PROPORTION AND RISK FACTORS OF DIFFICULT INTUBATION ASSOCIATED WITH THYROID SWELLING

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ABSTRACT

BACKGROUND AND AIM

Difficult intubation in a patient with thyroid swelling is associated with risk factors related to the patient and the thyroid swelling. The risk factors related to thyroid swelling causing difficult intubation has rarely been studied in our population and published studies are relatively small. By knowing the risk factors, Anaesthesiologist can take adequate measures to face such scenario and can reduce the mortality and morbidity associated with difficult intubation. The aim of this study is to determine the proportion and risk factors of difficult intubation associated with thyroid swelling.

METHODS

After obtaining Institutional and Ethical approval, 200 consenting patients scheduled for elective thyroidectomy were enrolled in this prospective observational study. Patients with history of difficult intubation and obvious airway anomaly were excluded. All patients are assessed for thyroid related and patient related variables by the investigator. After inducing anaesthesia, difficulty in intubation was assessed using Intubation Difficulty Scale (IDS) and IDS score was calculated for each patient by the anaesthesiologist in charge of the operation table. Patients are grouped as either not having or having difficulty in intubation. A univariate followed by a multivariate analysis was done to determine the potential and independent risk factors of difficult intubation associated with thyroid swelling.

RESULTS

Study shows a higher incidence of Thyroid disorders in female population (90.5%). In the study population, 39.5% have difficulty in intubation (IDS >0), of which 7% had severe intubation difficulty (IDS >5). Variables conferring increased odds of difficulty in intubation include male gender (OR 16.3, CI 3.6-72), thyroid swelling with tracheal deviation (OR 8.8, CI 3.4-22.8), thyroid swelling with compressive symptoms like dyspnoea, dysphagia or hoarseness of voice (OR 9.0, CI 2.8-35.5), swelling with duration more than 5 yrs. (OR 4.8, CI 1.8-13) and multinodular goitre (OR 6.3, CI 3.3-12.2). Of these male gender, thyroid swelling with compressive symptoms and malignant thyroid swelling are the three independent risk factors associated with difficult intubation.

CONCLUSION

Our study shows that 60.5% of patients with thyroid swelling can be intubated easily in the first attempt itself even without an assistant. The rest of the patients need some or other forms of manipulations or assistance. Three variables male gender, carcinoma thyroid and thyroid swelling with compressive symptoms are the independent risk factors associated with difficult intubation.

KEYWORDS

Thyroid Swelling, Difficult Intubation, Risk Factors, Intubation Difficulty Scale.

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INTRODUCTION

When a patient is scheduled for thyroid surgery, risk factors related to the patient as well as the thyroid swelling can lead to difficulty in intubation. Enlarged thyroid gland may cause tracheal deviation or compression or both, leading to difficult intubation.^[1] But it has been observed that the size of the thyroid swelling alone is not the only determining factor for difficult intubation. Many other risk factors related to thyroid may cause difficult intubation. Patient's airway related factors associated with difficult intubation has been widely investigated in the general surgical population.^[2-5] However, the risk factors related to thyroid swelling causing difficult

intubation has rarely been studied in our population and published studies are relatively small.^[6-8] If Anaesthesiologist knows the risk factors of difficult intubation associated with thyroid swelling, he can take necessary steps to face it and can avoid morbidity and even mortality associated with it. The aim of this study is to determine the proportion of difficult intubation in patients with thyroid swelling and also to find the thyroid related risk factors associated with difficult intubation.

METHODS

After obtaining Institutional and Ethical approval, consenting patients of either sex of all age groups and American Society of Anaesthesiologist (ASA) class 1 and 11, scheduled for elective thyroidectomy during the study period of one year were enrolled in this study until the sample size is achieved. Patients with history of difficult intubation and with obvious airway abnormalities were excluded from the study. For 95% confidence interval, 90% precision and 63% expected proportion the sample size calculated was 200.

