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Comparison between Lower Jaw Protrusion Maneuver and Mallampati Classification for prediction of difficult laryngoscopy and intubation - A cross sectional study

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Abstract

Introduction: Maintenance of patent airway in an anaesthetised patient is the prime responsibility of an anaesthesiologists. Various anatomical measurements, tests, protocols, algorithms, and different combinations of tests for airway assessment have been developed to predict difficult laryngoscopy and intubation, but difficult intubation and laryngoscopy always remains a primary concern for anaesthesiologists. The objective of this study was to compare Mallampati classification with lower jaw protrusion (LJP) maneuver in predicting difficult laryngoscopy and intubation.

Materials and Methods: In the present study 350 patients were included scheduled for elective surgeries under general anaesthesia requiring oral endotracheal intubation. All the patients underwent Mallampati classification and LJP maneuver for their airway assessment. After a standardized technique of induction of general anaesthesia, primary anaesthesiologists performed laryngoscopy and graded it according to the grades described by Cormack and Lehane. Sensitivity, specificity, accuracy, and positive predictive value (PPV) and negative predictive value (NPV) were calculated for both these tests using conventional laryngoscopy as gold standard.

Results: Lower jaw protrusion maneuver had higher sensitivity (94.03 % vs. 91.94%), specificity (86.67% vs 46.67 %), PPV (99.37 % vs 97.47%), NPV (39.39% vs 20.59%) and accuracy (93.71% vs 90%) when compared to Mallampati classification in predicting difficult laryngoscopy and intubation.

Conclusion: The study recommends that non-invasive and easily practice able LJP maneuver should be routinely practiced in pre-anaesthetic airway assessment protocol along with Mallampati classification for prediction of difficult laryngoscopy and intubation.

Keywords: lower jaw protrusion maneuver, Mallampati classification, difficult intubation

Introduction

Maintenance of patent airway in an anaesthetised patient is the prime responsibility of an anaesthesiologists. Unanticipated difficult laryngoscopic tracheal intubation remains a primary concern of anesthesiologists (1). Difficult intubation and laryngoscopy always remain a primary concern for anaesthesiologists. The reported incidence of a difficult laryngoscopy or endotracheal intubation varies from 1.5% to 13% in patients undergoing surgery (2). Because of the potentially serious consequences of failed tracheal intubation, considerable attention has been focused on attempts to predict patients in whom laryngoscopy and intubation will be difficult (3). Variety of anatomical measurements like Interincisor Gap (IIG), Stern omental distance (SMD), Thyromental distance (TMD), Hy omental distance, tests like Mallampati classification, upper lip bite test, lower jaw protrusion test (LJT), range of neck movement, radiographic assessment are available for prediction of difficult laryngoscopy and intubation (4,5,6). Modified Mallampati test is well accepted & routinely used standard test for pre-operative prediction of difficult airway (7). Lower jaw protrusion Maneuver is one of the simple bedside Maneuver for the prediction of difficult airway (8). It is an easy, simple, noninvasive maneuver which can be practiced in elective as well as emergency situations. It has a relatively simple grading system in which patients were graded depending on the extent to which they could translate their temporo-mandibular joint to approximate their superior to inferior incisors (9, 10, 11).

Hence, the present study was planned to evaluate & compare the sensitivity & specificity of Lower jaw protrusion maneuver with Mallampati test for prediction of difficult laryngoscopy & intubation.

Materials and methods

After approval from institutional ethics committee and obtaining written informed consent from the patients, the cross-sectional observational single group study was conducted at tertiary care centre during period of November 2018 to October 2020 in 350 patients scheduled for elective surgeries under general anaesthesia requiring oral endotracheal intubation. Inclusion criteria are ASA grade I & II patients requiring general anaesthesia with oral endotracheal inubation, age group 18 to 60 years, BMI < 28 kg/m2. Exclusion criteria are Unconscious & uncooperative bed ridden patients, edentulous or patients with incomplete teeth, patients with oral, upper airway & cervical spine pathology, patients with limited neck movements or impaired movements of temporomandibular joint, restricted mouth opening, BMI > 28 kg/m^2, patient refusal. Thorough pre-anaesthetic evaluation was done with necessary investigations. Patients airway was assessed by the principal investigations by Mallampati test and Lower jaw protrusion maneuver.

