STOP-BANG SCORE AND MANDIBULOHYOID DISTANCE IN PREDICTION OF DIFFICULT AIRWAY IN PATIENTS WHO COME FOR ELECTIVE SURGERY REQUIRING ENDOTRACHEAL INTUBATION IN HOSPITAL USM

BY
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ABSTRAK (BM)

Pemarkahan STOP BANG dan Pengukuran Jarak Mandibulohyoid Dalam Meramalkan Kesukaran Laringoskopi Di Kalangan Pesakit Yang Datang Untuk Pembedahan Elektif Dan Memerlukan Intubasi Trakea Di Hospital USM.

Latar Belakang:

Pesakit OSA berkemungkinan untuk menghadapi kesukaran laringoskopi dan intubasi. Peramalan kesukaran laringoskopi sebelum menjalani pembiusan am akan dapat mengurangkan komplikasi pembiusan di kalangan pesakit yang mengalami OSA.

Tujuan:

Tujuan kajian ini adalah untuk mengenalpasti faktor-faktor yang mungkin wujud dalam meramalkan kesukaran laringoskopi dan intubasi di kalangan pesakit yang mengalami OSA (kombinasi atau tidak kombinasi, pemarkahan STOP-BANG dan pengukuran jarak mandibulohyoid dalam x ray) .

Kaedah:

Kajian ini dibuat melalui pemerhatian, secara prospektif, keratan lintang dengan 41 orang pesakit yang memenuhi kriteria pemilihan. Saringan dibuat dengan menggunakan soal selidik STOP-BANG,pesakit yang memenuhi >3 markah dipilih . Pengukuran jarak mandibulohyoid melalui gambar sinar-X leher dijalankan sebelum pembiusan am. Kesukaran laringoskopi dicatatkan semasa pembiusan am. Cormach Lehance grad 3 dan 4 ditetapkan sebagai kesusahan laryngoskopi. Kemudian keputusan pengukuran dan pencatatan dianalisa secara statistik.

Keputusan:

Didapati pemarkahan STOP-BANG , jarak mandibulohyoid (mm), index jisim badan, pengukuran lilitan leher (cm) dan pemarkahan Mallampati adalah lebih tinggi di kalangan pesakit yang berkemungkinan mengalami OSA. Pesakit yang besar kemungkinan mengalami OSA juga menghadapi kesukaran laringoskopi . Kita dapat mengesan perhubungan antara pemarkahan STOP-BANG dan pengukuran jarak mandibulohyoid dalam proses peramalan kesukaran laringoskopi . AUC (95% CI) ,0.86 (0.74,0.97). Untuk STOP BANG sahaja,sensitivity dan spesifikasi (85.71, 66.7% masing-masing).Untuk pengukuran jarak mandibulohyoid sahaja, sensitivity dan spesifikasi (77.8%, 69.6% masing-masing) . Kombinasi pemarkahan STOP-BANG dan pengukuran jarak mandibulohyoid telah menunjukkan peningkatan dari segi spesifikasi dan sensitiviti (77.3% and 84.2% masing-masing) dalam proses peramalan kesukaran laringoskopi.

Kesimpulan:

Pemarkahan STOP-BANG dan pengukuran jarak mandibulohyoid terbukti memainkan peranan penting dalam peramalan kesukaran laringoskopi di kalangan pesakit yang berkemungkinan mengalami OSA. Keberkesanan peramalan kesukaran laringoskopi adalah lebih tinggi apabila kombinasi pemarkahan STOP-BANG dan jarak mandibulohyoid(mm) telah digunakan dalam proses peramalan. Pesakit OSA mempunyai kemungkinan yang lebih besar untuk menghadapi kesukaran laringoskopi.

ABSTRACT (ENGLISH)

Background:

Incidence of difficult laryngoscopy and difficult intubation are higher among patients with obstructive sleep apnoea (OSA). Precision in making the diagnosis and predicting difficult laryngoscopy preoperatively may help to reduce anaesthetic complications. This study was designed to evaluate the diagnostic performance of combined and non-combined radiological parameter (mandibulohyoid distance) and STOP-BANG questionnaire as screening tool.

Methodology:

Total of Forty-one subjects who score >3 using STOP-BANG questionnaire screening were recruited during admission (STOP BANG score >3 indicate the subject at risk for OSA). Lateral cephalometry(lateral head and neck x ray) was done to measure for mandibulohyoid distance and other radiological parameters. Evaluation for difficult laryngoscopy was carried out during general anaesthesia. Cormarch Lehance view of grade 3 and 4 were considered as difficult intubation, grade 1 and grade 2 were considering not difficult intubation. Result analysed using multiple logistic regression to look for association between STOP-BANG score and mandibulohyoid distance with difficult intubation in OSA patients.