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All patients enrolled in the study underwent a thorough pre-anaesthesia check-up by the principal investigator. The following study variables were noted. The demographic variables include age, gender, height, weight and the ASA PS status. The thyroid related variables recorded included duration of thyroid swelling in months; neck circumference which is measured at the point of maximum thyroid enlargement perpendicular to the long axis of the neck, presence of compressive symptoms like dyspnoea, hoarseness or dysphagia, presence of tracheal deviation in X-ray defined as deviation of upper part of trachea from the median line more than 1 cm when the clavicles are symmetric and the head is in neutral position in the radiograph of neck and chest, character of swelling which was noted as either a solitary nodule, multinodular goitre or as a cancerous swelling and whether the patient is on any thyroid related medication like hypo or hyperthyroid state.

The patient's airway related variables causing difficult intubation have been studied extensively elsewhere, but it cannot be excluded from the present study. Those variables are Mallampati class, Atlanto-occipital joint extension, Thyromental distance and Wilson score.

Mallampati classification.^[9,10,11] Patient is seated in front of the examiner so that the patient's oral cavity is at the examiner's eye level. Then ask the patient to open the mouth as widely as he can without protruding tongue or saying 'ah.'

Depending on the Structures that are Visible in the Oral Cavity, Patients are classified as follows:

Class I: Soft palate, tonsillar fauces, tonsillar pillars and uvula visualised.

Class II: Soft palate, tonsillar fauces and uvula visualised.

Class III: Soft palate and base of uvula visualised.

Class IV: Soft palate not visualised (Samson and Young Modification).

Intubation difficulty increases as patient comes under class III or IV.

Atlanto-occipital joint extension.^[4] This angle can be measured at the bedside by asking the patient to sit straight up with the head erect and the line of sight parallel to the ground. Then ask the patient to open mouth wide. In this position, the occlusal surfaces of the upper teeth are horizontal to the ground. On extending the atlanto-occipital joint, the angle created by moving the occlusal surfaces is estimated. Goniometer is used to estimate the angle more accurately. Reduction in extension is expressed in grades as Grade I: >35°, Grade II: 22°–34°, Grade III: 12°–21°, Grade IV: <12°. Normal angle of extension is 35° or more. There will be difficulty in intubation when the angle of extension becomes less.

Thyromental distance.^[4,12,13] Distance from the mentum to the thyroid notch, while patient's neck is fully extended. Normal distance is >6.5 cm. Expect difficulty in intubation if the distance is 6.5–6.0 and very difficult if the distance is <6.0 cm.

Mouth opening.^[5] The adequacy of mouth opening is assessed by measuring the inter-incisor distance. An inter-incisor distance of 3 cm provides sufficient space for intubation. This corresponds approximately to two finger-breadths. The two finger-breadth test is performed by placing the examiner's second and third digits between the patient's central incisors. If they fit, there should be adequate space to

perform laryngoscopy. If they do not fit, laryngoscopy may be difficult.

Wilson score.^[3] A simplified predictive rule based on adverse risk factors can identify patients who may be difficult to intubate. Risk factors are body weight, head and neck movement, jaw movement based on inter-incisor gap and mandibular subluxation, receding mandible, buck teeth. Wilson score of 5 or more is taken to indicate a risk of difficult intubation.

On the pre-operative day, T. Alprazolam 0.25 mg, T. Pantoprazole 40 mg with Domperidone 10 mg are given at bed time for all patients and are repeated at 6.00 am on the day of surgery. All patients received uniform technique of general anaesthesia as per the institutional protocol. After induction and confirming the adequacy of bag and mask ventilation succinylcholine (2 mg/kg) is given and ventilation with bag and mask is continued for 60 secs. Laryngoscopy was performed by the unassisted anaesthesiologist in charge of the operating table who has not less than 3 yrs. experience and laryngoscopic view is graded based on Cormack and Lehane grading. Patient is then intubated using appropriate-sized cuffed oral endotracheal tube. In cases of difficulty experienced during laryngoscopy, Macintosh size '4' blade is used or external laryngeal pressure is applied or intubated with the help of a bougie. The difficulty in intubation was assessed using Intubation Difficulty Scale (IDS) by the attending anaesthesiologist and IDS score was calculated for each patient. The IDS (Intubation Difficulty Scale) is a function of seven factors that have been associated with difficult intubation. There are number of intubation attempts, additional operators needed, additional intubation techniques used, Cormack-Lehane grade during laryngoscopy, lifting force required to make laryngoscopy, application of external laryngeal pressure and position of vocal cords during laryngoscopy.

