DOI: 10.21088/ijaa.2349.8471.12325.4

Indian Journal of Anesthesia and Analgesia
Volume 12 Number 3 July - September 2025

ORIGINAL ARTICLE

Preoperative Clinical and Sonographic Assessment of Airway and its Correlation with Cormack–Lehane Grading During Intubation in Predicting Difficult Airway

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HOW TO CITE THIS ARTICLE:

Bijitha V.K., Biju M.L., Sajil M.S. Preoperative Clinical and Sonographic Assessment of Airway and its Correlation with Cormack–Lehane Grading During Intubation in Predicting Difficult Airway. Ind J Anesth Analg. 2025; 12(3): 183-197.

ABSTRACT

Background and Objectives: Unexpected difficult airway is a major challenge in general anesthesia, associated with significant morbidity and mortality. Ineffective airway management can lead to rapid deterioration of oxygenation and ventilation, resulting in severe consequences such as brain injury and death. The preanesthetic evaluation of the airway is typically conducted using a variety of assessment techniques. However, these techniques often lack discriminative value when used in isolation and perform better when combined with other tests.

Ultrasound, when used alongside other risk assessment methods at different levels of the neck, may help identify predictors of a difficult airway, including challenging laryngoscopy, thus enabling faster and more accurate airway assessments in both routine and emergency situations.

Aim:

- To assess the effectiveness of ultrasonography in preoperative airway evaluation for predicting difficult airway.

Objectives:

- To evaluate the correlation between preoperative sonographic airway assessment and laryngoscopic CL grading.
- To identify the sonographic parameter with better predictability of difficult airway.

Methods: This prospective observational study was conducted with 68 patients presenting to Travancore Medical College, Kollam, for elective surgery under general anesthesia with endotracheal intubation. The three parameters anterior

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➢ **Received:** 12-03-2025 ➢ **Accepted:** 30-05-2025

neck soft tissue thickness at the level of the hyoid, anterior neck soft tissue thickness at the level of the vocal cords, and the hyomental distance ratio, which is calculated by dividing the hyomental distance in the extended position by the hyomental distance in the neutral position (HMDe/HMDn) and three physical criteria the Modified Mallampati (MPC) class, thyromental distance (TMD), and sternomental distance (SMD) were assessed and correlated with the Cormack-Lehane grading.

Results and Discussion: The optimal cutoff value for ANS-Hyoid to predict difficult laryngoscopy was >0.89 cm, with 22.2% sensitivity and 96% specificity (AUC = 0.6489). For ANS-VC, the best cutoff value was >0.87 cm, showing 22.2% sensitivity and 98% specificity (AUC = 0.695). The ideal cutoff value for HMDR was <1.15, with 38.89% sensitivity and 96% specificity (AUC = 0.75).

Our findings suggest that while ANS-Hyoid has high specificity, its low sensitivity indicates it may not alone be sufficient for identifying difficult intubation. The correlation between greater anterior neck soft tissue thickness at the vocal cord level and higher CL grades supports the use of sonographic measurements in predicting difficult laryngoscopy. HMDR demonstrated the best combination of sensitivity and specificity, highlighting its potential utility in improving the accuracy of pre-operative airway assessments.

Conclusion: Our study found that among the USG parameters evaluated, the Hyomental Distance Ratio (HMDr) provided the most reliable prediction of difficult intubation. In summary, integrating ultrasonography (USG) with both traditional and novel assessment tools is likely to enhance preoperative evaluations and lead to more effective management of difficult airway.

KEYWORDS

• Difficult airway • General anesthesia • Ultrasonography • Preoperative assessment • Cormack-Lehane grading • Sonographic parameters • Airway management Hyomental distance ratio • Anterior neck soft tissue thickness • Laryngoscopy

INTRODUCTION

A feared complication of general anesthesia is unexpected difficult airway, as it is associated with significant morbidity and mortality.[1] According to the American Society of Anesthesiologists, a difficult airway is defined as a situation where "a conventionally trained anesthesiologist experiences difficulty in ventilation of the upper airway with facemask, difficulty with tracheal intubation, or both."[2]

Failed airway management can lead to the rapid deterioration of oxygenation and ventilation, resulting in devastating consequences such as brain injury and death. Ensuring effective and timely management of airway is crucial to prevent these severe outcomes and maintain patient safety. Preoperative airway assessment aids the anesthesiologist to predict potential difficulties with mask ventilation, difficulty with a supraglottic airway devices (SGA), difficult laryngoscopy or difficult intubation.

The evaluation of the airway is done using a variety of assessment techniques. The most widely used techniques include Mallampati classification, status of teeth, inter incisor gap, thyromental distance, sternomental distance, degree of neck movements (especially extension), neck circumference, upper lip bite test, existence of beard, and noticeable visual indicators of head and neck.[3-4] However when used in isolation, they do not have the same discriminative value as they do when combined with other tests. These bedside physical airway assessments have significant interobserver variability and only moderate to fair sensitivity and specificity. Additionally, they can be challenging to use in emergency and critical care settings, where patients often exhibit disorientation, uncooperativeness, and an inability to follow directions.

