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Research Article

STUDY OF THE EFFECT OF ULTRASONOGRAPHICALLY CALCULATED VOLUME OF THYROID SWELLING ON ENDOTRACHEAL INTUBATION: A PROSPECTIVE OBSERVATIONAL DOUBLE-BLINDED STUDY

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A R T I C L E I N F O

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A B S T R A C T

Introduction: Patients with thyroid swelling are anticipated difficult airway due to the anatomical complications associated with it. This study was done to evaluate the effect of volume of thyroid swelling on endotracheal intubation.
Methods: Eighty patients posted for elective thyroid surgery of either sex, between 18 and 70 years, ASA grade I or II and Mallampati score 1 or 2 were enrolled. Ultrasound volume of thyroid swelling was calculated. After induction of general anaesthesia, tracheal intubation was done and time taken for intubation, Cormack-Lehane score and Intubation Difficulty score were noted.
Results: Mean volume of thyroid swelling was 57.13±46.21 ml. Thyroid volume was found to be positively and significantly correlated with time from insertion of laryngoscope to visualization of glottis (mean time: 14.69±7.94 sec; spearman correlation coefficient, ρ=0.398; p<0.001), time taken for successful intubation (mean time: 37.99±12.66 sec; ρ=0.391; p<0.001), Intubation Difficulty score (mean IDS: 1.75±1.64; ρ=0.602; p<0.001) and Cormack Lehane Score (mean: 1.40±0.56; ρ=0.626; p<0.001). With increase in size of gland, there is increase in the time for intubation, Intubation Difficulty score and Cormack-Lehane score.
Conclusion: The size and volume of thyroid swelling is found to be a good predictor of difficulty in intubation in patients undergoing thyroid surgery.

INTRODUCTION

Difficult endotracheal intubation has always been a concern for anaesthesiologists. Airway management is their major responsibility. Difficulties with tracheal intubation significantly contribute to the morbidity and mortality associated with anaesthesia[1].

Enlarged thyroid gland can lead to compromised airway with difficulty in tracheal intubation and thus are classified as difficult airway. A number of anatomical complications are possible with goitres and results in many implications to the airway. This can lead to laryngeal-malacia, lymphatic and vascular congestion causing restricted neck movements and distorted laryngeal anatomy. An enlarged thyroid gland producing tracheal deviation, compression, or both can lead to difficult airway and endotracheal intubation[3].Concerns regarding the management of these airways guide us to extract some parameters during the pre-anaesthetic evaluation which can help us in stratifying the associated difficulty.

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Any predictor that can anticipate the extent of difficulty in managing the airway of patients with thyroid neck swellings beforehand would be useful.

In the current era of radiodiagnosis, any swelling or mass is necessarily followed up by radiological evaluation as the physical examination can be misleading sometimes. The same is the situation with the airway also. Any swelling in an around the airway is a concern for anaesthesiologists and should be dealt with caution.

Keeping this in view, the current study was performed to know the relation of ultrasonographically calculated thyroid volume and the parameters of difficult endotracheal intubation.

MATERIALS AND METHODS

This study was conducted between august 2017 and july 2018. It was started after getting clearance from Institutional ethics committee. 80 American Society of Anaesthesiologists grade I-II patients between age of 18 and 70 years of either sex, Mallampati grade[2] 1 or 2 with thyroid neck swelling posted for elective thyroidectomy who gave written and informed consent were enrolled in the study. Patients with history of previous neck surgery or difficult intubation in any previous

surgery or with risk of aspiration and those with interincisor distance less than 4cm were excluded from the study.

During pre anaesthetic check up, any history of dyspnoea, dysphonia, dysphagia, recent change in voice or stridor were noted. Patients were examined for difficult airway parameters associated with thyroid swelling. Antero-posterior and lateral view of X-ray of neck were assessed for tracheal deviation or compression. Further, volume of thyroid swelling was calculated from the dimensions of ultrasound report available. The volume was calculated from the formula proposed by *Sheikh et al*[4] (2004). They defined the volume of any lobe of thyroid (in ml) as the lateromedial dimension (in centimeters) multiplied by 13 minus a constant of 15. Volume of lobes were calculated and added to get the volume of whole swelling. As ultrasonography reporting at our centre was in two dimensions, so this formula was used for the calculation of volume of lobes.

