Anaesthesia for thyroid and parathyroid surgery

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Thyroid disease has been long recognized: goitres were first described by the Chinese in 2700 BC. Thyroid surgery was first described in the 12th Century, but for many years the operations were so prone to complications that it prompted Samuel Gross to write in 1848:

> 'Can the thyroid in the state of enlargement be removed? Emphatically experience answers no. . .every stroke of the knife will be followed by a torrent of blood and lucky. . .if his victims lived long enough for him to finish his horrid butchery. No honest and sensible surgeon would ever engage in it'.

In the UK, Stanley Rowbotham pioneered anaesthesia for thyroid surgery in the 1940s. He combined local anaesthesia with light general anaesthesia, and even attempted to make the patient strain to test haemostatic sutures using one breath of ether.[1]

Anaesthesia for thyroid surgery requires an anaesthetist who is experienced in the recognition, assessment, and management of a potentially difficult, shared airway, in a patient who may also have significant co-morbidity.

Complexity of the procedure may vary from excision of a simple nodule to removal of retrosternal goitre to relieve tracheal compression. The latter can be excised through a standard collar incision, but it may be necessary to split the sternum to access the inferior pole of the enlarged gland. Although blood loss is usually minimal, there is potential for major haemorrhage from large blood vessels closely related to the gland, particularly if the thyroid extends retrosternally.

Preoperative assessment

History

The duration of the goitre is important. Long-standing compression of the trachea may be associated with tracheomalacia. A rapid increase in size suggests the possibility of malignancy. Symptoms of positional breathlessness, dysphagia, stridor, and voice change should be elicited. These give an indication of the extent of the goitre and possible problems in lying the patient flat for induction of anaesthesia.

Examination

The patient should be clinically euthyroid before surgery. Tachycardia and atrial fibrillation should be excluded by assessment of the resting pulse. Routine assessments of the airway should be done (e.g. Mallampati score, mandible protrusion, Patil's test) and the neck should be examined to assess the size of the goitre and its consistency; a hard goitre suggests malignancy. If it is possible to feel below the gland, then retrosternal spread is unlikely. It is also important to check for tracheal deviation, listen for stridor, and to assess the range of movement of the neck. Infiltrating carcinomas may make neck movement, and hence intubation, difficult.[2]

Superior vena caval (SVC) obstruction is indicated by the presence of distended neck veins that do not change with respiration. Pemberton's sign of SVC obstruction may be elicited by asking the patient to raise his arms straight up; if obstruction is present, the patient's face will become blue and engorged.

Investigations

Blood tests: A full blood count, electrolytes, thyroid function, and corrected calcium levels should all be routinely performed.

Chest X-ray: This may show tracheal deviation and narrowing. In complex or suspicious cases, lateral thoracic inlet views may be necessary to exclude retrosternal extension and to detect tracheal compression in the anteroposterior plane.

Key points

Thyroid surgery can range from excision of a simple nodule to removal of retrosternal goitre to relieve tracheal compression.

A computed tomography scan is advisable when the patient gives a history indicative of airway encroachment (e.g. positional dyspnoea).

Recurrent laryngeal nerve palsy may be unilateral or bilateral and present with respiratory difficulty or stridor.

Long-standing goitre may be associated with tracheomalacia.

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Computed tomography scan: This is advisable when the patient gives a history indicative of airway encroachment (e.g. positional dyspnoea). It is also helpful if there is suspicion of malignancy as it can illustrate tracheal invasion by a carcinoma. If there is >50% narrowing of the trachea on the plain chest film, a CT scan is necessary to accurately delineate the site and degree of airway compromise, in order to predict the tracheal tube diameter and length likely to be required.[3]

Nasendoscopy: This may be performed before operation to record any pre-existing vocal cord palsy. It is advisable for medicolegal purposes, as preoperative cord dysfunction because of malignancy or previous surgery may be asymptomatic. Nasendoscopy can also help to delineate laryngeal displacement.

Anaesthetic techniques

Several methods, including combinations of techniques, can be used safely and effectively.

Regional anaesthesia

In the UK, thyroidectomy is not routinely performed under regional anaesthesia. However, this has been shown to be safe and successful in a selected group of patients, resulting in low morbidity and high levels of patient satisfaction.[4] Anaesthesia is achieved using deep and superficial cervical plexus blocks, with or without sedation. Patients who cannot communicate verbally with the surgical and anaesthetic team, or who are obese, are unlikely to be good candidates for this technique.