Point-of-care ultrasonography (POCUS) has emerged as a novel, simple, portable, and non-invasive tool in clinical practice. Combining the skills of USG with thorough knowledge of regional anatomy can improve the quality of care. Preoperative ultrasound at different levels of the neck, along with other risk assessment methods, may help to identify the difficult airway predictors, including challenging laryngoscopy, thus enabling a faster and more

accurate assessment of airway in both routine and emergency situations.[5]

Researchers have hypothesized that the increased soft tissues thickness in the anterior neck could hinder the advancement of the pharyngeal structures, making airway management more challenging. USG allows for the detailed visualization of these critical structures and their relative positions, providing crucial information for effective airway management.[6]

Hyomental distance measured by ultrasonography appears to be a promising predictor of difficult laryngoscopy in cases of difficult airway management.[7,8] The literature is deficient in supporting a comparison between these ultrasound (US) parameters and the demographic parameters and Cormack-Lehane (CLG) grade.

The present study strives to investigate the use of ultrasonography (USG) in evaluating the airway by assessing three parameters: anterior soft tissue thickness of the neck at the hyoid level (ANS-Hyoid), anterior soft tissue thickness of the neck at the vocal cord level (ANS-VC), and the hyomental distance ratio, which is calculated by dividing the hyomental distance in the extended position (HMDe) by the hyomental distance in the neutral position (HMDn). Additionally, three physical criteria: the Modified Mallampati (MPC) class, thyromental distance (TMD), and sternomental distance (SMD), are assessed and correlated with the Cormack-Lehane grading

MATERIALS AND METHODS

Study Design

This is a Prospective observational Study

Study Setting

Travancore Medical College Hospital, Kollam

Study Population

Patients presenting to Travancore Medical College, Kollam for elective surgery under general anesthesia with endotracheal intubation.

METHODOLOGY

After obtaining approval from the ethical committee and written informed consent from patients, those who were over 18 years old, had no known airway pathology, and were undergoing elective surgery under general anesthesia with endotracheal intubation were included in the study. This prospective observational study was conducted at Travancore Medical College, Kollam. This study did not include patients with difficult airways, such as those with maxillofacial anomalies, restricted neck movements, obesity > 40 kg/m^2, cervical spine pathology, patients requiring rapid sequence intubation, pregnant patients, patients requiring fiberoptic tracheal intubation, and limited mouth opening.

Before surgery, each patient underwent a pre-anesthesia evaluation performed by a senior, skilled anesthetist. The airway assessment was conducted in two stages by the principal investigator. First assessment included recording the modified Mallampati class, thyromental distance (TMD—measured from thyroid notch to the mentum with the neck fully extended), and sternomental distance (SMD—measured from the suprasternal notch to the mentum with the neck fully extended.

Then on the day of surgery, in the preoperative room, ultrasonographic measurements of the anterior neck were taken with the patient in the sniffing posture (atlanto-occipital extension and cervical flexion) by a senior, skilled anesthetist using a portable ultrasound machine Versana Active TM, GE Healthcare. The measurements included the anterior neck soft tissue thickness at two levels , vocal cords (ANS-VC) and hyoid bone (ANS-H), as well as the hyomendal distance in both extended (HMDe) and neutral (HMDn) positions. To measure the anterior neck soft tissue thickness (ANS-H and ANS-VC), a linear array probe (6-12MHz) was placed horizontally across the anterior neck. For the hyomental distance (HMD) measurements in both positions, a curved array probe (3–6 MHz)was used sagittally below the mandibular region.The soft tissue thickness of anterior neck at the level of the vocal cords (ANS-VC), measured from the skin to the anterior commissure of the vocal cords (Figure 28), and at the level of the hyoid (ANS-H), measured from the skin to the anterior aspect of the trachea at the level of the hyoid (Figure 29). Additionally, the hyomental distance was measured sonographically from the top border of the hyoid bone to the lower border of the mentum in both the neutral (HMDn) and extreme head extension (HMDe)

positions using a curved probe with an appropriate frequency. (Figure 27)

The hyomental distance in extreme head extension (HMDe) was divided by the hyomental distance in the neutral head position (HMDn) to calculate the Hyomental Distance Ratio (HMDR). The degree of difficult laryngoscopy was assessed using the Cormack-Lehane (CL) score.

Based on the clinical and sonographic characteristics, the patients were categorized as either difficult or easy candidates for laryngoscopy (the DL and EL group) following preoperative examination. On the day of surgery, the patient was transferred to the operating room, where baseline monitors, including ECG, noninvasive blood pressure, and pulse oximeter, were attached and recorded. An intravenous line was secured, and IV fluids were started. The patient was preoxygenated with 100% oxygen. Intravenous (IV) midazolam 1 mg and fentanyl 2 µg/kg were administered. Anesthesia was induced with propofol at a dose of 2 mg/kg. After ensuring adequate ventilation, Cisatracurium 0.2 mg/kg was administered for muscle relaxation, and the patient was ventilated with a bag and mask for 3 minutes.

Laryngoscopies were performed by experienced Anesthesiologists using an appropriately sized curved Macintosh blade (size 3 for female and medium-sized male patients, or size 4 for well-built male patients) after 3 minutes. The Cormack-Lehane (CL) laryngoscopic grade was recorded, with grades 1 or 2 considered easy laryngoscopy, and grades 3 or 4 considered difficult. If an adequate laryngoscopic view was not achieved, external laryngeal pressure and the backward, upward, rightward pressure manoeuvre were applied, along with adjustments to the head and neck position.

