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Comparison of Neck Extension versus Ultrasound Guided Distance Measured From Skin to Epiglottis (DSE) As Sole Predictors of Difficult Intubation

Hassan Nasir Minhas, Mobeen Ikram, Nabeel Tahir Butt, Hafiz Ahmed Hassam Bhalli, Mansoor Ayub, Shahzada Irfan

ABSTRACT

Objective: The objective of this study is to compare the conventional measurement of neck extension versus ultrasound guided distance measured from skin to epiglottis (DSE) as sole predictors in determining difficult airway and laryngoscopy.

Study Design & Setting: Prospective observational study. Anesthesia department of Combined Military Hospital, Rwp from Jan-Jun 2023.

Methodology: All the patients included in the study were divided into two groups, Group N (n=75) undergoing neck extension as sole predictor and Group E (n=75) using DSE by USG as a sole predictor for difficulty airway. Primary variables measured were the sensitivity, specificity, positive and negative predicted values for neck extension and ultrasound guided DSE when compared with the outcome of the gold standard Cormack Lehane classification at intubation.

Results: Comparison of sensitivity and specificity of both parameters in diagnosing difficult airway showed a sensitivity of 76.9% in Group N (neck extension) versus 88.4% in Group E (DSE). Specificity showed 69.4% in Group N versus 87.5% in Group E. Neck extension had a positive predictive value of 73.2% whereas DSE was superior with a positive predictive value of 90.5%. The negative predictive value was also considerably less with neck extension as the sole perimeter with 73.5% versus 84.8% when DSE was used.

Conclusion: We conclude that the ultrasound guided distance measured from skin to epiglottis is superior to conventional neck extension when used as sole agents to diagnose difficult airway in suspected patients.

Key Words: Difficult, DSE, intubation, neck extension, ultrasound

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INTRODUCTION:

The management of difficult airway remains a priority for the anesthetist. The catastrophic unanticipated difficult airway remains an emergency in the operating room as well as in the emergency department during resuscitation of patients.[1] It is estimated that the incidence of number of difficult airways encountered in the operating room is around 10%.[2] A difficult airway is associated with considerable complications including hypoxia, aspiration, cardiac instability and critical arrythmias.[3,4] Early suspicion and confirmation through standard methods of airway assessments can prevent these adverse effects resulting in better patient outcome. Various international bodies have proposed various algorithms to deal with unanticipated difficult intubation, but all recommend an early assessment of the airway especially in non-emergency cases so that complications can be prevented in otherwise elective cases ending up in an emergency situation. The difficult airway society recommends guidelines for difficult intubation but also stresses the need for early recognition of at-risk cases and prepare and plan accordingly.[5]

Various parameters have been used to assess for difficult airway and it is rather the comparison between these

parameters and comparing them with each other in a system of assessment methods results in the best possible outcome for the patient. Studies have been carried out in comparing these parameters one by one and many of these have been proven to be better than the other with respect to sensitivity and specificity when comparing airway in a diverse group of patients. The presence of beard, advanced age, loose or lost teeth, short neck, inter-incisor distance have different specificities and sensitivities for airway assessment and anticipating difficulty in intubation in the operating room for the anesthetist.

Neck extension has been used as an acceptable method for predicting difficult airway and subsequent laryngoscopy in patients.[6] It has a good sensitivity and specificity, however, many patients who present with a decreased neck extension usually have easy intubations during laryngoscopy. Therefore, sole prediction of airway is usually combined with other methods to increase the reliability in the assessment.[7] But the more sensitive and specific a single predictor is in identifying the airway as difficult, the more it can add to the overall assessment criteria in diagnosing difficult airway and laryngoscopy.

Upper airway ultrasound techniques have been employed recently especially in the developing countries and confer advantages in predicting difficult airway.[8] Various measurements done by ultrasound have been used as predictors for difficult airway but the distance from skin to epiglottis (DSE) has merit in accurately measuring difficult airway in various studies.[9] Not only is it easy to perform but if added to the early assessment of patients in the emergency department or operation theater as a standard protocol, they may provide valuable information to the anesthetist in managing the airway of patients requiring subsequent intubation.

The aim of this study is to thus compare the conventional measurement of neck extension versus ultrasound guided distance measured from skin to epiglottis (DSE) as sole predictors in determining difficult airway and confirmed by subsequent laryngoscopy using the standard Cormack Lehane assessment.[10]

METHODOLOGY:

This prospective observational study was carried out at the Department of Anesthesiology, Combined Military Hospital from Jan-Jun 2023 after approval form the local institutional ethical review board Sr no. 431/12/21. 150 patients (minimum sample size 139 as per WHO calculator) were included in the study as per the inclusion criteria furnished keeping the confidence interval at 95%, margin of error at 5% with the incidence of difficult airway encountered by anesthesiologists in the operating room at 10%.[11] The method of sampling was non-probability consecutive via lottery method.

