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Airway Assessment by Comparing Clinical Parameters and Usg Parameters in Correlation With Cormack-Lehane Grade: A Prospective Observational Study

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Abstract

Introduction: Airway assessment before surgery is important for anesthesiologist's to predict difficult intubation. This assessment helps to identify a difficult airway, allowing time for adequate preparation, such as selecting the right equipment and technique.

Incapability to sustain a patent airway results in insufficient ventilation and oxygenation leading to hypoxic brain damage and death.

Recently Ultra sonogram (USG) gained importance in accurate prediction of difficult airway and has potential to become 1st line non- invasive airway assessment tool in future.

Aim: To compare the clinical parameters and USG parameters of airway assessment in predicting Cormack – Lehane grading in patients undergoing elective surgery under general anaesthesia.

Objectives

- To assess the usefulness of clinical findings to evaluate airway and to assess its use in recognizing difficult airways.
- To assess for the correlation between the ultrasound assessment of airway and Cormack –Lehane grade.
- To assess for the correlation between the clinical assessment of airway and Cormack –Lehane grade.

Methodology

Study Subjects : All patients undergoing elective surgery under general anaesthesia in Bundelkhand government medical college, Sagar,M.P.

Type of Study: Prospective Observational study

Inclusion Criteria

All patients undergoing elective surgery under general anaesthesia of age group 18-60 years belonging to ASA grade I & II

Exclusion Criteria

• Rapid sequence induction conditions

• unstable Cervical spine injuries.

• unanticipated difficult airway in emergency condition.

• Not willing patients

Ethical Consideration

The participants were assured that the information obtained will be for research purposes and would therefore be anonymous and kept strictly confidential..

- The study was done among 120 patients who have undergone elective surgery by general anaesthesia. These 120 patients were divided into twogroups.
- Group C – 60 subjects on whom Clinical parameters were studied. ; Group U – 60 subjects on whom USG parameters were studied.

Clinical Parameters

- **Modified Mallampatti Classification**

Modified Mallampati classification was defined by Samsoon and Young in 1987, they mentioned 4 grades according to the anatomical structures. They modified the classification given by Mallampati et al. and used it as an assessment tool for difficult intubation. Samsoon classified it as-

Grade 1: Easy visualization (Faucial Pillars, Uvula, Soft palate, Hard

Grade 2: Partial visualization (Uvula, Soft palate, Hard palate);

Grade 3: Limited visualization (Soft palate, Hard palate);

Grade 4: Most difficult visualization (Hard palate only).

Modified Mallampatti grades 1 and 2 were considered to be easy laryngoscopy whereas grades 3 and 4 were considered to be difficult laryngoscopy.

Figure 1:

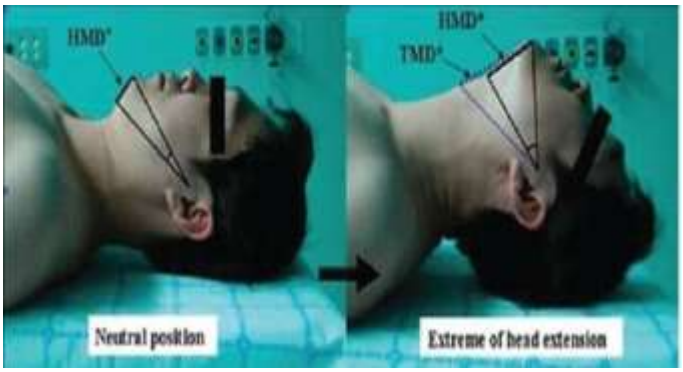
- **Thyromental Distance/ Patil's Test-**

The distance between the thyroid notch and the brain is called TMD. The patient was asked to keep his neck in extension and the distance was measured. It shows the position of the larynx andpharynx during intubation. The brief image shows that there may be limited space at the front of the neck, making it difficult to see the larynx (voice box) during laryngoscopy.

