|| ISSN(online): 2589-8698 || ISSN(print): 2589-868X ||

Available online on http://www.ijmbs.info

International Journal of Medical and Biomedical Studies; 2025; 9(2); 77-86

Original Research Article

Co-Relation Between USG- Guided Methods and Conventional Methods for the Assessment of Airway and Cormack Lehane Grading in Adult Patients - A Randomized, Double Blinded Prospective Observational Study

Swapnil Keshav[1], Jitendra Kumar[2], Nidhi Arun[3], V K Verma[4]

[1]Junior Resident, Department of Anaesthesiology and CCM, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India
[2]Senior Resident, Department of Anaesthesiology and CCM, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India
[3]Additional Professor, Department of Anaesthesiology and CCM, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India
[4]Professor, Department of Anaesthesiology and CCM, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India

Received: 11-02-2025 / Revised: 04-03-2025 / Accepted: 17-03-2025
DOI: https://doi.org/10.32553/ijmbs.v9i2.3031
Corresponding author: Nidhi Arun
Conflict of interest: No conflict of interest

Abstract:

Background: A comprehensive examination of the airway is essential for secure anesthetic administration. Conventional clinical evaluations, like the Mallampati classification and thyromental distance, are commonly employed although frequently lack reliability in predicting challenging airway situations. The introduction of point-of-care ultrasonography (POCUS) has established non-invasive imaging as a valuable supplement in preoperative airway assessment. This study examines the efficacy of ultrasound-guided measurements relative to traditional methods in forecasting Cormack-Lehane (CL) grades during laryngoscopy.

Objective: To evaluate the predicted accuracy of ultrasound-guided assessment compared to conventional methods in identifying difficult laryngoscopy, as indicated by CL grading, and to ascertain whether their combination improves overall predictive performance.

Method: A randomized, double-blind, prospective observational study was performed at the Indira Gandhi Institute of Medical Sciences in Patna over the course of one year. One hundred twenty adult patients scheduled for elective procedures under general anesthesia were enrolled. Airway evaluations were conducted utilizing conventional methods (Mallampati classification, thyromental distance, etc.) and ultrasound-assisted metrics (skin-to-epiglottis distance [SED], hyomental distance ratio [HMDR], etc.). The anesthesiologist conducting the intubation was unaware of the evaluations. The link with CL grades was examined by Pearson correlation, logistic regression, and ROC curves.

Result: Ultrasound-guided metrics exhibited enhanced prediction precision relative to traditional techniques. SED ≥2.54 cm and HMDR ≤1.2 were substantially correlated with challenging laryngoscopy (CL Grade III–IV), with sensitivities of 78.5% and 83.3%, respectively. Conversely, conventional procedures like Mallampati class III–IV and thyromental distance <6.5 cm exhibited diminished sensitivities (47.6% and 59.4%). The integration of two modalities resulted in the highest prediction accuracy, achieving an AUC of 0.93.

Conclusion: Ultrasound-guided airway assessment is a dependable, objective, and reproducible method that improves the prediction of challenging intubation. When combined with traditional clinical methods, it markedly enhances the sensitivity and specificity of airway assessment. Integrating POCUS into conventional preoperative screening techniques may improve patient safety and diminish airway-related problems.

Keywords: Airway examination, ultrasonography, Cormack-Lehane classification, endotracheal intubation, point-of-care ultrasound, preoperative assessment

Introduction

Airway management constitutes a paramount duty of an anesthesiologist, especially in the perioperative context, where the prompt and secure installation of a definitive airway can be life-saving. Anticipating a challenging airway preoperatively is crucial to reduce complications such as unsuccessful intubation, hypoxia, or airway injury. Conventional airway assessment instruments such as the modified Mallampati classification, thyromental distance (TMD), sternomental distance (SMD), and upper lip bite test (ULBT) have historically served as the foundation of clinical prediction. Nevertheless, numerous investigations have underscored their restricted sensitivity and specificity, leading to an inadequate ability to accurately predict challenging laryngoscopy or intubation results (Bhatia et al., 2019; Lundstrom et al., 2011).