Result:

STOP-BANG score, mandibulohyoid distance (mm) , were higher in the OSA group. OSA patients had a higher incidence of difficult laryngoscopy and intubation. There was association between STOP-BANG score and mandibulohyoid distance with difficult intubation in OSA patients. AUC (95% CI) ,0.86 (0.74,0.97). In prediction of airway difficulty, for STOP BANG alone, sensitivity and specificity (85.71% ,66.7%

respectively), for mandibulohyoid alone , sensitivity and specificity(77.8%, 69.6% respectively). Combination of STOP-BANG score and mandibulohyoid distance had improved the specificity and sensitivity of the screening tool to predict difficult airway.(77.3% and 84.2% respectively).

Conclusion:

The STOP-BANG score and mandibulohyoid distance proved to be useful in the preoperative diagnosis of difficult laryngoscopy and intubation. The performance of the diagnostic tool improved when combined both STOP-BANG score and mandibulohyoid distance (mm) .OSA patients were more prone to difficult laryngoscopy.

ABBREVIATIONS

AHI	Apnea /hypopnea index
ASA	American Society of Anesthesiology
AUC	Area under curve
BMI	Body Mass Index
BP	Blood Pressure
ETT	Endotracheal tube
HUSM	Hospital Universiti Sains Malaysia
HR	Heart Rate
IV	Intravenous
MAC	Minimal alveolar concentration
MHD /MPH	Mandibulohyoid distance
OSA	Obstructive Sleep Apnea
SBP	Systolic Blood Pressure
SPSS	Statistical Package for the Social Science
STOP BANG	Name of the screening questionnaire
TOF	Train of four (neuromuscular monitoring)

1. INTRODUCTION

There is a strong association between difficult intubation and Obstructive Sleep Apnea (OSA). These are two major problems for anaesthetists, which may contribute to perioperative morbidity and mortality because both are associated with upper airway abnormalities(1). About 20% of Obstructive Sleep Apnea patient have difficult intubation according to a retrospective study published in International Anesthesia Research Society (2).

Obstructive Sleep Apnea (OSA) is a potentially serious sleep disorder in which breathing repeatedly stops and starts during sleep. It has a prevalence of 2% for women and 4% for men in the general population(3). For anesthetist, the significant feature of OSA is the occurrence of perioperative respiratory adverse events , whereas one major consequences of OSA is the risk of difficult intubation(4).

Despite the frequency of difficult intubation in the general surgical populations is not extremely high , poor management of difficult airways account for 35% of all anesthesia related death(5).

Previous studies have suggested that OSA patients are at higher risk of difficult intubation than are control patients(2, 6). For that reason, the identification of OSA patient during preoperative assessment would prevent adverse events(1). A recent study also showed that 69% of the surgical patients had OSA and while 60% of the patients with moderate to severe OSA were not diagnosed preoperatively by anesthetist(7). Therefore, the ASA recommended routine screening of OSA by anesthetist preoperatively.

The are several screening tools for OSA, the STOP-BANG questionnaire is the most easy to use and proven validity(8). Beside , STOP-BANG ≥3 also predictive of potential difficult airway(9). There is no single airway test can provide a high index of sensitivity and specificity for the prediction of difficult airway. Therefore, it has to be a combination of multiple tests(10).

Radiological methods of prediction of difficult airway by using lateral cephalometry may increase the sensitivity and specificity of the models in prediction of difficult airway. This idea was supported by two studies done previously(11, 12).

In this study, firstly, we would like to define the association between STOP-BANG score, cephalometry; secondly, to determine the social demographic , clinical measurement , STOP-BANG score and cephalometric measurement in predicting difficult intubation in patients with Obstructive Sleep Apnea . Thirdly, we would like to assess whether combination of STOP-BANG score and lateral cephalometry measurement (mandibulohyoid distance) will improved the sensitivity and specificity of the models in prediction of difficult airway. Difficult airway can be divided into three parts, difficult mask ventilation, difficult laryngoscopy and difficult intubation. In our study, we will be assessing difficult laryngoscopy as part of difficult airway.

1.2 OBJECTIVE OF THE STUDY

1.2.1 GENERAL OBJECTIVE

To determine the association of STOP-BANG scores, cephalometric measurement with difficult intubation in patients at risk of Obstructive Sleep Apnea who come for elective surgery requiring endotracheal intubation.

1.2.2 SPECIFIC OBJECTIVES

1. To compare STOP-BANG scores between patients at risk of Obstructive Sleep Apnea in difficult and easy laryngoscopy groups who come for elective surgery requiring endotracheal intubation.

2. To compare Mandibulohyoid distance (cephalometric measurements) between patients at risk of Obstructive Sleep Apnea in difficult and easy laryngoscopy groups who come for elective surgery requiring endotracheal intubation.

3. To determine the correlation of STOP-BANG score and Mandibulohyoid distance (cephalometric measurement)in predicting difficult airway in patients at risk of OSA .

4. To determine the social demographic , clinical measurement , in prediction of difficult laryngoscopy in patients at risk of Obstructive Sleep Apnea who come for elective surgery required endotracheal intubation.