A shorter distance (less than 6.5 cm in adults) is typically associated with a more challenging intubation.

A longer distance (greater than 6.5 cm) indicates a potentially easier intubation.

Figure 2:



- **Sterno - Mental Distance**

Sternomental distance (SMD) is another measurement used during breath testing. It measures the distance between the upper part of the sternum and the head of the jaw when the neck is extended. This is due to the limited space at the anterior of the neck limiting the position of the laryngoscope and the view of the airway. A Sterno-mental Distance more than or equal to 12 cm was predicted to be easy laryngoscopy and Sterno-mental Distance less than 12 cm is associated with increased difficulty during intubation. These simple tests provide valuable information for healthcare professionals to anticipate potential difficulties during airway management procedures.

Figure 3:

Usg Parameters

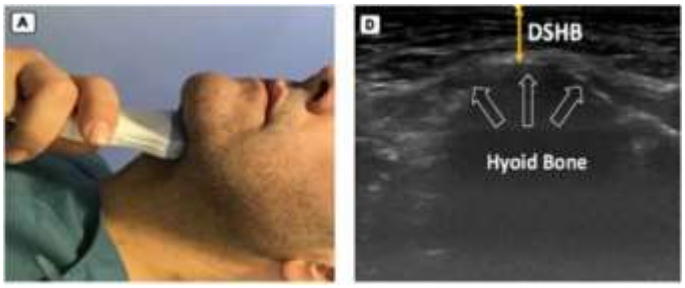
For USG parameters, the patient was made to lie down supine in a neutral position without a pillow under the head. The patient was instructed to keep his mouth closed and to take slow breaths during measurements.

- **Distance From Skin To Hyoid Bone (Ans-Hyoid)**

The distance from skin to hyoid bone {ANS-Hyoid} was evaluated by placing the linear high- frequency (4-10MHz) ultrasound probe transversely over the hyoid bone. The hyoid bone is seen as an inverted U-shaped hyperechoic structure in the submandibular region. The measurement from the skin to the midpoint of the hyoid bone was taken as ANS-Hyoid.

The distance from skin to hyoid bone using ultrasound if measured to be Skin to hyoid bone distance 0.70±0.18 cm was considered to be easy laryngoscopy and if more than or equal to 0.82±0.23 cm thickness, was considered to be difficult laryngoscopy.

Figure 4:



- **Distance from Skin to Thyroid Cartilage At Vocal Cords (Ans-Vc)**

The thyroid cartilage appears under the strap muscles. Deep within the thyroid cartilage are the vocal cords, which form a moderately shaded isosceles triangle.

ANS-Vocal cords of thickness 7.66±1.87 mm were predicted to be easy laryngoscopy groups compared to 9.81±1.54 mm thickness considered difficult laryngoscopy.