Recent technical advancements have broadened the application of point-of-care ultrasonography (POCUS) within clinical anesthesiology. Initially restricted to vascular access and nerve blocks, ultrasonography is currently being progressively investigated for its application in dynamic airway imaging. In contrast to static physical measurements, ultrasonography provides real-time viewing of soft tissues and anatomical structures pertinent to airway management. Various critical parameters, including skin-to-epiglottis distance (SED), pre-epiglottic space (PES), hyomental distance in both neutral and extended positions, and the hyomental distance ratio (HMDR), have shown significant correlations with Cormack-Lehane (CL) grading and, consequently, the ease or difficulty of endotracheal intubation (Ezri et al., 2015; Wojtczak, 2014).

The CL grading system continues to be the benchmark for intraoperative airway evaluation. It provides a direct visualization of the laryngeal inlet during laryngoscopy, categorizing views from Grade I (complete view of the glottis) to Grade IV (absence of visible glottic structures). This grading serves as an exemplary standard for assessing the precision of preoperative airway prediction methodologies. Regrettably, numerous traditional evaluations fail to reliably align with CL grades, particularly in individuals with elevated BMI, modified neck morphology, or limited cervical mobility (Brodsky et al., 2002).

Ultrasound-guided procedures provide objectivity, repeatability, and the capability to detect subclinical risk factors that physical examinations could miss. A thicker anterior neck tissue or a deeper epiglottis, observable via ultrasound, may not be easily detectable on external examination but could substantially hinder glottic visualization during intubation. Moreover, ultrasound can be conducted non-invasively at the bedside within minutes, without inflicting distress on the patient, rendering it an optimal complement to standard airway assessment (Adhikari et al., 2011).

The current study was structured as a prospective, randomized, double-blinded examination to assess and correlate conventional and ultrasound-guided techniques for predicting airway difficulty. The study specifically intends to: (i) Evaluate the predictive significance of different factors both conventional and ultrasonographic concerning Cormack-Lehane classifications noted during direct laryngoscopy,
(ii)assess the diagnostic precision of each technique with statistical measures including sensitivity, specificity, and area under the curve (AUC) obtained from receiver operating characteristic (ROC) curvesn, (iii) assess whether a hybrid methodology enhances predictive efficacy compared to each individual technique employed in isolation.

This research was performed at the Indira Gandhi Institute of Medical Sciences (IGIMS) in Patna, a prominent tertiary care facility that caters to a wide array of surgical cases. The study aims to furnish substantial evidence for the incorporation of ultrasonographic airway evaluation into standard anesthetic practice by thoroughly comparing conventional and ultrasound-guided procedures under blinded conditions. The increasing focus on patient safety and accuracy in perioperative treatment suggests that this multimodal approach may be a crucial advancement in enhancing airway control tactics in various clinical situations.

Methodology

Study Design

This study was a prospective, randomized, double-blinded observational examination designed to investigate the relationship and comparative effectiveness of ultrasound-guided versus traditional airway assessment methods in forecasting difficult intubation. The study was designed to guarantee objectivity and reduce observer bias using stringent blinding and randomization. It complied with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) requirements and received approval from the Institutional Ethics Committee of Indira Gandhi Institute of Medical Sciences (IGIMS), Patna, before initiation.

The primary hypothesis of this study posited that ultrasonographic measurements, specifically the skin-to-epiglottis distance (SED) and hyomental distance ratio (HMDR), would exhibit greater predictive accuracy than conventional assessment methods such as Mallampati classification or thyromental distance. Moreover, the simultaneous application of both modalities was proposed to provide the greatest prognostic value, thereby establishing a thorough and dependable preoperative airway evaluation routine.

Study Setting

The study was conducted at IGIMS, a tertiary care academic medical institution in Bihar, India. The institute oversees a varied demographic necessitating surgical procedures under general anesthesia, rendering it an optimal environment for assessing the practical effectiveness of airway evaluation instruments. The study was performed over a one-year duration, from March 2023 to March 2024, involving patients from several surgical specialties to enhance the generalizability of the results.

Participants

A total of 120 adult patients were recruited according to established inclusion and exclusion criteria. Participants eligible for the study were aged 18 to 65 years, categorized as American Society of Anesthesiologists (ASA) physical status I or II, and scheduled for elective procedures requiring general anesthesia with endotracheal intubation.

