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Patient's Mask-On Contactless Airway Assessment Predicting Intubation Difficulty During COVID-19 Pandemic

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Author`s Contribution

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ABSTRACT

Objective: The aim of this study was to determine the accuracy of a contactless airway assessment method to predict intubation difficulty in a patient without any physical contact.

Methodology: This cross-sectional study was conducted at the department of anesthesiology, Fauji Foundation Hospital, Rawalpindi from 1st February 2023 to 31st July 2023. A total of 206 patients between 18-60 years of age and scheduled for elective surgery requiring general anesthesia and intubation were included in this study. The attending physician found the sternomental distance by asking the patient to place the tip of a measuring tape on the chin and extend towards upper border of manubrium sterni with fully extended neck. Patient's BMI and neck movements were recorded. An assessment performa was filled to assess prediction for difficult laryngoscopy. The primary outcomes were sensitivity, specificity and negative and positive predictive values of the method.

Results: The results of this study reported contactless airway assessment method with Se (68.42%), Sp (93.452%), PPV (70.27%), NPV (92.899%) and accuracy (89%) in predicting DI ($p < 0.000$).

Conclusions: Contactless airway assessment based on sternomental distance, BMI and neck movements serves as reliable method for prediction of difficult intubation.

Keywords: Contactless airway assessment, Intubation, Laryngoscopy, Physical contact, Sternomental distance.

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Introduction

Contagious aerosol-borne diseases have always existed, but the coronavirus pandemic in recent years has shocked the world for several reasons. It was a novel virus in 2019, which meant that there was no immunity, no vaccine, no treatment or medication and little to no understanding of how it worked and how it behaved. The COVID-19 pandemic has infected over 7 million people in 210 countries around the world.[1] Although coronavirus is a multi-system disease, the majority of its effects are on the lungs, with up to 19% of patients developing severe acute respiratory disease, resulting in hypoxic respiratory distress. Admission in ICU and invasive mechanical ventilation is required in 5 to 15% of such patients.[2] This means that a large number of patients require emergency airway management.

Due to the highly contagious nature of this disease and other transmissible respiratory diseases, the healthcare workers (HCWs) are at a high risk of being infected while performing procedures that generate aerosols and direct contact with respiratory fluids. Hence airway management can be challenging for an anesthetist in a critically ill patient but this challenge is even greater in a patient with COVID-19. One of the major concerns with these patients is the high aerosol transmission of the virus, which poses a risk of infection for the anesthetist and other medical personnel. In these changed circumstances, we must protect the HCWs, who are a valuable resource and their infectivity presents an additional burden to an already overburdened healthcare system. They pose a risk by being a source of infection to coworkers, patients, family and community members.[3,4]

Airway management involves several procedures like bag mask ventilation, noninvasive ventilation, intubations, extubations, airway suctioning, performing bronchoscopies, and tracheostomies. All of these can pose risk when it comes to aerosol generation.[5] Due to close proximity to the patient's upper respiratory tract, the HCWs who intubates the patient (and in many cases, the main intubation team) are at a higher risk through either droplets or aerosols, or both. Furthermore, high viral

loads have been linked to increased disease severity in healthcare workers.[6]

One of the first and most important roles of an anesthetist is to ensure proper ventilation and oxygenation of the patient by securing their airway. Difficult Laryngoscopy is used as a surrogate indicator for difficult intubation. Preoperative evaluation of the patient's airway allows the anesthesiologist to anticipate the difficulty level to visualize the glottis, and to perform intubation. The management of difficult airways is therefore one of the most important and fundamental competencies for practicing anesthesiologists.[7]Managing the difficult airways plays a critical role in preventing mortality and other complications associated with anesthesia. Poor assessment and

identification of potential difficulty, or poor management planning, can lead to poor outcomes.[8] Difficult Laryngoscopy (Difficulty in visualizing any part of the vocal cords after multiple laryngoscopies) has been reported to be in the range of 5% to 20%, and various physical examination tests have been used for its assessment.[9,10]

As discussed above, there is a need to device a method for safety of the healthcare providers as well as to continue an uninterrupted healthcare facility to the patients. The importance of securing the airway during anesthesia is well established but predicting the intubation difficulty is equally important. [12] As none of the methods for the airway assessment is perfect, so a number of methods are applied during an assessment to predict the difficulty of the airway establishment. The most frequently used tests for predicting difficult intubation include parameters like inter-incisor gap (IIG), thyromental distance (TMD), mandibular protrusion (MP), sternomental distance (SMD), grade of laryngoscopic view and modified Mallampati (MM) grade.

