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MODERN PREDICTORS OF DIFFICULT AIRWAY IN ANESTHESHIA: A NARRATIVE REVIEW

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ABSTRACT

Accurate prediction of a difficult airway remains a persistent challenge in anesthesia, as failure to identify risk preoperatively can lead to hypoxaemia, prolonged attempts, airway trauma, and critical complications. Traditional bedside predictors—such as the Modified Mallampati Classification, thyromental distance, inter-incisor gap, upper lip bite test, and assessment of neck mobility are widely used because they are quick and non-invasive, yet recent evidence consistently demonstrates that these single-parameter tests have low sensitivity, high inter-observer variability, and limited predictive accuracy when used alone.

In response, modern approaches increasingly incorporate advanced techniques, particularly point-of-care ultrasound (POCUS), which provides objective measurements of upper-airway structures including the distance from skin to epiglottis, tongue thickness, hyomental distance ratios, pre-epiglottic space, and anterior neck soft-tissue thickness that correlate strongly with difficult laryngoscopy. Videolaryngoscopy further enhances airway assessment by enabling pre-induction visualization of the glottic inlet and identification of anatomical challenges not captured by bedside tests. Recent studies and guidelines highlight the superiority of integrative, multimodal models that combine traditional predictors with ultrasound-derived measurements and VL assessment, demonstrating significantly improved diagnostic performance and higher AUC values than any single method.

These multimodal strategies are now incorporated into clinical decision-making frameworks, including pathways determining the need for awake versus asleep intubation, as emphasized in the 2022 ASA Difficult Airway Guidelines. Overall, contemporary evidence shows a clear shift toward standardized, reproducible, and objective multimodal airway assessment to reduce the incidence of unexpected difficult airways and improve patient safety.

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1. Introduction

Accurate preoperative prediction of a difficult airway remains a major challenge in anesthetic and perioperative care. Failure to anticipate airway difficulty may lead to prolonged intubation attempts, hypoxaemia, aspiration, airway trauma, and in extreme cases, catastrophic outcomes. Although traditional bedside screening tools such as the Modified Mallampati Classification, thyromental distance, inter-incisor gap, and neck mobility assessments remain widely used, studies in recent years have repeatedly demonstrated their limited sensitivity, significant inter-observer variability, and modest predictive value when used in isolation. For example, a global research review published in 2023 noted that despite the variety of tools available for difficult airway prediction, "unanticipated" difficult airways still occur frequently, signalling the need for more robust predictors.[1]

In response to these limitations, attention has increasingly shifted toward advanced modalities for airway assessment. Among these, point-of-care ultrasound (POCUS) of the upper airway has emerged as a particularly promising technique: real-time sonographic measurements such as the distance from skin to epiglottis, tongue thickness, hyomental distance, and other peripharyngeal soft-tissue metrics have shown stronger correlation with difficult laryngoscopy or intubation than many traditional tests. For instance, a 2023 diagnostic-accuracy study published in Anaesthesia showed that POCUS of upper airway structures significantly improved prediction of difficult airway scenarios. [2,3]

Moreover, integrative predictive models which combine conventional clinical assessment with ultrasound-derived anatomical metrics—are being developed and validated. One recent 2024 study described a novel risk score amalgamating ultrasound measurements with classic bedside tests, achieving an area under the receiver-operating characteristic curve (AUC) of 0.84 (95% CI 0.74–0.95) for predicting difficult laryngoscopy.[4]

Given this evolving evidence base, this narrative review aims to critically synthesise current advances in difficult-airway prediction with particular emphasis on ultrasound-derived anatomical measurements and combined predictive models compare their performance with traditional bedside techniques, and explore the implications for clinical decision-making in anesthesia.