The lower jaw protrusion maneuver was performed by asking the patient to protrude his or her lower jaw as much as possible beyond the upper jaw. Patients were assigned to one of the three grades of mandibular protrusion as follows

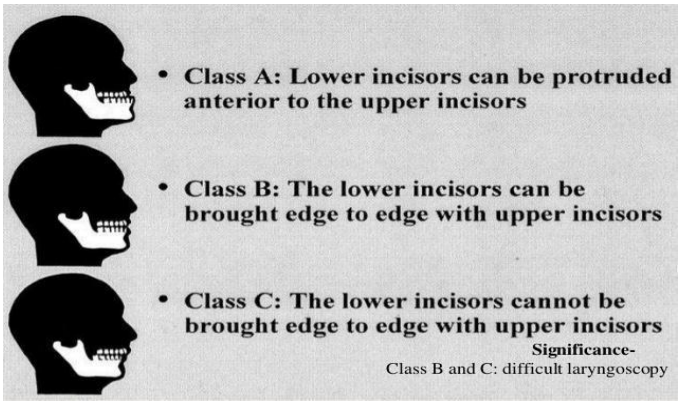
Lower jaw protrusion maneuver

Grade A Lower incisors can be brought anterior to the upper incisors

Grade B Lower incisors can only be protruded edge to edge with upper incisors

Grade C Lower incisors cannot be protruded edge to edge with upper incisors

Grade A was considered as a predictor of an easy laryngoscopy and tracheal intubation. Grade B and C were considered as a predictors of difficult laryngoscopy and tracheal intubation.



The Mallampati test was performed with the patient in sitting position, head neutral, mouth wide open, tongue protruded to its maximum, and patient not phonating. Modified Mallampati test

Grade I Visualization of the soft palate, fauces; uvula, anterior and the posterior pillars

Grade II Visualization of the soft palate, fauces and uvula

Grade III Visualization of soft palate and base of uvula

Grade IV Only hard palate is visible.

Grade I and II were considered as predictors of an easy laryngoscopy and tracheal intubation. Grade III and IV were considered as predictors of difficult laryngoscopy and tracheal intubation.

On the day of operation patients written informed consent was obtained after explaining all the procedure to the patient. NBM status was confirmed. Patients were then transferred to the operating room and head ring was placed below the head to achieve the Sniffing position. All the routine monitors including ECG, Non-invasive blood pressure (NIBP), Pulse oximetry (SpO2) were applied and the baseline readings were noted. Intravenous access was secured with 20 G intracath and Lactated Ringer's solution started. Premedicated with Inj. Glycopyrrolate 0.2 mg IV, Inj. Midazolam 1 mg IV, Inj. Fentanyl 100 mcg IV. Patients were preoxygenated with 100% oxygen for 3 minutes. Anaesthesia was induced with Inj. Propofol 2 mg/kg IV and Inj. Suxamethonium chloride 2 mg/kg. Patients were then manually ventilated with 100% O2 and 2% sevoflurane till the disappearance of fasciculations. An anaesthesiologist with minimum experience of more than 2 years, blinded to the results of the Lower Jaw Protrusion Maneuver performed laryngoscopy and tracheal intubation. Adequate size Macintosh blade as per the patient's frame was used and endotracheal intubation was done using polyvinyl chloride oroteacheal tube of size 7.5 mm ID and 8.5 mm ID for females and males, respectively. Number of attempts for the intubation, number of persons directly involved in performing endotracheal intubation, lifting force required for laryngoscopy, need to apply external laryngeal pressure, etc. was noted. If laryngoscopy was found to be difficult various measures e.g., change of position, change of blade or endotracheal tube and use of other gadgets e. g. bougie, stylet or other special advanced gadgets for endotracheal intubation were used as per the requirement and it was noted. Laryngoscopic view was graded as per Cormack and Lehane's grading and recorded (12). Overall endotracheal intubation will be graded as per the Intubation Difficulty Score (IDS) by observing various parameters as follows; N1: Number of additional endotracheal intubation attempts. Score zero for the first attempt One point each for every additional attempt. N2: Number of additional persons directly attempting endotracheal intubation (not assisting intubation) Score zero for the first person. One point each for every supplementary operators. N3: Number of alternative techniques used. Score zero for the standard technique. One point each for every alternative technique. Standard technique means pillow under the head and Macintosh size 3 for women and 4 for men.