2.0 BODY [MANUSCRIPT READY FOR SUBMISSION] CONTENT:

2.1 TITLE PAGE

2.1.1 ARTICLE TITLE

STOP-BANG SCORE AND MANDIBULOHYOID DISTANCE

IN PREDICTION OF DIFFICULT AIRWAY

IN PATIENT WHO COME FOR ELECTIVE SURGERY REQUIRING ENDOTRACHEAL INTUBATION IN HOSPITAL USM

2.1.2 RUNNING HEAD

STOP-BANG SCORE AND MANDIBULOHYOID DISTANCE

IN PREDICTION OF DIFFICULT AIRWAY

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2.2 MAIN DOCUMENT

STOP-BANG SCORE AND MANDIBULOHYOID DISTANCE IN PREDICTION OF DIFFICULT AIRWAY IN PATIENT WHO COME FOR ELECTIVE SURGERY REQUIRING ENDOTRACHEAL INTUBATION IN HOSPITAL USM

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***Keywords** : airway assessment , difficult airway, lateral cephalometry, predictive test ,mandibulohyoid distance*

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2.2.1 ABSTRACT (ENGLISH)

Background:

Incidence of difficult laryngoscopy and difficult intubation are higher among patients with obstructive sleep apnoea (OSA). Precision in making the diagnosis and predicting difficult laryngoscopy preoperatively may help to reduce anaesthetic complications. This study was designed to evaluate the diagnostic performance of combined and non-combined radiological parameter (mandibulohyoid distance) and STOP-BANG questionnaire as screening tool.

Methodology:

Total of Forty-one subjects who score >3 using STOP-BANG questionnaire screening were recruited during admission (STOP BANG score >3 indicate the subject at risk for OSA). Lateral cephalometry(lateral head and neck x ray) was done to measure for mandibulohyoid distance and other radiological parameters. Evaluation for difficult laryngoscopy was carried out during general anaesthesia. Cormarch Lehance view of grade 3 and 4 were considered as difficult intubation, grade 1 and grade 2 were considering not difficult intubation. Result analysed using multiple logistic regression to look for association between STOP-BANG score and mandibulohyoid distance with difficult intubation in OSA patients.

Result:

STOP-BANG score, mandibulohyoid distance (mm) , were higher in the OSA group. OSA patients had a higher incidence of difficult laryngoscopy and intubation. There was association between STOP-BANG score and mandibulohyoid distance with difficult intubation in OSA patients. AUC (95% CI) ,0.86 (0.74,0.97). In prediction of airway difficulty, for STOP BANG alone, sensitivity and specificity (85.71% ,66.7% respectively), for mandibulohyoid alone , sensitivity and specificity(77.8%, 69.6% respectively). Combination of STOP-BANG score and mandibulohyoid distance had improved the specificity and sensitivity of the screening tool to predict difficult airway.(77.3% and 84.2% respectively).

Conclusion:

The STOP-BANG score and mandibulohyoid distance proved to be useful in the preoperative diagnosis of difficult laryngoscopy and intubation. The performance of the diagnostic tool improved when combined both STOP-BANG score and mandibulohyoid distance (mm) .OSA patients were more prone to difficult laryngoscopy

2.2.2 INTRODUCTION

There is a strong association between difficult intubation and Obstructive Sleep Apnoea (OSA). These are two major problems for anaesthetist, which may contribute to perioperative morbidity and mortality because both are associated with upper airway abnormalities(1) . About 20% of Obstructive Sleep Apnoea patient have difficult intubation according to a retrospective study published in International Anesthesia Research Society(2) .

OSA is a potentially serious sleep disorder in which breathing repeatedly stops and starts during sleep. It has a prevalence of 2% for women and 4% for men in the general population(3). For anaesthetist, the significant feature of OSA is the occurrence of perioperative respiratory adverse events. One of the major concern is the risk of difficult intubation(4) .Even though difficult intubation do not occurs very commonly, poor management of difficult airways account for 35% of all anaesthesia related death(5) .

Previous studies suggested that OSA patients are at higher risk of difficult(2, 6). Thus the identification of OSA patient during preoperative assessment would prevent adverse events(1). A recent study showed that 69% of the surgical patients had OSA while 60% of the moderate to severe OSA were undiagnosed preoperatively. Therefore, the ASA recommended routine screening of OSA by anaesthetist preoperatively. There are several screening tools for OSA. The STOP BANG questionnaire is the easiest to use and has a proven validity(7) . A score of ≥3 predicts difficult airway(8) .

So far, there is no single airway test which can provide a high index of sensitivity and specificity for the prediction of difficult airway. A combination of multiple tests produced better predictive result(9) . Radiological methods by using lateral cephalometry (lateral head and neck x ray) may increase the sensitivity and specificity in prediction of difficult airway(10, 11).

2.2.3 METHODOLOGY

After approval obtained from Research Ethics Committee (Human) *(JEPeM)* of Universiti Sains Malaysia, 41 ASA class I and II patients, aged between 18 -to 75 year old, who undergone operation requiring general anaesthesia and fulfil the STOP-BANG score of $\geq$ 3 were chosen for this study.

