Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/9x1abj58

A STUDY TO CORRELATE ANTERIOR NECK SOFT TISSUE THICKNESS QUANTIFIED USING ULTRASOUND AND MODIFIED MALLAMPATTI SCORE FOR PREDICTING DIFFICULT LARYNGOSCOPY.

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ABSTRACT:

BACKGROUND AND AIMS:

Unanticipated difficult intubation remains a primary concern for anaesthesiologists. This study aims to correlate anterior neck soft tissue thickness quantified using ultrasound and Modified Mallampati score for predicting difficult laryngoscopy.

METHODS: This was a cross-sectional study conducted at BMC hospital from November 2018 to May 2020. This study aimed to evaluate the predictive ability of the Modified Mallampati Score (MMS) and anterior neck soft tissue thickness, measured by ultrasound, for difficult laryngoscopy in ASA Grade 1 and 2 adults undergoing elective surgery with general anaesthesia. Neck soft tissue thickness was measured at the hyoid bone, thyrohyoid membrane, and anterior commissure. Laryngoscopic views were classified using Cormack and Lehane. The study compared MMS and ultrasound measurements to identify the better predictor of difficult laryngoscopy

RESULTS:

Out of 210 cases, 74 (35.2%) were classified as difficult laryngoscopy. BMI, neck circumference, DSHB, DSEM, and DSAC were significantly higher in this group. Strong ($r = 0.642$), moderate ($r = 0.435$), and small ($r = 0.256$) positive correlations were observed between DSEM-DSAC, DSHB-DSAC, and DSHB-DSEM, respectively, all statistically significant ($p < 0.001$).

Compared to other airway assessment parameters, the Mallampati score showed low sensitivity, specificity, and the smallest AUC. Ultrasound-measured anterior neck soft tissue thickness was a more reliable predictor of difficult laryngoscopy.

CONCLUSION:

The anterior neck soft tissue thickness quantified using ultrasound is a good predictor of difficult laryngoscopy in addition to the conventional methods of assessing difficult airway.

KEY WORDS: Ultrasound, anterior neck soft tissue thickness, modified mallampatti score, difficult laryngoscopy, BMI.

Introduction:

One of the most critical abilities for anaesthesiologists in securing the airway during general anesthesia and resuscitation is endotracheal intubation. Life-threatening morbidity and mortality from anesthesia can result from failing to protect the airway[1]. Accurate preoperative airway assessment may, in theory, prevent or lessen unexpectedly difficult intubations. However, because existing protocols, algorithms, and screening tool combinations are not very reliable in identifying potentially problematic airways, the rate of difficult laryngoscopy and tracheal intubation is still between 1.5 and 13%.[2] In the Emergency Department (ED), being able to identify challenging airways is crucial. It is impossible to completely evaluate anatomical differences in airway architecture before intubation[3]. Although no single test has been developed that can properly predict a difficult airway 100% of the time, the modified Mallampati classification may be useful in clinical settings when combined with other difficult airway predictors.[4].

Airway management errors account for around 30% of anaesthesia-related deaths, and unexpectedly difficult airways are a major cause of peri-operative anaesthetic complications and mortality[5]. Further research has shown that the thickness of the anterior neck soft tissue, as determined by ultrasonography at the hyoid bone and thyrohyoid membrane levels, can be utilized as a predictor of challenging laryngoscopy[6]. Although CT, MRI, and other imaging methods are costly and not always available in operating rooms, they can precisely quantify the thickness of the soft tissue in the anterior neck. Most significantly, portable ultrasound can measure neck fat thickness as precisely as MRI7 and is quick, easy, and affordable to use in an operating room.

Objectives :

To correlate anterior neck soft tissue thickness quantified using ultrasound and modified mallampatti score for predicting difficult laryngoscopy.

Materials and methods

This was a cross-sectional study done to assess the ability to predict of the Modified Mallampati Score (MMS) and the anterior neck soft tissue thickness measured by ultrasound for challenging laryngoscopy among patients aged >18 years in hospital attached to BMC for a period of nov 2018-may 2020 included ASA Grade 1 and 2 adult patients undergoing elective surgery under general anaesthesia. The sample size was found to be 210 based calculated based on the formula

Sample size will be $n = Z\alpha 2 \times \sigma 2 /$

d2 Where,

$Z\alpha$ =standard table value for 95% confidence interval

σ =standard deviation=0.49

d = 0.07

$n=1.962\times0.492/0.072=190$

For better evaluation sample size taken to be 210

The accuracy of the ultrasound-measured anterior neck soft tissue thickness at three levels (hyoid bone, thyrohyoid membrane, and anterior commissure). The study included adult patients >18 years (ASA grades 1 and 2) undergoing optional procedures under general anaesthesia; patients with severe tooth loss, neck swellings, arthritis, or problems affecting the cervical, pharyngeal, or epiglottic regions were excluded.

