www.jmscr.igmpublication.org
Impact Factor (SJIF): 6.379
Index Copernicus Value: 79.54
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossrefDOI: https://dx.doi.org/10.18535/jmscr/v6i10.24

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Original Research Article

Comparative evaluation of the Modified Mallampati Score (MMC) and Modified Mallampati Score along with Thyromental distance, Anatomical abnormality, and Cervical mobility (M-TAC) in predicting difficult airway

Authors
Dr Aradhana Arya[1], Dr Lalit Mohan[2*], Dr Urmila Palaria[3], Dr A. K. Sinha[4], Dr Bikramjit Das[5], Dr Rajan Yadav[6], Soorej Balan[7]
[1,5]Assistant Professor, Department of Anaesthesiology, Govt Medical College, Haldwani, Uttarakhand
[2]Senior Resident, Department of Radiotherapy, Govt Medical College, Haldwani, Uttarakhand
[3]Professor, Department of Anaesthesiology, Govt Medical College, Haldwani, Uttarakhand
[4]Associate Professor, Department of Anaesthesiology, Govt Medical College, Haldwani, Uttarakhand
[6]Senior Resident, Department of Radiotherapy, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow
[7]Senior Resident, Department of Radiotherapy, Institute Rotary Cancer Hospital, All India Institute of Medical Sciences, New Delhi
*Corresponding Author
Dr Lalit Mohan
Senior Resident, Department of Radiotherapy, Govt Medical College, Haldwani, Uttarakhand, India
Email: *contactdrlalit@gmail.com*

Abstract
Background: *The MMC has been found to be of limited value and cannot be relied on for using in predicting difficult airway. Thus, we used a combination of multiple tests (combining MMC with Thyromental distance, Anatomical abnormality and Cervical mobility [M-TAC]to provide a high index of sensitivity and specificity for prediction of difficult airway.*
Methodology: *Two hundred patients, scheduled for general anaesthesia (GA) requiring endotracheal intubation for elective surgical procedures were evaluated in this prospective, double blind, case control study. Airway assessment was done first by MMC and then by combination of tests (M-TAC). Anaesthesiologists assessing and managing airway were different and blinded for airway parameter. Difficult intubation was assessed by modified Cormack and Lehane grading (CL) and correlated with pre-operative airway assessment. Patients, failed to be intubated, were intubated by different methods and excluded from the study.*
Results: *Our results showed that M-TAC in comparison to MMC had higher sensitivity (96.29% vs 74.07%), specificity (81.50% vs 73.41%), positive predictive value (PPV) (44.83% vs 30.30%). and negative predictive value (NPV) (99.30%vs 94.78%). The odd's ratio (114.60, (95% CI14.99 to 875.64 vs 7.89, 95% CI) was3.130 to 19.882, positive likelihood ratio (LR) was (1.20 vs 1.02), negative LR(1.17 vs 0.99) in predicting difficult airway.*
Conclusion: *M-TAC, as pre operative assessment test gives better prediction of difficult airway and therefore decreases the adverse outcome incidence related to unanticipated difficult airway though requires precision and time.*
Keywords: *endotracheal intubation, laryngoscopy, airway management, general anaesthesia.*

Introduction

Several risk factors for assessing airway difficulties have been identified, yet none have convincing diagnostic accuracy when using in isolation. Combining several risk factors increases the predictive value of the tests, therefore, multivariable risk models for difficult laryngoscopy and intubation have been developed, to provide a high index of sensitivity and specificity for prediction of difficult airway.

Mallampati *et al*. introduced a scoring system based on the visibility of the oropharyngeal structures,[1] and still today remains the most useful clinical assessment method for predicting difficult intubation worldwide, but accuracy of this has been questioned a number of times.

We hypothesized that M-TAC would have better predictive value than MMC in predicting difficult airway.

Methodology

After obtaining clearance from Institutional Ethics Committee, two hundred patients, scheduled for (GA) requiring endotracheal intubation for elective surgical procedures, were enrolled in this prospective, double blinded, case control study .Inclusion criteria were American Society of Anesthesiologists (ASA) physical status I or II and adult patients aged 18-60 years. Exclusion criteria were patient's refusal, ASA physical status III and IV, cervical spine disorder, obstructive airway tumour, edentulous/ irregular dentition, past history of difficult laryngoscopy & intubation, pregnancy, trauma to the airways or cranial, cervical & facial regions, burns to airways & adjacent structures, mouth opening<3 cm, age <18 years &> 60 years. This study was done as per Helsinki Declarations and it was registered in Clinical Trials.gov under registration number NCT02705794.

