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Research Article

Relationship of neck circumference and difficult endotracheal intubation in obese patients

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ABSTRACT

Background and Objectives: Patient identification with difficult intubation is important in planning anesthetic management and one major factor for difficult intubation in the obese patients is large neck circumference. The need for prediction of a potentially difficult airway received great importance as it plays a significant role in reducing morbidity and mortality. Therefore, this study was done to glimpse the effect of neck circumference on endotracheal intubation and to determine the frequency of difficult intubation.

Material and Methods: The study was cross sectional descriptive study and convenient sampling technique was used. Seventy patients of age between 19-50 years of both sexes were enrolled. Neck circumference was measured at the level of cricoid cartilage along with other airway assessments. Direct laryngoscopy was done and checked whether it is difficult one or easy using Intubation difficulty scale. Data were entered and analyzed by using statistical software SPSS version 15.0.

Results: Mean BMI was noted as 33.02±2.30 kg/m2 and the mean neck circumference was 43.64±2.30 cm. Difficult intubation was observed in 23 (32.86%) patients with mean neck circumference of 45.44±1.88 cm and normal intubation observed in 47(67.14%) patients with mean neck circumference of 42.77±1.98 cm. Linear correlation was found between the neck circumference and Intubation Difficulty Scale score with value of Pearson correlation=0.617.

Conclusion: Neck circumference of patient was found to have significant effects on difficult intubation. Frequency of difficult intubation was found in almost one third of obese patients with increasing neck circumference.

Key Words: Difficult Intubation, Endotracheal Intubation, Neck Circumference

INRODUCTION

The airway manipulation during induction of anesthesia is the primary and unique responsibility of the anesthesiologist. It is a stressful condition for anesthesiologist when "Cannot ventilate and cannot intubate" airway scenario arises [1]. A number of studies have shown that the endotracheal

intubation is much harder in the obese patients than in the leans patients [2].

In one of the current reviews, which uses the intubation difficulty scale scoring system (IDS) ,and potentially evaluated 70 obese subjects (Body Mass Index >30 kg/m2) and 61 lean subjects (Body Mass Index < 30 kg/m2), found that the intubation difficulty scale scoring system (IDS) >5 was commonly found in the obese subjects in comparison to the lean subjects [3]. The prevalence of difficult laryngoscopy was similar in 134 lean individuals having BMI < 30 kg/m2 when compared to 129 obese individuals having BMI > 35 kg/m2 patients [4].

Large-neck circumference has been publicized in various literatures to be a forecaster of difficult intubation in morbidly obese individuals. The neck circumference of 40 centimeter was linked with a 5% likelihood of challenging airway, while at 60 centimeter, the possibility increased up to 35 percent [5]. Neck circumference has been found to be individual factor that helps in forecasting obesity and overweight and could be utilized as a preliminary selection means for the intention of predicting difficult intubation. This is a simple and economical test and can be done in pre-operative assessment using a measuring tape [6]. Neck Circumference of $\geq$39.5 centimeter in male and $\geq$36.5 centimeter in female is found to be the excellent cutoff value for defining the individual with Body Mass Index of $\geq$30 kg/m^2 [7,8].

Therefore, this study was conducted to determine the frequency of the difficulty in intubation based on intubation difficulty scale and to find the correlation between neck circumference and intubation condition in patients in our prospective and predict its validity in the local scenario. This will help us in taking advance measures in patients with predicted difficult intubation.

MATERIAL AND METHODS

This cross-sectional descriptive study among 70 patients was conducted at the Department of Anaesthesia, Intensive Care Unit & Pain Management, PGMI, Lahore General Hospital, Lahore, Pakistan from Dec 2013 to June 2014. Convenient sampling technique was used. 18-50 years obese patient with BMI > 30, American Society of anesthesiologist physical status (ASA) [9] I and II patients scheduled to undergo surgery under general anesthesia was included.

After approval from Hospital Ethical Committee, 70 patients were included in the study after obtaining an informed consent. Height, weight and BMI were calculated for each patient. Airway assessment was done and neck circumference was measured at the level of cricoid cartilage and assessment was made whether it is difficult intubation or easy intubation. After induction of general anesthesia, direct laryngoscopy was done with size 3-4 Macintosh blade for endotracheal intubation and was checked whether it is difficult one or easy using Intubation difficulty scale. After evaluation endotracheal intubation was done according to standard protocol.

Data were entered and analyzed by using statistical software SPSS version 15.0. Pearson correlation coefficient was calculated for neck circumference and difficult intubation scale score. P-value $\leq$ 0.05 was considered statistically significant.

