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ORIGINAL ARTICLE

Comparison of Modified Mallampati Classification and Thyromental Height to Predict Difficult Intubation

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ABSTRACT

Introduction: Difficult intubation is an emergency situation that an anaesthetist come across frequently. It is a frequent cause of mortality in practice of anesthesia. Mallampati classification (MPC) of the oropharyngeal structures is a simple test to assess anticipated difficult airway for endotracheal intubation. thyromental height (TMH) test is now also commonly used to predict difficult intubation.

Objective: To evaluate diagnostic accuracy of modified mallampati classification and thyromental height using Cormack and Lehane's classification of laryngoscopy as a gold standard.

Study Design: Descriptive cross sectional validation study.

Setting: Department of Anaesthesia, Benazir Bhutto Hospital, Rawalpindi. Duration: 20-Sep-2021 to 19-Mar-2022.

Material and Methods: A total number of 1035 were included in this study. Pre-operatively modified Mallampati test (MMT) and TMH test was performed. Mallampati class III and IV were considered difficult. While TMH height >50 mm was considered as difficult intubation. Difficult intubation equipment's was ready, i.e. stylet, boogie, LMA, I-gel. General anaesthesia was induced in the operating room after collecting baseline vital signs. After three minutes, a skilled anesthesiologist performed a laryngoscopy while the patient was sniffing. To validate the diagnosis of difficult intubation, the laryngeal view was appraised using a modified Cormack and Lehane (C-L) grading system.

Results: Mean age of patients was 40.16±12.19 years. Mean height of patients was 152.94±8.32 cm, mean weight was 65.01±13.59 Kg and Mean body mass index (BMI) was 27.78±5.64 kg/m2. There were 768 (74.20%) males and 267 (25.80%) females. TMH was 77.8% sensitive, 94.6% specific having 70.0% PPV, 96.3% NPV and 92.27% accuracy. On diagnostic accuracy of MMP taking difficult intubation according to standard as gold standard, MMP was 92.4% sensitive, 90.1% specific having 60.2% PPV, 98.6% NPV and 90.3% accuracy.

Practical implications: Thyromental Height (TMH) needs more broad usage in multiple settings to be validated as a single most important predictor of difficult laryngoscopy. It will thus be used widely all over the country rendering fewer complications for the patients.

Conclusion: TMH was the test that was most sensitive and accurate at foretelling difficult laryngoscopy when compared to the modified Mallampati score. TMH has potential as a single anatomical metric to predict the possibility of a difficult laryngoscopy.

Keywords: Mallampati classification, thyromental height, Cormack and Lehane's classification, laryngoscopy.

INTRODUCTION

Difficult intubation is an emergency situation that an anaesthetist come across frequently. If insertion of the endotracheal tube takes more than 10 mins, requires more than three attempts by an experienced anaesthesiologist and insertion of an endotracheal tube is impossible despite of optimal laryngoscopy [1].

It is a frequent cause of mortality in practice of anesthesia.[2]Failure in managing the airway may result in anaesthesia related death or brain damage.[2,3] A compromised airway may be to blame for up to 32% of anesthesia-related fatalities. 4 In one study, the rate of challenging laryngoscopy was 12.3%, challenging intubation was 9%, and challenging unsuccessful intubation was 0.005%. 3. This has led to the requirement for extremely accurate tests for the detection of difficult-to-manage airways during anaesthetic and surgical procedures..[5]

Difficult airway and related morbidity can be reduced if it could be predicted correctly during the preoperative assessment [6]. Airway assessment includes a detailed history a careful physical examination and in certain cases inspection of relevant x-ray [3].

A large number of studies have been conducted to develop reliable predictor for difficult intubation[7,8]. Mallampati classification (MPC) of the oropharyngeal structures is a simple test to assess anticipated difficult airway for endotracheal intubation.[3] A positive Mallampati test indicates the possible restricted mouth opening or a narrow oropharyngeal space[3]. The "thyromental height test" measures the distance between the thyroid cartilage and the anterior borders of the mentum when the patient is supine with their mouth closed (TMHT).[9]

A variety of screening tests for the airways were evaluated. The most common tests were the Mallampati Score, the assessment of thyro-mental distance, the thromental height test, the upper lip bite test, the inter-incisors gap, and the sterno-mental distance..[7,8].

