Acta Anaesthesiologica Taiwanica 51 (2013) 141–144

Contents lists available at ScienceDirect

Acta Anaesthesiologica Taiwanica

journal homepage: www.e-aat.com

Original Article

Comparison of acromioaxillosuprasternal notch index (a new test) with modified Mallampati test in predicting difficult visualization of larynx

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ARTICLE INFO

Article history:
Received 17 July 2012
Received in revised form
2 August 2013
Accepted 7 August 2013

Key words:
anesthesia;
intubation;
intratracheal;
laryngoscopy

ABSTRACT

Background: We aimed to compare the efficacy of a new bedside screening test named acromioaxillosuprasternal notch index (AASI) with modified Mallampati (MMP).

Methods: A total of 603 adult patients, who were candidates for tracheal intubation in elective surgery, were enrolled in this prospective study. Preoperative airway assessment was carried out with AASI and MMP. The new AASI score is calculated based on the following measurements: (1) using a ruler, a vertical line is 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 is drawn perpendicular to line A from the suprasternal notch (line B); and (3) the portion of line A that lies above the point where line B intersects it is line C. AASI is calculated by dividing the length of line C by that of line A (AASI = C/A). After induction of anesthesia, the laryngeal view was recorded according to the Cormack–Lehane grading system. Receiver operating characteristic curve analysis was employed to compare between AASI and MMP.

Results: Difficult visualization of larynx (DVL, Cormack–Lehane III and IV) was observed in 38 (6.3%) patients. The best cutoff point for DVL was defined at AASI $>$ 0.49. AASI had a lower false negative rate and higher predictive values (sensitivity, positive predictive value, and accuracy) in comparison with MMP.

Conclusion: AASI was associated with higher predictive values than MMP and could be used for estimation of DVL.

1. Introduction

Maintaining a patent airway following the induction of general anesthesia is undeniably the most imperative concern for an anesthesiologist. Unanticipated difficult intubation, especially when associated with difficult or lack of ventilation in anesthetized patients, is still the main cause of morbidity or mortality.[1]

The incidence of difficult laryngoscopy or tracheal intubation was reported to be in the range of 0.1–20.2%; this variation is due to the different patient populations and criteria used.[2–9] Prediction of difficult intubation in preoperative evaluation has been attempted by numerous investigators using simple bedside physical examinations based on anatomical landmarks such as modified Mallampati test (MMP), interincisive distance, thyromental distance (TMD), sternomental distance, upper lip bite test, and hyomental distance ratio,[3,7,10,11] all of which have shown different sensitivities and specificities.

In the authors' experience, difficult visualization of larynx (DVL) was observed in individuals whose neck was situated deep in the chest (i.e., with a sloping clavicle); therefore, to consider a bedside test based on surface anatomy is suggested. We observed that the portion of the arm–chest junction above the level of suprasternal notch might be used as an indicator to estimate DVL. This study was aimed to evaluate the predictive validity of a new index (based on the surface anatomy of the upper chest), called the acromioaxillosuprasternal notch index (AASI), and compare it with a previously established test (MMP) for assessing difficult laryngoscopic view in patients who were candidates for general anesthesia.

Conflicts of interest: All authors declare no conflicts of interest.

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1875-4597/$ – see front matter
http://dx.doi.org/10.1016/j.aat.2013.12.001

2. Materials and methods

After obtaining approval from the Institutional Review Board and written informed consent from patients, 603 consecutive adult Asian patients aged 20–65 years with ASA class I–II, scheduled to undergo elective surgery requiring endotracheal intubation, were enrolled in this prospective observational study during the period February 2011–April 2012. Exclusion criteria were as follows: obvious anatomical abnormality, upper airway abnormality (e.g., tong tumor, maxillofacial tumor, or fracture), recent head and neck surgery, ASA class III–IV, and disability to open the mouth. Each patient underwent physical examination prior to surgery, and AASI and MMP were assessed. A new AASI index was developed by the first author (M.R.K). With the patients lying in a supine position and their upper extremities resting at the sides of the body, AASI was calculated based on the following measurements: (1) using a ruler, 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; Fig. 1); (2) a second line was drawn perpendicular to line A from the suprasternal notch (line B); and (3) the portion of line A that lay 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). MMP (the oropharyngeal view) was measured while patients were sitting, with a fully protruded tongue without saying "ah". MMP classification was as follows: class I = soft palate, fauces, uvula, and pillars were visible; class II = soft palate, fauces, and uvula were visible; class III = soft palate and base of uvula were visible; and class IV = soft palate was not visible.[8]

All patients received premedication with midazolam (0.03 mg/kg) and fentanyl (2 μg/kg). Anesthesia was induced with sodium thiopental (5 mg/kg) and atracurium (0.6 mg/kg). With the head in the sniffing position, laryngoscopy was attempted by an attending anesthesiologist blinded to the measurements following ventilation of the lungs with 100% oxygen. Laryngoscopy was performed after the loss of the fourth twitch in the train of four, with a Mackintosh blade (No. 3) and Cormack–Lehane grading was assessed. The laryngeal view was graded according to the Cormack and Lehane grading system: Grade I—full view of the glottis; Grade II—glottis partly exposed, anterior commissure not seen; Grade III—only epiglottis seen; Grade IV—epiglottis not seen (12).