Modified Mallampati Score (MMS)[7] was compared for identifying difficult laryngoscopy, classified by Cormack and Lehane grades. MMs and Ultrasound assessments were conducted preoperatively, and laryngoscopic grades were recorded during intubation. At the end, we compared, the 2 tests that is modified mallampatti scoring and anterior neck soft tissue quantified by ultrasound at 3 levels, which among these two is a better predictor of difficult laryngoscopy.

Statistical analysis: Data was entered in excel sheet, variables were calculated by frequency and percentage for qualitative data, Median and interquartile range were calculated for quantitative data, Chi square was applied to test the statistical association between qualitative variables Mann Whitney U test was applied to test the mean difference between two quantitative groups. The level of significance was set at 5%

RESULTS:

Table 1 shows the socio-demographic details of the patient. Allpatients whowere included in the study belonged to the age groupof 18 to60years. Amongour studyparticipants, majority were males (59%) and remaining 41% werefemales.Majority of the patients (50.5%)belonged to ASA grade1 and 49.5% belonged to ASA grade 2.

Table 1. Socio-demographic details of the study participants

Age	<20	9 (4.3%)
	21-30	68 (32.4%)
	31-40	54 (25.7%)
	41-50	51 (24.3%)
	51-60	28 (13.3%)
Gender	Male	124 (59%)
	Female	86 (41%)
ASA Grade	1	106 (50.5%)
	2	104 (49.4%)
Laryngoscopy	Easy	136 (64.8%)
	Difficult	74 (35.2%)
Total		210(100%)

Table 2 shows the Comparison of laryngoscopy outcomes with various airway evaluation parameters. The median DSHB value was 0.36 cm (IQR = 0.09) in the easy laryngoscopy group and 0.425 cm (IQR = 0.122) in the difficult laryngoscopy group ($p < 0.001$). The DSEM value was 0.41 cm (IQR = 0.107) for easy laryngoscopy and 0.58 cm (IQR = 0.135) for difficult laryngoscopy ($p < 0.001$). Similarly, the DSAC value was 0.41 cm (IQR = 0.1) for easy laryngoscopy and 0.63 cm (IQR = 0.103) for difficult laryngoscopy ($p < 0.001$). Neck circumference was also significantly higher in the difficult group, measuring 39 cm (IQR = 3) compared to 34.5 cm (IQR = 3) in the easy group ($p < 0.001$). These findings indicate that DSHB, DSEM, DSAC, and neck circumference values were significantly greater in the difficult laryngoscopy group.

Table2:Comparison of laryngoscopy with airway evaluating parameters.

	Easy(n-136)		Difficult(n-74)		P value*
	Median	IQR	Median	IQR	
Neck circumference(cm)	4.5	3	39	3	0.001
DSHB(cm)	0.36	0.09	0.425	0.1225	0.001
DSEM(cm)	0.41	0.1075	0.58	0.135	0.001
DSAC(cm)	0.41	0.1	0.63	0.103	0.001

Table 3 shows the correlation between DSHB, DSEM and DSAC. There was a strong positive correlation between DSEM and DSAC (r=0.642), moderate positive correlation between DSHB and DSAC(r=0.435), and small positive correlation between DSHB and DSEM(r=0.256) and

were statistically significant (p< 0.001). Spearman's correlation was calculated to assess the correlation between DSHB, DSEM and DSAC. All the airway parameters were positively correlated. ScatterplotsweredrawnandlinearregressionequationalongwithRsquareiscalculated for the respective airway parameters

Table3:Correlation between DSHB,DSEM and DSAC.

