Predicted Value of Thyro-Mental Distance, Mandibular Body Length and Symphysis Depth and Their Effect on Laryngoscope View

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Background: Airway assessment is an essential part of preoperative planning helps to predict potential problems during intubation. Measurements of anatomical distances and other bedside evaluation techniques may be the foundation of the assessment procedure. This study aims evaluate the level of difficulty related to direct laryngoscopy endotracheal using anatomical criteria.

Method: This prospective observational study comprised 70 patients, both sexes, over the age of 18 years, scheduled for elective surgery under general anaesthesia who required tracheal intubation. All cases with mandible anomalies were excluded from examination. Thyro-mental distance (TMD), mandibular body length (ML), as well as mandibular depth (MD) were measured, and their impact on intubation and laryngoscope view were investigated.

Result: Sixteen (22.9%) had difficult intubation. The current study demonstrated that TMD and ML had the greatest impact on the laryngoscope view grading, while MD had no effect on the laryngoscope view. The tested airway difficulty predictors sensitivities, were 20.75%, 20.83%, and 30.77%; while specificity were; and72.77% and 87.1% and 70.59%, for ML, MD, and TMD, respectively.

Conclusion: TMD showed higher specificity than TMD and MD. A future study should be done to outline the value of different airway tests for accurate validation of difficult airway predictions.

Keywords Airway, Mandible, Laryngoscope, Anaesthesia.

Introduction

Airway assessment is the first part of any airway management strategy, leading to the planning of the drugs, equipment, and techniques to be used. Airway assessment must go beyond carrying out a series of bedside examination. It must attempt to identify problems might be faced airway management and incorporate these into preventive strategy [(10)].

Assessing the airway before surgery is standard clinical practice. Both the Royal College of Anaesthetists UK and the Australian and New Zealand College of Anaesthetists emphasise the importance of conducting an adequate preoperative history and thorough examination of the airway during a pre-anaesthesia consultation [(18)].

Anatomical variances, airway disease, and prior tactics should all be taken into account. It is crucial to evaluate how these aspects may affect the likelihood of success for any particular technique or piece of equipment utilized. The skills of the anaesthetist and the equipment available must also be considered [(10)].

The aim of the assessment is to ensure that any abnormalities are detected and appropriate safe strategy is considered and employed. The need of maintaining breathing and oxygenation during airway management is a really well-made point [(19)].

Difficult laryngoscopy and/or intubation may cause various serious complication like; hypoxia, brain damage, or even death, if they are not managed early [(1)].There are many methods has been used to assess airway. However, the ideal and universally acceptable classification system for difficult airway prediction is still ongoing [(2)].

Cormack and Lehane Grading (CLG) is considered to be gold standard for predicting difficult laryngoscopy and tracheal intubation. But this this grading is commonly used after induction and muscle relaxation. Furthermore, it is not good to predict difficult laryngoscopy before induction [(1)].

Predictors of difficult laryngoscopy and tracheal intubation can be categorized as anatomical, physiological, or contextual. Anatomical classification of difficult airway and difficult laryngoscope is based on measuring many anatomical distances and some anatomical features in the head and neck area [(3)].

In this study, some anatomical distances were measured to investigate the effect of selected distances on the classic CLG system, which scores the laryngoscope view of the glottis.

Methodo

The study was performed on patients who require surgeries under general anaesthesia and need intra-tracheal intubation.

The data were collected from Zawia Medical Centre and Tripoli Central Hospital between April and September 2022.

Informed consent was obtained from the included participants. All, males and females, aged 18-55 years were studied. Patients with a BMI greater than 35 kg/m^2 (as measured by height and weight from their file) and facial bones malformations such as retrognathic and prognathic cases or injuries to the mandible were excluded from this study.

Also, if any case had limitation in cervical mobility or a short neck, the case was eliminated, as limitations in cervical mobility and short neck are both factors predicting patients with difficult airway.

Distances under investigation

1. Thyromental distance (TMD); length between the bony point of the mentum and the thyroid notch with the mouth closed.
2. Length of the body of the lower jaw (ML); from the angel of the lower jaw to symphysis.
3. Depth of the body of the lower jaw (MD); is the height of the mandibular symphysis.

The classic CLG under direct laryngoscopy, which according to the classification introduced in 1984, dictated that difficult intubation is classified into grades I–IV (8).

The airway is assessed by history, physical examination, and occasionally, laboratory exams (9). The study was designed to examine the effect of TMD, ML, and MD on the laryngoscope view according to classic CLG and to find out the value of measured distances as a predictive factor of airway difficulty.

Taking Measurements

Three dimensions of the lower jaw were taken and measured: length of the body of the lower jaw (ML), thyroid distance (TMD), and depth of the body of the lower jaw (MD). All measurements were taken in advance from conscious patient. All were measured using standardized measuring tape. (1) Measuring the length of the mandibular body (ML) the distance from the angel of the lower jaw to the symphysis was measured. Measuring the thayromental distance (TMD), with a fully extended neck, the distance from the anterior larynx (neck) to the lower jaw (chin) is the thyromental distance (TMD) As a last dimension, the depth of mandibular body depth (MD) was taken from the mandibular symphysis to the lower lip margin.

