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Original Research Article

Thyomental distance is a good difficult airway indicator: Truth or a misconception- A prospective observational study

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ABSTRACT

Background and Aims: Unanticipated difficult intubation can be a true challenge to any anaesthesiologist. The most widely used determinant till date in almost every airway study is Thyromental distance[TMD]. We aimed to determine if a TMD above the average values could indicate difficult intubation.

Materials and Methods: 70 patients were selected in this prospective observational study who require general anesthesia with endotracheal intubation for their respective surgeries. Patients who fulfilled the inclusion criteria were enrolled in the study and informed written consent was taken.

Routine pre-anesthetic check up was done. Thyromental distance was measured [thyroid notch to the lower border of the mandibular mentum-head fully extended] using a rigid ruler. Intraoperatively: After following standard general anaesthesia protocol, patients were intubated by anesthesiologist with atleast 2 years of experience and blinded to the study. The ease (0-5) / Difficulty (>5) in intubation was assessed with Intubation difficulty scale(IDS).

Result: Data was analysed using SPSS Software 16. Data was expressed in terms of frequency and percentage. In a total of 70 patients, 18.6% of the patients had difficult intubation. It was observed that 50 patients had a TMD >=7.5 cm out of whom, 7 patients were difficult to intubate. 12 patients had TMD<6.5 cm out of which 6 patients had an IDS of >5 indicating difficult intubation. Sensitivity, specificity, PPV, NPV were calculated. Categorical Pearson chi square test was done for TMD>7.5 vs IDS and it showed a p value of 0.017 (p<0.05).

Conclusion: We observed that a long TMD (TMD>=7.5cm) could be a difficult airway indicator just like a short TMD (TMD<=6.5). Therefore, our findings suggest that thyromental distance may not have a significant role as a standalone pre-operative indicator of a difficult airway and its reliability as a useful parameter in predicting difficult intubation is questionable.

1. Introduction

The management of a difficult airway is a significant challenge for any anaesthesiologist, and it remains a major source of morbidity and mortality in anesthesia practice.[1] The early identification and preparation is critical in reducing the risk of airway-related complications and fatalities.

To date, the most commonly used determinant in almost every airway research is thyromental distance[2] [TMD] and most studies have considered a short TMD of less than 6.5 cms as a predictor of difficult intubation.[3–5]

However, its predictive value has been subject to some debate, with conflicting results reported in the literature. Despite this, TMD continues to be widely used as a screening tool for difficult airway management due to its

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simplicity and ease of measurement. Further research is required to assess the reliability of TMD as a predictor of difficult intubation and to identify other factors that may enhance the accuracy of airway assessment. This study was aimed to determine whether a long Thyromental Distance (TMD), can serve as a reliable predictor of difficult airway and difficult intubation.

By evaluating the relationship between TMD and difficult airway and intubation, we hope to gain insights into the utility, reliability and limitations of TMD as a difficult airway predictor.

2. Materials and Methods

A prospective observational study was conducted after approval from institutional ethical committee at a tertiary care hospital and medical college in Bangalore, from March 2021 to September 2022, and involved 70 patients[6] who underwent elective surgery that required intubation for general anesthesia. All study subjects were provided with information about the study's purpose, procedures, potential risks, and benefits in their native language, and informed written consent was obtained from them.

Patients belonging to the ASA (American Society of Anesthesiologists) classification I-III, aged 18 years or older, and requiring endotracheal intubation were included in the study and Patients with congenital anomalies of the head and neck, upper airway pathology (such as maxillofacial fractures and tumors), cervical spine fractures, midline neck swellings, edentulous patients, and patients with limited neck extension were also excluded from the study. These patients may have unique anatomical features or pathological conditions that could affect airway management, potentially confounding the relationship between TMD and difficult intubation.

2.1. Sample size calculation

Sample size was calculated using the formula:[6]

$N = \frac{TP+FN}{(1-9)}$

Now,

$TP + FN = Z^2 \frac{[SP(1-SP)]}{W^2}$

N = Sample size, TP = True Positive, FN = False Negative, SP = Specificity,

Z = Confidence interval, P = Prevalence, W = Accuracy (allowable error)

The following values have been taken:[6]

P = 0.22, SP = 83%, W = 0.1, Z =1.96

Substituting,

$TP + FN = \frac{(1.96)^2 X [0.83(1-0.83)]}{(0.1)^2} = 54.2$

Therefore,

$N = \frac{TP+FN}{(1-P)} = \frac{54.2}{0.78} = 70$

Hence, a sample Size of 70 has been selected for the study.

