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Original Article

Anaesthesia Section

Incidence and Predictors of Difficult Intubation in Patients Undergoing Thyroid Surgery

LALENGKIMA HMAR DARNGAWN[1], VEENA NADARAJAN[2], VIMAL PRADEEP[3]

ABSTRACT

Introduction: Thyroid enlargement is considered a risk factor for challenging direct laryngoscopy and intubation. Airway management in patients with thyroid swelling presents unique challenges, requiring thorough preparation for potential difficult airways. Although airway management in the overall population has been thoroughly researched, there is a scarcity of literature specifically addressing airway management in individuals who have thyroid enlargement.

Aim: To evaluate the incidence of difficult intubation in patients undergoing thyroid surgery, utilising the Intubation Difficulty Score (IDS).

Materials and Methods: This cross-sectional observational study was conducted among 258 patients in the Department of Anaesthesiology, Government TD Medical College, Alappuzha, Kerala, India. Various parameters including Modified Mallampati score, neck circumference, Body Mass Index (BMI), inter-incisor distance, retrognathia, neck extension, thyromental distance, tracheal deviation, and tracheal compression were assessed for all patients with thyroid swelling. The incidence of difficult endotracheal intubation was analysed using the IDS and the time taken for successful intubation was recorded. Data were presented as mean±standard deviation (SD), frequencies, and percentages. The association between variables was analysed using the Chi-square test.

Results: Thyroid disorders were more common in females 220 (85.3%) than in males 38 (14.7%). The variables such as BMI, Mallampati score, thyromental distance, inter-incisor distance, and neck mobility were not found to be associated with difficult intubation. However, increased neck circumference (>43 cm) was statistically significant (p-value=0.007) in relation to difficult intubation. According to IDS, 94.2% of patients had easy intubation, while 5.8% experienced difficult intubation. In terms of intubation times, 72.5% of patients were intubated within 10-15 seconds, 24.4% within 16-20 seconds, and 3.1% took longer than 20 seconds.

Conclusion: Thyroid surgery itself is not an independent predictive factor for difficult intubation. Among the predictive factors in the study population, a neck circumference greater than 43 cm was found to be associated with difficult endotracheal intubation during thyroid surgery.

Keywords: Endotracheal intubation, Intubation difficulty score, Neck circumference, Thyroidectomy

INTRODUCTION

Airway management is a critical aspect of general anaesthesia [1]. Preoperative identification of patients or procedures at risk for difficult intubation is crucial. Airway evaluation is conducted to identify the likelihood of encountering a challenging airway, which allows for proper patient preparation, selection of suitable equipment and techniques, and involvement of skilled individuals in managing problematic airways. Confirming a normal airway prevents the need for time-consuming, invasive, and potentially more traumatic techniques of securing the airway. The main elements of airway assessment consist of gathering medical history, doing a basic physical examination, and utilising particular tests or indicators to suggest a challenging airway [1]. Past history include past operations, burns, injuries, or growths in the mouth, neck, and cervical spine. An extensive overall assessment of patients should include identifying anatomical features that may lead to challenging laryngoscopy and intubation [2]. Anaesthesiologists must be skilled at identifying both pathological and physiological variables that could impede laryngoscopy and intubation.

The American Society of Anaesthesiologists (ASA) defines a difficult airway as a clinical scenario where a traditionally proficient anaesthesiologist faces challenges with facemask breathing, tracheal intubation, or both [3]. Difficult laryngoscopy occurs when it is not possible to visualise any portion of the vocal cords, or only a part of the vocal cords is visible during conventional laryngoscopy, as defined by the ASA. This usually correlates to Cormack and Lehane's grade 4 or 3 laryngoscopic vision [4]. Difficult intubation occurs when tracheal intubation necessitates many tries, regardless of any tracheal issues. Clear visualisation of the glottis is crucial for effective endotracheal intubation. This viewing is accomplished by direct laryngoscopy while the patient is in the sniffing posture, which requires bending the neck forward and extending at the atlanto-occipital joint [1]. This alignment allows the oral, pharyngeal, and laryngeal axes to align with the laryngoscopist's view. Difficulty in airway control can occur at different levels: supraglottic, glottic (at the level of the vocal cords), or infraglottic (at the level of the trachea). Factors contributing to supraglottic difficulty include decreased mouth opening, increased tongue size, pathologies of the pharynx and submandibular space, impaired head and neck mobility, increased neck circumference, and obesity.