Number of Intubation Attempts

With every additional intubation attempt adding one point to the total score, one attempt was given zero point.

Number of Additional Operators

With each additional operator, add one point to the total score.

Number of Additional Intubation Techniques used (eg. Patient reposition, change of blade or tube change approach): With each modification, add one point to the score.

Cormack-Lehane Grade during Laryngoscopy

The Cormack and Lehane classification^[14] on the basis of a study of obstetric patients is the original and most widely used classification of laryngeal view during direct laryngoscopy. Grade I-Visualisation of entire laryngeal aperture, Grade II-Visualisation of only posterior commissure of laryngeal aperture, Grade III-Visualisation of Epiglottis, Grade IV-Visualisation of just the soft palate, Grade III and IV-Indicate difficult intubation. Patient will get a score equal to Cormack and Lehane grade minus 1. So if the grade is 1, score will be zero.

Lifting Force required to make Laryngoscopy: Normal lifting force gets no points. Increased force gets one point.

Application of External Laryngeal Pressure: If it is needed, one point is added to total score.

Position of Vocal Cords during Laryngoscopy: Zero point for the abducted position and one point for the adducted position.

A total score of zero indicate easy intubation, 1-5 score indicate slightly difficult intubation, a score of >5 indicate moderate-to-major difficulty. In this study, IDS score more than zero was taken as having difficult intubation. An IDS score 0 means one can intubate the patient in the first attempt itself with appropriate sized ETT without any assistant's help, without external laryngeal manipulation and without undue pressure on the vallecula.

Statistics

Data was analysed using computer software "Statistical Package for Social Sciences" (SPSS) Ver-16 for windows. Patients are grouped as either not having (IDS=0) or having (IDS >0) difficult intubation. A case control analysis was done to determine the risk factors of difficult intubation associated with thyroid swelling. Univariate analysis was done to

identify the potential thyroid related risk factors associated with difficult intubation. Multivariate analysis was done to identify the independent risk factors associated with difficult intubation.

RESULTS

IDS Score	Frequency (Number)	Percentage (%)
0	121	60.5
1-5	65	32.5
>5	14	7
Total	200	100

Table 1: Distribution according to IDS (Intubation Difficulty Score)

In the study population, 39.5% have difficulty in intubation (IDS >0), of which 7% had severe intubation difficulty (IDS >5); 60.5% of the study population were intubated very easily.

Gender	Difficult Intubation (IDS >0)	No Difficulty (IDS=0)	Odds Ratio (CI)	P value
Male	17(89.5%)	2(10.5%)	16.3 (3.6-72)	0.001
Female	62(34.3%)	119(65.7%)		

Table 2: Comparison of Two Groups by Gender

Out of the 200 study population, 181 (90.5%) constituted females and 19 (9.5%) males showing the higher prevalence of thyroid disorders in females. Of the 79 patients with mild-to-severe intubation difficulty, 17 were males and 62 females.

In males 89.5% showed intubation difficulty while only 34.3% in females, which was found to be statistically significant.

