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Sumidtra Prathep (prathepsumidtra@gmail.com)
Prince of Songkla University
Wilasinee Jitpakdee
Prince of Songkla University
Wisara Woraathasin
Prince of Songkla University
Maliwan Oofuvong
Prince of Songkla University

Research Article

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Sumidtra Prathep MD, Wilasinee Jitpakdee MD, Wisara Woraathasin, Maliwan Oofuvong MD
Department of Anesthesiology, Faculty of Medicine, Songklanagarind Hospital, Prince of Songkla University, Songkhla, Thailand

Please direct all correspondence to:

Sumidtra Prathep, M.D.
Department of Anesthesiology, Faculty of Medicine
Prince of Songkla University
15 Kanjanavanich Road
Hat Yai, Songkhla 90110
E-mail: prathepsumidtra@gmail.com
Phone: (+66) 088-752-3423
Office: (+66) 074-451-651
Fax: (+66) 074-429-621

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Abstract

Background: In morbidly obese patients, airway management is challenging since the incidence of difficult intubation is 3 times that in normal patient. Standard preoperative airway evaluation may help to indicate for probability of difficult laryngoscopy. Recent studies have used ultrasonography-measured distance from skin to epiglottis and pretracheal soft tissue at the level of vocal cords, and cut-points of 27.5 mm and 28 mm respectively, to predict difficult laryngoscopy. The purpose of this study is to use ultrasonography-measured distance from skin to epiglottis for predicting difficult laryngoscopy in morbidly obese Thai patients.

Methods: This prospective observational study was approved by the Ethics Committee of the Faculty of Medicine, Prince of Songkla University. Data were collected from January 2018 to August 2020. Eighty-eight morbidly obese patients (BMI $\geq$ 35 kg/m^2) requiring general anesthesia with endotracheal intubation for elective surgery in Songklanagarind Hospital were enrolled. Preoperatively, anesthesiologists or nurse anesthetists who were not involved with intubating the patients evaluated and recorded measurements (body mass index, neck circumference, inter incisor gap, sternomental distance, thyromental distance, modified Mallampati scoring, upper lip bite test, and distance from skin to epiglottis by ultrasound. The laryngoscopic view was graded on the Cormack and Lehane scale.

Results: Mean BMI of the eighty-eight patients was 45.3 ± 7.6 kg/m^2. The incidence of difficult laryngoscopy was 14.8%. Univariate analysis for difficult laryngoscopy indicated differences in thyromental distance, sternomental distance and the distance from skin to epiglottis by ultrasonography. The median (IQR) of thyromental distance in difficult laryngoscopy was 6.5 (6.3, 8.0) cm compared with 7.5(7.0, 8.0) cm in easy laryngoscopy (p-value 0.03). The median (IQR) of sternomental distance in difficult laryngoscopy was 16.8 (15.2, 18.0) cm compared with 16.0 (14.5, 16.0) cm in easy laryngoscopy (p-value 0.05). The mean distance from skin to epiglottis was 12.2 ± 3.3 mm Mean of distance from skin to epiglottis in difficult laryngoscopy was 12.5 ± 3.3 mm compared with 10.6 ± 2.9 mm in easy laryngoscopy (p-value 0.05). Multivariate logistic regression indicated the following factors associated with difficult laryngoscopy: age more than 43 years (A), thyromental distance more than 68 mm(B) and the distance from skin to epiglottis more than 13 mm(C). The scores to predict difficult laryngoscopy was calculated as 8A+7B+6C. One point is given for A if age was more than 43

years old, 1 point is given for B if thyromental distance was less than 6.8 cm and 1 point is given for C if the distance from skin to epiglottis by ultrasonography was more than 13.0 cm. The maximum predicting score is 21, which indicates a probability of difficult laryngoscopy among our patients of 36.36%, odds 0.57, likelihood ratio 3.29 and area under the ROC curve of 0.78.
Conclusions: Age, thyromental distance and ultrasonography for the distance from skin and epiglottis can predict difficult laryngoscopy among obese Thai patients. The predictive score indicates the probability of difficult laryngoscopy.