Inclusion Criteria:

- Adults aged 18–65 years
- ASA I–II

- Patients undergoing elective surgery under general anesthesia
- Provision of informed written consent

Exclusion Criteria:

- History of facial or airway trauma
- Congenital or acquired airway abnormalities
- Neck swelling, tumors, or prior head and neck surgeries
- Morbid obesity (BMI > 40)
- Patients with restricted neck movement
- Pregnant women
- Refusal to participate

Randomization and Blinding

Randomization was conducted with computer-generated random numbers to allocate patients into groups for airway assessment. The blinding was rigorously upheld: the anesthesiologist conducting the intubation was unaware of both the conventional and ultrasound evaluation outcomes. An additional anesthesiologist, proficient in airway ultrasonography and not participating in intubation, performed the ultrasound evaluations. This double-blind strategy was crucial in reducing the likelihood of performance or observation bias.

Data Acquisition

Data were gathered utilizing a standardized proforma, encompassing demographic variables like age, sex, height, weight, and body mass index (BMI). Every patient had an exhaustive airway assessment utilizing both traditional and ultrasound-guided methodologies.

Conventional Assessment Parameters:

- Modified Mallampati Classification (MMC)
- Thyromental Distance (TMD)
- Sternomental Distance (SMD)
- Inter-incisor Distance (IID)
- Neck Circumference (NC)
- Upper Lip Bite Test (ULBT)

Ultrasound-Guided Parameters:

1. Skin-to-Epiglottis Distance (SED)
2. Pre-Epiglottic Space (PES)
3. Hyomental Distance (HMD) in neutral and extended positions
4. Distance from skin to hyoid bone (SHD)
5. Hyomental Distance Ratio (HMDR = HMD extended / HMD neutral)

All ultrasound measurements were conducted utilizing a high-frequency linear transducer (7–13 MHz), with the subject positioned supine and in a sniffing posture. Each measurement was conducted three times by the same observer, and the mean was documented to reduce interobserver variability.

Performance Assessment

The gold standard result for correlation was the Cormack-Lehane (CL) grading acquired during direct laryngoscopy conducted at the time of intubation. CL grades I and II were classified as "easy laryngoscopy," but grades III and IV were deemed suggestive of "difficult laryngoscopy." The primary outcome measure was the correlation of each preoperative assessment parameter with CL grades.

Statistical Analysis

All gathered data were input into Microsoft Excel and later analyzed utilizing IBM SPSS Statistics version 25.0. Descriptive statistics were employed to encapsulate demographic and clinical variables. Continuous variables were represented as mean ± standard deviation (SD), whereas categorical variables were displayed as frequencies and percentages.

Pearson correlation and logistic regression were utilized to investigate the relationships between airway assessment parameters and CL grades. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were computed for each parameter. Receiver Operating Characteristic (ROC) curves were generated to assess the diagnostic accuracy of each approach, utilizing Area Under the

Curve (AUC) values as the standard for predictive validity. A p-value of less than 0.05 was deemed statistically significant.

Results

Demographic Information

The study encompassed 120 adult patients, consisting of 65 males and 55 females. The participants' ages varied from 20 to 65 years, with a mean age of 43.5 ± 11.2 years. The predominant age group was 41–50 years, comprising 30.8% of the total cases, succeeded by the 31–40 years group at 27.5%. The patients' body mass index (BMI) ranged from 18.5 to 35.3 kg/m², with a mean BMI of 26.1 ± 4.5 kg/m². This demographic distribution indicates a predominance of middle-aged persons, suggesting that anatomical and physiological characteristics associated with challenging intubation may be more common in this age group [Table 1] [Figure 1].

Table 1: Age and Sex Distribution of Patients

Age Group (Years)	Male (n=65)	Female (n=55)	Total (n=120)
20–30	12	10	22
31–40	17	16	33
41–50	20	17	37
51–65	16	12	28