Performing direct laryngoscopy can be difficult in individuals with Mallampati grade 3 or 4, limited mouth opening (<20 mm), decreased thyromental distance (<6 cm), reduced Wilson's angle of neck movement (<80°), obesity (elevated BMI), and raised neck circumference (>43 cm) [5,6]. Indirect laryngoscopy can be employed to assess glottic factors such as vocal cord movement, vocal cord palsies, and tumours affecting the vocal cords, as well as infraglottic factors like tracheal deviation and tracheal compression due to thyroid swelling, mediastinal masses, and lung pathologies such as bronchogenic carcinoma and lung fibrosis. Thyroid surgery is recognised as a risk factor for difficult intubation [7]. Therefore, it is essential for the safe management of anaesthesia. The nature of thyroid gland disease can lead to airway compression and deformity. Difficulty in intubation may arise from an enlarged thyroid

causing tracheal deviation, compression, or both. Managing the airway in patients with thyroid swelling presents unique challenges, and it is imperative to be thoroughly prepared for any anticipated or unforeseen difficult airway situations.

Airway management in the overall population has been thoroughly researched. However, there is a scarcity of studies specifically focusing on airway management in patients with thyroid swelling [7–10]. This study focuses on investigating the incidence and predictors of difficult intubation in the specific population of patients undergoing thyroid surgery under general anaesthesia using the IDS. Additionally, the study aimed to assess the potential association between various variables, namely Modified Mallampati score, inter-incisor gap, thyromental distance, neck circumference, BMI, mandibular protrusion, and neck extension, with difficult laryngoscopy in patients undergoing thyroid surgery.

MATERIALS AND METHODS

This was a cross-sectional observational study conducted at Government TD Medical College, Alappuzha, Kerala, India. The study spanned over three years from 2019 to 2021 and was conducted with ethical clearance under certificate number EC67/2018/TD dated 06/12/2018.

Inclusion criteria: Patients aged 18 to 60 years, consented for surgery and ASA status I and II were included in the study.

Exclusion criteria: Patients with history of difficult intubation were excluded from the study.

Sample size: The sampling method employed was through interviews and observations. Sample size was determined based on a previous study by Kalezić N et al., [11], where the incidence of difficult intubation was found to be 28.37%. The formula used for calculation was $4Pq/d^2$, with P representing the incidence of difficult intubation in thyroid surgery, d as 20% of P, and q as 100-P. Thus, the calculated sample size was 258.

Operational definitions

1. **Intubation Difficulty Score (IDS):** Intubation difficulty was assessed using the Intubation Difficulty Score (IDS) developed by Adnet et al. in 1997 [12]. The IDS is a composite score based on 7 criteria associated with difficult intubation.
    1. Number of intubation attempts.
    2. Number of operators.
    3. Number of alternative techniques.
    4. Cormack Lehane grade (grades 1, 2, 3, 4).
    5. Lifting force required during laryngoscopy.
    6. Necessity of laryngeal pressure.
    7. Position of the vocal cords.

If intubation is success in first attempt or by first operator, N1 or N2 is 0.

N1 (number of additional attempts): Every attempt adds 1 point.

N2 (number of additional operators): Every additional operator adds 1 point.

N3 (number of alternative intubation techniques): Every alternative technique adds 1 point.

N4 (Cormack Lehane grade for laryngoscopic view).

Fully vocal cords seen: N4=0.

Partial vocal cords seen: N4=1.

Only epiglottis seen: N4=2.

Neither glottis nor epiglottis seen: N4=3.

N5 (lifting force applied during laryngoscopy).

Normal lifting force: N5=0.

Increased lifting force: N5=1.

N6 (need to apply external laryngeal pressure).

Not applied: N6=0.

Applied: N6=1.

N7 (position of vocal cords at intubation).

Abduction: N7=0.

Adduction: N7=1.

IDS: A score of more than 5 indicates difficult intubation.

2. **Modified mallampati score:** The Modified Mallampati Score provides information about the adequacy of the oropharyngeal space for laryngoscopy, as proposed by Samsoon and Young [13]. This index evaluates the size of tongue in respect to the oropharynx. Patients are instructed to sit with their head in a neutral position and then open their mouth wide while extending their tongue as far as they can. Patients are advised to remain silent during the evaluation. The oropharynx is visualised at the level of their mouth, and based on the structures visualised, patients are categorised into four classes.