Introduction

Nowadays, the prevalence of obesity among patients is increasing. Anesthesiologists have to provide general anesthesia in obese patients. Shiga et al[1] showed that the incidence of difficult intubation in obese patients was three times that in normal patients. Obese patients typically have increased amount of adipose tissue deposits in the oral and pharyngeal tissues which decreases the size of airway and changes the shape of the oropharynx[2]. Furthermore, the patients have short and thick neck that contributes to developing airway obstruction and increases the expectation that it will be more difficult to perform direct laryngoscopy for endotracheal intubation under general anesthesia. In addition, obese patients have increased oxygen demand, decreased vital capacity, expiratory reserve volume, inspiratory capacity and functional residual capacity, and both low lung compliance and low respiratory system compliance, resulting in the patients being prone to rapid oxygen desaturation and respiratory complication.[3,4,5,6] As a result, they may have hypoxemia, brain damage and death afterwards[7].

Standard preoperative airway evaluation may help indicate the probability of difficult laryngoscopy. Honarmand, et al.[8] reported that the sensitivities of the modified Mallampati scoring, upper lip bite test, and thyromental distance were 62.5%, 48.86% and 37.5%, respectively. Brodsky et al.[9] and Gonazlez et al.[10] showed that difficult intubation is associated with Mallampati score more than 3 and increasing neck circumference. Moreover, Horner et al[2] found that patients with obstructive sleep apnea syndrome have more fat deposited at the collapsible segment of the pharynx.

Recent studies have used ultrasonography-measured distance from skin to epiglottis[11] and pre-tracheal soft tissue at the level of vocal cords[12], and cut-points of 27.5 mm and 28 mm respectively, to predict difficult laryngoscopy. Thus, the purpose of this study is to use ultrasonography-measured distance from skin to epiglottis for predicting difficult laryngoscopy in morbidly obese Thai patients.

Materials and Methods

Study design

A prospective observational study was approved by the Office of Human Research Ethics Committee, Faculty of Medicine, Prince of Songkla University, Thailand on 17th October 2017 (REC 60-184-08-1), clinicaltrial.gov number TCTR20171226001 on 26th December 2017. Informed consent was were obtained from all participants in the study.

Setting and Population

The data were collected from January 2018 to August 2020 at Songklanagarind Hospital, Thailand. Inclusion criteria were morbidly obese patient (BMI $\geq$ 35 kg/m^2), age between 18-80 years , American Society of Anesthesiologists Physical Status (ASA) class II– III, and requiring general anesthesia with endotracheal intubation for elective surgery in Songklanagarind Hospital. Patients were excluded if they had abnormalities of face or throat or oral cavity, maxillofacial abnormalities, cervical spine injury or cervical disease, or head and neck tumor. Patients who were pregnant, who had tracheostomy tubes, or who were unable to give consent were also excluded. The CONSORT diagram is shown as Figure 1.

Study Protocol

Prior to data collection, two co-investigators were trained to use ultrasound for performing difficult airway clinical screening tests. Airway ultrasound experience was obtained through additional bedside scanning and reviewing journal articles and images.

Preoperatively, anesthesiologists or nurse anaesthetists who were not involved with intubating the patients evaluated and recorded measurements (body mass index, neck circumference, inter incisor gap, sternomental distance, thyromental distance, modified Mallampati scoring, upper lip bite test, and distance from skin to epiglottis by ultrasound) and medical history (snoring, diagnosis of obstructive sleep apnea syndrome). To obtain the ultrasonography-measured distance from skin to epiglottis at the thyrohyoid membrane level in transverse plane as Figure 2, participants were placed supine with head and neck in neutral position without a pillow. The Philips Lumify linear array transducer (L12-4,12-4 MHz) was used in this study.