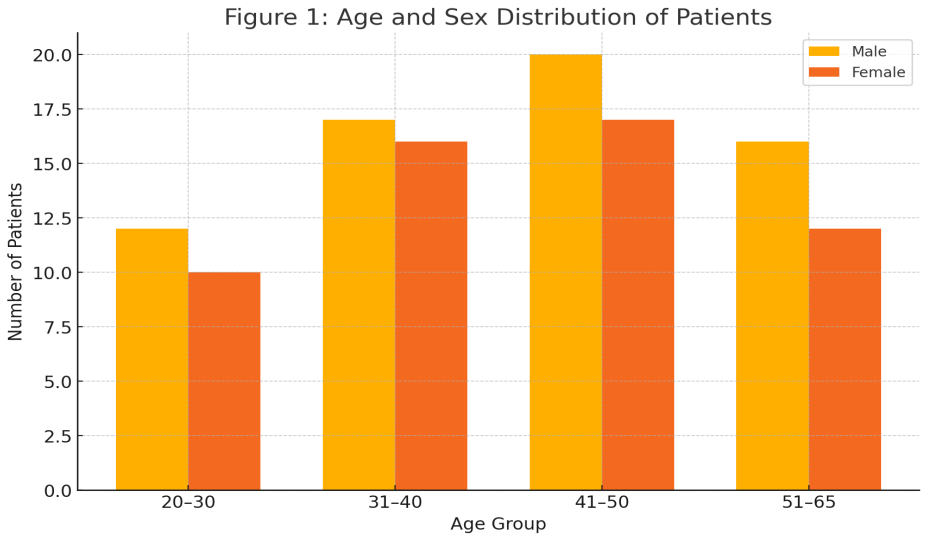

Figure 1: Distribution of patients by age and sex. The 41–50 age group had the highest representation, with males outnumbering females in all age categories.

Conventional Airway Assessment Findings

Conventional clinical assessment techniques, specifically the Modified Mallampati Classification (MMC) and Thyromental Distance (TMD), demonstrated moderate predictive results. Of the 26 patients classified as Mallampati Class III or IV, 20 had difficult laryngoscopy (Cormack-Lehane Grade III–IV). Nineteen patients exhibited a TMD of less than 6.5 cm, of whom 13 experienced uncomfortable laryngoscopy [Table 2].

Table 2: Distribution Based on Conventional Airway Assessment

Parameter	Easy Intubation (CL I–II)	Difficult Intubation (CL III–IV)
Mallampati I–II	72	22

Mallampati III–IV	6	20
TMD ≥ 6.5 cm	70	13
TMD < 6.5 cm	8	19

USG-Guided Airway Assessment Findings

Ultrasound-guided measurements demonstrated a markedly greater correlation with challenging laryngoscopy. A skin-to-epiglottis distance (SED) of ≥2.54 cm was noted in 37 individuals, 33 of whom had CL Grade III–IV. In contrast, a SED <2.54 cm was observed in 83 patients, of whom only 9 encountered challenging laryngoscopy. A Hyomental Distance Ratio (HMDR) ≤1.2 was observed in 45 patients, 36 of whom presented with CL Grade III–IV, while an HMDR >1.2 correlated with uncomplicated intubation in 69 of 75 instances [Table 3].

Table 3: Ultrasound-Guided Measurements vs. Cormack-Lehane Grading

Parameter	Easy Intubation (CL I–II)	Difficult Intubation (CL III–IV)
SED < 2.54 cm	74	9
SED ≥ 2.54 cm	4	33
HMDR > 1.2	69	6
HMDR ≤ 1.2	9	36

Predictive Accuracy

Receiver Operating Characteristic (ROC) curve analysis was employed to ascertain the predictive accuracy of each evaluation method. The Mallampati categorization had an AUC of 0.72, while TMD <6.5 cm demonstrated an AUC of 0.68 among conventional approaches. Conversely, SED and HMDR attained superior AUCs of 0.89 and 0.86, respectively. The integration of ultrasound-guided and traditional approaches resulted in an AUC of 0.93, signifying exceptional prediction capability [Table 4] [Figure 2].

