E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.48047/ijprt/16.02.871

Research Article

Preoperative Bedside Airway Tests for Difficult Tracheal Intubation in Elective Surgery

Eiman Elyas[1], Ahmed Khan[2], Abid Hussain[3], Khawar Aziz Siddiqui[4], Amjad Ali[5], Misbah Asghar[6]

1. Anaesthesia Technologist, Sheikh Shakhbout Medical City (SSMC) Abu Dhabi, UAE. Email: em-en09@hotmail.com
2. Associate Professor Anesthesia and Intensive Care, Liaquat Institute of Medical and Health Sciences Thatta Pakistan. Email: ahmed_anaes@yahoo.com (Corresponding author)
3. Specialist Anesthesia, Royal Commission Health Services Program / Royal Commission Hospital Jubail, Saudi Arabia. Email: anaesthesia001@gmail.com
4. Consultant Anaesthesia, Mediclinic Airport Road Hospital Abu Dhabi, United Arab Emirates. Email: khawarazizpk@hotmail.com
5. Professor Anaesthesia, Bolan Medical College Quetta Pakistan. Email: amjadalidr@gmail.com
6. Consultant Anaesthesia and Pain Physician, Alkhidmat Razi Hospital Satellite Town Rawalpindi Pakistan. Email: docmisba@yahoo.com

ABSTRACT

Background: Unexpected obstacle with tracheal intubation can interrupt oxygenation and increase perioperative risk. In fact, uncomplicated bedside tests are often employed before anaesthesia, although their ability to spot difficult airways varies, at least in principle.

Goal: To compare six preoperative bedside airway assessments for projecting difficult tracheal intubation among adults scheduled for elective surgery, at least for now.

Study design: Cross-sectional diagnostic-accuracy study.

Duration and place of study: This study was conducted at Liaquat Institute of Medical and Health Sciences Thatta @LUMHS Jamshoro from September 2025 to September 2026

Methodology: The study included 133 adults aged 18–65 years who were scheduled for elective surgery under general anaesthesia with tracheal intubation. The modified Mallampati test (MMT), thyromental distance (TMD), inter-incisor gap (IIG), upper lip bite test (ULBT), LEMON assessment and atlanto-occipital extension (AOE) were evaluated. Categorical findings and reported diagnostic-performance measures were summarized using IBM SPSS Statistics version 27.0.

Results: Positive screening findings were recorded for MMT in 19 participants (14.3%), TMD in 15 (11.3%), IIG in 31 (23.3%), ULBT in four (3.0%), LEMON in 35 (26.3%) and AOE in 13 (9.8%), in many respects. TMD had the lowest sensitivity (10%). MMT had the highest reported sensitivity (66%). At the same time, LEMON had the highest reported specificity (77%).

Conclusion: The reported performance differed across the tests. So, MMT had the highest reported sensitivity and LEMON the highest reported specificity, at least for now. Consistently (specifically in None shown this

setting) strong sensitivity and specificity. As, well, the findings are supporting interpreting bedside tests as part of a broader airway assessment, in actual application, and validation is being needed by a combined prediction rule.

Keywords: Airway management; difficult airway; tracheal intubation; Mallampati test; diagnostic accuracy

INTRODUCTION

Preoperative airway assessment is an significant part of anaesthetic planning, so induction of broad anaesthesia lowers upper-airway tone and protective reflexes, at least in principle. Difficult airway, difficult laryngoscopy and difficult tracheal intubation are related but separate outcomes. Diagnostic studies should prescribe which outcome their tests are intended to forecast [1,5], in real-world scenarios. At the same time, repeated or unsuccessful intubation attempts can (at least in most settings) contribute to hypoxaemia, airway injury, aspiration, cardiovascular instability and, in severe cases, cardiac arrest [1,2,3,4].

Several bedside assessments are used, because they're quick and inexpensive, alongside non-invasive. Indeed, the changed Mallampati test grades visible oropharyngeal arrangements. Thyromental distance is estimating available mandibular space. Inter-incisor gap measures mouth opening. In many respects. And mandibular protrusion is, in fact, being checked by the upper lip bite test. Neck mobility, covering atlanto-occipital extension, is also assessed, because positioning can impact direct laryngoscopy [5,6,7,8,9,10,11,12,13,14].

