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BY TAKING INTUBATION DIFFICULTY SCALE AS GOLD STANDARD IN ASSESSING DIFFICULT INTUBATION AND PREDICTIVE VALUE OF RESTRICTED NECK MOVEMENT

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Abstract:

Introduction: *The three main causes of respiratory related injuries of anesthesia are inadequate ventilation, esophageal intubation and difficult tracheal intubation. 17% of all respiratory related injuries are due to difficult intubation and it accounts for 28% of anesthesia related deaths'. Airway maintenance during anesthesia is crucial for adequate oxygenation and ventilation and failure to secure airway can lead to tissue hypoxia and ultimately death.*

Subjects and Methods: *This study involved 126 patients of both genders, aged between I8-70 years undergoing general anesthesia with endotracheal intubation on elective lists Difficult intubation was predicted on restricted neck movement (<80°) and was confirmed on IDS. IDS diagnosis was taken as gold standard and results of restricted neck movement were evaluated accordingly. Written informed consent was taken from every patient.*

Results: *The age of the patients ranged from 18 years to 70 years with a mean of 42.49 ± 14.56 years. There were 64 (50.8%) male and 62 (49.2%) female patients in the study group. There were 52 (41.3%) obese patients. Difficult intubation was confirmed in 90 (71.4%) patients on intubation difficulty scale (as per operational definition)1. The frequency of difficult intubation was higher among obese patients (80.8% vs. 64.9%; p 0.052) however the difference was insignificant. There were 90 (71.4%) true positive patients with 36 false positive patients. It yielded a positive predictive value of 71.4% for restricted neck movement in the prediction of difficult intubation taking IDS as gold standard. Similar positive predictive value was observed across age, gender and obesity groups.*

Conclusion: *The positive predictive value of restricted neck movement (<80°) was found to be 71.4% in predicting difficult intubation among patients undergoing general anesthesia with endotracheal intubation on elective list while taking intubation difficulty scale as the gold standard.*

Keywords: *Difficult Intubation. Intubation Difficulty Scale. Restricted Neck Movement.*

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INTRODUCTION:

The primary purpose of airway management is to oxygenate the patient, as loss of the airway is associated with hypoxemia causing significant morbidity and mortality. Patients need successful airway management as part of general anesthesia or for resuscitation when a patient is in extreme difficulty achieving satisfactory ventilation and oxygenation is a medical emergency, where prevention is better than the cure, and adverse outcomes follow rapidly with unprepared attempts by unskilled practitioners. Since the ASA closed claims studies [10], the critical importance of recognizing the difficult airway and preventing hypoxia has been a primary aspect of airway training. The advent of neuromuscular relaxants in the 1950s ushered in an era of tracheal intubation as this was considered the most effective way to ensure adequate ventilation during surgery. As a result, the vast majority of published literature looks at prediction of difficult tracheal intubation. However, mask ventilation is an equally critical component of successful airway management. Successful mask ventilation provides practitioners with a rescue technique during unsuccessful attempts at laryngoscopy and unanticipated difficult airway situations.

Difficulty with both tracheal intubation and mask ventilation is associated with increased risk of patient injury. Several clinical models and tests have been described for the prediction of difficult intubation and mask ventilation. These screening tests use history elements and quantitative or estimated measures of various aspects of the face, upper airway, and neck to describe either high or low risk of an expected difficult airway. In order to better understand the performance and accuracy of these tests, a working understanding of the anatomy of the structures of interest is essential [12]. A variety of systemic and local tissue factors impact the ease of tracheal intubation and mask ventilation. While the elective situation permits a vigorous examination of the airway, certain urgent and emergent clinical scenarios preclude a complete and thorough airway examination, making difficult airway situations more likely but less predictable. Irrespective of the urgency of airway instrumentation, clinical suspicion of a difficult airway helps prepare the practitioner for backup airway management strategies that often require additional personnel, equipment, and techniques for successful tracheal intubation. The purpose of this chapter is to describe the clinical features associated with the difficult airway and explore the clinical utility of these features on prediction of difficult mask ventilation and difficult tracheal intubation.

MATERIALS AND METHODS:

Study Design: It was a cross-sectional survey.

Setting: Research was conducted at Department of Anesthesiology. Services Hospital, Lahore.

Duration of Study: Duration of study was 6 months after the approval of synopsis from 15/11/2017 to 14/04/2018.

Sample Size: Sample size of 126 cases was calculated with 95% confidence level and 5% margin of error while taking expected percentage of positive predictive value of restricted neck movement (<80°) to be 76% in the diagnosis of difficult intubation taking intubation difficulty scale as gold standard.6

Sampling Technique: Patients were selected by Non-probability. Consecutive Sampling.

Sample Selection 5.6.1 Inclusion criteria: Patients of both genders, aged between 18-70 years undergoing general anesthesia with endotracheal intubation on elective list.