The classic Cormac Lehane grading system was used to determine the laryngoscope view.

The data was collected under standards and special putted metrics to avoid difficulties and obstacles that directly affect the scale, such as (jaw injuries, mental distortion of the mandible, poor dentation, and other problems).

Static Analysis

The collected data were analysed via SPSS version 23 software, with one-way ANOVA posthoc-tukeys test to compare between grade groups with P value at 0.05.

The area under the receiver operating characteristic (ROC) curve for the TMD, MD, and ML were used to calculate the best cut-off point of distances and to determine the predictive values. Data were used to construct the validity indices (sensitivity, specificity, positive, and negative predictive values).

Results

This study was performed in Libyan hospitals (Zawia Medical Centre, and Tripoli Central Hospital).

The 70 patients require surgeries under general anaesthesia were studied. The assessed patients were of both genders, 21 were males and 49 were females. The patient's ages ranged from 20 years old as the youngest to 54 as the oldest examined. The height of the included patients ranged from 150cm to 180cm, and their weight ranged from 45 Kg to 95 Kg. The body mass index (BMI) was calculated for each case, and it ranged from 21,43 Kg/m^2 to 34,33 Kg/m^2. All patients' demographic data were presented in table 1.

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Table 1: Demographic Patient's Data

Gender		Age (years)		BMI (Kg/m^2)	
M	21(30 %)	18 - 30	21 (30 %)	20-25	11(15.7%)
F	49(70 %)	31 – 42	23 (32.9 %)	26-30	44(62.9%)

	43 - 54	26(37.1 %)	31-35	15(21.4%)
	Total	70(100%)	Total	70(100%)

As presented in table 2; all grades of the classic Cormack– Lehane score were observed in this study. Patients with Grade I and grade II were the most seen with 27 patients for each grade (identical 38.6% for each grade), whereas grade III was seen in 13 patients (18.6%), and grade IV was the least common among all examined cases, it was seen just in 3 cases (4.3%).

The majority of the cases (54 (77.1%),) were easily intubated, and 16 cases (22.9%) have difficult intubation.Aids have been uses to facilitate the process, such as stellate and cricoid pressure.

Table 2: Cormacl-Lehane Grade and Intubation

View Grade		**Difficult Intubation**		**Attempt Times**	
Grade I	27 (38.6%)	Easy	54 (77.1%)	One	52 (74.3%)
Grade II	27 (38.6%)	Difficult	16 (22.9%)	Two	15 (21.5%)
Grade III	13 (18.6%)	Total	70 (100%)	Three	3 (4.3%)
Grade IV	3 (4.3%)			Total	70 (100%)
Total	70 (100%)				

Intubation is not always successful on the first attempt some cases; intubation may successful after second or third attempts. Among all cases, intubation was done after a third attempt in just 3 cases, whereas, most cases the intubation was succeed from the first attempt. Details of difficult airway are included in table 2.

The area under ROC curve was used to find out the cut-off point for studied distances. The ROC of measured distances showed the cut-off value for ML at 8.55cm and for TMD in our study was found to be 6.75cm (Fig. 1).

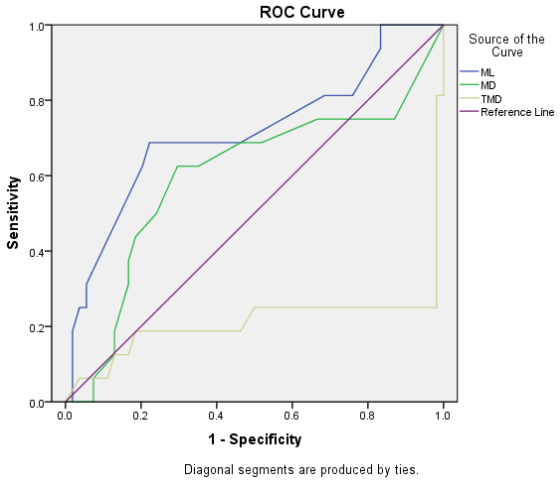

Fig.1 The ROC of TMD, MD and ML show their cut-off value

The measured distances were extended from 7cm to 10cm for ML, from 3cm to 5cm for MD, and from 4cm to 8.8cm for TMD (table 3).

The CCLS were significantly affect by the ML and TMD with P <0.000, whereas the MD has no significant effect on the view laryngoscope with P < 0.43 (table 3).

Table 3: Effects of Taken Measurements on Laryngoscope View

	CCLG 1	CCLG 2	CCLG 3	CCLG 4	P value
ML	7-9 cm	7.6-10 cm	7.8-9.9 cm	7.7-9.5 cm	0.000
MD	3-5cm	3-5 cm	3-4.9 cm	3-4.7 cm	0.430
TMD	4.5-8 cm	6-8.8 cm	4-8.8 cm	4-7.5 cm	0.000

TMD had the highest sensitivity (30.77%), specificity (87.09%), PPV (75%), and NPV (50%) among all the tests. ML had the least sensitivity (20.83%) and least least specificity (70.59%), and NPV (22.22%) and MD had the least PPV (62.5%). Validity indexes for TMD, ML, and MD to predict difficult laryngoscopy are shown in Table 4.

