

ORIGINAL RESEARCH

AIRWAY MANAGEMENT IN PATIENTS WITH THYROID SWELLING UNDERGOING THYROID SURGERY: A PROSPECTIVE STUDY

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ABSTRACT

Aim: Airway management in patients with thyroid swelling undergoing thyroid surgery.

Methodology: After approval from Institutional ethics committee, we conducted a prospective observational study including 60 consenting patients with thyroid swelling undergoing thyroidectomy. A standard OT protocol for routine pre anaesthetic check up was followed. The usual airway parameters such as mouth opening, MPC, slux, thyromental distance (TMD), neck movement were assessed. The euthyroid status of the patient was confirmed.

Results: In 54 (88.3%) patients propofol was used as induction agent. In 3 (5%) patients combination of dexmedetomidine & propofol was used as induction agent. In 2 (3.3%) patients sevoflurane and propofol was used as induction agent. In 1 (1.4%) patient etomidate was used as induction agent. 16 (26.7%) of patients required external laryngeal manoeuvre whereas 44 (73.3%) didn't require external laryngeal manoeuvre. Highest percentage of patients 48.3% (29) were intubated in 15-30sec, 13 (21.6%) patients required 30-45 sec, 12 (20%) required less than 15 sec, while 6 (10%) patients required more than 45 sec. Maximum time required for intubation was 58 sec. 1 (1.7%) patient had complaint of hoarseness of voice post-operatively. 1 (1.7%) patient had tracheomalacia for which tracheostomy was done. 1 (1.7%) patient was not extubated due to prolonged surgery. no patient had post-extubation desaturation.

Conclusion: From this study we concluded that thyroid swelling accompanied with airway deformity is a risk factor for difficult intubation. A thorough preoperative history in all patients with thyroid swelling is mandatory and should include duration of thyroid swelling, pressure symptoms and radiological investigations of the neck and thorax.

Keywords: Airway management, thyroid swelling, surgery

INTRODUCTION

Thyroidectomy is the most common endocrine surgery performed. Massive goitres with tracheal compression by itself are not a rare entity [1, 2]. Even a moderate size swelling because of its close proximity to trachea can cause its deviation or compression. Retro-sternal extension can lead to airway obstruction along with compression of great vessels of thorax [3,4] .Some patients may have even malignant changes in the thyroid gland.[5]

This causes apprehension among anaesthesiologists with respect to airway management in patients posted for thyroid surgery. An intimate knowledge of the anatomy, physiology, pathophysiology, pharmacology, and specific issues related to anaesthesia case management for thyroidectomy is essential to provide high-quality care. Airway management may be difficult despite a normal airway examination due to impingement of a thyroid mass on the laryngeal and tracheal structures. Anaesthesiologists must be prepared to use emergency airway adjuncts in case a patient cannot be ventilated or intubated. [7]

The commonest implications during such procedures involve the management of a potential difficult airway, especially in cases of retrosternal goitre and an enlarged thyroid gland compressing over the trachea for a prolonged duration.[8.6] The complexity of surgical intervention also adds to these existing challenges as the procedure may vary from simple excision of a thyroid nodule to removal of a large gland which may have a retrosternal extension.[9] Moreover, there always exists a potential risk of uncontrolled haemorrhage from a vascular injury as the major vessels lie in the vicinity of thyroid gland and sometimes from the injury to the thyroid vessels itself.[10]. Another problem that can arise during surgery is injury to recurrent laryngeal nerve causing vocal cord paralysis and resultant respiratory distress in postoperative period.

The various techniques for securing airway in such patients include intubation of trachea after routine induction of anaesthesia with I V anaesthetics and muscle relaxants, intubation after induction with inhalational agents avoiding muscle relaxants, awake direct laryngoscopy-aided intubation and awake fiberoptic intubation (AFOI).[1,2] A thorough preoperative evaluation helps in selecting of a proper method of securing airway [11] and reduces the airway related morbidity.

This study was carried out in patients with thyroid swelling being operated for thyroidectomy with the aim to assess

1. Method of induction of anesthesia and securing the airway and
2. Management of airway related complications during induction and extubation.