2. Discussion

2.1 Traditional Airway Predictor and Its Limitation

2.1.1 Modified Mallampati Classification

The Modified Mallampati Classification (MMC) is one of the most widely used bedside tools for pre-anaesthetic airway assessment. It evaluates the relationship between the base of the tongue and the oropharyngeal cavity to estimate how much of the posterior pharyngeal structures are visible when the mouth is fully opened. In its current, widely adopted form, the test is performed with the patient in a sitting position, mouth maximally open, tongue fully protruded, and without phonation, and the oropharyngeal view is categorized into four classes (I–IV) based on visibility of the soft palate, uvula, fauces, and pillars. A review emphasizes that the Mallampati score is a rapid, simple, and non-invasive method that can be incorporated into routine clinical practice across operating rooms, emergency departments, and critical care settings.[5,6]

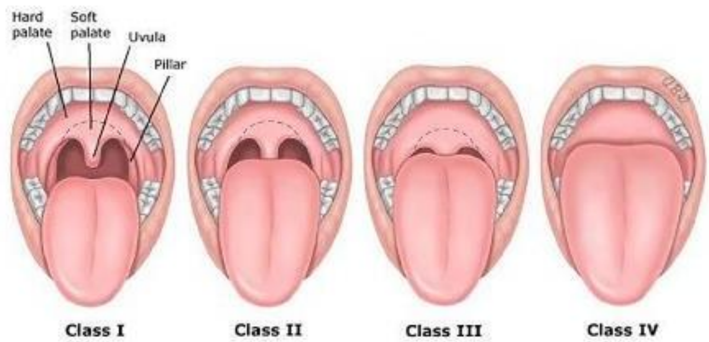

Figure 1. Modified Mallampati Test : Class I: Soft palate, fauces, uvula, and pillars all visible ; Class II: Soft palate, fauces, and major portion of uvula visible; Class III: Only soft palate and base of uvula visible; Class IV: Only hard palate visible[7]

Modified Mallampati test described as a core component of pre-anaesthetic airway assessment, typically combined with other physical examination findings such as thyromental distance, mouth opening, dentition, and cervical spine mobility. The 2022 American Society of Anesthesiologists (ASA) Difficult Airway Guidelines include the Modified Mallampati score among recommended pre-operative measurements (along with thyromental and sternomental distance, inter-incisor distance, and neck circumference), but stress that no single bedside test should be used in isolation for decision-making.[8]

From a performance standpoint, recent evidence confirms that the Modified Mallampati test functions more as a risk factor than a stand-alone predictor of difficult intubation. In a 2024 systematic review and meta-analysis of preoperative difficult airway prediction methods including 227 studies and 686,089 patients, Wang et al. reported that the Modified Mallampati test had a sensitivity of 0.39 and specificity of 0.86 for predicting difficult tracheal intubation.[4] This pattern relatively high specificity but low sensitivity—means that a high Mallampati class (III–IV) tends to increase the likelihood of difficulty, but many difficult airways will still present with lower classes (I–II). The same review concluded that traditional physical examination tests (including Mallampati, thyromental distance, and upper lip bite test) have limited discriminative power when used alone, and perform better when integrated into multivariate scores or combined with imaging modalities such as ultrasound.[7]

Recent narrative and scoping reviews on preoperative airway assessment support this interpretation. Marchis et al. (2024), in a comprehensive review published in *Diagnostics*, describe the Mallampati and Modified Mallampati scores as "basic" but low-power tests, noting that predictive accuracy significantly improves when they are combined with other parameters (e.g., thyromental distance, upper lip bite test, neck circumference) or embedded in composite risk scores such as LEMON or Wilson indices.[9]

More recent work has also explored refinements and criticisms of how the Mallampati score is applied. Paxton and Parotto (2024) examined the concept of the "best visible Mallampati score" and cautioned that optimizing patient positioning and repeated attempts to obtain the "best" view may artificially lower the class and overestimate airway ease, potentially masking true difficulty. They argue that while technical standardization (seated position, maximal mouth opening, full tongue protrusion, no phonation) is important, clinicians must recognize the intrinsic limitations of the score and avoid over-reliance on a single measurement when planning airway management.[10]