The ROC of measured distances shows the cut-off value for TMD was 6.750 cm, MD 3.95cm, and ML 8.55cm (Fig. 1).

Table 4: Validity Index of Measured Distances for Predicting Difficult Laryngoscopy

Tests	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)

ML	20.75%	70.59%	68.75%	22.22%
MD	20.83%	72.72%	62.5%	29.62%
TMD	30.77%	87.09%	75%	50%

Discussion

Maintenance of a patent airway is the primary responsibility of anaesthesiologists. Interruption of gas exchange, even for a few minutes, can result in catastrophic outcomes such as brain damage or death [12].

Screening tests have different diagnostic values depending on the variety of incidences of intubation, insufficient statistical power, and different test applications [13]. Recognizing that a patient's airway will be difficult allows the clinician to plan for and minimize the risks of airway-related morbidity [14].

As the facial bone growth continues up to puberty [15], all examined cases were above the age of 18. Additionally, age-related cervical lordosis increases the difficulty of tracheal intubation, and the changes in the relationships of the larynx to the pharynx in the elderly may influence the laryngeal exposure during tracheal intubation [16], so no patients over 60 years old were included in our study.

Dental injuries increase with poor dentition, along with associated anaesthesia-related risk factors and difficult intubation [20]. When people have weak teeth or lose teeth, the alveolar bone is resorbed, and the mandibular body height will reduce [15]. Consequently, all cases with poor dentation were excluded from the study. The presence of a mandibular fracture (mandible abnormality) may be considered a predictor of both difficult laryngoscopy and endotracheal intubation [21] mandibular deformity using anatomic criteria to define and grade of difficulty of endotracheal intubation with direct laryngoscopy [22]. Anatomic criteria for difficult airway such as a short neck; small mandible, were considered difficult tracheal intubation [23]. Accordingly, patients were screened for possible factors of difficult airway and thus, with any difficult factors were excluded.

The incidence of difficult laryngoscopy and intubation that required general anaesthesia is 1.3% to 13%, while a higher incidence of up to 20% has been reported [6][11].

In our study, an incidence of difficult intubation was found in 16 (22.9%) patients, and no failed intubation was found. Intubation with a stylet was used in 4 (5.71%) cases, while cricoid pressure was used in 5 (7.14%) cases. Some studies found a lesser incidence of difficult intubation was found (17.3%) [4], (16.5%) [6] and (18.2%)[5].

This variation in the incidence of difficult intubation might be due to ethnic differences among populations, head position, external laryngeal manoeuvres, and varied standards used to define difficult laryngoscopy and intubation.

Although various airway tests have been devised to improve diagnostic accuracy but, none of the tests individually have proven to be adequate. However, combining these tests haave been proposed to improve their predictive value [(4)].

The results clearly showed that TMD and ML had the most effect on the laryngoscope view grading with (P= 0.000) while, MD had no effect on the view grade P=0.430. These results strongly agree with previous study results. This pattern of results is consistent with the study of Karm *et al.,* in 2016 [(22).]

The cut-off value for TMD in our study was found to be 6.75cm by ROC curve. Different studies used cut-off value of 6.5 cm [(24)].

TMD used as a predictor of difficult intubation and it is vary with the patient's size and body proportion.

In our study, TMD had the highest specificity (87.09%) and PPV (75%), whereas sensitivity was (30.77%), and NPV (50%). These findings were partially similar to previous studies, in term of specificity and NPV of TMD, though it had very low sensitivity and low PPV [(4)]. Similarly, another study found TMD had low sensitivity and low PPV, while specificity and NPV were found to be high [(11)].

The different cut-off points used in different studies may result in this variation in PPV and NPV for the TMD from our study to another.

The ROC of measured distances showed the cut-off value for ML at 8.55cm. ML had a very low sensitivity and NPV and relatively high specificity and PPV. A similar study reported ML sensitivity 26.9%, specificity 85.5%, PPV 20.6% and NPV 85.5% [(7)]. This finding may be explained by the idea that, the differences in values between studies may be explained by using different cut-off values used as there are no identical values and different authors use different cut-off values.

MD was measured to evaluate its productivity as a new distance to assess the airway before intubation. In our study, we found MD showed higher specificity than sensitivity, and PPV was more than NPV. These results are further supported by the finding that ML and TMD had no statistically significant ability to predict difficult airway [(7)].

The lower sensitivity for all measured distances (TMD, ML, and MD) suggested that, all are inadequate predictors of difficult intubation due to their low sensitivity, but they could be good predictors for easy laryngoscopy as they had high specificity.

Recommendations and Limitations

For future work, more parameters need to be studied, such as ethnicity, age groups, and gender specific cut-off values to establish a more reliable and accurate test to predict difficult laryngoscopy.

The study's shortcomings included the fact that the validity indices of tests were examined individually for each test, rather than in combinations of each test with another.

Additionally, the cut-off value for males and females was not calculated separately. Last of all, the negative responses of some anesthesiologists limit this work.

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