

Measurement of Neck Circumference, Tongue thickness and Skin to Epiglottis Distance as Predictors of Difficult Intubation: A Prospective Study

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Abstract

Airway Assessment is essential in pre anesthetic assessment. Anticipating and preparing for difficulty in airway management is crucial to avoid airway catastrophes. Routine pre operative airway examination usually includes mouth opening and dentition, Mallampati classification, thyromental distance and neck movements. Neck circumference is a quick bedside test to determine difficult laryngoscopy. Increased tongue thickness and skin to epiglottis distance affects performance of laryngoscopy and tracheal intubation increasing the risk of difficult airway. Presently there is a search for non-invasive and accurate tools to overcome limitations of clinical airway assessment tests. Ultrasonography has been evolving as a useful device for airway assessment especially soft tissue structures in anterior surface of neck. Here we studied the measurement of neck circumference and ultrasound measurement of tongue thickness and skin to epiglottis distance as predictors for difficult intubation. The Aim of the study is to predict difficulty in intubation by measuring neck circumference, thickness of tongue and thickness of skin to epiglottis. Prospective observational study, 120 patients posted for surgery under general anesthesia, Department of anesthesia, Meenakshi medical college, Kanchipuram. After institutional Human ethical committee clearance, 120 Patients were screened during preoperative assessment for undergoing procedures under general anaesthesia. Neck circumference and other airway parameters were measured with measuring tape and distance between Skin to epiglottis and tongue thickness were measured with ultrasound linear probe. Patients were grouped into Group E (Easy Intubation) whose Cormack-lehane grade was 1 and 2 and Group D (Difficult intubation) whose Cormack-lehane grade was 3 and 4. SPSS version 16 was used for statistical analysis. There was no statistical significance seen between age, sex, height among easy and difficult intubation but significance was seen with weight ($p < 0.05$), Thyromental distance ($p < 0.05$) and Sterno-mental distance ($p < 0.05$). High significance was seen in Distance between skin to epiglottis distance ($p < 0.001$), Tongue thickness ($p < 0.001$) and Neck Circumference ($p < 0.001$) in difficult intubation cases. Neck circumference and ultrasonographic measurement of tongue thickness and skin to epiglottis can avoid unanticipated difficult intubation.

Keywords: Airway, difficult intubation, ultrasonography Skin.

1. INTRODUCTION

One of the primary responsibilities of an anesthesiologist is to manage the airway. Ever since the introduction of the bag and mask ventilation and endotracheal intubation, difficulty in ventilation and failed intubation are some of the major challenges.¹

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An unanticipated situation of “Cannot Intubate Cannot Oxygenate” is most dreaded among the anesthesiologists. These events mainly pertain to failure of maintaining patent airway.²To prevent such untoward events, many methods have been introduced to identify who can be easily intubated or not. Preoperative assessment of the airway in the patients posted for surgery is hence essential to identify such problems. Initially the airway assessment was carried out by single factors like Mallampatti’s classification (MPC), Thyromental distance (TMD), Head and neck movement and Inter incisor gap and neck mobility. ³These methods are quick and are easily performed at the bedside, but unfortunately, these bedside tests have high inter- observer variability and hence their sensitivity and specificity in predicting whether there is difficulty in airway management is very low. To combat this, multi- varied predictors are being applied to tackle difficult ventilation and intubation but still failure rate in predicting difficult airway has not reduced and many easy intubation prediction and airway ventilation has become difficult and vice versa.⁴

In the recent past, the Anesthesiologists have started to use Ultrasonography in their practice because of its applicability to identify structures which were previously done as blind techniques.⁵ This has led to many groundbreaking techniques and better outcomes in patients undergoing various procedures..Many studies have been conducted using ultrasonography to predict the difficulty in ventilation and intubation.^{6,7,8} Unanticipated difficulty in airway management thus needs to be predicted for every airway ventilation and intubation. So, in this study we have assessed the neck circumference, Ultrasonogram of tongue thickness and distance of skin to epiglottis in predicting difficult airway.