Modern guidance therefore places the Modified Mallampati classification in a supporting rather than central predictive role. It is explicitly notes that although the Mallampati score is associated with both difficult mask ventilation and difficult intubation it "cannot reliably predict airway difficulty" when used alone and should instead be interpreted alongside other established risk factors and patient-specific characteristics.[5]

The ASA 2022 Difficult Airway Guidelines echo this, recommending a multidimensional assessment strategy that uses Mallampati as one of several clinical indicators, supplemented where available by advanced techniques such as airway ultrasound, video laryngoscopy, and three-dimensional imaging.[8]

2.1.2 Thyromental Distance

Thyromental distance (TMD) is a long-standing bedside measurement used in preoperative airway assessment to estimate the mandibular space and predict potential difficulty in direct laryngoscopy. It is defined as the straight-line distance from the mentum to the thyroid notch with the patient's head fully extended and mouth closed. A shorter TMD suggests reduced submandibular space, increased anterior laryngeal positioning, and potential challenges in displacing the tongue during laryngoscopy. However, recent evidence demonstrates that while TMD remains a quick and non-invasive tool, its diagnostic performance is limited when applied in isolation. A comprehensive 2024 systematic review and meta-analysis evaluating 227 studies and 686,089 patients reported that TMD had a low sensitivity of approximately 0.38 but a relatively high specificity of 0.83 for predicting difficult tracheal intubation indicating that although a short TMD increases the likelihood of difficulty, many difficult airways present with normal distances.[7]

Similarly, a 2023 observational study found that TMD showed good specificity but consistently poor sensitivity across a general anesthesia population, reinforcing its limited reliability as a sole predictor.[11] Expert consensus published in 2023 also emphasized that TMD values less than 4–7 cm may indicate increased airway difficulty, yet variability in patient anatomy, measurement technique, and lack of universal cut-offs significantly reduce its predictive power. Collectively, recent data suggest that TMD should be interpreted as one component of a multimodal airway assessment, ideally integrated with other clinical predictors or adjunctive modalities such as ultrasound to improve overall predictive accuracy.[12]

2.1.3 Upper Lip Bite Test

The Upper Lip Bite Test (ULBT) is a simple bedside airway screening tool that evaluates mandibular mobility and the relative prominence of the upper incisors, both of which affect how easily the laryngoscope can displace the tongue and align the oral–pharyngeal–laryngeal axes during intubation. To perform the test, the patient is asked to bite the upper lip with their lower incisors as high as possible while keeping the head neutral. The result is commonly graded into three classes:[13]

A. Class I (lower incisors can bite above the vermilion line)
B. Class II (can bite the upper lip but not above the vermilion line)
C. Class III (cannot bite the upper lip)

Class III suggests restricted mandibular protrusion and is associated with more difficult laryngoscopy or intubation. This grading makes ULBT attractive because it is quick, needs no equipment, and directly tests a dynamic airway function rather than only static anatomy.[13]

Recent evidence shows that ULBT has high specificity but only moderate sensitivity. A large 2024 systematic review and meta-analysis (77 studies; >38,000 patients) found pooled sensitivity ~0.52 and specificity ~0.84, with an AUC around 0.85 for predicting difficult tracheal intubation. In practical terms, this means a positive ULBT (Class III) is fairly good at "ruling in" risk, but a negative ULBT does not reliably rule out difficulty.[7]

Conceptually, ULBT performs well because it captures jaw protrusion capacity, a key determinant of laryngoscopy view. Limited mandibular advancement prevents effective displacement of the tongue and reduces the space for blade insertion, increasing the chance of a poor Cormack–Lehane view. However, ULBT can be affected by dentition status (missing incisors, dentures), facial trauma, temporomandibular joint disorders, or patient cooperation, and these factors may lower accuracy in certain populations. This is one reason modern reviews now categorize ULBT as a useful but imperfect bedside test best for confirming risk when positive, not for safely excluding it when negative.[7,9]

