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PREDICTION OF DIFFICULT TRACHEAL INTUBATION

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ABSTRACT

Objectives: To find the best predicting test for difficult intubation in patients planned for general anesthesia with intubation.

Material and Methods: It was Analytical study of cross sectional comparative type and was conducted in Anesthesia Department, Khyber Teaching Hospital, Peshawar from July 2008 to June 2009. A total of 100 patients were selected who were to undergo General Anesthesia (GA) with intubation. They were divided into two groups A & B of 50 patients each. Group A patients were assessed by Mallampati ,Thyromental and Sternomental Distances. Group B patients were assessed by Wilson Risk Sum.

Results: Data was analyzed in Statistical Package for Social Sciences(SPSS) version 10.0. Frequency and percentage were computed for all parameters in both groups. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were computed for both techniques taking Cormac and Lehane classification as gold standard. Mallampati Classification, Thyromental Distance and Sternomental Distance evaluative methods proved to be more sensitive and specific and also showed high PPV and NPV than Wilson Risk Sum alone.

Conclusion: By combining Mallampati Classification with Thyromental and Sternomental Distances, the result of prediction of difficult intubation is more accurate and seems to be a better choice than Wilson Risk Sum alone.

Key Words: Difficult intubation, difficult airway, anticipation of difficult airway.

INTRODUCTION

Airway management and endotracheal intubation are fundamental skills for the safe conduct of anesthesia. The American Society of Anesthesiologists Task Force on management of difficult airways defines it as "an experienced anesthetist who feels difficulty in bag mask ventilation, laryngoscopy or endotracheal intubation or both is called difficult airway."[1]

Difficult intubation is common in general anesthesia. Its incidence is estimated to be 1-13%. Approximately half the cases are not predicted. Factors in patiens can be predicted not only by taking a careful history, but also by clinical examination, measurements and investigations.[2,3] Patient do not die from failure to intubate but from failure to ventilate.[4] Therefore it is necessary to have certain equipments and knowledge of bedside tests for predicting difficult intubation. The presence of an experienced anesthetist, and equipment for difficult airways is a must during intubation.

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When recognized before induction, all the difficult airways can be secured by the selected use of specialized tracheal intubation techniques. When unrecognized before attempts at intubation, the result can be catastrophic as spontaneous respiratory efforts are eliminated by muscle relaxats.[5] If not prepared for difficult intubation anesthetist may face serious problems especially in terms of morbidity (like bleeding from oral cavity, tooth damage, aspiration of gastric contents and esophageal intubation) and mortality.

Certain tests have been devised to anticipate difficult airways but none of them are 100% perfect. It has been suggested that combining these tests improves the predictive value.[6] The purpose of our study is to asses predictive value by combining Mallampati, Thyromental and Sternomental Distance measurements. and comparing the results with Wilson Risk Sum. The importance of our study is that these patients in whom intubation was proved to be difficult can be identified in advance and can be intubated by selected use of specialized intubation techniques.

MATERIAL AND METHODS

This cross sectional comparative study was conducted in the Anesthesia Department, Khyber Teaching Hospital, Peshawar from July 2008 to June 2009 after approval by the ethical committee. A total of 100 patients were selected who were to undergo

general anesthesia (GA) with intubation and they were divided into two groups A & B of 50 patients each. Both adult males and females (M:F = 2:3), belonging to American Society of Anaesthesiologist (ASA) status I, II and III were selected. However patients requiring special airway care like head injury, shock, caesarian section, temporomandibular joint disease, cervical spine injury, upper airway trauma, thyroid surgery were excluded.

Group A patients were assessed by Mallampati Classification, Thyromental and Sternomental distances. Group B patients were assessed by Wilson Risk Sum. The patients were visited in the surgical wards, an evening before their scheduled surgery. The purpose of the research study was explained to them in simple words and informed consent was taken. These simple observational airway assessment tests were conducted on the bed side. Patient cooperation was excellent as they understood the importance and safety of these tests. Simple portable instruments like measuring tape, torch, weighing machine were used.

Mallampati Classification

The patient is asked to sit at the level of the observer with head in neutral position. He should open his mouth as wide as possible and protrude the tongue as much as possible, without phonation. Modified Mallampati Classification includes slight head extension, protrusion of tongue with phonation.

Patients are classified according to pharyngeal view.

Class-I: Pillars, Uvula, Fauces, Soft palate, Hard palate seen.

Class-II: Soft palate, Fauces and portion of Uvula seen.

