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Prediction of Difficult Intubation in Apparently Normal Patients by Combining Modified Mallampatti Test and Thyromental Distance

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Abstract

Context: Difficult intubation is associated with serious complications, more so when there is failure of intubation. Inability to secure the airway during general anaesthesia remains one of the leading causes of morbidity and mortality worldwide. The principle goal of this study was to find the best predicting test in patients who are apparently normal by a combination of Modified Mallampatti test and Thyromental distance and comparing it with Cormack and Lehane Score. *Aims:* To use Mallampatti test & Thyromental distance test during pre-operative assessment to determine incidence of difficult laryngoscopy and intubation; To combine sensitivity and specificity of both the tests and determine, if the combination of both the tests increases the predictability of difficult intubation. *Settings and Design:* Prospective clinical study. *Methods and Material:* The preoperative airway assessment of Mallampatti grading & thyromental distance was done on 300 ASA grade 1 & 2 patients, aged between 18-60 yrs presenting for surgeries under general anesthesia. The preoperative Mallampatti test grading and the thyromental distance was compared with Cormack & Lehanelaryngoscopic grade. *Statistical analysis used:* Data was entered in to Microsoft Excel Worksheet and analyzed using SPSS (ver. 18) statistical package. In addition to sensitivity and specificity, the positive and negative predictive values were calculated. *Results:* The Mallampatti grade 3 & 4 were considered as predictors of difficult intubation 28 cases out of 300 patients (9.3%) of the study population belong to this group. Thyromental distance < 6 cm was considered as predictor of difficult intubation There were 17 cases out of 300 patients (5.7%) belonging to this group. When a combination of Mallampatti test and thyromental distance was used as a predictor of difficult intubation, there were 16 patients, which constituted 5.3% of the total cases. The incidence of difficult intubation is found to be 5%. *Conclusions:* The above result shows that the discriminative power is greater in combination of test than when used alone.

Keywords: Difficult Intubation; Mallampatti Test; Thyromental Distance.

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Introduction

An anaesthesiologist's fundamental responsibility is intubation and maintenance of patients airway which is the important step in anaesthesia practice. Difficult intubation is associated with serious complications, more so when there is failure of intubation. Inability to secure the airway during general anaesthesia remains one of the leading causes of morbidity and mortality worldwide. It is the responsibility of the anesthesiologist to perform an evaluation in order to predict potential difficult intubation. The principle goal of this study was to find the

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best predicting test in patients who are apparently normal by a combination of Modified Mallampatti test and Thyromental distance and comparing it with Cormack and Lehane Score.

The American society of Anesthesiologists (ASA) has defined endotrachel intubation as when proper placement of endotracheal tube with conventional laryngoscopy requires more than three attempts or more than 10 minutes. Difficult airway is also defined as a clinical situation in which conventionally trained anaethesiologist experiences difficulty with mask ventilation or difficult tracheal intubation or both [1]. Difficult intubation is the second most frequent proclaimed damaging event leading to anesthesia malpractice claims [2].

The ASA database of adverse respiratory events has found that a vast majority (85%) of airway related events involves brain damage or death, and as many as 1/3rd of death is attributed solely to anesthesia due to inability to maintain patent airway [3].

Occasionally with a patient who has difficult airway, the anesthesiologist is faced with a situation where mask ventilation is proved difficult or impossible. This is the most critical emergency that might be faced in the practice of anesthesia [4]. Most catastrophes have occurred when possible difficult airway was not recognized [5].

When anatomical abnormalities are hidden in the air passage, it is likely to be missed. In such patients if difficult intubation is predicted, it may be helpful. During routine anesthesia, the incidence of difficult intubation has been estimated at 5.8% [6].

Although an array of tests are available to predict difficult intubation, it is difficult to for the anesthesiologist as, no single score or combination of scores can be trusted to detect all patients who are difficult to intubate [7]. No system has yet been devised that has 100% positive predictive value or 100% sensitivity and specificity [8]. Hence unidentified difficult intubation can be challenging to the anesthesiologist.

The various bedside screening tests available to predict difficult intubation are the Mallampatti test which was introduced by Mallampatti S Rao and co-workers in 1985, which is classified based on visibility of oropharyngeal structures [9].

The distance from thyroid notch to mentum (thyromental distance), the distance from upper border of manubrium sterni to mentum (sternomental distance) and simple summation of risk factors (Wilson's risk score) are widely recognized as tools for difficult intubation [10,11].

