

An Observational Study Correlating Modified Mallampatti Staging with Ultrasonographic Quantification of Anterior Neck Soft Tissue Thickness for Prediction of Difficult Laryngoscopy

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Abstract:

Background and Aims: One of the major responsibility of the anaesthesiologist is to provide adequate ventilation to the patient. Therefore assessment of the airway is an essential aspect of the pre-anaesthetic assessment. Modified Mallampatti staging in sitting position is most commonly used and is a standard method of assessing the airway and for predicting potentially difficult intubation. Ultrasound has been evolving as a useful device for airway assessment. It can also be used for various other things such as determining the size of endotracheal tube size, for predicting malposition of LMA in children, to rule out suspected intraoperative pneumothorax. Furthermore it also helps to rule out the causes of inadequate ventilation, to determine the width of trachea, in predicting tracheostomy tube size and shape and also to assist with percutaneous dilatational tracheostomy.

Material and Methods: The present study is an observational study between the age group 18-60 years of either sex belonging to ASA grade I to II, Modified Mallampatti Stage 1 to 4 scheduled for elective surgery and requiring general anaesthesia with direct laryngoscopy and endotracheal intubation. Ultrasonography is done using curvilinear and linear probes at different levels such as submandibular region, hyoid bone, vocal cords, thyroid gland. Distance from the skin to hyoid bone, thyrohyoid membrane and skin to the anterior commissure of vocal cords using the USG machine followed by modified Cormack-Lehane score grade on laryngoscopy were noted.

Result: In this study 100 eligible subjects (47 female and 53 male) were included out of which 11 were difficult intubation (11%). MMS in difficult intubation was higher than in easy intubation. The USG measurements were also greater in difficult intubation than easy intubation.

Conclusion: Our study demonstrated that ultrasonographic measurements of tongue thickness and thickness of soft tissue of neck at hyoid bone level, at the level of thyrohyoid membrane and anterior commissure are useful tool to distinguish easy and difficult laryngoscopy.

Keywords: Airway assessment, Laryngoscopy, Ultrasonography, Difficult Intubation, Modified Mallampatti Staging, Cormack-Lehane score

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Introduction

Airway management is a core component of anaesthesia care, failure of which can lead to patient morbidity and mortality. It is therefore important to optimize methods to predict a difficult airway and ensure the necessary means to intervene. [1,2] Modified Mallampatti Staging (MMS) is a clinical screening test used assess difficult intubation. Ultrasonography has emerged as a useful tool for assessment of the airway as it is non invasive, repeatable, quick, safe, portable, widely available and it gives real-time dynamic image. [3] USG helps in predicting difficult laryngoscopy by measuring the tongue

thickness and thickness of soft tissue of neck at different levels such as

- Anterior commissure-distance from skin to AC (DSAC),
- hyoid bone-distance from skin to HB (DSHB),
- thyrohyoid membrane-distance from skin to epiglottis in between hyoid bone and thyroid (DSEM).

It can also be used for various other things such as determining the size of endotracheal tube size, for

predicting malposition of LMA in children, to rule out suspected intraoperative pneumothorax. [4,5] Furthermore it also helps to rule out the causes of inadequate ventilation, to determine the width of trachea, in predicting tracheostomy tube size and shape and also to assist with percutaneous dilatational tracheostomy. [6,7] Our main aim in this study is to determine the significance of USG measurements of tongue thickness, thickness of the soft tissue neck at various levels such as HB, thyrohyoid membrane and AC in predicting difficult laryngoscopy and to examine correlation between USG measurements and Modified Mallampati staging.

Material and Methods

This prospective, observational study was conducted on 100 patients who were posted for elective surgery under general anaesthesia. After institutional ethics committee approval and appropriate consent, patients between 18 and 60 years of age, of either sex, ASA Grade I-II requiring GA with intubation for elective procedures were included in the study.

Exclusion Criteria:

1. Patients with features of Cervical spine fracture or abnormality, Maxillofacial fracture or abnormality
2. Tumors of oral cavity such as of tongue, buccal mucosa,
3. History of any trauma or surgery of tongue and epiglottis,
4. abnormality of teeth, absent teeth, dentures etc
5. Obstetric and pediatric patients

All patients underwent a detailed preoperative airway evaluation before surgery. MMS was done in each patient preoperatively in upright sitting position, head in neutral position, mouth wide open, and tongue protruding out.

USG measurements were performed with patients in supine position with head and neck in the neutral position without pillow. The high-frequency linear probe (5-14 MHz) and the low-frequency curvilinear probe (3-7 MHz) of the ultrasound machine (Mindray) were used to measure the different usg parameters. A curvilinear usg probe was placed below the mentum along the mid-sagittal plane and was adjusted to obtain a clear image of the tongue contour. Thickness of the tongue was measured as the vertical length from submental skin to the surface of the tongue.

