rescue measures: oral airway, nasal airway or both, help of colleague anaesthetist (2 person technique).

Following Observations Were Noted:

1. STOP-Bang score
2. Mask ventilation grade
3. Modified Cormack-Lehane Grade
4. Number of attempts of intubation
5. Use of rescue measures

Table 1: STOP- Bang score

STOP		
Do you SNORE loudly (louder than talking or loud enough to be heard through closed doors)?	Yes	No
Do you often feel TIRED, fatigued, or sleepy during daytime?	Yes	No
Has anyone OBSERVED you stop breathing during your sleep?	Yes	No
Do you have or are you being treated for high blood PRESSURE?	Yes	No

BANG		
BMI more than 35kg/m2?	Yes	No
AGE over 50 years old?	Yes	No
NECK circumference > 16 inches (40cm)?	Yes	No
GENDER: Male?	Yes	No

TOTAL SCORE

High risk of OSA: Yes ≥ 3

Low risk of OSA: Yes < 3

Table 2 : Mask ventilation grading system[13] :

Grade 0	ventilation by mask not attempted
Grade 1	ventilated by mask
Grade 2	ventilated by mask with oral airway or other adjuvant
Grade 3	Difficult mask ventilation (inadequate, unstable or requiring 2 practitioners)
Grade 4	Unable to mask ventilate.

Table 3 : Laryngoscopy- Modified Cormack-Lehane grading system

1	Full view of glottis
2a	Partial view of glottis
2b	Arytenoids or posterior part of the vocal cords only just visible
3	only Epiglottis visible
4	Neither glottis nor epiglottis visible

Rescue measures: use of videolaryngoscope C Mac C or D blade, Stylette, Bougie, Fibre optic intubation, Supra-glottic airway like laryngeal mask airway.

Table 4: Modified Mallampati score:

Class 0	Any part of the epiglottis is visible
Class 1	Soft palate, uvula, and pillars are visible
Class 2	Soft palate and uvula are visible
Class 3	Only the soft palate and base of the uvula are visible
Class 4	Only the hard palate is visible

To properly assess a patient's Mallampati score, the patient is seated in the upright position and opens their mouth while maximally protruding their tongue. Classically this examination is done without phonation.

Statistical Analysis: The collected data was analysed using SPSS version 21, whereas P<0.05 was considered significant. Quantitative data were described using mean ± standard deviation. Comparison between the quantitative variables were done by using t test and ANOVA. Qualitative variables were analysed using Chi square test or Fischer's exact test.

Results: The mean BMI of study population was 40.33 ± 8.2kg/m^2. Distribution of study subjects according to WHO classification of obesity based on BMI into obesity class 1, 2, &3 were 42 (28%), 46 (31%) & 62 (41%) respectively. Mean weight of the study subjects was 106 ± 7.2 kg. Mean height of study population was 1.63 ± 0.08 metres.

Table 5: Comparison of STOP-Bang score with Mask ventilation grade

STOP-Bang Score	Mask ventilation grade			
	1	2	3	4
<3	27	1	0	0
≥3	67	45	10	0
Total	94	46	10	0
p value <0.01, using Fischer exact test, indicating that mask ventilation grade is significantly associated with STOP-Bang score				

As shown in Table 5, A total of 10 cases of difficult mask ventilation (mask ventilation grade ≥ 3) were noted in high STOP-Bang score (≥3) group (n =122). While difficult mask ventilation never occurred in patients with low STOP-Bang score (<3) (n = 28). Our study revealed that patients with high STOP-Bang score (≥3) were associated with difficult mask ventilation (grade 3) (P< 0.01, statistically significant) in comparison to patients with low STOP-Bang score. We did not encounter any impossible mask ventilation during our study. Grade 2 mask ventilation requiring an oral airway was significantly high in high STOP-Bang score group (n = 45) in comparison to low STOP-Bang score group (n=1).

