Airway management in thyroid swelling

ABSTRACT
Goitre is a common clinical entity with high prevalence in adult populations in endemic areas. One of the mechanical results of goitre is deviation and compression of the trachea. Difficulty with intubation may be caused by deviation and compression. Thyroid surgery is usually considered a risk factor for difficult intubation. However the incidence of difficult intubation in thyroid surgery had rarely been studied. Anaesthesia for thyroid surgery requires an anaesthetist who is experienced in the recognition, assessment and management of a patient who may also have significant co morbidity. The aim of this review is to recognise highly significant predictive criteria for difficult airway, to understand the difference between difficult & compromised airway, to identify application of newer devices like video laryngoscopy, fibre optic bronchoscopes in airway management, & also to diagnosis and advance treatment of complication related to airway management in patients with thyroid swelling. This review article is providing newer horizon toward management of airway in thyroid cases. For complete understanding of airway in thyroid cases, we have reviewed original articles, papers and case scenarios from different indexed journals.

Keywords: Airway, Thyroid, goitre

INTRODUCTION
Goitre is a common clinical entity with high prevalence in adult populations in endemic areas. One of the mechanical results of goitre is deviation and compression of the trachea. Difficulty with intubation may be caused by deviation and compression. Thyroid surgery is usually considered a risk factor for difficult intubation. However the incidence of difficult intubation in thyroid surgery had rarely been studied. One study found an association between difficult laryngoscopy and goitre with accompanied by airway deformity. Another study found no association between goitre and difficult intubation in patients undergoing thyroidectomy. A complete Airway assessment and anticipation of the difficulties is essential. Such patients do require experienced anaesthesia personnel for airway management during anaesthesia. Anatomy: The thyroid gland is a highly vascularized organ located anteriorly in the neck, deep to the platysma, sternothyroid and sternohyoid muscles, and extending from the 5th cervical (C5) to the 1st thoracic (T1) vertebrae. The gland consists of two lobes (left and right) connected by a thin, median isthmus overlying the 2nd to 4th tracheal rings, typically forming an "H" or "U" shape. Vocal cord is situated posterior to thyroid cartilage while thyroid isthmus is overlying 2 nd to 4 th tracheal rings. Thyroid gland usually enlarges either laterally and/or towards sternum. Enlargement of isthmus with lobe, over prolong period, can cause tracheal compression and tracheomalacia as isthmus is situated over 2nd to 4th tracheal rings.

Vocal cord (as it is posterior to thyroid cartilage) is rarely get compressed by thyroid gland (situated over 2, 3, 4 tracheal rings) enlargement. Only massive enlargement or thyroid malignancy may lead to anatomical changes at laryngeal inlet. Mechanism of Airway Obstruction in Thyroid Swelling: Mechanisms of airway obstruction include extrinsic tracheal compression (e.g., benign intrathoracic orsub sternalgoitre), tracheal invasion (e.g., thyroid cancer), tracheomalacia (e.g., after thyroidectomy), vocal cord paralysis (e.g., recurrent nerve paralysis after thyroidectomy), or a combination of the above. The most frequent cause of thyroid-induced airway obstruction is the presence of a substernal (benign or malignant) goitre compressing the trachea, with or without associated tracheomalacia. How to Diagnose Compromised...
Airway in Thyroid Enlargement: The appropriate airway management in goitre is always a challenge. It is of prime importance to judge a compromised airway in patients with goitre for management under anaesthesia and in the perioperative period. Clinical symptoms and signs of compromised airway are dysphagia, postural dyspnoea in supine position (relied in sitting position) and stridor. X-ray Chest: This may show tracheal deviation and narrowing. Lateral thoracic view may be necessary to diagnose retrosternal extension and to detect tracheal compression in the anterior posterior plane. CT scan is advisable when x-ray chest showing more than 50% tracheal narrowing and deviation. Computed tomography: CT scan is necessary to illustrate tracheal compression in case of goitre or to diagnose tracheal intraluminal invasion in case of thyroid carcinoma. Scan is also advisable to detect precise size and length of tracheal compression. Preoperative airway evaluation using new multislice 3D CT and high-resolution virtual laryngoscopy based on spiral CT data for patients with severe trachealstenosis is useful. 3D figures of the trachea and a virtual bronchoscopic movie can be obtained from multislice CT scanning to evaluate the stenotic region and to simulate the virtual bronchoscopic tracheal intubation. MRI: has the advantage to provide images of airway in the sagittal and coronal planes as well as transverse view. Indirect Laryngoscopy: has role to make record of any pre-existing vocal cord palsy. Naso endoscopy: can help to delineate laryngeal displacement and to rule out other anatomical derangement. Pulmonary Function test (flow volume loop): Flow volume loop remains the most sensitive method to detect upper airway obstruction. It should be performed only in supine position as it may be missed during the conventional method of performing a pulmonary function test in sitting posture. Upper airway sonography: Laryngeal ultrasonography can be a reliable, non-invasive method, in the evaluation of vocal cords, laryngeal morphology and the ease of airflow, which passed through vocal cords or subglottic area due to laryngeal oedema. The air column width during cuff deflation is a potential predictor of post-extubation stridor. Till date, there is no study on ultrasonography for predicting or detecting airway compromise specifically in massive goitre.