On the day of surgery, the participants were monitored with standard American Society of Anesthesiologists monitors and measurement of end tidal carbon dioxide. Preoxygenation was conducted by administering 100% oxygen via a tight anaesthetic facemask for more than 3 minutes. Attending anaesthesiologists could make decisions of any anaesthetic agents by themselves. The endotracheal intubations were performed using conventional McIntosh laryngoscope by experienced anaesthesiologists who had worked in the operating theater for at least two years. The grade of laryngoscopic view was recorded by anaesthesiologists who performed the endotracheal intubation. The laryngoscopic view was graded on the Cormack and Lehane scale[13] as grade I = full view of the glottis, grade II = partial view of the glottis, grade III = only epiglottis visible, and grade IV = neither epiglottis nor epiglottis visible. The laryngoscopic view, duration of intubation, and number of tracheal intubation attempts were recorded. A Cormack-Lehane grade 1 or 2 was categorized as an easy laryngoscopy, and a grade 3 or 4 was categorized as a difficult laryngoscopy. If the anaesthesiologist could not complete the intubation within two times with conventional Mcintosh laryngoscope, then they were allowed to manage according to practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway 2013[14].

Statistical analysis

The sample size was calculated using this formula for comparison of two independent means:

$$\boldsymbol{n_1} = \frac{(\boldsymbol{z_{1-\frac{\alpha}{2}}} + \boldsymbol{z_{1-\beta}})^2[\boldsymbol{\sigma_1^2} + \frac{\boldsymbol{\sigma_2^2}}{\boldsymbol{r}}]}{\Delta^2}$$

$$\boldsymbol{r} = \frac{\boldsymbol{n_2}}{\boldsymbol{n_1}}$$

$$\Delta = \boldsymbol{\mu_1} - \boldsymbol{\mu_2}$$

$$n_{sen} = \frac{z^2{}_{\frac{\alpha}{2}}\, P(1-P)}{d^2}$$

$$n_{total} = \frac{n_{sen}}{incidence}$$

This study used the referent data reported by Ezri T et al.[12] to calculate simple size. Where

μ_1 was 28

μ_2 was 17.50

σ_1 was 2.7

σ_2 was 1.8

Ratio(r) $= \frac{n_2}{n_1} = 10.00$

$Z_{1-\frac{\alpha}{2}}$ was 95% confidence interval = 1.96

Z_β was type II error (β = 0.200) = 0.84

Q was 1-p = 0.1

$Z_{\frac{\alpha}{2}}$ was 1.96

P was 0.9

d was 0.135

then

$n_{sen} = 19$

As the incidence of laryngoscopic view grade 3, 4 in obese patient was 22%.

$$\frac{n_{sen}}{0.22} = \frac{19}{0.22} = 87$$

The number of patients required for this study was 87.

Statistical analysis was performed using the STATA software. The Shapiro-Wilk normality test was used to assess the normality of continuous variables. Continuous variables were presented as mean and standard deviation (SD). Categorical variables were presented as number of patients and percentages. Continuous variables were analyzed by t-test or Wilcoxon rank sum test. Categorical variables were compared using Fisher's exact test or Pearson's Chi-square test. P-value less than 0.05 was considered as statistically significant. Kernel density estimation was used to explore the probability distribution of potential predictors of easy laryngoscopy and difficult laryngoscopy. Logistic regression was used to identify airway parameters associated with difficult laryngoscopy. From the best-fitting but parsimonious model, a predictive difficult laryngoscopy score was constructed. An integer weighting score was allocated to each predictive variable in the model such that the ratios among the scores were close to the ratios among the logistic coefficients. The summation of these weighting scores in each patient was used as the predictive score for difficult laryngoscopy. An ROC curve was constructed and used to determine suitable cut points that could be used to reflect the different probabilities of having difficult intubation.