2.1.4 Inter-incisor Gap

The inter-incisor gap (IIG) a measurement of maximal mouth opening between the upper and lower incisors is a longstanding component of difficult airway assessment because adequate oral aperture is essential for laryngoscope insertion and manipulation of the tongue. Recent evidence continues to support the relevance of IIG, although its predictive performance remains modest when used in isolation. A 2023 prospective observational study by *Harjai et al.* demonstrated that IIG was a significant independent predictor of difficult laryngoscopy ($p = 0.005$), with smaller mouth-opening measurements strongly associated with higher odds of a difficult view.[13]

Similarly, a 2025 cross-sectional study by Kuttarmare et al. reported that an IIG <3.5 cm increased the likelihood of difficult laryngoscopy nearly threefold (adjusted OR ≈ 2.87, $p = 0.014$), emphasizing that restricted mouth opening remains a clinically meaningful risk factor.[14] Despite this, broader analyses show traditional physical examination predictors including IIG are limited by low sensitivity, threshold variability, and inter-observer differences.[15]

Moreover, IIG can be influenced by pain, temporomandibular joint disorders, dentition, and patient cooperation, further reducing accuracy. These findings align with contemporary consensus that while a reduced IIG increases risk, the measurement alone is insufficient for safe prediction and should instead be integrated into multimodal airway assessment models alongside ultrasound and other modern predictors.

2.1.5 Neck Mobility

Neck mobility especially the ability to flex the lower cervical spine and extend at the atlanto-occipital/atlanto-axial joints is a key traditional airway predictor because successful direct laryngoscopy depends on bringing the oral, pharyngeal, and laryngeal axes into better alignment via the "sniffing" position. Clinically, mobility is assessed by asking the patient to flex the neck and then extend the head; reduced extension of the lateral atlanto-axial joint is specifically associated with difficult intubation, since limited extension prevents optimal axis alignment and restricts glottic exposure.[12]

Recent literature continues to recognize neck mobility as an important component of bedside prediction scores (e.g., Wilson/LEMON-type assessments), but also highlights its weaknesses when used alone. Contemporary reviews of preoperative airway assessment note that physical-exam predictors such as neck extension show variable, generally modest sensitivity and are vulnerable to inter-observer inconsistency, meaning normal neck motion does not reliably exclude a difficult airway.[9,12]

Evidence from modern radiologic studies further reinforces the mechanistic importance of cervical motion: in patients with cervical spondylosis or planned cervical spine surgery, extension-lateral cervical X-ray indices reflecting cervical mobility/extension angles predicted difficult laryngoscopy better than several single bedside tests, underscoring that restricted cervical extension materially increases laryngoscopy difficulty.[9]

2.1.7 Summary of These Predictors Show Low Sensitivity, High Variability, and Poor Predictive Accuracy

Traditional bedside airway predictors (modified Mallampati class, thyromental distance, upper lip bite test, inter-incisor gap, and neck mobility) tend to show low sensitivity, high variability, and weak predictive accuracy when used alone for several consistent reasons.[7]

First, each test captures only one anatomical or functional dimension (e.g., tongue–pharynx relationship for Mallampati, mandibular space for thyromental distance, mouth opening for inter-incisor gap, jaw protrusion for ULBT, or cervical extension for neck mobility), whereas difficult laryngoscopy/intubation is multifactorial driven by interacting features such as soft-tissue bulk, airway axis alignment, mandibular compliance, and cervical mechanics so a single measurement cannot represent overall difficulty. Large contemporary meta-analyses confirm this "single-dimension problem": traditional tests typically demonstrate high specificity but low sensitivity, meaning they may "rule in" difficulty when positive but frequently miss difficult airways when negative.[7]

Second, these predictors are subjective and technique-dependent, producing substantial inter-observer variability; Mallampati grading changes with patient posture, phonation, or examiner viewpoint, ULBT depends on dentition and patient effort, and neck mobility estimates vary with pain tolerance and clinician judgment, all contributing to inconsistent results across settings.[9]

