Section: Anaesthesiology

Original Research Article

COMPARISON OF ACROMIO-AXILLO-SUPRASTERNAL NOTCH INDEX, THYROMENTAL DISTANCE & STERNOMENTAL DISTANCE IN PREDICTING DIFFICULT VISUALISATION OF LARYNX

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Received : 12/01/2025
Received in revised form : 01/03/2025
Accepted : 16/03/2025

Keywords:
Acromio- axillo suprasternal notch index, thyromental distance, airway, larynx.

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DOI: 10.47009/jamp.2025.7.2.45

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (2); 221-225

Abstract

Background: There are several bedside screening tests available for prediction of difficult visualisation of larynx. However, no single test has shown hundred percent sensitivity or specificity. This study attempts to estimate the predictive ability of Acromio-axillo-suprasternal notch index (AASI), in comparison to Thyromental distance (TMD) and Sternomental distance (SMD), in predicting difficult visualisation of larynx. This study aimed to compare the predictive validity of AASI, TMD and SMD in predicting difficult visualisation of larynx among adult non-obstetric population. **Materials and Methods:** This comparative cross- sectional study was conducted on adult non-obstetric patients, of both sexes, of the age group 20 to 60 years, belonging to ASA-PS I/II, undergoing elective surgeries requiring endotracheal intubation. A total of 385 consenting patients were enrolled for the study. AASI, TMD and SMD were measured pre operatively. Visualisation of larynx was grading according to Cormack Lehane grading, with grades I&II being considered as 'easy visualisation of larynx' (EVL) and grade III&IV as 'difficult visualisation of larynx' (DVL). Data was analyzed using SPSS software version 20. Sensitivity, specificity, positive predictive value, and negative predictive value were calculated. ROC curves with calculation of area under the curve (AUC) were computed for the airway predictors. A p value of less than 0.05 was taken statistically significant. **Result:** The incidence of difficult visualisation of larynx in our study was 18.7 %. AASI had a better and significant AUC (0.91) in the ROC analysis, while compared to TMD (0.57) and SMD (0.61). AASI>/= 0.5 had higher sensitivity (86.1%), specificity (83.2%), positive predictive value (56.8%) and negative predictive value (94.7%). **Conclusion:** It is concluded from this study that AASI of >/= 0.5 was a better predictor of difficult visualisation of larynx than TMD and SMD, in adult non-obstetric population.

INTRODUCTION

The fundamental responsibility of an anaesthesiologist is to maintain the airway patency before and after induction of general anaesthesia. Unexpected difficulties in visualising the glottis for tracheal intubation can result in serious complications like hypoxia, brain damage and death. Difficult glottic exposure through direct laryngoscopy, or difficult visualisation of the larynx (DVL), points towards difficult intubation. There are several parameters frequently assessed for predicting difficult intubation. Modified Mallampati class scoring is commonly used for assessing airway while doing pre-anaesthetic check-up. Various other parameters such as Wilson risk sum score, sternomental distance (SMD), thyromental distance (TMD), upper lip bite test, Acromio-axillo-suprasternal notch Index (AASI) are available, of which AASI is a relatively new parameter when compared to thyromental distance and sternomental distance.[1,2] A test to predict difficult intubation should have high sensitivity so that it will identify most patients in whom intubation will truly be difficult. It should also have a high positive predictive value so that only a few patients who can be actually intubated easily are subjected to the protocol for management of a difficult intubation. The test should also be simple, painless, requiring no special equipment for the screening of difficult airway and with little inter-examiner variation.[2-4] The diagnostic accuracy of existing screening tests varies largely across studies and study settings. This can be further due to differences in techniques of intubation, equipment used, inadequate power of the test, differing thresholds used, and variations in patient characteristics.[5,6] AASI, a relatively new parameter, based on surface landmarks has been suggested to reliably predict DVL. It has been observed that DVL was observed in individuals with their neck situated deep in the chest. So, portion of the arm-chest junction above the level of supra sternal notch could be used as an indicator to estimate DVL.[7,8]

