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ORIGINAL ARTICLE

Diagnostic Accuracy of Hyomental Distance Ratio (HMDR) for Prediction of Difficult Laryngoscopy in Patients Undergoing Surgery Under General Anesthesia Using Tracheal Intubation

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ABSTRACT

Background: To keep the airway open, a flexible plastic tube (ETT) is inserted into the trachea during tracheal intubation. Even when done correctly, tracheal intubation requires much clinical experience, and catastrophic problems can occur. Mandibular space has been estimated using hyomental distance (HMD), although HMD has only been found to provide a limited amount of diagnostic accuracy on its own. In order to determine how well the Hyomental Distance Ratio (HMDR) predicts difficult laryngoscopy, we conducted this study.

Objectives: Using the Cormack and Lehane classification as the gold standard, the objective is to assess the diagnostic validity of the Hyomental Distance Ratio (HMDR) for the prediction of challenging laryngoscopy in patients undergoing surgery under general anaesthesia.

Materials & Methods: The department of anesthesiology and the general surgery operating rooms at Sir Ganga Ram Hospital in Lahore conducted this cross-sectional study over the course of six months in 2015–2016. The approach of non-probability purposive sampling was applied. Informed consent was acquired, and patient demographics were recorded. The researcher herself then assessed patients for HDMR. In order to determine if a patient had a difficult or normal laryngoscopy, HDMR was determined. After that, the researcher performed a laryngoscopy on the patients. If the vocal cords were visible, the mouth was opened, and the case was assessed using the Cormack and Lehane classification (CL), with easy or difficult laryngoscopy being designated. SPSS version 20 was used to enter and analyse all of the data.

Results: The patients in our study had a mean age of 43.23 11.63 years and a male to female ratio of 1.5:1. In this study, 43.91% of patients had an HDR difficult intubation. HDR's difficult intubation has a sensitivity of 95.05%, a specificity of 96.12%, and a diagnostic accuracy of 95.65% when using CL as the gold standard.

Practical Implication: According to this study, this strategy can be applied accurately in other hospitals. Government should establish guidelines for using the most trustworthy techniques as the benchmark in healthcare settings.

Conclusion: According to the findings of our study, the HMDR is a viable diagnostic tool for anticipating challenging laryngoscopy in patients having general anaesthesia with tracheal intubation. According to this study, this strategy can be applied accurately in other hospitals. Government should establish guidelines for using the most trustworthy techniques as the benchmark in healthcare settings.

Keywords: Laryngoscopy, difficult intubation, Cormack Classification, difficult surgery

INTRODUCTION

The field of anaesthesia is distinctive. The importance of the airway is emphasised from the beginning of our training, and every anesthesiologist has experienced the icy fear that comes with realising that normal anatomic features are obscured. Maintaining proper gas exchange is the anesthesiologists' primary duty. As a result, the airway must be controlled such that it is always patent [1].

A significant and potentially fatal consequence during the induction of general anaesthesia is challenging or unsuccessful tracheal intubation by direct laryngoscopy. It is thought that anywhere between 1% and 3% of intubation or secured airway complications are of any kind [2,3].

In patients having surgery, the rate of tracheal intubation difficulty has been estimated to range from 0.5 to 18%. Laryngoscopy visualisation of the glottis depends on a number of variables, including head extension and Hyomental distance (HMD). HMD, which measures the distance between the hyoid bone and the mentum, is occasionally used to forecast challenging direct laryngoscopy but is ineffective [4,5].

According to one study, using Cormack and Lehane categorization as the gold standard, the HMDR's sensitivity for predicting DL was 27.78%, specificity was 98.89%, PPV was 71.43%, and NPV was 93.19%.Cormack and Lehane's grading system, grade 3 and above (annexure I), has a sensitivity of 100% and a specificity of 99.6% for predicting difficult intubation. [6,7, 8]

A study found that due to its high specificity and NPV, HMDR is, to some extent, a clinically reliable predictor of DL. However, it could not be regarded as a reliable approach due to its extremely poor sensitivity and PPV [9,10].

However, according to a different study, HMDR had a sensitivity of 88%, a specificity of 60%, a PPV of 23%, and an NPV of 97% for predicting DL. The HMDR is a clinically reliable predictor of DL, and a value of 1.2 can be utilised as a test threshold, according to the authors' findings. [11,12,13,14]

The goal of this study is to determine the diagnostic efficacy of Hyomental Distance Ratio (HMDR) for difficult laryngoscopy prediction in patients having tracheal intubation after surgery while under general anaesthesia using the Cormack and Lehane classification as the gold standard.

Prior to intubation, patients undergoing general anaesthesia for surgery are routinely given the HMDR to estimate how easy or difficult it will be. However, the reliability of HMDR has generated conflicting results in the literature.