Class-III: Soft palate, Base of Uvula seen

Class-IV: Only Hard palate is visible.

Class-III and IV: are predicted as difficult intubation.

Thyromental Distance

It is the distance between the tip of the jaw and uppermost aspect of the thyroid cartilage. It should be > 6.5 cm, with the patient's mouth closed and neck fully extended.

Sternomental Distance

It is the distance from the jaw to the sternal notch. It should be > 12.5 cm with the patients head fully extended and mouth closed. If either of these measurements are below this figure, there is usually difficulty in airway management. The airway of group "B" patients were assessed by the following method.

Table 1: Wilson Risk Sum

Risk Factor	Level	Score
Weight	<90 Kg	0
	90-110 Kg	1
	>110 Kg	2
Head and Neck Movement	Above 90	0
	Below 90	2
Jaw Movement	*IG > 5 cm	0
	*IG< 5 cm	2
Receding Mandible	Normal	0
	Moderate	1
	Severe	2
Buck Teeth	Normal	0
	Moderate	1
	Severe	2

*IG = Interincisor Gap

Wilson Risk Sum

Wilson Risk Sum is calculated by using five parameter, as shown in Table 1.

Subjects having a Risk Sum of 2 or more are considered as difficult intubation cases.

The following day, after induction of anesthesia, direct laryngoscopy was done by a blind observer who assessed difficult intubation using the Cormac and Lehane classification as the gold standard.

Grade-I: Complete glottis visible

Grade-II: Anterior glottis not seen,only posterior commissure visible

Grade-III: Tip of Epiglottis seen but not glottis.

Grade-IV: Epiglottis not seen.

Grade III and IV: were considered as difficult intubation.

SENSITIVITY: The % of correctly predicted difficult intubation as a proportion of all intubations which proved to be difficult. True Positive / True Positive + False Negative.

SPECIFICITY: The percentage of correctly predicted easy intubations as a proportion of all intubations which proved to be easy. True Negative / True Negative + False Positive.

POSITIVE PREDICTIVE VALUE(PPV): The percentage of correctly predicted difficult intubations as a proportion of all predicted difficult intubations.

NEGATIVE PREDICTIVE VALUE(NPV): The percentage of correctly predicted easy intubations as a proportion of all predicted easy intubations.

TRUE POSITVE: The cases correctly predicted as difficult intubation.

TRUE NEGATIVE: The cases correctly predicted as easy intubation.

FALSE NEGATIVE: The cases not correctly predicted as difficult intubation.

FALSE POSITIVE: The cases not correctly predicted as easy intubation.

RESULTS

Complete data of 100 patients was collected, 50 patients in group "A" and other 50 patients were placed in group B. Data was analyzed in SPSS version 10.0. Percentages were computed for all parameters in both groups. Sensitivity, specificity, PPV and NPV of each method was calculated, using Cormac and Lehane score as the constant variable.

In group "A", 30 (60%) patients were females while 20 (40%) were males. The male to female ratio was 2:3. In group B the male to female ratio was also 2:3. The Classification of these patients according to Mallampati Classification, Thyromental and Sternomental Distance is shown in Table 2 and 3. The frequency of various risk factor used in Wilson Risk Sum is given in Table 4.

Table 2: Mallampati Classification
Group A n = 50

Class	No. of patients & percentages
Class I	23 (46.0%)
Class II	15 (30.0%)
Class III	12 (24.0%)
Class IV	0 (0%)

Table 3: Thyromental Distance and Sternomental Distance
Group A = 50

Thyromental Distance	No. of patients & percentages
>6.5cm	30 (60%)
<6.5cm	20 (40%)
Sternomental Distance	
>12.5cm	32 (64.0%)
<12.5cm	17 (34.0%)
12cm	1 (02%)

Table 4: Wilson Risk Sum
Group B n = 50

Risk Factor	Level & Score	Frequency percentage
Weight	<90Kg / 0 90-110Kg / 1 >110Kg / 2	18 (36.0%) 27 (54.0%) 5 (10%)
Head & Neck Movement	Above 90 / 0 Below 90 / 2	42 (84%) 8 (16%)
Jaw Movement	*IG > 5cm / 0 *IG < 5cm / 2	40 (80.0%) 10 (20.0%)
Receding Mandible	Normal / 0 Moderate / 1 Severe / 2	43 (86%) 6 (12%) 1 (02%)
Buck Teeth	Normal / 0 Moderate / 1 Severe / 1	24 (48.0%) 25 (50.0%) 1 (04%)

*IG = Interincisor Gap

Sensitivity, specificity, PPV and NPV were computed for both techniques taking Cormac and Lehane classification as gold standard and indentifying patients as difficult intubation.