Alternative techniques includes: a) Positioning of patient (Ramping/ Stacking), b) Change of materials (blade, endotracheal tube, bougie, addition of stylets), c) Change in approach (nasotracheal/orotracheal), d) Use of special instruments (fiberoptics, glide scope, video assisted intubation through laryngeal mask) N4: The laryngoscopic view as defined by Cormack & Lehane grading, grade 1 is visualization of the entire laryngeal aperture; grade 2 is visualization of only the posterior portion of the laryngeal aperture; grade 3 is visualization of only the epiglottis; and grade 4 is no visualization of the epiglottis or larynx. N5: represents the lifting force applied during the laryngoscopy, if little effort is necessary – 0; If subjectively increased lifting force is necessary – 1. N6: represents the need to apply external laryngeal pressure for optimized glottis exposure, if no external pressure or only the Sellick maneuver was applied – 0; if external laryngeal pressure was used – 1. N7: represents the position of vocal cords at intubation, if abducted – 0; if adducted (Impediment to tube passage) – 1. The final Intubation Difficulty Score was the sum of N1 to N7 (13). A score of zero indicates intubation under ideal conditions. Score 0 to <5 – Easy intubation Score >5 – Difficult intubation.

Results and Statistical analysis

Data was entered in MS Excel worksheet, coded and analyzed in a statistical software STATA, version 10.1, 2011. Descriptive statistics included univariate analyses to summarize data with statistical measures like frequency and percentage or mean and standard deviation for qualitative and quantitative variables respectively. P value <0.05 was set for deciding statistical significance for all comparisons.

Parameter	Mean ± SD
Age	34.17 ± 12.59
Weight	61.01 ± 8.52

Table 1: Distribution of subjects according to Age (yrs) & Body Weight (kg)

Majority of patients belonged to the age group of 21 to 30 years with mean age of study 34.17 ± 12.69 yrs and range of 18 to 60 yrs, while the majority of patients belonged to the weight group of 51 to 60 kg (39.71%) with mean weight of 61.01 ± 8.52.

Gender	Subjects	
	No.	%
Male	255	72.85
Female	95	27.15
Total	350	100.00

Table 2: Distribution of subjects according to gender

In the present study was done on 350 patients including 255 males (72.86%) and 95 females (27.15%), we observed male preponderance in our study.

Mallampati Grades	Subjects	%	LJP Grades	Subjects	%
I	31	8.86	A	33	9.43
II	3	0.86	B	280	80
III	181	51.71	C	37	10.57
IV	135	38.57			
Total	350	100	Total	350	100

Table 3: Distribution of subjects according to the Mallampati grading (MPG) & Lower Jaw Protrusion Maneuver (LJP)

The above table shows that out of total 350 patients, 31 patients (8.86%) had Mallampati grade I, 3 patients (0.86%) had Mallampati grade II, 181 patients (51.71%) had Mallampati grade III and 135 (38.57%) patients Pad Mallampati grade IV, 33 patients (9.43%) had LJP Grade A, 280 patients (80%) had LJP Grade B and 37 patients (10.57%) had LJP Grade C.

Mallampati Grades	Subjects	%	LJP Grades	Subjects	% %
Difficult	316	90.29	Difficult	317	90.57
Easy	34	9.71	Easy	33	9.43
Total	350	100	Total	350	100

Table 4: Distribution of subjects according to the prediction of easy and difficult intubation level by Mallampati grading (MPG) & Lower Jaw Protrusion Maneuver (LJP)

Out of 350 patients 316 patients (90.29%) had predicted difficult laryngoscopy and intubation and 34 patients (9.71%) had predicted easy laryngoscopy and intubation according to Mallampati grading.

LJP Maneuver predicted difficult laryngoscopy and intubation in 317 patients (90.57%) and predicted easy laryngoscopy and intubation in 33 patients (9.43%).

Difficulty assessed by Cormack's & Lehane's grading					
Difficult		Easy		Total	
No.	%	No.	%	No.	%
308	91.94	8	53.33	316	90.29
27	8.06	7	46.67	34	9.71
335	100	15	100	350	100

Table 5: Validity of difficulty level assessed by Mallampati grades (MPG) with Cormack's & Lehane's grading

In the above table Mallampati grade predicted difficult intubation in 316 (90.29%) patients and easy intubation in 34 (9.71%) patients.