2. Methodology

The study was duly submitted before Institutional Ethical Committee and approval was obtained after which the study was commenced. This was a prospective observational study and was conducted for a duration of one and an half with a sample size population of 120 patients receiving surgical procedure under general anesthesia. The Inclusion criteria was patients between 18-70 years, either sex, requiring general anesthesia using endotracheal tube for elective procedures, ASA grade from I- IV. Those excluded from the study were those patients refusing study, Maxillofacial anomalies, Restricted neck mobility, Morbid obesity with a BMI ≥ 40 , Limited mouth opening, Rapid sequence induction and Pregnant patients. The materials used in the study were Ultrasound machine (Sonosite M turbo) with high frequency (6-12MHz) linear transducer probe, Weighing scale and Measuring tape

All the patients were fully examined on the day prior to surgery and pre-operative assessment sheet was checked. The height, weight, body mass index of the patient was measured.

Clinical examination along with MPC, TMD and SMD were noted. Neck circumference was measured at level of thyroid cartilage All measurements recorded by using a measuring scale in cm. Patient was then made to lie in a supine position with head in neutral position without pillow and tongue thickness was measured by recording geniohyoid muscle thickness (Figure 1) using ultrasound probe in submandibular area in transverse view. Skin to epiglottis thickness was measured by ultrasound using a linear probe place at the level of thyrohyoid membrane midway between hyoid and thyroid (Figure 2). Other preoperative blood and radiological investigations were done



Figure 1: Ultrasound Measurement of Tongue Thickness.

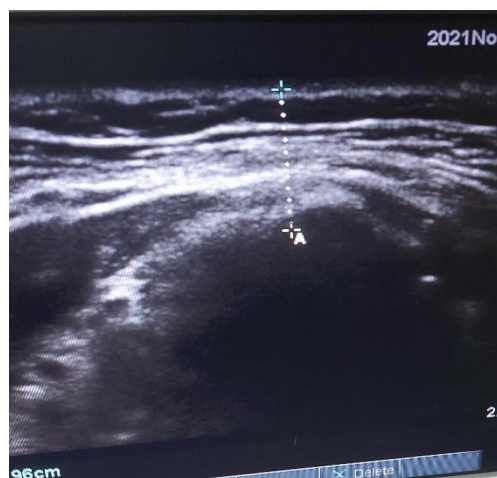


Figure 2: Ultrasound Measurement of Skin To Epiglottis Distance

After Informed consent, premedication given before surgery. On the day of the surgery, in the operating room, all standard monitors connected and baseline values were recorded.

After Preoxygenation with FiO₂ for 3 mins, IV midazolam 1mg and Fentanyl 2mcg/Kg were administered. Anesthesia was induced With IV Propofol 2mg/Kg. After muscle relaxation with Iv Vecuronium 0.1mg/kg and ventilation with oxygen and sevoflurane 2% for 3mins, direct laryngoscopy done with appropriate size Macintosh blade and Cormack-Lehane (CL) Laryngoscopic grade was noted in the first look without any external pressure.

CL I,II were categorized as easy laryngoscopy(GROUP E) and CL III,IV(GROUP D) as difficult laryngoscopy. Patient was then intubated with appropriate sized ET tube and allowed to proceed for surgery At the end of surgery, neuromuscular block was reversed and the patient was extubated.

3. Results

Data obtained was entered in Microsoft excel and analyzed using (SPSS) version 16. The data of age, gender, height, weight, MPC, TMD,SMD, neck circumference, ultrasonographic parameters and CL grade were summarized. In all cases, a p value of less than 0.05 was considered statistically significant a p value less than 0.001 was taken as highly significant.