Results

Ninety-three patients were enrolled into the study from January 2018 to August 2020. Three patients were excluded because attending anesthesiologists predicted they may have difficult endotracheal intubation. In addition, two patients were excluded owing to cancellation of the operation. Hence, data from eighty-eight patients were available for the analysis. Patient demographic data are shown in Table 1. BMI (mean ± SD) of the eighty-eight patients was 45.3 ± 7.6 kg/m^2(minimum BMI = 35.09 kg/m^2, maximum BMI = 69.79 kg/m^2).

The incidence of difficult laryngoscopy was 14.8%. The median (IQR) of thyromental distance in difficult laryngoscopy was 6.5 (6.3,8.0) cm compared with 7.5 (7.0,8.0) cm in easy laryngoscopy (p-value 0.03). The median (IQR) of sternomental distance in difficult laryngoscopy was 16.8 (15.2,18.0) cm compared with 16.0 (14.5,16.0) cm in easy laryngoscopy (p-value 0.05). The mean distance from skin to epiglottis was 12.2 ± 3.3 mm. Mean of distance from skin to epiglottis in difficult laryngoscopy was 12.5 ± 3.3 mm compared with 10.6 ± 2.9 mm in easy laryngoscopy (p-value 0.05). The values are shown in Table 2. There was no different significance in BMI, severity of OSA, modified Mallampati score, thyromental distance, interincisor gap, upper lip bite test, or neck circumference between easy and difficult laryngoscopy.

Multivariate logistic regression associated with difficult laryngoscopy consisted of age more than 43 years, thyromental distance more than 68 mm, and distance from skin to epiglottis more than 13 mm are shown in Table 3. Allocated weights to contribute to the predictive score are also shown in the table.

The scores to predict difficult laryngoscopy was calculated as 8A+7B+6C. One point is given for A if age was more than 43 years old, 1 point is given for B if thyromental distance was less than 6.8 cm and 1 point is given for C if the distance from skin to epiglottis by ultrasonography was more than 13.0 cm. The scores, probability, odds and likelihood ratio are shown in Table 4. The maximum predicting score is 21, which indicates a probability of difficult laryngoscopy among our patients of 36.36%, odds 0.57, likelihood ratio 3.29 and area under the ROC curve of 0.78 in Figure 3.

Discussion

The prediction of difficulty airway has low sensitivity and specificity[13]. The anaesthesiologists always need to prepare for difficult ventilation and intubation especially in morbid patients. Hypoxic arrest is the worst complication which can be happened if we cannot secure the patients' airway even we follow the guidelines of Difficult Airway Society Guidelines (DAS)[14] and Practice guidelines for management of the difficult airway reported by American Society of Anesthesiologists(ASA).[15] Kopanaki et al.[16] and Prakash et al.[17] found that sternomental distance was one of conventional parameters of airway assessment to predict difficult laryngoscopy among obese patients. We found that thyromental distance and sternomental distance predicted difficult laryngoscopy among obese Thai patients.

Obese patients typically have increased amount of adipose tissue deposit into oral and pharyngeal tissues that decreases the size of airway and changes the shape of the oropharynx.[2] Furthermore, the patients have short and thick neck that contributes to developing airway obstruction and increases the expectation that it will be more difficult to perform direct laryngoscopy for endotracheal intubation under general anaesthesia. Gonzalez et al[10] found that the difficult tracheal intubation is more frequent in obese than lean patients (14.3% vs 3%; p 0.03) similar to our study, which found that the incidence of difficult laryngoscopy was 14.8% among obese patients.

Ultrasound airway can play a role to provide us with an idea of the airway structure before we intubate the patients. Many parameters are used to predict how difficult of the intubation[131819]. Recent studies have used ultrasonography-measured distance from skin to epiglottis[11] and pre-tracheal soft tissue at the level of vocal cords[12], and cut-points of 27.5 mm and 28 mm respectively, to predict difficult laryngoscopy. However, Asian figures are likely to be different from Caucasians'. We found the distance between skin and epiglottis more than 13 mm can predict difficult laryngoscopy among obese Thai population.

