Is Acromio-Axillo-Suprasternal Notch Index a Reliable Test to Predict Difficult Tracheal Intubation in Adults in Supine Position - an Observational Study

Jitendra Singh Shekhawat[1], Poonam Gupta[2], Preeti Thakur[3]

ABSTRACT

Introduction: The applicability of the Modified Mallampati test in supine patients is doubtful. We undertook this study to evaluate the efficacy of acromio-axillo-suprasternal notch index (AASI) for predicting difficult intubation and to compare it with modified Mallampati test in supine position (MMT-S).

Material and Methods: This prospective observational study included 200 patients of American Society of Anaesthesiologist (ASA) physical status I and II of either gender, aged 18-60 years. Patients with anatomical abnormalities involving head and neck, pregnant, edentulous and BMI>35Kg/m^2 were excluded. AASI and MMT-S were assessed preoperatively. Direct laryngoscopy was performed by an experienced anaesthesiologist blinded to the result of airway assessment tests. Cormack Lehane grade (CL grade) and number of attempts to successful intubation were noted. Primary objective was to assess AASI as predictor of difficult visualisation of larynx (DVL) and secondary objective was to compare it with MMT-S. Statistical analysis- McNamer test was used to compare sensitivity and specificity of both the methods. Comparison of Area under Curve(AUC) of both the methods was performed.

Results: AASI was 92% sensitive and 97.71% specific in predicting difficult intubation whereas sensitivity and specificity of MMT-S was 76% and 84.57% respectively. Area Under Curve (AUC) of AASI was 0.97 with cut-off value >0.49 as a predictor of difficult intubation.

Conclusion: AASI with cut off value >0.49 has higher sensitivity and positive predictive value and is better in predicting difficult airway in supine patients as compared to MMT-S.

Keywords: Airway Assessment in supine, Modified Mallampatti Test, Acromio-Axillo-Suprasternal Notch Index

INTRODUCTION

Unanticipated difficult airway may result in serious complications like hypoxic brain damage or death. Of all the anaesthetic deaths, 30%-40% are attributed to inability to manage a difficult airway.[1] Modified Mallampati test performed in sitting position is a standard method of airway assessment and prediction of difficult intubation.[2,3]

Many a times, it is not possible to make the patients sit upright for airway evaluation eg. patients with haemodynamic instability, acute pain, prolapsed disc, cervical trauma, unconscious patients and uncooperative patients for emergency surgeries etc.[4] There is paucity of literature regarding airway assessment in supine patients and the applicability of the Mallampati classification in supine patients in such situation is doubtful.[5,6] Acromio-axillo-suprasternal notch index (AASI) is a relatively new, easy to perform and convenient bed side test that can be performed in supine position for predicting difficulty in intubation.[7]

This prospective observational study was hence designed to evaluate the efficacy of AASI for predicting difficult airway in patients undergoing general anaesthesia as a primary objective and to compare it with Modified Mallampati test in supine position(MMT-S) for predicting difficult laryngoscopic view and intubation as the secondary objective. Cormack-Lehane(CL) grade 1 and 2 were taken as easy visualization of larynx (EVL) and grade 3 and 4 were considered as difficult visualisation of larynx (DVL).

MATERIAL AND METHODS

This single-blinded prospective study was conducted over a period 18 months from October 2017- March 2019 in a tertiary care hospital. After obtaining approval from Hospital Ethics Committee, and informed consent, 200 patients of either gender, aged 18-60 years, with ASA physical status I and II scheduled for elective surgery requiring endotracheal intubation were included. Patients with anatomical abnormality (limitation of temporomandibular joint and atlanto-axial joint, oral tumour, maxillofacial tumour), recent head and neck surgery, pregnant, edentulous and BMI>35Kg/m^2 were excluded. On the day of surgery, airway assessment was done in the preoperative room.

