Original Research

# CORRELATION OF PALM PRINT SIGN AND DISTANCE FROM SKIN TO EPIGLOTTIS AS ASSESSED BY CORMACK-LEHANE GRADING IN PATIENTS UNDERGOING GENERAL ANAESTHESIA: A PROSPECTIVE OBSERVATIONAL STUDY

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## ABSTRACT

**Background and Aims:** Prediction and preparation for difficult airway management is important in minimising peri-operative airway complications. This study aimed to evaluate the correlation between palm print sign (PP sign), distance from skin to epiglottis (DSE) and hyomental distance ratio (HDMR) with Cormack-Lehane (CL) grading in patients receiving general anaesthesia.

**Methods:** After IEC clearance, CTRI registration and patient consent, a prospective observational study was conducted on 42 patients aged 18-65 years requiring tracheal intubation. Patients were randomised into two groups (n=21). Anaesthesiologist blinded to study assessed PP sign in Group A and performed airway ultrasonography in Group B to measure DSE and HDMR. Laryngoscopy was performed by single anaesthesiologist in both groups and CL grade noted, easy airway (CL-1,2a) and difficult (CL-2b,3,4). Principal investigator who is blinded analysed parameters of Group A and B with CL grading. DSE>2.5cm and HDMR< 1.2cm predicted difficult airway. Statistical analysis was done using Kendall's Tau Correlation test and Chi square test.

**Results:** The diagnostic performance of DSE, HDMR and PP sign was compared with Cormack-Lehane grading. HDMR showed highest diagnostic accuracy with sensitivity and specificity of 69.4%, positive predictive value (PPV) of 46.9% and negative predictive value (NPV) of 66.1%. PP sign demonstrated intermediate accuracy (sensitivity 54.5%, specificity 50.2%, PPV 38.9%, NPV 53.8%), while DSE showed lowest performance (sensitivity 36.5%, specificity 30.5%, PPV 28.9%, NPV 34.6%).

**Conclusion:** Sonologically measured HDMR is relatively better predictor of difficult laryngoscopy than DSE and PP sign. Airway ultrasound represents a useful and emerging tool for predicting difficult airway.

**Keywords:** Difficult Airway, Palm Print Sign, Skin to Epiglottis Distance, Hyomental Distance Ratio, Cormack-Lehane Grading.

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## INTRODUCTION

Difficult airway remains a significant contributing factor to mortality and morbidity in anesthetized patients.[1] Difficult airway management is one of the most critical aspects of perioperative care. Timely identification and appropriate airway strategies are essential in anaesthesiology to ensure

adequate oxygenation and prevent adverse outcomes. It is important to assess and predict difficult airway for choosing appropriate equipment and management strategy, failure can lead to catastrophic outcome.[2]Several bedside screening tests are used to identify difficult airway in patients but despite their accuracy, a small number of patients classified to an easy airway may still present an unexpected difficulty.[3]

Palm print sign is a useful predictor of difficult airway due to its association with limited joint mobility, especially in rheumatoid arthritis and diabetic patients. Grading 0-3 correlates with increasing airway difficulty. Its simplicity, non-invasive nature and ease of bedside application make it a valuable tool in airway assessment in Anesthesiology.[4] Ultrasound is a simple, compact, portable, noninvasive and safe tool for rapid airway assessment.[4] Ultrasound reliably images all structures visualized by CT and infrahyoid airway structures agree well with the parameters measured by CT.[5] The following measurements correlate with difficult airway: (1) Hyomental distance(HMD); (2) Thyrohyoid membrane(THM); (3) Distance fom skin to vocal cords(SVC). A full stomach rapid sequence intubation, gross visual anatomical abnormalities and restricted neck mobility from different causes preclude using ultrasound to assess the airway.[5]

Ultrasound have been used as a complementary tool to predict difficulty in airway management, both from a qualitative and quantitative perspective.[6] The anterior neck soft tissue thickness measured by ultrasound at hyoid bone and thyrohyoid membrane levels can be used as an index to predict difficult laryngoscopy, but only the anterior neck soft tissue thickness at thyrohyoid membrane levels can be used as an independent predictor of difficult laryngoscopy.[6]

We aimed to study the correlation of palm print sign and distance from skin to epiglottis as assessed by CL grading in patients undergoing general anaesthesia. The primary objective was to assess palm print sign in group A and to assess airway ultrasonography in group B. The secondary objective was to assess their correlation with CL grading and compare the correlation between the groups.

## METHODS

This prospective observational study [following Strengthening the Reporting of Observational studies in Epidemiology (STROBE) reporting guidelines] was conducted between May 2025 and September 2025 after approval from the institutional scientific research committee and ethics committee [EC/522; dated 17/03/2025] and registration with Clinical Trials Registry-India (CTRI/2025/04/084794, dated 15/04/2025), accessible at www.ctri.nic.in). The study was carried out using the principles of Helsinki guidelines and Good Clinical Practice guidelines.

