Evaluation Of Point Of Care Ultrasound (Pocus) In Pre-Anaesthetic Airway Assessment

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Abstract

Background: Identification of the difficult airway is the most important element in the anaesthesiology practice. The preoperative airway evaluation using clinical parameters is a mandatory step for an anaesthesiologist to predict difficult laryngoscopy. Point of care Ultrasound (POCUS) can be used as a reliable airway assessment tool by accurate prediction of difficult laryngoscopy. Difficult laryngoscopy can be correlated with various parameters measured with ultrasound. Therefore, this study was done to observe the usefulness of point of care Ultrasound (POCUS) in assessing the difficult laryngoscopy, utilizing soft tissue neck measurements at various levels.

Aim Of The Study: The objective of the study is to evaluate the feasibility of Ultrasound in pre-anesthetic airway assessment.

Methods: 100 patients undergoing surgery requiring General anesthesia and tracheal intubation were included in this study. The thickness of anterior neck soft tissue at the hyoid bone (DSHB), thyrohyoid membrane (DSEM), and Pre-E/E-VC (depth of the pre-epiglottic area/distance from the epiglottis to the midpoint of the distance between the vocal cords) were measured using ultrasound. The outcome was the reliability of the parameters in predicting difficult laryngoscopy (CL 3 & 4).

Results: Pre-E/E-VC is highly sensitive in predicting difficult laryngoscopy among the three parameters (DSHB, DSEM, Pre-E/E-VC) measured in the study. It has a sensitivity of 84.62% and a specificity of 85.06% in predicting difficult laryngoscopy. Other parameters are also effective in predicting difficult laryngoscopy.

Conclusion: Ultrasound is an effective tool in predicting difficult laryngoscopy. By combining ultrasound and clinical parameters, difficult laryngoscopy can be easily predicted. Thus, ultrasound is a useful tool for airway assessment in pre-operative patients.

Keywords: POCUS, Airway, Laryngoscopy, Intubation

Introduction

Identification of the difficult airway is the most important element in the anaesthesiology practice. The preoperative airway evaluation using clinical parameters is a mandatory step for anaesthesiologists to predict difficult laryngoscopy. Thus, it is important to have improved methods for airway evaluation before laryngoscopy. Upper airway POCUS can be used dynamically for optimal benefit in perioperative airway management, immediately before, during, and after airway interventions. [1]Acute airway procedures under real-time US guidance may become standard procedures in anesthesia, emergency, and intensive care settings. With a growing body of evidence in many clinical applications, there is a need to incorporate upper airway US education and training

of personnel responsible for perioperative airway management. POCUS of the upper airway has the potential to become a first-line non-invasive airway assessment tool. [2]Anterior soft tissue of the neck measured by US (Ultrasound) at the hyoid bone, thyrohyoid membrane, and anterior commissure levels are independent parameters in detecting difficult laryngoscopy. Combinations of the clinical parameters with US measurements increase the ability to detect difficult laryngoscopy. Point of care Ultrasound (POCUS) can be used as a reliable airway assessment tool by accurate prediction of difficult laryngoscopy. Difficult laryngoscopy can be correlated with various parameters measured with ultrasound. [3] Ultrasound can be used to assess the airway preoperatively, and several sonographic parameters can be measured. The highest sensitivity and negative predictive value were shown by the skin-to-epiglottis distance, followed by the volume of the tongue. [4]Ultrasound measurement of the anterior neck soft tissue at the level of vocal cords (ANS-VC) is a potential predictor of difficult intubation. A value of more than 0.23 cm is more sensitive than the physical parameters in predicting a CL grade of 3 or 4. US measurement of ANS-Hyoid is not a useful parameter in predicting difficult intubation. [5]Therefore, this study was done to observe the usefulness of point of care Ultrasound (POCUS) in assessing the difficult laryngoscopy, utilizing soft tissue neck measurements at the level of the hyoid bone (DSHB), epiglottis (DSEM), depth of pre-epiglottic space (Pre-E)/ distance from the epiglottis to the midpoint of the distance between the vocal cords (E-VC) (PRE-E/E-VC ratio) for predicting difficult intubation.[6]