MATERIALS AND METHODS

This comparative study was done at a tertiary care hospital after obtaining approval from the Institutional Ethics Committee. Informed written consent was obtained from all the participants of the study including consent to use the data for research purposes. The study was done in 385 patients aged between 20 and 60, who belonged to the American Society of Anaesthesiologists Physical Status classification I and II, undergoing elective surgical procedures under General anesthesia with endotracheal intubation. Patients with any gross anomaly of head, neck and thorax, those with cervical spine anomalies, those with Body Mass Index more than 30, obstetric patients, and those with limited mouth opening were excluded from the study. Basic sociodemographic details of the patients were obtained using a structured proforma. A pre-anaesthetic examination was done noting detailed history, conducting a meticulous general and systemic examination, and reviewing the relevant investigations of each patient. Acromio-axillo-suprasternal notch index (AASI) was measured at the bedside, preoperatively, with the patient lying in supine position and their upper limbs resting by the side of the body. Using a ruler, a vertical line was drawn from the top of the acromion process to the superior border of axilla at the pectoralis muscle (line A). Then, a second line was drawn perpendicular to line A form the suprasternal notch (line B). The portion of line A lying above the point at which line B intersected line A was termed as line C. AASI was calculated by dividing the length of line C by that of line A [AASI= C/A].

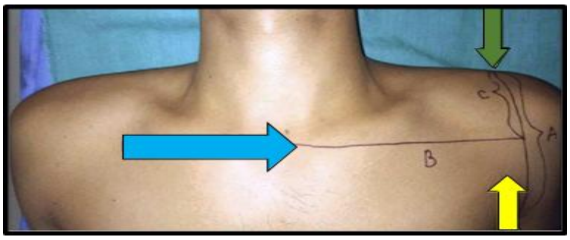

Figure 1: Measurement of Acromio-axillo -suprasternal notch index (AASI)

Thyromental distance (TMD) was measured as the distance from the mentum to the top notch of the thyroid cartilage, with the patient's neck fully extended and mouth closed. TMD of <6.5cm is considered as a predictor of difficult visualization of the larynx. Sternomental distance (SMD) was measured with a ruler and taken as the straight distance from the upper border of the manubrium sterni to the bony point on the mentum, with head fully extended and mouth closed. SMD of less than 12.5 cm is considered a predictor of difficult visualisation of larynx.

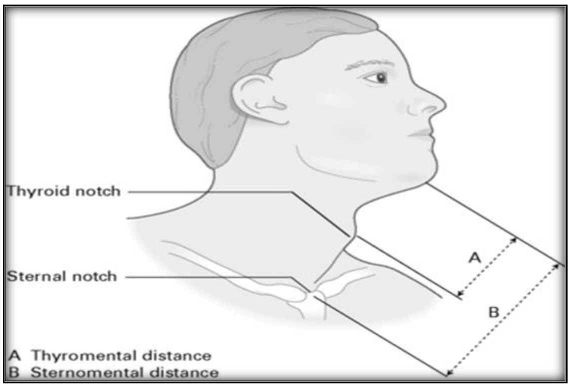

Figure 2: Measuring TMD and SMD

All patients were kept nil per oral overnight. In the operating room, intravenous line was secured and baseline heart rate, blood pressure and oxygen saturation (Spo2) were recorded. All patients received premedication with Inj.glycopyrrolate 0.2mgIV, Inj. Ondansetron 4 mg IV, Inj.Midazolam 0.02- 0.03mg/kg IV and Inj.Fentanyl 1- 2 mcg/kg IV. Preoxygenation was done with 100% oxygen for 3 minutes, prior to induction with Inj.Propofol 1%, 1-2 mg/kg as starting dose and subsequently titrated to loss of verbal response. Inj.Lignocaine 1.5 mg/kg IV was given to prevent intubation stress response.

Neuromuscular blockade was achieved with Inj.Succinylcholine 1-2 mg/kg IV. After 60 seconds, direct laryngoscopy & tracheal intubation was performed. Direct laryngoscopy was done by an anaesthesiologist with 3 years of experience with Macintosh laryngoscope with the head in 'sniffing the morning air' position. The anaesthesiologist performing laryngoscopy was masked to the airway parameters measured. The laryngeal view was graded according to the Cormack &Lehane grading system. Grades I & II were considered as Easy Visualisation

ISSN (O): 2687-5365; ISSN (P): 2753-6556

of Larynx (EVL) and Grades III & IV as Difficult Visualisation of Larynx (DVL).

Data was entered into Microsoft Excel and analyzed using SPSS version 20 and graphs were depicted using Microsoft Excel and SPSS. Continuous variables like the measurement parameters were summarized as Mean ± Standard deviation. The percentage of individuals having DVL was summarized as frequency and proportions. Sensitivity, Specificity, Positive and Negative predictive values were calculated to determine the predictive ability of AASI, TMD and SMD with 95% confidence interval using laryngoscopic view as the gold standard. Chi square test was used to check the association between DVL/EVL and the independent variables. Receiver operating characteristics (ROC) curves with calculation of Area Under the Curve (AUC) was computed for the airway predictors. P value of <0.05 was taken statistically significant.