Inclusion criteria included all ASA I and II patients aged 20-40 years presenting to the anesthesia department after pre-anesthesia assessment for subsequent elective surgeries under general anesthesia with neck extension angles less than 21 degrees as difficult and more than 21 as not difficult airway for Group N[12] and DSE distance more than 2.70 cm as difficult and less than 2.70 cm as not difficult for Group E.[13]

Exclusion criteria excluded patients with patients with a history of burns or trauma to the airways or to the cranial, cervical, and facial regions, patient with a history of tracheostomy or lower airway surgeries and patients unwilling to be included in the study.

A written informed consent was taken from each participant explaining in detail about the study procedure but not the outcome or analysis protocol and discussing possible complications.

The study method included all patients as per the inclusion criteria furnished. All the patients included in the study were divided into two groups, Group N (n=75) undergoing neck extension as sole predictor and Group E (n=75) using DSE by USG as a sole predictor for difficulty airway. Maximum angle for neck extension in Group N was measured with the patient sitting while keeping the head erect directly looking at the front with mouth wide open and then asked to extend the head maximally while the anesthetist measured the angle traversed by the occlusal surface of the upper teeth (Grade 1 >35 degrees, Grade 2, 24-32 degrees, Grade 3, 12-21 degrees, Grade 4, <12 degrees)(Figure-I). Measured angles of < 21 degrees as predictors of difficult airway and vice versa. In Group E, linear probe using ultrasound guidance was used to measure the distance from skin to epiglottis in the sniffing position with the patient lying supine by a consultant anesthetist with 5 years of USG experience. A cut-off value of 2.70 cm from literature was taken as a predictor of difficult airway and vice versa. To remove bias, the anesthetist performing pre-operative airway assessment were different to those confirming through Cormack Lehane scoring during intubation. Cormack-Lehane grade I (glottis fully exposed) and II (glottis partially exposed with anterior commissure not seen) were rated as easy intubations. Cormack-Lehane classifications of grade III (only epiglottis seen) and IV (epiglottis not seen) were rated as difficult intubations.[14]

After confirming nil per oral status, patients were taken to the OT. Standard monitoring including non-invasive blood pressure, heart rate, capnography and ECG were attached to participants in both groups. Anesthesia was induced in both groups and after adequate sedation and paralysis with standard doses of IV Propofol 2 mg/kg and IV Atracurium 0.5 mg/kg. IV Nalbuphine 0.15 mg/kg was given for analgesia with pre-induction agents IV Ondansetron 4mg and IV Dexamethasone 2 mg. Once adequate depth with 1.0 MAC was achieved of Isoflurane, the patient was then placed on the sniffing position, and a No. 3 Macintosh curved blade

was used to obtain the laryngoscope view by a consultant anesthesiologist.

Primary variables measured were the sensitivity, specificity, positive and negative predicted values for neck extension and DSE when compared with the outcome of the gold standard Cormack Lehane classification.

Demographic data were statistically described in terms of mean and SD, frequencies, and percentages when appropriate. Sensitivity, specificity, positive and negative predictive values were calculated for both tests. All statistical calculations were performed using Standard Package for Social Sciences 26.0.

RESULTS:

A total of 150 participants were included in the study divided into Group N (n=75) and Group E (n=75). Mean age of patients in Group N was 29.893.54 years versus 30.564.00 in Group E. Mean weight between both the groups was 75.234.91 kg in Group N versus 73.954.37 kg in Group E. Gender distribution showed 42 (56%) males versus 33 (44%) females in Group N versus 36 (48%) males and 39 (52%) females in Group E (Table-1).

When comparing the diagnostic accuracy of neck extension with the gold standard Cormack Lehane score, frequency distribution revealed 30 (40%) participants as true positives and 25 (33.3%) as true negatives. Similarly, when comparing DSE with the Cormack Lehane score, 38 (50.6%) participants were true positives versus 28 (37.3%) participants as true negatives (Table-2).

Comparison of sensitivity and specificity of both parameters in diagnosing difficult airway showed a sensitivity of 76.9% in Group N (neck extension) versus 88.4% in Group E (DSE). Specificity showed 69.4% in Group N versus 87.5% in Group E. Neck extension had a positive predictive value of 73.2% whereas DSE was superior with a positive predictive value of 90.5%. The negative predictive value was also considerably less with neck extension as the sole perimeter with 73.5% versus 84.8% when DSE was used (Table-3).