Once the patient was intubated with a suitable sized endotracheal tube, surgery proceeded. Anesthesia was maintained with sevoflurane and maintenance doses of Cisatracurium. Following the surgery, the patient was extubated, and the neuromuscular block was reversed.

RESULTS

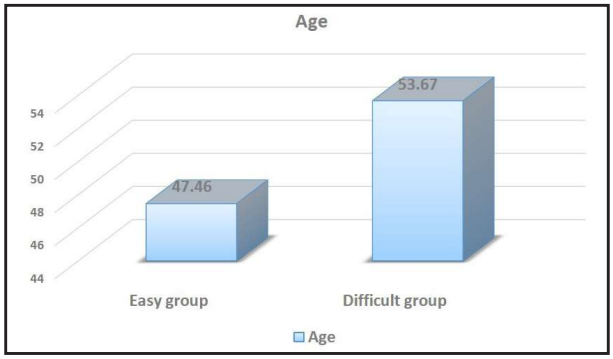
Our study comprised 68 patients who were undergoing elective surgery under general anesthesia with endotracheal intubation and had ASA physical status I ,II,or III. In both groups, every patient was successfully intubated.

1. Age Distibution

The two groups (difficult and easy laryngoscopy) had a similar age distribution. In group easy, the mean ± standard deviation was 47.46 ± 14.01, while in group difficult, it was 53.67 ± 13.17. Regarding age, there was no statistically significant difference observed between the two groups. (p = 0.107)

Table 1: Age distribution

Age	Cormack-Lehane grading			
	Easy (n = 50)		Difficult (n = 18)	
	Mean	SD	Mean	SD
	47.46	14.01	53.67	13.17
P-value	0.107			



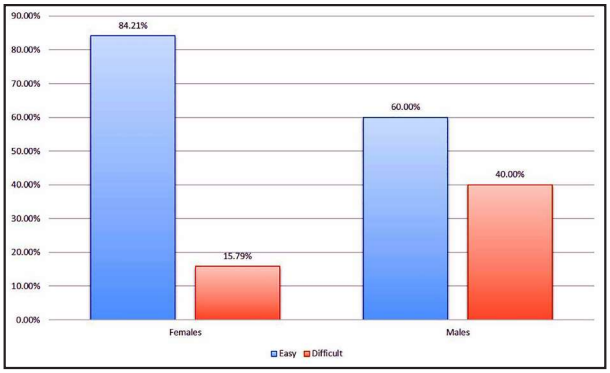
Graph 1: Age distribution

2. Gender Distribution

Among 68 patients, 38 were females and 30 were males. The difficult laryngoscopy showed higher incidence in male patients in our study i.e. n = 12(40%). This finding is statistically significant. (p=0.025)

Table 2: Gender distribution

Gender	Cormack-Lehanegrading				Total
	Easy		Difficult		
	No.	%	No.	%	No.
Female	32	84.21	6	15.79	38
Male	18	60%	12	40%	30
Total	50	73.53%	18	26.47%	68
P = 0.025					



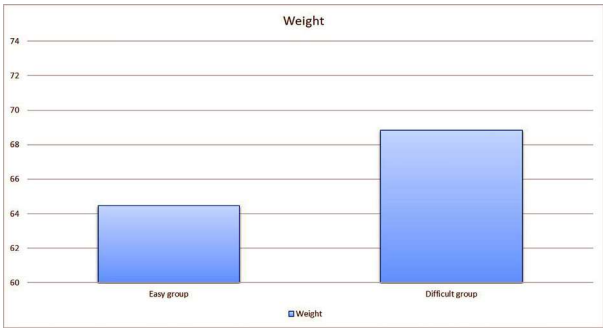
Graph 2: Gender distribution

3. Weight distribution

In the easy laryngoscopy group, the average weight of the patients was 64.48 ± 12.04 kg, while in the difficult laryngoscopy group, it was 68.83 ± 11.53 kg. Between the two groups, there was no statistically significant variation in weight. p is equal to 0.914.

Table 3: Weight distribution

Variable	Cormack-Lehane Grading	N	Mean	Sd	P-Value
Weight (KG)	Easy	50	64.48	12.04	0.914
	Difficult	18	68.83	11.53	



Graph 3: Weight distribution

4. Height distribution

Patients in the simple laryngoscopy group measured 160.36 ± 7.41 cm in average height, while those in the difficult laryngoscopy group measured 162.83 ± 7.8 cm on average. Between the two groups, there was no statistically significant difference (p=0.235).