There are several parameters for each of these tests and the accuracy and predictability of these parameters vary significantly.[12]

Among these parameters, SMD (standard way to measure SMD is by extending the head as much as possible on the neck while mouth is closed, the straight distance between the center of the chin to the center of sternal notch is measured) is mentioned as a good single test for predicting difficult laryngoscopy (DL) and thereby difficult intubation (DI). The neck length <12.5 cm as measured by SMD is a predictor of DI.13,14

As per discussed above, SMD can be used as a reliable method for assessing DL, the aim of this study is to determine the accuracy of this contactless airway assessment method (CAAM) in the prediction of DI, as assessed by DL in adults in our local population. The results of the study will help the anesthetists to predict intubation difficulty level without physical contact with the patient, a step closer to the safety of anesthetists, their team and the patients.

Methodology

This cross-sectional study was conducted in the Department of Anesthesiology, Fauji Foundation Hospital, Rawalpindi, over a period of six months, from February 1, 2023, to August 31, 2023. The sample size was calculated using a sensitivity and specificity calculator. The following values were used: sensitivity (Se) = 30.3%, specificity (Sp) = 87.6%, accuracy = 41.1%, positive predictive value (PPV) = 27.7%, and negative predictive value (NPV) = 88.8%. The prevalence of difficult laryngoscopy was estimated at 27.7%, with a margin of error of 12%. Based on these parameters, the calculated sample size was 206.

A total of 206 patients, aged between 18 and 60 years, with a negative COVID-19 PCR test within the last 48 hours and scheduled for elective surgery requiring general anesthesia with intubation, were included in the study using a consecutive sampling technique.

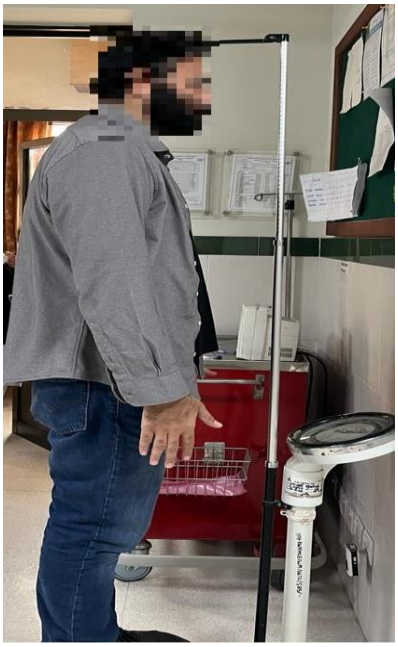
Exclusion criteria included patients with known airway difficulties (e.g., facial, head, or neck trauma or congenital anomalies), critically ill patients, and psychiatric patients (due to possible lack of cooperation).

Demographic and clinical histories of all patients were recorded. Body mass index (BMI) was calculated for each patient, and a BMI ≥30 was considered as indicative of potential difficult intubation.

Patients were asked to perform neck movements and were noted down on given Performa. Patient able to touch chin to chest at 90° and similarly able to move it backwards, touch right ear to right shoulder, touch left ear to left shoulder and turn face to left and to right was taken as good neck movements.

The attending physician asked the patient to place the tip of a measuring tape on the chin and extend towards upper border of manubrium sterni. The straight distance from upper border of the manubrium sterni up to mentum, with approximate measurement accuracy as near as 0.5 cm, while mouth closed and head is in full

extension was taken as SMD. SMD <12.5 cm was considered difficult intubation.