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Calculation of AASI [7] (Figure 1)

With the patients lying in supine position and their upper extremities resting by the side, AASI was calculated based on the following measurements: Using a ruler

(1) A vertical line was drawn from the top of the acromion process to the superior border of the axilla at the pectoralis major muscle (line A)

(2) A second line was drawn perpendicular to line A from the suprasternal notch (line B); and

(3) The portion of line A that lies above the point at which line B intersected line A was line C.

AASI was calculated by dividing the length of line C by that of line A (AASI = C/A).

Classification of MMP in supine position

Modified Mallampati test in supine position (MMT-S). MMT-S was assessed with the patients lying supine, head in sniffing position, with mouth wide open and tongue completely out without phonation. The oropharyngeal view was evaluated by the observer vertically from above.

Standard anaesthesia technique was followed. Direct laryngoscopy was done by an anaesthesiologist having atleast three years of experience who was blinded to the preoperative values of AASI and MMT-S class. Using size#3 Macintosch blade in the sniffing position, best possible laryngoscopic view (Cormack Lehane grade) was noted. Number of attempts to intubation and any other method used to improve the laryngeal view or intubate were also noted.

STATISTICAL ANALYSIS

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD and median. McNamer test was used to compare sensitivity and specificity of both the methods. To assess the validity of AASI and (MMT-S), we calculated sensitivity, specificity, positive and negative predictive values. Assessment of best cut-off point of AASI for difficult intubation was also assessed. Receiver operating characteristic(ROC) curve was assessed to find out area under curve of AASI and MMT-S for predicting difficult intubation. Comparison of Area under Curve(AUC) of both the methods was performed. A *P* value of <0.05 was considered statistically significant. The data analysis was done using latest Statistical Package for Social Sciences (SPSS) version 2016.

On the basis of original study[7], taking area under the receiver operative characteristic curve for AASI (AUC = 0.89) and of MMT-S (AUC = 0.74) and 5% level of significance with δ error as 0.05, calculated sample size was 200 patients.

RESULTS

Out of 200 patients enrolled, 116 patients were male (58%). The mean age, weight, height and body mass index of our patients were 36.7±14.8 year, 53.1±9.5 kg, 157.5±6.3cm and 21.3±3.5 kg/m^2 respectively. No significant difference was found in visualisation of larynx(EVL versus DVL) with respect to demographic profile.

Out of 46 patients with MMT-S class 3 and 4(predicted DVL), 27 were intubated easily (false positive) and out of

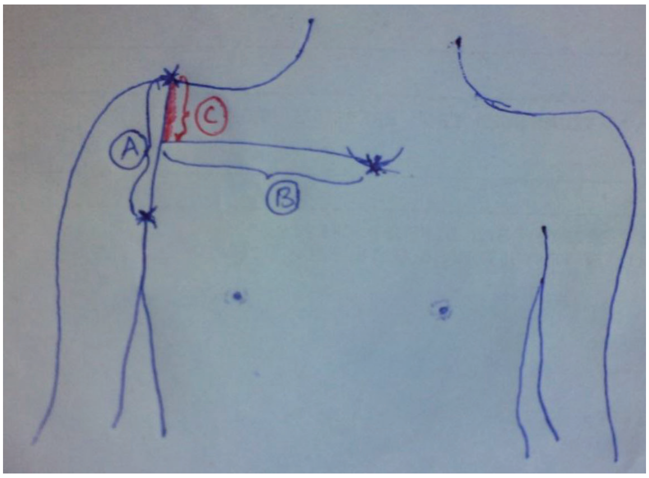

Figure-1: Calculation of AASI (Line A= vertical line drawn from the top of the acromion process to the superior border of the axilla at the pectoralis major muscle, Line B= line drawn perpendicular to line A from the suprasternal notch, Line C= The portion of line A that lies above the point at which line B intersected line A. AASI = Line C/Line A

154 patients with MMT-S class 1 and 2(predicted EVL), 06 had difficult intubation(false negative).

Out of 175 patient with AASI < 0.49, 173 had EVL and 02 patients had difficult visualisation, C-L grade 3&4 (false negative). All patients(n=25) with AASI ≥ 0.49 had DVL (true positives).