General anaesthesia

The majority of cases are straightforward even when imaging suggests significant degrees of tracheal deviation or compression. Full preoxygenation should precede i.v. induction and muscle relaxation with a neuromuscular blocking drug, once manual ventilation has been demonstrated. If preoperative assessment has increased concerns regarding the airway, the following options should be considered:

1. Induction in the semi-supine or sitting position.
2. Inhalation induction with sevoflurane: the patient should be premedicated to dry secretions, and airway adjuncts such as a nasopharyngeal airway of correct size should be immediately available in case the patient obstructs their airway as they lose consciousness. Sevoflurane in Heliox may be useful in cases when preoperative stridor is severe.
3. Fibreoptic intubation: care should be taken in patients with marked stridor in whom complete obstruction may result from insertion of the bronchoscope. This technique is useful when there may be severe laryngeal displacement or a co-existing airway problem (e.g. ankylosing spondylitis).
4. Tracheostomy under local anaesthetic may be performed by the surgeon.
5. Ventilation through a rigid bronchoscope can be performed if attempts to pass an endotracheal tube (ETT) fail because of a mid-lower tracheal obstruction.

Whichever approach is used, all equipment must be checked and the surgeon must be immediately available.

Anaesthesia may be maintained via inhalation agents or i.v. anaesthesia. The use of remifentanil for thyroid surgery has become increasingly popular. Remifentanil provides analgesia intraoperatively, and also contributes to the hypotensive anaesthetic required to provide a bloodless surgical field; it also obtunds laryngeal reflexes, so reducing the need for further doses of muscle relaxant.

Other perioperative considerations

The eyes should be taped and padded, especially, if exophthalmos is present. Reinforced ETTs are commonly used and taped into position to avoid ties around the neck. In theatre, the patient is positioned slightly head-up to prevent venous engorgement, with the head extended and stabilized using a head ring and sandbag between the scapulae. The arms are extended; thus, a long i.v. extension line is required to maintain adequate access. Muscle relaxation should be monitored. If surgery is likely to be complex or extensive it may be appropriate to administer i.v. steroid (e.g. dexamethasone 8 mg) to decrease the likelihood of postoperative oedema and subsequent respiratory difficulty. Dexamethasone also contributes to antiemesis after operation.

The anaesthetist may be asked to maintain the patient's intrathoracic pressure positive for 10–20 s (effectively performing a Valsalva manoeuvre) with the patient in the head-down position, in order to assess haemostasis before wound closure. Extubation is most safely performed with the patient fully awake and breathing spontaneously. If the goitre was large and long-standing, there may be a risk of tracheomalacia (erosion of the tracheal cartilages) that can lead to postoperative stridor and even complete airway obstruction with tracheal collapse. Some surgeons examine the trachea under direct vision or ask for partial withdrawal of the tracheal tube, so that the tip is just proximal to the site of the goitre. If there is concern, the anaesthetist should deflate the cuff of the ETT to ensure that there is a leak before extubation.

The patient should be recovered sitting upright as much as possible to avoid venous congestion and oedema. A superficial cervical plexus block can be useful for postoperative analgesia. Many surgeons infiltrate s.c. with local anaesthetic and epinephrine before incision. This will reduce the requirement for opioid analgesia in the recovery phase, and most patients will remain comfortable with regular paracetamol and NSAIDs after operation.

Postoperative complications

Haemorrhage: This may result in tense swelling in the neck and respiratory difficulty. Clip removers or stitch cutters must be kept at the bedside to evacuate blood and haematoma, if the patient is

in extremis. Otherwise, this is done expeditiously in theatre. Early reintubation is recommended in this situation.

Tracheomalacia: Airway obstruction secondary to this very rare complication requires immediate re-intubation.

Recurrent laryngeal nerve (RLN) palsy: This may be unilateral or bilateral and present with 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. RLN injury may result from ischaemia, contusion, traction entrapment, and actual transection. Traditionally, anaesthetists were taught to inspect the cords under direct vision immediately post-extubation, but this can be difficult and may be unreliable. The laryngeal mask airway and fibrescope has been used to make this technically easier and also to observe the vocal cords during surgery.[5] Increasingly, electrophysiological monitoring of the recurrent laryngeal nerves has been found to be useful,[6] particularly when the identification of the nerve is expected to be difficult. However, meticulous surgery by an experienced surgeon who routinely identifies the RLN is still thought to be the most reliable way of avoiding accidental nerve injury.

Laryngeal oedema: This is a rare cause of airway obstruction post-thyroidectomy, but may result because of a traumatic intubation or with complex surgery. This may require corticosteroid therapy and humidified oxygen.