We combined the conventional airway assessment and the parameter of the ultrasound airway for giving more information before intubation. Thyromental distance, sternomental distance and the distance between the skin and epiglottis are the parameters that showed significant differences between easy and difficult laryngoscopy among obese Thai patients in univariate logistic regression. Multivariate logistic regression revealed that the factors associated with difficult laryngoscopy consisted of age more than 43 years, thyromental distance more than 68 mm, and the distance from skin to epiglottis more than 13 mm. We calculated the score to predict difficult laryngoscopy using these parameters to indicate the probability and odds of difficult laryngoscopy, and the likelihood ratio for each value of the score. The good discriminating ability of the model was shown by the area under the ROC curve of ROC 0.77.

Conclusions

Age, thyromental distance and ultrasonography for the distance from skin and epiglottis can predict difficult laryngoscopy among obese Thai patients. The predicting scores showed the probability of difficult laryngoscopy.

Limitations

First, this is a single center study collecting data in Thailand. If we perform multicenter study in Asia, we may have the data in Asian population. Second, the airway ultrasound is new for the anaesthesiologists. They need to practice in non-obese patients as well.

Declarations

Abbreviations

ASA = American Society of Anesthesiology

BMI = Body Mass Index

CI = Confident Interval

DAS = Difficult Airway Society

IQR = Interquartile Range

OSA = Obstructive Sleep Apnea

SD = Standard Deviation

Ethics approval and consent to participate

This study was approved by the Office of Human Research Ethics Committee, Faculty of Medicine, Prince of Songkla University, Thailand on 17th October 2017 (REC 60-184-08-1), clinicaltrial.gov number TCTR20171226001 on 26th December 2017. All method were carried out in accordance with Declaration of Helsinki.

Consent for publication

Not Applicable

Availability of data and material

The datasets used and/or analyzed during the current study available form the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors'contributions

SP and WJ have given substantial contributions to the conception or the design of the manuscript.

SP, WJ, WW and MO have data collection.

SP and WJ to acquisition, analysis and interpretation of the data.

All authors have participated to drafting the manuscript, author A revised it critically.

All authors read and approved the final version of the manuscript.

All authors contributed equally to the manuscript and read and approved the final version of the manuscript.

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References

1. Shiga T, Wajima Z, Inoue T, Sakamoto A. Predicting difficult intubation in apparently normal patients: a meta-analysis of bedside screening test performance. *Anesthesiology* 2005; **103**: 429–37

2. Horner RL, Mohiaddin RH, Lowell DG, et al. Sites and sizes of fat deposits around the pharynx in obese patients with obstructive sleep apnoea and weight matched controls. *Eur Respir J* 1989; **2**: 613–22

3. Parameswaran K, Todd DC, Soth M. Altered respiratory physiology in obesity. *Can Respir J* 2006; **13**: 203–10

4. Yap JC, Watson RA, Gilbey S, Pride NB. Effects of posture on respiratory mechanics in obesity. *J Appl Physiol (1985)* 1995; **79**: 1199–205

5. Naimark A, Cherniack RM. Compliance of the respiratory system and its components in health and obesity. *J Appl Physiol* 1960; **15**: 377–82

6. Porhomayon J, Papadakos P, Singh A, Nader ND. Alteration in respiratory physiology in obesity for anesthesia-critical care physician. *HSR Proc Intensive Care Cardiovasc Anesth* 2011; **3**: 109–18

7. Cook TM, Woodall N, Frerk C. Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the

Difficult Airway Society. Part 1: Anaesthesia. *British Journal of Anaesthesia* [Internet] 2011 [cited 2020 Aug 2]; **106**: 617–31

