

# Thyroid disease

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Disease of the thyroid gland is common. For example, in endemic areas, the incidence of goitre is 15–30% of the adult population.<sup>66</sup> Most anaesthetists, although their practice may not include endocrine surgery, will frequently be required to manage patients with thyroid disease. Thyroid diseases that have anaesthetic implications include hypothyroidism, hyperthyroidism and conditions requiring thyroidectomy. Those presenting with well-controlled hypo- and hyperthyroidism do not present much difficulty for the anaesthetist. However, patients with uncontrolled myxoedema, or those with uncontrolled hyperthyroidism presenting as an emergency, are at considerable risk.<sup>42</sup> Anaesthesia for thyroidectomy may be complicated by airway problems such as retrosternal extension of the gland. The anaesthetist should, therefore, pay particular attention to preoperative assessment of the airway and should be able to deal with acute airway complications in the perioperative phase.

## History

In his book entitled *The History of Endocrine Surgery*, Richard Welbourn details the beginnings of thyroidectomy.<sup>99</sup> Goitres were recognized in antiquity and were described in Chinese literature in 2700 BC. Since they were never endemic around the Mediterranean, there was no mention of goitre in Egyptian or Greek writings. In the twelfth and thirteenth centuries, the school of Salerno in Italy was the cradle of thyroid surgery. At that time goitres were removed using horrific-sounding instruments such as setons, hot irons, stytics and asphodel powder. The American surgeon William Halsted could trace accounts of only eight operations in which the scalpel was used between 1596 and 1800. During one of these procedures, described by Fabricius in 1646, the patient, a 10-yr-old girl, died on the table and the surgeon was gaoled! In 1821, Hedenus reported the successful removal of six suffocating goitres by dissection and ligation of all the arteries. Needless to say, these operations were prone to complications which were often fatal and, in 1850, the French Academy of Medicine condemned operations on the thyroid gland.

However, the advances of anaesthesia, antisepsis and haemostasis allowed surgeons, such as Billroth of Vienna and Kocher of Berne, to perform many more thyroid operations with reduced mortality. In 1849, Nikolai Pirogoff of St Petersburg was the first to use general anaesthesia for a thyroid operation. He used ether on a girl of 17 yr whose goitre was causing tracheal compression.<sup>99</sup>

Thomas Peel Dunhill performed his first thyroidectomy in 1907 under local anaesthetic.<sup>94</sup> He developed surgery as an effective and safe treatment for thyrotoxicosis and in 1911 presented his series of 230 cases of exophthalmic goitre, which included only four deaths. Other notable thyroid surgeons included Charles Mayo and George Crile.

In the UK, Stanley Rowbotham was a pioneer of anaesthesia for thyroid surgery;<sup>18</sup> with his surgeon Cecil Joll, he performed 946 goitre operations between 1941 and 1944. Although these operations were performed before the introduction of antithyroid drugs, by Astwood in 1943,<sup>7</sup> there were only nine deaths in the series. Rowbotham combined local analgesia with light general anaesthesia and even contrived, at the request of the surgeon, to get the patient to strain when the haemostatic sutures were in place. He used one breath of ether to accomplish this manoeuvre.<sup>76</sup>

## Patients with thyroid disease scheduled for non-thyroid surgery

### Hypothyroidism

The incidence of hypothyroidism depends on the level of iodide in the diet.<sup>66</sup> The prevalence of overt hypothyroidism in iodine-sufficient areas is five per 1000 and that for the subclinical form is 15 per 1000.<sup>55</sup> Hypothyroidism may result in depression of myocardial function, decreased spontaneous ventilation, abnormal baroreceptor function, reduced plasma volume, anaemia,<sup>82</sup> hypoglycaemia, hyponatraemia and impaired hepatic drug metabolism.<sup>67</sup> Hypothyroid patients should be rendered euthyroid before

surgery<sup>42</sup> and, as with other types of endocrine surgery, close communication with the metabolic physicians is advised. It should be remembered that, because thyroxine (T4) has a half-life of 7 days, it will not have an effect for some time after administration. The half-life of triiodothyronine (T3) is 1.5 days. The combination of intravenous T3 and T4 is recommended in the management of preoperative myxoedematous coma, which is an extremely rare occurrence. Careful administration is essential, particularly in the elderly, as angina may be precipitated.<sup>60</sup>

There is some debate about whether or not surgery should be postponed in a mild or subclinical hypothyroid patient.<sup>10</sup> It is logical to avoid premedication in overtly hypothyroid patients and to use regional anaesthesia wherever possible. T4 may be omitted on the morning of surgery but it is advisable to give the patient's usual morning dose of T3. The presence of a hypometabolic state necessitates careful perioperative cardiovascular monitoring and judicious use of anaesthetic drugs.

Preventative measures should be adopted to protect against hypothermia. Because of an increased incidence of adrenocortical insufficiency and a reduced adrenocorticotrophic hormone response to stress, hypothyroid patients should receive hydrocortisone cover during periods of increased surgical stress.<sup>67</sup> There are several reports of severe cardiovascular and respiratory depression in hypothyroid patients during general anaesthesia. Hypothyroidism should therefore be considered in any obese, debilitated patient who displays perioperative cardiovascular or respiratory instability.<sup>54</sup>

### Hyperthyroidism

Thyrotoxicosis affects approximately 2% of women and 0.2% of men in the general population.<sup>27</sup> The prevalence of overt hyperthyroidism in iodine-sufficient areas is two per 1000 and that of subclinical hyperthyroidism is six per 1000.<sup>55</sup> The classical features of thyrotoxicosis are well known and include hyperactivity, weight loss and tremor. Of importance to the anaesthetist are the cardiovascular effects of hyperthyroidism including atrial fibrillation, congestive cardiac failure and ischaemic heart disease.<sup>44</sup> Thrombocytopenia may be associated with thyrotoxicosis.<sup>82</sup> General anaesthesia should be considered as the method of choice for patients with exophthalmos requiring eye surgery.<sup>17</sup>

