Section A-Research paper
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Validate the Predictive Value of Distance from Skin to Hyoid Bone Via Usg as a Predictor of Difficult Laryngoscopy

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Abstract

Background: Difficult tracheal intubation is a major concern for anaesthesiologists and contributes to preoperative morbidity and mortality. Many attempts have been made to develop reliable predictors for difficult intubation or difficult laryngoscopy. Suggested predictors for difficult intubation are Mallampati score III/IV, male patient, increased age, short neck, obesity and increasing Wilson score are few among them. **Method-** This study was conducted in 74 patients of age between 18-65 years of ASA I & II undergoing elective surgery at hospital Preoperative airway assessments were done and Distance from Skin to Hyoid Bone was measured using ultrasound machine. All patients were routinely monitored with NIBP, SPO2, ECG, and EtCO2. The patient will be anaesthetized and intubation was performed by senior anaestheologist and grading will be done according to modified Cormack Lehane grade. **Results-** As per the ROC curve, it was found that patients with the value of **≥0.75 cm** have a sensitivity and specificity of 80.9% and 43.5% respectively in predicting the difficult laryngoscopy with AUC 0.726. **Conclusion-** The ultrasound measurements of distance from skin to hyoid bone along with the clinical assessment of airway can be useful in predicting difficult laryngoscopy.

Keywords- Ultrasound, Distance, Skin, Hyoid Bone, Laryngoscopy, Difficult airway.

Introduction: Endotracheal intubation is one of the most important skills for anaesthesiologists in securing the airway during general anaesthesia and resuscitation.[1] In both the elective and emergency settings, there is a potential possibility of tracheal intubation to fail, and a consequent failure to provide adequate oxygenation and removal of carbon dioxide which can lead to life-threatening complications.[2] There are numerous tests to assess the airway like Mallampati's oropharyngeal classification[3-4], Thyromental distance [5], Head & neck movements, and Inter incisor gap. Some are very sensitive but lacks specificity. Presently, to overcome the above limitations of clinical airway assessment tests there is a search for non-invasive and more accurate tools for airway assessment. Portable, non-invasive and point of care characteristics of ultrasonography can aid us in airway assessment and prediction of difficult laryngoscopy.[6-7] In the last few years, there have been many studies using Ultrasonogram to assess the airway of patients and to predict difficult

intubation.[8–10] Ultrasound, provides a quick, relatively easy, and accurate information, with diagnosticand therapeutic relevance.[11-12] Various ultrasound derived measurements of airway have been used to predict difficult laryngoscopy. The sensitivity of ultrasound in predicting tough laryngoscopy was well-tried by the sturdy positive linear correlation among the thicknesses of anterior neck soft tissue measured by ultrasound at the hyoid bone, thyrohyoid membrane, and anterior commissure levels.[13-14]
The above study was conducted to validate the predictive value of distance from skin to hyoid bone via USG as a predictor of difficult laryngoscopy.

Materials And Methods
Study place- The study was conducted at hospital.
Study design- It was an observational study.
Inclusion criteria- Patients aged between 18-65 years undergoing elective surgeries under general anaesthesia, ASA grade 1 or 2 and those who were ready to give consent were included.
Exclusion criteria- Patients with facial, cervical, pharyngeal and epiglottic cancer or trauma, previous thyroid surgery or neck surgeries, tracheostomy, who were unable to sit up, and those who refused to participate were excluded.
Sample size- A similar study was conducted by Alessandri et.al[14] in (2019), where 194 patients were included in the study.
AUC = 0.93, precision (d) = 5%, α = 5%, $Z_{(1-\alpha)} = 1.96$
And by using the equation,