8. Honarmand A, Safavi M, Yaraghi A, Attari M, Khazaei M, Zamani M. Comparison of five methods in predicting difficult laryngoscopy: Neck circumference, neck circumference to thyromental distance ratio, the ratio of height to thyromental distance, upper lip bite test and Mallampati test. *Adv Biomed Res* 2015; **4**: 122

9. Brodsky JB, Lemmens HJM, Brock-Utne JG, Vierra M, Saidman LJ. Morbid obesity and tracheal intubation. *Anesth Analg* 2002; **94**: 732–6

10. Gonzalez H, Minville V, Delanoue K, Mazerolles M, Concina D, Fourcade O. The importance of increased neck circumference to intubation difficulties in obese patients. *Anesth Analg* 2008; **106**: 1132–6, table of contents

11. Pinto J, Cordeiro L, Pereira C, Gama R, Fernandes HL, Assunção J. Predicting difficult laryngoscopy using ultrasound measurement of distance from skin to epiglottis. *J Crit Care* 2016; **33**: 26–31

12. Ezri T, Gewürtz G, Sessler DI, et al. Prediction of difficult laryngoscopy in obese patients by ultrasound quantification of anterior neck soft tissue. *Anaesthesia* 2003; **58**: 1111–4

13. Roth D, Pace NL, Lee A, et al. Airway physical examination tests for detection of difficult airway management in apparently normal adult patients. *Cochrane Database Syst Rev* 2018; **5**: CD008874

14. Frerk C, Mitchell VS, McNarry AF, et al. Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults. *British Journal of Anaesthesia* 2015; **115**: 827–48

15. Apfelbaum JL, Hagberg CA, Caplan RA, et al. Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. *Anesthesiology* 2013; **118**: 251–70

16. Kopanaki E, Piagkou M, Demesticha T, Anastassiou E, Skandalakis P. Sternomental Distance Ratio as a Predictor of Difficult Laryngoscopy: A Prospective, Double-Blind Pilot Study. *Anesth Essays Res* 2020; **14**: 49–55

17. Prakash S, Mullick P, Bhandari S, Kumar A, Gogia AR, Singh R. Sternomental distance and sternomental displacement as predictors of difficult laryngoscopy and intubation in adult patients. *Saudi J Anaesth* 2017; **11**: 273–8

18. Soltani Mohammadi S, Saliminia A, Nejatifard N, Azma R. Usefulness of Ultrasound View of Larynx in Pre-Anesthetic Airway Assessment: A Comparison With Cormack-Lehane Classification During Direct Laryngoscopy. *Anesth Pain Med* 2016; **6**: e39566

19. Reddy PB, Punetha P, Chalam KS. Ultrasonography - A viable tool for airway assessment. *Indian J Anaesth* 2016; **60**: 807–13

