Original Article

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Identification of Patients With the Risk for Difficult Tracheal Intubation in the Intensive Care Unit.

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Abstract

Background: Aims: Identification of patients at risk for difficult visualization of the larynx (DVL) using Hyomental distance ratio (HMDR) in adopting an alternative strategy for intubation at intensive care unit. **Settings and Design:** Haemodynamicaly stable unconscious patients with GCS <8 admitted in intensive care unit requiring intubation. **Subjects and Methods:** A scale was put on to the surface on the skin near to hyoid bone, and distance from point near mentum to hyoid bone measured and was taken as the Hyo-mental distance (neutral position) and measurement taken by extension method and ratio calculated. After intravenous induction followed by paralysis,vocal cords were visualised and assessed with Cormach and Lehane method (C&L) classification. **Statistical analysis:** Done using students 't' test and chi-square test. **Results:** The highest sensitivity 26.30% observed in predicting DVL was with HMDR (26.30%). **Conclusion:** HMDR is a good and reliable predictor of DVL to certain extent , because of its higher specificity and negative predictive value.

Keywords: Hyo-mental Distance, Difficult visualization of larynx, Cormach and Lehane method (C&L) classification and Difficult airway, Intensive care unit.

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Introduction

Failure in managing airway is one of the significant cause for mortality and morbidity in intensive care unit patients. Staff are usually face increase in obese patients with deranged physiology and complex condition ,with airway difficulty, putting challenge to airway safety in intensive care unit.[1,2] Though several risk factors and scores for the difficult intubation are identified in anaesthesia practice, none of these are identified for intensive care unit patients. Such patients are different from patients undergoing elective surgery, with a increase in acute respiratory and hemodynamic variations and have bad intubating conditions than what we see in operative rooms. Significant complications can occur > 40% cases.[3-6] Early identification of the risk factors in difficult intubation could allow for an anticipation as well prepare for adequate material, use other alternative strategy for intubation, and call for additional assistance for intubation and to reduce morbidity. The hyomental distance (hmd) as been used for estimating mandibular space, but the Hyomental distance signally has shown to be only modest degree in diagnostic accuracy. Hyomental distance ratio (HMDR) that is the ratio of the Hyomental distance at neutral position and at extreme head extension. There were so many cases which the angle for optimal laryngoscopic view could exceed the extension capacity, in most apparently normal patients. In such case, optimal visualization of glottis could require maximum head extension while laryngoscopic intubation. Thus, assessment of extension capacity for occipito-atlanto-axial complex is very important component in pre-intubation test for predicting Difficult visualization of larynx.

Subjects and Methods

Inclusion Criteria

- Above the age of 18 years,
- Haemodynamicaly stable unconscious patients with GCS <8 in admitted in ICU.

Exclusion Criteria

- Pregnant patients
- Mouth opening <3cm
- Midline neck swellings
- Gross anatomical abnormality,
- Recent surgery for head and neck,
- Upper airway disease (eg; maxilla-facial fracture or tumours),
- Loose teeth, or patients requiring a rapid sequence intubation or awake intubation .

Experimental design

Approval taken from ethical committee . Written and informed consent from each patient attenders. Each patient will undergo a pre-intubation general physical examination and a detailed systemic examination. The patient kept in the supine position, with the head on a firm on ICU(Intensive care unit) bed. The patients head kept in neural position, asked to close the mouth. A plastic ruler was pressed on skin just near to the hyoid bone, and the distance from anterior most part of the mentum measured and it was defined as the Hyo-mental distance in neutral position . The patients were instructed to extend the head maximally as posible, taking care of shoulders which was not lifted during extention of the head. The Hyo-mental distance was measured again in this position, and this variable was defined as the Hyo-mental distance at extreme head extension. Using this method in the same position, straight distance from anterior part of the mentum to thyroid notch was measured and defined as thyro-mental distance at extreme head extension. The Hyo-mental distance ratio calculated as the ratio of Hyo-mental distance at extreme head extension to that in neutral position. After pre-oxygenation patients were induced by propofol and paralysed with neuro-muscular blocking agent suxamethonium after check ventilation to facilitate oro-tracheal intubation . Laryngoscopy were performed only after full relaxation. The head was placed in sniffing position over the head ring and an using appropriate Macintosh blade , by consultant anaesthesiologist (with 3 years experience). Glottic visualisation was assessed using modified Cormach and Lehane method classification with-out external laryngeal manipulation . External laryngeal pressure was permitted only after evaluation , for insertion of endotracheal tube. Cormack and Lehane grades 3 and 4 was defined as Difficult visualization of larynx in our study. The Statistical analysis done using sensitivity, specificity, positive and negative predictive values of each tests calculated by standard formula.