Table 6: Comparison of STOP Bang score with Modified Cormack-Lehane grading

Score	Modified Cormack-Lehane grading					
	1	2a	2b	3	4	Total
<3	16	9	2	1	0	28
≥3	44	42	28	8	0	122
Total	60	51	30	9	0	150
p value 0.125, using fischer exact test, indicating that modified Cormack-Lehane grade is not significantly associated with STOP-Bang score						

A total of 9 cases of difficult laryngoscopy with Cormack-Lehane grade 3 were noted. While 8 occurred in high STOP-Bang score group and only 1 in low STOP-Bang score group. There was no incidence of Cormack-Lehane laryngoscopy grade 4 . Our study revealed that difficult laryngoscopy i.e; Cormack-Lehane grade 3 and 4 and high STOP-Bang score are not associated (p = 0.125, statistically not significant) as shown in Table 6. 4 out of 9 cases of Cormack-Lehane grade 3 required use of rescue measures. Out of 4, in 3 cases we used videolaryngoscope C blade with the aid of videolaryngoscope monitor and 1 patient required use of videolaryngoscope D blade (could not be intubated with C blade using videolaryngoscope monitor). Rest of the 5 cases were intubated using stylette along with external laryngeal manipulation. All the patients were successfully intubated and we did not encounter any failed intubation. maximum attempts used were 2 with rescue measures. There were a total of 8 cases requiring second attempt for successful tracheal intubation. All the cases in which second attempt was made had STOP-Bang score ≥3 (Figure 1)

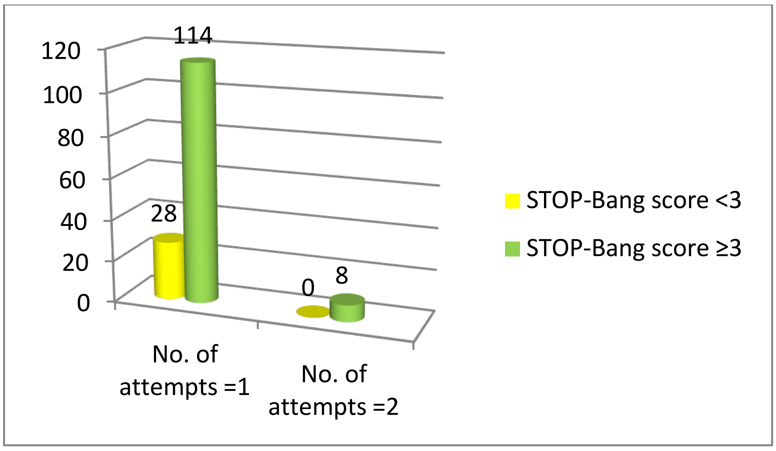

Figure 1: Comparison of number of intubation attempts with STOP-Bang score

Modified Mallampati grading analysis shows that 52 patients had modified Mallampati grading ≥ 3 (n=52 , III-47 & IV- 5) of which 50 patients had high STOP-Bang score(≥3). While only two patients with Mallampati grading 3 had low STOP-Bang score. Using Fischer exact test, it was found that STOP-Bang score is significantly associated with modified Mallampati grading (p <0.001), as shown in Table 7.

Table 7: Comparison of modified Mallampati grade with STOP-Bang score

STOP-Bang Score	Modified Mallampati grade	
	<3	≥3
<3	26	72
≥3	2	50
Total	28	122
p value 0.001, using Fischer exact test, indicating that Mallampati grade is significantly associated with STOP Bang score		

The conventional tests for prediction of difficult airway like mouth opening, modified Mallampati grading, Thyromental distance, and neck extension were analysed in comparison to neck circumference. The tests were marked positive if any one of the parameters were positive. Our study shows that neck circumference ≥ 40 cm was significantly associated with Difficult airway as predicted by conventional tests (p value 0.005) (Figure 2).