- Patients who exhibited restricted neck movement (as per operational definition).
- Patients who signed written informed consent to participate in the study.

Exclusion criteria: • Patients with a mass in front of the neck e.g. goiter (clinical examination).

- Patients with previous surgical scar or contracture on neck (clinical examination).
- Patients with nasopharyngeal growth (history and clinical record).

RESULTS:

The age of the patients ranged from 18 years to 70 years with a mean of 42.49 + 4.56 years. There were 64 (50.8%) male and 62 (49.2%) female patients in the study group. There were 52 (41.3%) obese patients. These findings have been summarized in Table 8.1.

Difficult intubation was confirmed in 90 (71.4%) patients on intubation difficulty scale (as per operational definition). The frequency of difficult intubation was higher among obese patients (80.8% vs. 64.9%; p 0.052) however the difference was insignificant as shown in Table 8.2 There were 90 (71.4%) true positive patients with 36 false positive patients. It yielded a positive predictive value of 71.4% for restricted neck movement in the prediction

of difficult intubation taking IDS as gold standard as shown in Table 8.3. Similar positive predictive value was observed across age, gender and obesity groups as shown in Tables 8.4 - 8.6.

Table 8.1 Baseline Characteristics of Study Population

Characteristics	Participants (n - 126)
Age (Years)	42.49 + 14.56 (18 - 70)
Gender	
Male	64 (50.8%)
Female	62 (49.2%)
Obese	
Yes	52 (41.3%)
No	74 (58.7%)

Table 8.2 Frequency of Difficult Intubation on IDS

Characteristics	n	Participants (n - 126)	P-Value
Overall	126	90 (71.4%)	-
Age Groups			
18 - 44 Years	74	52 (70.3%)	0.731
45 - 70 Years	52	38 (73.1%)	
Gender			
Male	64	46 (71.9%)	0.91
Female	62	44 (71.0%)	
Obese			
Yes	52	42 (80.8%)	0.052
No	74	48 (64.9%)	

Table 8.3 Stratification of Positive Predictive Value of restricted neck movement in predicting difficult intubation (n - 126)

Difficult intubation on RNM	Difficult intubation on IDS		Total	P-value
	Yes (90)	No (36)		
Yes	90 (71.4%)	36 (28.6%)	126 (100%)	N/A
No	0 (0%)	0 (0%)	0 (0%)	
Total	90 (71.4%)	36 (28.6%)	126 (100%)	

Chi-square test, N/A: No statistics are completed because Difficult Intubation on RNM is a constant.
True Positive = 90
False Positive = 36
Positive Predictive Value = 90 / 90 + 36 X 100 = 71.4%

Table 8.5 Stratification of Positive Predictive Value Across Age (n - 126)

Age	Difficult intubation on RNM	Difficult intubation on IDS		Total	P-value	PPV
		Yes (90)	No (36)			
18 - 44 (74)	Yes	52 (70.3%)	22 (29.7%)	74 (100%)	N/A	70.3%
	No	0 (0%)	0 (0%)	0 (0%)		
	Total	52 (70.3%)	22 (29.7%)	74 (100%)		
45 - 70 (52)	Yes	38 (73.1%)	14 (26.9%)	52 (100%)	N/A	73.1%
	No	0 (0%)	0 (0%)	0 (0%)		
	Total	38 (73.1%)	14 (26.9%)	52 (100%)		

Chi-square test, N/A: No statistics are completed because Difficult Intubation on RNM is a constant.

Table 8.5 Stratification of Positive Predictive Value Across Gender (n - 126)

Gender	Difficult intubation on RNM	Difficult intubation on IDS		Total	P-value	PPV
		Yes (90)	No (36)			
Male (64)	Yes	46 (71.9%)	18 (28.1%)	64 (100%)	N/A	71.9%
	No	0 (0%)	0 (0%)	0 (0%)		
	Total	46 (71.9%)	18 (28.1%)	64 (100%)		
Female (62)	Yes	44 (71.0%)	18 (29.0%)	62 (100%)	N/A	71.0%
	No	0 (0%)	0 (0%)	0 (0%)		
	Total	44 (71.0%)	18 (29.0%)	62 (100%)		

Chi-square test, N/A: No statistics are completed because Difficult Intubation on RNM is a constant.

Table 8.6 Stratification of Positive Predictive Value Across Obesity (n - 126)

Obesity	Difficult intubation on RNM	Difficult intubation on IDS		Total	P-value	PPV
		Yes (90)	No (36)			
Yes (52)	Yes	42 (80.8%)	10 (19.2%)	52 (100%)	N/A	80.80%
	No	0 (0%)	0 (0%)	0 (0%)		
	Total	42 (80.8%)	10 (19.2%)	52 (100%)		
No (74)	Yes	48 (64.9%)	26 (35.1%)	74 (100%)	N/A	64.90%
	No	0 (0%)	0 (0%)	0 (0%)		
	Total	48 (64.9%)	26 (35.1%)	74 (100%)		

Chi-square test, N/A: No statistics are completed because Difficult Intubation on RNM is a constant.

