Sonologically Assessed Skin to Epiglottic Distance at the Level of the Thyrohyoid Membrane in Predicting Difficult Direct Laryngoscopy: A Cross Sectional Study

Tania James[1], Irfana Hameed[2], Sreedevi C R[3], Anjusha N[4*]

[1]Assistant Professor, Department of Anesthesiology, Govt. Medical College Idukki, Kerala, India
[2]Senior Resident, Department of Anesthesiology, Govt. Medical College Idukki, Kerala, India
[3]Associate Professor, Department of Anesthesiology, Govt. Medical College Idukki, Kerala, India
[4]Consultant, Department of Anesthesiology, Govt. Medical College Idukki, Kerala, India

Abstract:

Purpose: The purpose of this study was to investigate the efficacy of ultrasound-guided measurement of skin to epiglottic distance (SED) at the level of the thyrohyoid membrane in predicting difficult direct laryngoscopy.

Methodology: The study was designed as a cross-sectional investigation conducted within the Department of Anaesthesiology at the Government Medical College, Idukki, over a period of six months following clearance from the Institutional Ethics Committee (IEC).

Result: The study's demographics indicate that the majority of participants were aged between 36 to 55 years (40%), with a female predominance at 68%. Body Mass Index (BMI) analysis showed 54% at a healthy weight, 28% overweight, 14% underweight, and 4% obese. Physiologically, participants had varying vital measurements, including weight (average 59.826 kg), height (average 158.62 cm), systolic blood pressure (average 122.04 mmHg), diastolic blood pressure (average 74.58 mmHg), heart rate (average 69.88 bpm), and skin to epiglottis distance (average 19.56 cm), indicating diverse airway anatomy. The comparison of sonographically assessed skin to epiglottic distance (SED) and Cormack-Lehane grades revealed a significant association ($\chi 2$ = 35.737, p = .000), with SED showing potential as a predictor of difficult laryngoscopy. However, Modified Mallampati classification did not correlate significantly with Cormack-Lehane grades (p = 0.439).

Conclusion: In our study, we found that the Modified Mallampati classification did not show a significant association with Cormack-Lehane grades. In contrast, sonographically assessed SED emerged as a better predictive tool for difficult laryngoscopy compared to Mallampatti classification alone. This suggests that SED may offer more reliable insights into preoperative risk assessment and patient safety during intubation procedures.

Keywords: American Society of Anaesthesiologists , Epiglottic Distance, Skin to Epiglottic Distance.

Introduction

Airway assessment is a critical component of pre-anesthetic evaluation, as securing the airway is paramount to safe anesthesia administration. Traditionally, the prediction of a difficult airway has relied on clinical assessments, incorporating tools like the modified Mallampati classification, inter-incisor gap measurement, sternomental distance, thyromental distance, and assessment of neck mobility. However, these clinical assessments have limitations in terms of sensitivity for predicting difficult laryngoscopy [1].

The complex and intricate anatomical structure of the upper airway poses significant challenges for anesthesiologists, necessitating thorough evaluation to ensure airway integrity. Failure to adequately

manage the airway can lead to severe complications. To enhance airway assessment, ultrasound has emerged as a valuable adjunct, providing detailed insights that complement traditional clinical parameters [2].

The primary aim of this study is to investigate the efficacy of ultrasound-guided measurement of skin to epiglottic distance (SED) at the level of the thyrohyoid membrane in predicting difficult direct laryngoscopy. Previous research, as demonstrated by Parameswari et al., has highlighted the potential of ultrasound in preoperative airway evaluation, with SED showing promising sensitivity and negative predictive value [3]. However, there remains a paucity of studies specifically addressing

the utility of ultrasound-guided SED in predicting difficult direct laryngoscopy, necessitating further investigation in this area.

Methodology

The study was designed as a cross-sectional investigation conducted within the Department of Anaesthesiology at the Government Medical College, Idukki, over a period of six months following clearance from the Institutional Ethics Committee (IEC).

