



A Study On Analysis Of Anterior Soft Tissue Thickness Using Ultrasonogram, Body Mass Index, And Neck Circumference In Predicting Difficult Intubation

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Abstract

Introduction: The purpose of undertaking airway assessment is to diagnose the potential for a difficult airway for a. Optimal patient preparation b. Proper selection of equipment and technique, and c. Participation of personnel experienced in difficult airway management. This usually leads to successful airway management. On the other hand, determining that the airway is normal, avoids time-consuming, invasive, and potentially more traumatic methods of securing the airway, from being adopted. The essential components of airway assessment are history taking, general examination of the patient, and specific tests/indices to predict difficult airways. Previous anesthesia records may reveal a documented history of the difficult airway.

Aim Of Study: The study aims to analyze paratracheal soft tissue using ultrasonogram, body mass index, and neck circumference in predicting intubation difficulties.

Methodology: It was a prospective, double-blinded study conducted in the Department of Anaesthesiology, Madras Medical College in the year 2019-2020 After taking history, airway assessment, anterior soft tissue thickness using ultrasound, Body mass index, and neck circumference taken up for the study. After analyzing the statistical data it is found that the anterior soft tissue thickness using ultrasound, Body mass index, and neck circumference, significantly predicted the difficulty of intubation 200 adult patients satisfying inclusion criteria were enrolled in this study.

Results: The age group of the patients ranges from 18 yrs to 70 yrs. The majority of the study population was in the 18 to 30 yrs age group. Neck flexion ranged from 25⁰ to 35⁰. Neck extensions ranged from 30⁰ to 40⁰. Sterno mental and thyromental distances ranged from 18.5 to 21 cm and 8 to 11 cm respectively. Inter incisor distance ranged from 3 to 5 cm. 5 patients had artificial dentures, 7 patients had buck teeth, 7 had loose teeth, and one patient was edentulous. In the upper lip bite test 184 patients scored 1 and 16 patients scored 2.

Conclusion: It can be concluded that the anterior soft tissue thickness using ultrasound, Body mass index, and Neck circumference, significantly predicted the difficulty of intubation and can be an important aid for the anesthesiologist.

Keywords: Anterior Soft Tissue Thickness, Ultrasonogram, Body Mass Index, Neck circumference, predicting difficult Intubation

Introduction

Endotracheal intubation is one of the most important skills for anesthesiologists in securing the airway

during general anesthesia and resuscitation. Failure to secure the airway can cause anesthesia-related life-threatening morbidity and mortality. Therefore, unanticipated difficult intubation remains a primary concern for anesthesiologists [1]. Theoretically, accurate preoperative airway evaluation can reduce or avoid unanticipated difficult intubation. However, the difficult laryngoscopy and tracheal intubation rate remain at 1.5–13% due to the poor reliability of traditional protocols, algorithms, and combinations of screening tools in identifying a potentially difficult airway [2]. Due to its portable, noninvasive characteristics, the point-of-care ultrasound (US) technique has been widely used in the operating room for ultrasound-guided nerve block, central venous access, and pneumothorax diagnosis. With improved visualization of airway structures, more studies have been focusing on airway structure and function [3,4]. Prasad et al. first found that the US can reliably image all of the structures visualized by CT, and the infrahyoid airway structure parameters measured by ultrasound agree well with the parameters measured by CT [5]. The anterior neck soft tissue thickness measured by ultrasound at the hyoid bone and thyrohyoid membrane levels can be used as an index to predict difficult laryngoscopy, but only the anterior neck soft tissue thickness at thyrohyoid membrane levels can be used as an independent predictor of difficult laryngoscopy. Interestingly, they did not find a correlation between US measurements and clinical screening tests [6].

