



An evaluation of impact of anaesthesiologist's experience on prediction of difficult airway

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Abstract

Background: This study evaluated impact of Anaesthesiologist's Experience on prediction of difficult airway using standard assessment tools.

Methods: 700 patients scheduled to undergo surgery under General Endotracheal Anaesthesia (GETA) were included in the study. Patients were randomly divided into two groups. In group I airway assessment was done by resident anaesthesiologists (with at least 2 years of experience) and in group II airway assessment was done by a consultant anaesthesiologist (> 5 years of experience) using Mallampati scoring system and LEMON scoring system. Airway was graded as difficult or not difficult. The actual presence/ absence of a difficult endotracheal intubation were reported by a consultant anaesthesiologist unaware of the prediction. These findings were compared to the pre anaesthetic evaluation finding to determine correct/incorrect prediction of difficult airway. Sensitivity, specificity, positive predictive value, negative predictive value and Youden index were determined for all tests.

Results: Difficult tracheal intubation occurred in 3% (21 patients) case and no failed intubation occurred. Group I had Sensitivity 55.56%, specificity 97.95%, PPV 64.29%, YOUDEN index 0.54, ODD'S ratio 59.64 % while Group 2 had sensitivity of 64.29%, specificity of 98.51%, PPV 64.29% YOUDEN INDEX 0.63, ODD'S ratio 119.16.

Conclusions: The present study suggests that increased experience of the evaluating Anaesthesiologists enhances the accuracy of Mallampati test for predicting difficult intubation with higher sensitivity, PPV and YOUDENS index when compared to evaluation done by inexperienced Anaesthesiologists.

Keywords: anaesthesiologist experience, mallampatti grading, lemon scoring

1. Introduction

Although anaesthesia is widely recognised as the safest medical speciality, inadvertent errors often lead to catastrophic outcomes. One of the most common causes of anaesthesia related mortality is the presence of difficult mask ventilation and endotracheal intubation or both [1]. The ability to predict the difficult airway is therefore one of the best tools to prevent airway related complications as it alerts the user and helps in better planning and execution in securing the airway [2].

Several tools have been devised to predict difficult airway in the surgical population. Most of these depend upon the presence of a combination of various anatomical observations to arrive at a score that predicts the absence/presence of difficult airway. Though extensively used, there is scant literature on the impact of observers experience in interpreting these tools/scoring systems.

The current study was designed to evaluate the impact of anaesthesiologist experience in predicting a difficult airway based on commonly used scoring systems. We used Mallampati grading and Lemons scoring systems to evaluate the same in the present same study.

2. Materials and Methods

The present study was carried out in a tertiary care teaching hospital in Rajasthan over a period of 6 months. Prior to

recruitment of participants institutional ethical committee approval was taken and the study was registered in CTRI (CTRI/2018/12/016504). The present study was prospective randomised double blind cross sectional study. All ASA grade I to IV patients of either gender scheduled to undergo surgery under general endotracheal anaesthesia who reported to the pre anaesthetic check-up clinic of the hospital were considered for inclusion in the study. Prior to the study the patients were counselled in detail about the study and a written, informed consent was taken from all the willing participants. 800 such participants who satisfied the above criteria were recruited for the study. These were then randomly divided into two groups of 400 each using a computer generated table of random numbers in opaque sealed envelopes

Group 1 (Inexperienced): Airway assessment was done by resident anaesthesiologist (with at least 2 years of experience)

Group 2 (Experienced): Airway assessment was done by a consultant anaesthesiologist with more than 5 years of experience

The said assessment was done by using Mallampati scoring system³ and LEMON scoring system [4]. (Appendix 1) The examining anaesthesiologist then graded the airway as

difficult or not based on Mallampati grade III/IV and/or LEMONS score of >7.

Each of these patients were subsequently evaluated by senior consultant or anaesthesiologist with a minimum experience of more than or equal to 10 years for the presence or absence of a difficult airway. This consultant was unaware of group allocation of the participants. The actual diagnosis of a difficult airway was made in accordance with the difficult airway society guidelines (A difficult airway is defined as “a clinical situation in which a conventionally trained anaesthesiologist experiences difficulty with facemask ventilation of the upper airway, difficulty with tracheal intubation or both) [2]. These presence and absence was then compared to the prediction made in the pre anaesthetic examination and the probabilities of a correct prediction were calculated in the two groups.