Nevertheless the diagnostic accuracy of these screening tests has varied from trial to trial probably because of difference in the incidence of difficult intubation, inadequate statistical power, different test thresholds, or difference in patient characteristics. Question remains as to whether a combination of tests may improve predictive accuracy.

Therefore there is a need for a test that is quick and easy to perform at the bedside that is sensitive so that majority of difficult cases can be identified and is also highly specific.

Aims and Objectives

To use Mallampatti test during pre–operative assessment to determine incidence of difficult laryngoscopy and intubation; to use Thyromental distance test during pre-operative assessment to determine incidence of difficult laryngoscopy and intubation; to combine sensitivity and specificity of both the tests and determine, if the combination of both the tests increases the predictability of difficult intubations.

Materials and Methods

Source of data

300 consecutive (apparently normal) American Society of Anesthesiologist grade 1 & 2 adult patients undergoing elective surgical procedures under general anesthesia with endotracheal intubation at a tertiary care hospital,were the subjects in this study. Study design was Prospective clinical study.

Inclusion Criteria

All patients aged between 20 to 60 years of either sex; patients belonging to ASA (American Society of Anesthesiologist) Grade 1 and 2 Physical status; patients undergoing elective surgery under general anesthesia with endotracheal intubation.

Exclusion Criteria

Pregnant patients; patients with body mass index more than 30; mouth opening less than 3 cms; mid-line neck swellings; difficult neck movements; ASA (American Society of Anesthesiologists) 3 and 4 patients.

Methodology

Preanesthestic evaluation: The preanesthestic evaluation of patient was done in the ward. The consent was taken for surgical procedure, anesthetic technique and study. Evaluation of the patient was done by history of medical illnesses, surgical procedure, medication, drug allergy and general physical examination. Blood pressure, pulse, hydration were noted, body mass index was calculated, systemic examination was done and American Society of Anesthesiologist (ASA) grading was determined.

Airway Assessment: Airway was assessed by modified Mallampatti test and thyromental distance.

Modified Mallampatti Test: It is done by examiner sitting in front of the patient, who should be sitting up with head in neutral position and the patient is asked to open their mouth maximally and protrude the tongue without phonating and Mallampatti grading is done accordingly.

Grade 1: Visualization of soft palate, fauces, uvula, anterior and posterior pillars.

Grade 2: Visualization of soft palate, fauces and uvula.

Grade 3: Visualization of soft palate and base of uvula.

Grade 4: Only Hard palate is visible, soft palate is not visible at all.

Grades 3 and 4 are classified as predictor of difficult intubations.

Assessment of airway using Thyromental distance:

Done using a measuring tape from the mentum of the mandible to thyroid notch in the midline with neck in full extension. Measurement of less than 6 cms is considered to be predictor of difficult intubation.

Patient Preparation

All patients were premedicated with Tab. Ranitidine 150 mg and Tab. Diazepam 10 mg given orally night before surgery.

On the morning of surgery patient were shifted to the O.T, Non-Invasive Blood pressure, ECG, SpO2 monitors were connected and basal vitals were recorded. Patients were given Inj Pentazoscine 20-30 mg, Inj Midazolam 25 µg/kg given IV and pre oxygenated for 3 mins with 100% Oxygen.

Induction done with sleep dose of Thiopentone (approx 5 mg/kg) IV and relaxation done with inj Vecuronium 0.1 mg/kg IV. Patients were ventilated with 50% Nitrous oxide and 1% Halothane in oxygen. After 3 mins laryngoscopy was done in sniffing position by using Macintosh blade no 3/4. Cormack & Lehane grading was done accordingly by a senior anesthesiologist with more than two years experience post qualification. Subsequently the patients were intubated.

The following is the Cormack and Lehane grading:

Grade 1: Visualization of entire laryngeal aperture.

Grade 2: Visualization of only posterior commissure of laryngeal aperture.

Grade 3: Visualization of only epiglottis.

Grade 4: Visualization of only soft palate.

Grade 3 and 4 predict difficult intubation. The patients were intubated with appropriate sized endotracheal tube which were secured and anesthesia was maintained.

Results

Three hundred apparently normal ASA grade 1 & 2 adult patients in the age group 18-60 yrs of either sex posted for elective surgical procedures were prospectively studied.

Method of Statistical Analysis

The following methods of statistical analysis have been used in this study. The data were entered into a Microsoft Excel Worksheet and analyzed using SPSS (ver. 18) statistical package.