In an attempt to prevent the dreaded complication of 'thyroid storm', patients should be euthyroid before surgery.<sup>42-86</sup> This is achieved by the use of antithyroid drugs, commonly carbimazole or propylthiouracil. These drugs block the synthesis of thyroxine but take 6–8 weeks to work. Beta-blockers, particularly propranolol, are used to ameliorate the effects of thyrotoxicosis<sup>13</sup> and are effective in the acute preoperative phase. Longer-acting beta-blockers such as atenolol or nadolol may achieve better control of

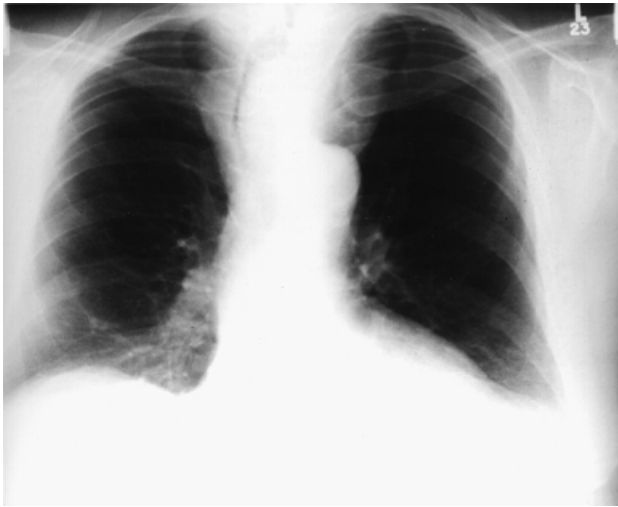
symptoms.<sup>27-36</sup> Anaesthetic drugs may be affected by the hypermetabolic state of hyperthyroidism. For example, the clearance and distribution volume of propofol are increased in hyperthyroid patients. When total intravenous anaesthesia is used, propofol infusion rates should be increased to reach anaesthetic blood concentrations.<sup>91</sup>

### Thyroid crisis

The hypermetabolic crisis known as 'thyroid storm' is frequently mentioned in textbooks of anaesthesia<sup>72</sup> but is now rarely seen because of the widespread use of antithyroid drugs, such as carbimazole, and beta-blockers. However, thyroid crisis still occurs in uncontrolled hyperthyroid patients as a result of a trigger such as surgery, infection or trauma. Pugh and colleagues described a case following Caesarean section<sup>73</sup> and Naito and colleagues described a tragic case resulting from active metastatic thyroid carcinoma in a severely burned patient.<sup>68</sup> Supportive management of thyroid crisis includes hydration, cooling, inotropes and, formerly, steroids. Beta-blockade, using propranolol, and antithyroid drugs are used as the first-line of treatment. Esmolol was successful in treating a child of 14 months who developed a thyroid crisis 3 h after thyroidectomy.<sup>47</sup> An 85-yr-old with multinodular goitre and severe thyrotoxicosis was also managed with esmolol.<sup>95</sup> However, it should be noted that thyroid crisis has been reported during beta-blockade.<sup>85</sup> An acute thyroid crisis on induction of anaesthesia, which was mistakenly diagnosed as malignant hyperthermia, was treated successfully by boluses of dantrolene 1 mg kg<sup>-1</sup>.<sup>9</sup> Christensen and Nissen reported the successful use of dantrolene to treat thyroid crisis in a child who had not responded to traditional measures.<sup>16</sup> Since thyroid hormones sensitize the adrenergic receptors to endogenous catecholamines, magnesium sulphate would seem to be, theoretically, a useful drug. Magnesium reduces the incidence and severity of dysrhythmias caused by catecholamines (James MFM, personal communication).

### Thyroidectomy

The indications for thyroidectomy include: proven or suspected thyroid malignancy; obstructive symptoms; retrosternal goitre, even in the absence of obstruction; hyperthyroidism that is unresponsive to medical management; recurrent hyperthyroidism; cosmetic reasons; anxiety (patients with a small goitre may insist on having it removed); patients with Hashimoto's disease, goitre and hypothyroidism usually respond to thyroxine therapy, but thyroidectomy would be indicated if there is any suspicion of superimposed lymphoma.<sup>90</sup>



