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Hyomental Distance Ratio as a Diagnostic Predictor of Difficult Laryngoscopy

KEYWORDS: Hyomental Distance Ratio, Predicting Difficult Laryngoscopy

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ABSTRACT *Purpose: This study has been done to evaluate the usefulness of the Hyomental Distance Ratio (HMDR) for accurately predicting difficult visualization of the larynx (DVL) in apparently normal patients in comparison with other predictors.*

Methods: 198 apparently normal patients of more than 18 years of age, with ASA I and II, undergoing general anesthesia with tracheal intubation were evaluated. A hard-plastic bond ruler is used to measure the distance from the tip to the anterior-most part of the mentum was measured and defined as the Hyomental distance. After induction using thiopentone and paralysis using suxamethonium, glottic visualisation was assessed by using modified Cormach and Lehane classification without external laryngeal manipulation

Results: The sensitivity of HMDR for predicting Difficult Laryngoscopy was 27.78% and specificity was 98.89%. The test has a positive predictive value of 71.43% , Negative predictive value of 93.19%

Conclusion: HMDR is a clinically reliable predictor of DVL to certain extent because of its high specificity and negative predictive value. Seeking an optimal combination of tests that includes the HMDR and other predictors is recommended.

INTRODUCTION

Failure to manage the airway is the most significant cause of morbidity and mortality in anesthetized patients.[1] Difficult laryngoscopy (defined by poor glottic visualization) is synonymous with difficult intubation during surgery in most patients.[2] Anesthesiologists have often been confronted with the difficult question of determining which patient will present an increased difficulty for intubation.

Visualization of the larynx is usually described using the Cormack and Lehane grades,[4] with grades 3 and 4 indicating difficult visualization of the larynx (DVL). The incidence of DVL is 1.5 - 8% in general surgical patients but higher in patients undergoing cervical spine surgery (20%) [5] or laryngeal surgery (30%).[6]

This study has been undertaken with a purpose to evaluate the usefulness of the HMDR for accurately predicting DVL in apparently normal patients. The preoperative airway predictors, alone and in combination; the modified Mallampati test, HMD in the neutral position, HMD and thyromental distance (TMD) at the extreme of head extension, and HMDR were examined.

PATIENTS AND METHODS

Ethics Committee approval was taken before starting the study. Written informed consent was taken from the patients involved in the study.

Patient selection: 198 apparently normal patients of more than 18 years of age, with ASA I and II, undergoing general anesthesia with tracheal intubation were evaluated. Exclusion criteria were: pregnant patients, mouth opening < 3cm, midline neck swellings, gross anatomical abnormality, recent surgery of the head and neck, upper airway disease (e.g. maxillofacial fracture or tumors), loose teeth, those requiring a rapid sequence or awake intubation.

Each patient underwent a preoperative assessment. Intraoperatively, the patients were positioned supine, with the head firm on the table. They were instructed to look straight ahead, keep the head in the neural position, close the mouth and not swallow.

A hard-plastic bond ruler was pressed on the skin surface just above the hyoid bone, and the distance from the tip to the anterior-most part of the mentum was measured and defined as the Hyomental distance (HMD) in the neutral position.

The patients were then instructed to extend the head maximally, taking care that the shoulders were not lifted while extending the head. The HMD was measured again in this position, and this variable was defined as the HMD at the extreme of head extension.

The straight distance from the anterior-most part of the mentum to the thyroid notch were measured and defined as the thyromental distance (TMD).

The Hyomental distance ratio (HMDR) was calculated as the ratio of HMD at the extreme of head extension to that in the neutral position.

After preoxygenation, all patients were induced using thiopentone and paralysed using suxamethonium to facilitate good orotracheal intubating condition. Laryngoscopy was performed after full relaxation. The head was placed in sniffing position on a head ring or pillow and an appropriate Macintosh blade was used by a consultant anaesthesiologist.

Glottic visualisation was assessed by using modified Cormach and Lehane classification without external laryngeal manipulation.