Airwayparameters	Spearman'scorrelation(r)	p value
DSHBand DSEM	0.256	0.001
DSHBand DSAC	0.435	0.001
DSEM and DSAC	0.642	0.001

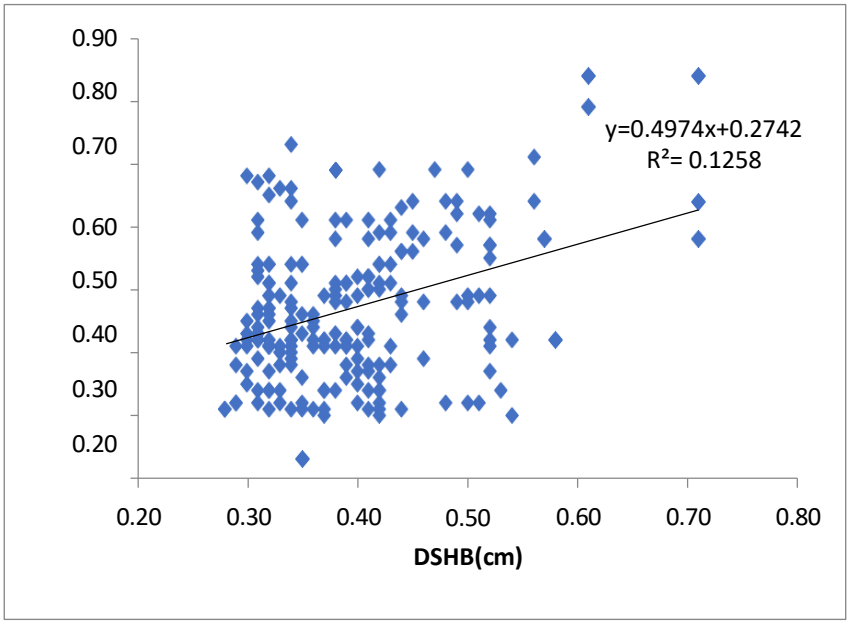

Figure1– Scatter plot to correlate DSEM and DSHB

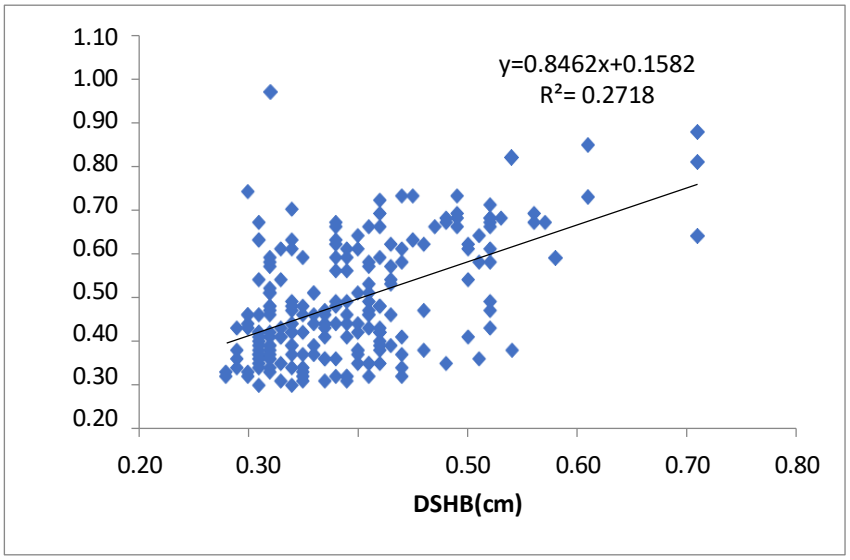

Figure2– Scatter plot to correlate DSAC and DSHB

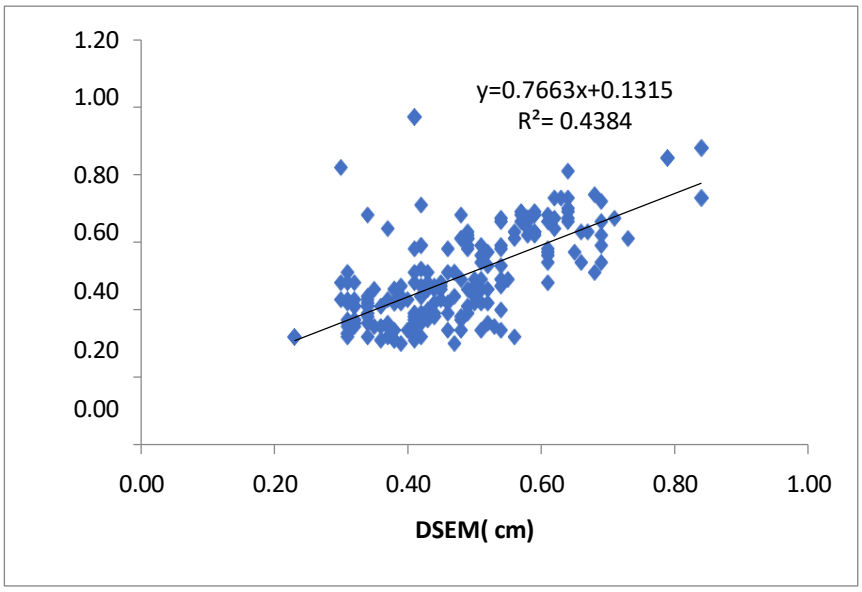

Figure3– Scatter plot to correlate DSAC and DSEM

Table 4 shows the comparison of laryngoscopy with modified Mallampatti scoring. Subjects with higher modified Mallampati scores were more likely to be in the difficult laryngoscopy group, with results showing statistical significance ($p < 0.001$). However, the Mallampati score demonstrated the lowest sensitivity (44.6%) and a specificity of 81.6%. Additionally, it had the smallest area under the