**Fig 1** Chest x-ray showing gross tracheal compression and deviation by a retrosternal goitre.

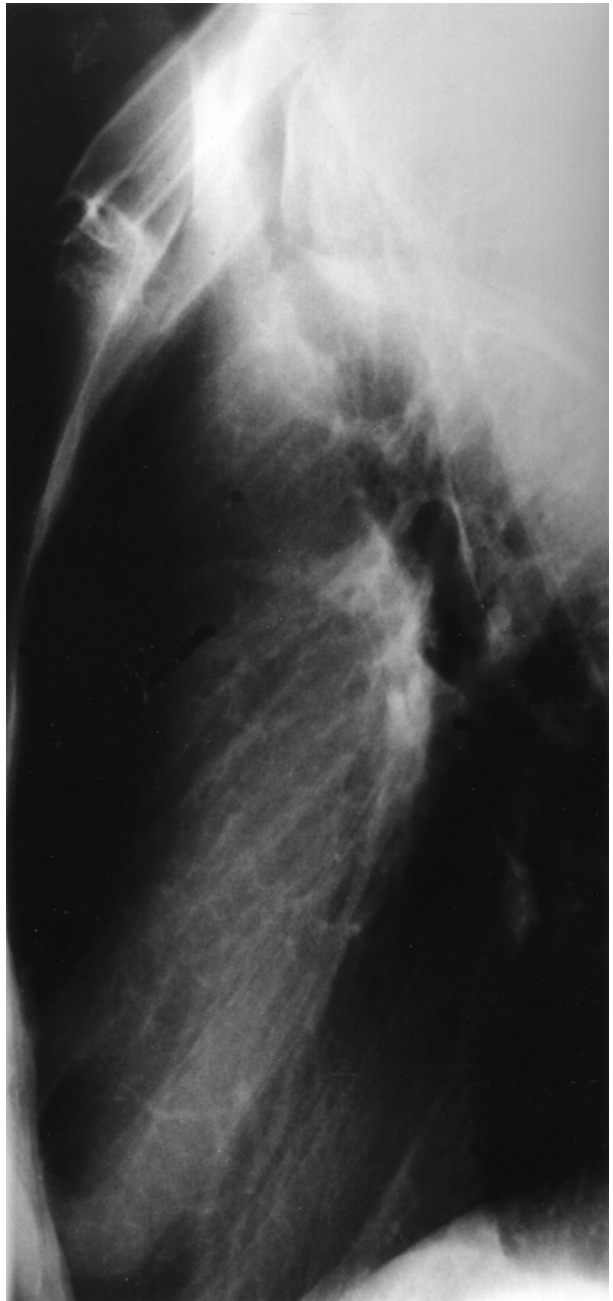
### *Preoperative assessment*

General history taking and examination of patients scheduled for thyroidectomy should include identification of abnormalities of thyroid function. Besides symptoms and signs of hypo- and hyperthyroidism, evidence of other medical conditions should be sought, particularly cardiorespiratory disease and associated endocrine disorders. For example, patients who require thyroidectomy for **medullary cancer** may have an **associated phaeochromocytoma**.<sup>101</sup>

Problems with **airway management** will be the main concern of the anaesthetist when confronted by a patient with a **goitre**. The patient may give a history of **respiratory difficulties**, for example **positional dyspnoea**, and this may be associated with a degree of **dysphagia**. As described later, patients with **retrosternal goitre** may exhibit signs of **vena caval obstruction**. Other assessments of the airway will include assessment of distances between incisors, the thyromental distance, the degree of protrusion of the lower teeth, head and neck mobility and observation of pharyngeal structures.<sup>75</sup>

Routine investigations include thyroid function tests, haemoglobin, white cell and platelet count, urea and electrolytes, including serum calcium, chest x-ray and indirect laryngoscopy. Patients may have had fine needle aspiration as a diagnostic test in the out-patient clinic. An ENT colleague routinely performs **indirect laryngoscopy in order to document any preoperative vocal cord dysfunction**.<sup>77</sup> This investigation is **useful** to the anaesthetist since the **need** for a **fibreoptic** instrument to view the **vocal** cords, if indirect laryngoscopy is unsuccessful, will alert the anaesthetist to the probability of a **difficult intubation**.

A **chest x-ray** (Fig. 1) is requested to seek evidence of tracheal **compression** and deviation and lateral thoracic inlet views have traditionally been used to



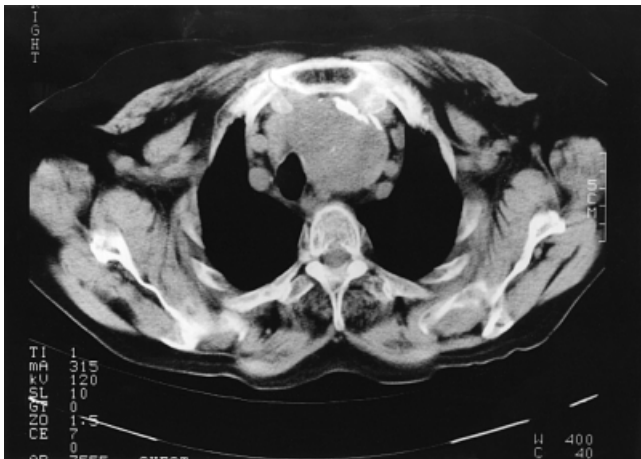
**Fig 2** Lateral thoracic inlet x-ray showing tracheal compression antero-posteriorly.

show tracheal compression in the antero-posterior plane (Fig. 2).

Other investigations, while not routine, will be of value in certain cases. Computerized tomography (**CT**) can provide excellent views of retrosternal goitres<sup>8</sup> (Fig. 3): compare the reconstructed CT scan in Fig. 4 with the chest x-ray of the same patient (Fig. 1).

Magnetic resonance imaging (**MRI**) has the advantage of providing images in the **sagittal** and **coronal** planes, as well as **transverse** views<sup>28</sup> (Figs 5–7). The coronal view of this patient (Fig. 6) indicated that it would not be possible to see





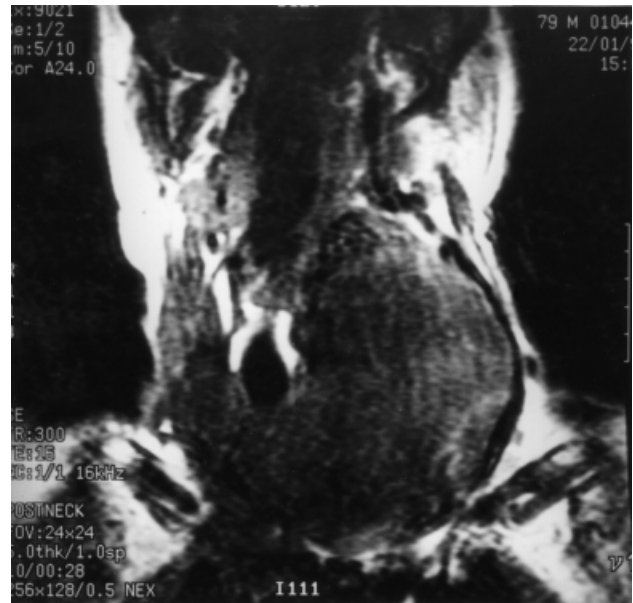
**Fig 3** CT scan of retrosternal goitre.