RESULTS

A total of 70 patients were enrolled in this study. Mean BMI of the patients was noted as 33.02±2.30 kg/m2, and the mean neck circumference of the patients was found to be 43.64±2.30 (Table 1 and table 2)

Table1: Descriptive statistics of Height, Weight & BMI of the patients

	Height	Weight	BMI
n	**70**	**70**	**70**
Mean	170.19	95.65	33.02
SD	6.62	10.13	2.30
Minimum	156.0	73.0	30.0
Maximum	187.0	121.5	40.6

Table 2: Descriptive statistics of Neck Circumference of the patients

Neck Circumference	**n**	**70**
	Mean	43.64
	SD	2.30
	Minimum	39.0

Figure 1 highlights the Mallampati score of the patients and Table 3 compares neck circumferences patients with different Mallampati score.

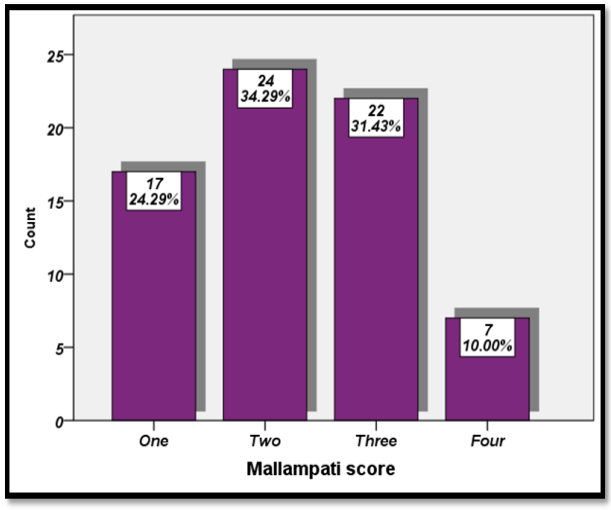

Figure 1: Distribution about Mallampati score

Table 3: Comparison of neck circumference at different Mallampati scores

Neck circumference	Mallampati score			
	I	**II**	**III**	**IV**
n	17	24	22	7
Mean	42.44	44.46	43.18	45.21
SD	2.32	2.05	2.36	0.99
Minimum	39.5	41.0	39.0	44.0
Maximum	47.0	48.0	48.5	47.0

Cormack and Lehane Laryngoscopy grade 1, 2, 3, and 4 was found as 8(12%), 31(44%), 23(33%), 8(11%) in patients (figure 2). Table 4 depicts the mean neck circumference at different laryngoscopic view groups.

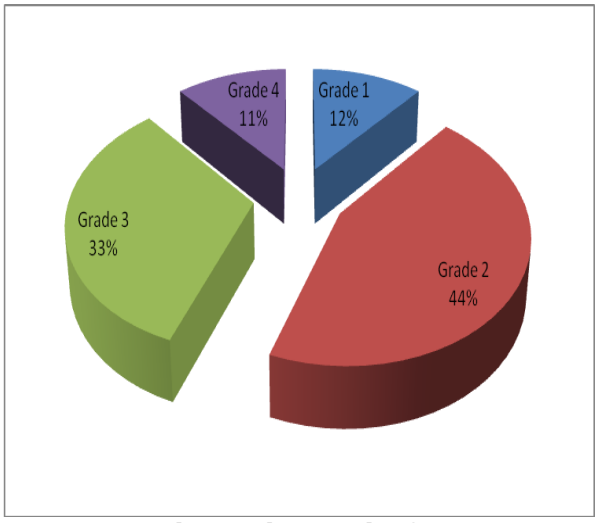

Figure 2: Distribution about grade of Laryngoscopy view

Table 4: Comparison of neck circumference at different laryngoscopic view groups

Neck circumference	Laryngoscopy view			
	1	2	3	4
n	8	31	23	8
Mean	41.63	42.98	44.46	45.88
SD	1.58	2.12	2.06	1.79
Minimum	39.0	39.0	41.0	43.0
Maximum	43.5	47.5	48.0	48.5

Table 5 and 6 depicts descriptive statistics of IDS Score and compares neck circumference at different IDS Score.