    I: Whole of uvula, faucial pillars, and soft palate are visible.

    II: A part of uvula and soft palate are visible.

    III: Base of uvula and soft palate are visible.

    IV: Only the hard palate is visible.

3. **Inter-Incisor Distance (IID):** The Inter-Incisor Distance is the distance in centimeters between the upper and lower incisors of the patient with the mouth fully open and the neck in a neutral position. The normal value is more than 3 cm or allows the insertion of two fingers [1].

4. **Thyromental Distance (TMD):** The TMD is measured with the patient in a sitting position with the neck fully extended. It is the distance in centimeters between the thyroid notch and the tip of the lower border of the mentum (chin). A measurement of less than 6.5 cm indicates a reduced submandibular space, which is a predictor of difficult laryngoscopy and intubation [14].

5. **Neck Circumference (NC):** Neck Circumference is measured when the patient is seated with the head in neutral position. The neck circumference is measured at the point of maximum bulge, typically due to a goiter, using a measuring tape [10].

6. **Neck Extension (mobility)/sternomental distance:** Neck Extension (Mobility) or Sternomental Distance is measured with the patient in a sitting position and the neck fully extended. It is the distance in centimeters between the suprasternal notch and the tip of the chin with the neck fully extended and the mouth closed. This measurement serves as a quantitative assessment of neck extension and mobility.

7. **Mandibular Protrusion (Retrognathia)/Upper Lip Bite Test (ULBT):** The Upper Lip Bite Test assesses the mobility of the temporomandibular joint, particularly the sliding movement. Patients are evaluated in a sitting position, where they are asked to bite their upper lip with their mandibular incisors, and the extent to which the mandible moves forward is noted [15].

Upper Lip Bite Test

Class I: Mandibular incisors can bite the upper lip above the vermilion line.

Class II: Mandibular incisors can bite the upper lip below the vermilion line.

Class III: Mandibular incisors cannot bite the upper lip.

8. **Body Mass Index (BMI):** The Body Mass Index is calculated as the weight of the patient in kilograms divided by the square of the height in meters [16]. It is used as an indicator of body fatness and can provide insight into the patient's nutritional status.

9. **Cook's modification [17] of cormack-lehane grading:** Cook's Modification of the Cormack-Lehane Grading provides a detailed classification of laryngoscopic views during intubation.

   Grade I: Entire vocal cord is visualised.

   Grade IIa: Posterior part of the vocal cord is seen.

   Grade IIb: Arytenoids only are visible.

   Grade IIIa: Only the epiglottis is seen and is liftable.

   Grade IIIb: Only the tip of the epiglottis is seen or it is adherent.

   Grade IV: No glottic structure is visible.

Procedure: Informed consent was obtained from all participants. Demographic details of the patients were obtained. Duration of thyroid swelling, surgical diagnosis of thyroid swelling, and any history of compressive effects were also documented. The attending anesthesiologist performed a preoperative assessment. Additionally, clinical features such as the appearance of a retrognathic midface or a prognathic mandibular profile were recorded. The presence or absence of radiological features such as tracheal deviation, tracheal narrowing, and retrosternal extension of goiter were also noted. The surgical diagnosis was categorised as follows: Simple or multinodular goiter, Toxic multinodular goiter, Thyroiditis, Grave's disease, or Malignant Goiter.

X-ray of the neck in lateral and anteroposterior views were taken. All patients were premedicated with tab pantoprazole 40 mg, tab ondansetron 4 mg, and tab alprazolam 0.25 mg at night before the surgery and at 6 am on the day of surgery. Patients were then taken to the operating room on the day of surgery, and intravenous cannulation with an 18-gauge cannula was performed on the non dominant forearm with fluid administration initiated. In the operating room, patients were monitored with non invasive blood pressure, pulse oximetry, electrocardiogram, and measurement of end-tidal carbon dioxide concentration. After administering oxygen via mask, patients were induced with inj. Fentanyl 1.5-2 mcg/kg, inj. Propofol (bolus 2-2.5 mg/kg), and succinylcholine 1-1.5 mg/kg. Tracheal intubation was performed orally using a Macintosh blade of appropriate size with the head in the sniffing position. Intubation was carried out by a Senior Anaesthesiologist.