External laryngeal pressure was permitted after evaluation for insertion of endotracheal tube. Cormack and Lehane grades 3 and 4 was defined as Difficult visualization of the larynx (DVL) in this study. The sensitivity, specificity and positive and negative predictive values of each tests was calculated according to standard formula.

Statistical analysis was done using students't' test and chi-square test.

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RESULTS:
The Chi-square test was used for statistical analysis of variables. The study done on 198 patients included 102 male (51.51%) and 96 female (48.48%) patients. We observe that there is slight male preponderance in the study.

	Frequency	Percent
Male	102	51.51
Female	96	48.48
Total	198	100

The sensitivity of modified Mallampati test for predicting Difficult Laryngoscopy (DL) was 44.44% and specificity was 99.44%. The test has a positive predictive value of 88.89% and negative predictive value of 94.71%.

The sensitivity of HMD at the extreme of head extension for predicting DL was 11.11% and specificity was 95.56%. The test has a positive predictive value of 20% and negative predictive value of 91.49%.

The sensitivity of HMD in the neutral position for predicting DL was 0% and specificity was 98.89%. The test has a positive predictive value of 0% and negative predictive value of 90.82%.

The sensitivity of HMDR for predicting DL was 27.78% and specificity was 98.89%. The test has a positive predictive value of 71.43%, and negative predictive value of 93.19%. (Table 1 and Figure 1).

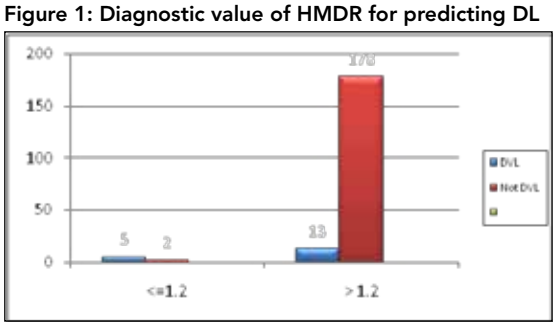
Table 1: Diagnostic value of HMDR for predicting DL

Table: Diagnostic Validity of HMDR for predicting Difficult Laryngoscopy.

HMDR		Difficult visualization of the larynx		Total
		Yes	No	
HMDR ≥ 1.2	Yes	5	2	7
	No	13	178	191
Grand Total		18	180	198

TP (a)	TN (a)	FP (a)	FN (a)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
5	178	2	13	27.78	98.89	71.43	93.19

Figure 1: Diagnostic value of HMDR for predicting DL



The sensitivity of TMD at the extreme of head extension for predicting DL was 11.11% and specificity was 96.67%. The test has a positive predictive value of 25% and negative predictive value of 91.58%.

In our study, overall sensitivity of the diagnostic predictors was relatively less. The highest sensitivity of 44.44% (8/18) was observed in predicting DVL with modified Mallampati followed by HMDR 27.78 % (5/18), TMD 11.11 % (2/18) and HMD at the extreme of Head (11.11 % (2/18). In contrast, the specificity in our study was relatively high. The highest specificity of 99.44 % (179/180) was observed in predicting DVL with modified Mallampati followed by HMDR 98.89 % (178/180), HMD at the neutral position 98.89 % (178/180), TMD 96.67 % (174/180) and HMD at the extreme of head extension at 95.56 % (172/180).

DISCUSSION:
DVL is a major cause of difficult intubation in many patients. Therefore, preoperative identification of those patients at risk for difficult laryngoscopy is important in adopting safer alternative strategies for the induction of anesthesia and intubation.

Though, various studies investigated diagnostic utility of HMD and other parameters, no study has quantified its diagnostic validity for predicting DVL. Therefore, this study has been undertaken with a purpose to evaluate the usefulness of the HMDR for accurately predicting DVL in apparently normal patients. The preoperative airway predictors; the modified Mallampati test, HMD in the neutral position, HMD and thyromental distance (TMD) at the extreme of head extension, and HMDR were examined.