MMC is a classification of oropharyngeal view where we assessed the size of tongue in relation to oral cavity. While being seated, each patient was asked to open his or her mouth wide and protrude the tongue maximally without phonation. MMC was classified as-Class 0- soft palate, uvula, fauces, tonsillar pillars, epiglottis, class 1 - soft palate, uvula, fauces, tonsillar pillars, class 2- soft palate, uvula, fauces, class 3- soft palate and base of uvula, class 4-soft palate not visible and each class was given a score which was equal to the respective class i.e, class 1 had score 1.

M-TAC consists of MMC and additionally three parameters

Thyromental distance (T) was measured along a straight line from the thyroid notch to the lower border of the mandible (mentum), with the head fully extended and the mouth closed. Thyromental distance (TMD) was classified as Class 0- ≥6.5cm, class 1- 5.5cm-6.4cm , class 2- <5.5cm and each class was given a score which was equal to the respective class i.e, class 1 had score 1.

Anatomical abnormality (A) assessed the anatomical abnormalities of face neck or oral cavity. It was classified as Class 0- No abnormality, class1- Protruding upper incisors or macroglossia or high arched palate, class 2- Micrognathia or inability to align lower with upper incisors and each class was given a score which was equal to the respective class i.e, class 1 had score 1.

Cervical mobility range (C) - the range of cervical mobility was evaluated according to the method suggested by Wilson et al[11] Patients were asked to extend the neck fully and a pencil was placed vertically on the forehead. While the pencil was held firmly in position, the neck was flexed and the angle was measured. It was classified as class 0 - ≥80◦, class 1- 60◦ - 80◦, class 2 - <60◦ and each class was given a score which was equal to the respective class i.e, class 1 had score 1.

Three anaesthesiologists participated in this study; one performed pre-anaesthetic assessment of the airway in the pre-anaesthesia clinic, and two performed laryngoscopy under GA (having >5 years experience of GA with endotracheal intubation). All information inrelation to the pre-anaesthetic check up was shared between the anaesthesiologists, except for the data relating to

airway evaluation specific to this study and M-TAC scoring.

Inside operating room, standard fasting guidelines were confirmed and venous access was established. Non-invasive monitoring including (use full form) was initiated. All patients were premedicated with intravenous (IV). Dexamethasone 8mg, Glycopyrrolate 0.01mg/kg, Midazolam 0.05mg/kg and Fentanyl 2 mcg/kg

Following preoxygenation for 3 minutes, anaesthesia was induced with IV Propofol 2mg/kg and succinylcholine 1.5mg/kg. Laryngoscopy was performed in sniffing position using a Macintosh laryngoscope and the best possible laryngoscopic view was obtained after confirmation by a second anaesthesiologist. In event of disparity regarding CL grading among fellow anaesthesiologist case was excluded from the study.

Maintenance of anaesthesia was done with oxygen, nitrous oxide and isoflurane & muscle relaxation with IV vecuronium 0.1mg/kg After completion of surgery anaesthesia was reversed with IV neostigmine 0.05mg/kg & glycopyrrolate 0.01mg/kg Patient was extubated when fully awake and responding to commands.

Difficult laryngoscopy was defined as the view observed corresponding to Grade 3 or 4 of the CL laryngoscopic view[23]. Three attempts at endotracheal intubation were allowed before the act was considered as a failure. In this situation, the participants followed the next step of the ASA difficult airway algorithm using the secondary intubationplan. If the airway could not be secured even with these, laryngeal mask airway (LMA) and other efforts to maintain ventilation and oxygenation were used.

Sensitivity of M-TAC score in a previous study was 96%[18]. Considering 25% difference between M-TAC & MMC and taking alpha error 0.05 and power of the study 80%, we calculated 196 patients were required for the study. So, we recruited a total of 200 patients. The data obtained from the200 patients entered in Microsoft excel sheet, checked for missing errors using SPSS v18 . For continuous variables the unpaired student's t -test is used whereas chi- square test is used for categorical data. The Receiver operating characteristic (ROC) curve is used to find the accuracy of both the screening tests like MMC & M-TAC in finding the difficult laryngoscopy.