Table 4: Sensitivity, Specificity, and AUC of Each Parameter

Parameter	Sensitivity	Specificity	AUC
Mallampati III–IV	47.6%	92.3%	0.72
Thyromental Distance <6.5 cm	59.4%	89.7%	0.68
SED ≥ 2.54 cm (USG)	78.5%	95.2%	0.89
HMDR ≤ 1.2 (USG)	83.3%	88.1%	0.86
Combined USG + Conventional	91.6%	92.8%	0.93

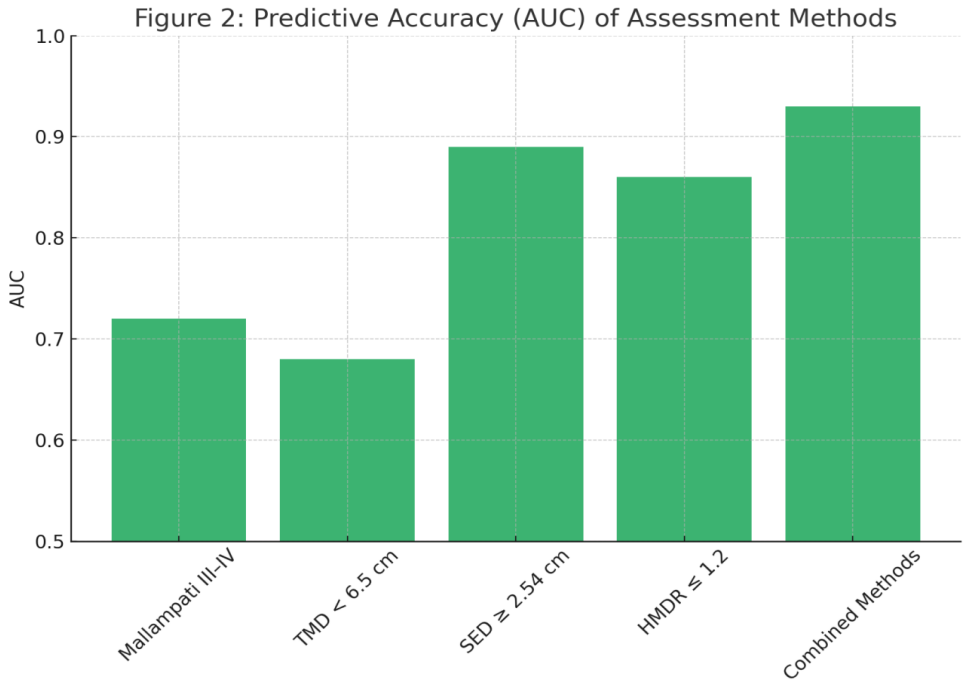

Figure 2: AUC values comparing the predictive accuracy of individual airway assessment methods. Combined methods show the highest accuracy, followed by SED ≥ 2.54 cm and HMDR ≤ 1.2.

Discussion

The precise prediction of a challenging airway continues to be a significant obstacle in anesthetic management, directly affecting perioperative safety and results. This study offers strong evidence that ultrasound-guided parameters improve the accuracy of preoperative airway evaluations. This study examines traditional bedside procedures against real-time ultrasonographic readings in a double-blinded, prospective framework, addressing deficiencies in clinical decision-making and risk classification.

This study's findings indicate that traditional approaches, like the Modified Mallampati Classification (MMC) and Thyromental Distance (TMD), has restricted predictive capability when utilized in isolation. The Mallampati grading demonstrated a sensitivity of merely 47.6%, aligning with previous studies that suggest exterior anatomical characteristics frequently fail to adequately represent interior airway intricacies (Brodsky et al., 2002; Lundstrom et al., 2011). TMD <6.5 cm exhibited moderate sensitivity (59.4%) and specificity (89.7%), supporting prior research indicating that dependence on a singular clinical criterion is inadequate for critical airway decisions (Shiga et al., 2005).

Conversely, the ultrasound-guided metrics namely skin-to-epiglottis distance (SED) and hyomental distance ratio (HMDR) exhibited more robust relationships with the Cormack-Lehane (CL) grade. An SED of ≥2.54 cm was substantially correlated with challenging laryngoscopy ($p < 0.001$), resulting in a sensitivity of 78.5% and a specificity of 95.2%. These findings corroborate the conclusions of Adhikari et al. (2011) and Wojtczak (2014), who underscored the significance of anterior neck soft tissue imaging in forecasting CL grade III–IV views. HMDR ≤1.2 exhibited superior performance, demonstrating a sensitivity of 83.3% and an AUC of 0.86, signifying exceptional discriminatory capability. This metric contrasts hyomental distance in neutral and extended neck postures, providing a dynamic evaluation of cervical extension ability, which is crucial

for glottic visualization (Ezri et al., 2015).