2.2. Methodology

A thorough preanaesthetic evaluation including Routine airway assessment like mouth opening, Mallampati test, temporomandibular joint movement, neck mobility, and the presence of loose teeth, buck teeth, or dentures, was performed and documented by a different anesthesiologist who was not involved in performing the laryngoscopy evaluation, to ensure objectivity and minimize bias.

The thyromental distance (TMD) was measured as the distance between the mentum and the thyroid cartilage with the patient lying on a bed, a pillow placed below the neck, and the head fully extended with a closed mouth. A rigid ruler was used to measure the TMD accurately.(Figure 1)

Fig. 1: Measurement of Thyromental distance using a rigid ruler

A standard protocol for general anesthesia was followed for all patients. The emergency difficult airway cart was kept ready in case of any complications during the procedure.

Once in the operating room, patient was continuously monitored using pulse oximetry, electrocardiography, and noninvasive arterial pressure measurements. Premedication was administered to each patient, including midazolam at a dose of 0.02 mg/kg, glycopyrollate at a dose of 0.004 mg/kg, ondansetron at a dose of 0.08 mg/kg, and fentanyl at a dose of 2 mcg/kg, intravenously.

Patient was preoxygenated with 100% oxygen for 3 minutes, and then induction was performed using Inj. Propofol at a dose of 2mg/kg. Muscle relaxation was achieved with Inj. Vecuronium at a dose of 0.1 mg/kg, after which the patient's airway was effortlessly ventilated using a face mask. Laryngoscopy was performed 3 minutes after induction using a Macintosh number 3 or 4 blade, with the patient's head in the "sniffing position." If there was no

laryngeal vision, cricoid pressure was applied. The Cormack Lehane grading[7] was noted, and the Intubation Difficulty Scale (IDS)[8] was used to assess challenging tracheal intubation. Finally, tracheal intubation was performed using an adequately sized endotracheal tube, and standard anesthetic control was maintained throughout the procedure.

3. Results

The findings obtained in the study were evaluated, the IBM Statistics 16 program was used for the statistical analysis.

Demographic data revealed that out of 70 patients, 31 patients were male ; 39 were female patients (Table 1). Majority of the patients [51 patients] belonged to age group of 20 years to 50 years. The mean age group was 38.27±14.21 years (Table 2). BMI ranged from <25.0 kg/m^2 around 40 patients to >25.0 kg/m^2 around 30 patients. Mean BMI calculated was 24.47±4.53.(Table 3)

Most of our patients (68) belonged to ASA 1 and 2 (Table 4). The patients Modified Mallampatti grading [MMPG] was equally distributed between 1 [21 patients], II [25 patients] and III [21 patients]. Only 3 patients had MMPG IV.(Table 5) 75% of patients had CL Grade 1 at intubation. Only 2.% patients had CL grade IV.(Table 6)

IDS was calculated and 80% patients had an IDS<5, whereas 20% patients had IDS >5 (Table 7). TMD with <6.5cm had 12 patients whereas >7.5 cm were 50 patients (Table 8).

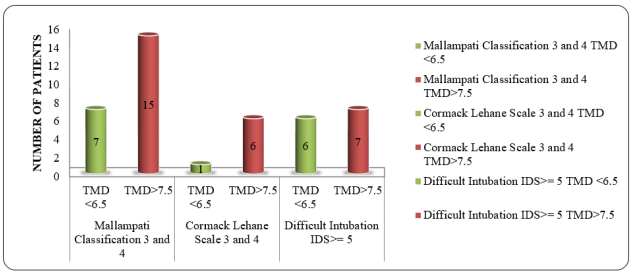
When IDS was charted against TMD, with TMD <6.5 cm, 50% patients had a difficult intubation scale <5 and compared to TMD>7.5cm, only 14% of the patients had IDS<5.(Table 9) Categorical Pearson chi square test was done for TMD>7.5 vs IDS and it showed a p value of 0.017 (p<0.05) which is significant.(Table 9)

When we compared TMD with MMPG, we found that 7 patients had MMPG> 3 along with TMD <6.5cm whereas 15 patients had MMPG > 3 along with TMD>7.5cm. Categorical Pearson chi square test done for Thyromental Distance and Modified mallampati grading showed an insignificant p-Value of 0.245.(Table 10)

The difficulty to visualize the vocal cord with Cormack Lehane grading was done and we found that only 1 patient had a CL Grade 3 with TMD<6.5 whereas 6 patients had a CL grade >= 3 with TMD >7.5. Similar, Categorical Pearson chi square test done for Thyromental Distance and Modified Cormack Lehane Grading showed an insignificant p-Value of 0.822 (Table 11)

The Sensitivity, specificity, Positive Predictive Value, Negative Predictive Value of TMD >=7.5cm vs Intubation difficulty Scale were calculated (Table 12).