Results

A total of 233 patients were recruited for the study, out of which 8 didn't give consent for the study, 7 had cervical spine disorders, 8 were edentulous, 4 had burns to airway/ surrounding structure, 6 had trauma to the airways so were excluded from the study.

Finally a total of 200 patients (108 males and 92 females) were analyzed. The baseline character-istics of both the groups (MMC & M-TAC) were comparable in terms of age, weight, sex, proportion of ASA physical status. (Table 1)

The difficult intubation occurred in 13.5% (n=27) as compared to easy intubation in 86.5% (n=173). (Table 1).

In MMC class the number of patients with score 3 (n=51) & 4 (n=15) with presumed difficult laryngoscopy only 17.65% (n=9) and 73.33% (n=11) had difficult laryngoscopy as confirmed by CL view, respectively. Whereas the score of 4 (n=23) & 5 or more (n=35) in M-TAC class which were predicted to be difficult, only 6 (26.09%) and 20 (57.14%) patients respectively were truly difficult by CL grade 3& 4. (Table 2) (fig 1).

The sensitivity (96.29%) and specificity (81.50%), positive predictive value (44.83%) and negative predictive value (99.30%) of M-TAC ≥4 were more in comparison with M3 and M4 in predicting difficult laryngoscopy. (Table 3 & 4)

Further, The odds ratio of M-TAC test is also more than MMC test (7.89 vs 114.60).The applicability of both the screening tests, in the presumptive diagnosis of patients having difficult laryngoscopy illustrated by using ROC curve (receiver observer characteristics curve) shows the area under the curve (AUC) for both the tests is more than 0.5. The M-TAC test is comparatively a better test in detecting difficult laryngoscopy in the patients as the AUC is more

in M-TAC i. e. 0.933 than in MMC test i. e. 0.811. (fig 2, fig 3).

Table 1: Comparison of demographic & clinical parameters between the easy & difficult intubation groups Data are presented as mean (SD) or number

Parameters	easy intubation group(CL 1 &2) (n=173)	difficult intubation group (CL 3 &4) (n=27)	P value
Age (in years)	33.26 ± 12.22	33.15 ± 11.91	0.965*
Weight (kg)	56.25 ± 10.46	58.26 ± 12.38	0.367*
Sex (M/F)	92/81	16/11	0.555†
ASA-I/II	99/74	10/17	0.05†

*unpaired student t test, †chi square test

Table 2: Distribution of patients according to scoring parameters (Modified Mallampati class & M-TAC score) and Cormack- Lehane grading, Data are presented as number or number %.

Scoring parameters	Total no. of patients	CL-1& CL-2 (%)	CL-3 & CL-4 (%)
MMC			
0	0	0	0
1	37	37 (100)	0 (0)
2	97	90 (92.7)	7 (7.22)
3	51	42 (82.3)	9 (17.65)
4	15	4 (26.6)	11 (73.33)
M-TAC	Total no. of patients	CL-1& CL-2 (%)	CL-3 & CL-4(%)
0	0	0	0
1	36	36 (100)	0
2	69	69 (100)	0
3	37	36 (97.3)	1 (2.70)
4	23	17 (73.9)	6 (26.09)
5 or more	35	15 (42.8)	20 (57.14)

Table 3: Accuracy/Validity of the Modified Mallampati Score in detecting difficult intubation

Anticipated intubation by MMC	Confirmed intubation by CL method		Total
	Difficult (CL-III/IV)	Easy (CL-I/II)	
Difficult (MMC 3or 4)	20 (TP)	46 (FP)	66
Easy (MMC 0 or 1 or 2)	7 (FN)	127 (TN)	134
Total	27	173	200
Sensitivity = 74.07%			
Specificity = 73.41%			
Positive predictive value (PPV) = 30.30%			
Negative predictive value (NPV) = 94.78%			
Positive (+) likelihood ratio (LR+) =1.02			
Negative (-) likelihood ratio (LR -) = 0.99			
Odd ratio (OR) = 7.89, 95% C.I is 3.130 to 19.882			

*TP is true positive, FP is false positive, FN is false negative, TN is true negative