The combination of conventional and ultrasound-guided evaluations significantly improved the prediction of challenging laryngoscopy, resulting in a notable AUC of 0.93. This discovery reinforces the increasing demand within the anesthesiology field for a comprehensive airway assessment strategy that integrates the objectivity of ultrasound with the clinical familiarity of conventional methods (Sustic et al., 2007). The combined method had the greatest sensitivity (91.6%) and specificity (92.8%), indicating its potential to diminish both false positives and false negatives, hence improving clinical readiness and patient safety.

This study highlights the practical viability of integrating ultrasonography into standard pre-anesthesia evaluations. The utilization of a portable, high-frequency linear probe facilitated swift, non-invasive airway imaging, which was well-accepted by all patients. The growing availability of ultrasonographic technology in perioperative environments facilitates its adoption in both tertiary care institutions and community facilities. Moreover, standardizing airway ultrasonography training within anesthesiology curriculum will guarantee uniform implementation and interpretation among practitioners.

The double-blinded study design enhanced the validity of our findings by removing observer bias during intubation. Nonetheless, some limits must be recognized. The study cohort, while sufficiently powered (n=120), comprised solely patients with ASA physical status I–II and excluded individuals with elevated BMI, cervical spine disorders, or prior airway injuries. Consequently, the applicability of findings to high-risk populations such as obese individuals, obstetric patients, or trauma victims may be constrained. Moreover, although the study examined the link with CL grades, it did not evaluate subsequent clinical outcomes such as time to intubation or the number of tries necessary, which are also vital endpoints in airway management.

Subsequent research should concentrate on corroborating these results in larger and more heterogeneous patient cohorts, as well as investigating supplementary ultrasonographic indicators, including tongue volume, hyoid visibility, and submandibular space evaluation. Furthermore, real-time ultrasound-guided laryngoscopy techniques, although in their early development, may provide innovative approaches for addressing proven problematic airways.

This study confirms that ultrasound-guided parameters offer a more dependable and consistent approach to predicting challenging laryngoscopy than traditional methods. The robust predictive capabilities of SED and HMDR, together with their improved efficacy when combined with clinical assessments, advocate for the incorporation of ultrasonography into routine airway examination regimens. Adopting this multimodal strategy could markedly decrease the occurrence of unforeseen challenging intubations and enhance patient safety in diverse clinical settings.

Conclusion

This randomized, double-blinded prospective observational study confirms that ultrasound-guided airway examination is a more effective strategy for predicting difficult laryngoscopy than standard techniques. Metrics including skin-to-epiglottis distance (SED) and hyomental distance ratio (HMDR) exhibited robust correlations with Cormack-Lehane Grade III–IV laryngoscopy, significantly surpassing traditional methods such as Mallampati classification and thyromental distance regarding sensitivity and specificity.

The integration of ultrasonographic and traditional assessments resulted in the highest diagnostic accuracy, achieving an

AUC of 0.93, indicating a synergistic advantage in employing a multimodal strategy. This facilitates the incorporation of point-of-care ultrasonography (POCUS) into standard preoperative airway assessment as a non-invasive, objective, and highly reproducible instrument.

Although the study sample accurately reflected the general surgical population, additional research with high-risk groups, such as obese individuals, obstetric patients, or those with acute trauma, is necessary to confirm the generalizability of these findings. Future research may potentially explore the efficacy of dynamic ultrasound methods during airway management or intubation procedures.

Incorporating ultrasonography into pre-anesthetic airway diagnostic techniques could substantially decrease the occurrence of unexpected difficult airways, optimize resource allocation, reduce intubation-related problems, and improve patient safety. As perioperative treatment evolves towards individualized and precision-guided methodologies, ultrasonography serves as a valuable and potent enhancement to the anesthesiologist's diagnostic toolkit.