Incidence:
In our study, the larynx was difficult to visualize (Cormack and Lehane grades III and IV) in 18 / 198 (9.09 %) patients. No failed tracheal intubations occurred. The incidence of 9.09% is consistent with the incidence reported in literature.

In one meta-analysis in 14,438 patients, a DVL incidence of 6% -27% was seen.[8] Huh et al reported 12.2% incidence of DVL in 213 apparently normal patients undergoing general anesthesia with tracheal intubation. The wide variations in the incidence of DVL may be related to factors such as age and ethnic differences among patients [9,10] or types of laryngoscope blade used. [11]

Sensitivity and specificity of HMDR:
The ideal test for DVL prediction should have 100% sensitivity and 100% specificity; however, sensitivity and specificity are inversely proportional to each other. Optimal cutoffs used in our study to calculate the sensitivity and specificity in our study were HMD at the extreme of head extension ≤5.3 cm; HMD in the neutral position > 5.5 cm; HMDR ≤1.2; TMD at the extreme of head extension ≤6.2 cm; Modified Mallampati Class ≥3.

In our study, overall sensitivity of diagnostic predictors was relatively less. The highest sensitivity of 44.44 % (8/18) was observed in predicting DVL with modified Mallampati followed by HMDR 27.78 % (5/18) and TMD (11.11 % (2/18)and HMD at the extreme of Head (11.11 % (2/18). In contrast, the specificity in our study was relatively high. The highest specificity of 99.44 % (179/180) was observed in predicting DVL with modified Mallampati followed by HMDR 98.89 % (178/180), HMD at the neutral position 98.89 % (178/180), TMD 96.67 % (174/180) and HMD at the extreme at head 95.56 % (172/180).

These findings are in contrast to the observations by Huh who reported that the HMDR with the optimal cutoff point of 1.2 had greater diagnostic accuracy (area under the curve of 0.782), than other single predictors ($P < 0.05$), and it alone showed a greater diagnostic validity profile (sensitivity, 88%; specificity, 60%) than any test combinations. Sensitivity and specificity of other diagnostic predictor were HMD at the extreme of head extension ≤5.3 cm (46% & 81 %); HMD in the neutral position > 5.5 cm (23% 95%); TMD at the extreme of head extension ≤6.2 cm (31% & 92%); Modified Mallampati Class ≥3 (12 %&94 %). [3]

Various studies that assessed the sensitivity, specificity and predictive values of different diagnostic predictors have come across variable findings and this was largely due to the different diagnostic criteria adopted by the investigators. Mathew et al demonstrated that patients with TMD of <6cm and horizontal length of mandible <9cm showed good correlation with MMT grade III and IV and had a higher probability of difficult intubation. On the other hand, those with TMD of < 6cm and horizontal length of mandible > 9 cm correlated well with MMT grade I and II with a lesser possibility of difficult intubation. [7]

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There are some potential limitations to our study design. First, intersubject variability was possible because the end point for extending the head maximally depended on the voluntary participation of each subject. We tried to clearly explain each maneuver to the patients and demonstrated it when necessary; thus, we believe that intersubject variability was of minor importance in this study. Second, intrarater variability was possible, because a single investigator performed all of the measurements at once in a test. Finally, although DVL is a major determinant of difficult intubation, it is not synonymous with difficult intubation. In this study, we defined the modified C-L Grade 3 or 4 as an indicator of DVL. In many clinical situations, however, the application of external laryngeal pressure facilitates a laryngoscopic view and intubation can be performed without difficulty in these patients. In addition, direct laryngoscopy is not the only way to secure and maintain an airway, although it is the most common means of facilitating intubation.

CONCLUSION:

We demonstrated that HMDR is a clinically reliable predictor of DVL to certain extent because of its high specificity and negative predictive value. However, due to very low sensitivity and positive predictive value, we proposed higher cut off (≤ 1.25) for HMDR. We recommend MMT test should be used because of its greater diagnostic accuracy than any other tests in this study. We also recommend seeking an optimal combination of tests that includes the HMDR and other predictors and performing the tests in combination, rather than using it alone.

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