Materials And Methods: After obtaining approval from Institute's ethical committee and getting written informed consent, **100** patients undergoing elective surgery requiring general Anaesthesia were chosen. The study is a prospective randomized study. Randomization was done with computer-generated numbers. This study was conducted at Government Thiruvarur Medical College, Tamilnadu, India, during the period from October 2021 to September 2022. Elective surgery requiring GA with direct laryngoscopy and endotracheal intubation, both gender, ASA physical status 1 & 2, and ages between 20 to 60 years old were included in this study. Patients with inter incisor gap < 3 cm and edentulous patients, Patients with head and neck pathology, Obese patients (BMI > 30kg/m2), Patients with altered level of consciousness, pregnant patients, and emergency surgeries were excluded from this study. The routine airway assessment including mouth opening, Modified Mallampatti scoring, and neck movements was done during the preanesthetic assessment. The patients not meeting inclusion criteria were excluded from the study and the enrolled patients underwent a sonographic assessment of the airway by the anaesthesiologist in the preanesthetic assessment. In the pre-anesthetic assessment area, with the patients lying supine and active maximal head-tilt/chin lift, the sonographic assessment was done. The high-frequency linear probe (6-13 HZ) utilizing (SonoSite) was placed in the submandibular area in the midline. Without changing the position of the probe, the linear array of the US probe was slided in the transverse planes from cephalad to caudal, until simultaneous visualization of the epiglottis was observed on the screen. Thereafter, the following measurements were obtained with the oblique-transverse US view of the airway (a) E-VC and (b) Pre-E. Then by changing the head and neck to the neutral position, the thickness of anterior neck soft tissue was obtained with the transverse view at the following level (1) At the level of the hyoid bone, that is, the minimal distance from the hyoid bone to the skin (DSHB) (2) at the level of the thyrohyoid membrane, that is, the distance from the skin to epiglottis midway between the hyoid bone and thyroid cartilage (DSEM). The patients were then taken to the operating room and the standard general anesthesia procedure was performed as per the attending anaesthesiologist and as per standard of care. General anesthesia was induced and the trachea was intubated by an anaesthesiologist who was blinded to the findings of preoperative ultrasonographic airway assessment. Direct laryngoscopy was performed using a Macintosh blade, and Cormack-Lehane (CL) grade was noted without external laryngeal manipulation. The CL classification was as follows. Grade 1: visualization of the entire laryngeal aperture. Grade 2: visualization of parts of the laryngeal aperture or the arytenoids. Grade 3: visualization of only the epiglottis. Grade 4: visualization of only the soft palate. The laryngoscopy was classified as easy (CL Grade 1 and 2) or difficult (CL Grade 3 and 4). The

trachea was intubated with an appropriately sized endotracheal tube and anesthesia was maintained.

Parameters Observed:

1) The thickness of soft tissue neck at the level of the hyoid bone (DSHB)

2) The thickness of soft tissue neck at the level of the thyrohyoid membrane (DSEM)

3) Depth of the pre-epiglottic space (Pre-E)

4) Distance from the epiglottis to the midpoint of the distance between the vocal cords (E-VC)
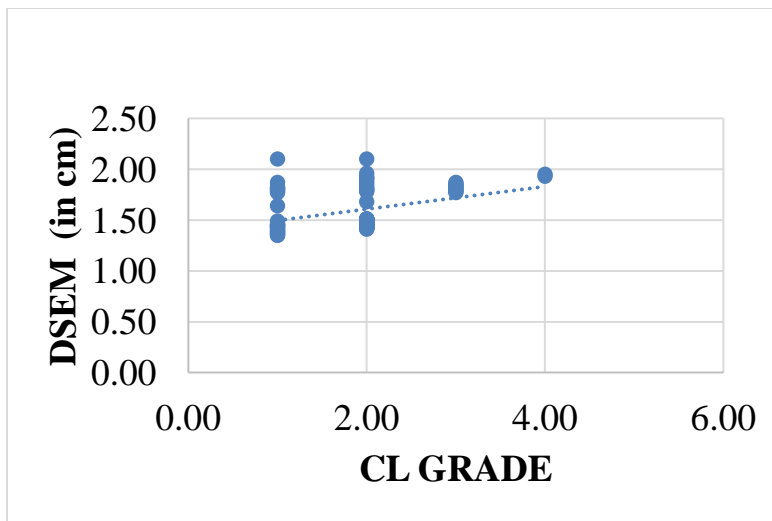
5) Pre-E/(E-VC)