**Fig 4** Reconstructed CT scan.



**Fig 5** Sagittal MRI scan of goitre.



**Fig 6** Coronal MRI scan of goitre.



**Fig 7** Transverse MRI scan of goitre.

the larynx by direct laryngoscopy and so fibreoptic intubation was planned.

The usefulness of respiratory function tests is debatable. Respiratory flow volume loops showed upper airway obstruction in 33% of 153 consecutive patients presenting with thyroid enlargement. This was unrelated to the type or size of goitre.<sup>33</sup>

Following a careful history and examination and with the assistance of a number of investigations, the anaesthetist can be in a position to discuss with the patient the various options for airway management. These options will include straightforward intravenous induction with tracheal intubation, inhalational induction or fibreoptic intubation. The patient should be warned what to expect postoperatively and an anxiolytic premedication prescribed.

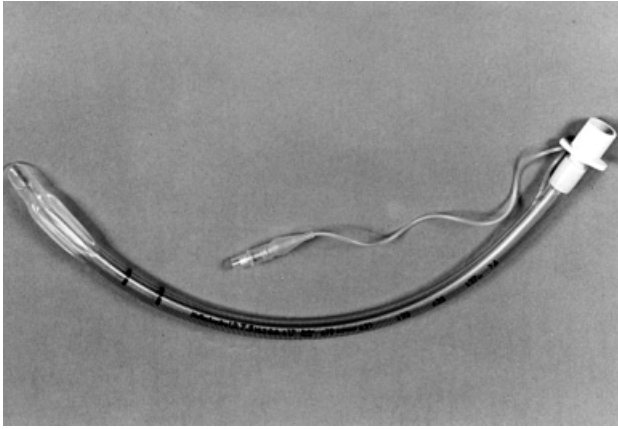


Fig 8 Armoured tracheal tube.

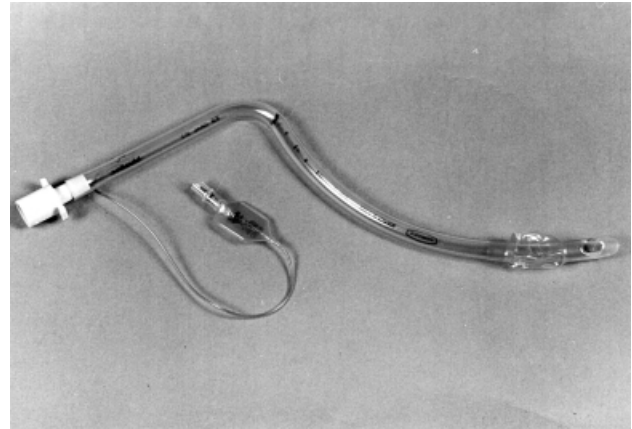


Fig 9 'North-polar' tracheal tube.

## Anaesthetic technique

### Regional anaesthesia

It is possible to perform thyroidectomy under bilateral deep or superficial cervical plexus blocks.<sup>50</sup> There are, however, a number of complications of this technique, including vertebral artery puncture, epidural subarachnoid spread and bilateral phrenic nerve block. Regional anaesthesia is a useful alternative for particular circumstances, for example, thyroidectomy for amiodarone-induced hyperthyroidism.<sup>46</sup> Thyroidectomy under regional anaesthesia is not routinely practised in the UK.

In some parts of the world, thyroidectomy is performed under acupuncture, with or without supplementary analgesics.<sup>45</sup> Hypnosedation, a combination of hypnosis and light conscious sedation, has been suggested for endocrine surgery including thyroidectomy.<sup>64</sup>

### General anaesthesia

General anaesthesia with tracheal intubation and muscle relaxation is the most popular anaesthetic technique for thyroidectomy. The laryngeal mask airway (LMA)<sup>†</sup><sup>14</sup> has been used with spontaneous respiration and intermittent positive pressure ventilation in thyroid surgery.<sup>34 38 88</sup> This technique requires close co-operation between surgeon and anaesthetist. Relative contraindications to the use of the LMA include tracheal narrowing and/or deviation.

As described in the section on postoperative complications, use of the LMA allows vocal cord movement to be seen via a fiberoptic laryngoscope when the recurrent laryngeal nerve is stimulated.<sup>88</sup> However, there is a risk that the LMA will be displaced during surgery and laryngospasm occurs in relation to surgical manipulation.<sup>15</sup> Use of

the intubating laryngeal mask in a patient with a large goitre proved difficult because of deviation of the laryngeal inlet.<sup>96</sup>

Induction of anaesthesia for routine thyroidectomy, when no difficulty with intubation is expected, is straightforward. The trachea is intubated usually using conventional laryngoscopy. The tracheal tube should not kink when it attains body temperature during prolonged surgery, so a reinforced tube should be considered (Fig. 8). 'North-polar' oral tracheal tubes (Fig. 9) are an alternative as they keep the respiratory filter away from the surgical field. Nasal tracheal tubes may also be used although vasoconstriction will be required to prevent epistaxis. It is wise to select a small reinforced tracheal tube if there is any degree of tracheal compression.

### Unexpected difficult intubation

Occasionally, even though no difficulty has been predicted, the larynx is not easily seen, so the anaesthetic team must be experienced and prepared to cope with an unexpected difficult intubation. Items which should be available to deal with such a situation include: various sizes of tracheal tubes; gum elastic bougies; a levering laryngoscope;<sup>61</sup> straight-bladed laryngoscopes; an LMA;<sup>14</sup> ready access to an intubating fibroscope; and some means of trans-tracheal ventilation.