curve (0.690) compared to other airway assessment parameters, including neck circumference, DSHB, DSEM, DSAC, and BMI.

Table4:Comparison of laryngoscopy with Modified Mallampati scoring.

Mallampati	Laryngoscopy		Total
	Easy	Difficult	
Class 1	61	14	75
	44.9%	18.9%	35.7%
Class 2	50	27	77
	36.8%	36.5%	36.7%
Class 3	24	22	46
	17.6%	29.7%	21.9%
Class 4	1	11	12
	.7%	14.9%	5.7%
Total	136	74	210
	100.0%	100.0%	100.0%
Yate'schisquare-28.964			
pvalue -0.001			

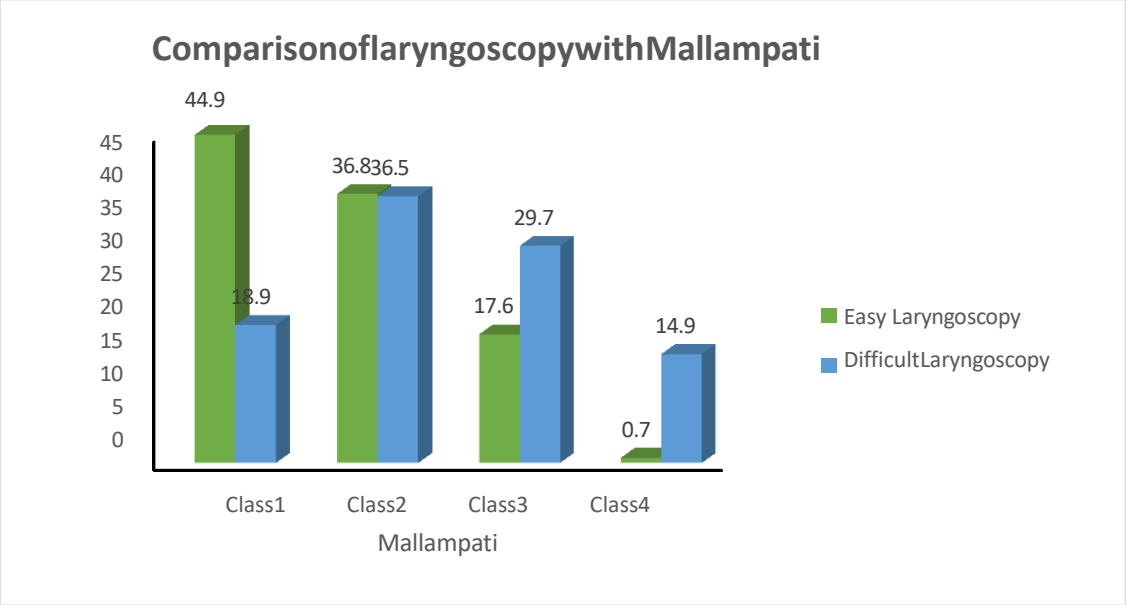

Figure4:Comparisonoflaryngoscopywith ModifiedMallampatiscoring.

Table 5 presents the receiver operating characteristic (ROC) curve analysis and area under the curve (AUC) calculations to identify the most effective airway parameters among neck circumference, DSHB, DSAC, BMI, and Mallampati score.