DISCUSSION

Difficult tracheal intubation remains relatively constant among anesthesia related patient injuries and is the 3rd most common respiratory related event leading to death and brain damage in the ASA closed claims analysis.[7]

The ideal method for pre-op airway assessment should have a high sensitivity and specificity and result in minimal false positive and false negative predictions. While a false positive outcome may result in a greater expenditure of time or cause inconvenience (eg. setting up fiberoptic bronchoscope), the outcome of false negative, which means not predicting difficult laryngoscopy and intubation, could cause major morbidity and mortality.[8]

When using only a single test, studies showed a low sensitivity and specificity. Mallampati Classification[9] and its modification by Samsoon and Young,[10] have undergone much criticism of its clinical usefulness, reliability and predictability. It's reliability as a predictor of difficult intubation has been questioned as it assesses only one aspect of the airway for the difficulty (i.e intraoral disproportion), and is subject to observer variations. Hence many false positive and false negative results occur. Mallampati Classification has been reported to be a good

Table 5: Mallampati Classification + Thyromental & Sternomental Distance vs Wilson Risk Sum (n=100)

Test		Sensitivity	Specificity	PPV	NPV
Mallampati Classification	Thyromental Distance Sternomental Distance	38%	21%	30%	20%
Wilson Risk Sum		24%	18%	28%	15%

predictor by many but found to be of limited use by others.[11]

Moreover in Wilson Risk scoring, in the upper lip bite test[12] or protrusion of mandible, if a patient is able to protrude the lower teeth beyond the upper incisors, intubation is usually straight forward.[13,14] Although these methods can predict difficult intubation, they also produce a high incidence of false positive results, which may limit their usefulness.[15,16] Some clinicians do not feel easy with examining so many parameters and describe Wilson Risk Sum as complex scoring system.

Another important parameter is the Thyromental Distance and Sternomental distance, which are indicators of head extension, position of larynx and size of submandiblar space.[17] Large as well as small Thyromental Sistances[18] and small Thyromental Distance (TMD) are both indicators of difficult intubation. The exact null point with respect to correlating the TMD with difficult intubation is not known correlation is useful over a small to moderately large distance.[19] In different studies the sensitivity of Thyronmental Distance was found to be greater as compared to Sternomental Distance, which is comparable to our results.

We combined Mallampati Classification with Thyromental and Sternomental Distances and found it to have a higher sensitivity (38%), specificity (21%), positive predictive value (30%) and negative predictive value (20%) than Wilson Risk Sum alone. Our results show similarity with Frerk[20] who showed that patients who fulfilled the criteria of grade III or IV of Mallampati Classification, and who also had a Thyromental Distance less than 7cm were likely to present difficulty with intubation. Frerk suggested the combined approach of predicting the majority of difficult intubations. Also in a meta analysis of bed side screening tests, a poor to moderate discriminative power was reported when any test was used alone. Combination of individual tests or risk factors add some incremental diagnostic value in comparison with the value of each test alone, the best combination was Mallampati Classification and Thyromental Distance.[21]

In a study by Randell[22] modified Mallampati Classification by Samsoon and Young was a found to have sensitivity of 42-81% and specificity of 66-84%, whereas Thyromental Distance the sensitivity was 62-91% and specificity was 25-82% for less than 6-7 cm. Combining Mallampati class 3 and 4 and Thyromental Distance of less than 6.5 cm improved the positive predictive value from 17% + 19% to 64%, as shown in our study.

Shiga T et al[21], and Domi[1] 2009 concluded that combination of factors increases specificity, i.e number of cases correctly predicted as difficult intubation. Khan and Hussain.[23] concluded that pre operative evaluation picked up only 15% to 45% of patients who had actually clinically difficult intubation, while a number of normal patients were labelled as difficult cases. Their results showed that positive predictive value of combination of test was much higher.[23] Whereas in our series it was 30%.

The predictive value of Mallampati Classification is strengthened if Thyromental and Sternomental Distances are added. There is no perfect predictor of difficult intubation. Certain abnormalities have a much higher predictive value of a difficult airway compared to others. Restriction of head extension, decreased submandidular space and higer Mallampati class have a significant association with difficult glottic exposure.[24]

CONCLUSION

If Mallampati Classification is combined with Thyromental Distance and Sternomental Distance, the result of prediction of difficult intubations will be more accurate and seems to be a better choice.

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