A study conducted in 2018 showed The incidence of difficult laryngoscopy was 8.2% using Cormack and Lehane's classification TMHT at cut-off value 50mm Showed accuracy of 97.7% specificity (98.97), sensitivity (84.62), PPV (88%), NPV (98.63%). whereas modified Mallampati score (III and IV) had low accuracy (80.3%), specificity (81.03%), sensitivity (73.08%)PPV (25.68), NPV (97.11) [10].

Another study showed (9.3%) of population had difficult laryngoscopy using Grade III and IV of Cormack and lehane's classification as gold standard TMHT at a cut-off value 50mm had accuracy higher (95%), specificity (97%) sensitivity (75%), PPV (73%), NPV (97%). while the accuracy of modified Mallampati test (MMT) has come as only 79% at cut-off value (III and with specificity (81%), sensitivity (53%), PPV (22%), NPV (99%).[11] Another study showed population with difficult Laryngoscopy is (12.0%) using C&L Grade III and IV, TMH had low accuracy 68.0% at a cut off value of 50 mm specificity (70.5%), sensitivity (49.3), PPV (18.6), NPV (91.1) than MMT with accuracy of (83.4 %) at cut-off value III or IV grade. specificity (89.7), sensitivity (37.0), PPV (32.9), NPV (91.3%).[12]

There is conflict in data collected by conduct of above mentioned studies, regarding superiority of one test over the other in terms of accuracy to predict difficult intubation. Accuracy of (TMH is 95% vs MMP 79%)11. (TMH 68.0% vs MMP 83.4%) 12. Due to lack of local published data and above mentioned conflict there comes a need to conduct another study in local population to determine an accurate and reliable predictor of difficult intubation either of TMH or MMP to reduce airway management related complications.

Objective: To evaluate diagnostic accuracy of modified mallampati classification and thyromental height using Cormack and Lehane's classification of laryngoscopy as a gold standard.

Operational definitions:

- Mallampati Classification: possible restricted mouth opening or narrow oropharyngeal space by visualizing uvula, faucial pillars, soft palate & Hard palate (Mallampati class III and IV were considered as difficult)
- Thyromental Height: The distance in mm b/w mentum and thyroid cartilage while patient in supine position and mouth closed with head in neutral position. (TMH less than 50mm was consider difficult.
- Difficult Intubation (Standard): if the patient had laryngoscopy Grade III and IV by Cormack and Lehane score or if assisted device (stylet, bougie, intubating LMA) was required to aid intubation or more than 3 attempts.
- True Positive: Patient having MMP ≥ III and IV or TMHD ≤ 50mm and have difficult intubation as per above definition.
- True Negative: Patient having MMP I or II or TMHD > 50mm and do not have difficult intubation as per above definition.
- False Positive: Patient having MMP ≥ III and IV or TMHD ≤ 50mm but do not have difficult intubation as per above definition.
- False Negative: Patient having MMP I or II or TMHD > 50mm but have difficult intubation as per above definition.
- Specificity; proportion of truly easy intubation out of all patient which don't have difficult intubation (true negative and false positive).
- Sensitivity; proportion of truly difficult intubation out of all patient with difficult intubation (true positive and false negative).
- Positive predictive value; probability of patient with MMP ≥ III and IV or TMHD ≤ 50mm truly have difficult intubation.
- Negative predictive value; probability of Patient having MMP I or II or TMHD > 50mm truly do not have difficult intubation as per above definition

RESOURCES AND METHODS

Study design: Descriptive cross sectional validation study.

Study population: Consecutive Cases of patients requiring intubation for general anaesthesia which fulfil the inclusion and exclusion criteria and sign informed consent. Study Setting: Department of Anaesthesia, Benazir Bhutto Hospital, Rawalpindi. Study duration: 6 months after approval of synopsis

Sampling technique: Non-probability Consecutive sampling.