Intubation difficulty was assessed using IDS, where a score of 5 or less indicated easy intubation, while a score greater than 5 indicated difficulty. Cook's Modification of Cormack-Lehane grading was also noted during laryngoscopy. The duration of intubation was recorded from the moment the laryngoscope touched the patient until the moment the endotracheal cuff was inflated.

STATISTICAL ANALYSIS

Data were presented as mean±SD, frequencies, and percentages. The association between variables was analysed using the Chi-square test. Statistical analysis was performed using SPSS version 25.0, with a p-value of <0.05 considered statistically significant.

RESULTS

Demographic details is shown in [Table/Fig-1]. The mean age of the subjects was 41.57±11.36 years, with a mean BMI of 24.55±3.29 kg/m^2, mean Thyromental Distance (TMD) of 7.27±1.04 cm, and mean Inter-Incisor Distance (IID) of 3.82±0.59 cm [Table/Fig-2]. Modified Mallampati Score (MMS), is shown in [Table/Fig-3]. Neck mobility findings is shown in [Table/Fig-4]. The mean Neck Circumference was 34.83±2.99 cms [Table/Fig-5]. In the study, the most common diagnosis was Multinodular Goiter (MNG) at 55.4%, followed by Solitary Nodule Thyroid (SNT) at 20.2%. Additionally, 99.6% of enrolled patients underwent Total Thyroidectomy. Regarding tracheal deviation, 86.4% had no deviation, 3.5% deviated to the left, and 10.1% deviated to the right. Compression was observed in 8.5% of cases [Table/Fig-6]. Cormack-Lehane (CL) Grade distribution is shown in [Table/Fig-7].

In the study, the distribution of scores for the IDS criteria were as follows: 3.5% had score 1 for N1, 4.7% had score 1 for N2, 4.3% had score 1 for N3, 36.8% had score 1 and 7% had score 2 for N4. 13.6% had score 1 for N5, 24.4% had score 1 for N5 and 0.8% had score 1 for N7. These scores reflect the various criteria within the IDS used to assess difficult intubation. In the study, 94.2% of patients were classified as having an easy intubation, while 5.8% were classified as having a difficult intubation based on the Intubation Difficulty Scale [Table/Fig-8].

Parameters		n (%)
Age (years)	<20	6 (2.3)
	21-30	40 (15.5)
	31-40	81 (31.4)
	41-50	86 (33.3)
	51-60	33 (12.8)
	61-70	10 (3.9)
	>70	2 (0.8)
Gender	Female	220 (85.3)
	Male	38 (14.7)
BMI	<1 8.5 (Underweight)	8 (3.1)
	18.5 to 24.9 (Normal)	130 (50.4)
	25 to 29.9 (Overweight)	99 (38.4)
	30 to 34.9 (Obesity)	21 (8.1)

[Table/Fig-1]: Demographics.

	Age	BMI	TMD	IID
N	258	258	258	258
Mean	41.57	24.55	7.27	3.82
Std. Deviation	11.36	3.29	1.04	0.59
Minimum	1 5	16.39	5.5	2.0
Median	41.00	24.75	7.0	4.0
Maximum	75	34.60	12.0	6.0
Range	60	18.21	6.5	4.0

[Table/Fig-2]: Age, BMI, TMD and IID Distribution.

MMS score	n (%)
1	58 (22.5)
2	142 (55.0)
3	58 (22.5)

[Table/Fig-3]: MMS grade distribution.

Neck mobility	n (%)
Mild restriction	22 (8.5)
No limitation	232 (89.9)
Severe restriction	4 (1.6)

[Table/Fig-4]: Neck mobility distribution.

Neck circumference	
N	258
Mean	34.83
Std. Deviation	2.99
Minimum	18
Median	35.00
Maximum	45
Range	27

[Table/Fig-5]: Neck circumference distribution.

Variables		n (%)
Diagnosis	Multi Nodular Goiter (MNG)	143 (55.4)
	Solitary Nodule Thyroid (SNT)	52 (20.2)
	Papillary carcinoma	24 (9.3)
	Toxic MNG	21 (8.1)
	Follicular carcinoma	7 (2.7)
	MNG with retrosternal extension	6 (2.3)
	Medullary carcinoma of thyroid	3 (1.2)
	Grave's disease	1 (0.4)
	Colloid goitre	1 (0.4)
Surgery	Hemithyroidectomy	1 (0.4)
	Total thyroidectomy	257 (99.6)
Tracheal deviation	Nil	223 (86.4)
	To left	9 (3.5)
	To right	26 (10.1)
Compression	Nil	236 (91.5)
	Present	22 (8.5)

[Table/Fig-6]: Diagnosis, Surgery, Tracheal Deviation and Compression distribution.