METHODOLOGY

After approval from Institutional ethics committee, we conducted a prospective observational study including 60 consenting patients with thyroid swelling undergoing thyroidectomy. Patients with co-existing obvious airway deformity or airway tumours in addition to thyroid swelling were excluded from the study.

A standard OT protocol for routine pre anaesthetic check up was followed. The usual airway parameters such as mouth opening, MPC, slux, thyromental distance (TMD), neck movement were assessed. The euthyroid status of the patient was confirmed.

In addition, an elaborate airway assessment was carried out. This included history, local examination of the swelling and radiological evaluation of the airway. Other specific investigations such as PFTs or ABG if carried out were noted.

PREOPERATIVE AIRWAY ASSESSMENT RELATED TO THYROID SWELLING

History: In history **duration of thyroid swelling** and any sudden increase in the size of swelling was asked. **H/O pressure symptoms** such as dyspnoea, dysphagia, stridor, hoarseness of voice, giddiness in sitting as well as in supine position, ability of the patient to sleep in the supine position in the night as well as preference for a particular position were asked.

Examination: Along with routine airway examination; size, consistency and extent of swelling, ability to palpate trachea and the lower border of thyroid gland were noted.

Investigations related to airway were noted such as: Indirect laryngoscopy for all patients and/or rigid laryngoscopy in certain cases.

Radiological investigations such as: Chest X-ray (PA view), X-ray neck (anterio-posterior and lateral view), in case of a very large-sized thyroid gland, retrosternal extension and symptomatic goiter, computed tomography (CT) scan or magnetic resonance imaging (MRI), if done, were noted to delineate the exact location and extension of thyroid swelling and pressure effects on surrounding structures.

Anesthesia Technique used, was at the discretion of the consultant anaesthesiologist The technique followed in each case was noted.

The parameters noted were as follows

1. a) Intubation after anesthetizing patient:

- Which anesthetic agent was used: intravenous or inhalational
- Which muscle relaxant was used for intubation.
- Specialized airway equipment kept ready and used were noted such as intubating bougie, flexitip laryngoscope, video laryngoscopes such as King vision, Airtraq and supraglottic airway devices
- Equipment for front of neck access, if kept ready

b) Awake Intubation after anesthetizing airway

- After direct laryngoscopy
- Fiber optic laryngoscope with endotracheal tube mounted on it.

2. Type of tube used and size was noted.

The commonly used endotracheal tubes are,

- PVC cuffed endo-tracheal tube.
- Flexo-metallic tube.
- Any other type of tube eg Microlaryngoscopy tube may be used in retrosternal airway obstruction and Electromyography endotracheal tube may be used for mapping recurrent laryngeal nerve.

3. The difficulty in tracheal intubation was assessed by

1. Cormack Lehane grading at laryngoscopy
2. Number of attempts required
3. Number of operators
4. Need for extra laryngeal maneuver
5. Time taken for intubation
6. Need for special airway gadget
7. Operator evaluation for ease of intubation

The position of endotracheal tube placement was confirmed by capnography and auscultation.

4. Airway Complications if any, during tracheal intubation were noted:

- Airway trauma such as injury to teeth, lips, tongue, tonsillar pillars and vocal cords
- Inability to ventilate, intubate
- Desaturation

The standard intraoperative Monitoring done was noted and it included, pulse, blood pressure, oxygen saturation, ETCO₂ and peak airway pressure.

The patients were reversed at the end of surgery using Inj Glycopyrrolate & Neostigmine and extubated after satisfying the clinical criteria of adequacy of return of consciousness and muscle power.

5. During extubation following factors were assessed and noted:

1. Whether leak test was performed prior to extubation.
2. Method of visualization of larynx either by direct laryngoscopy or fiber optic bronchoscopy or using any other equipment.
3. State of vocal cords.

Patients were monitored postoperatively for difficulty in breathing, stridor, desaturation and any change in voice. Any of these complications and the treatment offered were noted.

STATISTICAL ANALYSIS

Data was entered into Microsoft Excel (Windows 7; Version 2007) and analyses were done using the Statistical Package for Social Sciences (SPSS) for Windows software (version 22.0; SPSS Inc, Chicago). Descriptive statistics such as mean and standard deviation (SD) for continuous variables, frequencies and percentages were calculated for categorical Variables. Level of significance was set at 0.05.