Table 4: Height distribution

Variable	Cormack-Lehane Grading	N	Mean	SD	P-value
Height (CM)	**Easy**	50	160.36	7.41	0.235
	Difficult	18	162.83	7.8	

5. Body mass index

Patients in the simple laryngoscopy group had an average BMI of 26.59 ± 4.07 kg/m2, while those in the difficult laryngoscopy group had an average BMI of 25.86 ± 3.24 kg/m2. Between the two groups, there was no statistically significant difference. (p = 0.493)

Table 5: BMI distribution

Variable	Cormack-Lehane Grading	N	Mean	Sd	P-Value
BMI (KG/M2)	Easy	50	26.59	4.07	0.493
	Difficult	18	25.86	3.24	

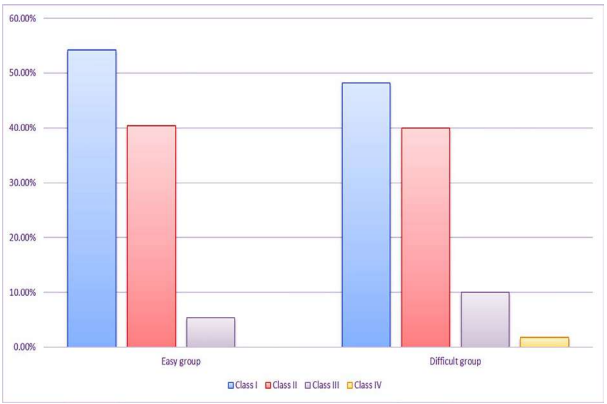
6. Bedside clinical screening tests

(i) Mallampati classification

There were n = 12 patients in Mallampati class 1. Of the total patients, there were 27 in Mallampati class 2, 28 in Mallampati class 3, and 1 in class 4. The two groups differed statistically significantly from one another. (p = 0.014)

Table 6: Mallampatiscore

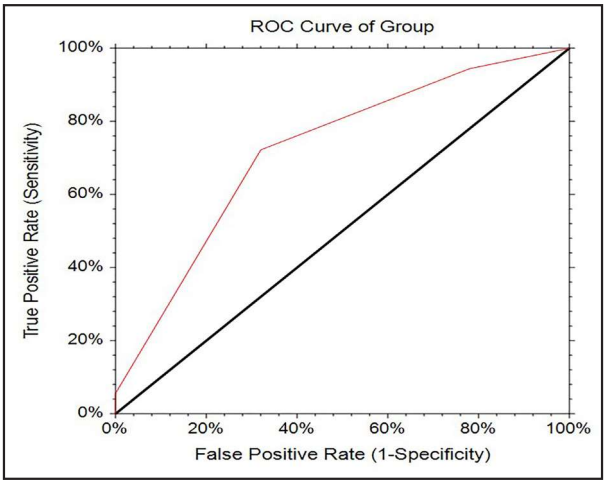
Mallampati score	Cormack-Lehanegrading				Total
	Easy		Difficult		
	N	%	N	%	N
1	11	91.67%	1	8.33%	12
2	23	85.19%	4	14.81%	27
3	16	57.14%	12	42.86%	28
4	0	0%	1	100%	1
	P = 0.014				



Graph 6: Mallampaticlass

Table 7: Sensitivity, Specificity, PPV, NPV, accuracy of MP class

Statistic	Value
Cutoff value	3
Sensitivity	72.2% 95% CI (46.52% - 90.31%)
Specificity	68% 95% CI (53.3% - 80.48%)
Positive Predictive Value	44.83%
Negative Predictive Value	87.18%
Accuracy	69.12%
AUC	0.721
p-value	0.0003



Graph 7: ROC plot for MP class and CL grade

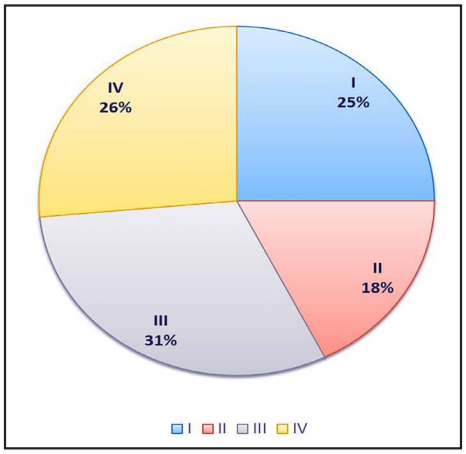
The Mallampatiscore showed a sensitivity of 72.2%, specificity of 68%, positive predictive value of 44.83%, negative predictive value of 87.18%with an accuracy of 69.12%. The Cutoff value for predicting difficult intubation was class 3, which had good predictive value. (AUC = 0.721)

(i) Cormack-Lehanegrade distribution

Twelve patients in our study had a CL view of Grade II, twenty-one patients had a CL view of Grade III, and eighteen patients had a CL view of Grade IV.

Table 8: Cormack-Lehanegrade distribution of the patients

Cormack-Lehanegrading	No. of patients	Percent (%)
1	17	25%
2a	12	17.65%
2b	21	30.88%
3	18	26.47%
Total	68	100%



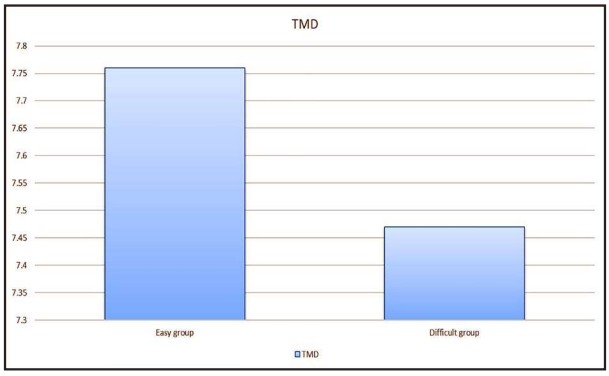
Graph 8: Cormack- Lehane grade distribution

