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Research Paper

Hyomental Distance Ratio & Prediction of Difficult Laryngoscopy with Cormack Leahane Grading

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ABSTRACT:- A prospective analysis of hyomental distance ratio in prediction of difficult laryngoscopy and intubation was undertaken in 300 patients posted for elective surgeries. Hyomental distance (HMD) is the distance between the tip of hyoid bone to mental prominence and is probably the only estimation not affected by age/sex/racial discrimation. Hyomental distance ratio is defined as the ratio of hyomental distance at extreme of head extension to hyomental distance in neutral position of head.

Thus, we evaluated the efficacy of HMDR in predicting difficult visualization of larynx (DVL) along with MMC and Body Mass Index (BMI).

METHOD: Preoperatively, 300 patients within the age group of 18-60 years, of both sexes, undergoing general anaesthesia with tracheal intubation, were evaluated for 5 airway predictors. Direct laryngoscopies were then performed by experienced anesthesiologist unaware of airway evaluation and graded the laryngoscopic views using the Cormack-lehane grading. DVL was defined as grade III and IV view. The optimal cut off point of each test were determined and statistically analyzed by chi square test with Yates correction two tailed p value.

OBSERVATION: Difficult laryngoscopy was assessed in 27 (9%) patients. From statistical analysis, extended position hyomental distance (EPHMD), HMDR, MMC and Height showed significant relation with DVL and variables like age, sex. weight, BMI and neutral position hyomental distance (NPHMD) were observed statistically insignificant in predicting correlation with DVL.

RESULT: HMDR with cutoff of 1.2, MMC class 3 and 4 are clinically reliable predictors of DVL but none of above test provided 100% prediction of difficult laryngoscopy and thus, we recommend seeking an optimal combination of tests that include HMDR, MMC and EPHMD for prediction of intubation than using them separately.

***Keywords**:-* Cormack-Lehane Grading (CL grading), Difficult laryngoscopy, Hyomental Distance Ratio (HMDR), Modified Mallampatti Classification (MMC).

I. INTRODUCTION

Airway management is a single most priority, which always takes precedence whether it is an operation theatre, labour suite, casualty department or critical care unit.[1] Maintaining patent airway is an important aspect of providing adequate ventilation and oxygenation; as failure to do so for even a brief period can be disastrous and can lead to morbidity and mortality. Therefore, airway evaluation and anticipation of difficult laryngoscopy is important in adapting safer alternative strategies for induction of anaesthesia and intuabtion.[2,3]

Since the first description of laryngoscopy and tracheal intubation, there have been numerous studies concerning both responses and maneuvers by which difficult intubation and difficult airway can be predicted. However, whether 100% true prediction is not possible and which variables should be used for evaluation remains debatable.

The hyomental distance (HMD) has been used to estimate the mandibular space, but the HMD alone was shown to have only a modest degree of diagnostic accuracy.[4] Recently, Takenaka et al defined the ratio of

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HMD in neutral position and at the extreme of head extension as the hyomental distance ratio (HMDR) and demonstrated that it was a good predictor of a reduced occipito-atlantoaxial (OAA) complex extension capacity.[5]

II. METHODS

This was single blind study conducted in attached teaching hospital after approval of ethics committee during period of August 2012 to August 2014. Written informed consent was obtained from all participating patients. The study was conducted in 300 adult patients of ASA grade I and II with age group of 18 to 60 years of both sexes who were scheduled to undergo general anaesthesia. Exclusion criteria included gross anatomical abnormalities, facio-maxillary surgeries, upper airway disease, those requiring rapid sequence induction or obese patients with BMI above 30.

The prior assessment of airway was performed by trained personnel who were not involved in laryngoscopy and tracheal intubation. Evaluation of MMC (Modified Mallampatti Classification) [6] and anthropometry was done preoperatively for further comparison with an original observation. Patients were kept in the supine position with the head on firm operating table and they were instructed to look straight ahead, keep the head in the neutral position, close the mouth and do not swallow. The distance from the tip to anterior most part of mentum was measured and defined as the 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 distance was measured again in this position and this variable was defined as the HMD at the extreme of head extension. HMDR was calculated as the ratio of the HMD at extreme of head extension to that in the neutral position.[2]

After all of the airway evaluations were completed, standard monitors were applied and after pre-oxygenation and premedication, anaesthesia was induced with standard protocol. Laryngoscopy was performed with the patient placed in the sniffing position using Macintosh blade under the effect of muscle relaxant.[7] Experienced anaesthesiologist blinded to the results of the airway assessments, performed all of the direct laryngoscopies and classified the laryngoscopic view according to Cormack-Lehane grading (CL grading).[8] Easy visualization of larynx (EVL) was defined as grade I and II and difficult visualization of larynx (DVL) was graded as III and IV.

Statistical analyses were performed with chi-square test with Yates correction two tailed p value.

III. OBSERVATION AND RESULTS: (Table 1)

From diagnostic validity profile table, out of study population of 300 patients, maximum patients belonged to age group of 18-30 years (young population). This study included 92 males and 208 females exhibiting female preponderance.

Difficult visualization of larynx (DVL) (CL grade III and IV) was observed in 27 patients (9%).