The results were presented in number and percentage in tables and figures.

The sensitivity and specificity of Mallampatti Grade predictor, Thyromental distance Predictor and Mallampatti + Thyromental distance, compared to the Cormack and Lehane Grading were determined. In addition to sensitivity and specificity, the positive and negative predictive values were calculated.

In our study Average age noted was 37.14±14.14; BMI was 24.04±1.687; female patients were 172 and male 128; Mallampatti grade 3 and 4 were considered as predictors of difficult intubation.28 cases out of 300 patients (9.3%) belonged to Mallampatti grade 3 and 4, remaining 272 were Mallampatti grade 1 & 2. Thyromental Distance

was found to be less than 6 cm in 17 and more than 6 cm in 283 patients. The Mallampatti Grade and Thyromental Distance in the Study Population as a combination was positive in 16 patients and negative in 284 patients.

Table 1: Distribution and Correlation of Mallampatti Grade with Cormack & Lehane Grade in prediction of difficult Intubation

Cormack and Lehane Grading	Mallampatti Grade predictor +ve (grade 3&4)	-ve(grade 1&2)	Total
+Ve (grade 3&4)	19	3	22
	86.4%	13.6%	100.0%
	67.86%	1.11%	7.33%
-Ve (grade 1&2)	9	269	278
	3.2%	96.8%	100.0%
	32.14%	98.89%	92.67%
Total	28	272	300
	9.3%	90.7%	100.0%
	100.0%	100.0%	100.0%

Table 2: Distribution and Correlation of Thyromental Distance with Cormack & Lehane Grade in prediction of difficult Intubation

Cormack & Lehane Grading	Thyromental Distance < 6 Cm	> 6 Cm	Total
+Ve (grade 3&4)	12	10	22
	54.5%	45.5%	100.0%
	70.59%	5.53%	7.33%
-Ve (grade 1&2)	5	273	278
	1.8%	98.2%	100.0%
	29.41%	96.46%	92.67%
Total	17	283	300
	5.7%	94.3%	100.0%
	100.0%	100.0%	100.0%

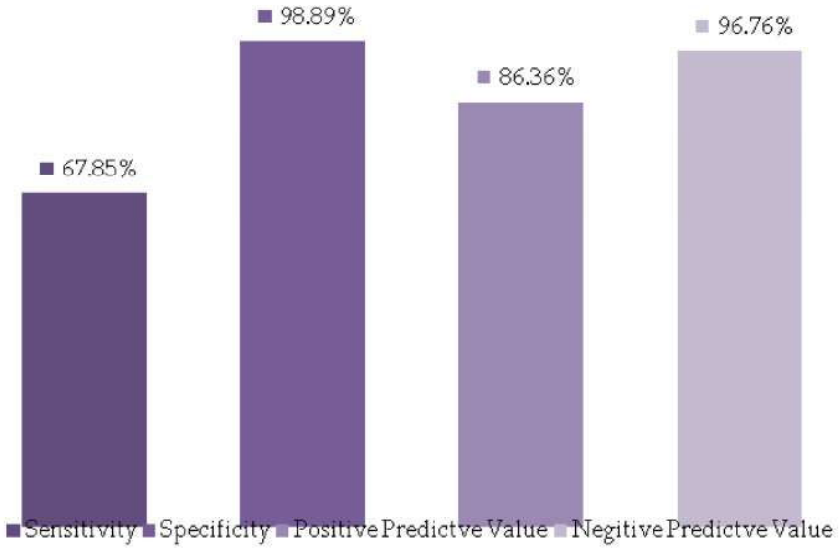

Fig 1: Sensitivity, Specificity, Positive Predictive Value and Negative Predictive Value of Cormack & Lehane Grading Vs Mallampatti Grade Predictor

