



A REVIEW ARTICLE ON RETROSTERNAL GOITRE- TESTING THE SKILLS OF ANESTHESIOLOGISTS.

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ABSTRACT

Though cases of thyroid are common to see but the ones with retrosternal extension are rare and thus their actual incidence is not known. Traditionally anaesthesiologist's main concern remains securing the airway and if unable to do so the consequences can be catastrophic. At presentation patient may be hypothyroid or hyperthyroid which brings the added complications. Cardiac complications and risk of bleeding and nerve injuries during surgery make the retrosternal goitre a frightening task for anaesthesiologists. Though the complication can occur at any stage preoperatively, intraoperatively or postoperatively but a detailed preoperative examination can prevent unanticipated complications.

KEYWORDS

Retrosternal mass, euthyroid patient, awake intubation, postoperative complications

Introduction

Thyroid swelling is the most common surgically managed anterior neck swelling. The growth may be small or large in size, single nodule or multi nodular. Pathology may vary from a benign goitre to a malignant growth. Patient may be hypo/hyper or euthyroid. The management gets more and more backbreaking as the size of swelling increases extending retrosternally; compromising the airway, deviating and compressing mediastinal structures over long periods of time². Retrosternal goitre (RSG) may be classified depending on the location of the goitre: grade 1, above the aortic arch; grade 2, between the aortic arch and pericardium; and grade 3, below the right atrium¹

Dyspnoea occurs due to tracheal compression while more commonly dysphagia occurs due to esophageal compression³. Retrosternal goitres may also cause serious complications like cerebral hypoperfusion and axillosubclavian vein thrombosis⁴. Intraoperatively cardiac complications and complex nature of surgery with potential risk of bleeding and nerve injuries adds to the challenge of anaesthesiologist.

Preoperative assessment:

For patient presenting for thyroid surgery it is important to ensure and achieve euthyroid state and check for any potential difficult airway management.

HISTORY TAKING:

Detailed history taking should be done and it should include history of dyspnea, orthopnea, dysphagia, stridor or breathlessness on assuming supine position. A rapid increase in size of goitre may be due to malignancy, hemorrhage and should be noted.⁵ A possibility of MEN syndrome should be ruled out.

A good preoperative assessment helps to prepare, anticipate and manage any complication.

Clinical and physical examination:

An active team of ORL surgeon, General surgeon, anaesthesiologist, cardiologist, radiologist, endocrinologist need to work together to diagnose the thyroid status and other comorbidities. It can be done under three subheadings—

- i) GENERAL EXAMINATION
- ii) LOCAL EXAMINATION
- iii) AIRWAY EXAMINATION

iv) OTHER SYSTEMIC COMORBIDITIES

i) GENERAL EXAMINATION-

Look for signs of deranged thyroid function (hyper/hypothyroidism) and correct them preoperatively:

Table 1:

	HYPERHYROIDISM	HYPOTHYROIDISM
GENERAL	Weight loss, Malaise, Muscle weakness, Heat intolerance, Cachexia, Palmar erythema, Proximal muscle wasting, Pretibial myxoedema (Graves disease)	Malaise, cold intolerance, Myalgia, Arthralgia, Dry, coarse skin. 'Peaches & Cream complexion', Loss of eyebrows, Hypothermia, Carpal tunnel syndrome, Myotonia
CNS	Irritability, Anxiety, Hyperkinesia, Tremor	Poor memory, depression, psychosis, Mental slowness, Dementia, Poverty of movement, Ataxia, Slow relaxing reflexes, Deafness
CVS	Palpitations, Angina, Breathlessness, Hypertension, Cardiac failure, Tachycardia, Tachyarrhythmias, Atrial fibrillation, Vasodilatation	Hypertension, Bradycardia, Heart failure, Oedema Pericardial & pleural effusions, Anaemia, Cool peripheries
GI	Increased appetite, Vomiting, Diarrhoea	Constipation, Obesity
GUS	Oligomenorrhoea, Loss of libido	Menorrhagia, Loss of libido
Eye (Graves disease only)	Blurred / double vision, Exophthalmos, Lid lag, Conjunctival oedema	

ii) LOCAL EXAMINATION:

Examination of goitre should include the size, consistency, duration and extent of enlargement.

