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Original Research Article

PRE-OPERATIVE USG BASED MEASUREMENT OF AIRWAY PARAMETERS FOR PREDICTING DIFFICULT AIRWAY- CROSS SECTIONAL STUDY

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ABSTRACT

Background: At present, neck ultrasonography is used as a tool in predicting difficult airway. There are no standardized ultrasonographic criteria which help to predict difficult airway. Objective is to ultrasonographically assess anterior neck soft tissue thickness preoperatively based on 2 parameters-DSHB (minimal distance from skin to hyoid bone) and DSEM (distance from skin to epiglottis midway between hyoid bone and thyroid cartilage) and find out if the above two USG parameters can predict difficult airway in adults by correlating with CL grading.

Materials and Methods: This study was conducted on 100 patients aged between 18-60 years belonging to ASA- I and II admitted for elective surgery under general anesthesia with endotracheal intubation. Sonography of airway was first performed preoperatively by an anesthesiologist. Sonography included two parameters –DSHB and DSEM. Patient was later classified as easy or difficult laryngoscopy on the basis of USG parameters criteria from literature available. DSHB >0.66cm - predicted to be difficult airway and DSHB <0.66cm - predicted to be easy. DSEM >2.03cm- predicted to be difficult airway and DSEM <2.03cm - predicted to be easy. After induction of anesthesia, direct laryngoscopy performed in the sniffing position by another anesthesiologist using appropriate size curved Macintosh blade and Cormack Lehane grade noted. CL grade I and II considered to be easy laryngoscopy. Appropriate statistical test was used to determine the significance of the predictability of the parameters studied.

Results: From our study we found that sonographic measurements DSHB and DSEM can be used to predict difficult laryngoscopy in adult patients as there was significant statistical significance between the USG measurements and Cormack Lehane grading with P value <0.001 & 0.0003. Of the two parameters, DSHB seems to have a better diagnostic value for prediction of difficult airway in our study as supported by the AUC of 89.0% compared to DSEM with AUC of 79.0%. DSHB has better sensitivity (sensitivity of 87.50%) and DSEM & DSHB has better specificity (specificity of 91.30%).

Conclusion: To conclude, our study showed that USG parameters DSHB and DSEM may aid in predicting difficult laryngoscopy as a strong statistical significance was present between sonographic measurements and CL grading. Also, DSHB appeared to have a better diagnostic value for prediction of difficult airway.

Keywords: Difficult Laryngoscopy, Ultrasonographic airway assessment.

INTRODUCTION

Airway management is vital in anesthesia, yet predicting difficult laryngoscopy remains challenging.[1] Cormack and Lehane grading has been used to grade difficulty of laryngoscopy which is more reliable to predict difficult airway. At present, ultrasonography is used as a tool for predicting difficult airway. Anterior soft tissue thickness of neck significantly predicted difficult intubation and can be an important aid for an anaesthesiologist.[2] The present study will be done using two USG measurements to predict difficult laryngoscopy in adult patients. The 2 parameters chosen will be – Thickness of anterior neck soft tissue in transverse view at level of hyoid bone - DSHB (minimal distance from hyoid bone to the skin) and Thickness of anterior neck soft tissue in transverse view at level of thyrohyoid membrane -DSEM (distance from skin to epiglottis midway between hyoid bone and thyroid cartilage).

MATERIALS AND METHODS

After obtaining ethical committee clearance and patient consent, this study was conducted on 100 patients aged between 18-60 years belonging to ASA-I and II admitted for elective surgery under general anesthesia with endotracheal intubation. Exclusion criteria were patients with anticipated difficult airway cases like obesity, pregnancy, head and neck anatomical pathologies, maxillofacial anomalies and edentulous patients. Sonography of airway was first performed preoperatively by an anesthesiologist along with noting down the standard clinical tests like Mallampati grading. Assessment of airway using GE LOGIQ Premium ultrasound system (GE Healthcare) is an advanced, high-resolution diagnostic ultrasound platform designed for multi-specialty clinical applications with linear frequency probe 3-5 MHz frequency.

The patient was made to lie down in supine position with head in neutral position without any support underneath, chin lift, looking straight with mouth closed and tongue touching floor of mouth and no movement. The linear high frequency probe was placed in submandibular area in midline. The thickness of anterior soft tissue (transverse view) was obtained at 2 levels –DSHB and DSEM. Patient was later classified as easy or difficult laryngoscopy on the basis of USG parameters criteria from literature available. DSHB >0.66cm - predicted to be difficult airway and DSHB <0.66cm - predicted to be easy. DSEM >2.03cm- predicted to be difficult airway and DSEM <2.03cm - predicted to be easy.