Study Subject's Selection:

- The inclusion criteria encompassed patients categorized under ASA (American Society of Anaesthesiologists) classes 1, 2, and 3, aged 18 years or older, scheduled for elective surgery under General Anaesthesia, and who provided informed consent.
- Exclusion criteria were defined to exclude patients with skin lesions on the anterior neck, pregnant individuals, and those with masses at the level of the thyrohyoid membrane.

Sample Size

The sample size calculation was based on previous research by Parameswari et al., which reported a sensitivity of 75% and a prevalence of difficult intubation at 9.2%. With an alpha of 0.05, Z value of 1.96, and an absolute precision of 5%, the calculated sample size was 33. However, to ensure robustness, 50 participants were included. Sampling was performed using consecutive sampling among eligible patients.

Data Collection Methodology

Data collection involved pre-operative clinical airway assessments, including temporomandibular joint insinuation, mouth opening, thyromental distance, modified Mallampati class, and anthropometry. Additionally, sonographically assessed skin to epiglottic distance (SED) was recorded using a linear high-frequency probe ultrasound machine by an experienced anaesthetist. General anaesthesia was administered on the following day, and direct laryngoscopy was performed to assess Cormack-Lehane grades, with grades 1 and 2A considered easy laryngoscopy and grades 2B,3 and 4 indicating difficult laryngoscopy.

Study Variable

The study variables included demographic details, clinical airway assessment parameters, and sonologically assessed SED. The primary outcome variable was the occurrence of difficult laryngoscopy, assessed by Cormack-Lehane grades.

Data Analysis

Data were entered into MS Excel and analyzed using SPSS software, Ethical clearance was obtained from the Institutional Ethics Committee before the commencement of the study.

Results

1. **Basic Demographic Details:** The study's demographics revealed notable trends, with the largest participant group falling in the 36 to 55-year age bracket, constituting 40% of the cohort. Females dominated the gender distribution at 68%, while males accounted for 32% of participants. Body Mass Index (BMI) analysis showed that 54% of individuals had a healthy weight, with 28% classified as overweight, 14% underweight, and 4% obese.

Table 1: Basic Demographic details

Variables		Frequency	Percent
Age	18-34yrs	17	34.0
	36 to 55 yrs	20	40.0
	55 yrs above	13	26.0
Gender	Female	34	68.0
	Male	16	32.0
BMI	>18 .5 under weight	7	14.0
	18.5-24.9 healthy weight	27	54.0
	25-29.9 over weight	14	28.0
	30 above -over weight	2	4.0
	Total	**50**	**100.0**

2. **Physiological Characteristics:** Physiologically, the participants exhibited a range of vital measurements. Weight varied from 39.0 kg to 90.0 kg, with an average weight of 59.826 kg. Heights ranged from 143 cm to 181 cm, with an average height of 158.62 cm. Blood pressure measurements showed an average systolic blood pressure (SBP) of 122.04 mmHg and an average diastolic blood pressure (DBP) of 74.58 mmHg. Heart rates ranged from 50 bpm to 110 bpm, with an average heart rate of 69.88 bpm. Additionally, the skin to epiglottis dis-

tance measurement ranged from 11.5 cm to 24.1 cm, with an average of 19.56 cm, highlighting variability in airway anatomy among participants. These physiological characteris-

tics provide a comprehensive overview of the participants' health status and physiological parameters.

Table 2: Descriptive Statistics: Physiological Characteristics

	N	Minimum	Maximum	Mean	Std. Deviation
Age	50	18	76	43.28	15.909
Weight	50	39.0	90.0	59.826	13.0014
Height	50	143	181	158.62	9.634
Systolic Blood Pressure(SBP)	50	100	150	122.04	11.553
Diastolic Blood Pressure(DBP)	50	60	92	74.58	7.709
Body mass index(BMI)	50	16.43	35.08	23.63	3.96
Heart Rate(HR)	50	50	110	69.88	10.734
skin to epiglottis distance measurement(SED)	50	11.5	24.1	19.560	2.8096

3. **Sonologically Assessed Skin to Epiglottic Distance (SED) vs. Cormack-Lehane Grade:** The comparison between sonographically assessed skin to epiglottic distance (SED) and Cormack-Lehane grades revealed significant associations ($\chi2 = 35.737$, p = .000). Among participants with SED measurements indicating difficult intubation (>23), 12% experienced difficult laryngoscopy, while none had easy in-

tubation. In the 18-23 SED range, 4% faced difficult intubation, with 68% experiencing easy intubation. Conversely, those with SED measurements less than 18 had 14% difficult intubation and 2% easy intubation. These findings suggest a strong correlation between SED measurements and Cormack-Lehane grades, highlighting the potential of SED as a predictor of difficult direct laryngoscopy.