Hence, these findings clearly indicate that a TMD<6.5cm as well as a TMD>7.5cm can give us a difficult airway intraoperatively.



Graph 1: Difficult airway predictor persuant to thyromental Distance <6.5cm and >=7.5cm. DI - Difficult intubation, C-Lgrade- Cormack Lehane grade, MMPG: Modified mallampati grading

4. Discussion

The accurate evaluation preoperatively and keeping our difficult airway armamentorium ready for any unanticipated difficult airway ensures patient safety during intubation. In our study, incidence of difficult intubation was 18.6%, similar to previous studies[2,8] in which the incidence varied between 1.5% and 20%. We observed that a long TMD (7.5cm≥TMD) could be a difficult airway indicator like a short TMD (TMD ≤ 6.5 cm).

Thyromental distance (TMD) has been recognized as a significant part of airway management guidelines and is among the most commonly used parameters for predicting difficult airway.[3–5,9] Despite being extensively studied, TMD has been the subject of ongoing debate, with some questioning its reliability as a predictor of difficult airway. However, the simple structure and ease of measurement of TMD have made it a valuable tool in clinical practice. Previous studies have suggested that a short TMD of ≤6.5 cm is an indicator of difficult intubation.[3–7]

A study by Gopalakrishnan et al.[10] aimed to evaluate the accuracy of thyromental distance in predicting difficult intubation in a meta-analysis of 26 studies involving 3,390 patients and found that a thyromental distance of less than 6 cm was associated with a higher risk of difficult intubation, with a sensitivity of 58% and a specificity of 76%.

Similarly, Shah et al[11] showed that TMD had a high specificity but low sensitivity because of interobserver variability. Shiga et al[12] proposed that because of wide range of cut off for TMD [5cm-7cm], there could be fallacies in detecting difficult airway.

Maximum number of studies have concentrated on the lower limit of TMD[3,13–16] compared BMI with TMD but no comment was made on long TMDs. Patil et al[14] showed that TMD<6 was a good indicator of difficult airway. But, studies have to be done on long TMD as well and find the upper limit also.

According to the results of our study, a TMD measurement of 7.5 cm or more had a high sensitivity of 92.9% in predicting difficult intubation. This indicates that

Table 1: Gender distribution among the study population

Gender Distribution	Frequency	Percent	Valid Percent	Cumulative Percent
Female	39	55.7	55.7	55.7
Male	31	44.3	44.3	100.0
Total	70	100.0	100.0	

Table 2: Distribution of subjects as per age

Age (in years)	Frequency	Percent	Valid Percent	Cumulative Percent
<20 Years	4	5.7	5.7	5.7
21-30Years	24	34.3	34.3	40.0
31-40Years	16	22.9	22.9	62.9
41-50Years	11	15.7	15.7	78.6
51-60Years	8	11.4	11.4	90.0
>60Years	7	10.0	10.0	100.0
Total	70	100.0	100.0	
Mean±SD			38.27±14.21 years	

Table 3: BMI distribution among the study population

BMI Distribution	Frequency	Percent	Valid Percent	Cumulative Percent
18.5	7	10.0	10.0	10.0
18.5-25.0	33	47.1	47.1	57.1
>25.0	30	42.9	42.9	100.0
Total	70	100.0	100.0	

Table 4: ASA Grade distribution among the study population

ASA Grade Distribution	Frequency	Percent	Valid Percent	Cumulative Percent
1	56	80.0	80.0	80.0
2	12	17.1	17.1	97.1
3	2	2.9	2.9	100.0
Total	70	100.0	100.0	

Table 5: MMPG distribution among the study population

MMPG Distribution	Frequency	Percent	Valid Percent	Cumulative Percent
1	21	30.0	30.0	30.0
2	25	35.7	35.7	65.7
3	21	30.0	30.0	95.7
4	3	4.3	4.3	100.0
Total	70	100.0	100.0	

Table 6: Cormack lehane grade distribution among the study population

Cormack Lehane Grade Distribution	Frequency	Percent	Valid Percent	Cumulative Percent
I	53	75.7	75.7	75.7
II	9	12.9	12.9	88.6
III	6	8.6	8.6	97.1
IV	2	2.9	2.9	100.0
Total	70	100.0	100.0	

Table 7: IDS distribution among the study population

IDS Distribution	Frequency	Percent	Valid Percent	Cumulative Percent
<5	56	80.0	80.0	80.0
>5	14	20.0	20.0	100.0
Total	70	100.0	100.0	