On correlating HMD at neutral position of head in predicting DVL showed no statistical significance with p value of 0.63; whereas extended position HMD of $\leq$ 6 cm showed statistical significance with p value of 0.0018. Similarly, HMDR (Hyomental Distance ratio) showed significant correlation in prediction of DVL with cut off of $\leq$ 1.2 with p value of 0.0081 and when MMC (Modified Mallampatti Classification) was correlated with CL grade, MMC class 3 and 4 showed high statistical significance with CL grade III and IV (i.e. DVL) with p value of < 0.0001.

Finally, in our study population height $\leq$ 160 cms was statistically significant with CL III and IV grade with p value of 0.0065 but failed to provide statistical significance with HMDR of $\leq$ 1.2 with p value of 0.4759.

Table no 1. Analysis of the variables affecting laryngoscopy difficulty.

Variable	EVL (CL grade I &II) n= 273	DVL (CL III & IV) n=27	p value
Gender (M/F) 92/208	86/187	6/21	0.43 Not significant
Age (years) Mean 31.2$\pm$ 9.8	30.9$\pm$9.43	34.4$\pm$12.7	0.56 Not significant
Weight (kgs) Mean 57.5+6.64	57.5$\pm$6.4	57.8$\pm$8.7	0.92 Not significant
Height (cms) Mean 164.5+6.55	164.9$\pm$6.39	160.7$\pm$7.1	0.007 Significant
BMI (kg/m^2) Mean 21.2+1.76	21.15$\pm$1.6	22.3$\pm$2.6	0.46 Not significant

MMC- Easy (class 1 &2) n=276	267	9	0.0001 significant
Difficult (class 3&4) n=24	6	18	0.0001 significant
HMD neutral NPHMD(cms)	5.78±0.5	5.6±0.92	0.64 Not significant
HMD in head extension EPHMD(cms)	6.98±0.59	6.3±1	0.002 Significant
HMDR	1.2±0.05	1.13±0.04	0.0081 Significant

(Significant < 0.05 and not significant > 0.05)

(EVL- Easy Visualisation of Larynx, DVL- Difficult Visualisation of Larynx, BMI- Body Mass Index, HMD- Hyomental Distance, HMDR- Hyomental Distance Ratio)

Table No. 2 – Categorization of patients of different HMDR with CL grades (n=300)

HMDR Grade (range)	CL GRADE				
	I	II	III	IV	TOTAL
1 – 1.1	0	5	8	1	14
1.11 – 1.2	100	62	14	1	177
1.21 – 1.3	71	22	2	1	96
1.31 – 1.4	8	3	0	0	11
>1.4	0	2	0	0	2
TOTAL	179	94	24	3	300

IV. DISCUSSION

Difficult Visualization of Larynx (DVL) is a major cause of difficult intubation leading to significant morbidity and mortality in anaesthetized patients. Therefore, preoperative identification of those patients at risk of difficult laryngoscopy is important in adopting safer alternative strategies for induction of anaesthesia and intubation.[3]

As there is no full proof test for predicting difficult laryngoscopy and intubation, multiple studies have been conducted globally and have different statistical figures.

The incidence of DVL in our study was 9% (27/300). No failed tracheal intubation occurred. The result was consistent with meta-analysis of 9 studies that included 14,438 patients having DVL incidence of 6-27%.[2,3] Huh et al (2009) reported 12.2% incidence of DVL in 213 apparently normal patients undergoing general anaesthesia with tracheal intubation.[2] The wide variation in the incidence of DVL may be related to factors such as age, ethnic difference or type of laryngoscopic blade used.[2,3]

In our study, we separately compared NPHMD and EPHMD with CL grading and evaluated EPHMD has statistical significance in predicting difficult visualization of larynx. Akinyemi (1990) predicted HMD in neutral position of less than 6cm had difficult laryngoscopy but he did not study EPHMD.[9]

On comparison between HMDR and CL grade, HMDR (Hyomental Distance Ratio) of less than equal to 1.2 had significant difficult visualization of larynx and more than 1.2 had maximum easy visualization of larynx. (Table 2)

Jin Huh (2009) and S.Rao (2013) had similar results of HMDR $\le$ 1.2 in DVL and Takenaka (2006) who studied ratio externally proved HMDR cutoff value of 1.25 for predicting DVL.

In addition when we studied above comparison of MMC of 3 and 4 was highly significant. Oates et al predicted MMC as bedside test with higher predictive value but had multiple problems like inter-observer variation and phonation.[10]

Other anthropometric parameters like weight, BMI (body mass index) when compared with HMDR showed non-significance of p value in DVL; but height of $\le$ 160 cms showed statistical significance with DVL, which was similar to study of Krobbuban (2005).[11]

There were some potential limitations in our study design which were similar to the study done by Jin Huh et al.[2] 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. We believe that intersubject variability were of minor importance in our study. Secondly, intrarater variability was possible, because the person measuring distance and performing laryngoscopy were different. Although DVL is a major factor defining difficult laryngoscopy, it is not synonymous with difficult intuabtion.

V. CONCLUSION

In our study, 9% of population was having difficulty in visualization of larynx but none of our patients had failed intubation. In prediction of DVL, HMDR of less than equal to 1.2 correlated with CL grading III and IV and proved to be of statistically significant diagnostic validity.

Although none of the above tests provided 100% prediction of difficult laryngoscopy, we concluded that HMDR is reliable bedside test predicting difficult laryngoscopy without getting affected by age, sex or racial discrimination. We recommend seeking an optimal combination of tests that include HMDR, MMC and EPHMD for prediction of difficult intubation than using them separately.

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Figure 1. HMD in neutral and maximal head extension