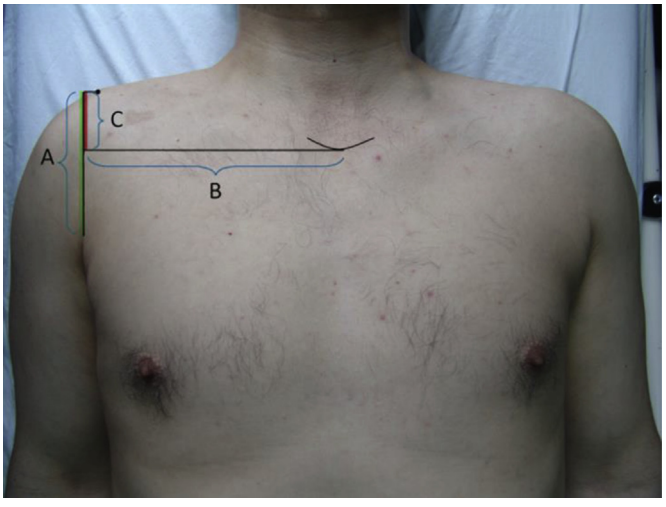

Fig. 1. Method for measuring the AASI. *A* represents the vertical distance between the superior aspect of the acromion process and superior border of axillary area, *B* the perpendicular line from suprasternal notch to line A, and *C* the portion of line A that lies above the cross-section between lines A and B. AASI is defined as *C* divided by *A* (AASI = C/A). AASI = acromioaxillosuprasternal notch index.

Grades I and II were considered as easy visualization of larynx (EVL) and Grades III and IV as DVL.

If the first intubation attempt failed and difficulty was encountered, intubation was attempted with Macintosh blade No. 4, coupled with adjustment of external laryngeal pressure and head position. All preoperative assessments including MMP and AASI were performed by an attending anesthesiologist. SPSS software version 16 (SPSS Inc., Chicago, IL, USA) was used to analyze the data. Predictive values of the abovementioned tests were determined. Sensitivity, specificity, positive and negative predictive values, accuracy, odds ratio, and positive and negative likelihood ratios were calculated. Receiver operative characteristic curves were used to compare AASI with MMP. Considering an incidence of difficult laryngoscopy of 5%, power of 80% with a type 1 error of 5%, to detect an improvement of discriminating power of an absolute value of 7% and using a two sided alternative hypothesis, 603 patients were estimated to suit the study. A comparison of the proportions of patients with DVL and EVL was performed by Chi-square test for diagnostic accuracy and t test for continuous independent variables. Two-sided $p < 0.05$ were considered statistically significant.

3. Results

A total of 603 patients were enrolled in the study. Patient characteristics are shown in Table 1. In total, 38 patients had a laryngoscopic view of Cormack–Lehane Grades III (30) and IV (8). The prevalence of difficult laryngoscopy was 6.3% [4.5–8.5%, 95% confidence interval (CI)]. Using discrimination analysis, AASI ≤ 0.49 was defined as the best cutoff point for difficult intubation. Predictive values of the two tests used are shown in Table 2. The main finding of this study was the area under the receiver operative characteristic curve for AASI (AUC = 0.89; 95% CI, 0.83–0.97) was higher than that of MMP (AUC = 0.74; 95% CI, 0.62–0.86; Fig. 2). Of the patients who underwent direct laryngoscopy with difficulties, 78.9% (54.4–93.9%, 95% CI) were identified correctly with an ASSI of ≤ 0.49. Among the patients who underwent direct laryngoscopy without difficulties, 89.4% (85.1–92.7%, 95% CI) were correctly predicted with ease. AASI had higher predictive values and a lower false negative rate than MMP (Table 2). Statistically significant differences were observed between sensitivity, positive predictive values, and accuracy of the two mentioned tests ($p < 0.05$), showing higher levels for AASI. Comparisons of specificity and negative predictive values between two tests did not depict significant differences ($p > 0.05$).

4. Discussion

Our study revealed that AASI had higher predictive values (sensitivity, specificity, positive predictive value, negative predictive value, and accuracy) and a lower false negative rate than MMP. Management of a difficult airway is still the most challenging duty

Table 1
Patient characteristics.

	All = 603	C-L 1 and 2 = 565	C-L 3 and 4 = 38	p
Gender				
Male	430 (71.3)	397 (65.8)	33 (5.5)	
Female	173 (28.7)	168 (27.9)	5 (0.8)	
Age (yr)	42.4 ± 16.3	42.17 ± 16.6	46.2 ± 10.5	0.2
Weight (kg)	71.2 ± 13.6	70.9 ± 13.5	75.1 ± 16.1	0.2
Height (cm)	168.7 ± 9.5	168.7 ± 9.6	168.0 ± 8.9	0.7
BMI (kgm^{-2})	24.9 ± 4.8	24.8 ± 4.7	26.9 ± 5.4	0.07

Data are presented as n (%) or mean ± SD.
BMI = body mass index; C–L = Cormack–Lehane grading; SD = standard deviation.