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Airway Evaluation to Predict Difficult Laryngoscopy: Evaluation of Routine Parameters and Defining the Cutoff Value for Skin to Epiglottis Distance in Nepalese Population

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ABSTRACT

Introduction

Anesthesiologist is responsible for securing a continuously patent airway, failure to do so within critical minitues results in hypoxic consequences. It is essential to able to predict difficult laryngoscopy and intubation for which conventional airway examinations for relied upon. These conventional airway examinations have been found not to be hundred percent sensitive or specific and have found to have high inter observer variability. In such context and in the absence of adequate datas on Nepalese population, this study was conducted to aid to the data of airway examination parameters in Nepalese population and to find the place of ultrasonography in preanesthesia airway examination. Aim: To evaluate different preanesthesia airway examination parameters and to find the cutoff value of skin to epiglottis distance.

Methods

The study included all 120 cases posted for elective surgeries. All the patients underwent preanesthesia airway examination and the parameters were noted by one anesthesiologist. All the patients also underwent ultrasonography of airway and skin to epiglottis distance was measured and noted by another anesthesiologists. All the patients underwent surgery under general anesthesia after laryngoscopy and intubation. The observed parameters and skin to epiglottis distance were used for statistical analysis.

Results

Prevalence of difficult intubation was 9.4%. Conventional airway examination parameters were observed to be very less sensitive and have less positive predictive value but the specificity and negative predictive value were high. Thyromental distance was observed to have highest sensitivity of 65% and sternomental distance was observed to highest specificity of 96.5%. In difficult intubation group, the mean of skin to epiglottis distance was 16.57±0.97 mm and the calculated cutoff value was 14.63 mm.

Conclusions

Prevalence of difficult Laryngoscopy is high. The conventional airway examination tests are useful but may not be totally relied upon and ultrasonography can be a helpful aid.

Keywords: airway; difficult Laryngoscopy; prediction; ultrasound guided.

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INTRODUCTION

The fundamental responsibity of an anesthesiologist is to secure a continuously patent airway. Failure to do so within minutes may result in hypoxic consequences. It is established that inability to manage a difficult airway accounts for as many as 30% of mortality totally attributed due to anesthesia.[1] Non of the tests employed for assessment for difficult intubation are found to be one hundred percent sensitive or specific. The highest sensitivity of 94% is with thyromental distance where as sternomental distance has highest specificity of 62%. The tests also have high inter observer variability.[1,2] In one of the study in Nepalese population, mallampatti score was found to have high specificity and sensitivity. [3]

During the search for tests with higher predictability , ultrasound of the upper airway has been found to be useful. Rational behind the use of ultrasonography of the anterior neck is based on the observation that direct laryngoscopy involves the displacement of anterior neck structures such as the tongue, epiglottis and hyoid bone into the subglottic space. Increase in the thickness of anterior neck is hypothesized to decrease the mobility of these structures. [4]

The Aim of the study is to find the place of preintubation ultrasonography of upper airway to predict difficult Laryngoscopy using the skin to epiglottis distance.

METHODS

After approval from institutional review committee (IRC), the study was conducted in the Department of Anesthesiology, College of Medical Sciences, Bharatpur, Chitwan, Nepal.

One hundred and twenty ASA I and II patients aged above 18 years old, posted for elective surgery under general anesthesia were included. Patients who were ASA more than II, aged less than 18, maxillofacial injury with painful mouthopening, posted for emergency surgery and with history of airway, neck and cervical spine surgery were excluded from the study.All patients underwent a detailed preoperative airway evaluation on the day before surgery. All patients also underwent a detailed preintubation sonographic assessment by the anesthesiologist who was experienced in airway ultrasound and skin to epiglottis distance was noted and recorded. All the patients underwent surgery under general anesthesia after endotracheal intubation. CL grading was noted by another anesthesiologist and the patients divided into groups accordingly.

For sonographic assessment of the airway, the patient was made to lie in the supine position with head in the neutral position without pillow, looking straight ahead with the mouth closed and without any movement. The linear high-frequency probe (LN 5-12 Hz) of the ultrasound machine(Samsung mysono U6, made in Japan) was used to measure the skin to epiglottis distance.

Sample size calculation was calculated using datas from study by parameswori et al[5] with prevalance of difficult intubation of 9.2% by using the following formula and with error of 5%. Sample size was calculated to be 113.09 therefore we decided to take sample size of 120.

$$n = \frac{\left(Z\,1 - \frac{a}{2}\right) 2\,p\,(1 - p)}{(d)2}$$

Where,

n = Sample size

Z 1-α/2 = Standard normal variate = 1.96

p = prevalence

d = Absolute error

thus,

$$n = \frac{(1.96)\ 2 \times p\ (1 - p)2}{(0.05)2}$$

n = 113.09

Datas were collected and recorded in Microsoft office excel and statistical analysis was done using IBM SPSS statistics version 20 software. The frequency, sensitivity, specificity, positive predictive value, and negative predictive value were calculated for all the measured parameters. The association between different predictors and difficult laryngoscopy was evaluated using Chi-square test. The conventional method was used to determine a cutoff value. The confidence interval(95%) of mean was obtained by using the formula

Lower limit = mean – 1.96 SD

Upper limit = mean + 1.96 SD

RESULTS

In our study, the total participants were 120 patients presenting for elective surgeries under general anesthesia. The demographical data of the study population is as shown in table no.1.