2.1 Statistical Analysis

All frequencies were expressed as absolute numbers and percentages. Categorical variables were compared using a Pearson’s chi square test.

Based on the estimations in the pre-anaesthetic examination and the actual presence or absence of a difficult airway, two by two tables were constructed.

The sensitivity, specificity, positive predictive value, negative predictive value and odd ratio on Youden index was calculated for each scoring system and the overall assessment. The significant level was considered as P value < 0.05 (5%).

2.2 Sample Size

The study was powered at 80% with an α error of 0.05 to detect a difference of 20% in the positive predictive value between the two groups. Based on this, total of 350 patients were required in each group using a Altman’s normogram. To compensate for dropouts, we decided to include 400 patients in each group.

3. Results

Table 1: Showing actual difficult intubation v/s predicted difficult intubation in group I

Group I	Actual Difficult Intubation	
	Predicted Difficult Intubation	True Positives (5/12)
	False Negatives (3/338)	TRUE Negatives (335/338)

True positive (+) means the cases correctly predicted as difficult intubations. **True negative (-)** means the cases correctly predicted as easy intubations. **False negative (-)** means the cases not correctly predicted as difficult intubations. **False positive (+)** means the cases incorrectly predicted as difficult intubations

Table 2: Showing actual difficult intubation v/s predicted difficult intubation in group II

Group II	Actual Difficult Intubation	
	Predicted Difficult Intubation	True Positives (9/14)
	False Negatives (4/336)	True Negatives (332/336)

Table 3: Showing comparison between different measured values in Group I and Group II

	Sensitivity	Specificity	PPV	NPV	Youden Index
GROUP I	55.56%	97.95%	41.67%	98.82%	0.54
GROUP II	64.29%	98.51%	64.29%	98.51%	0.63

*PPV→Positive Predictive Value

*NPV→Negative Predictive Value

Group I had sensitivity of 55.56%,specificity of 97.95%,PPV of 41.67%,NPV of 98.82% YODEN INDEX of 0.54 whereas group II had sensitivity of 64.29%,specificity of 98.51%,PPV of 64.29%,NPV of 98.51% YODEN INDEX of 0.63

4. Discussion

The difficult airway represents a complex interaction between patient factors, the clinical setting and skills of the practitioner.

Prediction of a potentially difficult airway therefore becomes a touchstone in preventing the airway related complications. This can be done by means of clinical assessment and scoring systems. The advent of advanced imaging has resulted in massive improvements in prediction of difficult airway. However, the poor access to advanced technology in most parts of the world means that scoring system based on certain clinical criteria remain the most important tool to anticipate a difficult airway.

Several scoring systems have been proposed for evaluation of the difficult airway with varying degrees of success. A combination of multiple pre-operative scoring systems is deemed superior to using single systems in assessing the airway preoperatively [5].

Some of the popular indices that are needed to predict the difficult airway includes Thyromental distance, upper lip bite test, Mallampati score, Mouth opening 3-3-2 rule, Atlanto-occipital joint extension, Mandibular space, Inter-incisor distance, Mandibulo-hyoid distance, LEMON airway assessment method, Micrognathia, Prayers sign, Obesity and previous history of Sleep apnea. However, no single index can provide a high index of sensitivity and specificity for prediction of difficult airway therefore it has to be combination of multiple tests. It must be recognized, however, that some patients with a difficult airway will remain undetected despite the most careful preoperative airway evaluation.

The usefulness of any screening test or predictive score is defined by two variables. First is the ability to accurately predict the presence or absence of a particular condition based on the combination of one or more factors. The second equally important variable is the uniformity and reproducibility of the score. This means that the score should make the same assessment given the presence of the same variable each time that it is applied. Further this assessment should be reproducible across different assessing individuals. This aspect of reproducibility in terms of observers experience has not been studied till date. Therefore, we designed the present study to evaluate the experience of the anaesthesiologist in the interpretation of a combination of Mallampati Grading and LEMON scoring system in predicting difficult airway.

Patients in the difficult airway group have higher LEMON scores. Although we had planned to use a combination of both Mallampati and LEMON scores for the present study, we did not find any patient who was predicted as difficult airway based on LEMON score and therefore it was not possible to evaluate the effectiveness of LEMON scoring in the present study, the discussion that follows pertains to Mallampati scoring alone.