(i) Thyromental Distance:

The average thyromental distance in the simple laryngoscopy group and the difficult laryngoscopy group, respectively, were 7.76 ± 0.86 and 7.47 ± 0.81 in our study. Between the two groups, there was no statistically significant difference. (p = 0.221)

Table 9: TMD distribution of the study groups

Variable	Cormack-Lehane grading	N	Mean	Sd	P-Value
Thyromental Distance	Easy	50	7.76cm	0.86	0.221
	Difficult	18	7.47cm	0.81	

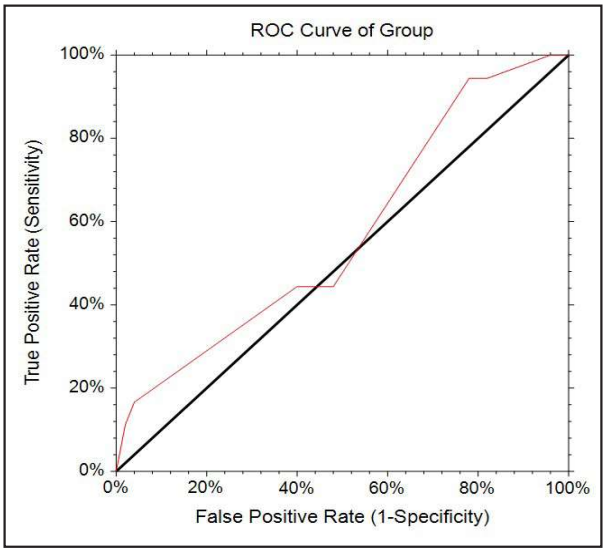


Graph 9: TMD distribution of the study groups

Table 10: Sensitivity, Specificity, PPV, NPV and Accuracy of TMD

Statistic	Value
Cutoff value	6.5 cm

Sensitivity	16.67% 95% CI (3.58% - 41.42%)
Specificity	96% 95% CI (86.29% - 99.51%)
Positive Predictive Value	60%
Negative Predictive Value	76.19%
Accuracy	75%
AUC	0.571
p-value	0.173



Graph 10: ROC plot of TMD with CL grade

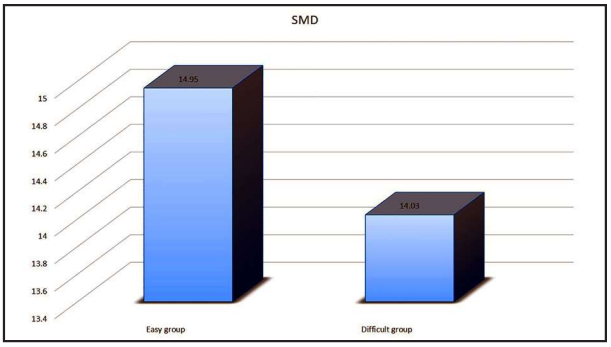
The Thyromental distance showed a sensitivity of 16.67%, specificity of 96%, positive predictive value of 60%, negative predictive value of 76.19% with an accuracy of 75%. The Cutoff value for predicting difficult intubation was 6.5cm, which had poor predictive value. (AUC = 0.571)

(ii) Sternomental Distance:

The sternomental distance in our study was 14.95 ± 1.43 for the easy laryngoscopy group and 14.03 ± 1.42 for the difficult laryngoscopy group, respectively. There was a statistically significant variation between the two groups. (p = 0.021)

Table 11: SMD distribution

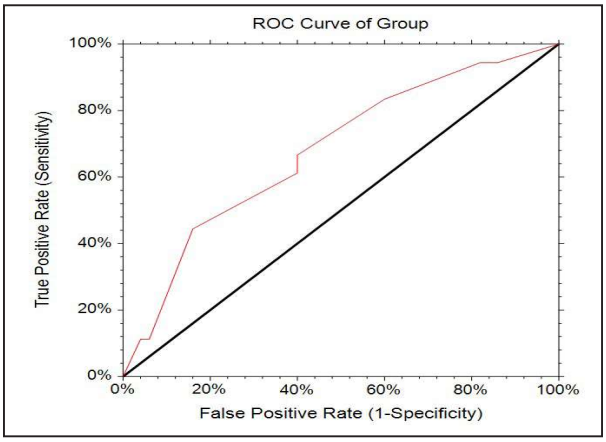
Variable	Cormack-Lehanegrading	N	Mean	Sd	P-Value
SMD	Easy	50	14.95	1.43	0.021
	Difficult	18	14.03	1.42	



Graph 11: SMD distribution of the study groups

Table 12: sensitivity, specificity, PPV, NPVand accuracy of SMD

Statistic	Value
Cutoff value	13 cm
Sensitivity	44.44% 95% CI (21.53% - 69.24%)
Specificity	84% 95% CI (70.89% - 92.83%)
Positive Predictive Value	50%
Negative Predictive Value	80.77%
Accuracy	73.53%
AUC	0.6783
p-value	0.0077