Table 1: Demographic distribution of the patients among the two groups (n=120)

(i) Age years		Group		p value*
		E (n=79)	D(n=41)	
Category, n	≤40 years	43 (35.8%)	12(10.0%)	0.541
	41-50 years	26 (40%)	22(18.3%)	
	>50 years	5 (4.1%)	8 (6.0%)	
(ii) Gender		Group		p value*
		E (n=79)	D (n=41)	
Male		33 (41.3%)	24 (58.5%)	0.492

Female		44 (55.7%)	19 (46.3%)	
(iii) Height	N	Mean(cm)	Standard Deviation	P Value*
Group E	79	157.6	6.123	0.614
Group D	41	158.4	6.423	
(iv) Weight	N	Mean(cm)	Standard Deviation	P Value*
Group E	79	60.1	7.019	0.000
Group D	41	86.4	6.306	

* p value by chi-square test

Table 1 shows :(i)Age distribution of the patients in the two groups.The pattern of age distribution was statistically insignificant (p>0.05) and hence follow similar distribution in both groups. (ii) In the gender distribution of the patients in the two groups, in the Easy intubation group female patients were more 44(55.7%) and in the difficult intubation group male patients were more 24 (58.5%). The pattern of gender distribution was statistically insignificant (p>0.05) and hence follow similar distribution in groups. (iii) The mean of heights in the group E is 157.6 cms ± 6.123 standard deviation and that in the group D is 158.4. cms ± 6.423 standard deviation. By using the chi square test p value was calculated as 0.614, which is statistically not significant. (iv)The mean of weight in the group E is 59.15 kgs ± 7.019 standard deviation and that in the group D is 72.82 kgs ± 6.306 standard deviation. Weight is highly significant in Group D

Table 2: MPC, TMD and SMDwith CL grading significance

MP CLASS	CL GRADE NUMBER		TOTAL	P VALUE#
	EASY	DIFFICULT		
1	20(16%)	10(8.3%)	30	P=0.0001 HIGHLY SIGNIFICANT
2	32(26%)	14(11.6%)	44	
3	36(30%)	15(12.5%)	36	
4	0	10(8.3%)	10	
TMD(cm)	CL grade number		Total	p value*
	EASY	DIFFICULT		
<6.5cm	4	16	20	P<0.05 significant
>6.5cm	85	15	100	
Total	89	31	120	
CL grade number				

SMD(cm)	EASY	DIFFICULT	Total	p value*
<12.5 cm	4	20	24	P<0.05 Significant
>12.5 cm	85	11	96	
Total	89	31	120	

#P value by independent t test, *p value by Chi square test

Table 2 shows (i) the Mallampatti and CL grade distribution of the patients and is divided into Easy and difficult based on the CL grade. The pattern was statistically highly significant (p=0.001) and hence follow similar distribution in both groups. (ii) shows the Significance between Thyromental distance and CL grade. It is insignificant with P < 0.05 done by Chi square test. (iii) shows the Significance between Sternomental distance and CL grade which is significant with a p value of < 0.5 done by chi square test

Table 3: Significance of Distance from skin to epiglottis, tongue thickness and neck circumference in relation to CL grading

PARAMETER	GROUP (CL)	N	MEAN	SD	P VALUE
(i)Distance from Skin to epiglottis (DSE)	Easy	79	1.56	0.11	P<0.0001
	Difficult	41	2.56	0.88	HIGHLY SIGNIFICANT
(ii)Tongue thickness (TT)	Easy	82	1.4	0.14	P<0.0001
	Difficult	36	2.36	0.78	HIGHLY SIGNIFICANT
(iii)Neck Circumference (NC)	Easy	79	37	0.17	P<0.0001
	Difficult	41	42	0.18	HIGHLY SIGNIFICANT

Table 3 shows (i)the relation of DSE with CL grading. P value shows high significance of < 0.001 done by student t test (ii) the relation between Tongue thickness and CL grading which shows a highsignificance of P value < 0.001 done by student t test (iii)the relation of NC with CL grade shown to have a statistically highly significant value of P < 0.001 done by Chi square test.

4. Discussion

Airway management is one the most important responsibilities for an anesthesiologist and maintaining the patent airway of a patient in an emergency situation is of utmost importance.⁹ The failure to maintain this patency has been recognised a very serious patient concern. The consequences for any difficulty in airway and intubation are potentially life threatening, so a complete thorough

preoperative airway assessment is crucial¹⁰.