Therefore, the purpose of this study is to verify if HMDR can be trusted to predict intubation. If not, we will employ another technique to determine if intubation will be simple or complicated. Furthermore, there was no local evidence in the literature on this subject. This will assist us in improving our procedures and rules while also assisting in achieving local magnitude for our population.

Objective: Using the Cormack and Lehane classification as the gold standard, evaluate the diagnostic validity of the Hyomental Distance Ratio (HMDR) for the prediction of challenging laryngoscopy in patients undergoing surgery under general anaesthesia.

Definitions for operations: Challenging laryngoscopy

The ratio of the hyomental distances in the neutral and maximum head extension positions, both measured in centimetres, is known as HDMR. If HMDR 1.2, laryngoscopy was classified as challenging. Laryngoscopy is referred to as difficult if Cormack and Lehane classification was grade III or higher.

HMDR 1.2 and Cormack and Lehane classification grade III or higher constitute true positives (TPs).

False positive (FP): When the HMDR is less than 1.2 yet the Cormack and Lehane classification is II or lower

When HMDR > 1.2 and Cormack and Lehane classification II or below, it is a true negative (TN).

False negative (FN): When the HMDR is more than 1.2 but the Cormack and Lehane classification is grade III or higher

TP/ (TP+FN) Sensitivity

Particularity: TN/ (TN+FP)

TP/ (TP+FP): Positive Predictive Value

TN/ (TN+FN): Negative Predictive Value

RESOURCES AND METHODS

Study Plan: Cross-sectional research

Setting: General surgery operating rooms and the department of anaesthesia at Sir Ganga Ram Hospital in Lahore

Time Spent on Study: Six Months

Instance Size: With a 95% confidence level, 9% sensitivity and 8% specificity margins of error, and using the expected percentage of difficult laryngoscopy (18%), HMDR sensitivity of 88%, and HDMR specificity of 60% as the gold standard, a sample size of 230 cases was computed.

Sampling Method: Successive non-probability sampling

Sampling Standards

Inclusion Standards: Patients with ASA I and II who are 20 to 60 years old, male or female, and having elective surgery under general anaesthesia with tracheal intubation

Exclusion Standards: Pregnant women Patients having a midline neck swelling, a mouth opening of less than 3 cm, or a major anatomical anomaly (clinical examination)

Patients with a recent head-and-neck surgical history and upper airway disease (e.g. maxillofacial fracture or tumors)

Patients that need an intubation quickly include those undergoing emergency procedures, those who are full, and those with an inflamed abdomen, such as those with appendicitis.

Data Collection Methodology: 230 patients who met the inclusion criteria were enrolled in the study from the operating room of the Department of Surgery at Sir Ganga Ram Hospital in Lahore after receiving approval from the hospital ethical council. A patient's informed consent was acquired, and the name, age, and procedure type of the patient were recorded. The researcher herself then assessed patients for HDMR. In order to determine if a patient had a difficult or normal laryngoscopy, HDMR was determined. After that, the researcher performed a laryngoscopy on the patients. If vocal cords were seen, the mouth was opened, and the case was rated using the Cormack and Lehane classification, with easy or difficult laryngoscopy being identified (as per operational definition). This data was captured on a proforma (attached).

Data Analysis Methodology: IBM SPSS 20 was used to enter and evaluate the data. Age and HMDR quantitative data were reported as mean and standard deviation. Qualitative information such as gender and the percentage of difficult laryngoscopies (based on the HDMR and Cormack and Lehane classification) were presented. Using Cormack and Lehane classification as the benchmark, 2x2 tables were created to calculate the sensitivity, specificity, PPV, NPV, and diagnostic accuracy of the HMDR. In order to account for effect modifiers, data were stratified by age, gender, and BMI. Chi-square test was used after stratification. P-values under 0.05 were deemed significant.

RESULTS

A total of 230 instances were included in our investigation. The patients ranged in age from 20 to 60 years old, with 43.23 as the mean age and 11.63 as the maximum. Table#1

In our study, patients made up 39.57% women and 60.43% men. There were 1.5 times as many men as women. Fig#1

According to the study's findings, 45 patients (19.6%) had an obese BMI, 60 patients (26.1%) had an underweight BMI, 66 patients (28.7%) had a normal BMI, 59 patients (25.7%) had an overweight BMI, and 60 patients (26.1%) had an underweight BMI. Table#2

According to the study's findings, the patients' mean HDR value was 1.520.57, with minimum and highest values of 0.60 and 2.50, respectively. Table#3

In this study, 43.91% of the patients had HDR difficult intubation, while 56.09% did not. Fig#2

In our study, 55 patients (23.9%) showed up with one CORMACK AND LEHANE (CL) classification, 74 patients (32.2%) showed up with two, 65 patients (28.3%) showed up with three, and 36 patients (15.7%) showed up with four CL classifications.Table#4