Table 4: Accuracy of the M-TAC screening test in detecting difficult intubation

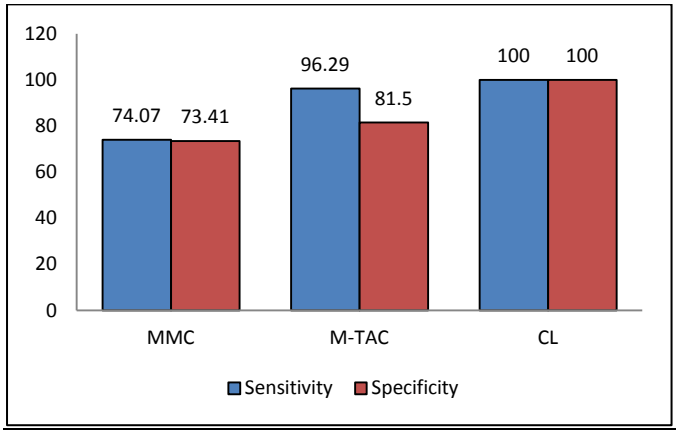
Anticipated intubation by MTAC test	Confirmed intubation by CL method		Total
	Difficult (CL-III/IV)	Easy (CL-I/II)	
Difficult (≥ 4 score)	26 (TP)	32 (FP)	58
Easy (< 4 score)	1 (FN)	141 (TN)	142
Total	27	173	200
Sensitivity of M-TAC = 96.29%			
Specificity of M-TAC = 81.50%			
Positive predictive value (PPV) = 44.83%			
Negative predictive value (NPV) = 99.30%			
Positive (+) likelihood ratio (LR+) = 1.20			
Negative (-) likelihood ratio (LR -) = 1.17			
Odd ratio (OR) = 114.60, 95% C.I is 14.99 to 875.64			

*TP is true positive, FP is false positive, FN is false negative, TN is true negative

Table 5: Applicability of screening tests in diagnosing difficult laryngoscopy using ROC curve

Screening tests	AUC	P value
MMC test	0.811	0.001
M-TAC test	0.933	0.001

Fig 1: Accuracy of MMC and M-TAC compared to Cormack-Lehane grading in terms of Sensitivity & Specificity.



x- axis shows - various groups and y- axis shows - %

Fig 2: ROC curve obtained when MMC is used as screening test for predicting laryngoscopy

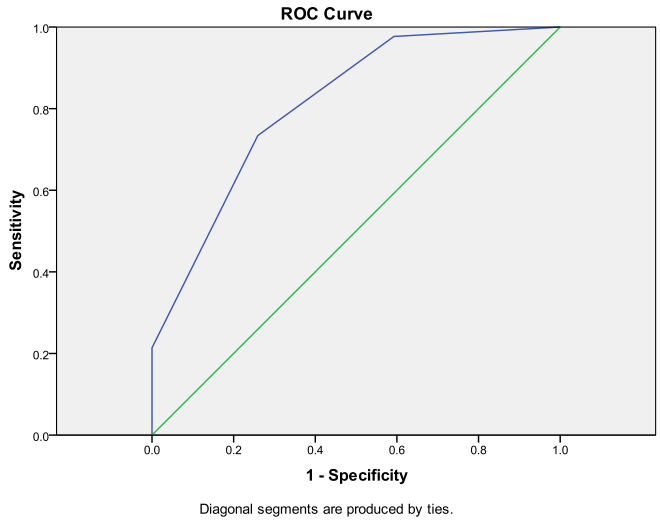
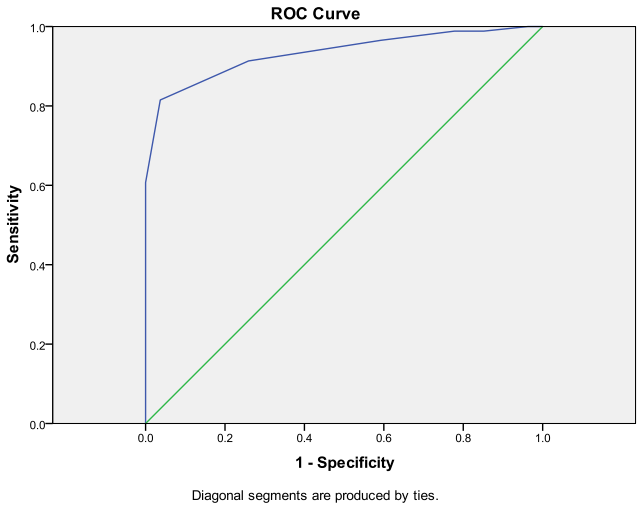


Fig 3: ROC curve obtained when MTAC is used as screening test for predicting difficult laryngoscopy



Discussion

The incidence of difficult laryngoscopy is various studies were of the order of 1.3%- 13% [1-5] depending on the criteria used to characterize it. Apparently, no clinical test; the MMC being no exception, can meet these criteria when used alone. Effective and reliable prediction requires a combination of several parameters e.g. age, height, weight, BMI, MMT, head and neck movement, dentition status, upper lip bite test, inter-incisor gap and TMD which increases accuracy but at the cost of time.