### Expected difficult intubation

If preoperative airway assessment and/or the inability of the ENT surgeon to see the vocal cords by indirect laryngoscopy have predicted any difficulty with intubation, then the anaesthetist must have a clear strategy for intubation. The anaesthetist should expect that 6% of tracheal intubations for thyroid surgery will be difficult.<sup>51</sup> It has been reported that the ease of intubation was unrelated to the extent of abnormality seen on imaging studies of the neck.<sup>62</sup> Whenever there is concern that the airway will be lost if anaesthesia is induced, awake fiberoptic intubation is the method of choice. The traditional technique of inhalational induction has regained acceptability following the introduction of sevoflurane.<sup>57 98</sup> It may be adopted when the

<sup>†</sup> LMA<sup>®</sup> is the property of Intavent Limited.



**Fig 10** Patient position.

patient is extremely anxious about awake intubation, and the anaesthetist believes that the size of the goitre will not cause the airway to be lost after induction of anaesthesia.

#### *Positioning the patient*

After intubation, by whatever means, the position of the tracheal tube is checked, the tube is secured and the patient's eyes are protected. These practical points are important as the use of head towels prevents the anaesthetist from inspecting the patient's face during the procedure. Particular care should be taken when the patient suffers from exophthalmos.

The patient is positioned with a sandbag between the shoulder blades and the head resting on a padded 'horse-shoe' or Whitlock headrest<sup>100</sup> (Fig. 10). Both arms are placed by the side, as the surgeon will need to stand on either side of the patient. A long connector for the i.v. infusion allows access from the foot of the bed. A 25° upward tilt of the head will assist venous drainage, although this should be performed with careful attention to arterial pressure, particularly in patients who have been receiving beta-blockers. Finally, slight head extension will allow the surgeon excellent access to the thyroid gland.

#### *Surgical technique*

The skin is infiltrated with 10–20 ml of 0.5% bupivacaine and epinephrine 1:200 000. Skin flaps are raised and the strap muscles separated in the midline. It is rarely necessary to divide the strap muscles. The upper pole is mobilized and the superior thyroid vessels ligated. Mobilization of the lobe is completed and the parathyroid glands and recurrent laryngeal nerve are identified routinely and protected during dissection of the thyroid from the trachea. Haemostasis is secured and the strap muscles and platysmal layers apposed. The skin is closed with staples.<sup>30</sup>

#### *Postoperative care*

Residual neuromuscular block is reversed and the patient is allowed to recover from anaesthesia. If there has been any concern during dissection of the recurrent laryngeal nerve,

the vocal cords are checked and the surgeon reassured. A fibreoptic endoscope may be used to view the vocal cords atraumatically.<sup>59</sup> When adequate spontaneous respiration and laryngeal reflexes have returned, the patient is extubated. Every attempt should be made to prevent coughing,<sup>32 40 49 63</sup> although recent chest infection<sup>69</sup> or a history of cigarette smoking<sup>22</sup> may make this difficult. If there is no immediate respiratory obstruction, the patient is transferred to the recovery ward. The patient is carefully observed for the development of a cervical haematoma and is returned to the ward after attaining appropriate discharge criteria. Signs of hypocalcaemia are treated by calcium supplements and, following total thyroidectomy, thyroxine 100 µg daily is prescribed. Postoperatively, vocal cord function is examined by indirect laryngoscopy before discharge. The new technique of video laryngostroboscopy is an accurate means of diagnosing vocal abnormalities after thyroidectomy, although it may not be cost-effective.<sup>48</sup>

## Thyroidectomy in special situations

### *Hyperthyroidism*

Thyroidectomy is offered to patients with autoimmune hyperthyroidism (Graves' disease) when medical treatment proves inadequate. Patients should be euthyroid before surgery. Approximately three patients per 1000 are unable to take antithyroid drugs because of serious adverse reactions, the most severe of which include agranulocytosis, hepatitis, aplastic anaemia and lupus-like syndromes.<sup>27</sup> The clinical manifestations of thyrotoxicosis are usually controlled by beta-blockers and it has been suggested that beta-blockers alone may be adequate preparation for thyroidectomy.<sup>36</sup> Traditionally, Lugol's iodine has been given for 10 days preoperatively, in a dose of 0.5 ml three times a day, to reduce bleeding, as antithyroid drugs make the thyroid more vascular. Although this contention was supported by measuring thyroid blood flow using uptake of a radioisotope of thallium,<sup>58</sup> many surgeons have abandoned this practice. This is because the thyroid gland is now usually dissected without transection.

### *Huge goitres*

Endemic goitre still exists in many parts of the world.<sup>87</sup> Huge nodular goitres can occur, with a neck circumference of about 60 cm (Fig. 11). The specimen from this patient weighed 700 g (Fig. 12). While these goitres may have a dramatic appearance, they often present fewer problems than smaller retrosternal goitres.<sup>39</sup> The problems associated with huge goitres include difficult intubation (although lifting the goitre anteriorly usually relieves airway obstruction), large blood loss, prolonged operating time and post-operative tracheomalacia.<sup>80 87</sup> Blood loss is less of a problem when the surgeon dissects the thyroid without transecting it, as shown in Fig. 12. Use of a small armoured