Sample size: Sample size is 1035 calculated by using specificity and sensitivity calculator, confidence level 95%. (specificity 81% and sensitivity 53%) .11 prevalence (9.3%)11, absolute precision is 10% 11.

Sampling standards:

Inclusion Criteria:

1. Patients who sign written informed consent to participate in the study.
2. Patients with ages in the range of 20-60 years.
3. ASA grades I-II.
4. Both male and female undergoing elective surgeries.

Exclusion Criteria:

1. ASA III and above
2. Emergency patient
3. Non-surgical intubation
4. Thyroid disease/ Neck swellings
5. Anatomical airway variation
6. Oral cavity tumors.
7. Pt with arthropathies e.g Rheumatoid Arthritis

Data collection Methodology: After approval from ethical review committee of the hospital, patients who full fill the selection criteria were enrolled and the details of the study were explained after written informed consent. Detailed history was taken from each patient. Basic demographic information including name, age, sex, was recorded.

Pre-operatively modified Mallampati test (MMT) was performed using torch with the patient in a sitting position, mouth widely open, tongue protruded and patient not phonating. Score was assessed according to ANNEXURE-1. Mallampati class III and IV were considered difficult. The TMH (in mm) was performed using a depth calliper placed on the prominent part of thyroid cartilage and horizontal hinge were at the level of mentum (mental protuberance of the mandible) height between thyroid cartilage and line of intersection of depth calliper were measured. The patient was in a supine position with a closed mouth; a pillow under the head should be used to preserve the head and neck in a neutral position. TMH less than 50mm was seen as challenging. Equipment for difficult intubations, such as a stylet, boogie, LMA, and I-gel, was prepared. Before surgery, all patients fasted for 8 hours. After obtaining baseline vital signs in the operating room, propofol 2-3 mg/kg was used to produce general anaesthesia, and atracurim 0.5 mg/kg was used to relax muscles. After 3 minutes, a skilled anesthesiologist (>5 years of experience) who was not involved in the airway assessment performed a laryngoscopy in the sniffing position using a Macintosh #3, 4 blade. A pillow (8 cm high) was positioned beneath the head to help the patient get into the sniffing position for intubation. Next, the trachea of the patient was intubated, and its location. The patient's trachea was subsequently intubated, and its location was verified via capnography and bilateral auscultation over the lung fields. Utilizing the modified Cormack and Lehane (C-L) grading method as shown in the ANNEXURE, the laryngeal view was evaluated.
An original performa was used to record all the data.

RESULTS

Mean TMH was 56.16±6.82 mm. Minimum TMH was 33 mm and maximum was 65 mm (Table 1).

On frequency of Comarck and Lahane grade, there were 494 (47.73%) patients with grade I, 397 (38.36%) with grade II, 103 (9.95%) with grade III, and 41 (3.96%) with grade IV (Figure 1).

On frequency of MMP class, there were 471 (45.51%) patients with class I, 372 (35.94%) with class II, 132 (12.75%) with class III, and 60 (5.80%) with class IV (Figure 2).

Intubation according to standard was difficult in 144 (13.91%) and it was not difficult in 891 (86.09%) patients (Figure 3).

Instruments (bougie, inbuating LMA, stylet) was used in 81 (7.83%) and it was not used in 954 (92.17%) patients.

Diagnostic accuracy of TMH for difficult intubation used as gold standard test. TMH was 77.8% sensitive, 94.6% specific having 70.0% PPV, 96.3% NPV and 92.27% accuracy. On diagnostic accuracy of MMP taking difficult intubation according to standard as gold standard, MMP was 92.4% sensitive, 90.1% specific having 60.2% PPV, 98.6% NPV and 90.3% accuracy.

Stratification of age was performed. In patients having age 18-39 years, TMH was 57.5% sensitive, 90.4% specific having 50.0% PPV, 92.8% NPV and 85.7% accuracy and MMP was 86.3% sensitive, 89.7% specific having 58.3% PPV, 97.5% NPV and 85.7% accuracy. In patients having age 40-65 years, TMH was 98.6% sensitive, 98.7% specific having 92.1% PPV, 99.8% NPV and 98.7% accuracy and MMP was 98.6% sensitive, 90.5% specific having 61.9% PPV, 99.8% NPV and 91.6% accuracy.