Variables		Difficult Intubation (IDS>0) Number (%)	No Difficulty (IDS=0) Number (%)	Odds Ratio (CI)	P Value
Mallampati Class	I & II	70 (38.7%)	111 (61.3%)	0.7 (0.2-1.8)	0.46
	III & IV	9 (47.4%)	10 (52.6%)		
Thyromental Distance	<6.5cm	2 (66.7%)	1 (33.3%)	3.1 (0.2-34)	0.33
	≥6.5cm	77 (39.1%)	120 (60.9%)		
Atlanto-Axial Extension	Grade 1	70 (36.8%)	120 (63.2%)	15.4 (1.9-124)	0.001
	Grade 11	9 (90%)	1 (10%)		
Wilson's Score	≥5	0	0		
	<5	79 (39.5%)	121 (60.5%)		

Table 3: Comparison of Two Groups by Airway Related Variables

Variables		Difficult Intubation (IDS>0) Number (%)	No Difficulty (IDS=0) Number (%)	Odds Ratio (CI)	P value
Duration	≥60 Months	16 (72.7%)	6 (27.3%)	4.8 (1.8-13)	0.001
	<60 Months	63 (35.4%)	115 (64.6%)		
Neck Circumference	≥35 cm	42 (53.2%)	68 (56.2%)	0.8 (0.51-5)	0.67
	<35 cm	37 (46.8%)	53 (43.8%)		
Compressive Symptoms	Yes	16 (84.2%)	3 (15.8%)	9.9 (2.8-35.5)	0.001
	No	63 (34.8%)	118 (65.2%)		
Tracheal Deviation	Yes	25 (80.6%)	6 (19.4%)	8.8 (3.4-22.8)	0.001
	No	54 (32.0%)	115 (68.0%)		
Type of Thyroid Disease	Ca Thyroid	1 (8.3%)	11 (91.7%)	0.12 (0.01-1.01)	0.02
	MNG	62 (58.5%)	44 (41.5%)	6.3 (3.3-12.2)	0.001
	Solitary Nodule	16 (19.5%)	66 (80.5%)	0.2 (0.1-0.4)	0.001

Table 4: Comparison of Two Groups by Thyroid Related Variables

Variables	B	S.E	Wald	df	Sig	Exp (B)	95% C.I
Gender	.785	.603	1.696	1	.193	2.193	.673 -- .785
Age	-.204	.229	.792	1	.373	.816	.512 -- -.204
Thyromental Distance	83.136	7.006E4	.000	1	.999	1.275E36	.000 -- 83.136
Wilson's Score	21.161	2.564E4	.000	1	.999	1.550E9	.000 -- 21.161
Mallampati Class	-.676	.745	.824	1	.364	.508	.118 -- -.676
Neck Circumference	-.038	.353	.012	1	.914	.963	.482 -- -.038
Atlanto-Occipital Extension	-.756	.942	.644	1	.422	.469	.074 -- 2.976
Ca Thyroid	.666	.649	1.054	1	.304	1.947	.546 -- .666
Multi-Nodular Goitre	-.724	.377	3.682	1	.055	.458	.231 -- -.724
Solitary Nodule	.311	.293	1.124	1	.289	1.365	.768 -- 2.426
Tracheal Deviation	-1.184	.682	3.009	1	.083	.306	.080 -- -1.184
Compressive Symptoms	.206	.765	.072	1	.788	1.229	.274 -- .206

Table 5: Log-Linear Model

Study shows a higher prevalence of Thyroid disorders in female population (90.5%) than the male (9.5%). In the study population 39.5% have difficulty in intubation (IDS >0), of which 7% had severe intubation difficulty (IDS >5). On univariate analysis, male gender (OR 16.3, CI 3.6-72), thyroid swelling with tracheal deviation (OR 8.8, CI 3.4-22.8), swelling with compressive symptoms (OR 9.0, CI 2.8-35.5), the duration of the swelling >5 yrs. (OR 4.8, CI 1.8-13) and type of the swelling (for MNG, OR 6.3, CI 3.3-12.2 when compared to solitary nodule) were identified as potential thyroid related risk factors associated with difficult intubation. Logistic regression showed that male gender, carcinoma thyroid and thyroid swelling with compressive symptoms were the three independent variables associated with difficult intubation.

