Original Article

Predicting difficult laryngoscopy in acromegalic patients undergoing surgery for excision of pituitary tumors: A comparison of extended Mallampati score with modified Mallampati classification

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Abstract

Background: There are numerous reports of difficult laryngoscopy and intubation in patients with acromegaly. To date, no study has assessed the application of extended Mallampati score (EMS) for predicting difficult intubation in acromegalics. The primary aim of this study was to compare EMS with modified Mallampati classification (MMP) in predicting difficult laryngoscopy in acromegalic patients. We hypothesized that since EMS has been reported to be more specific and better predictor than MMP, it may be superior to the MMP to predict difficult laryngoscopy in acromegalic patients.

Materials and Methods: For this prospective cohort study with matched controls, acromegalic patients scheduled to undergo pituitary surgery over a period of 3 years (January 2008-December 2010) were enrolled. Preoperative airway assessment was performed by experienced anesthesiologists and involved a MMP and the EMS. Under anesthesia, laryngoscopic view was assessed using Cormack-Lehane (CL) grading. MMP and CL grades of I and II were defined "easy" and III and IV as "difficult". EMS grade of I and II were defined "easy" and III as "difficult". Data were used to determine the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of MMP and EMS in predicting difficult laryngoscopy.

Results: Seventy eight patients participated in the study (39 patients in each group). Both MMP and EMS failed to detect difficult laryngoscopy in seven patients. Only one laryngoscopy was predicted to be difficult by both tests which was in fact, difficult.

Conclusion: We found that addition of neck extension did not improve the predictive value of MMP.

Key words: Acromegaly, airway, extended Mallampati score, Mallampati classification

Introduction

The modified Mallampati classification (MMP) is widely used for pre-operative assessment of airway,[1] and Mallampati scores of III and IV have been reported to be valuable in predicting difficult laryngoscopy in acromegalic patients as well.[2] As it is known that MMP not only assesses pharyngeal structures but also head and neck mobility. It has been suggested that craniocervical extension relates to mouth opening and limited head and neck mobility can result in poor MMP.[3,4] Mashour and Sandberg found that application of craniocervical extension improves the specificity and positive predictive value while retaining the sensitivity of the traditional MMP examination in a group of normal patients. The addition of craniocervical extension to the MMP was referred as the extended Mallampati score (EMS).[5] The authors found the position favorable for obese patients also.[6] The incidence of difficult intubation in acromegalic patients is higher than the general surgical population.[2,7,8] There are numerous reports of difficult laryngoscopy and intubation in patients with acromegaly.[9-13] To date, literature search did not reveal studies assessing the application of EMS in for predicting difficult intubation in acromegalics. The primary aim of this study was to compare EMS with MMP in predicting difficult laryngoscopy in acromegalic patients. We hypothesized that since EMS has been reported to be more specific and better predictor than MMP,[5] it may be superior to the MMP to predict the incidence of difficult laryngoscopy in acromegalic patients.

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Materials and Methods

Our local ethics committee approved this prospective, observational, and controlled study and a written informed consent was obtained from all patients. Over a period of 3 years (January 2008-December 2010) 39 consecutive acromegalic patients presenting for for excision of pituitary tumor were enrolled. The clinical diagnosis was confirmed by magnetic resonance imaging and biochemical assay of hormone. Acromegalic features such as prognathism, macroglossia, and soft-tissue swelling were present variably in acromegalic group. For each acromegalic patient enrolled, the subsequent non-acromegalic patient with pituitary tumor was also enrolled to serve as a control. Pre-operative airway assessment was performed by two experienced anesthesiologists and involved a MMP with patient sitting with the head in neutral position without phonation and then the EMS with head in full extension, as described in literature.[5] We excluded edentulous patients and those with associated cervical spine disease. The view on MMP and EMS was graded as follows: Class I = soft palate, fauces, uvula, and pillars visible; class II = soft palate, fauces, and uvula visible; class III = soft palate and base of the uvula visible; class IV = soft palate not visible at all.[1]

Airway management plan for each patient was left to the discretion of the attending anesthesiologist who performed independent pre-operative assessment. Standard monitoring prior to induction included electrocardiogram, non-invasive blood pressure, and pulse oximetry. After pre-oxygenation, general anesthesia was induced with fentanyl (2 mcg/kg) and propofol (1.5-2 mg/kg). Oropharyngeal airway and/or two-hand mask hold was used to facilitate mask ventilation, when required. Rocuronium (1 mg/kg) was administered to facilitate tracheal intubation. After loss of all four twitches on the train-of-four obtained by ulnar nerve stimulation at the wrist, laryngoscopy was performed by one of the two attending anesthesiologists, using an appropriately sized Macintosh laryngoscope blade and the laryngeal view was classified according to the method of Cormack and Lehane (Grade I = full view of the glottis, grade II = glottis partly exposed, anterior commissure not seen, grade III = only epiglottis seen, or grade IV = epiglottis not seen).[14] External laryngeal pressure was not applied while reporting the initial laryngeal view. However, it was allowed thereafter on instruction of the laryngoscopist in patients with initial laryngeal view grades III and IV. Both, MMP and EMS grades III and IV were considered predictors of difficult laryngoscopy, which was defined as Cormack-Lehane (CL) grades III or IV (before external laryngeal manipulation ELM). Intubation was defined as difficult if it required more than two attempts, change of blade, or use of a gum-elastic bougie/fiber optic bronchoscope/intubating Laryngeal Mask Airway.