We considered three airway parameters along with MMC. TMD, that singly has been advocated as a screening test for predicting difficult laryngoscopy.[6] A number of studies defined TMD < 7 cm a predictor of difficult intubation. Schmitt HJ et al found that the TMD when used alone, is unreliable, [7]which was supported by other studies also.[8], [9]. Other parameters which affect laryngoscopy are anatomical abnormality of head, neck and face and cervical mobility, which had been taken into account in several studies. [2], [10], [11].Movement of the cervical spine is an important component of direct laryngoscopy and tracheal intubation. The best position for direct laryngoscopy requires 35^0 neck flexion and face plane extension to 15^0.[12] The MMC,TMD and

mouth opening are all impaired by cervical spine limitation, which suggests the importance of adequate neck movement when predicting difficult tracheal intubation.[13]

In this study, when we used MMC as a single predictor of difficult laryngoscopy and intubation, sensitivity of MMC scoring system was 74.07% which was less than the study done by Khan et al(82.4%),[14] Mahmoodpoor et al(98.40%)[15] butmore than that of Bilgin et al(43%),[16] R Bhat (59%)[17] and was comparable with many other studies done by Mallampati et al(71%),[1] Ambesh et al(72%). [18]The specificity of MMC in our study was 73.41% which was more than that of Khan et al(66.8%),[14] and less than that of Mallampati et al(89%),[1] R Bhat (83.5%) [17]and comparable to Ambesh et al (78%).[18] This wide variation in reported sensitivity and specificity in various studies [19] including this study could be explained on the basis of inter observer variability and patients factors. As the visibility of the oropharyngeal structures depend on the patient's position during examination.

Traditionally, the diagnostic accuracy of a predictive test is denoted by sensitivity and specificity. High sensitivity and specificity would indicate a good predictive test. In this study it was found that although MMC and M-TAC had significant p –value ($p< 0.05$) indicating both were reliable predictors of difficult laryngoscopy but on comparison M-TAC proved to be superior as sensitivity, specificity, PPV, NPV were greater than of MMC. The PPV of M-TAC, 44.83%, which was consistent with various other studies[14], [20]. The odd's ratio of M-TAC was 15 times greater than MMC (114.6% vs 7.89%). That signified predicting difficult airway using M-TAC was 15 times more than that of MMC, which has been confirmed in other studies.[18]

The above fact is also supported by the ROC curve analysis. As the area under curve (AUC)for both the tests is more than 0.5, both the tests are useful in diagnosing difficult laryngoscopy. The M-TAC test is comparatively better than MMC in detecting difficult laryngoscopy as the AUC is more in M-TAC

The limitation of the study was that despite standardization of factors the incidence of difficult laryngeal view (DLV) was 13.5%, which is comparable with some of the other studies.[1],[5] The possible explanation can be involvement of different anaesthesiologists for airway assessment and laryngoscopy and BMI.[21,22].Body mass index and height were not included in the study.

So, we concludedthat, M-TACis a better predictor of difficult laryngoscopy when used as a bedside screening test in general population. Therefore, we suggest that M-TAC may be used instead of MMC alone as this will aid anaesthesiologists to be prepared for management of a difficult airway and therefore will decrease the adverse outcome incidence related to unanticipated difficult airway. Nevertheless, large multicentrictrialin different populations is yet to be performed to claim for the documentation of our results.

References

1. Mallampati SR, Gatt SP, Gugino LD, Waraksa B, Freiburger D, Liu PL. A Clinical sign to predict difficult intubation; A prospective study.Can Anaesth Soc J 1985; 32: 429-434.
2. Wilson ME, Spiegelhalter D, Robertson JA, Lesser P. Predicting difficult intubation. Br J Anaesth.1988 Aug;61 (2):211-6.
3. 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.
4. Yamamoto K, Tsubokawa T, Shibata K, Ohmura S, Nitta S, Kobayashi T. Predicting difficult laryngoscopy with indirect laryngoscopy. Anesthesiology. 1997;86:316 21.