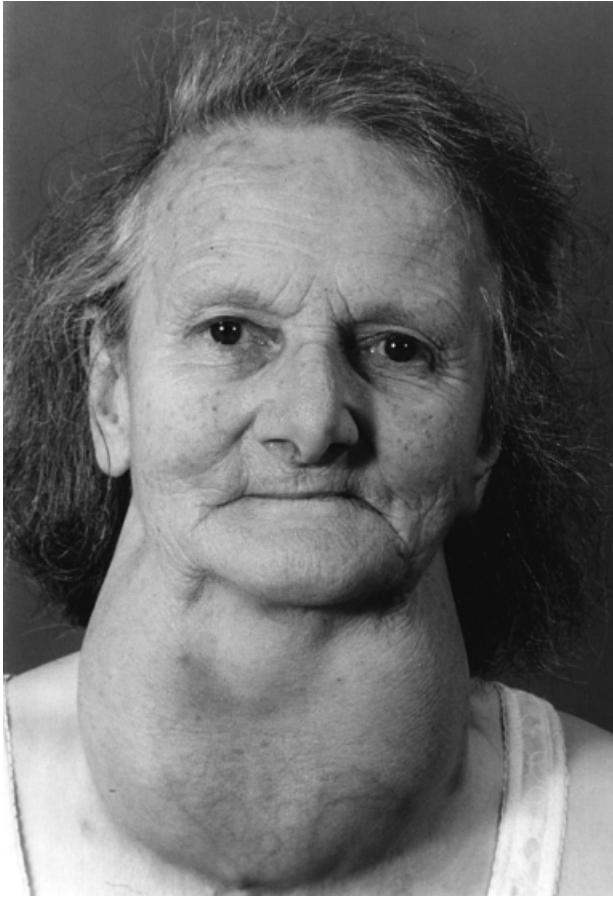


Fig 11 Patient with large goitre.

tracheal tube is recommended to negotiate the compressed and deviated trachea. An armoured tracheal tube is less likely to kink during surgical manipulation, while unarmoured tubes may soften during these prolonged procedures.

#### **Retrosternal** goitre

Retrosternal enlargement of the thyroid can be asymptomatic<sup>71</sup> but usually causes compression of mediastinal structures (Fig. 4). Dyspnoea, choking and hoarseness may occur. Dysphagia is the most common oesophageal symptom but a case has been reported where bleeding from varices was the first presentation of a retrosternal goitre.<sup>4</sup> Superior vena caval syndrome can occur and may be complicated by thrombosis.<sup>78</sup> Retrosternal goitres may also cause cerebral hypoperfusion as a result of arterial compression and thyrocervical steal, phrenic and recurrent laryngeal nerve palsies, Horner's syndrome, pleural effusions, chylothorax and pericardial effusions.<sup>4</sup>

Although some retrosternal goitres are large, the vast majority can be removed by the cervical route.<sup>71</sup> As the surgeon manipulates the retrosternal gland, compression of the trachea can be worsened. During excision of the



Fig 12 Specimen of large goitre; width 15 cm, weight 700 g.

retrosternal goitre shown in Fig. 13, obstructive symptoms were relieved when a retrosternal cyst within the goitre ruptured. Of 21 patients requiring surgery for acute, life-threatening airway obstruction resulting from goitre, only one required sternotomy.<sup>79</sup> Since parathyroid surgery also occasionally requires mediastinal exploration, the endocrine theatre team should be able to perform sternotomy. Dissection in the neck may stimulate the carotid sinus and this, coupled with median sternotomy, can produce profound vagal stimulation leading to bradycardia and even sinus arrest. Tracheal deviation and compression resolve immediately after excision of the goitre, but tracheomalacia should be anticipated when the patient has complained of a goitre of longstanding. Figure 14 shows the appearance immediately postoperatively of the patient in Figs 1 and 4. Note that some tracheal dilation remained above the site of the original compression.

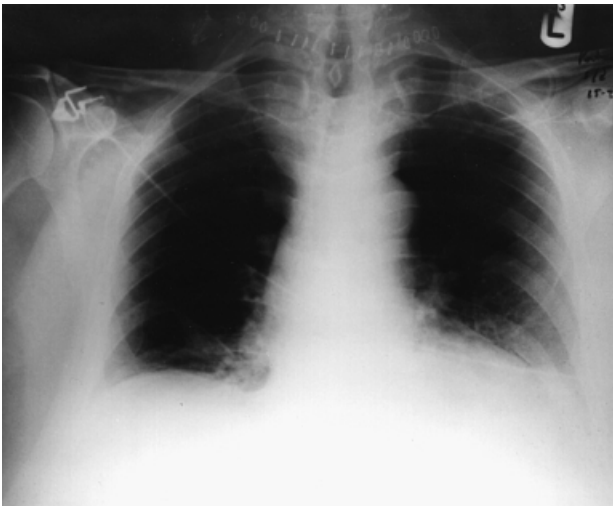
#### *Thyroid cancer*

When thyroidectomy is performed for removal of a thyroid cancer, there is potentially a greater risk of damage to the recurrent laryngeal nerve.<sup>89</sup> Medullary carcinoma may be associated with pheochromocytoma in patients with multiple endocrine neoplasia (MEN) type 2<sup>101</sup> (see 'Hormones and the gut' by Holdcroft, this issue). Medullary and papillary carcinoma spread to local lymph nodes and may require block dissection of the neck. These tumours may involve surrounding tissue, for example, muscle. Follicular carcinoma spreads via the blood to lungs and bone, and metastases can produce thyroxine.<sup>68</sup> Lymphoma is diagnosed by fine needle aspiration or core biopsy and is usually treated by radiotherapy. Anaplastic carcinoma is extremely malignant and usually only palliative radiotherapy is indicated.