Predictive values of the MMT-S and AASI are shown in Table -1. Hence, AASI had the better positive predictive values and was associated with more true positives and better diagnostic accuracy as compared to MMT in the supine position. In this study, the negative predictive value(NPV) was comparable in both the groups.

In 25 patients with CL grade 3 and 4, laryngeal view could be improved and intubation performed successfully by external laryngeal pressure (BURP) in 52% of patients(n=13). Ten patients needed a change of blade size or stylet. Intubation was achieved using videolaryngoscpe in 02 patients. AUC for ROC of AASI was significantly higher as compared to AUC of MMT-S [Figure 2]. We observed the cut off value of AASI for prediction of DVL to be ≥ 0.49.

DISCUSSION

Modified Mallampati test is one of the most popular test for prediction of difficult airway. However, its foremost recommendation of assessment in sitting position precludes its applicability in bed ridden or critically ill patients.[4] We evaluated the efficacy of AASI and MMT-S to predict difficult intubation in supine position.

Significant association was seen between MMT-S and CL grade (*P*<0.001) for EVL. More than 90% of patients with MMT-S class 1 and 2 had easy intubation suggesting a high specificity (84.57%). On other hand, 63.41% of patients with MMT-S class 3 had easy intubation suggesting a high false positive result. Eighty percent of the patients with MMT-S grade 4 had difficult intubation.

The incidence of DVL based on MMT-S class was 12.5%

	MMT- Supine	AASI	
True Positive (TP)	19	25	
False Positive (FP)	27	2	
True Negative (TN)	148	173	
False Negative (FN)	6	0	
Sensitivity95%CI	76(54.5-90.6)	92(74.0-99.0)	0.219
Specificity 95%CI	84.5(78.4-89.6)	97.7(94.3-99.4)	< 0.0001
Positive predictive value (PPV) 95%CI	41.3(27.0-56.8)	85.2% (66.8-95.8)	< 0.0001
Negative predictive value(NPV)	96.1 (91.7-98.6)	98.8(95.9-99.9)	0.163
Positive Likelihood ratio (PLR) 95%CI	4-93(3.3-7.4)	40.23(15.2-106.8)	
Negative Likelihood ratio (NLR) 95% CI	0.28 (01-06)	0.082 (0.02-0.3)	
Diagnostic Accuracy	83	95	<0.001
AUC On ROC	0.8 ±0.54	0.964±0.01	<0.001

Table-1: Table comparing sensitivity, specificity, positive and negative predictive values, positive and negative likelihood ratios, diagnostic accuracy and AUC of MMT-S versus AASI

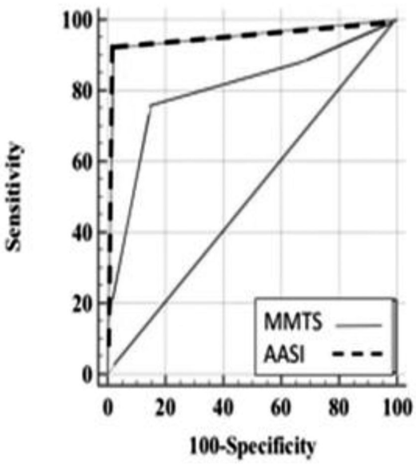

Figure-2: Comparison Of Receiver Operating Characteristic Curve Of Acromio-Axillo-Suprasternal Notch Index (Aasi) And Modified Mallampati Test in supine (MMTS) For Predicting Difficult Intubation

(25 out of 200 patients) which is higher than the result obtained in various other studies (6%).[7,8,9,10,11] This difference could be due to anatomic variations among populations, lack of uniformity in grading laryngoscopic views, inaccurate position of head, degree of muscle relaxation, type or size of laryngoscope blade. Assessment of MMT in supine position could have also contributed to higher percentage of DVL.[13]

All patients with AASI of ≤ 0.49(86.5%), had EVL and out of the remaining 13% of patients with AASI >0.49, only 02 had EVL. Hence, there was significant correlation between AASI and CL grade (*P*<0.001) for both EVL and DVL.