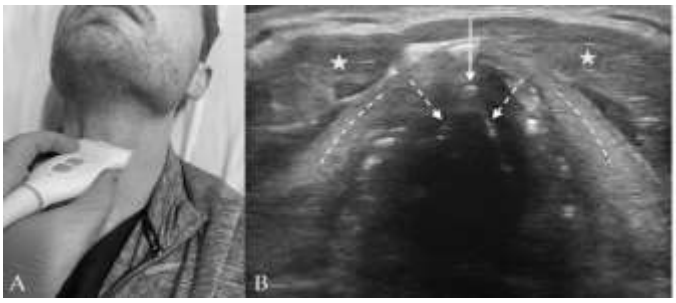


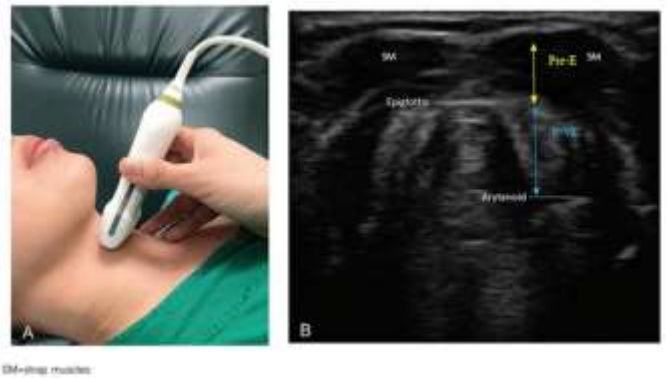
Figure 5: Thyroid View. (A) Thyroid probe placement on the subject's neck. (B) Thyroid view of the anterior neck with the linear probe transversely. The thyroid cartilage (dashed lines) appears lateral to the vocal cords, and the strap muscles (stars) are just superficial to the thyroid cartilage. The vocal cords (dashed arrows) join together at the anterior commissure (solid arrow).

- **Pre-Epiglottic Space/Epiglottis-Vocal Cord Ratio (PRE-E/E-VC)**

The ultrasound probe was positioned transversely between the hyoid and thyroid cartilage in the midline. The probe was then rotated in the transverse plane from the top to the bottom until an oblique transverse view showing the bilateral strap muscles (SM) and bisecting the epiglottis and the middle of the vocal folds was achieved. The pre-epiglottic space (PES) is visible between the thyrohyoid membrane and the epiglottis. The PES is a hyperechoic area containing adipose tissue, situated just deep to the strap muscles and superficial to the epiglottis.

The depth of the pre-E was measured from the anterior border of the hyperechoic epiglottic space to the epiglottis, which is marked as a bright linear air mucosal interface (the yellow arrow). The E-VC measured from the epiglottis to the middle of the vocal folds identified by the anterior border of the arytenoid. The cut off value for Pre-E/E-VC was ≥1.785 was considered for predicting difficult airway.

Figure 6:



Sample Size Estimation

- The sample size of 120 (60 per group) was justified based on standard statistical methods for sample size calculation. All consecutive cases consenting to the study with the age group 18 years to 60 years will be included with ASA grades I & II and were enrolled on this study for 1 year.
- Sample size calculation was performed using the formula:

$$n = \frac{2\sigma^2 \, (z_{1-\alpha} + z_{1-\beta})^2}{(\mu_{T-} \mu_S - \delta)^2}$$

- Where
- δ = Non-inferiority limit of the difference in means
- μ_T = Mean of the Group C
- μ_S = Mean of the Group U
- μ_T - μ_S = Expected mean difference
- σ = Standard deviation
- Z_((1-α)) = Significance level.
- Z_((1-β)) = Power

It was a prospective observational study that was conducted on around 113 patients for one year after approval by the institutional ethical committee in Bundelkhand Medical College and Hospital, Sagar MP.

- In the study, a sample size of 120 was chosen to lower the margin of error and obtain a statistically significant powerful analysis. The study involved

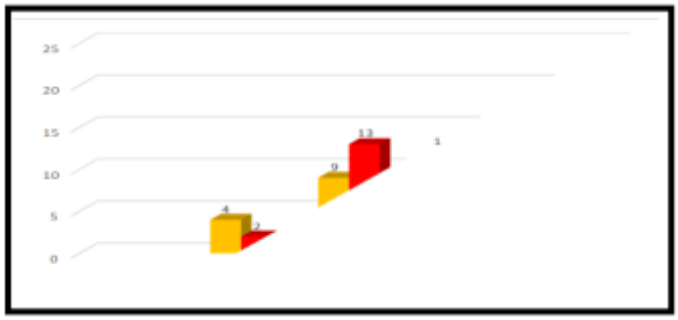
dividing 120 patients undergoing elective surgery under general anaesthesia into two equal groups and assessing various clinical and USG parameters.

- The statistical analysis plan mentioned that a combination of descriptive and inferential statistics would be used to analyse the collected data.