OBSERVATION AND RESULT

Over period of 18 months, total 60 patients undergoing thyroidectomy were included in our study. The mean age was 38.13 years (SD=12.75). The mean duration of swelling was 5.56 years (SD=1.68). 76.6% patients had swelling with duration of 1-2 year.

Table 1: Distribution of study subjects according to method of induction.

Intubation Technique	No.	Percent
Propofol	54	88.3
Dexmedetomidine & Propofol	3	5.0
Sevoflurane f/b Propofol	2	3.3
Etomidate	1	1.7

- In 54 (88.3%) patients propofol was used as induction agent.
- In 3 (5%) patients combination of dexmedetomidine & propofol was used as induction agent.
- In 2 (3.3%) patients sevoflurane and propofol was used as induction agent.
- In 1 (1.4%) patient etomidate was used as induction agent

Table 2: Distribution of study subjects according to muscle relaxant used for intubation of trachea.

Muscle Relaxant	No.	Percent
Atracurium	24	40.0
Vecuronium	19	31.7
Succinylcholine	17	28.3

During induction of general anaesthesia 24 (40%) patients were given atracurium as muscle relaxant. 19 (31.7%) & 17 (28.3%) patients were given vecuronium & succinylcholine respectively as a muscle relaxant

Table 3: Distribution of Study Subjects according to the Number of Attempts for intubation (N=60)

Number of Attempts	No.	Percent
1	40	66.7
2	17	28.3
3	3	5.0

- 40 (66.7%) were intubated in 1st attempt.
- 17 (28.3%) were intubated in 2nd attempt.
- 3 (5%) were intubated in 3rd attempt.

Table 4: Distribution of Study Subjects according to the Number of Operators (N=60)

Number of Operators	No.	Percent
1	44	73.3
2	14	23.3
3	2	3.3

- 44 (73.3%) of patients required only 1 operator.
- 14 (23.3%) of patients were intubated by 2nd operator.
- 2 (3.3%) of patients were intubated by 3rd operator.

Table 5: Distribution of Study Subjects according to the Need of external laryngeal manoeuvre (ELM) (N=60)

Need of ELM	No.	Percent
Yes	16	26.7
No	44	73.3

16 (26.7%) of patients required external laryngeal manoeuvre whereas 44 (73.3%) didn't require external laryngeal manoeuvre.

Table 6 Distribution of Study Subjects according to the Time for Intubation (N=60)

Time for Intubation (sec)	No.	Percent
<15	12	20.0
15-30	29	48.3
30-45	13	21.6
>45	6	10

Highest percentage of patients 48.3% (29) were intubated in 15-30sec, 13 (21.6%) patients required 30-45 sec, 12 (20%) required less than 15 sec, while 6 (10%) patients required more than 45 sec. Maximum time required for intubation was 58 sec.

Table 7: Distribution of Study Subjects according to the Special Airway gadget used (N=60)

Special Airway gadget used	No.	Percent
Flexitip & Intubating guide	17	28.4
Flexi-tip blade	3	5.0
Intubating guide	8	13.4
King Vision	2	3.3
None	30	50.0

- 17 (28.4%) of patients were intubated with the help of flexi-tip blade and intubating guide both.
- 8 (13.4%) & 5% (3) of patients required intubating guide and flexi-tip blade respectively for intubation.
- 2 (3.3%) of patients were intubated with the help of King vision.
- 30 (50.0%) of patients didn't require any special airway gadget for intubation.

Table 8: Distribution of Study Subjects according to the Change of Technique (N=60)

Change of Technique	No.	Percent
Awake oral FOB to DL under anaesthesia	1	1.7
King vision to direct Laryngoscopy	2	3.3
None	57	95.0

- 1 (1.7%) of patient awake FOB was converted to DL under anaesthesia.
- 2 (3.3%) of patients intubation with King's vision was converted to direct laryngoscopy.

Table 9: Distribution of Study Subjects according to the Extubation Trial & Leak Test (N=60)

Parameter	No.	Percent
Extubated on table	58	96.7
Not extubated i/v/o prolonged surgery	1	1.7
Tracheostomy done for tracheomalacia	1	1.7

- 2 (3%) of patients leak test was negative.
- 58(96.7%) of patients were extubated on table.