Stratification of gender was performed. In male patients, TMH was 87.6% sensitive, 94.6% specific having 71.9% PPV, 98.0% NPV and 93.6% accuracy and MMP was 98.1% sensitive, 89.9% specific having 60.6% PPV, 99.7% NPV and 91.0% accuracy. In female patients, TMH was 51.3% sensitive, 94.7% specific having 62.5% PPV, 91.9% NPV and 88.4% accuracy and MMP was 76.9% sensitive, 90.8% specific having 58.8% PPV, 95.8% NPV and 88.8% accuracy.

Stratification of BMI was performed. In patients having BMI ≤ 24.99, TMH was 83.9% sensitive, 95.2% specific having 72.3%

PPV, 97.6% NPV and 93.8% accuracy and MMP was 94.6% sensitive, 90.2% specific having 58.9% PPV, 99.1% NPV and 90.8% accuracy. In patients having BMI ≥ 25.00, TMH was 73.9% sensitive, 94.2% specific having 68.4% PPV, 95.5% NPV and 91.2% accuracy and MMP was 90.9% sensitive, 91.1% specific having 61.1% PPV 98.3% NPV and 90.2% accuracy.

Stratification of height of patients was performed. In patients having height 139-151 cm, TMH was 79.7% sensitive, 93.2% specific having 63.7% PPV, 96.8% NPV and 91.5% accuracy and MMP was 90.6% sensitive, 90.0% specific having 57.4% PPV, 98.5% NPV and 90.0% accuracy. In patients having height 152-190 cm, TMH was 76.3% sensitive, 95.9% specific having 76.3% PPV, 95.9% NPV and 93.0% and MMP was 93.8% sensitive, 90.3% specific having 62.5% PPV, 98.8% NPV and 90.8% accuracy.

Stratification of weight was also performed. In patients having weight 35-64 kg, TMH was 82.5% sensitive, 95.6% specific having 73.2% PPV, 97.4% NPV and 93.0% accuracy and MMP was 93.7% sensitive, 90.3% specific having 58.4% PPV, 99.0% NPV and 90.7%. In patients having weight 65-92 kgs, difficult intubation according to TMH with difficult intubation according to standard was 74.1% sensitive, 93.7% specific having 67.4% PPV, 95.3% NPV and 90.7% accuracy and MMP was 91.4% sensitive, 89.9% specific having 61.7% PPV, 98.3% NPV and 90.1% accuracy.

Table 1: Descriptive statistics of Thyromental Height (TMH).

Thyromental Height (mm)	
Mean	56.16
S.D.	6.82
Minimum	33
Maximum	65

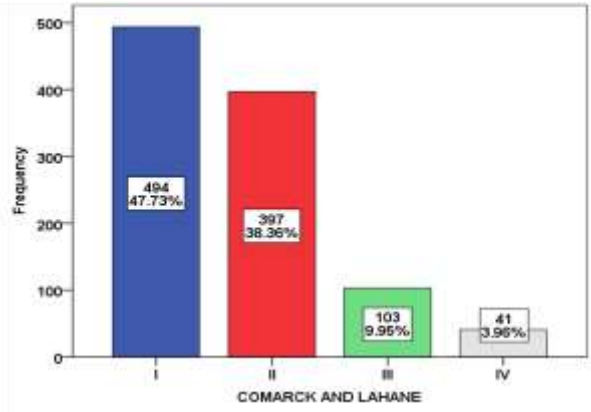

Figure 1: Frequency of Comarck and Lahane Grade.