Third, there is heterogeneity of cutoff values and populations: for example, thyromental distance thresholds and "abnormal" mouth-opening cutoffs differ between studies and ethnic groups, and the tests perform differently in obesity, OSA, trauma, or cervical spine disease—so pooled accuracy is diluted and hard to generalize.[9]

Finally, outcome definitions vary (difficult laryngoscopy vs difficult intubation vs failed first attempt), and because the prevalence of true difficult airways is relatively low, standalone tests have limited positive predictive value in routine practice. This is why recent clinical studies show prediction improves sharply only when multiple predictors are combined, with difficulty rates rising stepwise as more abnormal tests co-exist, supporting the move toward multimodal models.[14]

2.2 Modern Device on Difficult Airway

2.2.1 Point-of-Care Ultrasound (POCUS) of the Upper Airway

Point-of-care ultrasound (POCUS) of the upper airway has become a leading modern approach for difficult airway prediction because it provides objective, quantitative measurements of soft tissue and airway geometry that are hard to appreciate on physical exam. Multiple recent reviews and clinical cohort studies show that certain sonographic parameters correlate consistently with difficult laryngoscopy or intubation, especially where bedside tests are unreliable (e.g., obesity, OSA, cervical spine limitation).[16,17]

2.2.1.1 Distance from Skin to Epiglottis (DSE)

Distance from skin to epiglottis (DSE) is one of the most validated predictors. It is measured transversely at the thyrohyoid membrane level as the depth from skin to the epiglottis/air–mucosa interface. A review summarizing a meta-analysis reported DSE as the ultrasound parameter most strongly associated with difficult direct laryngoscopy, with higher DSE seen in higher Cormack–Lehane grades. Typical risk thresholds in recent cohorts fall around >2.0–2.5 cm, though some studies suggest slightly higher cutoffs in obese populations. Mechanistically, DSE reflects anterior neck soft-tissue bulk and the “depth” of the laryngeal inlet, both of which reduce the ability to lift soft tissues during laryngoscopy.[16]

2.2.1.2 Tongue Thickness

Tongue thickness (or tongue soft-tissue measures) is another consistent predictor, usually taken in the mid-sagittal or transverse submental view from the dorsal tongue surface to the submental skin or floor-of-mouth landmarks. Larger tongue thickness increases the chance of difficult laryngoscopy because it narrows the oropharyngeal space and impedes tongue displacement. A 2023 ultrasound diagnostic study reported that greater tongue thickness was significantly associated with difficult intubation, with good specificity and moderate sensitivity using a higher-thickness threshold.[18] In the 2023 cohort study mentioned above, tongue thickness >3.93 cm also independently predicted difficult laryngoscopy alongside DSE and hyomental indices.[19]

2.2.1.3 Hyomental Distance

Hyomental distance (HMD) is measured as the linear distance between the hyoid bone and mandibular symphysis, typically in neutral and maximally extended head positions. The key derived metric is the hyomental distance ratio (HMDR = HMDextended / HMDneutral), reflecting how much the airway “opens” with extension. Recent narrative and systematic reviews highlight HMDR as a reliable functional marker: lower HMDR means limited submandibular compliance and reduced anterior airway space, both linked to difficult laryngoscopy. Empirically, modern cutoffs often cluster around HMDR <1.18–1.2 for higher risk.[19,20]

2.2.1.4 Pre-Epiglottic Space

Pre-epiglottic space (PES) is assessed by placing the probe transversely at the thyrohyoid membrane and measuring the hypoechoic space anterior to the epiglottis. A larger PES implies more anterior soft tissue and a deeper laryngeal inlet, contributing to difficult glottic exposure. A prospective observational study comparing PES ultrasound with Mallampati grading found PES significantly associated with difficult laryngoscopy and suggested it can outperform some bedside tests in objectivity. Another recent cohort reported that PES-based ratios correlated positively with higher Cormack–Lehane grades, supporting its predictive value.[20,21]