Thyroid swellings were further divided into two groups based on the volume as suggested by *Bartsch et al*[5] (2018). Those swellings having a volume of >80ml were considered large and those with volume <80ml were considered small.

All the patients were fasted for solids for atleast 6 hours before the surgery. After taking patients in operation theatre, monitors were attached- Pulse oximetry, ECG, NIBP and baseline vitals were recorded. Induction was done with injection fentanyl 2mcg/kg iv and injection propofol (2-3mg/kg iv) titrated to induce anaesthesia in a dose sufficient to produce loss of verbal response; after checking for bag and mask ventilation, succinylcholine was given at 2mg/kg iv. After the onset of neuromuscular block, intubation was done with armoured endotracheal tube of appropriate size rail-loaded over gum-elastic bougie with Macintosh laryngoscope. Intubation was confirmed by square wave capnography.

The anaesthesiologist performing intubation was blinded for the findings about the size and volume of swelling. Time taken during laryngoscopy and quality of glottis viewed were noted. Any intubation requiring time >120 seconds were considered as failed intubation.

Assessment for quality of glottis viewed during laryngoscopy were done by Modified Cormack and Lehane grading[6] and Intubation Difficulty Scale (IDS) score[7].

Cormack and Lehane Grading

- Grade 1- visualisation of entire vocal cords
- Grade 2-visualisation of posterior part of the laryngeal aperture
- Grade 3- visualisation of only epiglottis
- Grade 4- no glottic structures or epiglottis seen

Intubation difficulty scale score: seven-point scoring system for detemining the difficulty of intubation based on several parameters. Scoring is as follows:

1. Number of additional attempts taken
2. Number of operators changed
3. Number of alternative techniques used
4. Cormack Lehane Grade minus 1
5. Amount of lifting force required (normal=0; increased=1)
6. Laryngeal Pressure required (no=0; yes=1)
7. Vocal cord mobility at the time of laryngoscopy (abduction=0; adduction=1)

IDS Score is Calculated and Inference Made

- IDS 0 = easy
- IDS 1-5 = slight difficulty
- IDS >5 = major difficulty in intubation.

Statistical Analysis

It was a prospective observational study. Statistical analysis was done using SPSS version 18.0 (SPSS Inc., Chicago, IL, USA) software. Arithmetic mean and standard deviation were used. The spearman correlation coefficient was used to know the association between the two variables. A two-sided (α=2) $p<0.05$ was considered statistically significant.

RESULTS

The present study enrolled 80 consecutive patients undergoing elective thyroid surgery. The demographic variables, ASA grade and malampatti grade of the patients are presented in Table 1. The percentage of female patients (77.5%) outnumbered the male patients (22.5%) reflecting the higher incidence of thyroid gland diseases in females.

Volume of thyroid swelling ranged from 3.2ml to 472.6ml. Mean volume of thyroid swelling was 57.13±46.21 ml. We divided the patients according to the volume of thyroid swelling into small swellings (volume<80ml) and large swellings (volume>80ml). 13 patients out of 80 were having large thyroid volume. Then both the groups were compared in the terms of pressure symptoms like dyspnoea, dysphonia, dysphagia, recent change in voice or stridor. The comparison is shown in Table 2.

Total time taken for intubation was further divided into two parts. First is the time taken from insertion of laryngoscope blade till visualization of glottis and second from the visualization of glottis till the confirmation of endotracheal intubation by capnography.

Volume of thyroid swelling was plotted against total time of intubation [Figure 1], time from insertion of laryngoscope to visualization of glottis [Figure 2], time from visualization of glottis to confirmation of endotracheal intubation [Figure3], Intubation Difficulty Scale score [Figure 4] and Cormack Lehane score [Figure 5]. The correlation of all the parameters with thyroid volume is shown in Table 3.