Table 10 Distribution of Study Subjects according to the method used for Visualisation of Vocal Cords prior to extubation (N=60)

Visualisation of Vocal Cords	No.	Percent
DL	55	91.7
Fibre-optic Bronchoscope	2	3.3
King vision	2	3.3
Not Extubated	1	1.7

- 55 (91.7%) patients vocal cords were visualized by direct laryngoscopy (DL).
- 2 (3.3%) patients visualization of vocal cords were done by fibre-optic bronchoscope (FOB).
- In 2 (3.3%) patients King's vision was used to visualize vocal cords.
- 1 (1.7%) patient was not extubated in view of prolonged surgery.

Table 11 Distribution of Study Subjects according to the State of Vocal Cords (N=60)

State of Vocal Cords	No.	Percent
Bilateral Mobile	58	96.7
Left Immobile	1	1.7
Not Extubated	1	1.7

- 58 (96.7%) patients had bilateral mobile vocal cords.
- 1 (1.7%) patient had left vocal cord immobile.
- 1 (1.7%) patient was not extubated due to prolonged surgery

Table 12 Distribution of Study Subjects according to the Post-operative complications (N=60)

Post-operative Complications	No.	Percent
Hoarseness of Voice	1	1.7
Tracheomalacia (Tracheostomy done)	1	1.7
Radical neck dissection (not extubated due to prolonged surgery)	1	1.7

- 1 (1.7%) patient had complaint of hoarseness of voice post-operatively.
- 1 (1.7%) patient had tracheomalacia for which tracheostomy was done.
- 1 (1.7%) patient was not extubated due to prolonged surgery.

- no patient had post-extubation desaturation.

DISCUSSION

Goitre is one of the most common causes of mid tracheal obstruction ⁽²³⁾ (external compression or stenosis), which may be associated with difficult intubation and difficult airway management, depending on the goitre size, type (benign or malignant) and infiltration into the surrounding tissue. Iodine deficiency disorders are still one of the most common causes of goitre in the population.

Expertise in airway management is absolutely essential for anaesthesiologists. A patent airway is necessary for adequate oxygenation and ventilation and failure to do so, even for a brief period of time, can be life threatening. Therefore, detailed preoperative examination of airway and thyroid swelling is important in patients with thyroid swelling undergoing thyroidectomy. Complete airway obstruction can occur during induction of anaesthesia, during surgical resection or at the time of extubation in a large compressive goitre.

Indications for thyroid surgery include: thyroid malignancy, goitres that produce obstructive symptoms and/or are retrosternal; hyperthyroidism resistant to medical management; cosmetic and anxiety related reasons. Patients with hypothyroidism usually respond to thyroxine therapy and surgery is rarely indicated.

In our study sample for all the patients undergoing thyroidectomy, premedication was individualised. Patients who were symptomatic, were not given sedative premedication like Inj.Midazolam. They were pre-oxygenated for 3 min. In majority of patients (88.3%) Propofol 2mg/Kg IV was used as induction agent [**Table 1**]. In symptomatic patients, where possibility of difficult airway was there, inhalational induction with sevoflurane was done, supplemented by Propofol as inhalational agents demonstrate breath to breath control and can be withdrawn at any point. In patients where large thyroid swelling was present along with compressive symptom, succinylcholine was used as muscle relaxant [**Table 2**]. Flexometallic endo-tracheal tube was used in 21 (35%) patients while PVC cuffed endo-tracheal tube were used in rest 39 (65%) patients. In patients with normal airway examination either atracurium or vecuronium was used. Similar report was seen in **Sukhminder et al. (12)** where propofol was the drug of choice in a dose of 2 mg/kg for induction of anaesthesia. In a difficult airway scenario, succinylcholine remains the drug of choice, but ideally vecuronium is the preferred muscle relaxant because of its cardio-stable nature. **(13)** The synergistic actions with opioids further widen the scope of propofol and fentanyl combination when used as a component of Total intra-venous anaesthesia (TIVA). On the contrary, in a study done by **Abderrahmane Bouaggad et al. (6)** they used thiopentone 5mg/kg as induction agent. In a study by **R. Amathieu et al(14)** anaesthesia was induced with remifentanil 0.5mcg/Kg/min for 1 minute and propofol 2.5mg/kg without neuromuscular blockade.