In this study, 43.91% of the patients had CL difficult intubation, while 56.09% did not. Fig#3

According to the study's findings, HDR difficult intubation had a sensitivity of 95.05% and a specificity of 96.12%, a PPV value of 95.05%, an NPV value of 96.12%, and a diagnostic accuracy of 95.65% when using CL as the gold standard. Table#5

The study's findings revealed that, in patients under the age of 40, the HDR difficult intubation was reported in 38 cases, while the CL intubation was noted in 37 cases. In patients over 40, the HDR difficult intubation was noted in 63 cases, while the CL intubation was noted in 59 cases. By stratifying by age, a statistically significant difference between the HDR and CL difficult intubations was discovered. p-values are 0.000 and 0.000, respectively. Table#6

In male patients, the HDR difficult intubation was reported in 61 cases, compared to 59 cases for CL intubation, according to the study's findings. For female patients, the HDR difficult intubation was noted in 40 cases, compared to 37 cases for CL intubation. By stratifying by gender, a statistically highly significant difference between the HDR and CL difficult intubations was discovered, with p-values of 0.000 and 0.000, respectively. Table#7

The study's findings revealed that the HDR difficult intubation was noted in 27 cases involving underweight patients, 27 of which also involved normal patients; similarly, the HDR difficult intubation was noted in 24 cases involving normal patients; in 29 cases involving overweight patients; and in 21 cases involving obese patients. According to statistics, the HDR and CL difficult intubations stratified by BMI were shown to differ significantly, with p-values of 0.000, 0.000, 0.000, and 0.000, respectively. Table#8.

Table#1

Descriptive statistics of age (years)

Age (years)	n	230
	Mean	43.23
	SD	11.63
	Minimum	20
	Maximum	60

Table#2

Frequency distribution of BMI

		Frequency	Percent
BMI	Underweight	60	26.1
	Normal	66	28.7
	Overweight	59	25.7
	Obese	45	19.6
	Total	230	100.0

Table#3

Descriptive statistics of HDR

HDR	n	230
	Mean	1.52
	SD	0.57
	Minimum	0.60
	Maximum	2.50

Table#4

Frequency distribution of CORMACK N LEHANE classification

		Frequency	Percent
CL classification	One	55	23.9
	Two	74	32.2
	Three	65	28.3
	Four	36	15.7
	Total	230	100.0

Table#5

Comparison of HDR difficult intubation with CL difficult intubation

		Difficult intubation CL		Total
		Yes	No	
Difficult intubation HDR	Yes	96	5	101
	No	5	124	129
Total		101	129	230

Sensitivity	95.05%
Specificity	96.12%
Positive Predictive Value	95.05%
Negative Predictive Value	96.12%
Diagnostic Accuracy	95.65%

Table#6

Comparison of HDR difficult intubation with CL difficult intubation stratifying by age

Age	HDR difficult intubation	CL Difficult Intubation		Total	p-value
		Yes	No		
< 40	Yes	37	1	38	0.000
	No	3	44	47	
≥ 40	Yes	59	4	63	0.000
	No	2	80	82	

Table#7

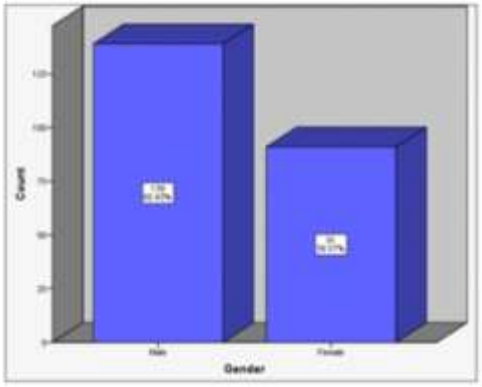
Comparison of HDR difficult intubation with CL difficult intubation stratifying by gender

Sex	HDR difficult intubation	CL Difficult Intubation		Total	p-value
		Yes	No		
Male	Yes	59	2	61	0.000
	No	2	76	78	
Female	Yes	37	3	40	0.000
	No	3	48	51	

Table#8

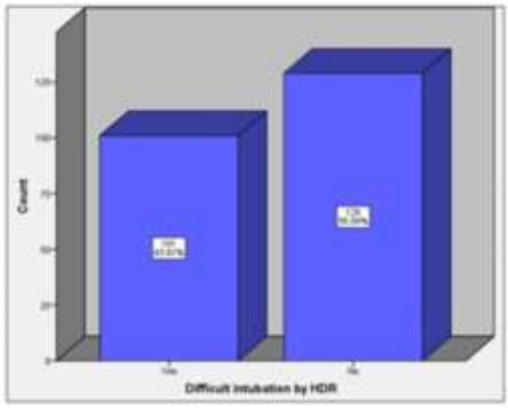
Comparison of HDR difficult intubation with CL difficult intubation stratifying by BMI