The distance from skin to HB (DSHB) was measured by placing the linear usg probe transversely over the HB, distance from skin to the thyrohyoid membrane (DSTM) was measured in between HB and thyroid cartilage at the level of the epiglottis and distance from skin to AC (DSAC) was measured at the level of midpoint of thyroid cartilage.

The subjects were shifted to the operating room and all vital monitors such as ECG, noninvasive blood pressure, and pulse oximeter were connected to the subjects and then baseline values were noted. After the patient was preoxygenated with 100% O₂ for 3 min, (IV) midazolam 1 mg and fentanyl 2 µg/kg were given. Anaesthesia was induced with IV propofol 2 mg/kg. Muscle relaxation was achieved by IV atracurium 0.05mg/kg and ventilation with 100% O₂ for 3 min was done. The Cormack–Lehane grade was noted by performing Direct laryngoscopy by a trained anaesthesiologist using an appropriate size curved Macintosh blade. Grade I and II of Cormack–Lehane (CL) grade were categorized as easy laryngoscopy and Grades III and IV as difficult laryngoscopy.

Result

Our study included 100 eligible subjects 47 female (47%) and 53 male (53%) with age ranging from 18 to 60 years. MMS in difficult intubation was higher than in easy intubation. The distribution of intubation grades for all subjects were 62%, 24%, 6%, 8% for grade 1, 2, 3 and 4 respectively.

Out of 100 subjects, 11 were categorised as difficult laryngoscopy ie 11%. Thirty eight patients falls under CL Grade I (39%), fifty two patients in Grade II (52%), nine patients had a CL view of Grade III (9%), and none in Grade IV.

The USG measurements of thickness of soft tissue neck and tongue thickness were greater in difficult intubation than easy intubation. In predicting Difficult intubation the optimal value for tongue thickness was > 5cm. For DSHB, it was > 1.8cm, for DSEM it was > 2.8 cm, and finally for DSAC it was >1.7cm. The mean measurements for difficult intubations are as follows- at hyoid bone (1.48±0.28CM), thyrohyoid membrane (2.43±0.36CM), anterior commissure (1.33±0.31CM) and tongue thickness (4.1±0.58CM). All usg measurements were greater in difficult laryngoscopy group. The *P* value was 0.001. Also significant correlation was found between MMS and USG measurements.

Parameters	DIFFICULT	EASY	P-VALUE
DSHB	1.48±0.28CM	0.98±0.27CM	<0.001
DSEM	2.43±0.36CM	1.56±0.37CM	<0.001
DSAC	1.33±0.31CM	0.86±0.18CM	<0.001
TONGUE THICKNESS	4.1±0.58CM	1.86±0.26CM	<0.001

MMS GRADE	DIFFICULT	EASY
GRADE 1	2.8%	38%
GRADE 2	18.2%	52%
GRADE 3	38%	8%
GRADE 4	41%	2%

Discussion

There are several parameters of predicting difficult laryngoscopy, but none of them are 100% sensitive and specific. [8] Ultrasound has emerged as a promising tool for anaesthesiologist which has revolutionized care in various areas. [9] The role of ultrasound in assessment of the airway is still new as there are no established standard parameters to predict a difficult laryngoscopy. [10] Our study shows the ability of upper airway USG parameters in predicting difficult intubation. In this study we studied thickness of soft tissue neck by measuring the distance from skin to HB, skin to the thyrohyoid membrane and skin to AC and tongue thickness using usg in predicting difficult laryngoscopy

Adhikari *et al.* in his study found that subjects with difficult intubation has greater thickness of anterior neck soft tissue at the level of hyoid bone and thyrohyoid membrane. [11] Similarly, a study conducted by Wu *et al.* in 203 patients shows that usg measurement at different levels such as at hyoid bone level, at the level of thyrohyoid membrane and anterior commissure can each predict difficult laryngoscopy. [10] Our study showed that the thickness of tongue was significantly higher in the difficult laryngoscopy group.

In our study we found that in predicting Difficult laryngoscopy the optimal value for tongue thickness was > 5cm, For DSHB, it was > 1.8cm, for DSEM it was > 2.8 cm, and finally for DSAC it was >1.7cm which were comparable with other studies. Our study also showed that in subjects with higher MMS, ultrasonographic measurements of anterior neck soft tissue were also increased.

Conclusion

Our study demonstrated that ultrasonographic measurements of tongue thickness and thickness of soft tissue of neck at hyoid bone level, at the level of thyrohyoid membrane and anterior commissure are useful tool to distinguish easy and difficult intubation. Clinical screening test ie Modified Mallampatti staging also correlated with ultrasonographic findings. Combination of Modified Mallampatti staging with ultrasonographic measurements increases the probability of predicting difficult intubation.

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