After induction of anesthesia, direct laryngoscopy performed in the sniffing position by another anesthesiologist using appropriate size curved Macintosh blade and Cormack Lehane grade noted. CL grade I and II considered to be easy laryngoscopy. Quantitative data was presented by Mean SD confidence interval, qualitative data was presented in percentage and P values less than 0.05 considered statistically significant. To determine discriminative power of individual tests, receiver operating characteristic (ROC) curve, area under curve (AUC) with 95% confidence interval was noted.

RESULTS

The observation of the study showed that maximum number of subjects were in the 21-30 years age group accounting to 31.0%. The next common age group was 51-60 years accounting to 27.0 %. Out of 100 patients, 42.0% were males and 58.0% were females. Among Body Mass Index distribution, 73.0% of the patients were in the 18.5-24.9 kg/m2 group and the next common being in 25.0-29.9 kg/m2 accounting to 22.0%. The study had 66.0% of ASA grade I and 34.0% of ASA grade II. The study revealed that out of 100 patients, 41.0% of patients had a Mallampati grade I, 34.0% had a Mallampati grade II, 25% had a Mallampati grade III.

The study showed that distance from skin to hyoid (DSHB) value was <0.66 cm in 82.0% of patients and >0.66 cm in 18.0%. The study showed that distance from skin to epiglottis (DSEM) value was <2.03 cm in 94.0% of patients and >2.03 cm in 6.0%. With respect to Cormack Lehane grading during direct laryngoscopy, the study showed that 44.0% of patients had CL grade I, 48.0% had CL grade II and 8.0% had CL grade III.

As shown in Table 1, it is observed that there was a total of 25 patients which as per MP grading were difficult intubations, of which 5 patients had DSHB value >0.66cm and no patients had DSEM value of >2.03cm. The P value for association of DSEM and DSHB in relation to MP grade was 0.772 and 0.332 respectively. Hence, there was no statistical significance between the two USG parameters and MP grade.

Table 1: Association of USG parameters DSEM and DSHB in relation to MP grade.

Variables	MP grade		Total	P value
	Easy intubation	Difficult intubation		
DSHB cm				
<0.66	62 (82.66%)	20 (80.00%)	82	0.7727, NS
>0.66	13 (17.34%)	5 (20.00%)	18	
Total	75	25	100	
DSEM cm				
<2.03	69 (92.00%)	25 (100%)	94	0.3321, NS
>2.03	06(8.00%)	0	6	
Total	75	25	100	

As shown in [Table 2], it is observed that there was a total of 8 patients which as per CL grading were difficult laryngoscopy, of which 7 patients had DSHB value >0.66cm and 4 patients had DSEM value of >2.03cm. The P value for association of DSEM and DSHB in relation to CL grade was <0.001 and 0.0003 respectively. Hence, this showed that there was a strong statistical significance showing strong association between DSHB and DSEM and CL grade.

Table 2: Association of USG parameters DSEM and DSHB in relation to CL grade

Variables	CL grade		Total	P value
	Easy intubation	Difficult intubation		
DSHB cm				
<0.66	81(88.04%)	1(12.5%)	82	<0.001, HS
>0.66	11(11.95%)	7(87.5%)	18	
Total	92	8	100	
DSEM cm				
<2.03	90(97.83%)	4(50%)	94	0.0003, HS
>2.03	2(2.17%)	4(50%)	6	
Total	92	8	100	

According to [Table 3], DSHB is having a better diagnostic value to predict difficult Laryngoscopy (Area under ROC is 89.0%) compared to DSEM with 79.0% area under ROC. DSHB has better sensitivity (sensitivity of 87.50%) compared to DSEM (sensitivity of 62.50%). Whereas DSEM and DSHB has same specificity (specificity of 91.30%). Diagnostic values based on Area under curve: 0.9-1.0 - Excellent test, 0.8-0.9 -Good test, 0.7-0.8 -Fair test, 0.6-0.7 - Poor test, 0.5-0.6-Fail.