A STOP-Bang score of $\geq$ 3 was chosen as it has a very high sensitivity and high negative predictive value for moderate to severe OSA, and had been suggested as a good cutoff value for high OSA prevalence among surgical populations such as bariatric patients (12).

Patients who were pregnant, not fasted for at least 6 hours, or those with GERD(gastric oesophageal reflux disease) were excluded. Written consents were obtained from all the patients before the study.

The patient's age, gender, ASA status (American Society of Anaesthesiologist classification of physical status, only I to IV), height, weight, BMI (body mass index), thyromental distance, and neck circumference, and modified Mallampati scores were recorded.

Modified Mallampati Test (Samsoon and Young) divides the visible airway structures into 4 classes:

→ Class I : the fauces, soft palate, the uvula and the anterior and posterior tonsillar pillars are visible.

→ Class II : all the class I structures are visible except for the tonsillar pillars.

→ Class III: only the base of the uvula is visible.

→ Class IV: the uvula cannot be seen and only the soft palate is visible.

After clinical assessment, Lateral Cephalometry (lateral head and neck x-ray) was taken in a neutral head position. Mandibular-hyoid distance was measured. Lateral head and neck x ray was not part of the standard pre-anaesthetics practice before elective surgery, but was taken for measurement of the mandibular hyoid distance in this study.

Patients were well fasted before the operation. No sedative premedication was given. Standard monitoring was applied before induction of anaesthesia. i.e. ECG, non-invasive blood pressure monitoring and a pulse oximeter.

Anaesthesia was performed by a skilled anaesthesiologist who was not the investigator for this study, and the cephalometric measurement and STOP-BANG scores of the patients**.** After preoxygenation, IV Fentanyl 1.5-2mcg per kg and IV Propofol 1-2mg per kg, were administrated in titration. 0.9 mg/kg IV Rocuronium (a muscle relaxant) was given after patient's loss of consciousness. When the state of, paralysis was achieved guided by TOF nerve stimulator, patient's head was placed in the sniffing position to facilitate intubation. Then a size 3 curved laryngoscopy was use to maximize the glottis exposure. Without pressing the thyroid cartilage, the airway was evaluated and graded following Cormack and Lehane's grading system:

→ Grade I is when the epiglottis and vocal cords are completely exposed.

→ Grade II is when only rear of the vocal cords can be seen.

→ Grade III is when only the epiglottis is exposed.

→ Grade IV is when only the soft palate can be seen.

The patient was subsequently intubated using videolaryngoscope and with appropriate-sized ETT.–After intubation, mechanical ventilation was conducted with volume control ventilation, at tidal volume of 8-9ml/kg IBW, rate of 12 breaths per minute. Anaesthesia was maintained with inhalational agent Sevoflurane with the MAC of 1. After operation, all patients were reversed using Sugammadex.

The Statistical Package for the Social Sciences (SPSS) version 22 software (with valid license for the institution) was used for data entry and analysis. Group A for whom the intubation is easy, is limited to the patients with a Cormack Lehance grade of 1 and 2 Group B for whom the intubation is difficult would comprise of patients given a Cormack Lehance grade of 3 and grade 4. All of the values are shown as mean ± SDs and as percentages. Independent sample t-test , cross-tabulation and chi square test were used to compare the two groups. A comprehensive evaluation is done by binary logistic regression analysis and a multivariate test to see the effects of each independent variable on the dependent variables.$P<0.05$ is considered statistically significant.

2.2.4 RESULT

We evaluated 41 patients, participants characteristics were evenly distributed, 22(53.7%) are females and 19(46.3%) are males. Difficult laryngoscopy was observed in 21 of 41 patients. STOP-BANGs score , mandibulohyoid distance , age, BMI, neck circumference, Mallampati, height, weight, submandibular angle and mandibular angle were checked for normality by using histogram, all are approximately to normal distribution.

The incidence of difficult intubation was 51.22% for patient at risk of OSA. The distribution of participants based on Cormack-Lehane grading system was shown in table 5.7 , 13 participants(31.75) were graded Class I, 7 participants(17.1%) in Class II, 16 participants (39%) in Class III and only 5 participants(12.2%) has Class IV laryngeal view. Cormach –Lehane class III and classes IV were considered difficult laryngoscopy.

By using STOP-BANG score model alone, out of 41 participants, 14 (34.2%) participants were forecasted to be difficult and 27 (65.9%) participants were deemed easy. The area under the curve covered was 0.81 (0.68,0.95), AUC(95%CI) as shown in figure 5.3. Tables 5.4 showed the diagnostic values of STOP BANG score, sensitivity was 85.7% and specificity was 66.7%. Positive likelihood ratio from the study was only 2.57 with a false positive rate of 33.4%. The false negative rate was in this study was as much as 14.3%. Accuracy was only 73.2%. The diagnostic odd ratio was marginally adequate at 3.46.