The incidence of difficult intubation is found to be 5%

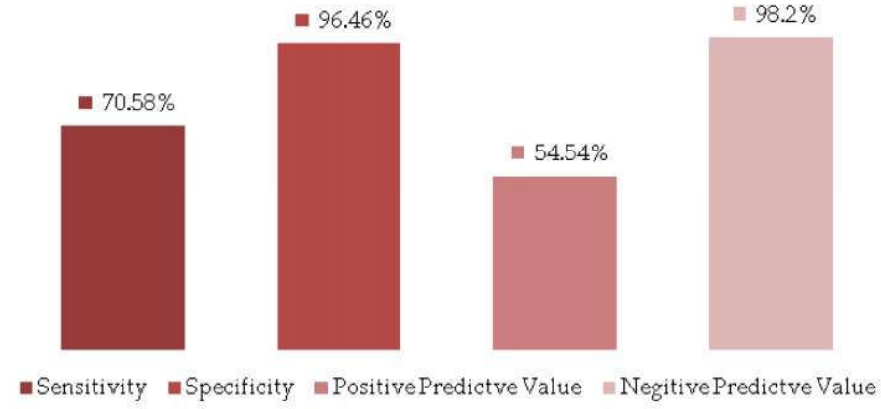

Fig 2: Sensitivity, Specificity, Positive Predictive Value and Negative Predictive Value of Cormack & Lehane Grading Vs Thyromental Distance Predictor

Table 3: Distribution and Correlation by Combination of Tests: The Mallampatti Grade and Thyromental distance with Cormack & Lehane grade in Prediction of difficult Intubation

Cormack and Lehane Grading	Mallampatti Grade		Total
	+ve(grade 3 &4)	-ve(grade 1 &2)	
+Ve	12	3	15
	80%	20%	100%
	75%	1.1%	5%
-Ve	4	281	285
	1.4%	98.6%	100%
	25%	98.9%	95%
Total	16	284	300
	5.3%	94.7%	100.0%
	100.0%	100.0%	100.0%

Table 4: Distribution of Combination of Tests - The Mallampatti Grade and Thyromental distance in Various Age Groups

Age	Mallampatti+Thyromental distance		Total
	+Ve	-Ve	
21 – 30 Yrs	5	108	113
	4.4%	95.6%	100.0%
31 – 40 Yrs	3	56	59
	5.1%	94.9%	100.0%
41 – 50 Yrs	1	52	53
	1.9%	98.1%	100.0%
51 – 60 Yrs	8	58	66
	12.1%	87.9%	100.0%
Total	17	283	300
	5.7%	94.3%	100.0%

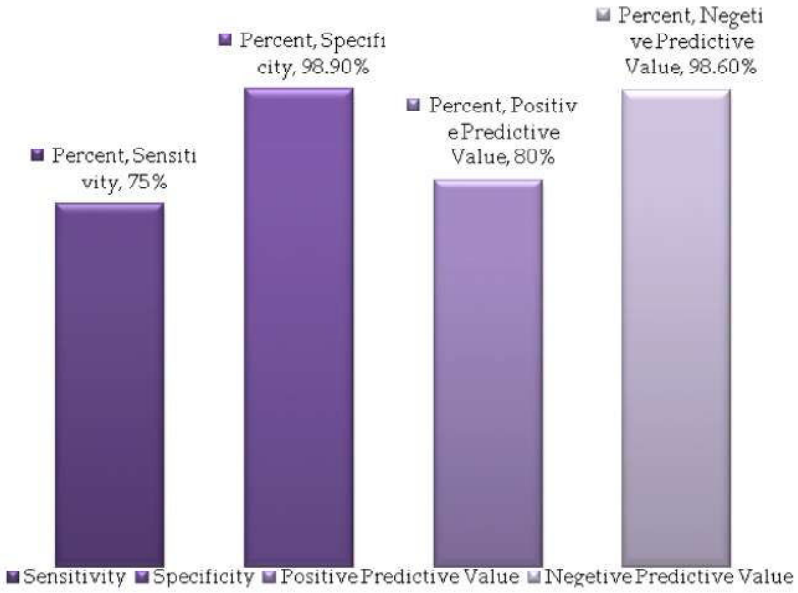

Fig 3: Sensitivity, specificity, PPV and NPV of Cormack and Lehane grading **vs**Mallampatti + Thyromental distance