Predictors of Difficult Tracheal Intubation in Thyroid Enlargement: Conclusions of few studies which were focused on prediction of difficult intubation in thyroid surgeries are
1. Classical predictive criteria (mouth opening < 35 mm, Mallampati III or IV, short neck, neck mobility < 80°, thyromental distance < 65 mm, and a retrognathic mandible) are significantly reliable as risk factors for difficult intubation.
2. The large goiter is not associated with a more frequent difficult endotracheal intubation. However, the presence of a cancerous goitre is a major factor for predicting difficult endotracheal intubation.
3. Neck thickness in patients with goitre is a significant predictor of difficult intubation and should be used in preoperative assessment to anticipate difficult intubations.
4. The incidence of difficult intubation is highest in patients with polynodal goitre but extremely difficult intubations are present mostly in patients with hyperthyroidism. Men seem to be at higher risk for difficult intubation than women.

Understanding of Intubation Procedure in a Patients with Thyroid Enlargement: Conventional laryngoscopic (Macintosh blade) intubation has three components
1. Visualisation of larynx (glottis exposure)
2. Entry of endotracheal tube in to laryngeal inlet
3. Passage of endotracheal tube into larynx and trachea

The optimum position for laryngoscopy is neck flexion of 35 degree and face plane extension of 15 degree. (Sniffing position) Visualisation of laryngeal inlet: The isthmus of thyroid gland overlies the 2nd to 4th tracheal rings, with both lobes lying laterally to trachea, below the level of
thyroid cartilage. Most enlargement of thyroid gland occur either in the lateral lobes or towards sternum \retrosternally, thereby sparing the thyroid cartilage, hence the position of the glottic opening is usually undisturbed and tracheal compression and/or displacement is seen only below the level of thyroid cartilage. As a result, during laryngoscopy, the glottis opening is visualised normally, in its anatomic position. Enlargement of thyroid gland do not alter alignment of oro-pharyngeal –laryngeal axis. Normal visualisation of laryngeal opening is possible during intubation in patient with goitre. Huge goitres with decrease neck mobility and/or malignant infiltration of airway may cause anatomical derangement on laryngeal inlet, which may make difficult visualisation of laryngeal opening during laryngoscopy in sniffing position. The presence of a cancerous goitre is a major factor for predicting difficult endotracheal intubation. The glottic opening can be visualised normally, in its anatomical position. Enlargement of thyroid gland do not alter alignment of oro-pharyngeal –laryngeal axis. Normal visualisation of laryngeal opening is possible during intubation in patient with goitre. Huge goitres with decrease neck mobility and/or malignant infiltration of airway may cause anatomical derangement on laryngeal inlet, which may make difficult visualisation of laryngeal opening during laryngoscopy in sniffing position. The presence of a cancerous goitre is a major factor for predicting difficult endotracheal intubation. Entry of endotracheal tube in to trachea: Tracheal compression and/or deviation is commonly encountered in large goitres, hence passing the ET tube may be tricky and may present problems. To circumvent these problems, and to be prepared with the appropriate equipment and equipment, the pre-operative CT scan is a useful tool. Assessment of the length, direction and degree of tracheal compression can be done accurately using the CT scan, which helps in pre-procedural selection of the appropriate size of the ET tube. Wire reinforced tubes are usually advisable in patients with tracheal compression and/or deviation. Role of newer airway devices in intubation of huge goitre: Airtraq and king vision laryngoscope (video laryngoscope) has curvature of 90 degree, identical with normal anatomical oropharyngeal curvature. Line of visualisation and insertion of endotracheal tube is one (same) in Airtraq and King Vision laryngoscope. So, it is advisable to use Airtraq laryngoscope for intubating a patient with huge goitre causing restriction on neck mobility. Even with altered neck movement and position, view of glottis inlet is satisfactory by using Airtraq and King vision laryngoscope. Role of fibre optic intubation: Awake fibreoptic intubation is mandatory in selected cases with severely compromised airway proved by radiological investigation and/or pulmonary function test. Large multinodular goitres with