AASI was 92% sensitive and 97.71% specific in predicting difficult intubation which is higher than the corresponding values of 78.9% and 89.4% the previous study.[7] This variation may be the due to difference in population studied.

Specificity of AASI (97.71%) was significantly better than that of MMT-S (84.57%) for predicting easy intubation but the sensitivity of AASI (92%) though higher than that of MMT-S (76%) for predicting difficult intubation, was not statistically significant.

In this study, the positive and negative predictive value of AASI were higher than those of MMT-S. The results were comparable to the previous study.[6] The positive predictive value of AASI in our study was 85.2% as compared to 33.3% in the previous study.[7] It could be due to difference of age-group, BMI and inter-observer error. The negative predictive value of AASI was 98.9% in our study which is comparable to previous study(98.4%).[7]

The likelihood ratio (LR) measures the number of times more likely that a patient with a positive test result will present with difficult laryngoscopy.[13] The LR was 40.25 for the AASI, whereas it was 4.93 for the MMT-S in our study. LR is a useful measure to judge the efficacy of a predictive tool in daily practice.

The diagnostic accuracy of AASI(97.00%) was higher than MMT-S(83.5%), consequently AASI has lower false positive and negative values in predicting difficult tracheal intubation [table-1]. Similar results were observed by different authors.[7]

Significant difference was seen in the area under curve of AASI and MMT-S for predicting difficult intubation(P<0.001). [figure 2] AUC of AASI was higher as compared to that of MMT-S, difference being 0.146. Interpretation of the area under the ROC curve showed that the performance of AASI was excellent (AUC 0.964; 95% CI: 0.928 to 0.985) and that of MMT-S was good (AUC 0.803; 95% CI: 0.741 to 0.856) for predicting difficult intubation. Hence, it can be concluded that AASI has better discriminatory power as compared to MMT-S with minimum standard error. The cut off value > 0.49 predicts difficult intubation. Our cut off value was in concurrence to various previous studies.[14,15,16]

Literature reviewed revealed many studies comparing Mallampati test in sitting and supine and showed an inconsistent results.[18] Modified Mallampati class has been reported to be higher on changing posture from sitting to supine.[16,17,18] Amadassan et al reported better Mallampati grade on supine position.[19] Tham et al described a small, nonsignificant change in the Mallampati scores of ASA I-II patients when assessed in the sitting and supine positions.[5] No study has been done to compare AASI and Mallampatti score in supine postion. More studies are needed to validate the predictive performance of AASI in supine position using various parameters and their combination. Rationale behind the anatomical basis of the index has not been explained well in initial studies on AASI. Rajkhowa et al explained that higher the C/A ratio, the more deep the neck is situated in the chest thus accounting for DVL.[20]

The limitations of our study were that, we did not compare MMT in the sitting position and MMT in the supine position with phonation. Other limitation is that we studied a single population. As the anatomy varies with different people from different ethnic backgrounds, the findings may vary. Future studies need to be performed considering these factors.

CONCLUSION

Airway evaluation using AASI with cut off >0.49 can be well applied for prediction of difficult intubation in patients in supine position. AASI has the highest specificity, likelihood ratio, positive predictive value, negative predictive value and AUC in comparison with MMT-S. It is not dependent on patient position and hence can prove to be a reliable and accurate tool for difficult airway prediction in any position.