DISCUSSION:

The foremost responsibility of an anesthesiologist is to maintain patency of the airway to allow oxygen to move down into the lungs to ensure adequate gas exchange. Inability to maintain ventilation and oxygenation for several minutes alter the patient is rendered apneic following induction of anesthesia results in catastrophic complications including death. Such problems account for 30 % of deaths occurring during anesthesia1. The difficult airway can be represented by difficulty with laryngoscopy, intubation and mask ventilation. Before an anesthetic agent is administered, it is of paramount importance to correctly diagnose and assess potential airway problems to choose alternative modalities of airway management1'5'6. It is a kind of dress rehearsal before a potentially hazardous march on the enemy and should under no circumstances be under estimated. Approximately half of all cases of Dl are not predicted and this is particularly alarming as it can potentially turn into a life threatening event1.

Precise pre-operative assessment of airway is therefore extremely important to identify high risk patients and adopt appropriate measures to reduce the morbidity and mortality in patients with difficult intubation 2. Until now a number of pre-operative screening tests have been devised with variable positive predictive value (PPV); Malampati score (59.3%), Cormack-Lchane score (78.6%), short thyromental distance (81.6%)4 and upper lip bite test (72.8%)3. But all these tests have their own limitations and demerits particularly, the interobserver reliability.

Restricted neck movement has been shown to be a reliable pre-operative predictor of difficult intubation. It also has the advantage of being simple, non-invasive and cost-effective tool. However, the available evidence contained conflicting results (Table 9.1) while no such local published material was available.

Table 9.1 PPV of Restricted Neck Movement in Existing Literature

Author	Year	Population	PPV
Karakus et al. 65	2015	Turkish	75.80%
Bhatnagarct al. 66	2005	Indian	77.00%
Nasa et al 6	2012	Indian	76.00%
Orozco-Diaz et al. 7	2010	Mexican	67.00%
Wong et al. 67	2016	Singapore	46.70%
Srinivasa et al. 8	2014	Indian	40.00%
Ciupta er al. 68	2010	Indian	34.60%
Cattano et al. 9	2004	Italian	9.00%
Present Study	2016	Pakistani	71.40%

In the present study, the positive predictive value of restrict neck movement was found to be 71.4%. Our results are in line with those of Karakus et al. 65 (2015) who reported similar PPV of 75.8% in Turkish population. Nasa et, al. 6 in 2012 (76%) and Bhatnagar e, al.66 in 2005 (77%) reported similar positive predictive value of restricted neck movement in Indian population while Orozco-Diaz et al. in 2010 reported relatively lower PPV of 67% in Mexican such patients.

The present study is first of its kind in local population and has found the positive predictive value of restricted neck movements to be 71.4% which is comparable to other preoperative predictors currently in practice; Mallampati score (59.3%), Cormack-Lehane score (78.6%). short thyromental distance (81.6%)4 and upper lip bite test (72.8%)3. However, compared to these methods, this new predictor is easy to perform, non-invasive and has high inter-observer reproducibility which makes it more ideal. On the basis of the results of the present study, it can be advocated that future patients who are planned for general anesthesia with endotracheal intubation should be assessed pre-operatively for restricted neck movements to identify patients who are high risk for difficult intubation. So that optimum measures can be undertaken to avoid failed intubation with consequent hypoxia and morbidity. A very strong limitation to the present study was that we didn't consider the interobserver reproducibility of this clinical pre-operative predictor. Future studies addressing this aspect are therefore strongly recommended.

CONCLUSIONS:

The age of the patients ranged from 18 years to 70 years with a mean of 42.49 $\pm$ 14.56 years. There were 64 (50.8%) male and 62 (49.2%) female patients in the study group. There were 52 (41.3%) obese patients. Difficult intubation was confirmed in 90 (71.4%) patients on intubation difficulty scale (as per operational definition). 1'he frequency of difficult intubation was higher among obese patients (80.8% vs. 64.9%; p 0.052) however the difference was insignificant. There were 90 (71.4%) true positive patients with 36 false positive patients. It yielded a positive predictive value of 71.4% for restricted neck movement in the prediction of difficult intubation taking IDS as gold standard. Similar positive predictive value was observed across age, gender and obesity groups. The positive predictive value of restricted neck movement (<80°) was found to be 71.4% in predicting difficult intubation among patients undergoing general anesthesia with endotracheal intubation on elective list while taking intubation difficulty scale as the gold standard.

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