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

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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 breaking as the size of swelling increases extending retrosternally; compromising the airway, deviating and compressing mediastinal structures over long periods of time. 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 atrium.

Dyspnoea occurs due to tracheal compression while more commonly dysphagia occurs due to esophageal compression. Retrosternal goitres may also cause serious complications like cerebral hypoperfusion and axillosubclavian vein thrombosis. Interspersedly 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, anesthesiologist, 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

iv)OTHER SYSTEMIC COMORBIDITIES

Table 1:

<table>
<thead>
<tr>
<th>GENERA L</th>
<th>CNS</th>
<th>CVS</th>
<th>GI</th>
<th>GUS</th>
<th>Eye (Graves disease only)</th>
</tr>
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<tbody>
<tr>
<td>Weight loss, Malaise, Muscle weakness, Heat intolerance, Cachexia, Palmar erythma, Proximal muscle wasting, Pretibial myxoedema (Graves disease)</td>
<td>Irritability, Anxiety, Hyperkinesis, Tremor</td>
<td>Palpitations, Angina, Breathlessness, Hypertension, Cardiac failure, Tachycardia, Tachyarrhythmias, Attrial fibrillation, Vasodilatation</td>
<td>Increased appetite, Vomiting, Diarrhoea</td>
<td>Oligomenorrhoea, Loss of libido</td>
<td>Blurred / double vision, Exophthalmos, Lid lag, Conjunctival oedema</td>
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<tr>
<td>Malaise,cold intolerance, Myalgia, Arthralgia, Dry, coarse skin, 'Peaches &amp; Cream complexion', Loss of eyebrows, Hypothermia, Carpal tunnel syndrome, Myotonia</td>
<td>Poor memory ,depression, psychosis, Mental slowness, Dementia, Poverty of movement, Ataxia, Slow relaxing reflexes</td>
<td>Hypertension, Bradycardia, Heart failure, Oedema Pericardial &amp; pleural effusions, Anaemia, Cool peripheries</td>
<td>Constipation, Obesity</td>
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PREOPERATIVE ASSESSMENT:

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

\[ \text{i)GENERAL EXAMINATION} \]

\[ \text{iv)OTHER SYSTEMIC COMORBIDITIES} \]
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. Thymomental 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 elicit 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) scan or magnetic resonance imaging (MRI) is preferable to delineate the exact location and extension. 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.

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

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 measures.

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 measures.

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.
Airway Preparation:

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

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. Whenever ETT is used, and whatever way it is inserted, it should be advanced beyond the point of extrinsic compression. In our institute, though fibreoptic 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 anesthesia, although this is only available in specialist hospitals. 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. 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 establish vascular access or even to carryout femoral cannulation and bypass before securing the airway. Shorter acting opioids such as fentanyl, remifentanil, sufentanil 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 head up 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 RNL and save it from operative injury. 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

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, remifentanil, sufentanil 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.

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RLN function and other factors like size, extent, duration, and symptoms produced by the mass 14. In our institute, if the retrosternal mass was large, patients were electively ventilated for 24 hours and extubated uneventfully after visualisation of vocal cords.

6) Thyroid Storm - Characterised by hyperpyrexia, tachycardia, altered consciousness and hypotension this is a medical emergency. Although 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 1 mg/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 maintained 12. Awake intubation is always preferred in patients which could have been done either using a fibreoptic 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 preservation 3. This is important as 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:
7. C.F.Melissant,S.J. Smith, Lung function ,CTscan and X-ray in upper airway obstruction due to thyroid goiter. Eur Respir 1994,7:1782-1789