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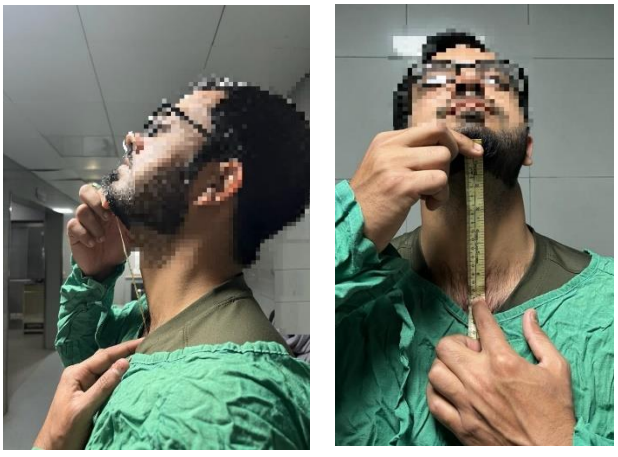

All the methods used for the assessment will be done with patient's face covered with mask, social distancing and without any physical contact.

An assessment Performa was filled to assess prediction for DI using these measured values during pre-anesthesia assessment.

An anesthetist performing intubation will later fill the performa to mention status of intubation using Cormack and Lehane classification which was taken as reference. The primary outcome was Se, Sp, PPV, NPV and accuracy of the CAAM.

Ethical approval was taken for conducting the study from ethical committee of the hospital. A written consent was taken from each patient to participate in the study.

All quantitative data was expressed in Mean±SD while qualitative data was presented in frequency and percentage. Fisher's exact 2 × 2 tests were applied with 95% confidence interval while taking p-value < 0.05 as statistically significant.

Results

The Mean±SD of age in this study was 40.64±11.44 years with an age range of 20 to 60 years. Details of demographic and clinical findings are given in Table-I.

Table I: Demographics and clinical findings (n=206)

Age (years) Mean±SD		40.51±11.23
Gender	Male n (%)	107 (51.94)
	Female n (%)	99 (48.06)
BMI	29.68±4.85	
ASA status	I n (%)	105 (50.97)
	II n (%)	73 (35.43)
	III n (%)	28 (13.59)
Neck movements	Yes	171 (83.00)
	No	35 (17)
Sternomental distance (cm)	Yes	171 (83.00)
	No	35 (17)

CAAM predicted 37 (17.96%) patients with DI while Comark and Lehane classification reported 38 (18.45%) patients with Difficult Intubation as shown in Table-II.

Table- II: Overall results of CAAM and Comark and Lehane classification in diagnosis of Difficult Intubation. (n=206)

Difficult Intubation	CAAM n (%)	Comark and Lehane classification n (%)
Positive	37 (17.96)	38 (18.45)
Negative	169 (82.04)	168 (81.55)
Total	206 (100%)	206 (100%)

CAAM showed Se of 68.421 %, Sp 93.452%, diagnostic accuracy by 89%, PPV 70.27% and NPV 92.899% in diagnosis of difficult intubation (p < 0.000) as shown in Table-III.

Comparison of CAAM versus Comark and Lehane classification for diagnosis of difficult intubation is given is Table-IV.

Table-III: CAAM sensitivity, specificity and predictive values. (n=206)

CAAM	Results
Se (%)	68.421
Sp (%)	93.452
Diagnostic accuracy (%)	89%
PPV (%)	70.27
NPV (%)	92.899

Table-IV: Comparison of CAAM versus Comark and Lehane classification for predicting DI. (n=206)

	Comark and Lehane classification		Total
CAAM	**Positive**	**Negative**	
Positive	26 (TP)	11 (FP)	37
Negative	12 (FN)	157 (TN)	169
Total	38	168	206

Discussion

The findings of studies describe that the incidence of DL is found in 1.5–8.5% in cases of general anesthesia and a similar ratio is reported for DI.[15] Hence the parameters that allow contactless airway assessment becomes focus of discussions to assess DL. Among these parameters, SMD is discussed as simple and easy to perform contactless airway method.