Rarely is a patient's condition allowed to progress to severe respiratory distress before surgical intervention is



**Fig 13** Retrosternal goitre with severe tracheal compression.

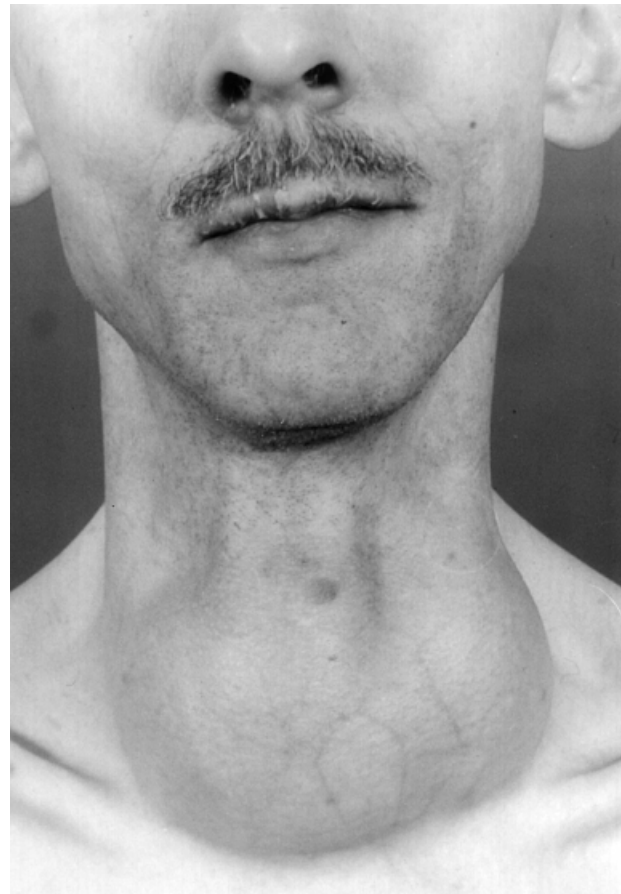


**Fig 14** Post-operative chest x-ray showing immediate recovery of tracheal position.

recommended. Percutaneous dilatational tracheostomy has been performed to relieve severe airway obstruction as a palliative measure.<sup>1</sup> A large neglected thyroid lymphoma with associated supraglottic oedema was managed by controlled tracheotomy following femoro-femoral cardio-pulmonary bypass that had been initiated under local anaesthetic. This is described as the ultimate solution to the problem of a difficult airway!<sup>11</sup>

### *Multiple endocrine neoplasia*

Patients with MEN2 are at risk of early medullary thyroid cancer. Prophylactic thyroidectomy is advocated in children of MEN2 families, who are shown by genetic screening to carry a mutation of a proto-oncogene. Children with



**Fig 15** Patient with medium sized goitre.

MEN2B should have thyroidectomy in the first year of life.<sup>5 92</sup> I have anaesthetized two siblings, aged 10 yr and 8 yr, for prophylactic thyroidectomy. Histopathology revealed islands of pre-malignant cells in the specimen from the younger child.

### *Lingual thyroid*

Embryologically, the thyroid grows from the third and fourth branchial arch and descends from the foramen caecum towards the neck. If its development is arrested, a lingual thyroid may result. This can be diagnosed by thallium or technetium scan and should be treated with respect, as it may be the patient's only thyroid tissue. Furthermore, it may bleed excessively if biopsy is attempted. The presence of a lingual thyroid should alert the anaesthetist to a potential difficult intubation.<sup>26</sup>

### *Concomitant disease*

Patients who require thyroidectomy may have other unrelated diseases that affect their anaesthetic management. Figures 15 and 16 show a patient with a medium sized goitre and minimal neck extension. His chest x-ray (Fig. 17)



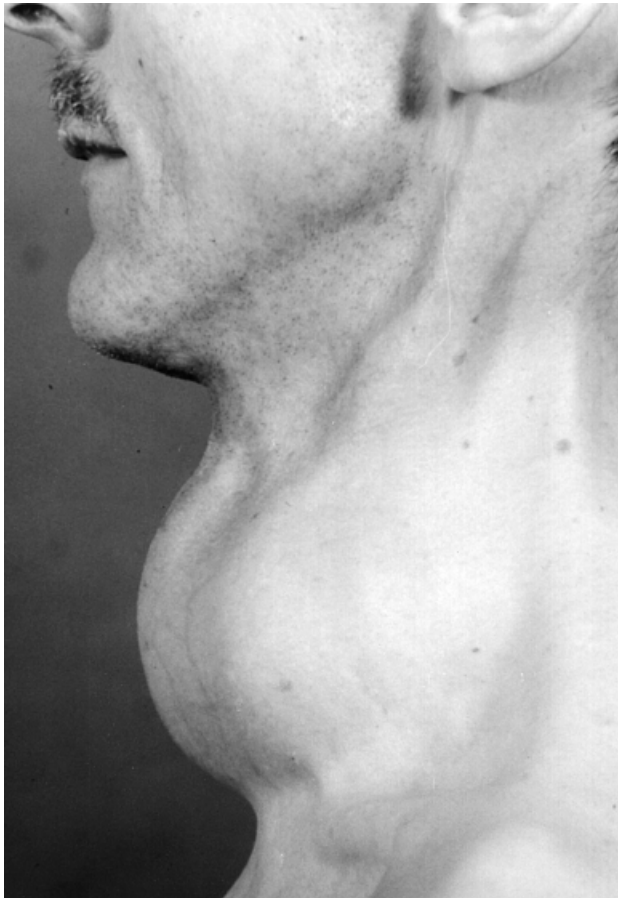


Fig 16 Minimal neck extension.

confirmed the clinical impression of tracheal deviation. Careful inspection of the chest x-ray and the lateral x-ray of his cervical spine (Fig. 18) show the reason for the poor neck extension. This patient had severe ankylosing spondylitis but tracheal intubation was performed relatively easily by the awake fiberoptic technique.<sup>25</sup>

### Postoperative complications

As complications often occur during procedures for recurrent goitre, it is important to eliminate the former practice of 'partial thyroidectomy'. When total thyroidectomy is not indicated then, at least, total thyroid lobectomy should be performed.