The highest AUC was observed for DSAC (0.941), followed by DSEM (0.895), neck circumference (0.856), BMI (0.846), DSHB (0.735), and Mallampati score (0.690). All parameters were statistically significant in predicting difficult laryngoscopy ($p < 0.05$).

Table5:Area under curve of airway predicting parameters.

TestResultVariable(s)	Area	p value	Asymptotic95%CI	
			Lower Bound	Upper Bound
Neckcircumference(cm)	.856	.000	.804	.909
DSHB(cm)	.735	.000	.661	.809
DSEM(cm)	.895	.000	.844	.946
DSAC(cm)	.941	.000	.904	.978
BMI	.846	.000	.785	.908
Mallampatti	.690	.000	.614	.766

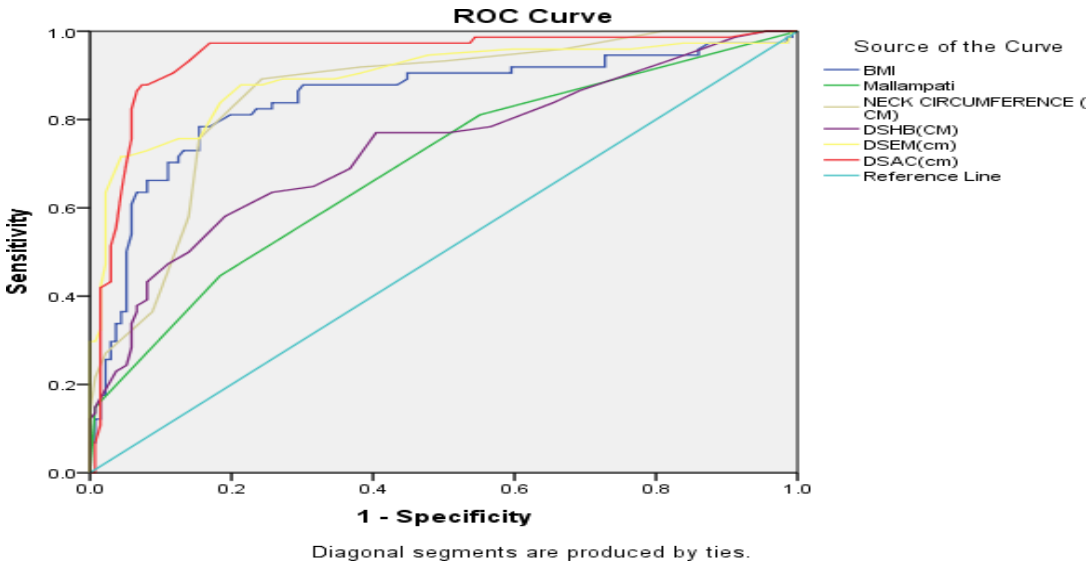

Figure5:Area under curve of airway evaluating parameters.

Cut-off values, sensitivity, and specificity were calculated to assess difficult laryngoscopy. According to the provided cut-offs, the highest sensitivity was found in neck circumference (89.2%), followed by DSAC (87.8%), BMI (78.4%), DSEM (71.6%), DSHB (58.1%), and Mallampati score (44.6%). The highest specificity was observed in DSEM (95.6%), followed by DSAC (92.6%), BMI (84.6%), Mallampati score (81.6%), DSHB (80.9%), and neck circumference (75.7%).

DISCUSSION:

DEMOGRAPHIC PARAMETERS

In our study, 210 eligible patients were included, with 74 (35.2%) classified as difficult laryngoscopy based on Cormack-Lehane grades 3 and 4. The cohort consisted of 59% males and 41% females, with no significant differences in age, sex, or ASA grading between groups.

The BMI was significantly higher in the difficult laryngoscopy group (30.92 ± 3 kg/m²) compared to the easy laryngoscopy group (26.5 ± 3 kg/m², $p < 0.001$). Wu J et al. [9] similarly reported higher BMI in the difficult laryngoscopy group (25.63 ± 2.80 kg/m² vs. 23.61 ± 3.43 kg/m², $p < 0.05$).

Neck circumference was also significantly larger in the difficult group (39 ± 3 cm) compared to the easy group (34.5 ± 3 cm, $p < 0.001$). Ezri T et al. [10] observed similar findings, with a greater neck circumference in difficult laryngoscopy patients (50 ± 3.8 cm) versus easy cases (43.5 ± 2.2 cm). Brodsky et al. [11] also emphasized neck circumference at the thyroid cartilage as a strong predictor of difficult laryngoscopy.