The pre-operative assessment data were used to determine the accuracy of the two tests in predicting difficult intubation. Several statistical measures were calculated that have been frequently used and are provided in Appendix 1. Most of these measures could be easily calculated using the 2 × 2 table. Statistical analysis was done using software STATA 9.1 (College Station, Texas, USA). Data are presented as mean (standard deviation, SD), number or percentage. The demographic data were compared using two sample *t*-test with equal variance. The value of $P < 0.05$ was considered significant.

Results

A total of 78 patients participated in the study and one patient from control group was excluded from final analysis. In the control group, 39 patients were enrolled and one was excluded from final calculations because of inability to obtain CL grade. In the Acromegalic group, a total of 39 patients were enrolled and taken for analysis. The demographic details are shown in Table 1. MMP and CL grade of the patients are shown in Table 2. A total of eight patients in acromegalic group and six patients in control group had a difficult airway manifesting as grade III and IV on laryngoscopy without external laryngeal manipulations.

Incidence of class III, IV MMP assessment in normal and extended position was 18% and 31% in acromegalics. Incidence of difficult laryngoscopy assessed by CL grade was 20% in acromegalic group. The sensitivity of both the positions was equal (13%) whereas specificity for MMP and EMS was 81% and 65% respectively in acromegalics. Almost similar values of negative predictive value were obtained (78% for MMP and 74% for EMS) on contrary MMP was associated with higher positive predictive value (14%) as compared to EMS (1%) [Table 3]. The incidence of class III, IV MMP assessment in normal and extended position was 13% for both positions in control group. Incidence of difficult laryngoscopy as assessed by CL grade was 16% in control group. There was wide variation in sensitivity of both the positions. MMP had a sensitivity of 50% whereas EMS had a sensitivity of 0%. Specificity for MMP and EMS was 94% and 84% respectively in control group. Positive predictive value for MMP and EMS was 60% and 0% respectively, whereas

Table 1: Demographic deatils of the study groups mean (SD) or *n*

Parameters	Acromegalics *N*=39	Controls *N*=38	*P* value
Age (years)	37.3 (10.6)	40 (12.2)	0.34
Weight (kg)	71.3 (12.4)	69.7 (14.1)	0.6
M:F	19:20	17:21	

N=Number of patients, M:F=Male:Female ratio, SD=Standard deviation

Table 2: Relationship between modified Mallampati test and extended Mallampati score with Cormack-Lehane grading of laryngoscopic view in the two study groups

Variables	CL I, II (*n*)	CL III, IV (*n*)
Acromegalics		
MMP		
I, II (*n*=32)	25	7
III, IV (*n*=7)	6	1
EMS		
I, II (*n*=27)	20	7
III, IV (*n*=12)	11	1
Controls		
MMP		
I, II (*n*=33)	30	3
III, IV (*n*=5)	2	3
EMS		
I, II (*n*=33)	27	6
III, IV (*n*=5)	5	0

MMP=Modified mallampati test, CL=Cormack-lehane grade, n=Number of patients, EMS=Extended mallampati score

Table 3: Statistical terms used for modified Mallampati test and extended Mallampati score as predicting tests for difficult laryngoscopy (number or %)

Test	TP	FP	TN	FN	Se%	Sp%	PPV%	NPV%
Acromegalics								
MMP	1	6	25	7	13	81	14	78
EMS	1	11	20	7	13	65	01	74
Controls								
MMP	3	2	30	3	50	94	60	91
EMS	0	5	27	6	0	84	0	82

MMP=Modified mallampati test, EMS=Extended mallampati score, TP=True positive, FP=False positive, TN=True negative, FN=False negative, Se=Sensitivity, Sp=Specificity, PPV=Positive predictive value, NPV=Negative predictive value

negative predictive value associated with these positions was 91% and 82% [Table 3].