Methodology: It was a prospective, double-blinded study conducted in the Department of Anaesthesiology, Madras Medical College-GGH in the year 2019-2020 After taking history, airway assessment, anterior soft tissue thickness using ultrasound, Body mass index, and neck circumference taken up for the study. After analyzing the statistical data it is found that the anterior soft tissue thickness using ultrasound, Body mass index, and neck circumference, significantly predicted the difficulty of intubation 200 adult patients satisfying inclusion criteria were enrolled in this study. Inclusion Criteria: 1. Elective adult surgical patient

requiring general endotracheal anesthesia. 2. Males and Females. 3. ASA Physical Status 1-2. 4. Age 18 years of age and older. 5. Who has given valid informed consent. Exclusion Criteria: The patients with the following conditions are not included in this study. 1. Patients not satisfying inclusion criteria. 2. Patients requiring special techniques for intubation such as rapid sequence induction. 3. Patients intubated before surgery. 4. Patients with severe cardiovascular, hepatic, or renal disease, or mental illness. 5. Are unconscious or very severely ill. 6. Need for nasal intubation. **Airway assessment:** Previous anesthesia records, H/O snoring, H/O voice change, H/O previous surgery, Trauma, Burns, tumors in & around the oral cavity, and Neck or cervical spine were asked in the history. H/O of systemic illnesses like Diabetes, Ankylosing spondylitis, and Rheumatoid arthritis were asked and recorded. The general examination included examination for facial anomalies, Temporomandibular joint pathology, Anomalies of mouth & tongue, pathology of the nose, and pathology of the palate. Height in meters and weight in kilograms were recorded and BMI was calculated. Measurement of airway indices: Individual indices were measured. A-0 joint movement: The patient was asked to look at the ceiling without raising an eyebrow and the range of movements was measured with a gonioscope. The incidence of difficult intubation in obese patients with large necks and OSA is claimed to be several times more frequent than in non-obese patients. A recent study concluded that obese patients with neck circumference > 50 cm had a greater chance of problematic intubations than those with < 50 cm.

Results: This prospective, randomized, double-blinded study predicted the intubating conditions by measuring anterior soft tissue thickness using ultrasonogram, Body mass index, and Neck circumference and evaluated the advantages, effective airway time, and airway trauma. All data were collected and tabulated. Statistical analyses were conducted using SSPC 13.0 version.

Table :1 Age Distribution

Age (yrs)	18-30	31-40	41-50	51-60	61-70

N	66	37	49	45	3
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Table :1 Age group of the patients ranges from 18 yrs to 70 yrs. The majority of the study population was in the 18 to 30 yrs age group Among the study population 42% were male and 58% were female.

Table:2 Body Mass Index :

BMI	≤ 20	21-25	26-30	31-35	≥ 35
N	50	61	48	21	17

Table:2 Body mass index of patients ranged from 18 to 45

Table :3 Modified Mallampati Classification :

Modified Mallampati score distribution was 60% / 26% / 12.4% / 1.6%.

MMC	1	2	3	4
N	159	33	9	0
%	79.5	16.5	1	0

Table:3.1 ANTERIOR SOFT TISSUE THICKNESS :

Mm	9.5 – 10.4	10.5 – 11.4	11.5 – 12.4	12.5 – 13.4
N	102	61	28	9

Table 3.1 Anterior soft tissue thickness was measured at three levels (vocal cord, thyroid isthmus, and supra sternal notch), and their mean value was calculated and tabulated. Neck flexion ranged from 25⁰ to 35⁰. Neck extensions ranged from 30⁰ to 40⁰. Sterno mental and thyromental distances ranged from 18.5 to 21 cm and 8 to 11 cm respectively. Inter incisor distance ranged from 3 to 5 cm.5 patients had artificial dentures, 7 patients had buck teeth, 7 had loose teeth, and one patient was edentulous. In the upper lip bite test 184 patients scored 1 and 16 patients scored 2.

Table:4 OUTCOME MEASURES :

Cormack & Lehane grading :

Samson & young modification of Cormack & Lehane's classification was used to grade the laryngeal view

Cormack & Lehane	1	%	2a	%	2b	%	3a	%	3b	%	4	%
	176	88	16	8	7	3.5	1	0.5	0	0	0	0

Table 4.1 INTUBATION DIFFICULTY SCORE

IDS	0	1	2	3	4	5	6	□
n	170	5	9	12	2	2	0	0
7%	95	2.5	1.5	6	1	1	0	0

Table 4.1 Intubation difficulty score of ‘0’ is considered EASY and more than and equal to ‘1’ is considered difficult.