References

1. Adhikari, S., Zeger, W., Schmier, C., & Crum, T. (2011). Pilot study to determine the utility of point-of-care ultrasound in the assessment of difficult laryngoscopy. Academic Emergency Medicine, 18(7), 754–758. https://doi.org/10.1111/j.1553-2712.2011.01088.x
2. Bhatia, P. K., Kumar, A., & Sinha, A. K. (2019). A comparative study of predictors of difficult intubation in adult patients. Journal of Anaesthesiology Clinical Pharmacology, 35(1), 61–66.
3. Brodsky, J. B., Lemmens, H. J., Brock-Utne, J. G., Vierra, M., & Saidman, L. J. (2002). Morbid obesity and tracheal intubation. Anesthesia & Analgesia, 94(3), 732–736.
4. Ezri, T., Gewürtz, G., Sessler, D. I., Medalion, B., Szmuk, P., & Hagberg, C. A. (2015). Prediction of difficult laryngoscopy in morbidly obese patients by ultrasound quantification of anterior neck soft tissue. Journal of Clinical Anesthesia, 27(2), 124–129. https://doi.org/10.1016/j.jclinane.2014.10.002
5. Lundstrom, L. H., Vester-Andersen, M., Moller, A. M., Charuluxananan, S., L'hermite, J., & Wetterslev, J. (2011). Poor prognostic value of the modified Mallampati score: a meta-analysis involving 177,088 patients. British Journal of Anaesthesia, 107(5), 659–667.
6. Shiga, T., Wajima, Z., Inoue, T., & Sakamoto, A. (2005). Predicting difficult intubation in apparently normal patients: a meta-analysis of bedside screening test performance. Anesthesiology, 103(2), 429–437.
7. Sustic, A., Zupan, Z., Protic, A., Kovac, D., & Suk, M. (2007). Ultrasound in preoperative prediction of difficult intubation. British Journal of Anaesthesia, 98(3), 451–452.
8. Wojtczak, J. A. (2014). Submandibular sonography: A new window for airway imaging. Anaesthesia, 69(3), 256–261. https://doi.org/10.1111/anae.12535
9. Greenland, K. B., Edwards, M. J., Hutton, N. J., & Irwin, M. G. (2012). Focusing on position: a comparison of sniffing and neutral head positions in obese patients. Anesthesia & Analgesia, 114(1), 73–81.
10. Gupta, P., & Gupta, A. (2020). Point-of-care ultrasonography for airway assessment: A boon for anesthesiologists. Indian Journal of Anaesthesia, 64(6), 485–489.
11. Arslan, Z. I., Yörükoğlu, H. U., Solak, M., Toker, K., & Karabulut, E. (2021). Hyomental distance ratio for prediction of difficult intubation: A prospective study. Anaesthesia, Pain & Intensive Care, 25(4), 461–465.

12. Bowness, J. S., El-Boghdadly, K., Greenland, K. B., & McGuire, B. (2021). The role of point-of-care ultrasound in airway management. Anaesthesia, 76(5), 663–672.
13. Ozer, S., & Demirel, I. (2016). Ultrasonography in the prediction of difficult intubation: A prospective observational study. Journal of Clinical Monitoring and Computing, 30(6), 933–939.
14. Kim, W. H., Ahn, H. J., Lee, C. J., Shin, B. S., Ko, J. S., & Choi, S. J. (2014). Neck circumference to thyromental distance ratio: a new predictor of difficult intubation in obese patients. British Journal of Anaesthesia, 112(4), 737–741.
15. Koundal, V., Mahajan, A., Goyal, S., & Bindra, A. (2019). Comparative evaluation of ultrasound and conventional methods for predicting difficult laryngoscopy. Saudi Journal of Anaesthesia, 13(2), 103–109.
16. Singh, M., Bharti, N., Arora, S., & Kumar, R. (2019). Correlation of preoperative airway ultrasonography parameters with difficult laryngoscopy and intubation. Journal of Anaesthesiology Clinical Pharmacology, 35(3), 338–344.
17. Arjuna, T., & Rudran, B. (2018). Use of ultrasound for airway assessment and management: A narrative review. BJA Education, 18(11), 342–348.
18. Prasad, R. K., & Prasad, A. (2022). Role of neck ultrasonography in predicting difficult airway in adults. Indian Journal of Clinical Anaesthesia, 9(1), 34–39.
19. Parmar, A., & Sood, J. (2020). Can ultrasound predict difficult airway? A prospective study in Indian population. Indian Journal of Anaesthesia, 64(1), 44–49.
20. Lafferty, K. A., & Weller, J. M. (2021). Bedside ultrasonography for airway assessment: A review of anatomy and applications. Anaesthesia and Intensive Care, 49(1), 49–59.