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KEY WORDS: Inter Incisor Distance (IID), Inter Incisor Gap (IIG), Mallampati classification, Ratio of neck circumference to inter incisor gap.

COMPARISON OF THE RATIO OF NECK CIRCUMFERENCE TO INTER INCISOR GAP TO PREDICT DIFFICULT INTUBATION

Dr. Tejinder Singh Ajmani* Assistant Professor, Department Of Anaesthesia, People's College Of Medical Sciences & Research Centre, Bhopal, Madhya Pradesh *Corresponding Author

Dr. Somya Pareek Final Year Resident, Department Of Anaesthesia, People's College Of Medical Sciences & Research Centre, Bhopal, Madhya Pradesh.

Dr. Mahima Batra Professor & Head, Department Of Anaesthesia, People's College Of Medical Sciences & Research Centre, Bhopal, Madhya Pradesh

ABSTRACT

Introduction: Careful airway assessment before the induction of anaesthesia is of utmost importance as poor airway management has been recognized as a serious patient safety concern for almost three decades. Many studies have tried to develop some bedside tests that are easy to perform and don't take the time and need special equipment, but all these tests have their limitations, and no single one is complete. **Methodology:** Data was collected in two steps; Pre operative assessment & Intra operative assessment Pre operative assessment. Measurements of airway assessment variables like Inter Incisor Gap (IIG), IID, Neck Circumference were taken in pre op room or one day prior to surgery. Intra operative assessment Difficulty of intubation was assessed by the anaesthetist performing intubation. **Results:** 118 patients were studied for evaluation of the effectiveness of the ratio of neck circumference to inter incisor gap ratio in predicting difficult intubation. RNCIIG was found to have a sensitivity of 80.00% (44.39% to 97.48%), a specificity of 96.30% (90.79% to 98.98%), a PPV of 66.67% (42.14% to 84.60%), a NPV of 98.11% (93.77% to 99.45%) and a diagnostic accuracy of 94.92% (89.26% to 98.11%). **Conclusion:** The study recommends the use of ratio of airway assessment tests, preferably RNCIIG, for routine preoperative examination of patients as they have been found to have very good diagnostic accuracy and are highly effective in predicting difficult intubation as it is simple & convenient.

BACKGROUND

Airway management has always been a major concern for anaesthesiologists world over [1]. Most anaesthetic maneuvers are targeted at maintaining oxygenation at the tissue level to prevent hypoxia. Therefore, endotracheal intubation becomes pivotal in patient management while delivering general anaesthesia and in emergency situations. Unanticipated difficult tracheal intubation that can cause intubation delay or failure, significantly increases the morbidity and mortality associated with general anaesthesia [2]. The incidence of difficult laryngoscopy and intubation in various settings has been reported in a wide range of studies, from 1% to 15% [3–8]. In the Indian population, the incidence of difficult laryngoscopy and intubation was 9.7% and 4.5%, respectively, according to Smitha et al. [9]. A large number of studies have been conducted to develop reliable predictors for a difficult airway.

There are various measurements like neck circumference, thyromental distance, inter- incisor gap, hyomental distance, and ratios of these measurements that are employed to predict difficult airways during pre-op assessment of patients. The predictive ability of these tests as determined by various studies is highly variable and there is no consensus as to which among these is the best preliminary test to predict a difficult airway.

Therefore, we conducted this study in the Indian population to know predictive values and accuracy of RNCIIG, in an attempt to determine reliability for predicting unanticipated difficult intubation. The Intubation Difficulty Scale (IDS) has been used as a validated score for rating difficult intubations.

Aim

To determine the effectiveness of the ratio of neck circumference to inter incisor gap to predict difficult airway and Intubation.

Objectives

Objective of this study was to determine the Positive Predictive Value, Negative Predictive Value of the ratio of neck circumference to inter incisor gap to predict difficult intubation & to calculate its sensitivity & specificity.

Inclusion & Exclusion Criteria:

All mentally competent patients with ASA grading I & II between the age group 18-60 yrs, posted for elective surgeries under General Anaesthesia who would undergo endotracheal intubation were included in this posted.

Following patients were excluded from the study: Patients with ASA grade III and above. Cases posted for regional anaesthesia converted to general anaesthesia intra operatively, patients with oropharyngeal mass, TM joint immobility/ cervical joint problems. Pregnant females & procedures under general Anaesthesia using supraglottic airway devices were also excluded.

Methodology

Study type: Prospective observational study.

Sample size: All elective cases posted for GA during the duration of study, who met the inclusion criteria during 1st Dec 2019 to 31st August 2021.

Blinding: Single blinding of the anaesthetist who would perform the intubation. He would not be informed about the patient's measurements obtained pre operatively.