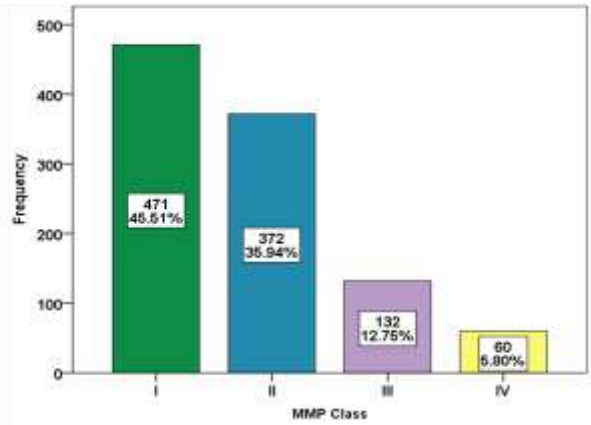

Figure 2: Frequency of MMP Class.

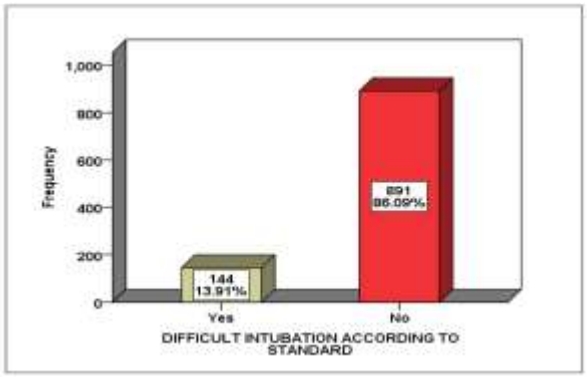

Figure 3: Difficult intubation according to standard.

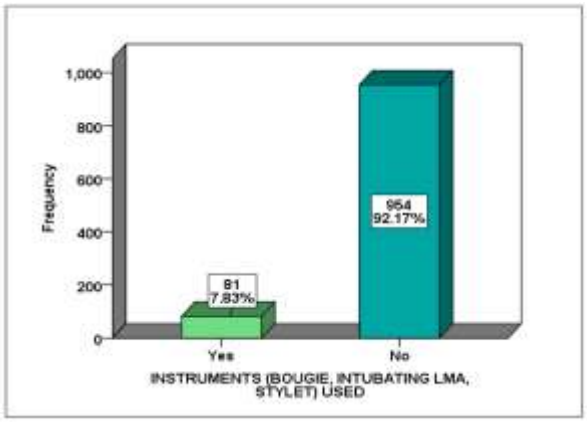

Figure 4: Frequency of Instruments (bougie, inbuating LMA, stylet) used.

DISCUSSION

The safe management of the difficult airway has consistently been a core topic of interest in anaesthesia research and in clinical practice guidelines. The Difficult Airway Society published its latest guidelines in 2015 for managing unanticipated difficult or failed tracheal intubation.[13] Although there has been a substantial decrease in the number of claims for death and brain damage during the induction of anaesthesia over the last few decades, the risk stratification of, and response to, unanticipated difficult airways remain occasionally suboptimal.[14]

The term "difficult airway" (or "DA") refers to a clinical condition in which a traditionally educated anesthesiologist has challenges during tracheal intubation, face mask ventilation of the upper airway, or both. Direct tracheal access, airway instrumentation (such as with supraglottic airway devices), and airway consideration during extubation would all be part of a more comprehensive definition. 15 According to the findings of the 4th National Audit Project, management planning errors or a failure to detect and assess possible problems may have a negative impact on the outcome. Beyond performing a series of tests on the patient at the bedside, airway assessment must make an effort to identify issues with each aspect of airway management and incorporate them logically into a plan of action.[16]

The most accurate approach to assess mouth opening capacity is by the inter-incisor gap. Although some video laryngoscopy (VL) blades require as low as 1.8–2 cm for insertion, successful supraglottic device (SAD) use has been observed in individuals with 2 cm mouth openness, a distance of 3 cm is widely considered as a non-reassuring sign. The modified Mallampati classification, which is frequently used, evaluates the link between the size of the oropharyngeal cavity and the tongue. This is done while the patient is sitting, opening their mouth wide, and sticking out their tongue as much as possible. Depending on the