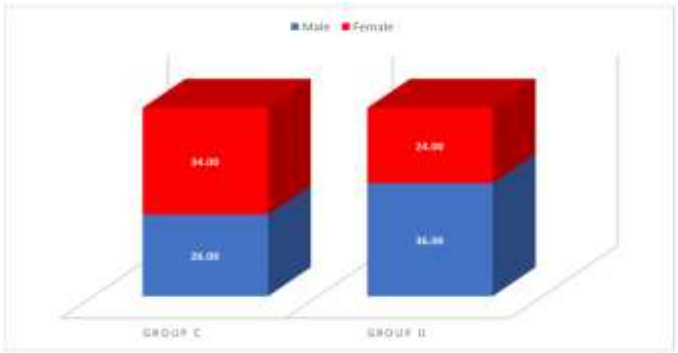
Observations & Results

Descriptive statistics of demographic distribution among both the groups-

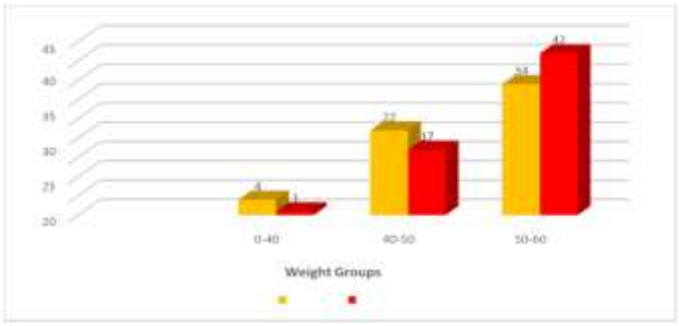
Graph 1: Age distribution among subjects in GROUP C and Group U



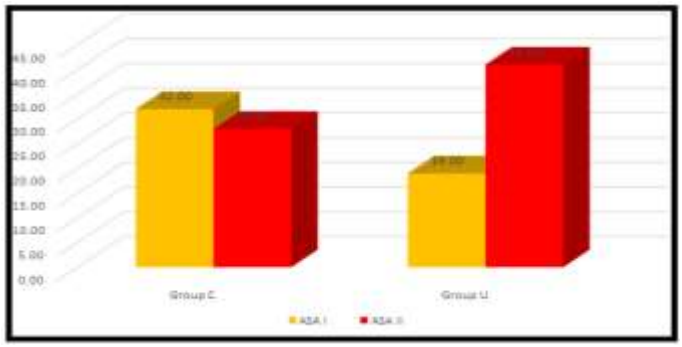
Graph 2: Gender distribution among Group C and Group U