2.2.1.5 Soft Tissue Thickness at the Hyoid and Thyroid Membrane

Soft tissue thickness at the hyoid and thyrohyoid membrane (often termed skin-to-hyoid distance or skin-to-thyrohyoid membrane distance) captures anterior neck tissue depth at key airway landmarks. These measures reflect fat and soft-tissue deposition overlying the airway, which mechanically limits lifting of airway structures during laryngoscopy. Recent syntheses list these thickness measures among the most useful ultrasound predictors, with studies showing higher values in difficult laryngoscopy groups and moderate-to-high specificity[16,19]

2.2.2 Video Laryngoscopic

2.2.2.1 Video Laryngoscopic in Airway Difficulty

Videolaryngoscopy (VL) is increasingly recognized not only as an intubation device but also as a predictive assessment tool for difficult airway management. Unlike direct laryngoscopy, VL provides an indirect, camera-based view of the glottis, allowing clinicians to visually assess airway anatomy before committing to induction. Recent reviews emphasize that "pre-intubation VL assessment" can be used in patients with suspected difficult airways to inspect the oropharynx–larynx pathway, identify anatomical barriers (large tongue base, redundant supraglottic tissue, anterior larynx, distorted epiglottis), and estimate expected laryngoscopic grade.[9,22]

This concept extends to glottic visualization before induction in carefully selected patients (awake or minimally sedated), where the VL view can confirm whether a standard asleep VL intubation is likely to be successful or whether the airway appears too restricted for safe induction. Contemporary difficult-airway guidance and narrative syntheses note that such real-time visualization helps triage patients toward awake intubation when a poor view, supraglottic obstruction, or high risk of rapid desaturation is anticipated, and conversely supports asleep VL when anatomy looks favorable despite equivocal bedside tests.[9,23]

2.2.2.2 Advantage of Video Laryngoscopic

The advantages of VL for prediction mirror its advantages for intubation. By improving line-of-sight around the tongue and epiglottis, VL yields superior glottic visualization and more reliable assessment of the laryngeal inlet than direct laryngoscopy, which is why recent clinical reviews consistently show VL reduces poor laryngeal views and first-pass failure rates.[22,24]

Importantly for your review scope, VL becomes particularly valuable when traditional predictors are inconclusive (e.g., Mallampati and thyromental distance disagree, obesity/OSA obscures landmarks, limited neck motion makes axis-alignment estimates uncertain). In these settings, VL provides an objective "look ahead" at the airway—a functional anatomical preview rather than a probabilistic bedside estimate—allowing better planning of technique, equipment (hyperangulated vs Macintosh-style VL, bougie use), and rescue pathways.[9,22]

Overall, recent evidence and guidelines support VL as a modern predictor that adds direct anatomical information to risk stratification, especially to guide the key decision of awake versus asleep intubation and to prevent unexpected difficult airways.[9,23]

2.2.3 Integrative/Multimodal Airway Prediction

2.2.3.1 Models Risk Scores Combining Clinical Tests + Ultrasound

Recent evidence strongly supports the use of integrated risk scores that combine traditional clinical predictors with upper-airway ultrasound measurements, as these models significantly outperform single bedside tests. Traditional predictors such as Mallampati, thyromental distance, or ULBT evaluate only isolated anatomical components, whereas multimodal models incorporate multiple soft-tissue, dynamic, and functional domains, improving discrimination. A 2024 study developed a clinical ultrasound composite model incorporating distance from skin to epiglottis, hyomental distance ratio, and tongue thickness; the combined model demonstrated a significantly higher AUC and diagnostic accuracy compared with clinical predictors alone.[25]

These findings emphasize that airway difficulty prediction improves substantially when clinical tests are not used in isolation, but instead are integrated with objective POCUS measurements capturing submandibular compliance, soft-tissue depth, and laryngeal geometry.[19]