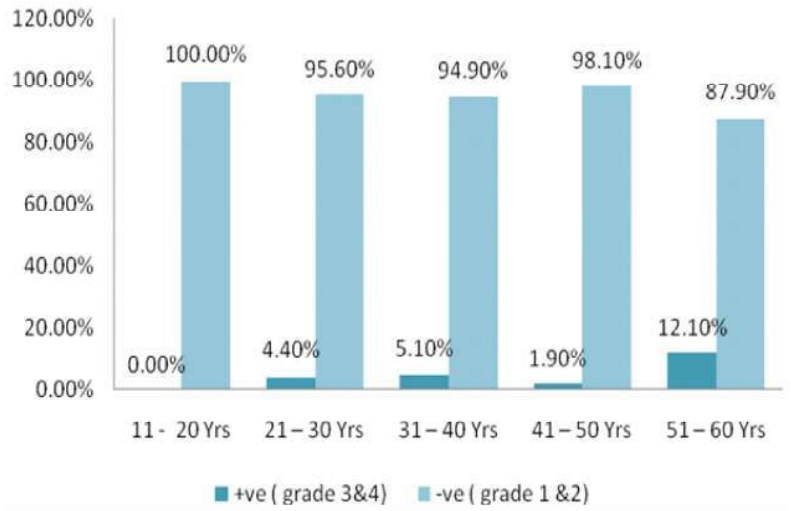

Fig 4: Distribution of combination of tests in various age groups

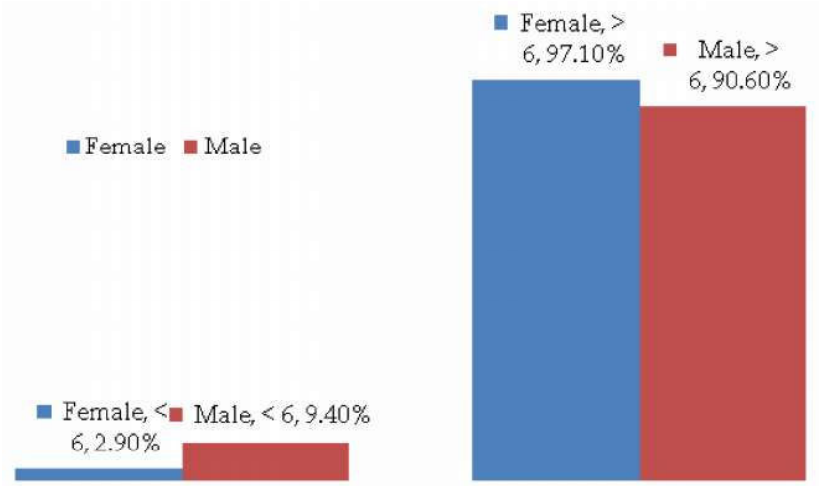

Fig 5: Gender and The Mallampatti Grade and Thyromental distance distribution of study population

Table 5: Distribution of Combination of tests The Mallampatti Grade and Thyromental distance in Male & Female

Gender	Mallampatti Grade + Thyromental distance		Total
	+Ve	-Ve	
Female	5	167	172
	2.9%	97.1%	100.0%
	29.40%	59.01%	57.3%
Male	12	116	128
	9.4%	90.6%	100.0%
	70.60%	40.99%	42.7%
Total	17	283	300
	5.7%	94.3%	100.0%
	100.0%	100.0%	100.0%

Discussion

In earlier days anesthesia was induced by anesthetic vapours given through face mask. Due to inability to maintain a patent airway, adequate depth of anesthesia for surgical procedures and its complication leading to morbidity and mortality led to development of safer anesthetic practice by maintaining anesthesia through endotracheal insufflation.

The endotracheal tube is one of the airway devices which can be introduced into the trachea either orally or nasally, to maintain a patent airway in both unconscious and Anaesthetized patients. The significance of difficult or failed tracheal intubation following induction is a well recognized cause of morbidity and mortality in anesthetic practice. Moreover the need to predict potentially difficult tracheal intubation has received wide attention but withmeagre success.

Many anatomical characteristics and pathological conditions (like Pierre Robin syndrome, Ludwig's angina) have been suggested to be useful in assessing anticipated difficult intubation by altering or distorting the regional anatomy of the airway Unheralded difficult intubation is a risk to the patient's life and a challenge to the skill of the anesthesiologist.

In the absence of pathological conditions, radiographic methods are time consuming and cannot be used routinely for prediction of the difficult intubation. But these factors have limitations because of observer variability, inadequate statistical power and difference in incidence of difficult intubation Based on these observations and studies, our study was conducted to overcome a few of these limitations and hence we have used two simple bed side airway assessment tests i.e., Mallampatti test and measurement of thyromental distance to predict the incidence of difficult intubation.

The study population consisted of 300 ASA grade 1 & 2 patients with apparently normal airway who underwent surgical procedures under general anesthesia. In our study the prediction of difficult intubation was done by combining Mallampatti test grade 3 & 4 and thyromental distance < 6 cm during the preoperative airway assessment and correlating it with the Cormack & Lehane laryngoscopic grading at intubation. Grade 3 & 4 of Cormack & Lehane was considered difficult intubation.