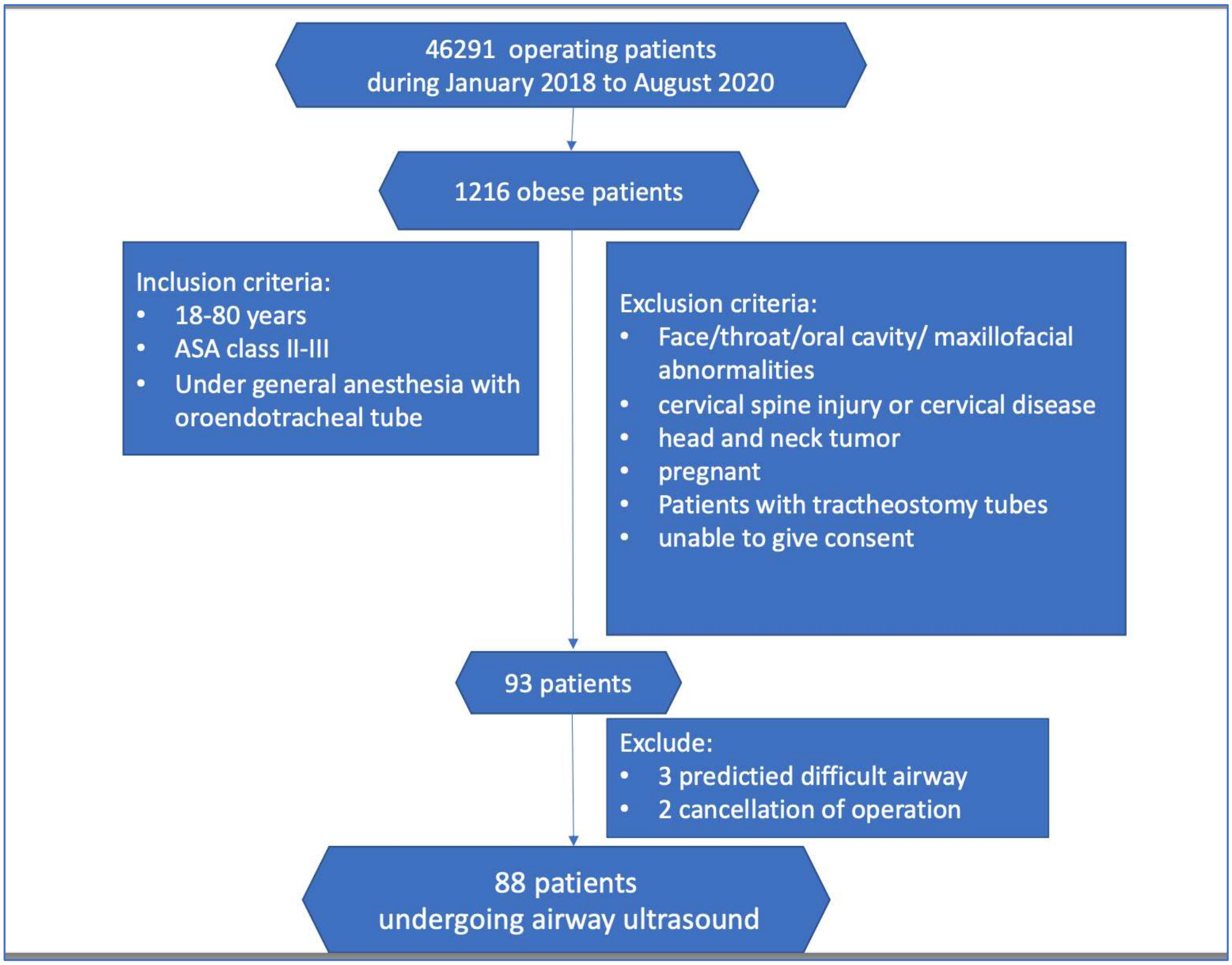

Figure 1: Study Protocol, ASA=American Society Anesthesiologist

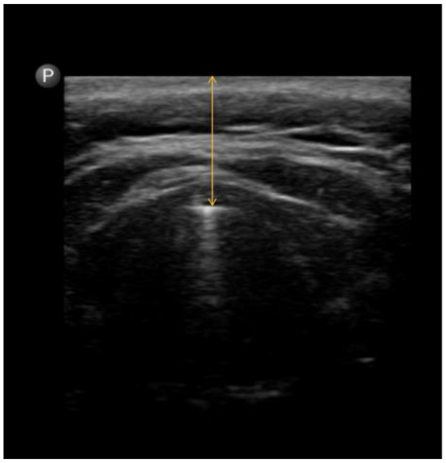

Figure 2: Transverse ultrasound view of the distance between skin and epiglottis at the vocal cord level (arrow)

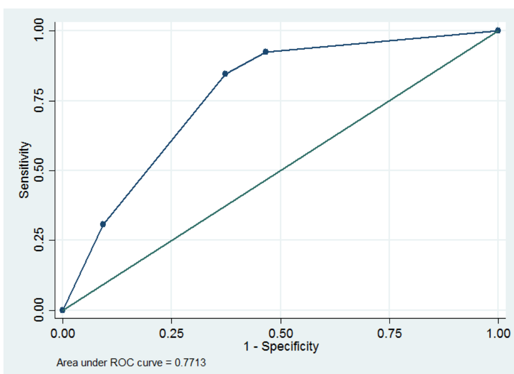

Figure3: ROC Curve shown the Probability of Difficult Laryngoscopy

Table 1: Demographic data; shown as Number(%) and Mean±SD.