2.2.3.2 Proposed "airway bundles"

The concept of an "airway bundle" has emerged as a structured approach in which clinicians perform a standardized set of airway evaluations typically a combination of bedside predictors, ultrasound parameters, and occasionally videolaryngoscopic preview—to reduce variability and improve accuracy. Recent narrative reviews describe these bundles as an evolution of the traditional LEMON or LEON frameworks, updated to include ultrasound markers such as DSE, hyomental distance ratios, and anterior neck soft-tissue depth. Bundled assessment ensures that multiple anatomical contributors to difficulty are evaluated, avoiding the incomplete picture provided by any single predictor. Furthermore, modern ultrasound-based bundles, such as stepwise Airway-USG protocols, have been validated in prospective cohorts, demonstrating superior reliability and reproducibility. The movement toward airway bundles reflects a broader trend in anesthesiology: shifting from subjective, isolated tests toward standardized, multimodal, reproducible evaluation systems.[26,27]

2.2.3.3 AUC-Based Performance Comparison

When comparing predictors using Area Under the ROC Curve (AUC), multimodal models consistently demonstrate superior performance. Recent systematic reviews and meta-analyses show that traditional bedside tests have low sensitivity (often <0.50) and only moderate specificity, resulting in modest AUC values that limit their usefulness as standalone predictors.[19] In contrast, models integrating ultrasound parameters—such as DSE, hyomental distance ratio, tongue thickness, and pre-epiglottic space—achieve significantly higher AUCs, reflecting robust discrimination between normal and difficult laryngoscopy.[1] For example, adding ultrasound measurements to Mallampati or thyromental distance produces notable AUC improvement, sometimes shifting from "acceptable" to "strong" performance. The consistent pattern of improved AUC across multiple studies reinforces the conclusion that difficult airway prediction is best approached through multidimensional, combined models, not isolated measurements.[25]

2.2.3.4 Clinical Pathways for Deciding Awake vs Asleep Intubation

Multimodal airway prediction has direct clinical implications, particularly in determining whether an airway should be secured awake or asleep. Isolated physical tests have insufficient sensitivity to guide this high-stakes decision, but integrated clinical–ultrasound models provide a more accurate estimation of risk. The 2022 ASA Difficult Airway Guidelines specifically recommend using *multiple indicators* to guide the awake-intubation pathway, including predicted difficult laryngoscopy, expected difficulty with mask or supraglottic ventilation, aspiration risk, physiologic intolerance of apnea, and difficulty with emergency surgical airway. When multimodal assessment identifies several converging risk factors such as multiple positive ultrasound predictors, abnormal clinical tests, or inconclusive VL previews awake intubation using VL or flexible endoscopy is recommended to maintain airway control and spontaneous ventilation. Conversely, when multimodal risk is low, asleep VL or DL can be performed safely with appropriate backup plans. Thus, integrated airway models not only improve prediction accuracy but also feed directly into evidence-based decision pathways that reduce the likelihood of unexpected difficult airway events.[8]

3. Conclusion

Prediction of a difficult airway remains challenging because traditional bedside tests such as Mallampati, thyromental distance, upper lip bite test, inter-incisor gap, and neck mobility evaluate only single anatomical aspects and therefore show limited sensitivity and high variability.

Modern evidence demonstrates that advanced modalities, particularly point-of-care ultrasound (POCUS), provide more objective and reliable measurements of upper-airway structures, while videolaryngoscopy offers direct visualization that enhances anatomical assessment beyond physical examination. The strongest predictive accuracy emerges from multimodal, integrated assessment models that combine clinical tests with ultrasound parameters and, when indicated, videolaryngoscopic preview.

These integrative approaches align with current guidelines including the 2022 ASA Difficult Airway Guidelines and significantly reduce the likelihood of "unanticipated" difficult airways. Overall, the shift toward standardized, ultrasound-enhanced, and multimodal airway evaluation represents a crucial advancement in improving safety, accuracy, and decision-making in contemporary anesthetic practice.

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