Graph 3: Weight categorisation of subjects among Group C and Group U

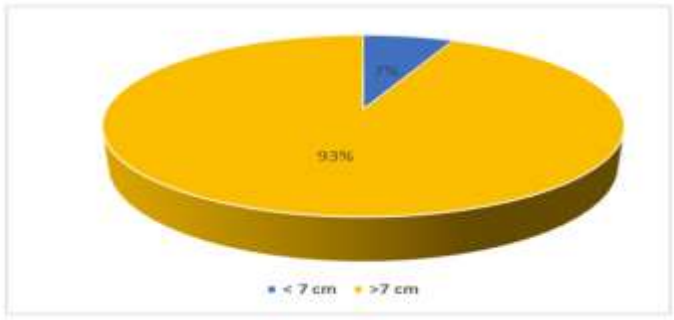


Graph 4: ASA-PS distribution among study subjects in Group C and Group U

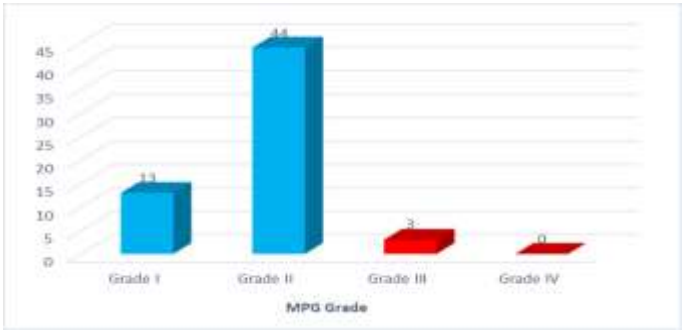


Descriptive statistics of clinical parameters

Graph 5: Distribution of TMD in group C patients



Graph 6: Distribution of MPG in group C patients-



Distribution of SMD in group C patients

Inferential Statistics Of Group C In Whom Clinical parameters Were Checked

Comparison of clinical parameters and Cormack-Lehane grade -

Comparison of Clinical parameters and CL Grading by chi-square test was done.

There was statistical significance between MPG-Modified Mallampatti Grading and CL grading with p value of 0.013.

No significant correlation found between CL grade and thyromental distance.

Similarly, no significant correlation found between CL grade and sternomental distance.

Table 1:

Clinical Parameter		Cormack- Lehane (CL) Grading 1	2	3	4	chi-square value	p-value
Modified Mallampati Grading (MPG)	I	8	4	1	0	12.64	0.013
	II	13	26	5	0		
	III	0	1	2	0		
	IV	0	0	0	0		
Thyro- Mental Distance	< 7 cm	2	2	0	0	0.85	0.65
	> 7 cm	19	29	8	0		
Sterno- Mental Distance	≤ 12.5 cm	1	2	0	0	0.56	0.75
	> 12.5 cm	20	29	8	0		

Descriptive statistics of USG parameters-

Graph 7: Distribution of CL Grading in Group U

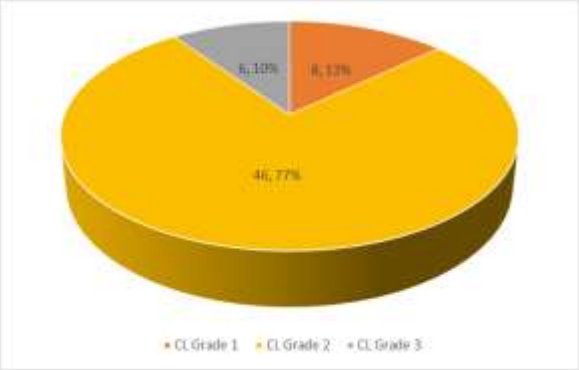


Table 2:

Cormack- Lehane (CL) Grading	Frequency	Percentage
Grade 1	8	13.33
Grade 2	46	76.67
Grade 3	6	6
Grade 4	0	0
Total	60	96

Inferential Statistics Of Group U In Whom Ultrasound parameters Were Checked

There is a significant association between ANS-Vocal cords and CL grading

- ANS-VC are progressively increasing with increasing CL grading severity and this was significant.
- The easy intubation group (CL1&2) had ANS-Vocal cords 2.69± .36 and 2.83±.55 compared to 3.55±1.3 in difficult intubation group.
- There was also a statistically significant relation between the distance from E-Vocal cords and CL Grading.

Table 3:

USG Parameter(mm)	Cormack-Lehane (CL) Grading 1	2	3	4	t value	p-value
ANS-Hyoid	4.5 ± 0.4	5.05 ± 1.18	5.28 ± 1.44	0	28.55	0.05
ANS-Vocal cords	2.69 ± 0.36	2.83 ± 0.55	3.55 ± 1.3	0	-53.66	0.034
Pre E	8.97 ± 0.73	9.29 ± 1.12	9.095 ± 1.18	0	62.037	0.06
E-Vocal cords	13.91 ± 1.49	14.54 ± 0.98	12.99 ± 1.34	0	88.574	0.023
Pre E/ E-Vocal cords	0.65 ± 0.09	0.64 ± 0.06	0.71 ± 0.14	0	-109	0.051

Discussion

- A thorough assessment of the patient's airway, preoperatively facilitates the anesthesiologist to predict the difficulty of visualizing the glottis and whether intubation can be performed efficiently.
- Though, there are numerous traditional clinical airway assessment parameters such as obstructive sleep apnea, history of snoring, body mass index (BMI), modified Mallampati grading (MPG) etc. which are typically used to anticipate a difficult airway preoperatively, . Despite using these parameters, the diagnostic precision of a pre-anesthetic airway assessment in predicting difficult intubation is very less and unanticipated difficult intubations may occur.