By using Mandibulohyoid distance (mm) model alone, out of the total 41 participants18 (43.9%) participants were forecasted to be difficult and 23 (56.1%)

participants were deemed easy. The area under the curve covered 0.79 (0.64,0.94) ,AUC(95% CI) as shown in figure 5.5. Tables 5.6 showed the diagnostic values of mandibulohyoid distance (mm), sensitivity was 77.8% and specificity was 69.6%. Positive likelihood ratio from the study was only 2.56 with a false positive rate of 22.2%. The false negative rate was in this study was as much as 30.4%. Accuracy was only 73.2%. The diagnostic odd ratio was marginally adequate at 1.26.

When combined STOP-BANG score and Mandibulohyoid distance (mm) model was used, Out of the total 41 participants 19 (46.3%) participants were forecasted to be difficult and 22 (53.7%) participants were deemed easy. The area under the curve covered was 0.86 (0.74,0.97) ,AUC(95%CI) as shown in figure 5.7. Table 5.7 showed the diagnostic values of STOP BANG score and mandibulohyoid distance (mm), sensitivity was 84.2% and specificity was 77.3%. Positive likelihood ratio from the study was only 3.71 with a false positive rate of 15.8%. The false negative rate was in this study was as much as 22.7%. Accuracy was only 80.5%.

A simple logistic regression analysis was done on patient characteristics to look for their association with difficulty laryngoscopy. The results were shown on table 5.13. The BMI, weight, neck circumference, mallampati score had significant association with difficult laryngoscopy. The age, height and gender were not a significant predictor for difficulties of laryngoscopy.

By using Independent t test, Table 5.3 showed that Mandibulohyoid distance was significant larger in difficult laryngoscopy group (25.60+/- 5.46 mm) as compared to easy laryngoscopy group (19.95+/- 4.28 mm) , p value = 0.001. STOP-BANG score was also statistically higher in difficult laryngoscopy group(5.76+/- 1.14) compare to easy laryngoscopy group(4.40+/- 0.94), p value = <0.001.

Associated factors of difficult laryngoscopy by univariable and multiple logistic regression models were showed in Table 5.9. Similar analyses were done on participant's characteristics to evaluate their association with STOP BANG score and Mandibulohyoid distance. None of them were found to be confounding factors. STOP BANG score and mandibulohyoid distance were likely to be independent factor to difficult laryngoscopy.

Correlation between STOP-BANG score and mandibulohyoid distance (mm) was tested using Pearson correlation test (r = 0.421 with p value= 0.006.)

2.2.5 DISCUSSION

Our aim of the study was to develop more predictive models for difficulty in laryngoscopic intubation in patient at risk of obstructive sleep apnoea (OSA). Many assessment criteria had been incorporated, but do not consistently produce accurate evaluation of the risk of failed intubation (13, 14). Direct laryngoscopy is the gold standard for tracheal intubation. There is no single definition of difficult intubation. Difficult glottic view on direct laryngoscopy is the most common cause of difficult intubation. Therefore our study outcome was based on difficult laryngoscopy with vocal cord visualization.

Our study major findings were STOP-BANGs score alone had a good sensitivity, and accuracy to predict difficult airway. However, with combined STOP-BANG score and mandibulohyoid distance (mm), the overall diagnostic performance had improved.

The study found that age, height and gender did not show significant differences between the easy laryngoscopy and difficult laryngoscopy group. On the other hand, BMI and weight had shown to have significant differences between the easy laryngoscopy and difficult laryngoscopy groups, these were correlating with the previous study(2) . Mallampati classification has been reported to be a good predictor by many but found to be of limited value by others (15-19). An important factor in achieving a reliable score for Mallampati classification is ensuring that the patient opens the mouth and protrudes the tongue maximally. Failure to do this is a major pitfall when performing the assessment. Mallampati class may be affected if the patient inadvertently phonates during the assessment(20). Our study findings' where mallampati had significant value in predicting difficult laryngoscopy, also consistent with findings shown in study done in 13380 obstetric patients (21). A recorded mallampati score and score > 1 was still a significant independent predictor for difficult airway in obstetric population(22) .However, Modified Mallampati score was inadequate as a stand-alone test of difficult laryngoscopy or tracheal intubation(23, 24) .Neck circumference had great influence in laryngoscopy, the greater it is , the higher the score by Cormack Lehane classification(14) . This finding was comparable to our study result.

We also found that the diagnostic performance of combined model was characteristically better than STOP BANG score model alone and Mandibulohyoid distance (mm) alone. It showed that specificity and sensitivity of each test is not perfect, but when we used these tests together, specificity and sensitivity will increase (24).