Hypocalcaemia: Temporary hypocalcaemia requiring calcium replacement may occur in up to 20% of patients after thyroidectomy for large multinodular goitre, but permanent hypocalcaemia is rare. It may present with perioral tingling, twitching, or tetany. If left untreated, it can progress to seizures or ventricular arrhythmias. The diagnosis may be made clinically by precipitating carpopedal spasm through cuff inflation (Trousseau's sign) or facial twitching by tapping over the facial nerve at the parotid gland (Chvostek's sign). The ECG may show prolonged QT intervals. If the serum calcium is > 2 mmol litre^{-1}, oral calcium supplements are prescribed. If the serum calcium is below this concentration, urgent treatment should be commenced with i.v. calcium (usually 10 ml of 10% calcium gluconate for more than 3 min). A calcium infusion may be necessary.

Pneumothorax: This is a possible complication of retrosternal dissection.

Parathyroid surgery

The four parathyroid glands are responsible for maintaining calcium homeostasis via secretion of parathyroid hormone. Parathyroid hormone acts on the bones and kidneys to increase serum calcium and decrease serum phosphate. It stimulates osteoclasts to release calcium and phosphate into the extracellular fluid, and simultaneously increases phosphate excretion and calcium re-absorption in the kidney.

The commonest indication for surgery is primary hyperparathyroidism (PHP) from a parathyroid adenoma. The incidence of PHP is thought to be 25 per 100 000 of the UK population, and as high as 1 in 500 of women over the age of 45 years.[7] An increased circulating parathyroid hormone concentrations causes hypercalcaemia that leads to fatigue and bone, abdominal, urological, and mental symptoms. Thus, PHP was described historically as a disease of 'stones, bones, abdominal groans, and psychic moans'. PHP is also associated with a higher incidence of cardiovascular deaths related to hypercalcaemia,[8] impaired glucose tolerance, increased fracture risk, and poorer quality of life scores than the normal population.[9]

Traditionally, parathyroidectomy involved a collar incision, bilateral exploration of the neck, identification of all four glands, and removal of the diseased gland or glands. This requires a general anaesthetic technique similar to that for thyroid surgery although airway encroachment is rare. It is important to remember that operating times may be unpredictable, especially if frozen section or parathyroid assays are performed, and active heat conservation should therefore be considered.

Minimally invasive parathyroidectomy

More than 80% of patients with PHP have a solitary adenoma, removal of which guarantees cure. The lack of a consistently reliable method for localizing parathyroid tumours hampered the introduction of minimal access approaches to parathyroid disease. For example, ultrasonography of the neck is operator dependent, whereas thallium–technetium subtraction scintigraphy is dependent on the size of the adenoma. Technetium-99 m sestamibi scanning has revolutionized preoperative localization of parathyroid glands, as it accurately identifies the size and site of the tumour in 88% of patients. Subsequently, a minimal access approach may be adopted, which is most commonly achieved through a 2-cm skin incision placed over the appropriately localized parathyroid gland.

Anaesthesia

Although general anaesthesia is still common, using either a reinforced tracheal tube or a laryngeal mask airway, this procedure is increasingly carried out with local anaesthesia, which may be particularly suitable for the patient with marked cardiorespiratory disease. Local anaesthesia may involve cervical nerve blocks or surgical infiltration with or without sedation.

Cervical nerve blocks may be deep, superficial, or both. The deep cervical block is technically more challenging and has significant risks, including inadvertent injection into the dural cuff or vertebral artery and phrenic nerve palsy. For this reason, it is generally advised that bilateral deep cervical blocks should be avoided. When patients anaesthetized with superficial cervical block alone were compared with patients having combined superficial and deep blocks for parathyroidectomy, there was no difference between the groups regarding requirement for supplementary analgesia, patient satisfaction, pain scores, or postoperative analgesia requirements, except that the combined group requested analgesia earlier. Whichever technique is used, it is generally accepted

that supplementation is required to the upper poles of the thyroid to allow retraction.

Surgical infiltration may be supplemented with sedation. In the authors' unit, this is effectively achieved using a combination of midazolam and remifentanil, or alfentanil.

Postoperative care

Serum calcium should be checked at 6 and 24 h after operation. Hypocalcaemia, as discussed above, requires supplementation; persisting hypercalcaemia is rare. Pain is not usually severe and easily controlled with oral analgesia, although NSAIDs should be avoided in patients with renal compromise.

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Please see multiple choice questions 22–25