The accuracy of individual tests is inconsistent. Sensitivity describes how often a test is positive among patients with the target outcome, while specificity describes how often it is negative among those without that outcome. Reviews report that many bedside predictors have limited sensitivity and variable specificity, with results affected by patient characteristics, examiner technique and threshold definitions [5,6,7]. Therefore, a negative result from a test with low sensitivity cannot reliably exclude difficulty.

Composite approaches, including the El-Ganzouri risk index and LEMON assessment, combine anatomical and clinical features in an effort to improve risk evaluation [15,16,17]. Their performance may differ between populations and clinical settings, so the value of any composite approach needs appropriate validation. Studies in elective surgical populations have also linked difficult laryngoscopy or intubation with higher Mallampati grades, shorter thyromental distance, limited mouth opening and restricted neck extension [18,19,20,21,22,23,24].

This study compared six bedside airway assessments in adults undergoing elective surgery. It evaluated reported sensitivity and specificity for MMT, TMD, IIG, ULBT, LEMON and AOE, with the aim of describing their relative performance and supporting careful preoperative planning.

MATERIALS AND METHODS

A cross-sectional diagnostic-accuracy study was conducted in an elective surgical setting. Study setting and data-collection period are presented with anonymized placeholders.

A convenience sample of 133 adults aged 18-65 years scheduled for elective surgery, under the broad anaesthesia with tracheal intubation was, more correctly, covered, at least in principle. Exclusion criteria were an airway or neck mass, restricted neck or jaw movement, inability to sit for assessment, or facial trauma, in real-world scenarios. The target sample was, as a matter of fact, estimated employing an anticipated difficult-airway prevalence of 10%, a 95% confidence level and 5% absolute precision.

Participants underwent MMT, TMD, IIG, ULBT, LEMON and AOE assessment employing the study data-collection form, before anaesthesia, to a significant degree. Categorical data were recapped as frequencies

and percentages. The available sensitivity and specificity approximations were reported for each test, at least in practice. IBM SPSS Statistics version 27.0 was employed. Categories were dichotomized according to the study protocol and compared with the recorded intubation outcome.

Ethical approval was obtained from the institutional review board, and permission was obtained from participating hospitals. Participation was voluntary, written informed consent was obtained, and confidentiality was maintained. The institution and approval identifier are omitted to preserve anonymity.

RESULTS

All 133 participants were included in the descriptive analysis. The largest age group was 31–40 years (56; 42.1%), followed by 18–30 years (33; 24.8%), 41–50 years (25; 18.8%) and 51–65 years (19; 14.3%). There were 80 men (60.2%) and 53 women (39.8%). ASA physical status was Grade I for 51 participants (38.3%), Grade II for 48 (36.1%) and Grade III for 34 (25.6%) (Table 1).

The proportion classified as having a positive screening finding ranged from 3.0% for ULBT to 26.3% for LEMON. Findings were positive in 19 participants (14.3%) on MMT, 15 (11.3%) on TMD, 31 (23.3%) on IIG, four (3.0%) on ULBT, 35 (26.3%) on LEMON and 13 (9.8%) on AOE (Table 2). These are screening classifications and should not be interpreted as the confirmed prevalence of difficult intubation.

MMT had the highest reported sensitivity (66%), followed by LEMON (33%); TMD had the lowest sensitivity (10%). Reported specificity ranged from 67% for IIG to 77% for LEMON. The remaining estimates are shown in Table 3. Participant-level contingency data were unavailable, so the estimates could not be independently recalculated.

Table 1. Demographic and clinical characteristics of participants

Characteristic	Category	n (%)
Age, years	18–30	33 (24.8)
	31–40	56 (42.1)
	41–50	25 (18.8)
	51–65	19 (14.3)
Sex	Male	80 (60.2)
	Female	53 (39.8)
ASA physical status	I	51 (38.3)
	II	48 (36.1)
	III	34 (25.6)

ASA, American Society of Anesthesiologists.