The STOP-BANG questionnaire appears to promise a good diagnostic performance in predicting difficult laryngoscopy. In the study, it showed high sensitivity and high accuracy and reasonable specificity. STOP-BANG questionnaire is quite easy to use, very cost effective. The severity of OSA increases linearly as the score increases from 3 to 8(12) . Our study findings were consistent with this. From practical point of view, we were actually killing two birds with one stone, by using the STOP-BANG questionnaire; we were detecting OSA and predicting possibility of difficult laryngoscopy .False positive rate was slight higher and the positive likelihood ration is slightly lower. To improve the quality of it diagnostic performance, we decided to combine another parameter with diagnostic value.

Cephalometry has provided us substantial insight into the pathophysiology of OSA, identifying the most significant craniofacial characteristics associated with this disease. The increased in Mandibulohyoid distance (mm) was found to be significantly associated with large neck circumference and therefore OSA. Studies on lateral cephalometry on OSA patient showed that, there was association between changes of mandibulohyoid distance (mm) with difficult laryngoscopy and tracheal intubation. It showed that increased in mandibulohyoid distance in OSA patient has increased risk of difficult laryngoscopy(10) .Therefore, we decided to combine STOP BANG score and Mandibulohyoid distance to form a screening tool The finding was, the sensitivity remained relatively unchanged i.e. >80%. However, there was a significant improvement in specificity as much as 10 %. Accuracy had increased as much as 7% to 80.5%. Nevertheless, the positive likelihood ratio, had increased from 2.5 to 3.7. The positive predictive value had increased from 57% to 79%, whereas the negative predictive value remained static. There was also reduction in false positive rate about 50% from the initial value (33% to 15%). Overall, the diagnostic performance of the new model which combined STOP BANG score and MHD (mm) had improved compared to STOP BANG score alone.

The measurement of the radiographic parameters are electronically done, it does not depend on the skill of assessor thus preventing inter assessor variability. Our experience noted the mandibulohyoid distance (mm) was easily measured electronically on a computerized radiographic system such as the picture archiving and communicating system (PACS) used in this institution. Results were accurate and could easily be retrieved for re-examination. In addition, a single cephalometry has the benefits of revealing other radiographic parameters.

The mandibulohyoid distance technique, however, is limited by the need of the lateral cephalometry. Risk of additional ionizing radiation is always a consideration. According to the biological Effects of Ionizing radiation Committee VII (BEIR VII) reports, the risk of cancer death is 0.8% per rem doses of radiation received acutely and 0.04% per rem for doses received over a long period. The amount of radiation from a lateral cephalometry is 1.1 to 1.7 mSV(25) . Since 1 rem equals to 10mSV, therefore the risk of developing a fatal cancer from a single exposure from lateral cephalometry is only very minimal. Clearly the benefits of a single exposure of cephalometry with the aim of assessing ease of laryngoscopy outweighed the risk, given the risk of death from difficult airway management was as high as 40%.

In this study there were some limitations, Cormach Lehance grading system as outcome measure may not be as accurate as other classification system such as ASA Intubation Difficult score, repeated Intubation Attempt, Cook's grading system. The grading system is operator dependent. Difficult mask ventilation was not assessed in our study, and yet it is part of the predictor of difficult intubation. The present study only involved patients who were at risk of obstructive sleep apnoea, therefore, the predictive value of difficult airway may not be practical in general population. The sample size of 41 candidates was a bit small, a larger population study is vital to validate results. This study, attempts to direct the course of a larger work, and also hopes to fill the lacunae which currently exist where airway management in HUSM Operation room is concerned. Factors such as duration of laryngoscopy attempts, the number, and seniority of airway managers involved, though described as markers of difficult intubation, have not been included in this study because of their many confounding factors. These may, however be assessed in further studies. The study was conducted in an institution with patients who are mainly Asian. This group of patients are known to have higher incidence of difficult laryngoscopy. Therefore, it may not representative of other population worldwide .In order to obtain a diagnosis of OSA and Apnoea- hypopnoea index, sleep study must be performed prior to operation for all the participants. STOP-BANG score may not be as accurate as sleep study as the indicators of severity of obstructive sleep apnoea. STOP-BANG score may not discriminate those patients in whom difficult laryngoscopy is caused by limited head and neck mobility in the OSA patients. This cannot be detected using both STOP-BANG score and mandibulohyoid distance.

2.2.7 CONCLUSION

Mandibulohyoid distance and STOP-BANG score have significant association in predicting of difficult laryngoscopy.

A conclusion could be drawn that the combined STOP-BANG score and Mandibulohyoid distance (mm) can improved the overall diagnostic performance of the model to predict difficult laryngoscopy. This model had high sensitivity, higher specificity, higher accuracy, higher positive predictive value and negative predictive value, higher positive likelihood ratio, and lower false positive rate when compared to STOP-BANG score alone as a screening model.

The technique provides relatively easy, reproducible and objective judgement that assessor can safely trust in order to make decision on patient's ease of laryngoscopy.

The technique is limited only by the need of a lateral cephalometry, which subject patient to additional ionizing radiation but the benefits of a conclusive test as such may outweigh the risk that was evidently found to be low.