Fixed and hard gland points toward malignancy, while inability to

feel the lower border of thyroid gland indicates retrosternal extension. The retrosternal extension of a large thyroid gland may cause

- 1) Superior venocaval obstruction syndrome (dilated veins, in neck and upper part of chest, facial edema)
- 2) Pleural and Pericardial effusion
- 3) Horner's syndrome- ptosis, anhydrosis, miosis, all of which are due to compression effect on the surrounding vital structures.

iii) Airway evaluation

Airway examination should include Mallampatti grading, assessment of neck movements in all planes (especially atlanto-axial flexion and extension), other factors of difficult intubation should be ruled out (e.g., buck teeth, obesity, protruding or retrognathic mandible etc. Thyromental distance is not reliable in a case of thyroid swelling due to deformed anatomy.

iv) **OTHER COMORBIDITIES** should be ruled out and detailed systemic examination should be done to illicit its implications on the well being of the patient.



Fig 1: A large retrosternal goitre Investigations and lab findings:

Routine investigations should include hemoglobin (Hb), white blood cell count, platelet count, renal function tests, serum electrolytes including serum calcium, thyroid function tests, ECG, Chest Xray. The relevance and implications of deranged TFT are discussed later.

ENT examination:

Indirect laryngoscopy should preferably be carried out by an ENT specialist to look for vocal cord, position, movement and paralysis. A 70 degree endoscopy also adds to the available information. The presence of an ORL surgeon in the Operation Theater with rigid bronchoscopy is also essential.

Radiological investigations:

In case of a very large sized thyroid gland and retrosternal extension, X-ray antero-posterior and lateral view of neck computed tomography (CT) scan⁶ or magnetic resonance imaging (MRI) is preferable to delineate the exact location and extension⁷. The diagnosis of tracheal stenosis is possible with spiral CT scan. It is important to note the position and diameter of trachea where it is narrowest.

Though pulmonary function tests are not required in majority of cases, they can be useful adjuncts in cases of large thyroid gland or with retrosternal extension so as to elicit any fixed upper airway obstruction.⁷

Usually patient is posted for elective surgery when euthyroid and the large retrosternal mass is removed.



Fig 2: X ray showing tracheal compression

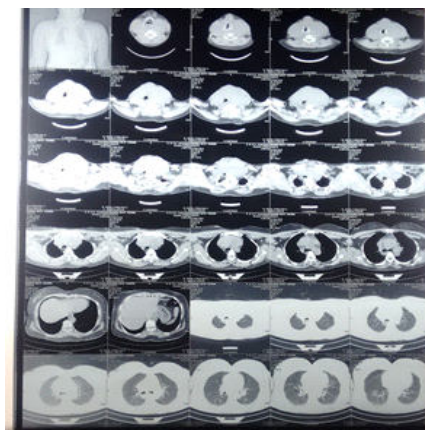


Fig 3: CT scan to delineate the margins

DERANGED THYROID FUNCTION TESTS AND ITS IMPLICATIONS:

The main goal is to convert a hypo/hyperthyroid patient to euthyroid preoperatively as patient is usually posted for elective surgery.

Hyperthyroidism- This means that body has high levels of circulating thyroid hormones. These hormones act at cellular levels, bind to the nuclear receptors and increase cell function. It affects all systems CNS, CVS, metabolism and growth. It sensitizes the body to the action of catecholamines. Carbimazole is the drug of choice but propylthiouracil and methimazole can also be used. Beta blockers provide symptomatic relief and are cardioprotective but has no role in preventing thyroid storm.

If not able to optimize preoperatively the perioperative management of thyroid storm with beta blocker (labetalol, esmolol) and antithyroid drugs should be kept ready with other supportive measures⁸.

Hypothyroidism: This leads to decreased thyroid function, decreased metabolic rate, decreased metabolism of drugs and delayed recovery from anesthesia, anemia and hypoglycaemia. Thyroxine remains the drug of choice.

If not able to optimize preoperatively the perioperative management of myxedema coma with intravenous T3, T4 and hydrocortisone should be kept ready with other supportive measures⁸.

Pre-operative Preparation and Premedication:

Preop planning and preparation is of utmost importance in such cases. Although regional anesthesia with superficial and deep cervical block may be employed for small thyroid swelling, it has no role in retrosternal goitre where general anesthesia is the preferred technique.

Premedication is usually avoided in these patient because of potential difficult airway scenario and any possible respiratory obstruction. However, H2 blockers like ranitidine or Ondansetron and Oral sodium citrate solution with metoclopramide and anticholinergics like glycopyrrolate or atropine to dry up secretions

are routinely used for premedication. A difficult airway trolley should be made ready and an ENT surgeon should be ready with rigid bronchoscope and jet ventilation before induction of anesthesia⁹.