- The rationale behind our study was to search for a simple bedside noninvasive method to predict difficult airways and determine whether the ultra sonographic assessment has any advantage over clinical airway assessment tests in evaluating difficult airways preoperatively

Demographic profile

- No statistical significance between age and CL grade found in both the groups in our study. Similar results found in study of Rana et al. (2018).
- No statistically significant association found between weight and C-L Grading in group C patients but statistically significant association found between weight and C-L Grading in group U patients similar to study results of Ezri. Et al (2003).
- The association between gender and C-L Grading in group C did not show any statistical significance in both the groups.
- The association between ASA-PS status and C-L Grading in both group C and group U patients did show statistical significance. With increasing ASA grading, CL grading might increase similar to findings of Gupta et al 2011.
- The association between weight and C-L Grading in group U patients did show statistical significance. With increasing weight, CL grade might increase. No association found between weight and C-L Grading in group C patients. Gonzalez and Brodsky et al. (2008) found that obese patients had a higher incidence of difficult tracheal intubation compared to lean individuals.

Clinical parameters

- There was statistical significance between MPG-Modified Mallampatti Grading and CL grading. 3(5%) of MPG III and 44(73.33%) of MPG II belonged to CL Grade 3 and this was statistically significant with p value of 0.013.
- No statistical significance found between CL grade and thyromental distance.
- Similarly, no statistical significance found between CL grade and sternomental distance. Our findings were similar to results found in study of Kanoujiya et al. (2019).

USG parameters

- The easy intubation group (CL1&2) had ANS-Vocal cords 2.69± .36 mm and 2.83±.55 mm compared to 3.55±1.3 mm in difficult intubation group. There was also a statistically significant relation between the distance from E-Vocal cords and CL Grading.
- This is similar to the vocal cord (ANS-VC) and CL-level studies of Jion Min et al (2016) and Prakash et al (2013). It is important to note that ANS-VC gradually increases with increasing CL levels. There is also a significant relationship between the distance from the epiglottis to the middle of the midline (E-VC) and the CL level .
- As per Reddy et al (2016), ANS-VC >0.23 cm is a potential predictor of difficult intubation.

Limitations

However, our study has some limitations. The sample size was generally small and the study was conducted in regional conditions in Central India, so anatomical data may differ across races and ethnic groups. Factors that may affect airway assessment, such as age, gender, body mass index (BMI), facial complexity, mandibular protrusion, obstructive sleep apnea, difficulty opening the mouth, and dentistry, have not been investigated. Additionally, obese and pregnant women who are at high risk for difficult laryngoscopy were not included in this study.

Conclusion

- The study encompassed 120 patients undergoing elective surgery under general anesthesia, divided into two groups:
- Group C: Studied using clinical parameters.
- Group U: Evaluated with ultrasound (USG) parameters.

Key Findings

- Incidence of difficult airway (CL III & IV) was 13.3% in Group C and 10% in Group U.
- Gender distribution was similar across both groups.
- Majority of patients in both groups belonged to ASA-II classification.
- Clinical parameters like Modified Mallampatti Grading (MPG) and anatomical measurements (Thyro-Mental Distance, Sterno-Mental Distance) correlated significantly with Cormack-Lehane (CL) grading in Group C.
- Ultrasound parameters (ANS-VC, ANS-HYOID, Pre-E/E-VC) also showed significant associations with CL grading in Group U.
- The study underscores the utility of ultrasound in enhancing the prediction of difficult airways during elective surgeries. While clinical parameters remain valuable, ultrasound offers additional precision.

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