DISCUSSSION:

The study was carried out to assess the sole predictive values of the most common parameters used to assess difficult airway. The rationale was that the higher the predictive values and sensitivity and specificity, the more that predictor

Figure 1: Measuring Maximum Angle for Neck Extension

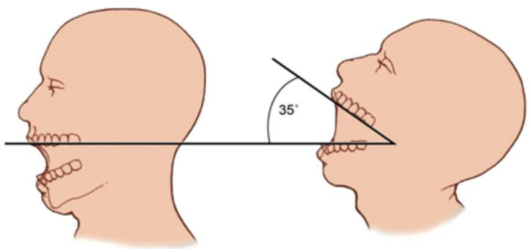

Table 1: Demographic Variables (n=150)

VARIABLE	GROUP N (n=75)	GROUP E (n=75)
MEAN AGE (YEARS)	29.893.54	30.564.00
MEAN WEIGHT (KG)	75.234.91	73.954.37
GENDER DISTRIBUTION		
• **MALE**	42 (56%)	36 (48%)
• **FEMALE**	33 (44%)	39 (52%)

Table 2: Comparison Between Neck Extension and Distance from Skin to Epiglottis (DSE) with Cormack Lehane Findings (N=150)

		Difficult	Not Difficult
Neck extension (n=75)	Difficult	30 (a)	11 (b)
	Not difficult	09 (c)	25 (d)
Distance from skin to epiglottis (DSE) (n=75)	Difficult	38 (a)	04 (b)
	Not difficult	05 (c)	28 (d)

Legend: A: (True Positives/Sensitivity), B (False Positives/Type-I Error), C (False Negatives/Type Ii Error), D (True Negatives / Specificity)

Table 3: Sensitivity, Specificity, Positive and Negative Predictive Values (n=150)

Variable	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Neck extension	76.9%	69.4%	73.2%	73.5%
DSE	88.4%	87.5%	90.5%	84.8%

would add to correct assessment of difficult airway when added to part of a combined scoring or assessment system.[15] The reason for using neck extension and DSE was to compare their individual power to diagnose difficult airway and compare whether one is superior to the other quickly and effectively.

The advent of ultrasonography has revolutionized the assessment and diagnosis of various parameters in the field of anesthesia. From interventional procedure using fast and focused assessment to rule our critical diagnoses to regional anesthesia techniques and blocks, the effects of USG in the field of anesthesia are paramount. Therefore, the use of this fast, effective, non-invasive, and safe modality to diagnose difficult airway was the point of focus during our study. We aimed to see whether results compared to conventional methods proved to be subpar or superior so we can propose to add novel methods that can quickly diagnose patients with anticipated difficult airways. The use of this modality would also be very useful in patients where neck extension and mobility are partially restricted due to injury, trauma, burns and contractures.

A study carried out by Carsetti et al[16] revealed that DSE was an excellent parameter in diagnosing difficulty airway when compared to conventional methods of neck extension,

thyromental distance and thyrohyoid distance. It was also proposed in a study carried out by Moura et al[17] that the diagnostic value can be further increased by adding Mallampatti score along with DSE in diagnosing difficult airway. Studies carried out by Giordano et al[18] showed that the sensitivity of DSE was around 95% which is line with findings of our demographic setup as well. The study also included obese patients with similar results but lesser negative predictive values.[19] Various studies carried out by the difficult airway society also mention the modern use of USG guided airway assessment methods to be superior yielding better overall sensitivity and specificity for airway assessment.[19] We also recommend the routine use and practice of residents and consultants in USG guided airway assessment methods as they provide better overall idea of whether a difficult airway should be anticipated during intubation in the patents.

Studies done at the local demographic levels remain scarce on the predictive value of USG for difficult airway. The reason can be attributed to non-availability and non-widespread use of the modality for airway assessment in pre-anesthesia clinics as well as operating rooms. The study aims to propose its frequent use because of better results in difficult airway diagnosis. The same has been proposed by studies done by Wu et al.[20]

The use of USG guided methods for employment in anesthesia have been less developed in our treatment setups. Lack of resources and decreased expertise have hindered their effective and widespread use. The use of USG guidance in regional nerve blocks is gaining momentum and acceptance both from anesthetist and surgical specialists and we hope the results of this study will direct physician towards using this excellent modality for methods and procedures other than pain relief and regional anesthesia practice.

CONCLUSION:

We conclude that the ultrasound guided distance measured from skin to epiglottis is superior to conventional neck extension when used as sole agents to diagnose difficult airway in suspected patients.

Authors Contribution:
Hassan Nasir Minhas: Conception, design, acquisition, analysis and interpretation of data, drafting of article
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