Results

The study done on 301 patients included 152 male (50.50%) and 149 female (49.50%) patients. We observe that there is slight male preponderance in the study.

Table 1: Diagnostic value of hmd in extension position for predicting DVL.

HMD extreme head extension		DVL = Yes	DVL= NO	Total
hmd extreme head extension</=5.3	YES	4	16	20
	NO	24	257	281
Grand Total		28	273	301

Sn =14.29% Sp=94.14% Ppv=20% Npv=91.46%

Sensitivity(Sn) of hmd at extreme head extension for predicting dl was 14.29% and specificity(Sp) was 94.14%. The test has a positive predictive value (ppv) of 20% and negative predictive value(npv) of 91.46%.

Table 2: Diagnostic value of hmd of neutral position for predicting DVL

HMD neutral position		DVL=YES	DVL=NO	Total
hmd neutral position>/= 5.5	YES	2	8	10
	NO	18	273	291
Grand total		20	281	301

Sn =10% sp=97.15% ppv=20% npv=93.81%

The sensitivity of hmd in the neutral position for predicting DVL was 10% and specificity was 97.15%. The test has a positive predictive value of 20% and negative predictive value of 93.81%.

Table 3: Diagnostic value of HMDR for predicting DVL

HMDR		DVL=YES	DVL=NO	Total
HMDR </=1.2	YES	10	4	14
	NO	28	259	287
Grand total		38	263	301

sn=26.30% sp=98.48% ppv=71.43% npv=90.24%

The sensitivity of HMDR for predicting DVL was 26.30% and specificity was 98.48%. The test has a positive predictive value of 71.43%, and negative predictive value of 90.24%. [Table 1].

Table 4 : Diagnostic value of tmd for predicting DVL

tmd at the extreme head extension		DVL=YES	DVL=NO	Total
tmd at the extreme head extension </= 6.2	Yes	3	10	13
	NO	28	260	288
Grand Total		31	270	301

sn=9.68% sp=96.30% ppv=23.08% npv=90.23%

The sensitivity of tmd at the extreme of head extension for predicting DL was 9.68% and specificity was 96.30%. The test has a positive predictive value of 23.08% and negative predictive value of 90.23%.

In this study, overall sensitivity of all the diagnostic predictors found to be relatively less. The highest sensitivity 26.30% observed in predicting DVL was with HMDR (26.30%), followed by hmd at extreme head extension (14.29%),hmd at the neutral head position 10%,lowest was with tmd (9.68%) . Where as the specificity in this study was relatively high.

The highest specificity of was 98.48% observed in predicting DVL with HMDR 98.48%, followed by hmd at the neutral position 97.15%, tmd 96.30%. and hmd at the extreme of head extension at 94.14%.

Discussion

DVL is a major cause of difficult intubation in many patients. A pre-planned strategy is central to managing airway problems.[7,8]

Therefore, identification of all the patients with risk for difficult laryngoscopy is an important thing in adopting safer alternative strategies for the intubation in Intensive care unit.

Various studies have investigated utility of hmd and other parameters, none of the study has quantified its diagnostic validity in predicting DVL in Intensive care unit patients. Therefore, this study was undertaken with purpose to evaluate the usefulness of HMDR for predicting DVL in normal patients. The pre-operative airway predictors the hmd in neutral position, hmd and thyro-mental distance (tmd) at extreme head extension, and hmd was examined.

Incidence: In this study, difficult to visualize larynx (Cormack and Lehane method grades III and IV) in 18 / 198 (9.09 %) patients. Failed tracheal intubations did not occur.

