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Original contribution

Determination of the diagnostic value of the Modified Mallampati Score, Upper Lip Bite Test and Facial Angle in predicting difficult intubation: A prospective descriptive study

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ABSTRACT

Background: Difficult intubation is a significant cause of mortality and morbidity related to anesthesia. We decided to evaluate the value of Modified Mallampati Score, Upper Lip Bite Test and Facial Angle in the prediction of difficult intubation.
Methods: In a prospective descriptive study, data from 132 patients who were candidates for elective maxillofacial surgeries under general anesthesia were gathered. Facial Angles were measured by a maxillofacial surgeon according to cephalometry. The Modified Mallampati Score and Upper Lip Bite Test were first measured by an anesthesiologist and then another anesthesiologist was assigned to record the Cormack and Lehane score during the intubation. Grades 3 and 4 were considered as difficult intubation. Sensitivity, specificity, positive predictive value, negative predictive value and Youden index were calculated for all tests.
Results: Difficult intubation was reported in 12% of the patients. Facial Angle ≤ 82.5° can predict difficult intubation with 87.5% sensitivity and 88.8% specificity. Among the three tests, a high Modified Mallampati Score had the highest specificity (94.5%) and a high Modified Mallampati Score and Facial Angle (FA ≤ 82.5°) had the highest sensitivity (87.5%). The highest NPV, sensitivity and Youden index were observed when using Facial Angle with the Modified Mallampati Score or with Upper Lip Bite Test.
Conclusions: Facial Angle has a high sensitivity, NPV and Youden index for the prediction of difficult intubation, but the best result is achieved when Facial Angle is used in combination with either the Modified Mallampati Score or Upper Lip Bit Test.

1. Introduction

A no ventilate-no intubate scenario is one of the most dreadful situations that could be encountered by an anesthesiologist. Difficult intubation (DI) still remains as one of the anesthesia-related mortality and morbidity contributors. Although most intubations are easy, DI might be faced in 1.5–13% of the general anesthesia cases which could be associated with serious morbidities and mortality [1–5]. Numerous methods have been introduced to overcome DI; yet, no standard test has been proposed to evaluate and predict DI [3–5]. Nevertheless, some methods are routinely used by anesthesiologists as follows: Upper Lip Bite Test (ULBT), Modified Mallampati Score (MMS), Hyomental distance, Thyromental distance, Neck movement, Body mass index (BMI), Palm print, Head extension, Jaw protrusion, Wilson Score, and Lemon method [3,6,7].

Most researchers believe that no single test is able to predict DI and a combination of these tests rather than a single test should be used [8,9]. Anatomical evaluation of the airway includes the visible (e.g. mouth, teeth, tongue and neck) and invisible (e.g. tongue base, larynx and epiglottis) parts. One of the contributing factors to DI is the Facial Angle (FA); its being less or more than the usual degrees would lead to backward or inward displacement of the jaw which in turn would cause DI. Consequently, to improve the quality of the airway evaluation, all above-mentioned factors ought to be considered simultaneously. In

Abbreviation: DI, difficult intubation; ULBT, Upper Lip Bite Test; MMS, Modified Mallampati Score; FA, Facial Angle.

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this study, we aimed to answer the question of whether measuring the FA would be optimum for the prediction of DI. Mallampati Score and ULBT were measured in all subjects.

2. Methods

After the approval of the study by the Ethics Committee of Tabriz University of Medical Sciences (date: 2012/6/5, President of Ethics Committee, Dr. Ostadrahimi, Protocol Number: 91107), 132 patients scheduled to undergo elective maxillofacial surgeries under general anesthesia were included in this study from 2012 June till 2013 July. Sample size was calculated based on the following formula: $n = p(1-p)z^2/d^2$. ($z = 1.96$, $p = 9\%$ according to the previous studies with absolute error of 5%). Participants received information on the survey through a typed letter. Written informed consent was obtained by the corresponding author of this article (HS).

Inclusion criteria were all 18–50 year-old patients scheduled to undergo elective maxillofacial surgeries under general anesthesia with oral intubation. Exclusion criteria consisted of unwillingness of the patient to participate, subjects with limited mouth opening, edentulous patients, subjects with limited movement in their temporomandibular joints (TMJ), with dental abnormalities, with long mustache or beard and with large tongue. One day prior to the surgery, patients were visited by an anesthesiologist in the preoperative clinic. ULBT and Modified Mallampati Test were performed for all subjects by the anesthesiologist and the obtained data were registered in the allocated forms. In order to evaluate the range of motion for the TMJ and the dental structure of the patients, ULBT was used based on the following classifications: Class I: lower teeth can cover the mucosa of the upper lip; Class II: lower teeth can partially cover the mucosa of the upper lip; and Class III: lower teeth cannot cover the mucosa of the upper lip [10]. The Modified Mallampati Test was performed while the subject was sitting on a chair. Later, the patient was asked to open his/her mouth as much as possible without producing any noise. Based on the pharyngeal view, patients were classified in groups 0–4 [10].