$$\boldsymbol{n} = \frac{(Z_1 - a)^2 \times \vartheta(AUC)}{d^2}$$

Where, $\boldsymbol{\vartheta}$ (AUC) = ϕ^{-1}(AUC) × 1.414
 n = 74
The sample size required is 74.
Data analysis- Data was collected and saved in Microsoft Excel (Microsoft Corporation) and was analyzed using **MedCalc®** Statistical Software version 20.014 (MedCalc Software Ltd, Ostend, Belgium; https://www.medcalc.org; 2021) and level of significance was set at **p<0.05**.
Ethical considerations- Approval from the ethical committee was taken and written informed consent from the patients was also taken.
Participants was pre-medicated with oral pantoprazole 40 mg the night before and 2 hours prior to surgery. Preoperative airway assessments were done. Distance from Skin to Hyoid Bone was measured using ultrasound machine(GE Logiq™ V2, GE healthcare – USA) with linear transducer probe. A neutral position of head and neck was maintained with a pillow beneath the head during the examination. After applying standard monitoring, premedication was given with Midazolam 0.05-.1mg/kg IV, Glycopyrrolate 0.005mg/kg IV, Fentanyl 1–2 µg/kg IV, Ondansetron 0.1mg/kg IV, anaesthesia was induced with, Propofol 1.5–2 mg/kg IV, and bag and mask ventilation and muscle relaxant Vecuronium 0.1mg/kg IV was given. After 3-5 minutes of mask ventilation, Laryngoscopy was accomplished in a sniffing position using a size 3 or 4 Macintosh blade by a group of anaesthetists who had at least 2 years of experience. They were blinded to the Distance from Skin to Hyoid Bone assessment using ultrasound. Laryngoscopic view without backward-upward-rightward pressure (BURP) manoeuvre was graded as per the modified Cormack–Lehane (CL) scale from I–IV (**Grade I:** full view of the vocal cords, **Grade II a:** partial view of the vocal cords, Grade II b; only arytenoids and epiglottis seen, **Grade III:** only epiglottis visible, **Grade IV:** neither the

epiglottis nor glottis visible). Grade I and II a was categorized as easy visualization and grade II b and above was categorized as difficult visualization. All the difficult laryngoscopies was visualized by external laryngeal pressure and intubations done using bougie or McCoy blade. The gradings was noted by the same investigator doing the intubation. Data of the preoperative bedside screening tests and laryngoscopic visualization was used together to assess and validate the Distance from Skin to Hyoid Bone in predicting difficult laryngoscopy.

Results

Table 1: AGE DISTRIBUTION

Category	MEAN	SD
AGE	38	15

Mean age of the participants was 38 with a standard deviation of 15.

Table 2: COMPARISON BASED ON ASA GRADE

Category	NUMBER	PERCENTAGE
1	36	48.6
2	38	51.4

Regarding ASA GRADE, more than half of the participants were (51.4%) categorized under ASA 2 and the remaining were under ASA 1 (48.6%).

Table 3: MEAN HEIGHT, WEIGHT AND BMI

Category	MEAN	SD
HEIGHT	158.81	6.49
WEIGHT	62.78	9.83
BMI	24.85	3.27

Mean height of the participants was (158.81±6.49), Weight was (62.78±9.83) and the BMI was (24.85±3.27).

Table 4: DSHB (MEAN&SD)

Category	MEAN	SD
DSHB	0.8	0.167

Mean distance from skin to hyoid bone in participants was 0.8 with a standard deviation of 0.167.

Table 5: Cormack Lehane Grade

Category	NO	PERCENTAGE
1	23	31.8
2a	18	24.3
2b	15	20.2
3a	12	16.2
3b	6	8.2
TOTAL	**74**	**100**

Participants were categorized in to 1(31.8%), 2a (24.3%), 2b (20.2%), 3a (16.2%) and 3b (8.2%) under Cormack Lehane grade.

Table 6: Prediction by ultrasound

Category	NUMBER	PERCENTAGE
DIFFICULT	**33**	**44.5**
EASY	**41**	**55.5**

As per the prediction by ultrasound, 55.5% (N=47) intubation were categorized as easyand the remaining 44.5% (N= 33) were as difficult.

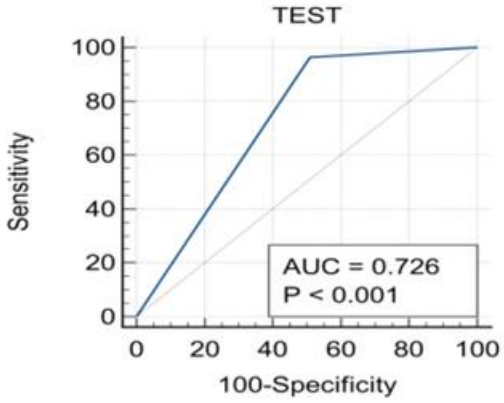

Figure 69: ROC curve

Table 7: ROC Curve values

Area under the ROC curve (AUC)	0.726
Sensitivity	80.9
Specificity	43.5
CUT OFF	0.75