This study confirmed that incidence of difficult laryngoscopy in OSA patients is not negligible and suggest the use combined STOP-BANG score and mandibulohyoid distance (mm) as a predictive score to improve patient safety.

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2.2.7 FIGURE FOR MANUSCRIPT

The Cormack-Lehane Classification

Class I =
Visualization of the entire laryngeal aperture

Class II =
Visualization of parts of the laryngeal aperture or the arytenoids

Class III =
No part of the glottis can be seen except the epiglottis

Class IV =
Not even the epiglottis can be seen

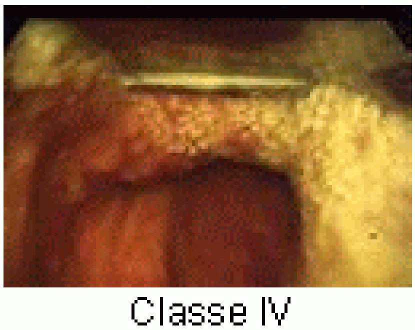

Figure 1 The Cormack-Lehane Classification

Modified Mallampati Classification

Class I =
soft palate, fauces, uvula
and pillars seen

Class II =
soft palate, fauces, and
uvula seen

Class III =
soft palate and base of
uvula seen

Class IV =
soft palate not visible

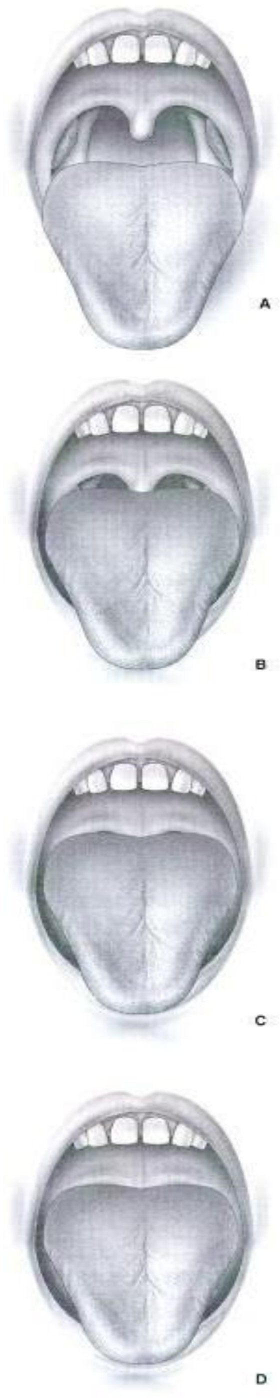

Figure 2 The Modified Mallampati Classification

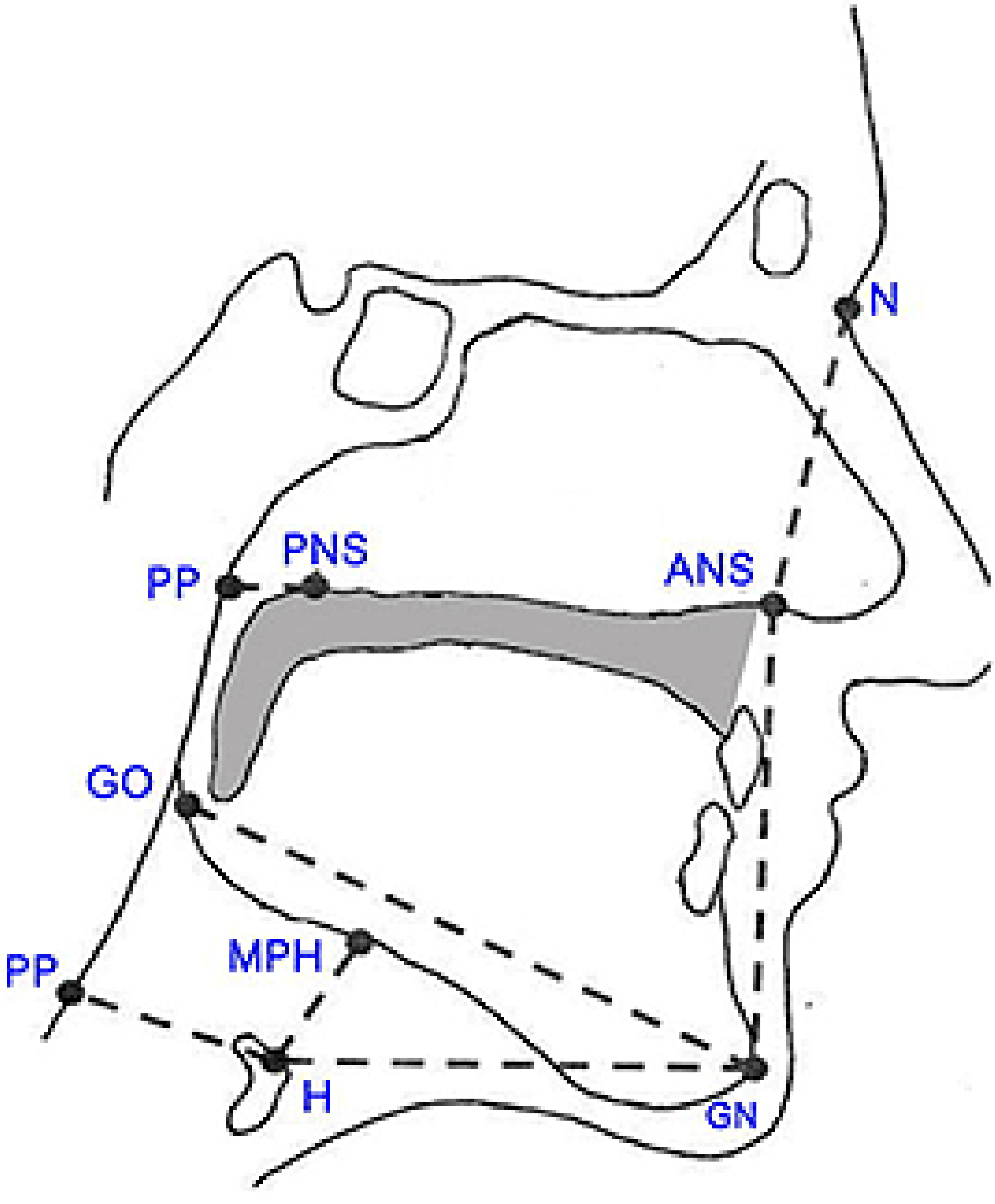

Figure 3 The diagram of Lateral Cephalometry, MPH (Mandibulohyoid distance in mm)

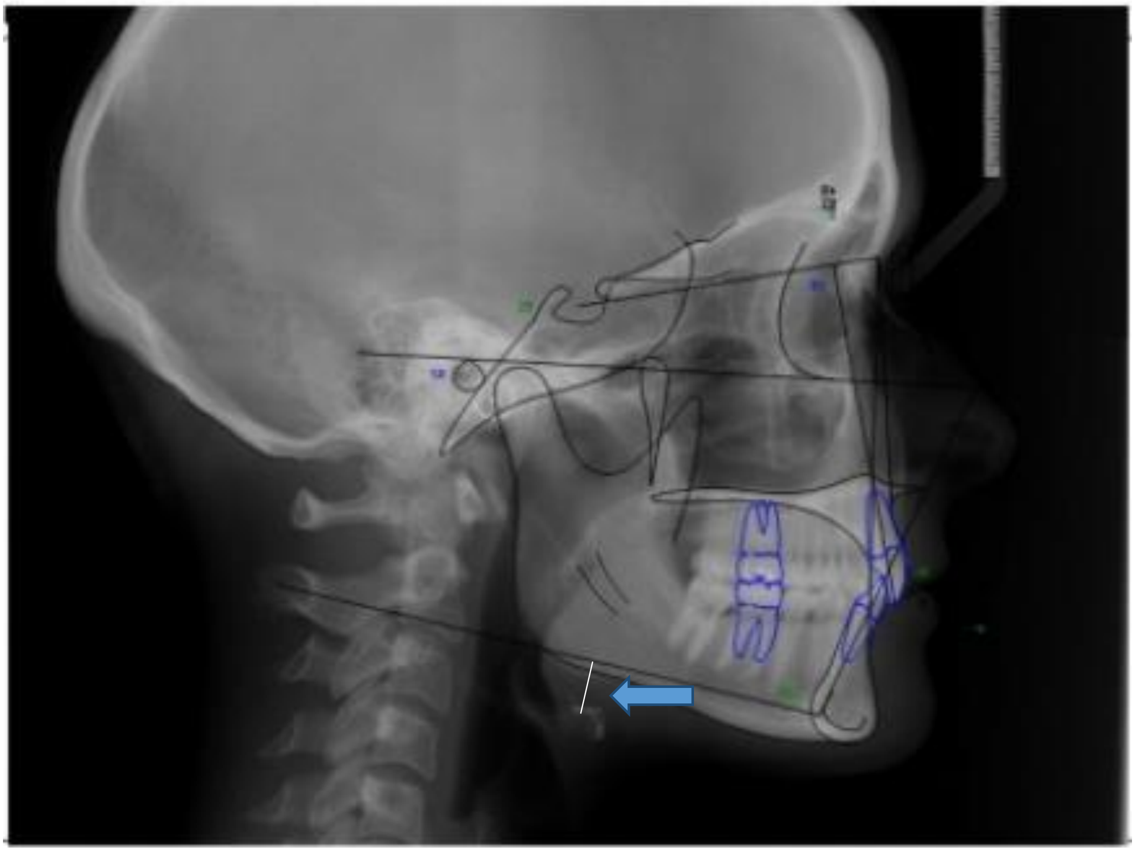

Figure 4 The Lateral Cephalometry, MPH (Mandibulohyoid distance in mm) arrow.