Results:

In this randomized prospective observational study, 100 eligible patients posted for elective surgery under General anesthesia requiring endotracheal intubation were included, out of which 13 patients (13%) were categorized as difficult laryngoscopy (CL grade 3 & 4). It was observed that 30 patients (30%) had CL grade 1, 57 patients (57%) had CL grade 2, 11 patients (11%) had CL grade 3 and 2 patients (2%) belonged to CL grade 4. Therefore, the incidence of easy laryngoscopy was 87% and difficult 13%. In the study, 2 patients belonging to CL 4 required either more than a single attempt or additional equipment to achieve endotracheal intubation. The DSHB measured distribution was (mean ± SD: 0.85± 0.04 and 0.86± 0.04) cm for CL grade 1 & 2, while the measurement was 0.97 ± 0.00 and 1.15 ± 0.00 cm, respectively for CL grade 3 and 4 (P < 0.0001).
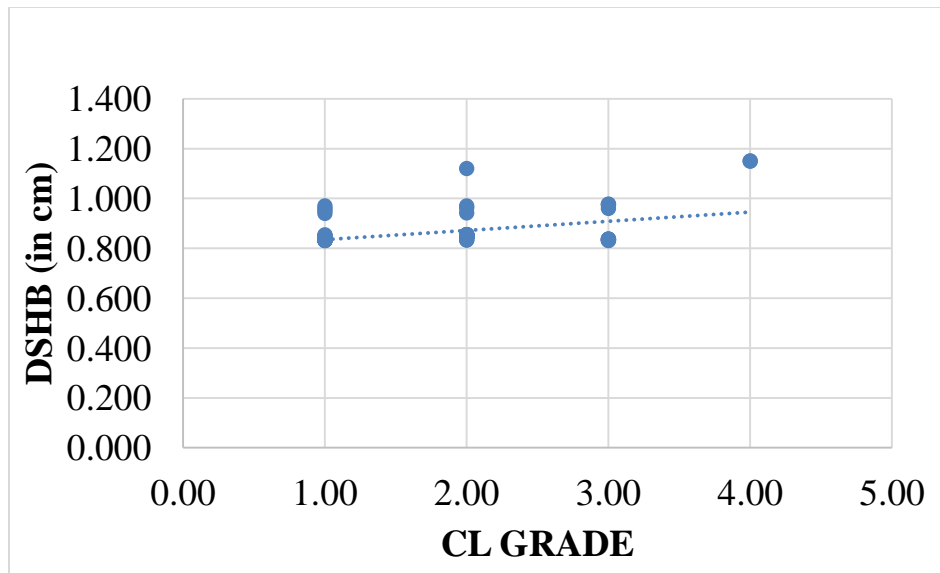
The distribution of CL grade as predicted by USG measured DSEM was (mean ± SD; 1.45± 0.14, 1.57± 0.22) cm for CL grade 1 and 2 respectively, and 1.72 ± 0.17 and 1.94± 0.01 for CL grade 3 and 4 (P < 0.0001).

The values of the Pre-E/E-VC ratio were (mean ± SD: 1.40 ± 0.35 and 1.58 ± 0.16) cm for CL grade 1 and 2 respectively, and 1.88± 0.10, 2.24 ± 0.01 corresponded to CL grade 3 and 4 (P < 0.0001).