5. Krobbuaban B, Diregpoke S, Kumkeaw S, Tanomsat M. The predictive value of the height ratio and thyromental distance: four predictive tests for difficult laryngoscopy. Anesth Analg. 2005 Nov;101(5):1542-5.
6. Patil VU, Stehling LC, Zauder HL. Predicting the difficulty of intubation utilizing an intubation guide. Anaesthesiology, 1983; 10: 32.
7. Schmitt HJ, Kirmse M, Radespiel-Troger M. Ratio of patient's height to thyromental distance improves prediction of difficult laryngoscopy. Anaesth Intensive Care. 2002 Dec;30(6):763-5
8. Butler PJ, Dhara SS. Prediction of difficult laryngoscopy: an assessment of thyromental distance and Mallampati predictive tests. Anaesth Intensive Care 1992;20:139e42
9. Jimson CT, Eric BR, hussain A. Predicting difficult airway in surgical patients scheduled for general anaesthesia: A prospective blind study. Anesth Analg 1995;81:254-258
10. El-Ganzouri AR, McCarthy RJ, Tuman KJ, Tanck EN, Ivankovich AD. Preoperative airway assessment: predictive value of a multivariate risk index. Anesth Analg. 1996 Jun;82(6):1197-204
11. Bilgin H, Ozyurt G. Screening tests for predicting difficult intubation. A clinical assessment in Turkish patients. Anaesth Intensive Care. 1998;26(4):382-6.
12. Greenland KB. Airway assessment based on a three column model of direct laryngoscopy. Anaesth Intensive Care. 2010 Jan;38(1):14-9
13. Cook TM, Woodall N, Frerk C. Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 1: anaesthesia. Br J Anaesth. 2011 May;106(5):617-31
14. Khan ZH, Gharabaghian M, Nilli F, Ghiamat M, Mohammadi M. Easy endotracheal intubation of a patient suffering from both Cushing's and Nelson's syndromes predicted by the upper lip bite test despite a Mallampati Class 4 airway. Anesth Analg. 2007 Sep;105 (3):786-7.
15. Mahmoodpoor Ata, Soleimanpour Hassan,Jafar panahi Rahimi, et al. Sensitivity of Palm Print, Modified Mallampati Score and 3-3-2 Rule in Prediction of Difficult Intubation. Int J Prev Med. 2013 September; 4(9): 1063–69.
16. Bilgin H, Ozyurt G. Screening tests for predicting difficult intubation. A clinical assessment in Turkish patients. Anaesth Intensive Care. 1998;26(4):382-6.
17. Bhat RR, Kumar Miashra, Badhe AS. Comparison of upper lip bite test and modified mallampati classification in predicting difficult intubation. Internet J Anesthesiol 2007;13(1)
18. Ambesh S , SinghN, Rao P , Gupta D 1et al. A combination of the modified Mallampati score, thyromental distance, anatomical abnormality, and cervical mobility (M-TAC) predicts difficult laryngoscopy better than Mallampati classification. Acta Anaesthesiologica Taiwanica 2013;51: 58-62.
19. Adamus M, Jor O, Vavreckova T, Hrabalek L, Zapletalova J, Gabrhelik T, et al. Inter-observer reproducibility of 15 tests used for predicting difficult intubation. Biomedical Papers of the Medical Faculty of Palacky University in Olomouc, Czech Republic. 2011;155 (3):275-81.
20. Naguib M, Scamman FL, O'Sullivan C, Aker J, Ross AF, Kosmach S, et al. Predictive performance of three multivariate difficult tracheal intubation models: a double-blind, case-controlled

study. Anesth Analg. 2006 Mar;102 (3):818-24

21. Wilson ME, Spiegelhalter D, Robertson JA, Lesser P. Predicting difficult intubation. Br J Anaesth.1988 Aug;61 (2):211-6.
22. Adamus M, Jor O, Vavreckova T, Hrabalek L, Zapletalova J, Gabrhelik T, et al. Inter-observer reproducibility of 15 tests used for predicting difficult intubation. Biomedical Papers of the Medical Faculty of Palacky University in Olomouc, Czech Republic. 2011;155 (3):275-81.
23. Cormack RS, Lehane J: Difficult tracheal intubation in obstetrics. Anaesthesia 1984; 39:1105-1111.