Cormack Lehane (CL)	n (%)
1	142 (55.0)
2A	60 (23.3)
2B	37 (14.3)
3A	18 (7.0)
3B	1 (0.4)

[Table/Fig-7]: Cormack Lehane (CL) Grade distribution.

	0	1	2
	n (%)	n (%)	n (%)
N1	249 (96.5)	9 (3.5)	0
N2	246 (95.3)	12 (4.7)	0
N3	247 (95.7)	11 (4.3)	0
N4	145 (56.2)	95 (36.8)	18 (7)
N5	223 (86.4)	35 (13.6)	0
N6	195 (75.6)	63 (24.4)	0
N7	256 (99.2)	2 (0.8)	0

		n (%)
Intubation difficulty scale	<5 (Easy)	243 (94.2)
	≥5 (Difficult)	15 (5.8)

[Table/Fig-8]: Intubation difficulty scale.

Intubation duration is shown in [Table/Fig-9], the findings indicate that the intubation process was predominantly efficient, with the vast majority of patients successfully intubated within the initial 15-second timeframe.

Duration of intubation (seconds)	n (%)
10 to 15	187 (72.5)
16 to 20	63 (24.4)
>20	8 (3.1)

[Table/Fig-9]: Duration of Intubation distribution.

In the study, no significant association was found between TMD, IID and MMS with IDS. However, a significant association was identified between the duration of intubation and IDS. Patients predicted to have difficult intubation required a longer duration for intubation compared to those classified as having an easy intubation [Table/Fig-10].

In the study, no significant association was found between Neck mobility, retrognathia and BMI with IDS. However, among the subjects with difficult IDS, 93.3% had an easy and 6.7% had a difficult grading, whereas among the subjects with easy IDS, 99.6% had an easy and 0.4% had a difficult intubation. This suggests that the majority of patients with an easy IDS score also had an easy intubation outcome. A significant association was observed between neck circumference and IDS grading [Table/Fig-11]. This finding suggests that neck circumference plays a role in predicting the difficulty of intubation, as indicated by the association with IDS grading.

Variables		Intubation Difficulty Scale		
		>5 (Difficult)	<5 (Easy)	Total
		n (%)	n (%)	n (%)
TMD	<6.5 cms (difficult)	0	1 (0.4)	1 (0.4)
	>6.5 cms (easy)	15 (100)	242 (99.6)	257 (99.6)
	Total	15 (100)	243 (100)	258 (100)
χ^2=0.062, df=1, p=0.803				
IID	<3 cms (difficult)	0	3 (1.2)	3 (1.2)
	>3 cms (easy)	15 (100)	240 (98.8)	255 (98.8)
	Total	15 (100)	243 (100)	258 (100)
χ^2=0.1 87, df=1, p=0.665				
MMS	>2 (difficult)	5 (33.3)	53 (21.8)	58 (22.5)
	<2 (easy)	10 (66.7)	190 (78.2)	200 (77.5)
χ^2=1 .076, df=1, p=0.300				
Duration of intubation	10 to 15 sec	0	187 (77)	187 (72.5)
	16 to 20 sec	7 (46.7)	56 (23)	63 (24.4)
	>20 sec	8 (53.3)	0	8 (3.1)
	Total	15 (100)	243 (100)	258 (100)
χ^2=1 44.37, df=2, p<0.001*				

[Table/Fig-10]: Association between TMD, IID, MMS, Duration of Intubation and Intubation Difficulty Scale.