Table 2. Distribution of bedside airway assessment findings

Assessment	Category	n (%)
Modified Mallampati test	Class I	99 (74.4)
	Class II	15 (11.3)
	Class III	16 (12.0)
	Class IV	3 (2.3)
Thyromental distance	Class I	118 (88.7)
	Class II	11 (8.3)
	Class III	4 (3.0)
Inter-incisor gap	Class I	102 (76.7)
	Class II	31 (23.3)
Upper lip bite test	Class I	91 (68.4)
	Class II	38 (28.6)
	Class III	4 (3.0)
LEMON assessment	0/10	98 (73.7)
	>0/10	35 (26.3)
Atlanto-occipital extension	Grades I–II	120 (90.2)
	Grades III–IV	13 (9.8)

Table 3. Reported performance of bedside tests for predicting difficult intubation

Test	Sensitivity (%)	Specificity (%)
MMT	66	71
TMD	10	74
IIG	20	67
ULBT	20	70
LEMON	33	77
AOE	20	75

DISCUSSION

In this sample, the reported diagnostic performance varied among six bedside assessments. MMT had the highest reported sensitivity, while LEMON had the highest specificity. The low reported sensitivity of TMD, IIG, ULBT and AOE means that a negative result from these measures alone may fail to identify some patients with a difficult airway. Positive findings also require clinical interpretation because the reported

specificities were moderate rather than uniformly high.

The relative ranking of MMT is consistent with its broad clinical use, although systematic reviews show that Mallampati classification alone has limited ability to rule out difficult laryngoscopy or intubation [5,6,7]. Results may vary with posture, phonation, head position and examiner interpretation [8,9]. The test reflects oropharyngeal visibility but does not directly measure glottic exposure, which may help explain its moderate reported specificity.

TMD and IIG each encapsulate a person anatomical attribute. So, distinct thresholds and measurement methods, across the studies are making direct comparisons difficult, at least empirically. And thus, neither alone represents the combined effects of mandibular space, tissue compliance, cervical movement and laryngoscope positioning [7,10,11,18], on the whole. Prior observational studies and multivariable models have, as a matter of fact, correspondingly evaluated multiple predictors together [15,18,19,20,21,22].

LEMON had the highest reported specificity and the greatest proportion of positive screening findings, and is combining several airway features, at least for now, and yet, its scoring and intended use can differ between emergency and elective settings [16,17], so any score above zero was treated as positive in this dataset, broadly speaking. And before it's embraced in other populations, validation is being needed by that inclusive threshold. And thus, mandibular protrusion and dentition are being assessed by ULBT. Well the same, its low sensitivity in this sample means it shouldn't be employed alone to leave out roadblock [12,13,23].

Taken together, the findings are supporting a structured assessment that's analyzing several clinical traits and informs preparation, alternative airway equipment and timely help, in line with current airway guidance [1,3,4]. This study didn't prove a prespecified combined score, so it can't establish that any particular combination is superior, in actual application.

The study includes descriptive findings for all 133 participants and compares several low-cost bedside measures in an elective setting. Limitations include a single-centre convenience sample, a limited sample size, exclusion of some patients with obvious anatomical risk, possible small numbers of difficult cases and unavailable participant-level contingency data. Confidence intervals and predictive values therefore could not be reconstructed from the aggregate results. Examiner variability, operator experience and the reference-outcome definition may also affect the estimates and their generalizability. Future work should report complete two-by-two data, use prespecified thresholds and include external validation in larger cohorts [5,6,7].

CONCLUSION

The bedside airway assessments showed variable reported ability to predict difficult tracheal intubation in adults undergoing elective surgery. MMT had the highest reported sensitivity and LEMON the highest reported specificity; the other tests had low sensitivity as standalone screens. These findings support interpreting several airway features together, while prospective validation is needed before adopting a specific combined prediction rule.

Funding source

None

Conflict of interest

None

Permission

Permission was taken from the ethical review committee of the institute.

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