As per the ROC curve the cutoff point decided for Distance from skin to hyoid bone (DSHB) in differentiating the difficult/easy laryngoscopy was 0.75. Based on the cut off value, out of 74 patients, 41 patients were predicted as easy and 33 patients were predicted as difficult group. Sensitivity and Specificity were also calculated for the DSHB.
Cut-off point -0.75
Sensitivity-80.9%Specificity-43.5%
Area under the curve- 0.726

Table 8: Correlation between age and DSHB-Pearson correlation test

Category	**AGE**	**P VALUE**
DSHB	0.19	0.12

*P <0.05 is statistically significant (Pearson correlation test)
Pearson correlation test was used to correlate between AGE of the participants and DSHB. A weak non-significant correlation was seen between the two variables.

Discussion

This prospective observational study of 74 patients confirms and extends available knowledge on the association between skin-to-hyoid-bone distance ultrasonography evaluation and difficult laryngoscopy. We studied anterior neck soft tissue thickness by measuring the distance from skin to hyoid bone, skin in neutral position. Yadav et al [15] found out the mean value of skin to hyoid bone distance in neutral and sniffing position were significantly different in easy and difficult group. Mean distance from skin to hyoid bone in participants was 0.8 cm with a standard deviation of 0.167 cm and as per the ROC curve the cut-off point decided for Distance from skin to hyoid bone (DSHB) in differentiating the difficult/easy laryngoscopy was 0.75 cm with a sensitivity and specificity of 80.9% and43.5% respectively. The association between ultrasound measurements of anterior neck soft-tissue thickness at the hyoid bone and thyrohyoid membrane levels predicted difficult laryngoscopy in one investigation, but there was no link between the ultrasound measurements with clinical screening tests. Perhaps the more stable distance is DSHB. Wu et al [13]. investigated 203

individuals and discovered that ultrasound measurements at the hyoid bone, thyrohyoid membrane, and anterior commissure can predict difficult laryngoscopy independently. When compared to conventional screening tests, these parameters showed a larger area under the ROC curve. The hyoid is the fulcrum of the upper airway, connecting to the tongue by the genioglossus muscle and to the larynx via the hyoepiglottic and thyrohyoid membranes, and hence can affect every aspect of airway management. This could explain why DSHB showed a better specificity and sensitivity in diagnosing difficult laryngoscopy. However, our results were found to be lower than those obtained in earlier research, which could be attributed to the study's population.

Yadav et al [15] used ultrasonography to measure the distance between the skin and the hyoid bone, the skin to the thyrohyoid membrane in neutral and sniffing positions, and tongue thickness to predict difficult laryngoscopy. In the easy and difficult laryngoscopy groups, the mean value of skin to hyoid bone distance and skin to thyrohyoid membrane distance in a neutral and sniffing posture were substantially different. They discovered that the ultrasound measurements had a larger area under the ROC curve for determining difficult laryngoscopy than the clinical airway assessment tools. The ultrasound measurements had a better sensitivity and specificity than that of a bedside clinical test for detecting difficult laryngoscopy. Previous airway ultrasonography studies have evaluated on tongue thickness, volume, skin to hyoid bone distance in supine and neck extended positions, and the ratio of these two distances, skin to thyrohyoid membrane distance, distance from the epiglottis to the midpoint of the vocal cord (EVC), depth of the pre-epiglottic space, and the ratio of these two distances to predict difficult laryngoscopy.

The various clinical indicators used to predict difficult intubation are recognized to be unreliable due to their low sensitivity and specificity. In terms of sensitivity and specificity, as well as AUC, sonographic measurements performed better than earlier studies in detecting difficult laryngoscopy. The study has a few limitations: first, the ultrasound-derived parameters were obtained from a community in the southern portion of India, therefore the results cannot be applied to other populations. Second, the experience of the person who is performing laryngoscopy may also influence the CL view obtained and alter the grading of laryngoscopy. Third, because the ultrasound measurements of the anterior soft tissue neck are taken in centimeters, the amount of pressure applied by the ultrasound probe to the neck might cause a difference in values and change the results, therefore gentle probe application is recommended.

Conclusion

In conclusion we found out that difficult intubation can be predicted by measuring the distance from skin to hyoid bone using ultrasound machine. The person performing direct laryngoscopy will be facing difficult intubation if the distance from skin to hyoidbone is ≥ 0.75 cm.

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