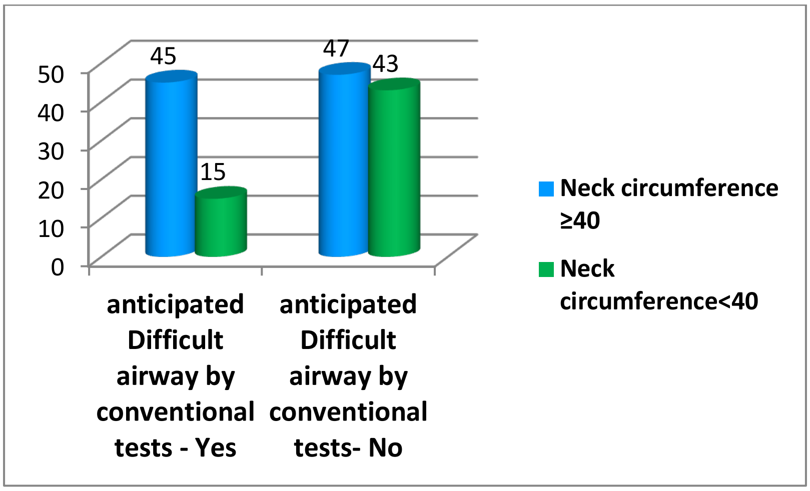

Figure 2 : Comparison of anticipated difficult airway by conventional tests with neck circumference

Discussion:

Airway management continues to remain one of the most challenging entities for anaesthesiologists even after invention of wide variety of airway gadgets. Unanticipated difficult airway, in particular, is difficult to manage. Anticipation of difficult airway is most crucial for anaesthesiologist which can be done by pre-operative assessment. Though many assessment tools have been invented since the inception of anaesthesia, we are still far away from designing an ideal airway assessment tool with 100% accuracy (with high sensitivity & specificity). Anticipating difficult airway in pre-operative visits helps in taking necessary precautions during intra-operative management of airway. Conventional tests of airway like mouth opening, modified Mallampati grading, thyromental distance and neck movements are simple bedside tests but have poor sensitivity. Cluster of parameters were used to predict difficult airway like Wilson risk score, modified Mallampati grading, Benumof's score and intubation difficulty score (IDS). [4-6] None of the above scores include Obstructive sleep apnea as a predicting factor of difficult airway.

In this study, we incorporated one more criteria i.e. STOP-Bang questionnaire in obese patients for airway assessment. The STOP-Bang score is validated for the diagnosis and severity of OSA, generally associated with obesity. The morbidity and mortality associated with unanticipated difficult airway is very high especially in obese patient as obesity affects multiple organs. By correct anticipation and taking appropriate measures we can reduce it significantly. The present study was conducted to evaluate STOP-Bang score as an airway assessment tool for predicting difficult mask ventilation and difficult intubation in obese patients in addition to conventional airway assessment tools (mouth opening, modified Mallampati grade, thyromental distance and neck movement. Our study revealed that high STOP-Bang score ($\geq$ 3) was more common (n=122) than low STOP-Bang score (< 3) (n=28) among obese patients, which is similar to study conducted by Gokul et al. [14] It reiterates that among obese patients high STOP-Bang score is more common.

In present study it has been found that the mask ventilation grade was significantly associated with STOP-Bang score ($p<0.01$). It showed that higher the STOP-Bang score, greater the difficulty in mask ventilation. This finding was in accordance with the study conducted by Langeron et al [15] which identified significant association between age > 55 years, BMI > 26 kg/m2, snoring, presence of beard and difficult mask ventilation. However, two of the four criterias used by Langeron et al [15] are included in the STOP-Bang questionnaire used in this study. Difficult mask ventilation and its association in patients with high risk for OSA as predicted by high STOP-Bang score correlates well with the study conducted by Corso et al, [16] Plunkett et al, [17] Gokul et al. [14]