Written informed consent was obtained for participation in the study and use of the patient data for research and educational purposes. A total of 42 patients undergoing elective surgery requiring tracheal intubation were included. Patients aged 18-65 years of either gender were included in the study. Those with a BMI>35kg/m2, Burns contracture, oral malignancies, large neck masses and patient refusal were excluded from the study.

All 42 patients were randomized into two groups of 21each using computer generated random sequence table. Allocation concealment was carried out by sealed envelope technique.

GroupA- For assessment of Palm print sign

GroupB- For assessment of distance from skin to epiglottis, skin to hyoid bone.

Preoperatively, a anesthesiologist blinded to the study assessed palm print sign in Group A. The palm and fingers of the dominant hand of patient is firmly pressed against a blue ink pad. The patients hand was then pressed firmly against a white sheet of paper on a hard surface, grading was done as Grade 0(all phalangeal areas visible), Grade 1(deficiency in the inter- phalangeal area of the fifth digit or both fourth and fifth), Grade 2(deficiency in the inter-phalangeal areas of second to fifth digit) and Grade 3(only the tips of digits seen).

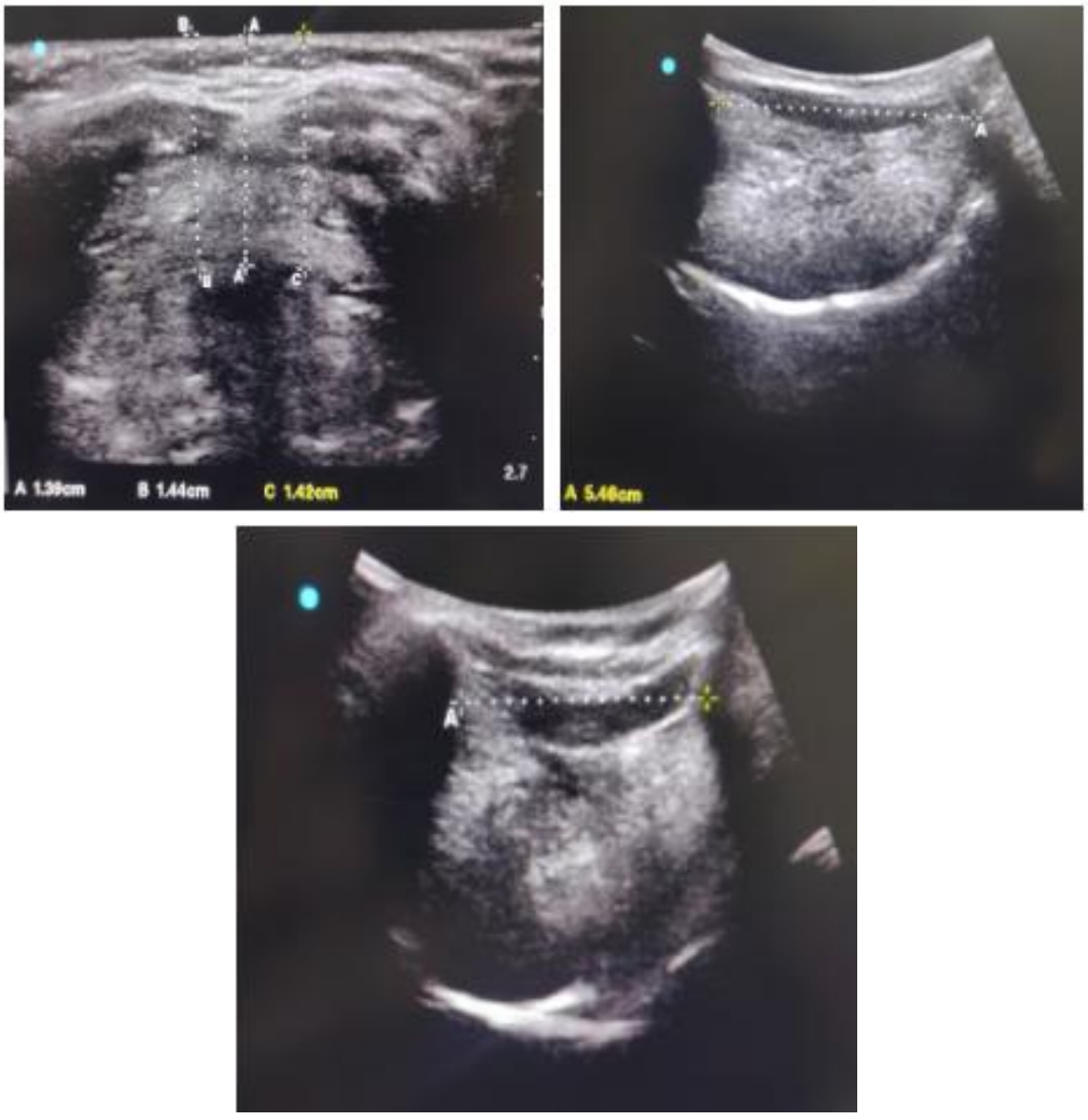
Airway ultrasound measurements in Group B patients was performed by the same anaesthesiologist using a linear probe(5-10MHz) of the ultrasound machine (Sonosite Micromaxx, Sonosite-Fujifilm Inc. Bothell, WA) with the patient supine and the head and neck in neutral position. At hyoid bone level, the distance from hyoid bone to skin surface was measured. At thyrohyoid membrane level, the distance from skin to epiglottis midway between the hyoid bone and thyroid cartilage was measured.