Butler PJ. et al. conducted on 250 patients, who did the pre-operative airway assessment by Mallampatti test and thyromental distance [12].

The incidence of difficult laryngoscopy in their study was 8.2%. Yildiz TS et al. conducted study on 1674 patients of ASA 1-3, whose pre-operative airway assessment was done with Mallampatti and Thyromental distance. They found incidence of difficult intubation was 4.8% and increased with age [13].

Ittichaikuthol W et al. conducted study on 1888 patients undergoing elective surgery under general anesthesia. Airway was evaluated using Mallampatti test and Thyromental distance. They found incidence of difficult intubation to be 3.2% [14].

Khan ZH et al. conducted a prospective study on 380 patients for assessment of airway using various screening tests including Mallampatti test and Thyromental distance. The prevalence of difficult intubation was 5% [15].

Shiga et al. conducted a meta-analysis of bed side screening tests for difficult intubation in apparently normal patients with no airway pathology. Tests included Mallampatti test, Thyromental distance, Sternomental distance and Wilson score. They found an overall incidence of difficult intubation to be 5.8% [16]. The incidence of difficult intubation in our study is 5%, which is comparable to the above mentioned study.

Similar study conducted by Koh et al. on 605 patients, a combined Mallampatti test grade 3 & 4 and thyromental distance < 6 cm was noted during preoperative airway assessment and correlated to Cormack & Lehane laryngoscopic grading during intubation. Grade 3 & 4 were considered difficult intubation [17].

Vani et al. conducted a study on 50 patients whose preoperative airway assessment combined Mallampatti grade 3 & 4 and thyromental distance < 6 cm to Cormack & Lehane grading during intubation. Grade 3 & 4 were considered difficult intubation [18].

Study conducted by Ezri et al. on 1472 patients also used similar parameters for prediction of difficulty during intubation. The results obtained in our study in predicting difficult airway using Mallampatti test alone was found to be having a sensitivity of 67.85% and specificity of 98.89%, the positive predictive value was 86.36%, and a negative predictive value was 96.76% [19].

Iohom et al. conducted a study in predicting difficult airway by using Mallampatti test, thyromental distance and sternomental distance. They found the sensitivity of Mallampatti test to be 43%, specificity 93%, the results of our study are comparable to the values obtained to this study [20].

In our study when thyromental distance was used alone in assessing the difficult airway, the sensitivity was 70.58%, specificity was 96.46%, positive predictive value was 54.4% and the negative predictive value was 98.2%. Frerk conducted a study in predicting difficult airway by using Mallampatti test and thyromental distance. The sensitivity of thyromental distance was found to be 88% and specificity 81% which are comparable to this study [21]. When the combination of Mallampatti test and thyromental distance was used to assess difficult airway and it was used to correlate it with Cormack and Lehanelaryngoscopic grading, the sensitivity was 75%, specificity 98.9%, positive predictive value 80% and negative predictive value 98.6% was obtained. The above result obtained show that, the discriminative power is greater when used in combination rather than alone.

Ulrich B et al. in 1998 conducted a study on 1993 patients surgical patients showed if during the laryngoscopy, a satisfactory laryngeal view is not obtained, the backward – upward-rightward-pressure (BURP) manoeuvre may aid in improving the view. The BURP manoeuvre has shown to improve the laryngeal view, decreasing the difficult intubation in these patients from 4.8% to 1.8% [22].

Benumof et al. described optimal external laryngeal manipulation by pressing posteriorly and cephalad over the thyroid, cricoid, and hyoid improved the laryngeal view by at least one Cormack & Lehane grade [23].

In our study the patients with difficult airway determined by Cormack and Lehane grade 3 & 4 were intubated either by "BURP" manoeuvre or bougie. There were 22 patients belonging to Cormack & Lehane grade 3 and 4 out of which 17 patients were intubated with BURP manoeuvre and 5 patients were intubated with bougie. The airway management was not associated with any patient morbidity or mortality. Further, surgery was never cancelled or postponed secondary to difficulties with airway management.

Conclusion

In our study the incidence of difficult intubation was found to be 5%. No single anatomical factors can be used as a sole predictor of difficult intubation, with few exceptions. Patients with obvious pathological and anatomical deformity of airway have difficult intubations. The present study has shown that the combination of modified Mallampatti test and thyromental distance is better than when used alone in predicting difficult intubation.

Conflict of Interest: None

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