Table:5 BODY MASS INDEX AND IDS SCORING

		< 20	21-25	26-30	31-35	> 35	
EASY	N	49	51	43	16	11	170
	Row %	28.8	30.0	25.3	9.1	6.5	85.0
	Col %	98.0	79.7	89.6	76.2	61.7	
DIFFICULT T	N	1	13	5	5	6	30
	Row %	3.3	13.3	16.7	16.7	20.0	15.0
	Col %	2.0	20.3	10.1	23.8	35.3	
COLUMN		50	6	18	21	17	
TOTAL		25.0	32.0	21.0	10.5	8.5	

Table:6 BMI in our study population is divided into five categories (< 20, 21-25, 26-30, 31-35, > 35) in patients with BMI < 20 only 2% population had difficult intubation. But in patients with BMI >35, this value increased to 35.3 %. The correlation between BMI and difficult intubation was analyzed with the chi-square test. The correlation was statistically significant.

Table:6 ANTERIOR SOFT TISSUE THICKNESS AND IDS SCORING:

		9.5 – 10.4	10.5 – 11.4	11.5 – 12.4	12.5 – 13.4	
EASY	N	95	51	18	3	170
	Row %	55.9	31.9	10.6	1.8	85.0
	Col %	93.1	88.5	61.3	33.3	
DIFFICULT	N	7	7	10	6	30
	Row %	23.3	23.3	33.3	20.0	15.0
	Col %	6.9	11.5	35.7	66.7	
COLUMN		102	61	29	9	

TOTAL	51.0	30.5	11	1.5	
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Anterior soft tissue thickness was assessed by Ultrasound at three levels and the mean values were categorized into four groups and analyzed.

Table:6 In category 1 difficult intubation was observed in 6.9% of patients. But in category 4 difficult intubation was noted in 66.4%. The results were analyzed using the Chi-square test and the correlation of increasing anterior soft tissue thickness with difficult intubation was statistically significant.

Table:7 NECK CIRCUMFERENCE AND IDS SCORING

		< 35	35-40	>40	
EASY	N	32	120	18	170
	Row %	18.8	70.6	10.6	85.0
	Col %	94.1	86.3	66.7	
DIFFICULT	N	2	19	9	30
	Row %	6.7	63.3	30.0	15.0
	Col %	5.9	13.7	33.3	
COLUMN		34	139	27	
TOTAL		17.0	69.5	13.5	

P = .00835

Table:7 Neck circumferences of the study population divided into three categories (< 35 cm/ 35-40cm/ > 40cm). In category 1 - 5.9%; category 2- 13.7; and category 3- 33.3% population were difficult to intubate.

Table:8 Duration

Seconds	15-Oct	16-20	> 20
n	135	58	7
%	67	29	3.5

The Table:8 Mean duration was 17 seconds. The range was 10 to 25 seconds. 58.8% were intubated in 10 to 15 seconds.

Table:9 Trauma:

In 5 patients minor degree of trauma was noted. In 2 patients abrasion of lips, in 2 patients minor abrasion in the pharynx, and in 1 patient abrasion in the base of the epiglottis was noted.