Patients were taken to the operating room and positioned with a standard pillow under the head and monitored by ASA standard monitors: ECG, NIBP, pulse oximetry, capnography. . Premedicated with Inj.Glycopyrrolate 0.005mg/kg iv, Inj.Midazolam 0.02mg/kg iv and Inj.Fentanyl 2mcg/kg iv, Preoxygenated with 100% FiO2 for three minutes. Patient were induced with injection propofol 2mg/kg and Inj.Atracurium 0.5mg/kg. At the end of three minutes, after full muscle relaxation, direct laryngoscopy was done by single anesthesiologist in both groups using an appropriate size curved Macintosh blade, and Cormack-Lehane(CL) laryngoscopic grade will be noted( Grade 1 – full view of glottis ,Grade 2a- posterior part of cords visible ,2b – only Arytenoids visible, 3- epiglottis

visible, 4- no laryngeal structures visible. The correct positioning of the endotracheal tube is confirmed via capnography and bilateral auscultation of lungs. The intubating anesthesiologist is not involved in preoperative assessment of palm print sign and airway ultrasonography, graded intubation easy (CL 1,2) and difficult(CL-3,4) .

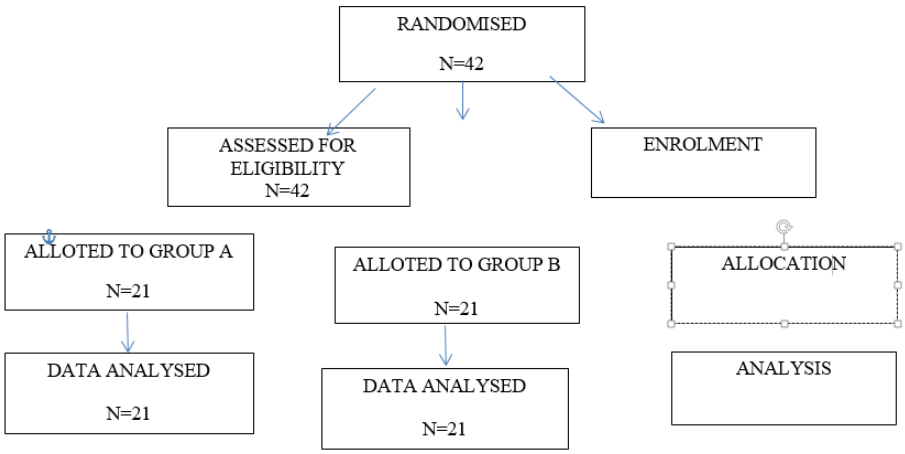
Principle investigator who is blinded analysed parameters of group A and group B with CL grading. DSE of <2.5cm was considered as easy, and >2.5cm was considered as difficult laryngoscopy. HDMR of >1.2cm was considered as easy and <1.2cm was considered as difficult laryngoscopy.

The sample size was estimated using formula, $n=Z(1-\alpha/2)2\times\hat{p}(1-\hat{p})/d2$, where p is sensitivity in percentage, Z is type I error, and d is precision of sensitivity. A total sample size of 42 was arrived at using a sensitivity of 77%, 5% of type I error and a precision rate of 83% based on the study by HashimKV et al. Initial data were entered and analysed in an Excel spreadsheet. SPSS statistics software version 26.0 (IBM Corp, Chicago, IL, US) was used for statistical analysis. Inferential statistics was done using Chi square test. Kendall's Tau B Correlation test was used for correlation analysis. The predictive values of the tests, such as palm print sign, DSE and HDMR, were assessed by calculating the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV).



## RESULTS

A total of 42 patients with a mean age of 44.50 (SD: 13.20) were recruited [Figure 2] into the study, which included 23 females (%) and 19 males (%). The mean height of the study population was 162.50 (SD: 9.25) cm. The mean weight of the study population was 63.67 (SD: 13.82) kg. BMI of patients ranged from 15 to 34 kg/m2 with a mean of 25 (SD: 5.09) kg/m2.