The past few years have seen the field of anesthesia gaining more eyesight with the help of the ultrasonogram¹¹. It is a safe and non invasive tool providing real time imaging. The uses of ultrasonogram in anesthesiology are vascular cannulation, ultrasound guided peripheral nerve block techniques, airway assessment and identification of lung pathologies, etc. The modern ultrasonograms have a multi array variable transducerswith cross beam facility and improved resolutions so high quality imaging is obtained.

In the analysis of demographic profile we included patients in the age group of 18-70 years in our study. Age, gender, height were not significant among the 2 groups. The mean and standard deviation of weight showed a significant difference among both the groups and P value as calculated was significant. So this concludes that the weight of the patients have a significant contribution to difficult intubation. This result is comparable with the study conducted by W.H.Kim et al.¹²

Mallampatti and CL grade distribution of patients divided into easy and difficult based on CL grade showed a statistically highly significant p a value of 0.001 where 30 of the patients were in MPC 1, 44 in MPC 2, 36 in MPC 3 and 10 in MPC 4. This is in correlation with the studies conducted by Hanouz et al¹³ where Mallampati classification was compared with Cormack-lehane for predicting difficult airway where p value of <0.001 and showed high statistical significance.

Thyromental distance and CL correlation has shown 16 cases with TMD<6.5cm and the rest of the 104 cases had a TMD of >6.5cm with p value of < 0.05 which was not highly statistically significant. This is in conjecture with the studies done¹⁴ where TMD showed a significance but was not highly significant when compared with CL grading.

Sternomental distance and CL grade showed a P value significance of < 0.05 with SMD <12.5cm in 20 cases with difficult airway. This was comparable in studies done by E Kapanaki et al¹⁵ where reduced SMD of <12.5 cm showed significance but is not highly significant when in comparison of CL grading.

The distance from skin to epiglottis showed the thickness cutoff of 2.65 cm (±3.26cm) and was able to identify all the 41 cases of difficult intubation. That is, it was able to detect 100% of the difficult intubation cases. Hence this range can be taken as a cut off range at thyrohyoid membrane level in detecting difficult intubation.

This result was comparably to the study by Agug Senapathi

TG et al [16] In their study of 128 patients who underwent general anaesthesia, the distance between skin to epiglottis distance measured using ultrasonogram showed that $> 2.65\text{cm}$ is risk factor for difficult intubation. Also, this result correlates with the study done by Aruna Parameshwari et al [17] who described difficulty in intubation in cases where skin to epiglottis distance was more than $20\text{ mm}(2\text{cm})$.

The Tongue thickness showed a cutoff of $2.32\text{cm}(\pm 3.24)$ and was able to identify 36 cases of difficult airway. This range was used to correlate with difficult airway and appropriate management of same could be anticipated and done. This is comparable with the studies done by Masahiro et al [18] and W. Yao et al [19] whose ultrasonography measurements of the tongue thickness of more than 2.5cm and 2.4cm respectively showed a higher preponderance for difficulty in airway.

Relation of neck circumference with CL grading was done and cutoff of $40\text{cm}(\pm 4\text{cm})$ was seen with a cut off of 40 cm which was highly significant of $p\text{value} < 0.0001$. This range was also taken for difficult airway as any $\text{NC} > 40\text{cm}$ had an incidence of difficult airway. This was in comparison with the studies conducted by Raid Walled et al [20] where the neck circumference was $> 40\text{cm}$ in predicting difficult airway.

5. Conclusion

When compared to difficult airway predictors like Thyromental distance and Sterno-mental distance; Mallampatti classification Neck circumference, tongue thickness and Distance from skin to epiglottis by ultrasonographic measurement and neck circumference was more significant in predicting difficult airway. From this it can be concluded that ultrasonogram can be used as an independent tool for assessing airway, which will be helpful in cases of emergency intubations and cases of cervical injuries which require intubation. A new score for assessing may be derived using the above parameters and further studies may be done.

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Conflicts of interest: none

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