Ethical Approval:

Ethical approval for the study was obtained from the Research Advisory Committee (RAC) of People's College of Medical Sciences, Bhopal [Ref. No. PCMS/OD/2019/1440(14), dated 01/10/2019] and the Institutional ethics committee (IEC) of People's College of Medical Sciences, Bhopal [Project code No. IEC-2019/41, Ref. No. PCMS/OD/2019/1439(15), dated 01/11/2019]. Participant recruitment was commenced only after receiving the approval from RAC & IEC.

Study Variables: Demographic data (age, gender, Hosp IPD no, ASA status), Neck Circumference, IIG, IDS, MPC grade.

Data Collection Procedure
Data was collected in two steps: Pre operative assessment & Intra operative assessment.

Pre Operative Assessment
This included proforma containing patient's demographic details and hospital IPD no. Measurements of airway assessment variables like Neck Circumference (NC), Inter Incisor Gap (IIG), MPC grading were taken in pre op room or one day prior to surgery after taking written informed consent from each study participant.

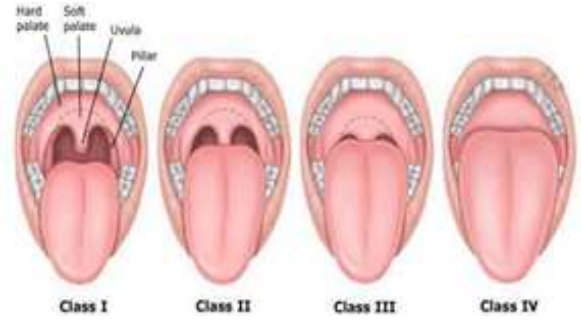


Figure 1: Mallampati Grading

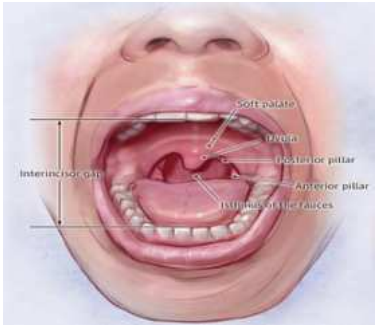


Figure 2: Inter Incisor Gap

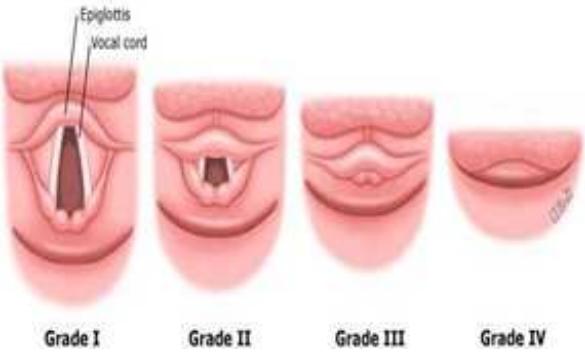


Figure 3: Cormack Lehane grading

Intra operative assessment:
Difficulty of intubation was assessed by the anaesthetist performing intubation. He would later fill up the Intubation Difficulty Score (IDS). IDS consists of 7 variables from N1 to N7. The sum of N1 to N7 gives the final IDS score.

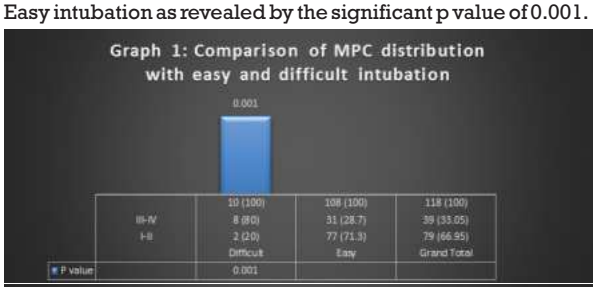
Statistical Analysis
All the data analysis was performed using IBM SPSS ver. 20 software. Frequency distribution and cross tabulation was performed to prepare the tables. Quantitative data was expressed as mean and standard deviation whereas categorical data was expressed as number and percentage. Chi Square test was performed to obtain p value for categorical variables. Independent sample t test was used to compare the means. Sensitivity, Specificity, Positive Predictive Value, Negative Predictive value was calculated using standard formulae. ROC was used to obtain the predictive variables for different parameters. AUC was calculated from respective ROC curves. P value of <0.05 was considered significant.

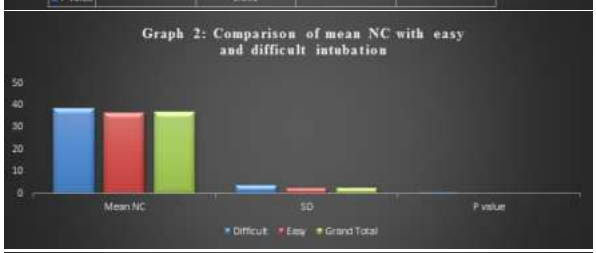
RESULTS:
A total of 118 patients were assessed for this study after obtaining written informed consent. The duration of study was between 1st Dec 2019 to 31st Aug 2021. Among the 118 patients recruited for the study, 10 (8.47%) patients were found to have difficult intubation, as assessed by Intubation Difficulty Score (IDS>5) while 108 (91.53%) patients had easy intubation (IDS<5). These are the results obtained.

