Diagnostic Accuracy of Neck Circumference to Thyromental Distance Ratio in Predicting Difficult Intubation in Obese Patients

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ABSTRACT

Background: Difficult tracheal intubation is a frequent cause of anesthesia related morbidity and mortality in obese patients. Search for a suitable clinical test to identify reliable predictors for difficult intubation or difficult laryngoscopy continues. This study aims to determine accuracy of neck circumference to thyromental distance (NC/TM) ratio as a predictor of difficult intubation in obese patients. **METHODOLOGY:** 264 patients undergoing general anesthesia with tracheal intubation were enrolled in this cross-sectional survey at PKLI, DHQ Teaching Hospital Gujranwala and Sargodha. Difficult intubation was predicted with NC/TM ratio > 5 and was confirmed against intubation difficulty scale (IDS > 5) in obese patients (BMI > 30 kg/m2). Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of NC/TM ratio as predictor of difficult intubation in obese patients were determined. **RESULTS:** Prevalence of difficult intubation was 18.1%. NC/TM showed Sensitivity 87.27%, Specificity 82.30%, PPV 56.47%, NPV 96.09% and accuracy 83.33%. **CONCLUSION:** NC/TM ratio is a sensitive preoperative predictor of difficult intubation among obese patients.

INTRODUCTION:

Airway assessment is a mandatory component of preoperative anesthesia evaluation. Incidence of difficult intubation is about 17 % and inadequate assessment and planning of airway could lead to catastrophic effects that includes brain injury, myocardial injury and death.[1] Anticipating difficult airway through airway difficulty predictors such as Mallampati classification, upper lip bite test, sternomental distance, neck mobility and thyromental distance etc is in routine practice but the ideal test to predict difficult airway does not exist because of the lack of statistical predictive power of individual airway tests.[2]

Airway management in obese patients is a challenge for anesthesiologist. Fat deposition around the neck narrows the airway which makes mask ventilation and intubation difficult. Moreover, fat deposition in the abdomen and upper body makes controlled ventilation difficult. Neck circumference above 40 cm is associated with difficult mask ventilation.[3]

Chara et al. in 2014 documented the sensitivity and specificity of thyromental distance (cut-off = ≤7 cm, sensitivity: 34.9%, specificity: 83.9%) and neck circumference (cut-off = >37.5 cm, sensitivity: 69.8%, specificity: 44.6%).[4] Combining these predictors could enhance their diagnostic accuracy of difficult airway. This study was designed to determine the accuracy of neck circumference to thyromental distance ratio (NC/TM) in predicting difficult intubation in obese population taking intubation difficulty scale as gold standard.

METHODOLOGY:

This cross-sectional survey was conducted at the Department of Anesthesiology PKLI, Department of anaesthesia DHQ Teaching Hospital Gujranwala and DHQ Teaching Hospital Sargodha from August 2017 to April 2018. In this survey, 264 patients aged 18-60 years having BMI above 30 kg/m^2 undergoing elective surgeries requiring general anaesthesia with endotracheal intubation were included. Patients undergoing anesthesia without endotracheal intubation, inability to open mouth, edentulous, cervical spine or maxillofacial fractures and upper airway pathology such as upper airway tumors were excluded.

After written informed consent from the patient, detailed history and examination was conducted in the preoperative area. Neck circumference was measured in centimeters at the level of cricoid

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cartilage while thyromental distance was measured in centimeters from thyroid notch to the mentum with the neck fully extended (Figure 1). Neck circumference to thyromental distance Ratio (NC/TM) calculated and ratio of $\geq$ 5.0 was taken as positive for difficult intubation. Patients underwent standard general anesthesia induction. A laryngoscopy was performed on Macintosh blade 3 or 4 by an anesthesiologist who was unaware of NC/TM ratio. Difficult intubation on laryngeal view was graded on IDS scale as gold standard. An IDS score of $\geq$ 5 was regarded as difficult intubation. All the patients were evaluated by a single anesthesiologist to eliminate bias. The patient was intubated and rest of anesthesia continued as routine. Patients with failed intubations were managed as per Difficult Airway Society guidelines.

Sample size of 250 cases was calculated with 95% confidence level, 5% precision for sensitivity while taking expected frequency of difficult intubation among obese to be 13.2% and expected sensitivity and specificity of neck circumference to thyromental distance ratio to be 88.2% and 83% respectively in predicting difficult intubation in obese patients. We recruited 264 patients. Data was analyzed through SPSS version 19. A 2x2 contingency table was generated to determine sensitivity, specificity, PPV and NPP and accuracy for prediction of difficult intubation with IDS as gold standard.
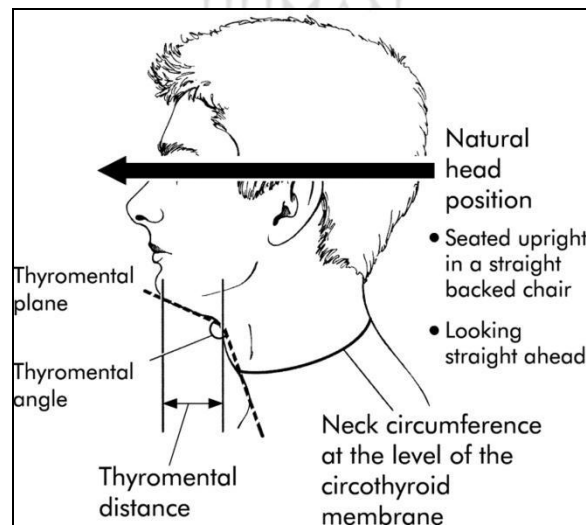