RESULTS

A total of 385 patients who fitted the inclusion criteria were selected for the study. Everyone agreed to participate in the study thus accounting for a response rate of 100%.

Table 1: Sociodemographic distribution of the study participants.

Characteristics	Frequency (%)
Age group	
<40 years	115 (29.9)
41 - 50 years	122 (31.7)
>51 years	148 (38.4)
Gender	
Male	214 (55.9)
Female	171 (44.1)
ASA status	
I	199 (51.7)
II	186 (48.3)
BMI grading	
Normal (18.5 – 24.9)	214 (55.6)
Overweight (25.0 – 29.9)	171 (44.4)
Cormack Lehane grading	
I	115 (29.8)
II	198 (51.4)
III	64 (16.6)
IV	8 (2.1)

There was almost equal representation of the age groups,with majority belonging to >51 years age group(38.4%).Of the total study participants,199 patients belonged to ASA class I (51.7%) &186 patients belonged to ASA class II (48.3%).Almost 44% of the study participants belonged to the overweight category according to the WHO criteria for BMI.The mean age of distribution of the study participants was 46.1(+/- 10.4)years. Cormack Lehane grades III & IV were taken as cases of DVL. The incidence of DVL in our study was found to be 18.7%.

Table 2: Association of demographic characteristics of the study participants with difficult visualisation of larynx.

Characteristics	EVL (%)	DVL (%)	P value
Age group			
<40 years	105 (91.3)	10 (8.7)	0.001
41 - 50 years	101 (82.7)	21 (17.2)	
>51 years	107 (72.3)	41 (27.7)	
Gender			
Male	124 (72.5)	47 (27.5)	<0.001
Female	189 (88.3)	25 (11.6)	
BMI grading			
Normal (18.5 – 24.9)	195 (91.2)	19 (8.8)	0.048
Overweight (25.0 – 29.9)	118 (69.1)	53 (30.9)	

[Table 2] explains the association of demographic characteristics of the study participants with DVL. There was significant difference observed in the incidence of DVL among the study participants based on the age (p value <0.001), gender (p value <0.001), and BMI grading (p value 0.048). There was increased incidence of DVL among patients of higher age group (>51 years), male gender and those belonging to the overweight category (25.0-29.9).

ISSN (O): 2687-5365; ISSN (P): 2753-6556

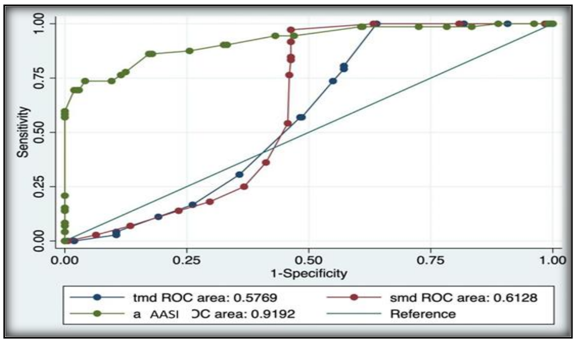

Figure 3: Comparison of AASI, TMD and SMD as predictors of DVL

ROC analysis was done for comparing the AASI, TMD and SMD in predicting the incidence of DVL.

The blue graph explains the ROC analysis for Thyromental distance to predict the incidence of DVL using the cutoff point of 6.5 cm. The ROC graph shows that the area under the curve for TMD in predicting DVL was 0.5769 (0.52 – 0.63). The red graph explains the ROC analysis for Sternomental distance to predict the incidence of DVL using the predetermined cut off of 12.5 cm. ROC graph shows that area under the curve for SMD in predicting DVL was 0.6128 (0.55 – 0.66). The green graph explains the ROC analysis for acromio- axillo-suprasternal notch index (AASI) >/= 0.5 to predict the incidence of DVL.ROC graph shows that area under the curve for AASI in predicting DVL was 0.9192 (0.87 – 0.95).