REFERENCES

1. Crosby ET. The unanticipated difficult airway with recommendations for management. Can J Anaesth1998;45:7:757 -76.
2. Gatt SP, Gugino LD, Desai SP, Waraksa B, Freiberger D, LiuPL, Mallampati SR, A clinical sign to predict difficult tracheal intubation: A prospective study, Can AnaesthSoc J 1985; 32:429–34.
3. Samsoon GL, Young JR. Difficult tracheal intubation: a retrospective study. Anaesthesia 1987;42: 487-90.
4. Bair AE, Caravelli R, Tyler K, Laurin EG. Feasibility of the Preoperative Mallampati Airway Assessment in Emergency Department patients. J Emerg Med. 2010; 38: 677-80.
5. Tham EJ, Gildersleve CD, Sanders LD, Mapleson, WW, Vaughan RS. Effects of posture, phonation and observer on Mallampati classification. Br JAnaesth 1992; 68; 32-8.
6. Singhal V, Sharma M, Prabhakar H, Ali Z, Singh GP. Effect of posture on mouth opening and modified Mallampati classification for airway assessment. J Anesth 2009; 23: 463-65.
7. Kamranmanesh MR, Jafari AR, Gharaei B, Aghamohammadi H, Poor Zamany N.K. M, Kashi AH. Comparison of acromioaxillosuprasternal notch index (a new test) with modified Mallampati test in predicting difficult visualization of larynx. Acta Anaesthesiol Taiwanica. 2013;51:141–4.
8. Mallampati SR, Gatt SP, Gugino LD, Desai SP, Waraksa B, Freiberger D, Liu PL. A clinical sign to predict difficult tracheal intubation: a prospective study. Can Anaesth Soc J 1985;32:429–34.
9. Al Ramadhani S, Mohamed LA, Rocke DA, Gouws E. Sternomental distance as the sole predictor of difficult laryngoscopy in obstetric anaesthesia.Br J Anaesth 1996; 77: 312-6
10. Wilson ME, Spiegelhalter D, Robertson JA, Lesser P. Predicting difficult laryngoscopy. Br J Anaesth 1988; 61: 211-6.
11. Yamamoto K, Tsubokawa T, Shibata K, Ohmura S, Nitta S, Kobayashi T. Predicting difficult laryngoscopy with indirect laryngoscopy. Anesthesiology 1997; 86: 316-21.
12. Amadasun FE, Adudu OP, Sadiq A. Effects of position and phonation on oropharyngeal view and correlation with laryngoscopy view. Niger J Clin Pract. 2010; 13: 417-20.
13. Merah NA, Wong DT, Ffoulkes-Crabbe DJ, Kushimo OT, Bode CO. Modified Mallampati test, thyromental distance and inter-incisor gap are the best predictors of difficult laryngoscopy in West Africans. Can J Anaesth 2005; 52: 291-6.
14. Kamranmanesh MR, Jafari AR, Gharaei B, Aghamohammadi H, Poor Zamany NKM, Kashi AH. Comparison of acromioaxillosuprasternal notch index (a new test) with modified Mallampati test in predicting difficult visualization of larynx. Acta Anaesthesiol Taiwan 2013;51:141-4.
15. Safavi M, Honarmand A, Hirmanpour A, Zareian. Acromio-axillo-suprasternal notch index: A new screening test to predict difficult laryngoscopy in obstetric patients scheduled for caesarean delivery. Eur J Anaesthesiol 2016;33:596-8.
16. Safavi M, Honarmand A, Hirmanpour A, Sheikhani Q, Jalali H. Acromio-axillo-suprasternal notch index: A new screening test to predict difficult laryngoscopy in general population. J Anesth Surg 2016;3:142-7.
17. Khatiwada S, Bhattaraj B, Pokharel K, Acharya R, Ghimire A, Baral DD. Comparison of modified mallampati test between sitting and supine positions for prediction of difficult intubation. Health Renaiss 2012;10:12-5.
18. Bindra A,PrabhakarH, Singh GP, Ali Z, Singhal V. Is modified mallampatti test performed in supine a reliable predictor of difficult tracheal intubation. J Anesth 2010;24:482-85.
19. Amadasun FE, Abudu OP, Sadiq A. Effects of position and phonation on oropharyngeal view and correlation with laryngoscopy view. Niger J Clin Pract.2010;1394:417-20.
20. RajkhowaT, SaikiaP, DasD. An observational prospective study of performance of acromioaxillosuprasternal notch index in predicting difficult visualisation of larynx. Indian J Anaesth. 2018;62:945-50.

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