When the total difficult intubation predicted by MPG were compared with the gold standard Cormack & Lehane's grading there were 308 (91.94%) patients who actually had difficult intubation and the rest 8 (53.33%) had an easy intubation.

When the total easy intubation predicted by MPG were compared with the gold standard Cormack & Lehane's grading there were 7 (46.67%) patients who actually had easy intubation and the rest 27 (8.06%) had a difficult intubation.

Table 6: Validity of difficulty level assessed by Lower jaw protrusion (LJP) with Cormack's & Lehane's grading.

Difficulty assessed by lower jaw protrusion test	Difficulty assessed by Cormack's & Lehane's grading					
	Difficult		Easy		Total	
	No.	%	No.	%	No.	%
Difficult	315	94.03	2	13.33	317	90.67
Easy	20	5.97	13	86.67	33	9.43
Total	335	100.0	15	100.0	350	100.0

In the above table LJP Maneuver predicted difficult intubation in 317 (90.67%) patients and easy intubation in 33 (9.43%) patients.

When the total difficult intubations predicted by LJP were compared with the gold standard Cormack & Lehane's grading there were 315 (94.03%) patients who actually had difficult intubation and the rest 2 (13.33%) had easy intubation.

When total easy intubations predicted by LJP were compared with the gold standard Cormack & Lehane's grading there were 13 (86.67%) patients who actually had easy intubation and the rest 20 (5.97%) had difficult intubation.

Parameter	Estimate by LJP	Estimate by MPG	P value
Sensitivity	94.03%	91.94%	0.2790
Specificity	86.67%	46.67%	0.0001*
Positive Predictive Value	99.37%	97.47%	0.0438*
Negative Predictive Value	39.39%	20.59%	0.0001*
Diagnostic Accuracy	93.71%	90%	0.0728
Likelihood ratio of a Positive Test	1.72	7.05	0.0001*
Likelihood ratio of a Negative Test	0.07	0.17	0.0001*
Diagnostic Odds	102.4	9.98	0.0001*

Table 7: Comparison of Validity measures and accuracy of predicting difficulty level by Lower jaw protrusion (LJP) and Mallampati Grading (MPG)

Good (>93%) accuracy of LJP in predicting difficulty level was observed whencompared with the Conventional criteria i.e. MPG grading. Likelihood ratio of a positive test >1 indicates that difficulty will be present if LJP test result is positive. Likelihood ratio of a negative test <1 indicates that difficulty will not be present if LJP test result is negative. High diagnostic odds (>100) indicates that LJP will be positive if difficulty is present as against LJP being positive when difficulty is not present.

Discussion

Unanticipated difficult laryngoscopy and tracheal intubation always remain a primary concern for the anaesthesiologist, as the failure to maintain a patent airway after the induction of general anesthesia is one of the most common causes of anesthesia-related morbidity and mortality. Although many advances have been made and many time-tested methods, for example MT, stern omental distance, Interincisor gap, upper lip bite test, thyromental distance alone or in combination, have been used to overcome the conundrum of an unanticipated difficult laryngoscopy and tracheal intubation but none of them are totally reliable. Difficult laryngoscopy and tracheal intubation can cause soft-tissue damage, bronchial intubation, laryngospasm, bronchospasm, inability to ventilate or intubate, hypoxic brain injury, and even death (14,15,16,17). Difficult intubation is defined in a number of ways, but an unanticipated poor laryngoscopic view is mainstay of definition (18). UL Haq et al concluded that LJP Maneuver was a better test to predict difficult laryngoscopy and tracheal intubation than the MT (19). Green SM et al in 2019 They concluded that the Mallampati score lacks the accuracy, reliability, and feasibility required to supplement a standard airway evaluation before ED airway management or procedural sedation (20). El-radaideh Kh et al They concluded that LJP Maneuver comes out to be a better predictor of difficult laryngoscopy and tracheal intubation.it is easy to perform and can be used in anticipating difficulty in laryngoscopy and endotracheal intubation. We therefore suggest adding it to the routine preoperative assessment of airway (21). Objective of our study was to compare the sensitivity and specificity of MT with LJP Maneuver in predicting difficult laryngoscopy and intubation using Cormack and Lehane's criteria of intubation as a gold standard. In the present study when validity measures and accuracy predicting difficulty level by lower jaw protrusion Maneuver (LJP) with Cormack & Lehane's grading was