Airway management:

In retrosternal goitre the relaxation caused by the anesthetic agents and muscle relaxants may lead to obstruction of the airway which can present with marked stridor initially during induction of anesthesia and inability to ventilate partially or completely with face mask after administration of general anesthesia, therefore at no point should anaesthesiologist risk losing spontaneous respiration.

Wherever fiberoptic bronchoscope is available it remains the gold standard to manage retrosternal goitres, because it helps to place the ETT beyond obstruction under vision¹⁰.

A few other institutes employ DLscopy with adequate airway preparation as a resort to secure airway, though the chances of failure to intubate remain high. Even with this technique spontaneous respiration should never be lost.

The nature of surgery warrants a free space around the patients head end for a smoother procedure and free movement of the assistants. As such, there are chances that a simple PVC tube can get kinked under the drapes.

Therefore, either a flexometallic or armored endotracheal tube (ETT) or Ring, Adair and Elwyn (RAE) tube (North Pole) is the preferred device for securing the airway as they have minimal chances of kinking and causing respiratory obstruction. Whichever ETT is used, and whatever way it is inserted, it should be advanced beyond the point of extrinsic compression. In our institute, though fiberoptic was kept ready but for grade 1 retrosternal goitre we opted for direct laryngoscopy after airway preparation. The gland was lifted and a 6.5 mm flexometallic tube slid over a ventilating bougie.

If retrosternal goitre is huge then another 'awake technique' is to establish cardiopulmonary bypass (CPB) or extracorporeal membrane oxygenation (ECMO) via femoral vessel cannulation under local anaesthesia, although this is only available in specialist hospitals.¹¹ This is indicated for those at risk of CICV (and those whose airways cannot be safely secured by other means) or mediastinal mass syndrome (MMS). In severe cases, MMS may cause compression of the trachea, bronchi, heart and major vessels (SVC and pulmonary artery) leading to cardiac hypotension or arrest, and/or acute respiratory compromise.¹² Risk factors for peri- and intra-operative MMS include: pericardial effusion, tracheal compression >50% on CT scan and cardiopulmonary signs and symptoms. CPB/ ECMO is logistically difficult to set up and the timing of femoral cannulation varies therefore some anaesthesiologists advocate establishing vascular access or even established bypass before securing the airway. It must be noted that it takes several minutes to cannulate the femoral vessels and achieve full bypass, and this delay may result in brain hypoxia if CPB is not established before hand. Therefore, all patients with trachea with ≥50% reduction of the cross-sectional area on a CT scan 'should have the femoral vessels cannulated under local anaesthesia in readiness for CPB prior to induction of anaesthesia respectively). RSG has not been widely reported to cause MMS and the retrosternal goitres in our institute did not have tracheal compression >50% (the tracheal diameters from CT scan studies in normal subjects, results in mean values of 11 and 13 mm (females and males)), and thus were managed without CPB/ECMO¹³.

In situation of crisis, laryngeal mask airway (LMA) can be used for ventilation, but for thyroid surgery, its utility is doubtful as there can be compression or deviation of trachea due retrosternal extension of goiter causes obstruction in the lower airway.

AIRWAY PREPARATION: Airway to be nebulized with 5 ml of

4% xylocaine half an hour before the operation to anaesthetize her upper airway. On the operation table oral xylocaine gargles and lox 10% to be sprayed over tongue and pharynx.

The transtracheal block and superior laryngeal nerve block is difficult to manoeuvre and hence not administered.

DRUGS USED FOR ANESTHESIA:

In the present day, practice of anaesthesiology is bounded by medicolegal restrictions, general anesthesia with endotracheal intubation is the only safest approach for such delicate procedures. Pre-oxygenation with 100% oxygen enhances the functional residual volume and thus can provide enough time for securing the access to difficult airway. Shorter acting opioids such as fentanyl, remifentanyl, sufentanyl should preferably be used but we used fentanyl 50 micrograms in incremental doses due to availability in our institute. Currently, role of dexmedetomidine is increasingly being used and helps to decrease dose of opioids.

Propofol is the drug of choice in a dose of 2 mg/kg for induction of anesthesia for its excellent clinical characteristics and pharmacological actions such as rapid onset, rapid recovery

Total intravenous anesthesia (TIVA) with propofol has become increasingly popular for all the thyroid procedures but we use gaseous agent sevoflurane in our institute which is equally efficacious. Though a few authors prefer not to use muscle relaxants at all. Ideally vecuronium is the preferred muscle relaxant because of its cardiostable characteristics. The synergistic actions with opioids such as fentanyl further reduces the dose of propofol.