The absence of prior studies on the impact of experience on prediction of difficult airway mandated us to do a retrospective sub-group analysis of published literature in an attempt to compare and contrast our findings with the existing body of knowledge.

Sensitivity

In the current study, the prediction of Difficult Intubation by Mallampati had a sensitivity of 55.56% in Group I as compared to 64.29% in Group II (Table 3). It is apparent that the sensitivity which is a measure of detecting possible outcomes is greater amongst the experienced Anaesthesiologist. Our results compared well with those of Basunia *et al.* [6], Adamus *et al.* [7] and D. Savva [8] who have reported a sensitivity of 62.5%, 64.6%, 64.7% respectively. It needs to be noted that while these figures replicate those of Group II in present study, sensitivity of Group I was much lesser (55.56%). Further SAVVA's study was the only one in which one of the three assessors was inexperienced. However, the contribution of these inexperienced observers has not been elaborated by SAVVA.

The sentinel paper by Mallampati *et al.* [9] has reported a sensitivity of 50%. This might be because of the "newness" of the test and the fact that only six of the twenty two assessors were consultants.

Specificity

The specificity of a diagnostic test is a reflection of its ability to accurately predict the outcome in all the evaluated subjects. We found a specificity of 97.95%, 98.5% in group I and Group II respectively (Table 3). Our results are in agreement with those of Basunia *et al.* [6] (93.4%), Domi *et al.* [10] (97%) and Patel *et al.* [11] (93%). Patel *et al.* have also reported that addition of Thyromental distance, Sternomental distance parameters did not increase the specificity while increasing the sensitivity from 28.6% to 100%. They have not specified the experience, qualification of the assessing Anaesthesiologist in their study.

Therefore it is reasonably safe to derive that the specificity of Mallampati Grading is not affected by experience or addition of further tests.

Predictive values

The present study had almost similar Negative predictive values of 98.82% and 98.51% in Group I and Group II respectively (Table 3). These results are in agreement with those of Adamus *et al.* [7], Aswini *et al.* [12] and Mallampati *et al.* who have reported Negative predictive values of 98.6%, 94.1%, and 98.4% respectively.

The Positive predictive values of Group II was 64.29% much higher than Group I (41.67%) further stressing that the experience of the evaluating Anaesthesiologist plays a major part when Mallampati grading is used to predict Difficult Intubation. Domi R [10] evaluated 426 ASA I and ASA II patients more than 14 years old who underwent

general anaesthesia for prediction of Difficult Tracheal Intubation. He used Mallampati score, Thyromental distance, Sternomental distance, previous history of Difficult intubation, Inter-incisor distance, Delilkan test, Lower jaw protrusion test, Neck Movement, Lower jaw length, BMI, and Wilson's score. He reported a Positive predictive value of 75% for Mallampati score which is comparable with our results for Group II. All the assessments in Domi's study were done by a senior Anaesthesiologist similar to the assessment in Group II of our study.

Aswini B *et al.* Evaluated 305 patients by Mallampati grading, Thyromental distance, Sternomental distance and various combinations thereof. They have reported a Positive predictive values of 34.4% which is comparable with that of Group I in our study. Similar results have been reported by Mahmoodpoor *et al.* [13].

Youden index

It combines both sensitivity and specificity as a way of summarising the performance of diagnostic test. Value ranges from 0 to 1. Value of 1 indicates a perfect test while 0 indicates a useless test. YOUDEN index is unique as it gives the probability of an informed decision and takes into account all prediction.

In the current study the YOUDEN index was 0.54 and 0.63 for Group I and Group II respectively which implies that the "informedness" of the Mallampati score is significantly higher when carried out by experienced versus inexperienced Anaesthesiologist.

5. Limitations and future directions of our study

The present study was carried out in a single centre with 700 patients. Due to this a larger number of Anaesthesiologists could not be enrolled for evaluating the patients. A larger prospective, Multicentric trial is warranted to corroborate or reflect our results.

6. Conclusion

The present study suggests that increased experience of the evaluating Anaesthesiologists enhances the accuracy of Mallampati test for predicting difficult intubation with higher sensitivity, PPV and YOUDEN'S index when compared to evaluation done by inexperienced Anaesthesiologists

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7. References

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