Discussion

The incidence of difficult intubation in general population has been described to be 5.8% in overall population, 6.2% for normal patients excluding obstetric and obese patients, 3.1% for obstetric patients and15.8% for obese patients by Shiga *et al.* in meta-analysis of bedside screening test performance. Mallampati test has been performed in with and without phonation and/or with different head or tongue positions in these studies, but despite theoretical arguments, this test has yielded poor to moderate sensitivity and moderate to fair specificity (moderate discriminative power). Pooled sensitivity of MMP is 49% and specificity being 86%, positive likelihood ratio 3.7, and negative likelihood ratio 0.5.[15] Diagnostic efficacy of these screening tests has been reported variously because of multiple factors like different patient characteristics, different test thresholds, inadequate statistical power and variable and low incidence of difficult intubation. It is virtually impossible to accurately predict difficult intubation.[16] In our study, incidence of class III, IV MMP assessment in normal and extended position was 13% for both positions in control group. Incidence of difficult laryngoscopy assessed by CL grade was 16% in control group. Heterogeneity in Mallampatti data has been reported with likely reasons being inconsistency and uncertainty in performing these tests.

The incidence of difficult laryngoscopy and intubation is higher in acromegalics than general population. The incidence of difficult intubations in acromegalics in two retrospective studies has been described as 12 and 30/100 patients.[17,18] In a study by Schmidt *et al.* incidence of difficult intubation was 10%. They defined difficult intubation as greater than two attempts at intubation, use of gum elastic bougie or change of laryngoscope blade. They reported 26% incidence of difficult laryngoscopy grade (CL III) but with application of ELM, it decreased to 10%. None of their patients had CL IV laryngoscopy grade.[2] In our study, the incidence of class III, IV MMP assessment in normal and extended position was 18% and 31% in acromegalics. Incidence of difficult laryngoscopy as assessed by CL grade (III, IV) was 20% in our study. The discrepancy may be because of the degree of acromegaly which may have led to more difficult airway.

Multiple bed side tests have been proposed for anticipation of difficult laryngoscopy and intubation, most common being the MMP. Recently, the upper lip bite test has also been used and compared with MMP to predict difficult laryngoscopy in acromegalic patients.[19] So far these tests have reported poor to moderate (20-62%) sensitivity with moderate to fair specificity (82-97%) as described by Shiga *et al.* in their meta-analysis of 35 studies enrolling 50,760 patients. The diagnostic accuracy of these tests varies from trial to trial because of inter-observer differences, different test thresholds, inadequate statistical power and racial variation. The pooled sensitivity of MMP has been described 41-57%, pooled specificity is 81-90%.[15] Difficult intubation has been described variously as number of attempts at intubation, use of additional airway devices or difficult laryngoscopy grade (CL III, IV). We considered CL III/IV grades as difficult intubation.

It has been suggested that craniocervical extension relates to mouth opening and limited head and neck mobility can result in poor MMP as mouth opening is limited and submaximal in neutral position.[3,4] Mashour *et al.* found that application of craniocervical extension improves the specificity and predictive value of Mallampati airway evaluation. The sensitivity of two

positions was 83% whereas addition of craniocervical junction increased the specificity from 70% to 80%. Positive predictive value was better with described maneuver.[5,6] We found a sensitivity of 50 and 0% in normal and extended position in control group while the values for acromegalics were 13% in each position. The specificity 94% and 84% was seen in normal and extended position in control group while values were lower in acromegalic group (81% in neutral position and 65% in extended position). Addition of neck extension did not improve the predictive value of MMP, which may be ascribed to the racial variation in the studied population, small sample size, or inter observer variability and criteria for difficult intubation. These could also be considered a limitation of our study.

Conclusion

Despite theoretical arguments that craniocervical extension relates to mouth opening and limited head and neck movement may restrict mouth opening, we were not able to find any additional benefit of neck extension while doing MMP for pre-operative assessment of airway in either control or acromegalic group. Currently available bed side screening tests for difficult airway have poor to moderate diagnostic value when used alone. Hence, combination of tests should be used until an ideal test is formulated.

Appendix 1

Statistical terminology

True positive (TP) = a difficult intubation that had been predicted to be difficult

False positive (FP) = an easy intubation that had been predicted to be difficult

True negative (TN) = an easy intubation that had been predicted to be easy

False negative (FN) = a difficult intubation that had been predicted to be easy

Sensitivity = The percentage of correctly predicted difficult intubations as a proportion of all intubations that were truly difficult, i.e., TP/(TP + FN)

Specificity = percentage of correctly predicted easy intubations as a proportion of all intubations that were truly easy, i.e., TN/(TN + FP)

Positive predictive value = The percentage of correctly predicted difficult intubations as a proportion of all predicted difficult intubations, i.e., TP/(TP + FP)

Negative predicted value = The percentage of correctly predicted easy intubations as a proportion of all predicted easy intubations, i.e., TN/(TN + FN)

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