Table 1 Demographic variables, ASA grade and malampatti grade of patients

Variable	Values
Age (Mean±SD) (in years)	36.85±11.79
weight (Mean±SD) (in kg)	56.65±9.90
Gender	male= 18 (22.5%) female=68 (77.5%)
ASA Grade	I= 57 (71.25%) II= 23 (28.75%)
Mallampatti grade	1= 30 (37.5%) 2= 50 (62.5%)

Table 2: Parameters of patients in relation to thyroid volume

Parameters	Volume<80ml	Volume>80ml
Number of patients	13	67
History suggesting	10 (76.92%)	12 (17.9%)

pressure effect		
Xray neck showing compression &/or deviation of trachea	11 (84.6%)	23 (34.32%)

Table 3 Correlation of volume of thyroid swelling with time taken for intubation, Intubaion Difficulty Score and Cormack Lehane Score

Variable	Spearman Correlation	p-value
Total time taken for intubation	0.391	<0.001
Time from insertion of laryngoscope to visualization of glottis	0.398	<0.001
Time from visualization of glottis to confirmation of endotracheal intubation	0.230	0.046
Intubaion Difficulty Score	0.602	<0.001
Cormack Lehane Score	0.626	<0.001

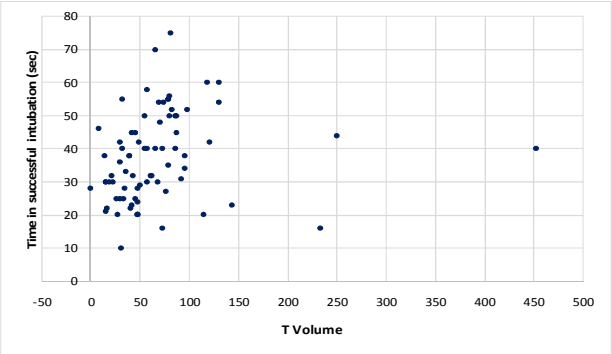

Figure 1 Scatterplot showing correlation of thyroid swelling volume with time in successful Intubation

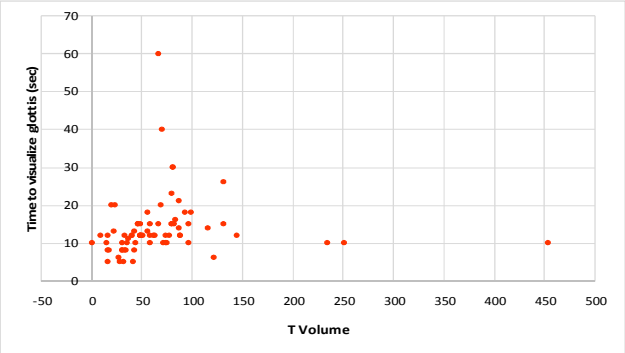

Figure 2 Scatterplot showing correlation of thyroid swelling volume with time to visualize glottis

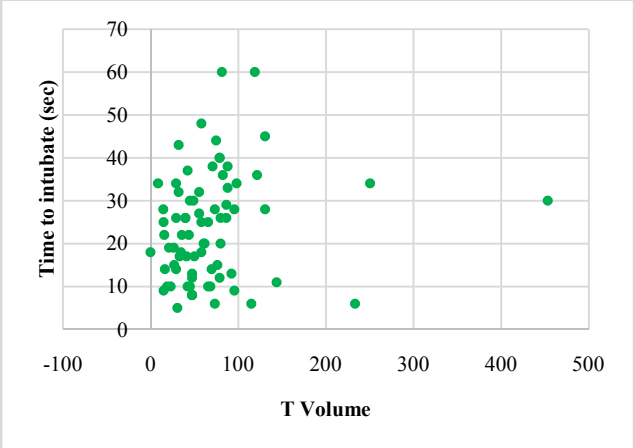

Figure 3 Scatterplot showing correlation of volume of thyroid swelling aand time from visualization of glottis to confirmation of endotracheal intubation