Table 1: Comparison Of Ultrasound Parameters And Cormack – Lehane Cl Grade

PARAMETER	CL GRADE	N	MEAN VALUE OF PARAMETERS MEASURED BY ULTRASOUND	SD VALUE OF PARAMETERS MEASURED BY ULTRASOUND	P value
DSHB	1	30	0.85	0.04	< 0.0001
	2	57	0.86	0.04	
	3	11	0.97	0.00	
	4	2	1.15	0.00	
DSEM	1	30	1.45	0.14	< 0.0001
	2	57	1.57	0.22	
	3	11	1.72	0.17	
	4	2	1.94	0.01	
Pre- E/E-VC	1	30	1.40	0.35	< 0.0001
	2	57	1.58	0.16	
	3	11	1.88	0.10	
	4	2	2.24	0.01	

Using SPSS software, Kendall's tau_b is calculated which gives a correlation coefficient to assess the relation between USG-guided DSHB, DSEM, and Pre-E/E-VC with CL grading. There was a positive correlation between DSHB (r = 0.285; P < 0.0001) and DSEM (r = 0.358; P< 0.0001) whereas Pre-E/E-VC has a strong positive correlation with CL grading (r = 0.721; P < 0.0001).

			DSHB
Kendall's tau_b	CL GRADE	Correlation Coefficient	0.285
		Sig. (2-tailed)	<0.0001
			DIEM
Kendall's tau_b	CL GRADE	Correlation Coefficient	0.358
		Sig. (2-tailed)	<0.0001
			Pre-E/E-VC
Kendall's tau_b	CL GRADE	Correlation Coefficient	0.721
		Sig. (2-tailed)	<0.0001

Utilizing receiver operating curves, the cutoff value of DSHB for predicting difficult laryngoscopy came out to be $\geq$ 0.97 with a sensitivity of 61.5% and specificity of 96.55%. The NPV of DSHB was 94.38% and PPV 72.72%. The cutoff value of DSEM for predicting difficult laryngoscopy came out to be $\geq$ 1.75 with a sensitivity of 69.23% and specificity of 82.76%. The NPV of DSEM was 97.37% and PPV was 45.83%. The cutoff value of Pre-E/E-VC for predicting difficult laryngoscopy came out to be $\geq$ 1.85 with a sensitivity of 84.62% and specificity of 85.06%. The NPV of Pre-E/E-VC was 97.37% and PPV 45.83%.

Discussion:

Ultrasound has now become part of the anaesthesiologist's work to facilitate various procedures. Ultrasound has now become the new application for airway management after regional nerve blocks. In the study by **Falcetta S** et al., the incidence of difficult intubation was 12.5% with the distribution CL grade as predicted by ultrasonography measured DSHB was (mean $\pm$ SD: 0.837 $\pm$ 0.1632, 0.850 $\pm$ 0.171) cm for CL grade 1 and 2, while the measurement was 0.976 $\pm$ 0.23 and 1.15 $\pm$ 0.18 cm, respectively, for CL grade 3 and 4 which is comparable with our present study.[7] In the study by **Pinto J,** et al., difficult laryngoscopy is predicted by ultrasonographic measurement of the distance from skin to epiglottis measures DSE with a sensitivity of 64.7% and P< 0.001 which is comparable with our study showing DSEM with a sensitivity of 69.23% and a P value of < 0.001.[8] In the study by **Reddy PB** et al., difficult intubation was observed in 12.5% of patients. The mean $\pm$ standard deviation (SD) of the Pre-E/E-VC ratio was 1.33 $\pm$ 0.335, 1.62 $\pm$ 0.264, and 1.87 $\pm$ 0.243, 2.22 $\pm$ 0.29 for CL grades 1,2,3 and 4, respectively (P = 0.00) which

is comparable with our present study. [9] In our study, Pre-E/E-VC is a potential parameter in assessing the difficult laryngoscopy with a sensitivity of 84.62% and NPV of 97.37%. Other parameters DSHB and DSEM were also found to be statistically significant. Therefore, they can also predict difficult laryngoscopy. The previous study on ultrasound for predicting difficult laryngoscopy also shows a positive correlation of Pre-E/E-VC to the CL grading. [10]

Conclusion: We conclude that POCUS should be incorporated in the pre-anesthetic evaluation of the airway for its better accuracy and correlation in predicting CL grading. The good predictive value of USG measured parameters, that is, Pre-E/E-VC, and DSEM ensure reliability of these variables in detecting difficult laryngoscopy.

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