The correlation between PP grading and CL grade was analyzed using Kendall's tau-b correlation coefficient. The results showed a negligible correlation between PP grading and CL grade (correlation coefficient = 0.019, $p$ = 0.929), indicating no statistically significant association. Similarly, HDMR and DSE also showed moderate positive correlation coefficients of 0.54 and 0.52, respectively, but these associations were not statistically significant ($p$ = 0.16 and $p$ = 0.17). These findings suggest that PP grading, HDMR, and DSE are not significantly correlated with CL grade in this sample.

The diagnostic performance of DSE, HDMR, and PP Grade was assessed against the CL Grade reference standard. HDMR demonstrated the highest sensitivity and specificity, both at 69.4%, with a positive predictive value (PPV) of 46.9% and a negative predictive value (NPV) of 66.1%, indicating relatively strong diagnostic accuracy. In contrast, DSE showed the lowest performance, with a sensitivity of 36.5% (95% CI: 29.7–42.3), specificity of 30.5% (95% CI: 23.6–39.7), PPV of 28.9%, and NPV of 34.6%. The PP Grade showed intermediate performance with a sensitivity of 54.5% (95% CI: 48.7–59.6), specificity of 50.2% (95% CI: 42.5–55.8), PPV of 38.9%, and NPV of 53.8%.

Table 1: Prediction of Difficult Airway Based on Palm Print Sign, Distance from Skin to Epiglottis and Hyomental Distance Ratio

| Palm print sign, DSE and HDMR | CL Grade-Difficult laryngoscopy | CL Grade- Easy Laryngoscopy |
|---|---|---|
| Palm print grade (0,1) | 5 | 16 |
| Palm print grade (2,3) | 0 | 0 |
| DSE <2.5cm | 6 | 15 |
| DSE >2.5cm | 0 | 0 |
| HDMR >1.2cm | 0 | 0 |
| HDMR <1.2cm | 6 | 15 |

Table 2: Comparison of Palm Print Sign, DSE and HDMR in Predicting Difficult Airway

| Variables | Sensitivity | Specificity | Positive predictive value (%) | Negative predictive value (%) |
|---|---|---|---|---|
| Palm print sign | 54.5 (48.7-59.6) | 50.2(42.5-55.8) | 38.9 | 53.8 |
| DSE | 36.5(29.7-42.3) | 30.5(23.6-39.7) | 28.9 | 34.6 |
| HDMR | 69.4(60.4-73.2) | 69.4(62.6-76.4) | 46.9 | 66.1 |

## DISCUSSION

We studied Palm print sign and sonologically measured Distance from skin to epiglottis at the level of thyrohyoid membrane and Hyomental distance ratio at the level of hyoid bone to predict difficult airway. We found that palm print grading, DSE and HDMR showed no significant correlation with CL grading. The sensitivity and specificity of hyomental distance ratio was higher than those of palm print sign and DSE to detect difficult airway.

In our study, all 21 patients in group A showed palm print grading 0,1 predicting easy airway, showing negligible correlation with CL grading, indicating. All 21 patients in group B showed DSE >2.5cm and HDMR <1.2cm, predicting easy airway showing moderate positive correlation with CL grading. PP grading, HDMR, and DSE are not significantly correlated with CL grade in this study. To establish a statistical significance larger sample sizes are warranted.

In the study by, Karimbanakkal et al., El-Goanzouri risk index (EGRI) was compared with sonologically measured skin-to-epiglottis distance (SED) for predicting difficult laryngoscopy. Sonologically measured SED was a better parameter in terms of sensitivity and specificity to predict the difficulty in laryngoscopy than EGRI.[7]

Phulli et al., studied various airway ultrasonographic parameters in predicting difficult intubation and found that HDMR poorly correlated with CL grading and intubation difficulty scoring and thus failed to predict difficult intubation.[10] Abdelhady et al., compared ultrasonography with convental methods (Mallampatti score and thyromental distance) for prediction of difficult airway and revealed good correlation between Ultrasonographic measurement of SED and CL grade, therefore it might be considered as a predictor of difficult laryngoscopy.[8]

## CONCLUSION

Our study shows that sonologically measured HDMR is relatively better predictor of difficult laryngoscopy than DSE and palm print sign. HDMR has relatively higher sensitivity and specificity compared to DSE and palm print sign for predicting difficult laryngoscopy. Airway ultrasound represents a useful and emerging tool for predicting difficult airway.

### Study Data Availability

De-identified data may be requested with reasonable justification from the authors (email to the corresponding author) and shall be shared upon request.

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Nil.

### Conflicts of Interest

There are no conflicts of interest.

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