retropharyngeal extension can cause obstructive sleep apnoea (OSA) due to tracheal compression and oedema. Difficult mask ventilation can be encountered in patients with OSA. Fibre optic intubations are advisable to increase safety margin in patients with goitre causing OSA. While performing fibreoptic intubation, selection of proper size of bronchoscope, size and type (wire reinforced) of endotracheal tube are important for success of intubation. Awake fibreoptic intubation in sitting position prevents further airway compromise in severe obstruction. Induction Methods: If preoperative assessment is not predictive of difficult airway, induction with conventional techniques will remain effective and practical. If preoperative assessment is predictive of difficult airway, awake fibreoptic intubation, induction in semi supine (head up) or induction with sevoflurane in spontaneous ventilation are recommended and should pursue according to available resources and expertise. Intraoperative Airway Management: Proper positioning of endotracheal tube with tip distal to obstruction is essential to prevent intraoperative airway pressure changes. Chances of migration of tube from its position should be considered during patient’s positioning for surgery. Strategies for Extubation: Conventional extubation can be considered in patients without difficult intubation and non-suspected tracheomalacia or vocal cord palsy. Extubation over a flexible bronchoscope or by substituting supraglottic airway device: This can be considered in suspected vocal cord paralysis, tracheomalacia. An LMA is substituted and the patient is allowed to resume spontaneous ventilation while still anaesthetized. A flexible bronchoscope is then advanced through the LMA. This enables visualization of the anatomy and assessment of laryngeal function. If required, reintubation can be facilitated using an Aintree intubation catheter which jackets the flexible bronchoscope. The latter is then removed along with the LMA and the patient is reintubated over the catheter. Use of a tracheal tube exchange catheter (reversible tracheal extubation) This strategy is especially useful for patients expected to be difficult to reintubate, in case of tracheomalacia and/or in case of suspected injury to recurrent laryngeal nerve during surgery. Check points during extubation: Vocal cord visualisation is always advisable during extubation to rule out vocal cord palsy. Nasal fibre optic endoscopy provides accurate assessment of vocal cord mobility with reasonable patient comfort in the immediate post-operative period. Macintosh laryngoscope fails to give optimum visualization and predisposes the patient to significant discomfort and stress. Newer video laryngoscopes like Airtraq and King vision laryngoscope provide optimum visualisation of vocal cord (compare to
2. The cuff leak test to diagnose tracheomalacia. A cuff leak refers to normal airflow around the ETT after the cuff is deflated. When a cuff leak is absent, it suggests a reduced space between the ETT and the larynx.

**Post Operative Airway Complications:**

**Vocal cord palsy** This may be unilateral or bilateral and present with or without respiratory difficulty or stridor. With unilateral palsy or partial cord paralysis, the patient may simply complain of hoarseness of voice or have difficulty in phonation. Recurrent laryngeal nerve injury may result from ischemia, contusion, traction entrapment, and actual transection. Intraoperative electrophysiologic recurrent nerve injury. Bilateral vocal cord paralysis is a serious complication requiring emergency intervention to resolve the potentially life-threatening respiratory distress. Arytenoidectomy associated with posterior cordectomy is a satisfactory surgical treatment of bilateral vocal cord paralysis because it leads to a considerable and stable enlargement of the breathing space.

**Tracheomalacia:** Tracheomalacia is a rare complication that may occur in patients undergoing thyroidectomy for a long-standing goiter. Airway obstruction secondary to this very rare complication requires immediate re-intubation.

Several techniques have been advocated for management of tracheomalacia such as prophylactic endotracheal intubation, tracheostomy, tracheoplexy, intraluminal tracheal splints and autologous costal cartilage ring grafts to support the trachea anteriorly. Interventional bronchoscopic procedures including Nd-YAG laser treatment and stenting are valuable alternatives of treatment of thyroid-induced tracheal obstruction.

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