Table 3: ROC CURVE analysis

Variables	ROC results in prediction of Difficult Laryngoscopy						Cut off	AUROC	SE	P value
	Sensitivity	Specificity	PPV	NPV	LR+	LR_				
DSHB cm	87.50	91.30	46.60	98.80	10.05	0.13	>0.64	0.890	0.011	<0.001**
DSEM cm	62.50	91.30	38.50	96.50	7.18	0.41	>1.98	0.790	0.017	<0.001**

DISCUSSION

At the time of induction of anaethesia, there can be a difficulty in achieving adequate ventilation or of performing endotracheal intubation that may result in the catastrophic situation of cannot intubate /cannot ventilate. Several risk factors have been recognized to aid in anticipating difficult airway. Adhikari S et al conducted a study which showed that screening tests such as Mallampati classification, thyromental distance, interincisor gap and neck mobility have poor sensitivity to predict difficult laryngoscopy.[3] Many studies have been done after the pilot study by Adhikari S et al, on finding the utility of USG to aid airway assessment, to compare and contrast numerous USG parameters and use of specific USG parameters in head and neck cancers. We conducted this study to determine two chosen USG parameters (DSHB, DSEM) performed preoperatively can predict difficult laryngoscopy by correlating with CL grading in adult patients. Demographic characteristics were comparable to similar studies, with no significant differences. Patients underwent diverse surgical procedures, indicating no selection bias.

Among 25 patients predicted difficult by Mallampati, only 5 (20%) had DSHB >0.66 cm and none had DSEM >2.03 cm, showing no significant association between ultrasound parameters and Mallampati grade (p=0.772, 0.332). In contrast, among 8 patients with difficult laryngoscopy, 7 (87.5%) had DSHB >0.66 cm and 4 (50%) had DSEM >2.03 cm, demonstrating strong association with CL grade (p<0.001, 0.0003). These findings indicate that airway ultrasound—especially DSHB—is a reliable predictor of difficult laryngoscopy.

In the study conducted by Saranya et al,[4] they performed USG airway preoperatively of anterior neck soft tissue thickness at three levels-hyoid bone, thyrohyoid membrane and suprasternal notch. They compared this to CL grade at direct laryngoscopy. The demographic variables were age, sex and BMI. They found that there was increased thickness at all three levels corresponding to increase in difficulty of intubation. This was similar in our study, but we had considered only two parameters showing similar results. On ROC curve analysis, USG measurement made at thyrohyoid membrane was found to be very sensitive and specific with 2.08cm marking the difference between easy and difficult laryngoscopy. But in our study, measurement at hyoid bone was of better diagnostic value.

In the study conducted by Yadav NK et al,[5] they measured anterior neck soft tissue at the level of hyoid bone, thyrohyoid membrane and tongue thickness and compared this to CL grade at intubation. They performed USG in neutral and sniffing position unlike in our study where USG was performed only in neutral position. This gave varied results in USG measurements in both positions, where it was seen that cut off value obtained from ROC curve for DSHB in neutral and sniffing position was 0.66cm,0.77cm respectively while it was 2.03cm,1.9cm for DSEM in neutral and sniffing position respectively. Also, USG proved to be better than clinical parameters (interincisor gap,

Mallampati grade, neck circumference, thyromental and sternomental distance). In our study, we had similar results, but we had considered only Mallampati grade.

In the study conducted by Yadav U et al,[6] they conducted a study to find effectiveness of sonographic parameters ANS-hyoid, ANS-VC, Pre-E/E-VC that were different from the parameters chosen by us. Clinical parameters included Mallampati classification, thyromental distance and hyomental distance while we considered only Mallampati classification. Their study revealed that there was significant statistical difference between patients with easy and difficult laryngoscopy and the highest sensitivity was shown by ANS-VC and AUC while hyomental distance showed the highest specificity.

The results of our study can be supported by the anatomical model described by Greenland et al,[7] and Adnet et al.[8] Based on this model, upper airways are shaped by two curves, the oropharyngeal /primary curve and pharyngo-glossic tracheal/secondary curve. An adequate visualization of the larynx needs both the curves to be aligned with the visual axis.[7] A greater skin to epiglottis distance can be due to a higher upwards concavity of oropharyngeal /primary curve that causes lesser visualization of the glottis.[9] Also, the laryngoscope blade needs to lift the tissue at hyoid bone and hence a higher CL grade is anticipated with increase in tissue thickness.[5] Hence increasing anterior soft tissue thickness at the level of hyoid bone and thyrohyoid membrane (DSHB and DSEM) can mean higher CL grading.

CONCLUSION

Our study demonstrated that ultrasonographic airway parameters, DSHB and DSEM may aid in predicting difficult laryngoscopy. Among the parameters evaluated, DSHB appeared to have superior diagnostic performance for predicting difficult airway, and hence it may serve as a useful adjunct to conventional clinical airway assessment.

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