Graph 12: ROC curve for SMD

The Stern omental distance showed a sensitivity of 44.44%, specificity of 84%, positive predictive value of 50%, negative predictive value of 80.77% with an accuracy of 73.53%. The Cutoff value for predicting difficult intubation was 13cm, which had poor predictive value. (AUC = 0.6783)

7. Sonographic measurements:

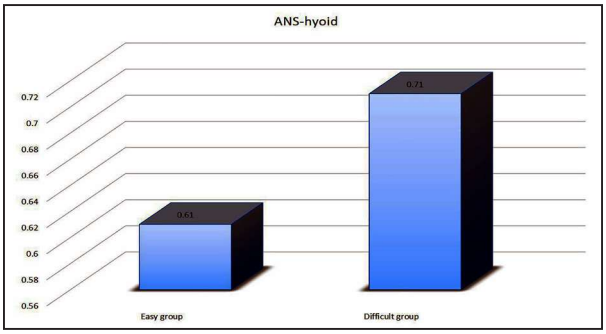
(a) ANS – Hyoid (distance from the skin to the anterior aspect of the trachea at the

level of the hyoid)

In our investigation, the average ANS-hyoid for the simple and difficult laryngoscopy groups were, respectively, 0.61 ± 0.15 cm and 0.71 ± 0.22 cm. There was a statistically significant variation between the two groups. (p = 0.03

Table 13: ANS-hyoid distribution of the study groups

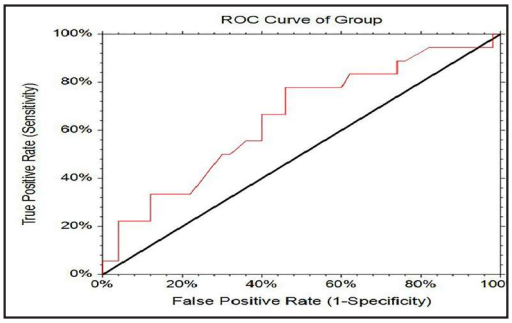
Variable	Cormack-Lehanegrading	N	Mean	Sd	P-Value
ANS-hyoid	Easy	50	0.61	0.15	0.03
	Difficult	18	0.71	0.22	



Graph 13: ANS-hyoid distribution of the study groups

Table 14: Sensitivity, specificity, PPV, NPV and accuracy of ANS-hyoid

Statistic	Value
Cutoff value	0.89cm
Sensitivity	22.2% 95% CI (6.41% - 47.64%)
Specificity	96% 95% CI (86.29% - 99.51%)
Positive Predictive Value	66.67%
Negative Predictive Value	77.42%
Accuracy	76.47%
AUC	0.6489
p-value	0.027



Graph 14: ROC curve for ANS-hyoid

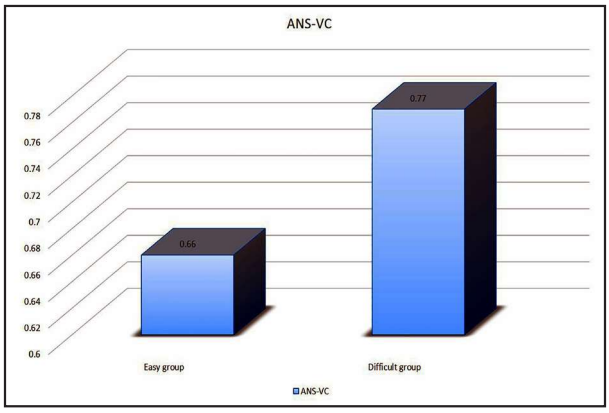
The optimal cut-off values (sensitivity and specificity in parentheses) determined by the ROC curve for ANS-hyoid to predict difficult laryngoscopy was >0.89 cm (22.2%, 96%). The area under the curve for the parameter was 0.6489.

(b) ANS – VC (distance from the skin to anterior commissure of true vocal cords)

The mean ANS-VC for the simple and difficult laryngoscopy groups in our study were 0.77 ± 0.21cm and 0.66 ± 0.12cm, respectively. There was a statistically significant variation between the two groups. (p = 0.009)

Table 15: ANS-VC distribution

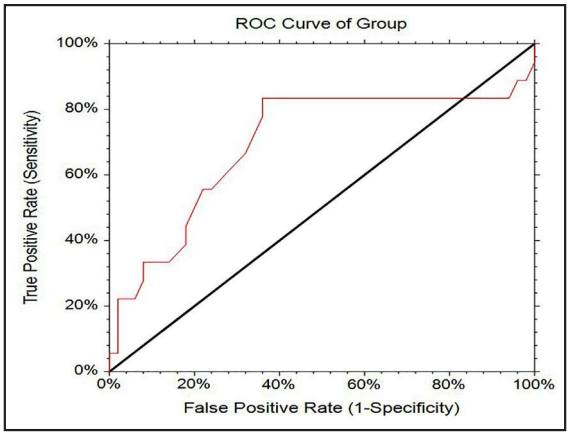
Variable	Cormack-Lehanegrading	N	Mean	Sd	P-Value
ANS-VC	Easy	50	0.66	0.12	0.009
	Difficult	18	0.77	0.21	