Table 5: Descriptive statistics of IDS score

IDS Score	**n**	**70**
	Mean	4.86
	SD	2.86
	Minimum	1
	Maximum	11

Table 7: **Comparison of neck circumference with normal and difficult intubation**

Neck Circumference	**Intubation**	
	Difficult	**Normal**
n	23	47
Mean	45.44	42.77
SD	1.88	1.98
Minimum	41.0	39.0
Maximum	48.5	47.5

Table 6: Comparison of neck circumference at different IDS scores

Neck Circumference	**IDS score**									
	1	2	3	4	5	7	8	9	10	11
n	5	9	16	12	5	7	7	2	4	3
Mean	41.10	42.17	42.66	43.88	43.20	45.36	44.93	44.00	45.75	47.33
SD	1.60	1.52	2.26	1.76	1.35	2.36	1.77	1.41	1.26	1.04
Minimum	39.0	39.5	39.0	40.5	41.5	41.0	43.0	43.0	44.0	46.5
Maximum	43.0	44.0	47.5	46.0	44.5	48.0	47.5	45.0	47.0	48.5

Difficult Intubation of the patients was observed (Figure 3). Table 7 compares neck circumference with normal and difficult intubation of patients**.**

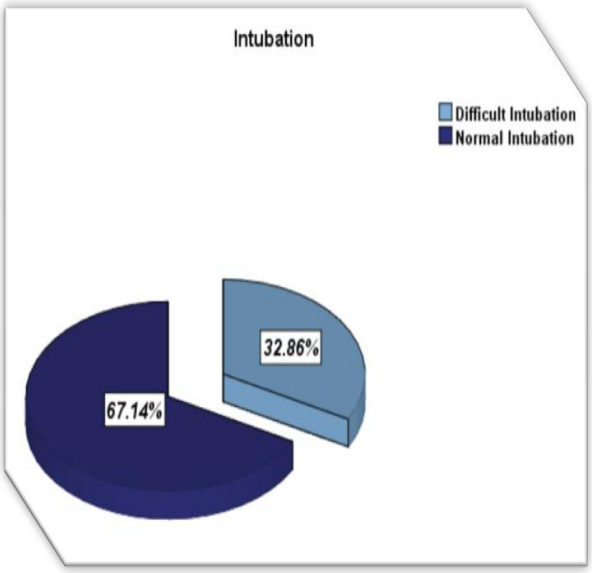

Figure 3: Distribution about Difficult Intubation of the patients

Linear correlation was found between the neck circumference and Intubation Difficulty Scale score with value of Pearson correlation=0.617 (Figure 4). The above graph shows the correlation between the neck circumference and IDS score of the patients. Linear correlation was found between the neck circumference and IDS score with value of Pearson correlation=0.617.

When factors affecting intubation were checked in combination, it was observed that BMI and neck circumference of patient has significant effects on difficult intubation i.e. p-value<0.05., compared to other indices like sex, thyromental distance and Mallampati score which has insignificant impact in combination i.e. p>0.05. Out of 70 patients, difficult intubation was observed in 23(32.86%) patients whereas 47 (67.14%) patients were observed with normal intubation.

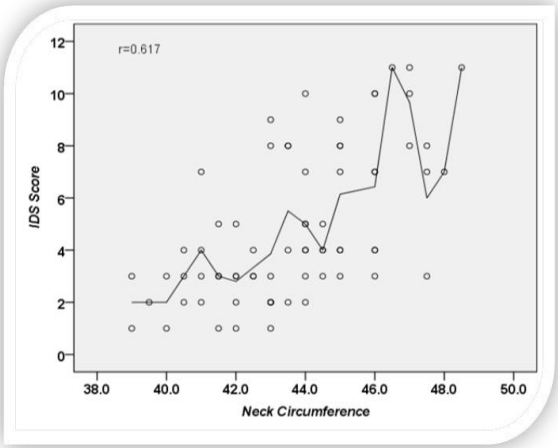

Figure 4: Correlation between Neck circumference and Intubation Difficulty Scale score

DISCUSSION

In this study higher Intubation Difficulty Scale score was seen with the increasing of neck circumference, high Body Mass Index (BMI), and there was linear correlation found between neck circumference and difficult intubation with value of Pearson correlation=0.617. Gonzalez H et al., 2008 found in their study that difficult intubation was related to high Body Mass Index (BMI) , increasing neck circumference, short thyro-mental distance, and the Mallampati score of > or = 3 and stated that Neck circumference was an self-sufficient warning feature to predict difficulty in intubation in overweight subjects [3, 10].

In this study, Mallampati score I, II, III and IV was found in 17(24.29%), 24(34.29%), 22(31.43%), 7(10%) patients, with mean neck circumference of 42.44±2.32cm, 44.46±2.05cm, 43.18±2.36cm, 45.21±0.99cm, respectively showing higher Mallampai score with increasing neck circumference.