DISCUSSION

Two hundred patients posted for elective thyroid surgery who fulfilled the inclusion criteria were evaluated, of which 39.5% (79 out of 200) had mild or severe difficulty in intubation (IDS >0). Seven percent (14 of 200) of the same had moderate-to-severe difficulty (IDS >5). This is comparable with that of general population and found that thyroid swelling as such does not increase the incidence of difficult intubation.^[6,7,15]

In the study by Bouaggad et al^[6] using the IDS showed that in a population of 320 patients undergoing thyroidectomy for goitre, the incidence of moderate-to-severe intubation difficulty was only 5.3%, but mild difficulty for intubation was found in 57.8% of cases. In another study by Amathieu et al^[7] of the 324 patients undergoing thyroidectomy, 11.1% had moderate-to-severe difficulty (IDS >5) during tracheal intubation. Another prospective study of 199 patients for thyroidectomy by Voyagis et al,^[15] the incidence of difficult intubation was 8.5%.

The study showed that even though the prevalence of goitre is low in male population, they showed more intubation difficulty (89.5%) than females (34.3%), which was also found to be statistically significant (OR 16.3, CI=3.6-72). In a study, Kalezcic Nevena K et al^[16] had described that

incidence of difficult intubation in thyroid gland surgery is twice more in men than in women.

Of the airway related variables studied, only atlanto-axial extension has significant association with difficult intubation. But this variable did not have significant association on multivariate analysis. The influence of mouth opening could not be assessed in relation to intubation difficulty since all patients had mouth opening >2 finger-breadth (3 cm) in the study. Mallampati class and Thyromental distance did not have any significant association with difficult intubation in the present study. Wilson's score again showed no association, since none among the population had a score >5. This warrants the need for further study with more sample size.

Of the thyroid related variables, swellings with duration >5 yrs. showed statistically significant association (OR 4.8, CI=1.8-13) with difficult intubation (With 72.7% showing difficulty). Malhotra et al^[17] in their literature had described the importance of the duration of goitre associated with intubation difficulty.

In our study, we have taken neck circumference as a surrogate measure for the size of thyroid swelling; 53.2% of patients with mild-to-severe intubation difficulty had neck circumference more than or equal to 35 cms, though it was not found to be statistically significant (OR 0.8, CI=0.5-1.5). Eight patients with severe intubation difficulty (57.1%), had neck circumference more than or equal to 35 cms. In the study by Gonzalez et al,^[18] neck circumference >43 cm at the laryngeal cartilage level has been described for prediction of difficult intubation.

In the study by Bouaggad et al^[6] using the IDS found an increase in difficulty of intubation only when malignant thyroid was present. Our study also have significant association between carcinoma thyroid and difficult intubation (OR 6.3, CI=3.3-12.2). In a study of 2000 patients by Kalezcic N et al,^[16] they found an association between MNG and difficult intubation.

Many articles^[19-21] have been published suggesting that goitre when accompanied by tracheal compression constitutes an aggravating factor for difficult airway, but no

resistance was encountered in passage of the endotracheal tube through the compressed or narrowed portion of the trachea. Our study have significant association for both compressive symptoms (OR 9.9, CI=2.8-35.5) and tracheal deviation (OR 8.8, CI=3.4-22.8) with difficult intubation.

Even though univariate analysis showed significant association with male gender, tracheal deviation, compressive symptoms, duration of swelling and type of swelling, logistic regression showed that male gender, malignant thyroid and swelling with compressive symptoms are three independent variables associated with difficult intubation.

CONCLUSION

The Major Findings of this Study are

- (a) Easy tracheal intubation is possible in 60.5% of patients with thyroid swelling. Of the remaining 39.5%, 7% was associated with moderate-to-severe difficulty. This is comparable with that of general population indicating the fact that thyroid swelling as such does not increase the risk of difficult intubation.
- (b) Male gender, carcinoma thyroid and thyroid swelling with compressive symptoms were independent risk factors for difficult intubation.
- (c) The size of the thyroid swelling as such was not associated with a high risk of difficult Intubation.

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