Graph 15: ANS-VC distribution

Table 16: Sensitivity, specificity, PPV, NPV and accuracy of ANS-VC

Statistic	Value
Cutoff value	0.87cm
Sensitivity	22.2% 95% CI (6.41% - 47.64%)
Specificity	98% 95% CI (89.35% - 99.95%)
Positive Predictive Value	80%
Negative Predictive Value	77.78%
Accuracy	77.94%
AUC	0.695
p-value	0.01



Graph 16: ROC curve for ANS-VC

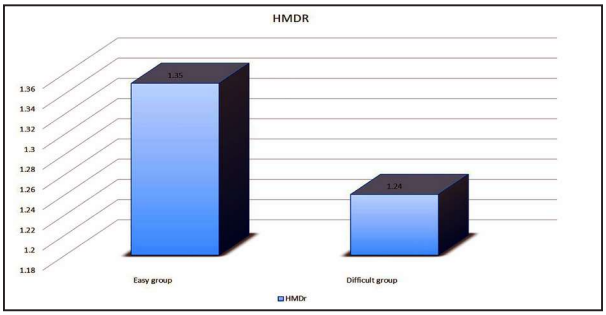
The optimal cut-off values (sensitivity and specificity in parentheses) determined by the ROC curve for ANS-VC to predict difficult laryngoscopy was<0.87cm (22.2%, 98%). The area under the curve for the parameter was 0.695.

(c) Hyomental Distance Ratio [HMDr] (dividing HMD in extreme head extension [HMDe] by HMDn in neutral head position)

Within the simple and difficult laryngoscopy groups in our investigation, the mean HMDr was 1.35 ± 0.16 and 1.24 ± 0.17, respectively. There was a statistically significant variation between the two groups. (p = 0.015)

Table 17: HMDR distribution of the study groups.

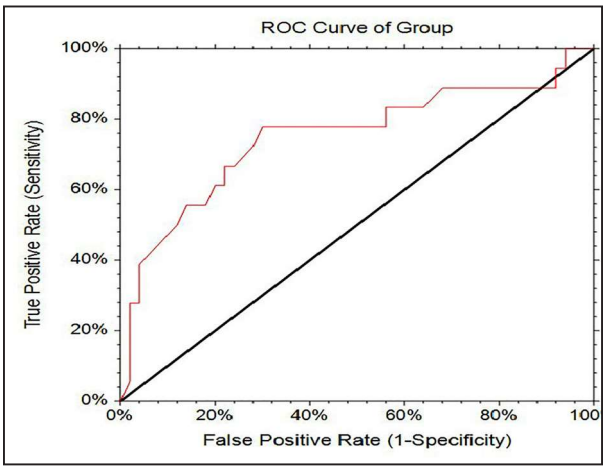
Variable	Cormack-Lehanegrading	Mean	Sd	P-Value
HMDe	Easy	6.88	0.62	0.006
	Difficult	6.4	0.64	
HMDn	Easy	5.13	0.7	0.659
	Difficult	5.22	0.8	
HMDr	Easy	1.35	0.16	0.015
	Difficult	1.24	0.17	



Graph 17: ANS-hyoid distribution of the study groups

Table 18: Sensitivity, specificity, PPV, NPV and accuracy of HMDr

Statistic	Value
Cutoff value	1.15
Sensitivity	38.89% 95% CI (17.3% - 64.25%)
Specificity	96% 95% CI (86.29% - 99.51%)
Positive Predictive Value	77.78%
Negative Predictive Value	81.36%
Accuracy	80.88%
AUC	0.75
p-value	0.0007



Graph 18: ROC curve for HMDr

The optimal cut-off values (sensitivity and specificity in parentheses) determined by the ROC curve for HMDr to predict difficult laryngoscopy was<1.15 (38.89%,96%). The area under the curve for the parameter was 0.75.

Correlation Between HMDR and Other Parameters

Table 19: Correlation co-efficients of HMDR

	HMDr	
	r-value	P-value
Cormack-Lehanegrading	-0.5517	0.0006
Mallampatiscore	-0.3379	0.0048
TMD	0.2219	0.069
SMD	0.3561	0.0029
ANS-hyoid	-0.461	0.0001
ANS-VC	-0.4832	0.00001
BMI	-0.453	

A low positive correlation was seen between HMDr and TMD and SMD in our study. A moderate negative correlation was seen between HMDr and CL grade, ANS-hyoid and ANS-VC, Mallampatti score, BMI in our study. And the p values were statistically significant.

Graph 19: Scatter plot of HMDr and ANS-hyoid, ANS-VC

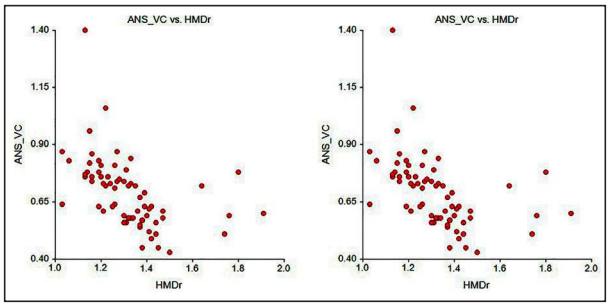


Table 20: AUC of bed side and sono graphic parameters

Area Under the Curve					
Variable(s)	AUC	SE	P-value	95% Confidence Interval	
				Lower Bound	Upper Bound
MPS	0.7217	0.0641	0.0003	0.5709	0.8254
TMD	0.5717	0.0762	0.1736	0.4037	0.7023
SMD	0.6783	0.0737	0.0077	0.5069	0.7982
ANS-hyoid	0.6489	0.0775	0.027	0.4708	0.776
ANS-VC	0.695	0.0845	0.01	0.4909	0.826
HMDr	0.75	0.0778	0.0007	0.5541	0.8672

The area under the curve for the parameters was better for HMDr compared to others in our study. Hence HMDr has better prediction of difficult intubation compare to other parameters.