Factors associated with higher laryngoscopic grading are related with various factors such as short thyromental distance, limited head, neck and jaw movement, receded mandible an neck circumference, prominent teeth etc, and of all these neck circumference was associated with difficult intubation [5]. In this study Cormack and Lehane Laryngoscopy grade 1, 2, 3, and 4 was found in 8(11.4%), 31(44.3%), 23(32.9%), 8(11.4%) patients, with the mean neck circumference of 41.63±1.58 cm, 42.98±2.12 cm, 44.46±2.06 cm, 45.88±1.79 cm, respectively showing that laryngoscopy grade 3 and 4 was associated with higher neck circumference, and thus difficult intubation.

In this study, mean BMI of the patients was noted as 33.02±2.30 kg/m2 and mean neck circumference of the patients was 43.64±2.30 cm. Khan et al., in 2010, studied difficult tracheal intubation in patient undergoing thyroid surgery in 139 patients and accomplished that neck thickness is a major predictor of difficult intubation and should be used as preoperative assessment to predict difficult intubation [11]. In a recent study by Kim et al., 2011, done in 123 obese patients and 125 non-obese patients, established that the ratio of neck circumference to thyromental distance was a superior way to predict difficulty in intubation compared to other well-known predictor. This study reported that difficulty in intubation was seen frequently in obese patients when compared with the non obese patients (13.8 percent *vs.* 4.8 percent; $P = 0.016$) [12].

In this study, difficult intubation was observed in 23 (32.86%) patients who had mean neck circumference of 45.44±1.88 and normal intubation observed in 47(67.14%) patients with mean neck circumference of 42.77±1.98, showing difficulty in intubation was associated with increasing neck

circumference. Naim et al., 2014 showed 45% patients of difficult intubation having IDS score > 5. Mallampati grade 3 or 4, and these patients were obese (BMI = 39.9(4.3) [13].

The intubation difficulty scale (IDS) score mirror all the procedure of endotracheal intubation, while the Cormack lehane grading acknowledge only the laryngoscopic view. The Intubation Difficulty Scale was suggested in the year 1997 to differentiate and institutionalize the complexity in endotracheal intubation [14]. Intubation Difficulty Scale (IDS) score greater than five has been considered as the designation for difficult intubation in diverse cases.

Our study showed that the mean Intubation Difficulty Scale score of the patients was 4.86±2.86 with minimum and maximum values of 1 & 11 respectively, and mean neck circumference for IDS score was : N-1=41.10±1.60, N-2=42.17±1.52, N-3 =42.66±2.26, N-4=43.88±1.76, N-5 =43.20±1.35, N-7=45.36±2.36, N-8= 44.93±1.77, N-9 =44.00±1.41, N-10=45.75±1.26, and N-11=47.33±1.04. This result shows increasing IDS score with increase in neck circumference. Hingorjo et al 2012 studied 41 male and 109 female patients and appraise the importance of the neck circumference to be a useful marker of obesity and concluded that neck circumference of >35.5 cm in male and > 32 cm in female to be taken as cut-off mark in obese individual [6].

In this study, when factors affecting intubation were checked in combination, it was observed that BMI and neck circumference of patient had significant effects on difficult intubation i.e. p-value<0.05., compared to other indices like sex, thyromental distance and Mallampati score which had insignificant impact in combination i.e. p>0.05. To find a simple bedside assessment that helps in anticipating difficulty in intubation is still demanding. Among the possible forecaster we checked out, the helpful bedside examination were short thyromental distance, high body mass index (BMI), increasing neck circumference and a higher Mallampati score among which neck circumference was most significant.

CONCLUSION

This study concludes that difficult intubation was associated with increasing neck circumference, high BMI and a high Mallampati score in obese patients. When these factors were checked in combination, BMI and neck circumference of patient had significant effects on difficult intubation. i.e. p-value<0.05. Frequency of difficult intubation was found in almost one third of obese patients with a linear correlation between the neck circumference and Intubation Difficulty Scale score, showing difficulty in intubation with increasing neck circumference. This study supports the use of assessing neck circumference preoperatively to predict a potentially difficult intubation. In future, we can predict the success of intubation by measuring neck circumference.

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AUTHOR'S CONTRIBUTION

AKK- Data collection, principal investigator of this research, preparation of the first draft of manuscript and final revision; **KB-** Study design, supervision to the research and final approval of the manuscript prepared.

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CONFLICT OF INTEREST: None declared.

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