Table 3.Sonologically Assessed Skin to Epiglottic Distance (SED) vs. Cormack-Lehane Grade:

Variable		Cormack - Lehane grade		Total	X^2, p value
		Difficult Intubation	Easy Intubation		
SED	>23 dffictut intubation	6(12%)	0	6(12%)	35.737
	18-23 easy intubation	2(4%)	34(68%)	36(72%)	P=
	Less than 18 difficult intubation	7(14%)	1(2%)	8(16%)	0.000
Total		15(30%)	35(70%)	50(100)	

4. **Modified Mallampati Classification vs. Cormack-Lehane Grade:** The analysis explored the relationship between Modified Mallampati classification and Cormack-Lehane grades. The classification was divided into difficult and easy intubation categories. Among difficult intubation cases, 33.3% were classified as difficult Mallampati, while among easy intubation cases, 66.7% were classified as easy Mallampati. Statistical testing, however, did

not reveal a significant association between Modified Mallampati classification and Cormack-Lehane grades in this study population (p = 0.439). These findings suggest that while sonologically assessed SED shows promise as a predictive measure for difficult intubation, Modified Mallampati classification may not be as directly correlated with Cormack-Lehane grades in this context.
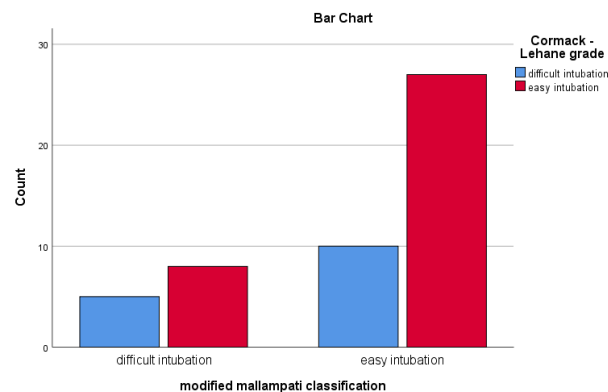
Figure 1: Modified Mallampati Classification vs. Cormack-Lehane Grade:

Discussion

The results of our study shed light on the efficacy of different airway assessment measures in predicting difficult laryngoscopy. Firstly, our findings regarding sonographically assessed Skin to Epiglottic Distance (SED) revealed a strong correlation with Cormack-Lehane grades, indicating its potential as a predictive measure for difficult direct laryngoscopy. Participants with SED measurements indicative of difficult intubation (>23) experienced a notably higher rate of difficult laryngoscopy compared to those with SED measurements suggesting easier intubation. This underscores the value of incorporating SED measurements into preoperative airway evaluations, providing clinicians with valuable insights into potential airway challenges during intubation procedures.

In contrast, our analysis of Modified Mallampati classification and Cormack-Lehane grades did not yield a significant association in this study population. While the Modified Mallampati classification has been traditionally used as a bedside predictor for difficult laryngoscopy, our results suggest that its correlation with Cormack-Lehane grades may not be as direct in this context. This highlights the limitations of relying solely on traditional bedside predictors and emphasizes the need for more advanced techniques, such as sonographically assessed parameters like SED, in preoperative airway assessment protocols.

Our findings align with prior research that has emphasized the shortcomings of traditional bedside predictors, such as neck circumference, modified Mallampati classification, thyromental distance, and maximum mouth opening, in accurately predicting difficult laryngoscopy. The meta-analysis by Lundstrøm et al. [5]and studies by Wang et al. [6] and Baker et al. [7]have highlighted the limitations and errors associated with these predictors, particularly in specific patient populations or when relying on external landmarks for measurements.