In this study 22 (36.6%) patients had difficult intubation that is CL III & IV on direct laryngoscopy. There were no failed intubations, and no difficulty was encountered in passage of the endotracheal tube through the compressed or narrowed portion of the trachea. 17 were intubated in 2nd attempt while 3 patients required 3 attempts for endotracheal intubation [**Table 3**]. 14 patients were intubated by 2nd operator and 3 patients were intubated by 3rd operator [**Table 4**]. 16 of them required external laryngeal manoeuvre (ELM) for intubation [**Table 5**]. 13 patients were intubated in 30- 45 sec while 6 patients required more than 45sec

for intubation [Table 6], maximum time required for intubation was 58 sec. 17 patients were intubated with the help of Fexitip blade and intubating guide while 2 patients were intubated with help of king vision [Table 7]. In 1 patient, awake FOB was converted to DL under anaesthesia, as the patient was not cooperative. In 2 patients, intubation with King's vision videolaryngoscope was converted to direct laryngoscopy [Table 8].

58 patients were extubated on table, 1 patient wasn't extubated in view of tracheomalacia and elective tracheostomy was done while other patient wasn't extubated in view of prolonged surgery due to radical neck dissection [Table 9].

In majority of patients vocal cords were visualized postoperatively by direct laryngoscopy, while in 2 patients FOB was used and king vision was used in 2 patients [Table 10]. One patient had immobile left vocal which was informed to surgeons [Table 11]. One patient had hoarseness of voice and one patient had tracheomalacia [Table 12].

Post-operative complications like: In our study, 1 patient had hoarseness of voice post-operatively, which can be seen after injury to recurrent laryngeal nerve and 1 patient had tracheomalacia (weakening of tracheal wall due to infiltration of thyroid gland which results in airway collapse), both were identified by leak test and elective tracheostomy was done. None of the patient had bleeding and hematoma around trachea, dyspnoea, stridor and desaturation post-operatively. In a study done by **G A Dempsey et al. (14)** post thyroidectomy digital assessment of tracheal wall confirmed that there is no tracheomalacia in any patient. 3 cases reported to have post-operative bleeding requiring re-intubation and re-exploration to evacuate hematoma and achieve hemostasis. 3 patients had recurrent laryngeal nerve injury resulting in hoarseness of voice. **Gebregzi Hailekiros et al. (15)** 1 patient had episode of desaturation in post-operative period but there was no stridor or airway obstruction, and patient was managed conservatively with oxygen inhalation. Therefore, close monitoring of patients after thyroidectomy in post-operative period is essential for early diagnosis and treatment of these complication.

The limitations of our study were small sample size. Since it was a prospective study, we got only 60 patients coming for thyroidectomy during the study period. Another limitation was that we relied mainly on x-ray neck reports for tracheal deviation and narrowing. The best way of determining tracheal deformity was by using a CT scan, which was not available for all the patients. It was also difficult to measure the exact size of the gland by palpating preoperatively and considering it as a predictive factor as goitre usually grows internally and we cannot determine the correct size preoperatively.

CONCLUSION

From this study **we concluded that** thyroid swelling accompanied with airway deformity is a risk factor for difficult intubation.

A thorough preoperative history in all patients with thyroid swelling is mandatory and should include duration of thyroid swelling, pressure symptoms and radiological investigations of the neck and thorax.

A single universal technique of induction of anaesthesia and intubation may not be favourable in all circumstances and must be tailored to meet individual patient's symptoms and anatomical and radiological variations.

Airway management in such patients poses unique challenges and one should be thoroughly prepared for any anticipated or unpredictable airway difficulty. Careful selection of intubation technique has been to be done as per risk versus benefit of various techniques available.

It is important to carry out leak test prior to extubating the trachea and visualization of cords is important, either under direct vision or using videolaryngoscope or fiberoptic laryngoscope. When in doubt, extubate over airway exchange catheter or with tracheostomy standby.

Thus the complication rate was extremely low as the anaesthesia management was tailored according to the patient's history, examination and radiological findings rather than following a fixed protocol.

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