Table 1. Demographical distribution of study population.

Patient characteristics	Values
Age in years	41.19±18.93
Gender Male Female	68 52
Weight in kg	63±19

Mallampatti grade I and II were observed in 108 and grade III and IV were observed in 12 participants. Mouth opening of more or equal to 4 cm was seen in 111 and less than 4 cm was seen in 9 participants.Sternomental distance was more or equal to 12 cm in 113 and less than 12 cm in 7 participants.In thyromental parameter, it was observed that 109 participants had more or equal to 6 cm and 11 participants had less than 6 cm.Difficult laryngoscopy view , grade III and IV, was seen in 11 particiapants, as shown in table no.2.

It was observed that all the routine preanesthetic checkup parameters have low sensitivity and positive predictive value, but have high specificity and negative predictive value, as shown in table no.3

Table 2. Frequency of different parameters.

Airway parameters	Group	Parameters (frequency)
Mallampatti	Grade I and II Grade III and IV	90.2% 9.8%
Mouth Opening	>or=4cm <4cm	92.5% 7.5%
Sternomental	>or=12cm <12cm	94.2% 5.8%
Thyromental	>or=6cm <6cm	90.8% 9.2%
Cormack and Lehane Grading	Grade I and II Grade III and IV	90.6% 9.4%

Table 3. Sensitivity, specificity, positive and negative predictive values of different parameters.

	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Mallampatti	55.5	92.9	59.2	92.7
Mouth Opening	55.8	94.9	67	92
Sternomental Distance	45.9	96.5	71	90.6
Thyromental Distance	65	93	63.4	93.5

The conventional method to determine a cutoff is 95% confidence interval of means.In our study, mean of skin to epiglottis distance, in difficult intubation group was 16.57 ± 0.97 mm. Thus the lower limit calculated was 16.57 – 1.96 x 0.97 = 14.66 mm.

DISCUSSION

During induction of anesthesia sequence of procedures done are preoxygenation with 100% oxygen, bag and mask ventilation in patients with empty stomach, laryngoscopy, tracheal intubation and assessment of proper placement of endotracheal tube. Preoxygenation with 100% oxygen buys time to avoid severe desaturation during difficult or failed intubation. Difficult bag and mask can result due to inadequate mask seal, excessive gas leakage or excessive resistance due to inadequate patency of the airway. Difficult laryngoscopy is defined as not being able to visualize any portion of the vocal cords after multiple attempts. Many include Cormack –Lehane grade III and grade IV and others define grade IV alone as difficult laryngoscopy. Difficult laryngoscopy is synonymous with difficult intubation in majority of patients. Tracheal intubation is defined as difficult when it requires multiple attempts in presence or absence of tracheal pathology, and inability to intubate after multiple attempts is called failed intubation.[1]

Prevalence of difficult laryngoscopy view (grade III and IV) in our study was 9.4%, which is higher than study done by shah et al in Nepalese population but was comparable with the study done by parameswori et al in indian population.[3,5] The differences in the result may be attributed to demographical difference and difference in ethnicity between the study population.

In overall study population, the predictors used were mouth opening, mallampatti, thyromental distance and sternomental distance. All the predictors in our study have very less sensitivity and positive predictive value but the specificity and negative predictive value are high. The results of the study, thus does not suggest to limit the use of these tests. The results are similar to study done by shah et al and singha et al.[3,6] Among the predictors, thyromental distance was the most sensitive (65%) indicator and sternomental distance (96.5%) was the most specific indicator of difficult laryngoscopy view.In other studies, one parameter of airway examinations have been suggested to be more sensitive and specific than another parameter. [3,7,8] Conflicting results of different studies have also lead to suggestions to use more than one predictors. [9]

Preoperative airway assessment tests requires to be highly sensitive and specific with low false positive and negative predictive values to identify the population at high risk of difficult laryngoscopy. [9] The results of our study also indicates the need of more specific tests to predict difficult laryngoscopy.

In our study, mean of skin to epiglottis distance

in difficult intubation group was 16.57 ± 0.97. Calculated lower limit is 14.66 mm which we suggest is the cutoff value for skin to epiglottis distance in Nepalese population. In different studies, cut off value of skin to epiglottis distance was 17.8 mm to 28 mm with varied sensitivity and specificity.[10,11] The differences may be attributable to sampling size, ethnicity and technique.

CONCLUSIONS

This study suggests that prevalence of difficult laryngoscopy is common in Nepalese population. None of the usually performed preoperative airway examination are not sensitive enough though specificity is high. High vigilance is always necessary to avoid difficult laryngoscopy and intubation. Combination of more than one tests is recommended. Use of easily available ultrasonography may aid in predicting difficult laryngoscopy.

Limitations

Limited datas due to less number of study on airway predictors in Nepalese population and study in small population.

Recommendations

We highly recommend use of more than one test and use of ultrasonography during airway examination. Further studies including different ultrasonography parameters is essential to establish the place of ultrasonography in preoperative airway examination.

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Conflict of Interest: The authors declare that no competing interests exist.

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