DISCUSSION

Upper airway ultrasonography is a valuable, non-invasive, compact, and portable point-of-care tool for evaluating airway management, even in cases where anatomy has been altered by illness or trauma. With ongoing advancements in technology, increased accessibility, and greater awareness, upper airway ultrasonography is poised to become the primary non-invasive method for airway assessment. The purpose of this study is to ascertain how useful ultrasonography is for predicting challenging airway conditions during preoperative airway assessment.[30,32]

We had 68 patients with ASA physical status I, II, and III undergoing elective surgery under general anaesthesia with end otracheal intubation in this study. All patients were successfully intubated in both the groups. Following were our findings.

Age

Age distribution between the two groups (difficult and easy laryngoscopy) was comparable. The mean ±standard deviation, ageingroupeasy and group difficult was 47.46 ± 14.01 and 53.67 ± 13.17 respectively. Nostatistical difference was seen between the two groups with respect to age. (p=0.107).

Gender

In our study, out of 68 patients, 38 were females and 30 were males. The incidence of difficult laryngoscopy was higher in male patients, with 12 out of 30 males (40%) experiencing difficult laryngoscopy. This difference was statistically significant (p=0.025), suggesting a notable gender-related disparity in laryngoscopy difficulty.

This finding is consistent with some previous studies that have reported a higher incidence of difficult intubation in males. It may be attributed to anatomical differences, such as a more anteriorly positioned larynx in males, which can complicate intubation procedures.

Overall, while gender appears to influence the likelihood of encountering difficult laryngoscopy, it should be considered along with other parameters for a comprehensive assessment. This gender-based finding highlights the need for tailored airway management strategies that account for individual patient characteristics.

Weight

The average weight of patients in the easy laryngoscopy group was 64.48 ± 12.04 kg, whereas in the difficult laryngoscopy group, it was 68.83 ± 11.53 kg. The difference in weight between the two groups was not statistically significant (p = 0.914), suggesting that weight alone does not significantly influence the difficulty of laryngoscopy in our sample.

This contrasts with some studies that have suggested an association between higher body weight and increased risk of difficult intubation, often attributed to associated factors such as obesity. Overall, while weight

is an important consideration in overall patient assessment, its direct impact on laryngoscopy difficulty appears limited based on our results. Other factors, including anatomical and clinical variables, should be considered to provide a more comprehensive evaluation of intubation challenges.

Height

Patients in the simple laryngoscopy group measured 160.36 ± 7.41 cm in average height, while those in the difficult laryngoscopy group measured 162.83 ± 7.8 cm on average. Between the two groups, there was no statistically significant difference (p=0.235).

BMI

In our study, the average BMI was 26.59 ± 4.07 kg/m² in the easy laryngoscopy group and 25.86 ± 3.24 kg/m² in the difficult laryngoscopy group. The difference between the two groups was not statistically significant (p = 0.493), suggesting that BMI alone may not be a strong predictor of laryngoscopy difficulty in our sample.

These findings align with the study by N Kalezic *et al.*, who observed no significant variation in the frequency of difficult intubation based on patient age, sex, or BMI.[63]

Similarly, the study by Preethi B *et al.* indicated that while higher BMIs were associated with more challenging laryngoscopies, their investigation involved a wide range of BMI values (14.2 to 39.0 kg/m²), with thicknesses greater than 0.23 cm linked to difficult intubation. This suggests that while higher BMI may contribute to more challenging laryngoscopies, the association is not straightforward and may be influenced by other factors.[56]

Zane *et al.* also highlighted that their analysis found a higher incidence of difficult laryngoscopy in patients with higher BMIs, but they emphasized that the relationship between HMDR and difficult laryngoscopy remains debatable. This indicates that while BMI can be a factor in airway management, it should not be used in isolation to predict difficult intubation.

In summary, our study supports the view that BMI alone may not be a reliable predictor of difficult laryngoscopy. Instead, BMI should be considered alongside other parameters and clinical factors to improve the accuracy of airway assessments.

CONCLUSION

Upper airway ultrasonography (USG), due to its portability, non-invasive nature, affordability, and repeatability, holds significant promise for improving airway management. The increasing body of research suggests that USG could be integrated into standard preoperative airway assessment, monitoring, and imaging practices. While USG measurements of soft tissue thickness offer valuable insights, they should be used in conjunction with other anatomical and clinical factors to enhance the accuracy of predicting difficult intubation.

Our study found that among the USG parameters evaluated, the Hyomental Distance Ratio (HMDr) provided the most reliable prediction of difficult intubation.

In summary, incorporating a multi-faceted approach that includes USG alongside traditional and novel assessment tools will likely enhance preoperative evaluations and contribute to more effective management of difficult intubations.

Conflict of Interest: Nil

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