FA was determined by a maxillofacial surgeon using cephalometry X ray and was registered in the forms. FA is the angle made by two anatomic lines (i.e. Frankfurt horizontal and facial planes). The Frankfurt horizontal plane is a line which crosses the inferior border of the bony orbit and the superior border of the external auditory meatus. The facial plane or nasion-pogonion line attaches the connection site of the upper section of the nasal bone and frontal border to the most anterior part of the mentum. The normal range for this angle is 90 ± 3 [11] (Fig. 1). All data related to the subjects including the type of the surgery, age, sex, weight, height, BMI, and facial trauma were recorded. Later, the subjects were visited by the second anesthesiologist who was blinded to the previously performed tests on the day of the surgery. The second anesthesiologist performed laryngoscopy and determined the Cormack and Lehane grade for each subject [12]. Premedication of the subjects was performed using midazolam 0.02 mg/kg and Fentanyl 1 μg/kg. Anesthesia induction was performed using propofol 1–1.5 mg/kg and atracurium 0.5 mg/kg. Intubation was performed after adequate hypnosis and muscle relaxation was achieved. Whenever there was uncertainty about the relaxation, train of four (TOF) ratio was measured using a peripheral nerve stimulator. Accordingly, at TOF ratio of zero, laryngoscopy and intubation were performed by the anesthesiologist assigned to the case using a Macintosh No. 3 blade while the patient's head was placed in the "sniffing" position. Patients with Cormack and Lehane grade of I or II were considered as easy intubation and those with Cormack and Lehane grade of III or IV were considered as DI. The anesthesiologist who performed the test was a single person to decrease the inter-observer variation. All collected data were analyzed using SPSS for windows version 15 (SPSS Inc., Chicago, IL, USA). To analyze the data diagnostic value, determination tests (sensitivity, specificity and positive and negative predictive values) and ROC curves to determine cutoff point for FA were used. P value ≤ 0.05 was considered statistically significant.

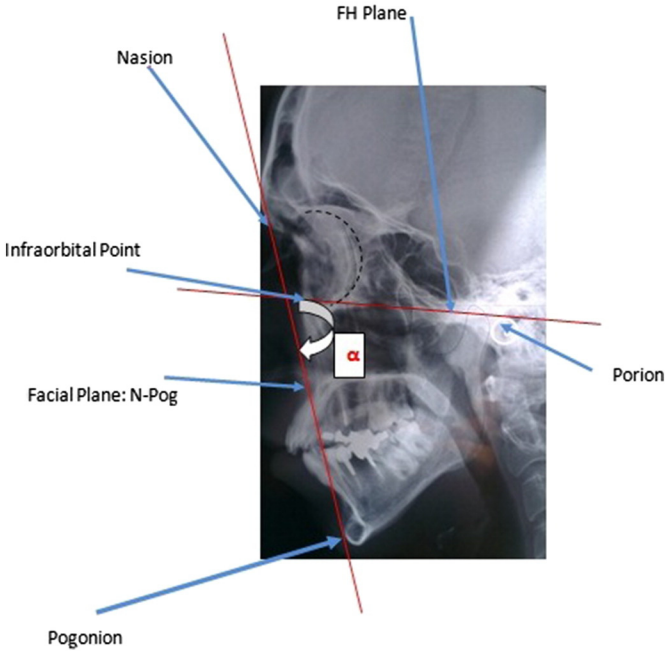

Fig. 1. Skeletal reference plans regarding Facial Angle: α: facial angle, FH plane: Frankfurt horizontal plane (as portion to infraorbital points), facial plane: N-Pog (nasion-pogonion).

3. Results

Of the studied subjects, 16 people (12%) were considered as DI based on the Cormack and Lehane grading system. We managed this problem with inserting LMA or using fiberoptic bronchoscope or the method which was explained by Parish et al. [5] in their study. There is no significant statistical relationship between the demographic findings (age and BMI) and DI but the intubation time and Facial Angle were relevant to DI (Table 1). Sensitivity and specificity of a high Modified Mallampati Score (Classes III and IV) in predicting DI were 87.5% and 94.5%, respectively (PPV = 70, NPV = 98.5). Sensitivity and specificity of high ULBT (Classes II and III) were 81.3% and 89.7%, respectively (PPV = 52, NPV = 97.2) and the FA had the sensitivity and specificity of 87.5% and 88.8% (PPV = 52, NPV = 98.5) (Table 2). The area for ROC was 0.963 and $p \leq 0.0001$. The most appropriate cutoff angle was ≤82.5° which could predict DI with a sensitivity and specificity of 87.5% and 88.8%, respectively (Fig. 2).

4. Discussion

The ability to evaluate and manage the airway has always been a major concern for physicians [2]. Based on the data obtained from our study, patients with an FA of <82.5° will probably face DI with a sensitivity of 87.5% and patients with an FA of higher than 82.5° will probably face easy intubation with a specificity of 88.8%. ULBT with a sensitivity

Table 1
Patient's demographic data and their risk factors for difficult intubation based on Cormack and Lehane views (EI = easy intubation, DI = difficult intubation).

Parameters	EI	DI	*P* value
Age (year)	26.8(±7.06)	26.3(±8.07)	0.78
BMI	24.0(±3.91)	24.7(±3.53)	0.48
Facial Angle	86.6(±3.72)	78.5(±2.89)	0.000
Intubation time (seconds)	11.2(±4.52)	21.8(±12.6)	0.011