Anterior neck soft tissue thickness (DSHB, DSEM, DSAC) was significantly higher in the difficult group ($p < 0.001$), with strong positive correlation between DSEM and DSAC ($r = 0.642$), moderate correlation between DSHB and DSAC ($r = 0.435$), and small correlation between DSHB and DSEM ($r = 0.256$). Adhikari S et al. [6]and Wu J et al. [8] concluded that ultrasound measurements of anterior neck soft tissue at various levels are reliable predictors of difficult laryngoscopy, consistent with our findings.

While the modified Mallampati score (MMS) was higher in the difficult group ($p < 0.001$), it had the lowest sensitivity (44.6%), a specificity of 81.6%, and the smallest AUC (0.690) compared to other parameters like BMI, neck circumference, and ultrasound-based measurements. The limitations of MMS, including dependence on patient cooperation and body position, have been highlighted by others (27–30). A meta-analysis of 177,088 patients confirmed MMS as inadequate as a standalone predictor but valuable in multifactorial models[12]. Our findings support this conclusion.

Yadav U et al. [13] demonstrated that combining clinical and sonographic parameters improves the prediction of difficult laryngoscopy, aligning with our study's results. Similarly, Wu J et al. [9]concluded that ultrasound measurements combined with other screening tests enhance predictive accuracy, consistent with our findings.

CONCLUSION:

Our study concludes that anterior neck soft tissue thickness quantified using ultrasound is a good predictor of difficult laryngoscopy in addition to the conventional methods of assessing difficult airway.

CONFLICT OF INTEREST: NIL

FUNDING SUPPORT: NIL

REFERENCES:

1. Law JA, Broemling N, Cooper RM, et al. Difficult airway with recommendations for management - part 1- difficult tracheal intubation encountered in an unconscious/induced patient. Can J Anesthesia 2013; 60:1089-118.
2. Khan ZH, Kashfi A, Ebrahimkhani E, et al. A comparision of the upper lip bite test (a simple new technique) with modified mallampatti classification in predicting difficulty in endotracheal intubation: a prospective blinded study. Anesth Analog 2003; 96: 595-99.
3. Hall EA, Showaihi I, Shofer FS, et al. Ultrasound evaluation of the airway in the ED: a feasibility study. Crit Ultrasound J 2018; 10:
4. Hagberg c, Artime C. Airway management in adult. In Miller RD. Miller’s anesthesia, 8th ed, volume 2. Philadelphia: Elsevier; 2015. P. 1652.
5. Wang L, Feng YK, Hong L, et al. Ultrasound for diagnosing new difficult laryngoscopy indicator: a prospective, self-controlled, assessor blinded, observational study. Chin Med J (Engl) 2019;132(17):2066-2072.
6. Adhikari S, Zeger W, Schmier C, et al. Pilot study to determine the utility of point-ofcare ultrasound in the assessment of difficult laryngoscopy. Acad Emerg Med 2011; 18: 754-58.
7. Abe T, Kawakami Y, Sugita M, et al. Use of B mode ultrasound for visceral fat mass evaluation: comparisions with magnetic resonance imaging. Appl Human Sci 1995; 14: 133-39
8. Mallampati SR, Gatt SP, Gugino LD et al. A clinical sign to predict difficult tracheal intubation: a prospective study. Can Anaesth Soc J 1985; 32: 429–34.
9. Wu J, Dong J, Ding J, Zheng J, et al. Role of anterior neck soft tissue quantification by ultrasound in predicting difficult laryngoscopy. Med SciMonit 2014; 20: 2343-50.
10. EzriT,Gewurtz G,SesslerDI,etal.predictionofdifficultlaryngoscopyinobesepatients by ultrasound quantification of anterior neck soft tissue. Anesthesia 2003; 58: 1111-14.
11. Brodsky JB, Lemmens HJ, Brock-Utne JG, Vierra M, Saidman LJ. Morbid obesity and tracheal intubation. AnesthAnalg. 2002; 94:732–6.
12. Lundstrom LH, Vester-Andersen M, Moller AM et al. Poor prognostic value of the modified Mallampati score: a meta-analysis involving 177088 patients. Br J Anaesth 2011; 107: 659–67.
13. Yadav U, Singh RB et al. Comparartive study of preoperative airway assessment by conventional clinical predictors and ultrasound – assisted predictors. Anesthesia Essays and Researches 2020; 14: 213-218.