anatomical structures that are visible, a score of 1-4 is produced. Class 3 (when the base of the uvula and soft palate are visible) and Class 4 (where only the hard palate. Common measurements include sternomental distance (SMD) and thyromental distance (TMD). TMD is defined as the distance, measured with the head extended, from the upper border of the thyroid cartilage to the tip of the jaw; a distance of approximately 6.5 cm is associated with DL. In contrast, SMD is defined as the distance, measured with the head extended, from the sternal notch to the tip of the jaw; a distance of approximately 12.5 cm is similarly associated. Since fingerbreadths are erratic and inaccurate, it is better to measure these lengths with rulers or measuring tape. 17,18 Thyromental height (TMHT) is a recently published anatomical measure with possibly more accurate predictive capabilities, but it has to be verified in large-group investigations.[19]

In present study, we determined the diagnostic accuracy of modified mallampati classification and TMD in predicting difficult intubation taking Cormack and Lehane's classification of laryngoscopy as gold standard. In present study the sensitivity of mallampati classification was 77.8% sensitive, 94.6% specific having 70.0% PPV and 96.3% NPV. On diagnostic accuracy of MMP taking difficult intubation according to standard as gold standard, MMP was 92.4% sensitive, 90.1% specific having 60.2% PPV and 98.6% NPV.

A study conducted in 2018 showed the incidence of difficult laryngoscopy was 8.2% using Cormack and Lehane's classification TMHT at cut-off value 50mm Showed accuracy of 97.7% specificity (98.97), sensitivity (84.62), PPV (88%), NPV (98.63%). whereas modified Mallampati score (III and IV) had low accuracy (80.3%), specificity (81.03%), sensitivity (73.08%), PPV (25.68), NPV (97.11).[10]

Another study showed (9.3%) of population had difficult laryngoscopy using Grade III and IV of Cormack and lehane's classification as gold standard TMHT at a cut-off value 50mm had accuracy higher (95%), specificity (97%) sensitivity (75%), PPV (73%), NPV (97%). while the accuracy of modified Mallampati test (MMT) has come as only 79% at cut-off value (III and with specificity (81%), sensitivity (53%), PPV (22%), NPV (99%).[11]

A meta-analysis of studies on the screening test for the airway physical examination was published by Shiga et al. They wanted to know how well bedside diagnostics might diagnose difficult intubations in patients without airway disease. From computerised data bases, 35 trials (50,760 patients) were chosen. The Mallampati oropharyngeal classification, TMD, SMD, mouth opening, and Wilson risk score were among the screening tests that were included. When performed independently, each test had low to moderate sensitivity (20–62%) and fair to good specificity (82–97%). They discovered that a combination of MPC and TMD had a sensitivity of 36% and a specificity of 87% for predicting difficult tracheal intubation.[19]

Some of the strengths of our study include a large sample size and an effort to re-evaluate TMHT at a defined cutoff value. Nevertheless, patients who are physically or cognitively unable to cooperate for other tests like the modified Mallampati score or the upper lip bite test may benefit from the TMHT. Our research had few restrictions. Care should be taken when extrapolating the findings from our particular ethnic group to populations with various morphological traits. Tools for assessing the airways were evaluated individually. However, a recent systematic evaluation revealed the limited utility of particular test combination. It is possible that the subjective measurements were prone to observer bias, and the laryngoscopic grading was vulnerable to interobserver variability. It is also important to note TMHT's limitations..

Future research should aim to establish and validate ethnicity-specific cutoffs given that racial differences in body type and craniofacial characteristics exist. Data on the Caucasian population from TMHT are scarce (21, 22). Before beginning a clinical evaluation, the appropriate method of measuring the airway parameters should be established, and pilot testing for interobserver variability should be actively encouraged. It bears repeating that in order to predict difficult intubations, doctors should stop relying solely on one airway diagnostic technique.

CONCLUSION

TMH was the test that was most sensitive and accurate at foretelling difficult laryngoscopy when compared to the modified Mallampati score. TMH has potential as a single anatomical metric to predict the possibility of a difficult laryngoscopy. Thyromental Height (TMH) needs more broad usage in multiple settings to be validated as a single most important predictor of difficult laryngoscopy. It will thus be used widely all over the country rendering fewer complications for the patients.

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