Variables		Intubation Difficulty Scale		
		>5 (Difficult)	<5 (Easy)	Total
		n (%)	n (%)	n (%)
Neck Mobility	Mild restriction	3 (20)	19 (7.8)	22 (8.5)
	No limitation	12 (80)	220 (90.5)	232 (89.9)
	Severe restriction	0	4 (1.6)	4 (1.6)
χ^2=2.880, df=2, p=0.237				
Retrognathia	Nil	14 (93.3)	238 (97.9)	252 (97.7)
	Present	1 (6.7)	5 (2.1)	6 (2.3)
	Total	15 (100)	243 (100)	258 (100)
χ^2=1 .321, df=1, p=0.250				
BMI	<1 8.5 (Underweight)	0	8 (3.3)	8 (3.1)
	1 8.5 to 24.9 (Normal)	6 (40)	124 (51)	130 (50.4)
	25 to 29.9 (Overweight)	7 (46.7)	92 (37.9)	99 (38.4)
	30 to 34.9 (Obesity)	2 (13.3)	19 (7.8)	21 (8.1)
	Total	15 (100)	243 (100)	258 (100)
χ^2=1 .648, df=3, p=0.649				
Neck circumference	<43 cms (Easy)	14 (93.3)	242 (99.6)	256 (99.2)
	>43 cms (Difficult)	1 (6.7)	1 (0.4)	2 (0.8)
	Total	15 (100)	243 (100)	258 (100)
χ^2=7.1 87, df=1, p=0.007*				

[Table/Fig-11]: Association between Neck Mobility, Retrognathia, BMI, Neck Circumference and Intubation Difficulty Scale.

DISCUSSION

Expert airway management is a critical skill for anaesthesiologists, especially when faced with a "Difficult airway," which is defined as a scenario where conventional methods of mask ventilation or tracheal intubation pose challenges. The actual occurrence rate of challenging laryngoscopy and tracheal intubation is uncertain but could be as high as 7.5% in the overall general population [18,19]. Difficulties with tracheal intubation are often due to challenges with direct laryngoscopy, where the view of the vocal cords is impaired. Many instances of difficult intubation are not apparent

until after anaesthesia induction. Unexpectedly tough intubation can rapidly lead to severe conditions, especially in individuals prone to gastrointestinal regurgitation, difficult mask ventilation, or with low cardio-pulmonary reserves. Unsuccessful endotracheal intubation can lead to serious health issues and death in patients under anaesthesia, emphasising the necessity of anticipating challenges, particularly when dealing with goiter.

Common factors linked to challenging laryngoscopy include a short sternomental distance, short thyromental distance, high neck circumference, restricted head and neck movement, limited jaw movement, retrognathia, and prominent teeth [6,20]. However, despite these known factors, there is a gap in research focusing on the prediction of difficult endotracheal intubation specifically in thyroid surgeries. This study aims to address this gap by carrying out an observational study to assess the determinants and occurrence of challenging endotracheal intubation in patients undergoing thyroid operations. Thyroid disorders can affect individuals across a wide range of ages. In this study, patients between 18 to 60 years old were included, with the majority falling in the 41 to 50 years age group. The study also observed a higher prevalence of thyroid disorders among females, with 83.3% of the study population being women compared to 14.7% men.

According to the World Health Organisation (WHO) expert consultation criteria, a Body Mass Index (BMI) of 27.5 kg/m^2 or higher is considered obese in the Asian population [16]. In this study, the mean BMI was 24.55, and analysis showed no significant association between BMI and Intubation Difficulty Scale (IDS) grading (p-value=0.649). The MMS classification is a predictor of difficult intubation based on the relative sizes of the oral cavity and tongue, as proposed by Samsoon and Young [13]. In our study, 22.5% of patients were classified as MMS Class 1, 55% as Class 2, and 22.5% as Class 3. However, there was no significant relationship found between MMS and difficult intubation (p-value=0.300). TMD is an indicator of difficult laryngoscopy because it shows how well the mandibular space allows for moving the tongue to the side during direct laryngoscopy. Difficult intubation is more prevalent when the TMD is less than 6.5 cm than when it is larger than 6.5 cm [6,21,22]. In present study, the mean TMD was 7.267 cm, and analysis revealed no significant association between TMD and difficult intubation (p-value=0.803). IID is also a predictor of difficult laryngoscopy, as it is influenced by temporomandibular joint and upper cervical spine mobility. An IID gap of less than 3 cm indicates a higher likelihood of difficult intubation [21,23]. In present study, the mean IID was 3.82 cm, suggesting that difficult intubation was less likely, and this was statistically insignificant (p-value=0.665).