BMI	HDR difficult intubation	CL Difficult Intubation		Total	p-value
		Yes	No		
Under weight	Yes	27	0	27	0.000
	No	1	32	33	
Normal	Yes	22	2	24	0.000
	No	1	41	42	
Over weight	Yes	28	1	29	0.000
	No	2	28	30	
Obese	Yes	19	2	21	0.000
	No	1	23	24	



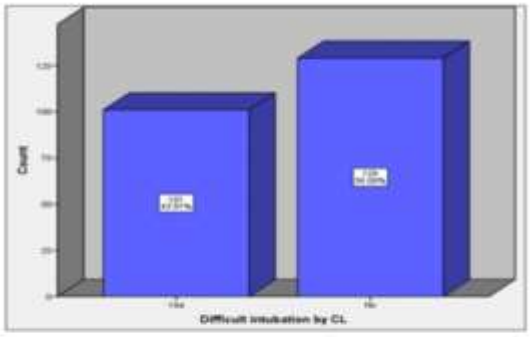
Fig#1

Frequency distribution of gender



Fig#2

Frequency distribution of HDR difficult intubation



Fig#3

Frequency distribution of CL difficult intubation

DISCUSSION

The goal of the current cross-sectional study, which used the Cormack and Lehane classification as the gold standard, was to evaluate the diagnostic efficacy of the Hyomental Distance Ratio (HMDR) for the prediction of difficult laryngoscopy in patients undergoing surgery under general anaesthesia using tracheal intubation. The study was conducted at the department of anesthesiology and general surgery operation theatres, Sir Ganga Ram Hospital, Lahore.

Whether in an operating room, labour and delivery room, casualty department, or critical care unit, airway control is the first concern and always takes precedence. Intubation problems are a frequent cause of anesthesia-related morbidity and mortality. Intubation challenges are typically accompanied by challenges during direct laryngoscopy glottis exposure [15,16, 17].

In our investigation, HDR difficult intubation had a sensitivity of 95.05%, a specificity of 96.12%, and a diagnostic accuracy of 95.65% when using CL as the gold standard [18,19]. The research that support our analysis are discussed in the sections that follow.

Due to its high specificity and negative predictive value, the HMDR is a clinically valid predictor of DVL to some extent, according to [20, 21] However, we suggested a higher cut off for HMDR (1.25) due to the extremely poor sensitivity and positive predictive value.

According to one study, using Cormack and Lehane categorization as the gold standard, the HMDR's sensitivity for predicting DL was 27.78%, specificity was 98.89%, PPV was 71.43%, and NPV was 93.19% [22].

Cormack and Lehane's grading system, grade 3 and above (annexure I), has a sensitivity of 100% and a specificity of 99.6% for predicting difficult intubation.Huh 9 made the following observations, stating that the HMDR with the ideal cut off point of 1.2 had better diagnostic accuracy (area under the curve of 0.782) than other single predictors (P 0.05), and that it alone demonstrated a better diagnostic validity profile (sensitivity, 88%; specificity, 60%) than any test combinations [23,24,25].

In a recent study, defined the hyomental distance ratio (HMDR) as the ratio of the HMD in neutral position and at the maximum head extension, and they showed that it was a reliable indicator of a decreased capacity for occipito-atlantoaxial (OAA) complex extension [26,27.]

According to another study, HMDR had a sensitivity of 88%, a specificity of 60%, a PPV of 23%, and an NPV of 97% for predicting DL. The HMDR is a clinically reliable predictor of DVL, and a value of 1.2 can be utilised as a test threshold, according to the authors' findings [28,29].

HMDR values of less than 1.2 corresponded with CL grades III and IV and had statistically significant diagnostic validity when used to predict DVL. They came to the conclusion that the HMDR

is a trustworthy bedside test that accurately predicts difficult laryngoscopy without being influenced by age, sex, or racial prejudice [30].

On the other hand, came to the conclusion that there is no exact predictor of a difficult intubation. Compared to other anomalies, some have substantially increased odds of having a problematic airway. Restricted head extension, a smaller mandibular space (mento-hyoid distance), and a low Mallampati oropharyngeal class all significantly correlate with challenging glottis exposure, in that order.

CONCLUSION

Based on the findings of our investigation, Cormack and Lehane classification can be replaced with the HMDR as a reliable diagnostic tool for predicting difficult laryngoscopy in patients undergoing surgery under general anaesthesia utilising tracheal intubation. According to this study, this strategy can be applied accurately in other hospitals. Government should establish guidelines for using the most trustworthy techniques as the benchmark in healthcare settings.

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