studied it was found that sensitivity was 94.03%, specificity was 86.67%, PPV was 99.37%, NPV was 39.39%, diagnostic accuracy was 93.71%, likelihood ratio of positive test was 7.05, likelihood ratio of negative test 0.07 and Area under curve 0.6938 compared to Mohd. Irfan et. al. in which it was found that sensitivity was 95.88%, specificity was 88.47%, PPV was 70.56%, NPV was 98.56%, Accuracy was 90.13%, likelihood ratio of positive test was 8.32, likelihood ratio of negative test was 0.046 and Area under curve was 92.2% (19). Khaled el-Radaideh et. al. in which it was found that sensitivity was 46.7%, specificity was 71.4%%, PPV was 33.3%, NPV was 81.4% accuracy was 65.6% by LJP grade (21). When the sensitivity observed by MPG (91.94%) in the present study was compared with the sensitivity observed by LJP (94.03%), both were comparable (P - 0.2790) for the prediction of easy laryngoscopy and intubation in the present study. Mohd. Irfan et. al. and Khaled et. al.

observed LJP to be more sensitive than the MPG. When the specificity observed by MPG (46.67%) was compared with the specificity observed by LJP (86.67%), the MPG was found to be more specific statistically (P - <0.05) for prediction of difficult laryngoscopy and intubation. Mohd. Irfan et. al. and Khaled et. al. also observed comparable specificity with LJP and MPG in both the studies. The Positive Predictive Value and the negative predictive value assessed by LJP and MPG in the present study were compared it was observed that LJP is more superior than MPG (p-<0.0438) and (p-<0.0001) respectively. This finding in the present study correlates with the

observations of Khaled et. al. However, Mohd. Irfan et. al. observed that MPG is better for predicting NPV than MPG (98.7%) vs (82.0%). He also observed similar and comparable positive predictive value with LJP and MPG in their study.

The diagnostic accuracy with LJP (93.71%) was found to be higher than that assessed by MPG (90%) though it was not significant statistically (p- 0.0728). In our present study True positive and false positive patients assessed by MPG were found to be 308 (91.94%) and 8 (53.33%) resp. In Mohd. Irfan et. al. true positive and false positive patients assessed by MPG were found to be 46 (6.05%) and 25 (3.28%) resp. In Khaled el- radahdeh et. al. true positive and false positive patients assessed by MPG were found to be 2 (3.12%) and 14 (21.87%) resp. In our present study True positive and false positive patients assessed by LJP were found to be 315 (94.03%) and 2 (13.33%) resp. In Mohd. Irfan et. al.

true positive and false positive patients assessed by LJP We found to be 163 (21.44%) and 68 (8.94%) resp. In Khaled el- radahdeh et. al. true positive and false positive patients assessed by MPG were found to be 7 (10.93%) and 14 (21.87%) resp. Thus, P value of true positive was 0.2897 and false positive was 0.0201. In our present study True negative and false negative patients assessed by MPG were found to be 7 (46.67%) and 27 (8.06%) resp. In Mohd. Irfan et. al. true negative and false negative patients assessed by MPG were found to be 5 65 (74.34 %) and 124 (35.4%) resp.

In Khaled el- radahdeh et. al. true negative and false negative patients assessed by MPG were found to be 35 (54.68%) and 13 (20.31%) resp. In our present study True negative and false negative patients assessed by LJP were found to be 13 (86.67%) and 20 (5.97%) resp. In Mohd. Irfan et. al. true negative and false negative patients assessed by LJP were found to be 522 (74.34 %) and 7 (0.92%) resp.

In Khaled el- radahdeh et. al. true negative and false negative patients assessed by MPG were found to be 35

(54.68%) and 13 (12.5%) resp. Thus, P value of true negative was 0.0201 and false negative was 0.2897.

Conclusion

The study concludes that lower jaw protrusion Maneuver has significant sensitivity, positive and negative predictive value than routinely practiced standard technique of MPG grading, the specificity and accuracy of LJP is comparable with MPG. Hence, the study recommends that this non-invasive and easily practicable LJP Maneuver should be routinely practiced in pre-anaesthetic airway assessment protocol along with MPG for prediction of difficult laryngoscopy and intubation.

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