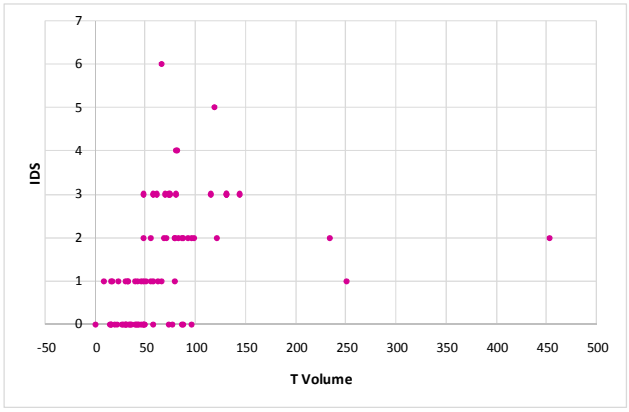

Figure 4 Scatterplot showing correlation of volume of thyroid swelling and Intubation Difficulty Scale score

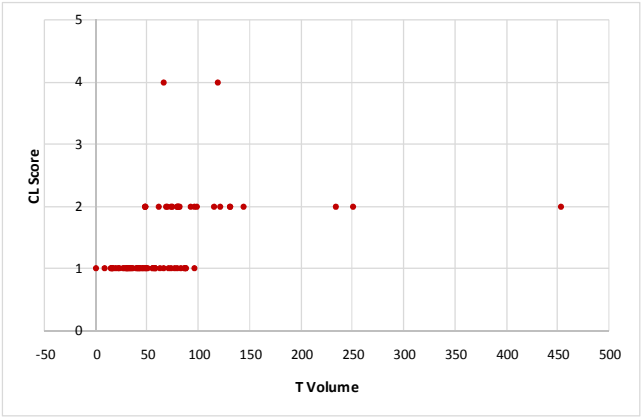

Figure 5 Scatterplot showing correlation of volume of thyroid swelling and Cormack Lehane score

DISCUSSION

In this study, 80 patients were enrolled. 13 patients out of them had large thyroid swelling (>80ml). It was observed that 10 patients out of these 13 patients (76.92%) had history of pressure symptoms like dysphagia, dysphonia, dyspnoea and hoarseness/ stridor but only 12 patients out of the rest 67 patients (17.9%) with small swellings had those symptoms. This finding suggests that airway compressive features increased with increase in size of thyroid swelling. Further comparison was made in regards of the findings of neck X-ray (both anteroposterior and lateral views): 11 patients (84.6%) with large swellings showed signs of tracheal compression and/ or deviation but only 23 patients out of 67 (34.32%) with small swellings had those signs in neck X-ray again suggesting a positive influence of size of thyroid swelling on airway compression and further on difficult airway and intubation. This finding is consistent with the findings of a retrospective analysis done by *Eng et al*[8] (2014) on 99 patients undergoing thyroidectomy who stated that thyroid nodule size and lobe size appear to directly correlate with compressive symptoms.

In a study done by *Meco et al*[9] (2015) on 50 patients undergoing thyroid surgery to compare difficult intubation predictors and thyroid-related parameters. They infered that thyroid volume is not associated with difficult intubation. But in this study, results are not consistent with the findings of *Meco et al*. In the present study, volume of thyroid swelling was plotted against the time taken for intubation. It had a positive and significant correlation with the time from insertion of laryngoscope blade to visualization of glottis (mean time: 14.69±7.94; Spearman correlation coefficient,

ρ=0.398; p<0.001) and with the overall time taken for intubation (mean time: 37.99±12.66 sec; ρ=0.391; p<0.001).
On plotting against Intubation Difficulty Scale score also, thyroid swelling volume was found to be positively and significantly correlated with it (mean IDS: 1.75±1.64; ρ=0.602, p<0.001). On the same way, plotting against Cormack-Lehane grade, volume was positively and significantly correlated with it also (mean score: 1.40±0.56; ρ=0.626, p<0.001).

We came across few limitations in this study despite all the measures taken to minimise them. Firstly it was a single centred study on a small population, so a large multicentric study is required in future for better understanding the effect of thyroid swelling. Secondly, many of the parameters in the results were subjective, like pressure symptoms of patients and Cormack Lehane grading done during intubation.
Keeping this study into consideration it can be infered that with increase in the size of the gland, there is an increase in the airway compression done by the swelling, time taken for intubation, Intubation Difficulty Scale score and Cormack-Lehane score. So we conclude that the size of thyroid swelling can be used as an important predictor for difficulty in laryngoscopy and intubation in these patients. Further studies in patients with thyroid swellings are required in future to conclude more firmly on this association.

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