Positioning:

For maximum exposure of thyroid gland which can be achieved by placing a padded ring under the head of the patient and a rolled sheet under the shoulders. The administration drugs necessitate an easy access to intravenous line which can be made possible with the use of extension tubing. Two wide bore cannula should be secured for the surgery. All patients and especially those with hyperthyroidism having proptosis and exophthalmos should have their eyes covered with soft cotton pad. The gravitational drainage of the blood from the surgical site by a headup position is a desirable feature and should be routinely practiced.

Monitoring:

Standard monitors ECG, SpO₂, Temperature, BP, EtCO₂ are used. Invasive monitoring is indicated in state of hyperthyroidism or if large blood loss is expected. Monitoring during the perioperative period should be intense as there are potential chances of hemodynamic and respiratory complications. Monitoring of temperature is also of utmost significance as there are potential risks of developing hyperthermia and hypothermia in hyperthyroid and hypothyroid patients, respectively, during the perioperative and postoperative periods. Urine output should be monitored. Neuromuscular monitoring is important to identify RLN and save it from operative injury¹⁶. Intraoperative steroids are definitely helpful in prevention of airway edema and reduce the incidence of postoperative nausea and vomiting (PONV) as well.

EXTUBATION :

The stress response during extubation should be prevented as it can avoid any accidental hemorrhage from the wound site due to bucking movements from the trachea during reversal of anesthetic and muscle relaxant effects.

Dexmedetomidine has a significant role in attenuation of stress response during these procedures. The main disadvantage in carrying out extubation in a deeper plane of anesthesia is the possible failure of elicitation of vocal cord movements. However, easy methods to detect such a complication include asking the patient to speak the letter "e" or the word "moon". There is a high incidence of hyperthyroid patients having associated myasthenia gravis, and as such neuromuscular blockade should be titrated and monitored with twitch monitor. On table extubation may or may not be attempted depending on tracheomalacia (leak test), intact

RLN function and other factors like size, extent, duration and symptoms produced by the mass. In our institute, if the retrosternal mass was large, patients were electively ventilated for 24 hours and extubated uneventfully after visualisation of vocal cords



Fig 4: 17 x 14 cm retrosternal mass



Fig 4: 17 x 14 cm retrosternal mass

Postoperative Considerations

1) Haemorrhage¹⁵ - Postoperative bleeding can cause compression and rapid airway obstruction. Signs of swelling or haematoma formation that is compromising the patient's airway should be immediately decompressed by removal of surgical clips. Clip removers should be kept by the patient's bedside. If there is time to return to theatre, reintubation should be performed early.

2) Laryngeal oedema - This is an uncommon cause of postoperative respiratory obstruction. It can occur as a result of traumatic tracheal intubation or in those who develop a haematoma that can cause obstruction to venous drainage. It can usually be managed with steroids and humidified oxygen.

3) Recurrent Laryngeal Nerve (RLN) Palsy¹⁵ - Trauma to the recurrent laryngeal nerve can be caused by ischaemia, traction, entrapment or transection of the nerve during surgery and may be unilateral or bilateral. Unilateral vocal cord palsy will present with respiratory difficulty, hoarse voice or difficulty in phonation whilst bilateral palsy will result in complete adduction of the cords and stridor. Bilateral RLN palsy requires immediate reintubation and the patient may subsequently need a tracheostomy.

4) Hypocalcaemia - Unintended trauma to the parathyroid glands may result in temporary hypocalcaemia. Permanent hypocalcaemia is rare. Signs of hypocalcaemia may include confusion, twitching and tetany. This can be elicited in Trousseau's (carpopedal spasm precipitated by cuff inflation) or Chvostek's sign (facial twitch on tapping parotid gland). Calcium replacement should be instituted immediately as hypocalcaemia can precipitate laryngospasm, cardiac irritability, QT prolongation and subsequent arrhythmias.

5) Tracheomalacia - The possibility of tracheomalacia should be considered in those patients who have had sustained tracheal compression by large goitres or tumours. A cuff leak test just prior to extubation is reassuring but equipment should be available for immediate reintubation if it occurs.

6) Thyroid Storm - Characterised by hyperpyrexia, tachycardia, altered consciousness and hypotension this is a medical emergency. Although less commonly seen now as patients are rendered euthyroid prior to surgery it can still occur in patients with hyperthyroidism when they sustain a stress response such as surgery or infection. Management is supportive with active cooling, hydration, beta blockers and antithyroid drugs. Dantrolene 1mg/kg has also been successfully used in the treatment of thyroid storm but is rarely available in India.