Patel B conducted a study to discuss validity of different parameters for prediction of DI in patients planned for general anaesthesia including MM test, TMD and SMD. Laryngoscopic evaluation was then done for these patients using Cormack and Lehane grading to keep it as gold standard. With parameter of considering SMD of <12.5 cm as DL, the results showed a sensitivity of 91% and specificity of 92.7 %. All the parameters were declared good however the results of SMD were better than the other 2 methods.[15]

In view of incidences of difficult or failed tracheal intubation leading to mortality and morbidity, Tamire T conducted a study to find the predictive values of different tests that are recommended in adult patients preoperatively for assessment of DL and DI. The airway related tests conducted in this study were IIG, MM grade, TMD, MP, Laryngoscopic grade and SMD. The results of the study proves that the methods of MM grade, TMD and SMD were independent predictors of DL/DI (p=0.000, p=0.017, p=0.008 respectively). The result of SMD shows Se (30.3%), Sp (87.6%), PPV (27.7%), NPV (88.8%) and accuracy (41.1%) for DL while the results for DI were Se (8.3%), Sp (84.8%), PPV (27.7%), NPV (94.6%) and accuracy (53.4%). These results therefore concluded that SMD <12 cm is one of among the tests that can be used as independent predictor of DI.[12]

l-Radaideh K and co-workers evaluated different tests which are considered useful in determining DI in patients planned to undergo surgical processes and were seemingly normal. They evaluated MP, TMD, IIG, MM Test and SMD. Cormack and Lehane grading were documented and taken as reference. The tests like MP (p=< 0.001), TMD (p=< 0.02) and SMD (p=0.01) for DL were found to be significantly associated with DI. The results of the study reported Se (53.33%), Sp (86.20%), PPV (28.6%), NPV (94.7%) and accuracy (83.13%) with SMD in predicting DI. The study also reported TP (8 cases), FP (20 Cases), TN (125 cases) and FN (7 cases) with SMD. This study also importantly reported a SMD of 24.00 ± 14.80 cm in patients without DI and SMD of 12.80 ± 2.80 cm in patients with DI.[16]

The Mean±SD of age in our study was 40.51±11.23 years with an age range of 20 to 60 years. The percentage of male patients was 51.94% while female patients were 48.06% of the total study population. The Mean±SD of BMI was 29.68±4.85. Majority of patients belonged to ASA status I (50.97%), followed by ASA status II (35.43%) and ASA status III (13.59%). Neck movements were reported normal in 171 (83%) of the patients while restricted neck movements were reported in 35 (17%) of the patients. The SMD was found to be <12.5 cm in 36 (17.48%) patients while SMD ≥12.5 was measured in 170 (82.52%) of the patients.

The CAAM predicted DL in 37 (17.96%) of the patients as reported by the visiting physician while the anesthetist reported DI in 38 (18.45%) of the patients as predicted by Cormack and Lehane classification.

The results of our study reported CAAM with Se (68.42%), Sp (93.452%), PPV (70.27%), NPV (92.899%) and accuracy (89%) in predicting DI (p < 0.000). The study also reported TP (26 cases), FP (11 Cases), TN (157 cases) and FN (12 cases) using CAAM. The results of our study are in line with studies conducted previously for finding good contactless airway assessment methods.[12,15,16]

Hence the results of our study prove that patient's mask-on contactless airway assessment based on SMD is an independent predictor for DI in patients scheduled for elective surgery requiring general anesthesia and intubation.

Limitations: The limitations of this study include that it is a single-centered study and representative of the patients of our hospital only with a limited number of patients.

Future study with a greater number of patients and multiple centers involved may be helpful in extracting even more beneficial results.

Conclusion

The results of our study conclude that the "Contactless Airway Assessment" based on sternomental distance serves as a reliable contactless method for assessment of difficult intubation in place of methods which requires physical contact with the patients. The method therefore greatly reduces the chances of transmission of infection like COVID-19 for anesthetist and the attending physicians

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