Parameswari et al.'s prospective study in adult patients demonstrated a correlation between preoperative ultrasonographic airway assessment and laryngoscopic view, providing valuable insights into the predictive capabilities of ultrasound in assessing airway anatomy [8]. This aligns with our study's emphasis on sonographically assessed Skin to Epiglottic Distance (SED) as a predictive measure for difficult direct laryngoscopy, highlighting the growing importance of ultrasound techniques in preoperative airway evaluations. Additionally, Yadav et al.'s study on ultrasound measurement of anterior neck soft tissue and tongue thickness to predict difficult laryngoscopy observed a significant difference in ultrasound parameters between easy and difficult laryngoscopy cases, further supporting the utility of ultrasound in predicting airway difficulties during intubation procedures [9]. Their findings complement our study's emphasis on advanced airway assessment methods like airway ultrasound, reinforcing the need for comprehensive approaches in preoperative airway assessments to enhance predictive accuracy and patient safety.

The significance of our study lies in highlighting the potential of sonographically assessed SED as a valuable tool in predicting difficult direct laryngoscopy, complementing and potentially surpassing the predictive capabilities of traditional bedside predictors. However, further research is warranted to validate these findings across diverse patient populations and clinical settings. Incorporating advanced techniques like airway ultrasound into routine preoperative assessments can enhance predictive accuracy, improve patient safety, and optimize procedural outcomes during intubation procedures

Conclusion

In our study, we found that the Modified Mallampati classification did not show a significant association with Cormack-Lehane grades. In contrast, sonographically assessed SED emerged as

a better predictive tool for difficult laryngoscopy compared to Mallampatti classification alone. This suggests that SED may offer more reliable insights into preoperative risk assessment and patient safety during intubation procedures.

References

1. Shiga T, Wajima ZI, Inoue T, Sakamoto A. Predicting difficult intubation in apparently normal patients: a meta-analysis of bedside screening test performance. The Journal of the American Society of Anesthesiologists. 2005 Aug 1;103(2):429-37.
2. Pinto J, Cordeiro L, Pereira C, Gama R, Fernandes HL, Assunção J. Predicting difficult laryngoscopy using ultrasound measurement of distance from skin to epiglottis. Journal of critical care. 2016 Jun 1; 33:26-31.
3. Carsetti A, Sorbello M, Adrario E, Donati A, Falcetta S. Airway ultrasound as predictor of difficult direct laryngoscopy: a systematic review and meta-analysis. Anesthesia & Analgesia. 2022 Apr 1;134(4):740-50.
4. Sotoodehnia M, Rafiemanesh H, Mirfazaelian H, Safaie A, Baratloo A. Ultrasonography indicators for predicting difficult intubation: a systematic review and meta-analysis. BMC Emergency Medicine. 2021 Jul 3;21(1):76.
5. Lundstrøm LH, Vester-Andersen M, Møller AM, Charuluxananan S, L'hermite J, Wetterslev J. Poor prognostic value of the modified Mallampati score: a meta-analysis involving 177 088 patients. British journal of anaesthesia. 2011 Nov 1;107(5):659-67.
6. Wang B, Peng H, Yao W, Guo L, Jin X. Can thyromental distance be measured accurately?. Journal of Clinical Monitoring and Computing. 2018 Oct; 32:915-20.
7. Baker PA, Depuydt A, Thompson JM. Thyromental distance measurement–fingers don't rule. Anaesthesia. 2009 Aug;64(8):878-82.
8. Parameswari A, Govind M, Vakamudi M. Correlation between preoperative ultrasonographic airway assessment and laryngoscopic view in adult patients: A prospective study. Journal of Anaesthesiology Clinical Pharmacology. 2017 Jul 1;33(3):353-8.
9. Yadav, N. K., Rudingwa, P., Mishra, S. K., & Pannerselvam, S. (2019). Ultrasound measurement of anterior neck soft tissue and tongue thickness to predict difficult laryngoscopy - An observational analytical study. Indian journal of anaesthesia, 2019; 63(8):629–634.