Table 8: TMD distribution among the study population

TMD Distribution	Frequency	Percent	Valid Percent	Cumulative Percent
<6.5	12	17.1	17.1	17.1
6.5-7.5	8	11.4	11.4	28.6
7.5	50	71.4	71.4	100.0
Total	70	100.0	100.0	

Table 9: Thyromental distance and intubation difficulty scale distribution

IDS Distribution	TMD			Total
	<6.5	6.5-7.5	>7.5	
	6	7	43	56
<5 (Easy Intubation)	10.7%	12.5%	76.8%	100.0%
	50.0%	87.5%	86.0%	80.0%
	6	1	7	14
>5 (Difficult Intubation)	42.9%	7.1%	50.0%	100.0%
	50.0%	12.5%	14.0%	20.0%
	12	8	50	70
Total	17.1%	11.4%	71.4%	100.0%
	100.0%	100.0%	100.0%	100.0%

X^2 = 8.156, p value = 0.017 (SIG). *p value <0.05 is significant. Pearson Chi-square test done

Table 10: Thyromental distance and modified mallampati grading distribution

MMPG Distribution	TMD			Total
	<6.5	6.5-7.5	>7.5	
	3	2	16	21
1	14.3%	9.5%	76.2%	100.0%
	25.0%	25.0%	32.0%	30.0%
	2	4	19	25
2	8.0%	16.0%	76.0%	100.0%
	16.7%	50.0%	38.0%	35.7%
	5	2	14	21
3	23.8%	9.5%	66.7%	100.0%
	41.7%	25.0%	28.0%	30.0%
	2	0	1	3
4	66.7%	.0%	33.3%	100.0%
	16.7%	.0%	2.0%	4.3%
	12	8	50	70
Total	17.1%	11.4%	71.4%	100.0%
	100.0%	100.0%	100.0%	100.0%

X^2 = 7.905, p value = 0.245 (NS), *p value <0.05 is significant. Pearson Chi-square test done

patients with a TMD of 7.5 cm or more are at a higher risk of difficult intubation. Similarly, Kizilcik N et al[17] conducted a study "Is there an upper limit on Thyromental Distance?" and concluded that TMD>=7.5 cm could predict difficult intubation.

The probable explanation to this is given by Chou H C, Wu T-L.[18–20] The larynx lowers caudally during the growth of a human from a neonate to an adult (known as ontogeny), just as it did during the evolution of the human species (ontogeny recapitulates phylogeny). In some people, the caudad descent of the larynx is relatively lengthy, resulting in a significant portion of the tongue being in the hypopharynx. In this particular case, a large TMD indicates a challenging intubation.[18–20] On the other hand, in some individuals, the descent of the larynx during development is relatively small, and the mandible is short. In this instance, a small TMD is an indicator of difficult intubation.[18–20] Therefore, both a long and a small TMD can predict difficult intubation.[21]

5. Conclusion

Present study findings suggest that the reliability of TMD as a sole predictor is questionable. Although TMD is widely used in airway management guidelines, our research has demonstrated that both a short TMD (<6.5cm) and long TMD (>7.5 cm) can indicate difficult intubation. Thus, incorporating other predictors in preoperative assessment is

Table 11: Thyromental distance and Cormack lehane (C-L) grade distribution

CL Grade Distribution	TMD			Total
	<6.5	6.5-7.5	>7.5	
	10	7	36	53
I	18.9%	13.2%	67.9%	100.0%
	83.3%	87.5%	72.0%	75.7%
	1	0	8	9
II	11.1%	.0%	88.9%	100.0%
	8.3%	.0%	16.0%	12.9%
	1	1	4	6
III	16.7%	16.7%	66.7%	100.0%
	8.3%	12.5%	8.0%	8.6%
	0	0	2	2
IV	.0%	.0%	100.0%	100.0%
	.0%	.0%	4.0%	2.9%
	12	8	50	70
Total	17.1%	11.4%	71.4%	100.0%
	100.0%	100.0%	100.0%	100.0%

X^2 = 2.897, p value = 0.822 (NS). *p value <0.05 is significant. Pearson Chi-square test done

Table 12: TMD >= 7.5 cm vs IDS

Sensitivity	92.9%
Specificity	12.5%
Positive predictive value	21.0%
Negative predicitve value	87.5%

crucial to accurately identify patients at risk and develop appropriate management strategies.

6. Limitations

The study had some limitations, including a relatively small sample size in the difficult intubation group, high inter-observer variability, and the determination of the IDS score had subjective variability.

7. Source of Funding

None.

8. Conflict of Interest

None.

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