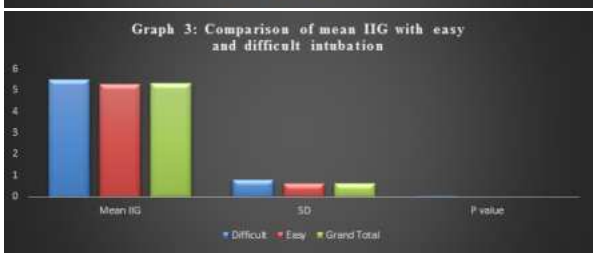
No significant difference was obtained in age, gender & ASA class distribution between easy and difficult intubation.

Comparison Between Various Airway Assessment Tests
Following table shows the comparison of MPC distribution with easy and difficult intubation.

Mallampati classification is a basic and perhaps the most routinely used bedside airway assessment test. It was found that 8 out of 10 (80%) patients with difficult intubation and 31 out of 108 (28%) patients with easy intubation had higher Mallampati score. Those with difficult intubation had significantly higher MPC (80%) as compared to those with Easy intubation as revealed by the significant p value of 0.001.





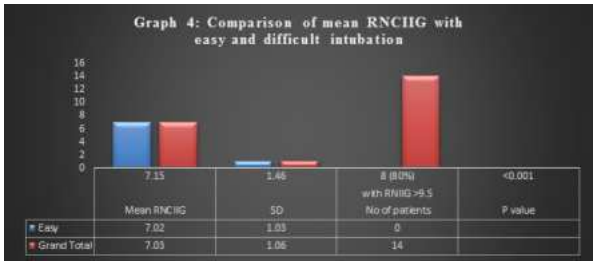


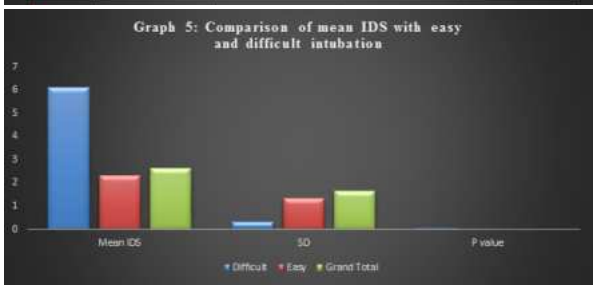
Graph 2 shows the comparison of mean NC with easy and difficult intubation. Patients with difficult intubation had significantly higher neck circumference (38.45±3.69) compared to those with Easy intubation (36.58±2.30) as revealed by the significant p value of 0.001.

Graph 3 shows the comparison of mean IIG with easy and difficult intubation. Patients with difficult intubation had a mean IIG of 5.5 while those with easy intubation had a mean IIG of 5.2. Data shows that difficult intubation cases had significantly higher IIG (5.51±0.80) compared to those with Easy intubation (5.29±0.62) as revealed by the significant p value of 0.001.

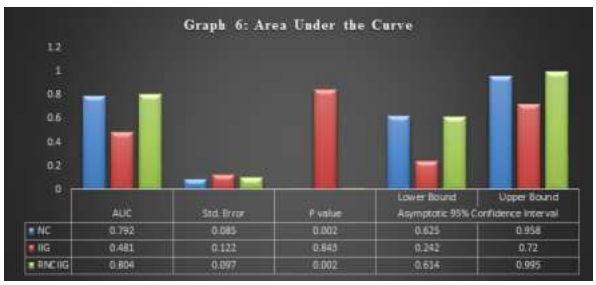
Graph 4 shows the comparison of mean RNCIIG with easy and difficult intubation. Patients with difficult intubation had a mean RNCIIG of 7.15 while patients with difficult intubation had a mean RNCIIG of 7.02. 8 out of 10 patients (80%) with

difficult intubation had a RNCIIG>9.5. Patients with difficult intubation had significantly higher RNCIIG (7.15±1.46) compared to those with Easy intubation (7.02±1.03) as revealed by the significant p value of 0.001.