Neck mobility and extension are assessed by examining the atlanto-occipital joint extension. During this assessment, the patient is instructed to keep their head upright, facing forward, and then extend the head as far back as possible. Normal extension is considered to be 35° or more, while neck flexion ranges from 25 to 35°, indicating movement of the head toward the chest [21]. Additionally, neck rotation to the left and right sides was also evaluated. In present study, 8.5% of patients exhibited mild restriction, 1.6% had severe restriction, and 89.9% showed normal extension, predicting easy intubation (p-value=0.237). Patients with a neck circumference greater than 43 cm are more likely to experience difficulty with intubation compared to those with a circumference less than 43 cm [24]. Aggarwal N et al., aimed to evaluate the volume of the normal thyroid gland and thickness of thyroid isthmus by ultrasonography. They found that cases with normal NC showed an increment in total volume of thyroid gland. The correlation was mild, but significant (r=0.474, p-value <0.001). As there is a dearth of literature concerning the correlation between NC and thyroid volume assessment, this is what distinguished their study [25]. Also, Meco BC et al., sought to identify airway management challenges by utilising ultrasound-based thyroid volume assessment and NC >43 cm as predictors of problematic intubation [26]. In present study, the mean neck circumference was 34.83 cm. Among patients with an IDS score greater than 5, 6.7% had a neck circumference greater than 43 cm. In contrast, among patients with an IDS score less than 5, 99.6% had a neck circumference less than 43 cm, and only 0.4% experienced difficult intubation. Therefore, there was a significant association found between neck circumference and difficult intubation (p-value=0.007).

Mandibular protrusion, or the ability of the patient to protrude the mandible forward, is quantitatively measured using the upper lip bite test [15]. In present study, seven patients exhibited retrognathia (receding mandible). However, there was no significant relationship found between retrognathia and intubation difficulty (p-value=0.250). Bouaggad A et al., research found that challenging tracheal intubation during thyroid surgery is not linked to the size of goiters [27]. Two criteria found to be independent risk factors for challenging endotracheal intubation in thyroid surgery are Cormack grade III or IV and cancerous goiter. Thyroid enlargement is not linked to difficult endotracheal intubation, as per the study. Tracheal deviation was observed in 3.5% to the left and 10.1% to the right, while tracheal compression was present in 8.5%, though statistically insignificant in this study. The IDS was utilised to evaluate challenging intubation scenarios, a metric created by Adnet F et al., [12]. This scoring system combines subjective and objective criteria, allowing for both qualitative and quantitative evaluation of the progressive nature of intubation difficulty, and is considered one of the best indicators available. The IDS categorises intubation as easy for a score of 0 or <5, and moderate to substantial difficulty for a score more than 5 [28]. In present study, 94.2% of the study population experienced easy intubation, while 5.8% encountered difficulty. The majority (72.5%) were intubated within 10 to 15 seconds, 24.4% within 16 to 20 seconds, and 3.1% took more than 20 seconds for successful intubation.

In this study, various predictors of difficult intubation in thyroid surgery patients were studied. While factors like neck circumference proved to be significant predictors of difficult intubation, others such as Modified Mallampati score, thyromental distance, and inter-incisor distance did not show significant associations. The majority of patients had easy intubation according to IDS, indicating successful airway management. These findings emphasise the importance of thorough preoperative assessment, particularly considering neck circumference, to anticipate and manage potential airway challenges in thyroid surgery patients.

Limitation(s)

Patients presenting for thyroid surgery were prospectively enrolled for the study, which could have resulted in selection bias. The study was conducted in a single tertiary care centre. So the results may not be generalisable to all areas.

CONCLUSION(S)

The study revealed that neck circumference greater than 43 cm was substantially linked with difficult endotracheal intubation. Other factors such as Modified Mallampati score, thyromental distance, and inter-incisor distance did not show significant associations. The majority of patients had easy intubation according to IDS. This highlights the importance of preoperative assessment, particularly considering neck circumference, to anticipate and manage difficult airways in thyroid surgery patients. Further research with larger cohorts could delve deeper into these factors, enhancing ones understanding and improving clinical approaches to airway management in this specific population.

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PARTICULARS OF CONTRIBUTORS:
1. Junior Resident, Department of Anaesthesiology, Government TD Medical College, Alappuzha, Kerala, India.
2. Professor, Department of Anaesthesiology, Government TD Medical College, Alappuzha, Kerala, India.
3. Associate Professor, Department of Anaesthesiology, Government TD Medical College, Alappuzha, Kerala, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Vimal Pradeep,
Anugraha Nadackavu, Perungala PO, Kayamkulam-690559, Kerala, India.
E-mail: vimalpradeep1980@gmail.com

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