Figure No. 1: Measurement of TM and NC

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RESULTS:

The baseline characteristics of patients have been summarized in Table 1. The frequency of suspected difficult intubation on NC/TM ratio was 85 (32.2%) while it was confirmed in 55 (20.8%) patients on IDS. NC/TM had sensitivity of 87.27%, specificity 82.30%, PPV 56.47% and NPP 96.09%. Overall accuracy of NC/TM was 83.33%. (Table 2)

Table No. 1: Patient Characteristics	
Age (Years, Mean + SD)	43.64 + 8.39
Gender n (%) Male Female	 113 (42.8) 151 (57.2)
BMI (Mean + SD, kg/m^2)	35.54 + 2.75
ASA Class II III	 227 (86.0%) 37 (14.0%)
NC/TM Ratio (Mean + SD)	4.96 + 1.21
IDS Score (Mean + SD)	3.89 + 1.45
ASA: American Society of Anesthesiologists, NC: Neck Circumference; TM: Thyromental distance; IDS: Intubation Difficulty Scale; SD: Standard deviation	

Table No. 2: Contingency Table for NC/TM across IDS			
NC/TM Diagnosis	**IDS Diagnosis**		**Total**
	Difficult Intubation	**Not Difficult Intubation**	
Difficult Intubation	48	37	85
Not Difficult Intubation	7	172	179
Total	55	209	264

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Sensitivity	87.27%
Specificity	82.30%
Positive Predictive Value	56.47%
Negative Predictive Value	96.09%
Accuracy	83.33%

DISCUSSION:

Difficult endotracheal intubation could lead to life-threatening complications such as brain anoxia and death.[5]About 30% of anesthesia deaths can be attributed to compromised airway management.[6] Variety of tests have been used to predict difficult intubation and difficult laryngoscopy. These predictors include mouth opening, neck circumference, mallampati score, upper lip bite test, sternomental distance, hyomental distance and thyromental distance but all have variable sensitivity and specificity. [7]

Obesity is a growing problem globally. It is currently suffering as an emerging epidemic in Pakistan as more and more people are becoming obese.[8] Obese patients pose a big challenge as far as anaesthesia management is concerned. Anaesthesiologist's sound understanding of altered physiology, associated co-morbidities, increased incidence of difficult airway and remodeled pharmacokinetics in obese patients could make significant impact on their morbidity and mortality in perioperative period. [9] Impaired respiratory mechanics and increased sensitivity to adverse events of apnea and hypoxia make endotracheal intubation in obese patients challenging. [10]

Airway management in obese patients can be a challenging task because of difficult ventilation, difficult laryngoscopy or difficult intubation. The incidence of difficult intubation in normal patients is 6.2%[11] whereas in obese patients, it varies between 10% and 15%.[12]

Combination of two different variables could enhance the diagnostic accuracy of difficult intubation prediction tests.[13] A new predictor for difficult airway anticipation with a numerator of NC and a denominator of TM distance (NC/TM) has been developed and evaluated as a new

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index on the assumption that obese patients with both a large neck circumference and a short neck might be more difficult to intubate than patients with a large neck circumference or a short neck alone.

Our study shows that NC/TM ratio has sensitivity of 87.27%, specificity of 82.30%, positive predictive value of 56.47% and negative predictive value 96.09% in predicting difficult intubation in obese patients taking IDS as gold standard. Our results are in line with those of Kim et al. who reported sensitivity of 88.2%, specificity of 83%, positive predictive value of 45.5% and negative predictive value of 97.8% for NC/TM ratio in predicting difficult intubation in obese patients taking IDS as gold standard. [14]Hirmanpour et al. reported much lower sensitivity (71.7%), specificity (70.2%), PPV (17.4%), NPV (96.6%) and accuracy (70.3%) of NC/TM ratio. However, they only included female patients undergoing cesarean section. [15]Naim et al. reported sensitivity of 76.9% and specificity of 89.4%, PPV 65.6% and NPV 93.7% NC/TM ratio > 5. [16]

We included obese patients with BMI > 30 kg/m^2. World Health Organization defines a person as overweight (BMI ≥25 kg/m^2) and Obese (BMI ≥30 kg/m^2).[17]The mean BMI of the patients was 35.54 + 2.75 kg/m^2 in our study. Siriussawakul et al. in 2015 (34.30±4.6 Kg/m^2)[18] and Castro et al. in 2013 (37±5.1 Kg/m^2)[19] reported a similar mean BMI among Thai and Portuguese population. In addition, there were 42.8% male and 57.2% female patients in our study group. Finding is consistent with Tanzil et al who reported obesity is more prevalent in females in Pakistan.[8] A similar female predominance has also been reported by Kim et al. (62.60%).[14]

We used The Intubation Difficulty Scale (IDS) as the gold standard against which NC/TM ratio was assessed. IDS is an objective scoring system that allows qualitative and quantitative assessment of difficult intubation. Several studies have used IDS to assess various parameters for their accuracy to predict difficult intubation.[3,4]

The present study shows that NC/TM is a sensitive and specific predictive tool to identify obese patients at higher risk of difficult intubation. Pre-operative identification of high risk patients can enable optimum measures to avoid difficult intubation and hypoxemia at the operation table.

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