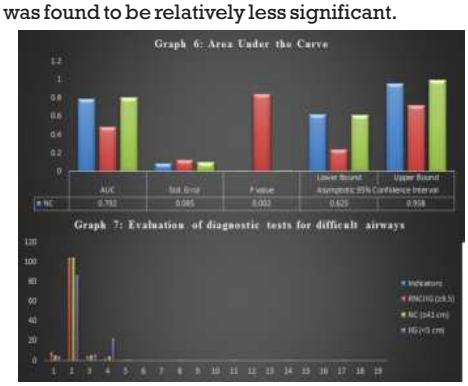




Graph 5 shows the comparison of mean IDS with easy and difficult intubation. Patients with difficult intubation had significantly higher IDS (6.10±0.32) compared to those with Easy intubation (2.32±1.32) as revealed by the significant p value of 0.001.



Graph 6 shows the predictive values of the common airway assessment tests for predicting difficult laryngoscopy. The AUC of NC & RNCIIG were 0.792, 0.804 respectively. This highlights that NC (p=0.002) & RNCIIG (p=0.002) had significant role in predicting difficult intubation. IIG with AUC 0.418 was found to be relatively less significant.



Graph 7 presents a comparative study between various airway assessment tests.

RNCIIG has a sensitivity and specificity of 80% and 96% respectively, with a diagnostic accuracy of 94%.

Airway assessment tests are imperative in the practice of anaesthesia. An array of tests like Mallampati, Neck Circumference, Thyromental distance, Inter Incisor Gap, Wilson score etc have been used as bedside screening tests for a long time. These tests have, however, been criticized for their poor predictive ability. Therefore, the use of a combination of these tests, preferably as a ratio, is found to have better outcomes.

This study was done among 118 patients posted for surgeries under general anaesthesia, in a tertiary care hospital, to determine the relevance of the ratio RNCIIG as predictor of difficult intubation. The study also compared this ratio with other established airway assessment tests like NC, TMD and IIG when used alone.

DISCUSSION:

According to the data analyzed, it was found that cases of difficult intubation were evenly distributed in various age groups. There was no statistical significance between age and the incidence of difficult intubation, as determined by an insignificant p value (p=0.6). The finding is contrary to studies by Han et al. [10] and Karakus et al. [11], where older patients were found to have a greater incidence of difficult intubation as compared to younger patients. No such observation was found in our study. The gender distribution in the study population was nearly even, with mild male preponderance (with 61 males and 57 females).

The incidence of difficult intubation in both genders was found to be similar. The incidence is 8.7% in females and 8.1% in males. The finding is contrary to studies by Karkouti et al.[12] where a male preponderance was seen in difficult intubation cases. The incidence of difficult intubation was 13.6% in males and 5% in females. In our study, however, no such difference was seen. The ASA distribution in both groups of easy and difficult intubation was also statistically insignificant, as ascertained by an insignificant p value (p=0.992). A study by Basil Manayaliul et al. [11] found an increased incidence of difficult intubation in ASA class 2 and 3 patients (73%). They had a cohort of obese patients with comorbidities in order of hypertension, diabetes mellitus, and hypothyroidism. Our study, however, included patients with ASA 1 and 2 as the study population, and no significant change in the incidence of difficult intubation was noted in either group. In other words, age, gender, and ASA grade were found to be statistically insignificant, therefore inconsequential in predicting difficult intubation cases.

In a study by Han et al. [10] the RNCIIG was found to have a sensitivity of 88.6% (78.1-99.1%) and a specificity of 62.9% (55.8-70%). The PPV and NPV were 32% and 96.6% respectively. In our study, we found RNCIIG to have a similar sensitivity and NPV of 80% and 98%, but a much higher PPV of 66.6% and a specificity of 96.3%. The AUC was calculated to be 0.8. The findings of this study closely corroborate with the findings of the present study, as this study has ascertained RNCIIG as superior to other indicators, including RNTMD. In the current study too, we have found that though both RNTMD and RNCIIG are very good indicators for predicting difficult airway, and comparable in most parameters, RNCIIG is superior to other parameters due to its higher sensitivity.

Limitations Of The Study

a) The participant size in the current study was lesser as compared to other similar studies.
b) Complete blinding was not possible as the anaesthesiologist performing intubation would recognize physical characteristics of a patient expected to have difficult intubation. Also, he would perform some airway assessment tests himself prior to intubation.
c) Any record of previous difficult intubations in study participants could not be obtained due to the unavailability of previous documentation.

CONCLUSION:

Unanticipated difficult airway, leading to failed intubation, remains one of the most important causes of morbidity and mortality related to anaesthesia. Therefore, it is of paramount

importance to identify a simple yet effective pre operative test to diagnose difficult intubation.

The study recommends the use of ratio of airway assessment test RNCIIG, for routine preoperative examination of patients as it has been found to have very good diagnostic accuracy and are highly effective in predicting difficult intubation.

The predictive ability of the ratios is significantly higher than that of individual indices like neck circumference, thyromental distance, or inter-incisor gap. These individual indices, therefore, should not be relied upon as effective airway assessment tests when used alone.

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