Variables	**Mean±SD or Number (%)**
Gender	
Male	26 (29.5)
Female	62 (70.5)
Age(year)	40.55 ± 12.7
ASA classification:	
II	2 (2.3)
III	86 (97.7)
BMI (kg/m^2)	45.3 ± 7.6
Snoring	84 (95.5)
OSA test	57 (64.8)
OSA severity	
Mild	11 (19.3)
Moderate	12 (21.1)
Severe	34 (59.6)
Department	
General surgery	60 (68.2)
Gynecology	22 (25)
ENT	2 (2.3)
Others	4 (4.4)

ASA=American Society of Anesthesiologist, BMI=Body Mass Index, OSA=Obstructive Sleep Apnea, Kg/m^2=kilogram/squaremeter

Table 2: Variables comparing Easy and Difficult Laryngoscopy

Variables	Easy Laryngoscopy (n=75)	Difficult Laryngoscopy (n=13)	P value
[b]Age	38(29,48)	48(46,57)	0.08
[b]Body mass index	44.0 (39.8, 50.8)	41.8 (37.4, 45.9)	0.19
[c]Snoring	72 (96)	12 (92.3)	0.48
[c]OSA test	48 (64)	9 (69.2)	
[c]OSA severity			
mild	9 (18.8)	2 (22.2)	
moderate	10 (20.8)	2 (22.2)	
severe	29 (60.4)	5 (55.6)	
[c]Modified Mallampati score			0.46
I	28 (37.3)	5 (38.5)	
II	24 (32)	6 (46.2)	
III	19 (25.3)	1 (7.7)	
IV	4 (5.3)	1 (7.7)	
[b]Thyromental distance (cm)	7.5 (7.0,8.0)	6.5 (6.3,8.0)	**0.03**
[b]Sternomental distance (cm)	16.8 (152,180)	16.0 (145,163)	**0.05**
[a]Interincisor gap (cm)	4.6 (0.7)	4.5 (0.8)	0.59
[a]Neck circumference (cm)	42.8 (4.3)	41.9 (3.8)	0.51
[c]Abnormal upper teeth	12 (16)	1 (7.7)	0.68
[c]Upper lip bite test			0.60
I	43 (57.3)	10 (76.9)	
II	29 (38.7)	3 (23.1)	
III	3 (4)	0 (0)	
[a]Distance from skin to epiglottis (mm)	10.5 (2.9)	12.5 (3.3)	**0.05**

[a] Data are presented as mean (Standard Deviation)

[b] Data are presented as median (Interquartile range)

[c] Data are presented as number (Percentage)

Table 3: Multivariate Logistic Regression of Difficult Laryngoscopy Factors.

Factors	Coefficient	Standard Error	P-value	95%CI	Allocated Weight
Age > 43 years	1.35	0.73	0.065	0.11 to 2.92	8
Thyromental distance > 68 mm	1.17	0.66	0.077	-0.19 to 2.35	7
Distance from skin to epiglottis >13 mm	0.98	0.85	0.252	-0.70 to 2.65	6

cm=centimeter, mm=millimeter, CI=Confident Interval

Table 4: The Predicting Scores of Difficult Laryngoscopy, Odds and Likelihood Ratio

scores	Probability of difficult laryngoscopy	Odds	Likelihood Ratio
0-6	2.44	0.03	0.17
7-8	12.50	0.14	0.83
13-15	25.00	0.33	1.92
21	36.36	0.57	3.29