TRAUM	LIPS	DENTURE	TONGU	PALAT	PHARYN	EPIGLOTTI	LARYN	Σ
A		S	E	E	X	S	X	
N	2	0	0	0	3	0	0	5

Discussion

A “Difficulty airway” has been defined as a clinical situation in which a conventionally trained anesthesiologist experiences problems with mask ventilation, tracheal intubation, or with both. The incidence of difficult laryngoscopy and tracheal intubation is unknown, but it may be as frequent as 7.5% in the normal surgical population. Difficulties with tracheal intubation are mostly caused by difficult direct laryngoscopy with an impaired view of the vocal cords. Many difficult intubations will not be recognized until after induction of anesthesia.[7] Unanticipated difficult intubation can lead to critical situations, especially in those patients who are at risk for gastric regurgitation, who are difficult to ventilate by mask, or who have limited cardio-pulmonary reserves. The medical literature on this subject is confusing because multiple univariate and multivariate indices are proposed for predicting difficult intubation. Unfortunately, despite all the information currently available, no single factor reliably predicts these difficulties[8] There have been many attempts to develop a score to measure the complexity of endotracheal intubation. Most methods are quite complicated, involving numerous variables. Factors that have been associated with difficult laryngoscopy include short Sternomental distance; short thyromental distance; large neck circumference; limited head, neck, and jaw movement; receding mandible; and prominent teeth.[9] The disposition of excessive soft tissue to the vellopalate, oropharynx, and submandibular regions may partially explain the mechanism of supraglottic airway collapse during sleep or anesthesia. The increased amount of pre-tracheal neck soft tissue in these patients impaired laryngoscopy by reducing anterior mobility of pharyngeal structures. Some studies demonstrated that Quantification of neck soft tissue at the level of the vocal cords, thyroid isthmus, and suprasternal notch was the best predictor of difficult laryngoscopy, with no overlap in values for the difficult and easy laryngoscopies. MRI and CT scans have been used to demonstrate the presence of abundant soft neck tissue in the pharynx oropharynx, suprascapular region, and lateral k regi of obese patients.[10] However, MRI and CT scans are costly, may involve some risks to the patients, and require excessive time to be practical. Instead, ultrasound quantification of the anterior neck soft tissue can be a

novel means of predicting difficult laryngoscopy. The patient with a history of Obstructive Sleep Apnea and heavy snoring is the most likely candidate to go into difficult mask ventilation after induction of anesthesia. In obese patients, adipose tissue deposits in the lateral pharyngeal wall; These deposits are not attached to bony structures and are highly mobile. They tend to protrude into the airway, thereby narrowing it and drawing further into the airway during negative airway pressure as the patient tries to breathe against an obstructed airway. As a result, excessive adipose tissue tends to obstruct the airway even more during the inspiratory phase of spontaneously breathing patients. This study was designed to evaluate the usefulness of Neck circumference, Pretracheal soft tissue, and Body mass index in predicting difficult airways. I [11] Neck circumferences of the study population were divided into three categories (<35 cm/ 35-40cm/ >40cm). In category 1 - 5.9% in category 2 - 13.7; and category 3 - 33.3% population was difficult to intubate. Results were analyzed with a chi-square test and a statistically significant correlation was obtained between increasing neck circumference and difficult intubation. BMI in our study population is divided into five categories (<20, 21-25, 26-30, 31-35, >35) in patients with BMI < 20 only 2% population had difficult intubation. But in patients with BMI >35, this value increased to 35.3 %. In our study, the correlation between BMI and difficult intubation was analyzed with the chi-square test. The correlation was statistically significant. This is comparable to the available literature [12] Anterior soft tissue thickness was assessed by Ultrasound at three levels and the mean values were categorized into four groups and analyzed (9.5 – 10.4 / 10.5- 11.4 / 11.5-12.4 / 12.5-13.4 mm). In category 1 difficult intubation was observed in 6.9% of patients. But in category 4 difficult intubation was noted in 66.4%. the results were analyzed using the Chi-square test and the correlation of increasing anterior soft tissue thickness with difficult intubation was statistically significant.[13,14] Acute traumatic complications Injury to the lips, teeth, tongue, nose, pharynx, larynx, trachea, and bronchi can occur during laryngoscopy and intubation. Traumatic complications have been extensively described in two excellent reviews.[15]

Conclusion: It can be concluded that the anterior soft tissue thickness using ultrasound, Body mass index, and Neck circumference, significantly predicted the difficulty of intubation and can be an important aid for the anesthesiologist. Among the other potential predictors we evaluated, neck circumference and a history of sleep apnoea were the only other useful predictors of difficult laryngoscopy. Our results showed that neck circumference at the thyroid cartilage is a valuable predictor of difficult laryngoscopy in obese patients. Interestingly, all other putative predictors were similar in the two populations. Thus, thyromental distance, mouth opening, neck mobility, Mallampati score, and abnormal teeth poorly predicted difficulty in laryngoscopy in this population.

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