Table 4: Sensitivity, Specificity, PPV and NPV of the cutoff points for AASI, TMD and SMD in predicting DVL

Parameter	Sensitivity (95%CI)	Specificity (95%CI)	PPV (95%CI)	NPV (95%CI)
AASI (>/=0.5)	86.1 (74.1 – 94.4)	83.2 (68.9 – 90.1)	56.8 (32.5 – 67.3)	94.7 (87.1 – 99.5)
TMD (6.5 cms)	18.1 (7.4 – 43.2)	42.8 (29.4 – 61.4)	13.5 (6.7 – 32.5)	87.3 (81.9 – 94.6)
SMD (12.5 cms)	25.3 (15.8 – 47.6)	54.6 (39.2 – 73.3)	21.4 (11.1 – 45.4)	90.7 (83.4 – 97.1)

[Table 4] shows the Sensitivity, Specificity, PPV and NPV of the cutoff points for AASI, TMD and SMD in predicting DVL. It was observed that AASI (>=0.5) had better sensitivity, specificity, PPV and NPV when compared to TMD (6.5 cms) and SMD (12.5 cms). While comparing SMD and TMD, SMD was found to be a better predictor with a higher sensitivity, specificity, PPV, and NPV than TMD.

DISCUSSION

Managing a difficult airway has always been a challenge for all anaesthesiologists. Failure or difficulty in intubation is more frequently encountered among individuals in whom there is difficulty in viewing the glottis (DVL) during direct laryngoscopy under general anaesthesia. Despite the fact that predicting difficult intubation during the pre-anaesthetic check-up or preoperatively would be highly useful, we do not have a single bedside test that has adequate sensitivity and specificity in predicting DVL. This study compares AASI, TMD, and SMD in predicting DVL.1 In our study we found that the incidence of DVL was found to be 72 out of a total of 385 individuals (18.7%). This finding was found to be comparable to other studies from similar study settings. It was also observed that this incidence was found to be larger compared to some studies from various other study settings. These differences seen across the studies could be due to the variations in study settings, study population, individual characteristics, and variations in the criteria used to describe DVL. This could also be due to factors such as differences in anthropometric parameters, changes in intubation protocols, varying degrees of muscle relaxation, differences in head position during assessment, presence or absence of cricoid pressure application, different grades of laryngeal view and variations in the size and type of laryngoscope and blades used for visualising the glottis. We found that there was a significant difference in the incidence of DVL among the study participants with respect to their age group, gender distribution and BMI grading. This highlights the importance of clinical characteristics in predicting DVL, and the magnitude of influence that clinical characteristics can exert on the various parameters used for predicting DVL. Our findings were also comparable with that of other studies published from India.[9,10] Difficult visualisation of larynx and problems in airway management can also be predicted based on analysis of previous anaesthesia records, medical history of the patient and by physical examination of anatomical features of the individual. Several newly proposed radiological and bedside screening tests are available that have gained importance, in order to predict DVL preoperatively. When TMD, SMD and AASI were compared, we found that AASI had a better predictive validity in identifying patients who were possible candidates for difficult intubation (represented by a higher AUC value). We also observed that the accuracy (sensitivity and specificity) and the predictive parameters (positive predictive value and negative predictive value) of AASI were found to be much higher and better than TMD and SMD. While comparing SMD and TMD, SMD was found to be a better predictor with a higher sensitivity, specificity, PPV and NPV than TMD. With regard to AASI, we decided to determine an optimal cutoff for predicting DVL, using the sensitivity analysis. The ROC area under the curve obtained was around 0.91 (0.87 – 0.95). This finding was also supported by evidence from other studies, which also showed a very high AUC for AASI, in predicting DVL. We also determined the cutoff point for AASI which was found to be >/=0.5. This cutoff point was chosen as it showed the maximum sensitivity and specificity i.e. 86.1% and 83.2%

respectively. This finding was also supported by evidence from several other studies from different study settings. The PPV and NPV of AASI in predicting DVL was found to be 56.8% and 94.7% respectively, which were comparable to the findings from studies by Shekhawat et al and Honarmond et al.[11,12] The decision whether to combine various bedside screening tests or to choose a single test for predicting DVL has always been a controversial subject and conclusive evidence has not been generated yet. Several studies have showed that combining Modified Mallampati classification with TMD or SMD have not improved the sensitivity and specificity of either of these tests in predicting DVL. An optimal screening test should have high sensitivit, high positive predictive value and low false positive rates. From our study, we found that AASI had higher sensitivity and specificity and higher PPV when compared to other screening tests that are commonly used during pre-anaesthetic checkup.[13,14]

CONCLUSION

Our study has compared and contrasted the predictive validity of Acromio-axillo-suprasternal notch index, Thyromental distance and Sternomental distance and came to the conclusion that AASI, in predicting DVL, is superior to the conventional ones like TMD and SMD. It was proved that AASI has better sensitivity, specificity, positive predictive value, and negative predictive value when compared to TMD and SMD.A cutoff of >/=0.5 for AASI results in accurate prediction of difficulty in visualizing the larynx.

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