In order to achieve objectivity, video larygoscope C mac c blade (Karl Storz) (equivalent to Mcintosh laryngoscope blade size 3 and 4) was used for laryngoscopy in the present study. The laryngoscopist who performed conventional laryngoscopy was blinded for the monitor. The live video laryngoscopy was observed on the monitor by the second experienced anaesthetist who gave his own laryngoscopy grading. This was done to exclude interobserver variability. Modified Cormack-Lehane grade 3 and 4 images were captured and presented in this study. This is an improvement over various other studies where only laryngoscopist graded the laryngoscopy. It was found that the laryngoscopy grade is not significantly associated with STOP-Bang score (p=0.125). In other words, STOP-Bang score does not necessarily predict difficult laryngoscopy. This observation is in concordance with few other studies. [18-20] However, there are other studies which differ with this finding. [15,16,21] Most of these studies induced the patients in standard sniffing position except studies conducted by Juvin et al [18] in which patients were anaesthetised in semi-recumbent position and Gokul et al [14] in which ramped position was used by placing a wedge under the head and shoulder. In our study we used ramped position such that external auditory meatus horizontally aligned with the sternal notch by placing wedge under the head and shoulder. This ramped position might have made significant difference in ease of laryngoscopy and intubation. This is similar to the study conducted by Collins et al [22] which concluded that ramped position allows better visualisation of the vocal cords than sniffing position.

Our study found that patients with high STOP-Bang score required more intubation attempts in comparison to low STOP-Bang score. However, the difference was statistically not significant (p=0.353). The study by Neligan et al [19] also failed to identify any relation between number of attempts and BMI. We did not come across any patient of impossible mask ventilation or failed intubation in our study subjects.

This study revealed that high Mallampati grade ($\geq$ 3) is significantly associated with high STOP-Bang score ($\geq$3) ($p < 0.001$). This result reiterates the findings in the literature that high Mallampati grading is associated with difficult airway. [19,23]

One more statistically significant point noted in our study was that the neck circumference is significantly associated with difficult airway (p=0.005). Thus, greater the neck circumference higher the incidence of difficult airway. This is in accordance with studies conducted by Brodsky et al, [20] Gonzalez et al, [23] Ganzouri et al, 24 and Lee et al [25] which showed neck circumference is associated with difficult airway.

The limitation of our study was that patients with very high STOP-Bang score were not referred to sleep clinic for definitive diagnosis of OSA by polysomnography, however intra-operative and post-operative OSA precautions were taken in the management of all patients.

Conclusion:

The study was aimed to evaluate STOP-Bang score in predicting difficult mask ventilation and difficult intubation in obese patients in addition to conventional airway assessment tools (mouth opening, modified Mallampati grade, thyromental distance and neck movements). It was a observational study which included ASA grade 2 and 3 patients undergoing various surgeries under general anaesthesia.

We concluded that a high STOP-Bang score which is an OSA screening score is a good predictor of difficult mask ventilation. However, a high STOP-Bang score did not predict difficult laryngoscopy and this may be because of ramped position instead of sniffing position. Hence we strongly recommend to use ramped position by placing wedge under head and shoulder in such a way that external auditory meatus horizontally aligned with the sternal notch in all obese patients undergoing any surgery under general anaesthesia. It definitely helps in easing out laryngoscopy and intubation. One of the criteria of STOP-Bang score i.e. Neck circumference ≥ 40 cm has a direct association in predicting difficult airway (both mask ventilation as well as laryngoscopy). Literature also had showed it as an independent risk factor for difficult airway. we recommend measurement of neck circumference along with neck movements in the armamentarium of predictors of difficult airway. It is a simple test with very high predictive value. Among conventional airway assessment parameters, modified Mallampati grading has significant association with high STOP-Bang score, greater the Mallampati grading and STOP-Bang score, higher will be the difficulty in airway. We may also suggest that use of STOP-Bang score and modified Mallampati grade should be used together in obese patients for a better evaluation for anticipating difficult airway. However, further studies with larger study population may be required to validate the usefulness of the STOP-Bang score in predicting difficult airway among obese patients.

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