CONCLUSION:

A step wise approach is required to manage retrosternal goitre. Extensive preoperative preparation and definitive planning to overcome difficult intubation and secure airway. Airway access is usually awake or inhalational with spontaneous breathing maintained¹³. Awake intubation is always preferred in patients which could have been done either using a fiberoptic bronchoscopy or laryngoscopy under direct vision.

If, the thyroid does not have retrosternal extension then inhalational induction can be tried, as lifting the goitre anteriorly usually relieves airway obstruction. If a patient has grade 1 retrosternal goitre with trachea shifted and narrow (but diameter not be reduced ≥ 50) an awake intubation without CPB can be planned. If the patient has Grade 2 or Grade 3 retrosternal goitre or tracheal narrowing $>50\%$, then it is usually advised to do awake intubation with CPB/ECMO kept ready.

Anesthesia can be maintained by TIVA or inhalational sevoflurane with NMB using vecuronium as first choice.

Neuromuscular monitoring if done helps to identify laryngeal nerves and helps its preservation⁹. This is important as recurrent nerve injury/palsy (unilateral/bilateral) is a common, dreaded but preventable complication of retrosternal goitre surgery. In our institute we used Neuromuscular monitor to check RLN function and preserve it postoperatively.

Tracheomalacia, another serious complication can be assessed with the presence of peritubal breathing and cuff leak test.

A skilled anaesthesiologist with an integrated team with vigilant preoperative examination and planning is the basic requirement to manage patients with retrosternal goitres.

Reference:

- Huis CT, Georgalas C, Mehrzad H, Tolley NS: A new classification system for retrosternal goiter based on a systematic review of its complications and management. *Int J Surg* 2008;6:71-6
- Srivastava D, Dhiraaj S. Airway management of a difficult airway due to prolonged enlarged goiter using loco-sedative technique. *Saudi J Anaesth* 2013;7:86-9
- NJL Gittoes, MR Miller, upper airway obstruction in 153 consecutive patients presenting with thyroid enlargement. *BMJ* 1996;13: 312:484.
- D. Nakra, G. D. Puri ; Anaesthetic Management of Retrosternal Goitre: *J Anaesth Clin Pharmacol* 2005; 21(3) : 309-311
- Peter Chee Seong Tan and Norzalina Esa: Anesthesia for massive retrosternal goiter with severe intrathoracic tracheal narrowing: the challenges imposed - A case report. *Korean J Anesthesiol.* 2012 May; 62(5): 474-478
- The use of computed tomography in the evaluation of large multinodular goiter. *Ann R Coll Surg Engl* 1991;11:73:32-5.
- C.F.Melissant, S.J. Smith, Lung function ,CT-scan and X-ray in upper airway obstruction due to thyroid goiter. *Eur Respir J* 1994;7:1782-1787
- Sarlis NJ, Gourgiotis L. Thyroid emergencies. *Rev Endocr Metab Disord* 2003; 4:129.
- Chao YK, Liu YH, Hsieh MJ, Wu YC, Liu HP, Wang CJ, Ko PJ *Interact Cardiovasc Thorac Surg.* 2005 Jun; 4(3):175-9: Controlling difficult airway by rigid bronchoscope--an old but effective method.
- Bouaggad A, Nejmi SE, Bouderkka MA, Abbassi O. Prediction of difficult tracheal intubation in thyroid surgery. *Anesth Analg* 2004; 99:603.
- Bitter D: Respiratory obstruction associated with induction of general anesthesia in a patient with mediastinal Hodgkin's disease. *Anesth Analg* 1975;59:399-403
- Cook TM, Morgan PJ, Hersch PE.: Equal and opposite expert opinion. Airway obstruction caused by a retrosternal thyroid mass: management and prospective international expert opinion. *Anaesthesia* 2011;66:828-36.
- Erdős G, Tzanova I: Perioperative anaesthetic management of mediastinal mass in adults. *Eur J Anaesthesiol.* 2009 Aug; 26(8):627-32
- Fischer MM, Raper RF. The "cuff-leak" - test for extubation. *Anaesthesia* 1992;47:10-2.
- Pieracci FM, Fahey TJ 3rd: Substernal thyroidectomy is associated with increased morbidity and mortality as compared with conventional cervical thyroidectomy. *J Am Coll Surg* 2007;205:1-7.
- Angelos P. Recurrent laryngeal nerve monitoring: state of the art, ethical and legal issues. *Surg Clin North Am* 2009; 89:1157.