The incidence of 9.09% is correlating with the incidence reported in the literature.
In one of the meta-analysis 14,438 patients, a DVL incidence 6% -27% was seen. Huh et al reported 12.2% incidence in DVL of 213 apparently normal patients requiring general anesthesia with tracheal intubation. The wide variations in the incidence of DVL be related to factors like age, ethnic differences in patients ,types of blade used.
Sensitivity and specificity of HMDR, The ideal test for DVL prediction must have 100% sensitivity with 100% specificity, however, sensitivity and specificity are inversely proportional for each other. Optimal cut-offs used in this study to calculate sensitivity and specificity in this study was hmd at extreme head extension ≤ 5.3 cm, hmd in neutral position > 5.5 cm,HMDR ≤ 1.2,tmd at extreme head extension ≤ 6.2 cm, modified Mallampati Class ≥ 3.
In this study, over all sensitivity of diagnostic predictors were less. The highest sensitivity of 44.44 % (8/18) was observed in predicting DVL with modified Mallampati following that HMDR 27.78 % (5/18) and tmd (11.11 %) (2/18) and hmd at extreme Head position (11.11 %) (2/18). In contrast, the specificity in this study was relatively higher. The highest specificity was 99.44 % (179/180) observed for predicting DVL with modified Mallampati, following HMDR 98.89 % (178/180), hmd at neutral position 98.89 % (178/180), tmd 96.67 % (174/180) and hmd at extreme head 95.56 % (172/180).
Findings are contrast to that observed by Huh who reported that the HMDR with the optimal cut-off point was 1.2 had great diagnostic accuracy (area under the curve - 0.782), (P < 0.05), and it alone showed the greater diagnostic validity profile (sensitivity- 88% ,specificity-60%) than other test combinations. Sensitivity and specificity of the other predictor was hmd at extreme head extension ≤ 5.3 cm (46% and 81 %), hmd in neutral position > 5.5 cm (23% and 95%); tmd at extreme head extension ≤ 6.2 cm (31% and 92%), modified Mallampati class ≥3 (12 % and 94 %).
Many studies which assessed the sensitivity, specificity and predictive values for different diagnostic predictors have come with various findings and that was due to different diagnostic criteria adopted by investigators. Mathew et al demonstrated patients with tmd of < 6cm, horizontal mandible length < 9cm showed correlation with mmt grade III and IV with higher probability for difficult intubation. Where as, those with tmd < 6cm, horizontal mandible length > 9 cm correlated well with mmt grade I and II with lesser possibility of difficult intubation.
There are many potential limitations in this study design. First, inter-subject variability possible because of end point extending the head to maximally depended on the voluntary participation by each subject. We tried clearly to explain each maneuver to patients and demonstrated when necessary, thus we believed that inter-subject variability was minor importance in our study. Second, intra-rater variability may be possible, because single investigator performed measurements once during test.

Finally, although DVL is major determinant for difficult intubation, it is not synonymous with difficult intubation. In this study, we defined the modified Cormack and Lehane method grades III and IV as indicator of DVL. In most clinical
situations, the application of external laryngeal pressure facilitates laryngoscopic view and intubation can be performed without difficulty in these patients. Direct laryngoscopy is not the only method for securing and maintain the airway, though it is the most common method for facilitating intubation.

Conclusion

We could demonstrate that HMDR is very reliable predictor of DVL to a great extent because of higher specificity and negative predictive value. Tracheal intubation will be acute airway emergency by itself. Unstable haemo-dynamics and failing oxygenation at the time of emergency intubations will be life threatening. Delayed securing of airway or awaking the patient is not a better option during difficulty in Intensive care unit. Intubation failure or predicted difficulty could lead us to alternatives such as that of Non-invasive ventilation or tracheostomy. Tracheal intubation performed / supervised by experienced doctor is associated with least complications. Familiarity with the rescue airway techniques is of great help. Developing standardized evidence based protocols is most important need for the hour in airway management in at Intensive care unit environment. Incorporation of supraglottic device early for oxygenation and definitive airway followed by surgical or percutanous tracheostomy in airway management in critically ill patients needs future prospective studies. 9,10 We recommend seeking of optimal combination of the tests including the HMDR and other predictors , performing tests in combination, other than using alone is better.

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