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

Jitendra Singh Shekhawat¹, Poonam Gupta², Preeti Thakur³

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 (MMS).

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/m² were excluded. AASI and MMS 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 MMS. 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 MMS 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 MMS.

Keywords: Airway Assessment in supine, Modified Mallampati 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.²³ 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.⁵⁶ Acromio-axillo-suprasternal notch index (AASI) is a relatively new, easy to perform and convenient bedside 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 (MMS) 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/m² were excluded. On the day of surgery, airway assessment was done in the preoperative room.

¹Final Year Resident, Department of Anaesthesia and Intensive Care, Vardhan Mahavir Medical College & Safdarjang Hospital, New Delhi, ²Consultant, Department of Anaesthesia and Intensive Care, Vardhan Mahavir Medical College & Safdarjang Hospital, New Delhi, ³Assistant Professor, Department of Anaesthesia and Intensive Care, Vardhan Mahavir Medical College & Safdarjang Hospital, New Delhi, India

Corresponding author: Dr.Preeti Thakur, 42, Second Floor, Anupam Apartment, MB Road, Saket, New Delhi, 110068, India

How to cite this article: Jitendra Singh Shekhawat, Poonam Gupta, Preeti Thakur. Is acromio-axillo-suprasternal notch index a reliable test to predict difficult tracheal intubation in adults in supine position - an observational study. International Journal of Contemporary Medical Research 2020;7(7):G5-G8.

DOI: http://dx.doi.org/10.21276/ijcmr.2020.7.7.18

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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 at least three years of experience who was blinded to the preoperative values of AASI and MMT-S class. Using size \#3 Macintosh 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 \(\pm\) 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 operating characteristic curve for AASI (AUC = 0.89) and of MMT-S (AUC = 0.74) and 5% level of significance with \(\delta\) 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\(\pm\)14.8 year, 53.1\(\pm\)9.5 kg, 157.5\(\pm\)6.3 cm and 21.3\(\pm\)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 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 \(\geq\) 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 videolaryngoscope 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 \(\geq\) 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%...
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.

The positive predictive value of AASI in our study was 85.2% as compared to 33.3% in the previous study. 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%).

The likelihood ratio (LR) measures the number of times more likely that a patient with a positive test result will present with difficult laryngoscopy. 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. Significant difference was seen in the area under curve of AASI and MMT-S for predicting difficult intubation (P<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.

<table>
<thead>
<tr>
<th></th>
<th>MMT- Supine</th>
<th>AASI</th>
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<tbody>
<tr>
<td>True Positive (TP)</td>
<td>19</td>
<td>25</td>
</tr>
<tr>
<td>False Positive (FP)</td>
<td>27</td>
<td>2</td>
</tr>
<tr>
<td>True Negative (TN)</td>
<td>148</td>
<td>173</td>
</tr>
<tr>
<td>False Negative (FN)</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Sensitivity 95%CI</td>
<td>76(54.5-90.6)</td>
<td>92(74.0-99.0)</td>
</tr>
<tr>
<td>Specificity 95%CI</td>
<td>84.5(78.4-89.6)</td>
<td>97.7(94.3-99.4)</td>
</tr>
<tr>
<td>Positive Predictive Value (PPV) 95%CI</td>
<td>41.3(27.0-56.8)</td>
<td>85.2%(66.8-95.8)</td>
</tr>
<tr>
<td>Negative Predictive Value (NPV) 95%CI</td>
<td>96.1(91.7-98.6)</td>
<td>98.8(95.9-99.9)</td>
</tr>
<tr>
<td>Positive Likelihood ratio (PLR) 95%CI</td>
<td>4.93(3.3-7.4)</td>
<td>40.23(15.2-106.8)</td>
</tr>
<tr>
<td>Negative Likelihood ratio (NLR) 95%CI</td>
<td>0.28(01-06)</td>
<td>0.082(0.02-0.3)</td>
</tr>
<tr>
<td>Diagnostic Accuracy</td>
<td>83</td>
<td>95</td>
</tr>
<tr>
<td>AUC On ROC</td>
<td>0.8 ±0.54</td>
<td>0.964±0.01</td>
</tr>
</tbody>
</table>

**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

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. The positive predictive value of AASI in our study was 85.2% as compared to 33.3% in the previous study. 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%).

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Literature reviewed revealed many studies comparing Mallampati test in sitting and supine and showed an inconsistent results. Modified Mallampati class has been reported to be higher on changing posture from sitting to supine. Amadassan et al reported better Mallampati grade on supine position. 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. No study has been done to compare AASI and Mallampati score in supine position. 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.

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