### Extubation problems

In general the incidence of respiratory complications at tracheal extubation and in the recovery room is greater than that at intubation.<sup>6</sup> These complications include coughing, oxygen desaturation, laryngospasm and respiratory obstruction. Coughing at extubation should be avoided, but this is often difficult to achieve, particularly if the patient has irritable airways because of smoking<sup>22</sup> or recent respiratory

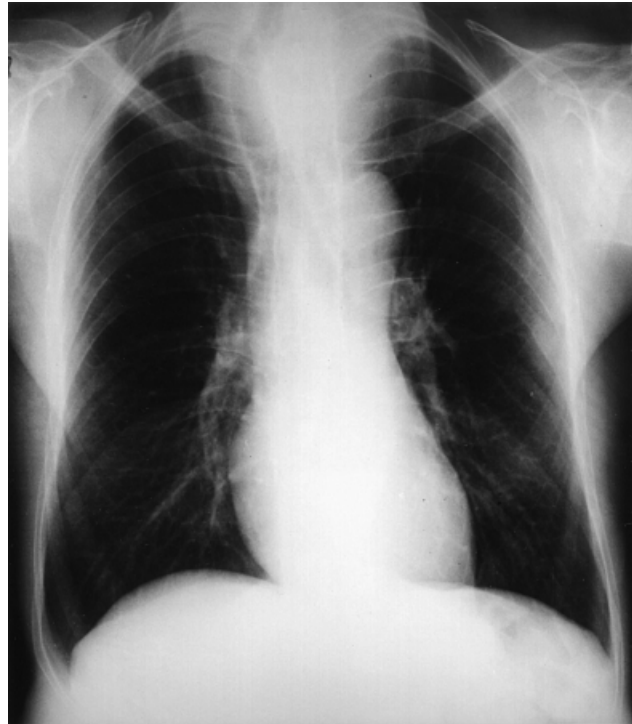


Fig 17 Chest x-ray of patient in Fig. 15 showing tracheal compression and rigid thoracic spine.

tract infection.<sup>69</sup> Upper airway reflex sensitivity decreases with increasing age.<sup>23</sup> Possible preventive interventions include extubation during relatively deep anaesthesia, administration of intravenous narcotics, for example alfentanil<sup>63</sup> and lidocaine. Lidocaine may be administered intravenously<sup>32</sup> or topically,<sup>49</sup> or even prestored in the cuff of the tracheal tube.<sup>40</sup>

### Haematoma

Postoperative haemorrhage is potentially catastrophic when one is operating on the neck, but can be avoided by meticulous haemostasis. The anaesthetist may be asked to maintain the patient's intrathoracic pressure positive for 10–20 s in order to assess haemostasis before wound closure.<sup>74</sup> Recovery ward staff should be experienced at observing the early signs of haematoma formation so that both the surgeon and anaesthetist can be alerted. Traditionally, clip removers were kept at the bedside to enable rapid relief of a haematoma. If it is necessary to re-open the incision to relieve compression of the airway, then it is essential to open all layers.

Repeat surgery for haemorrhage is rare (0.36% of 3008 cases).<sup>51</sup> Prompt decision-making is important and early re-intubation is recommended. The anaesthetic team should be aware of the problems involved in the induction of anaesthesia in a patient for cervical re-exploration. Obviously, the later the intubation is performed, the more difficult it becomes as the haematoma expands and compresses the airway.



**Fig 18** Lateral cervical spine x-ray of patient in Fig. 15 showing typical 'bamboo spine' of ankylosing spondylitis.

Respiratory obstruction may be caused by laryngeal and pharyngeal oedema as a result of venous and lymphatic obstruction by the haematoma, rather than direct tracheal compression. Early re-intubation rather than precipitous re-opening of the incision is the best way to manage this complication (James MFM, personal communication).

#### **Recurrent laryngeal nerve damage**

Good operating technique with routine identification of the recurrent laryngeal nerve greatly minimizes accidental

nerve injury.<sup>37</sup> Injury to the recurrent laryngeal nerve can occur by a number of mechanisms, including ischaemia, contusion, traction, entrapment and actual transection. The incidence of temporary unilateral vocal cord paralysis resulting from damage to the recurrent laryngeal nerve is 3–4%.<sup>30</sup> Permanent unilateral vocal cord paralysis occurs in <1% of patients<sup>51</sup> and bilateral vocal cord paralysis should be extremely rare. There is a greater risk of nerve damage during surgery for malignancy<sup>89</sup> and secondary operations. Anatomical variability<sup>70</sup> and distortions will increase the risk of nerve injury, particularly when the surgeon is inexperienced.

The surgeon may seek reassurance by asking the anaesthetist to observe the movement of the vocal cords at the end of surgery. This may prove difficult as the patient is emerging from the anaesthetic. Rather than using a Mackintosh laryngoscope, vocal cords may be observed using a fibrescope.<sup>59</sup> The LMA may be used to maintain the airway during this procedure.

Attempts to protect the recurrent laryngeal nerve during thyroidectomy have involved detecting vocal cord movement after stimulation of the nerve. Vocal cord adduction causes pressure changes in the inflatable cuff of a tracheal tube placed between the cords.<sup>19</sup> A fiberoptic bronchoscope can be used to observe the vocal cords via an LMA during surgery.<sup>88</sup> Intraoperative electro-physiological monitoring has been performed<sup>21</sup> using a tracheal tube with integrated EMG electrodes positioned at the level of the vocal cords. Succinylcholine is used to intubate the trachea and no further muscle relaxant is used. When the recurrent laryngeal nerve has been identified, the nerve is stimulated with a current of 0.1 mA, increasing in 0.05 mA steps, until an evoked EMG is obtained. While it is unlikely that nerve stimulation will become routine for all thyroidectomies, it may be a useful technique when identification of the recurrent laryngeal nerve is expected to be difficult. However, it is expensive, time-consuming, requires the patient to breathe spontaneously and false-negative responses may occur. Some surgeons are concerned about the effects of repeated nerve stimulation.

Bilateral vocal cord paralysis will lead to stridor at tracheal extubation. Re-intubation will be required and tracheostomy should be considered. Unilateral vocal cord paralysis leads to glottic incompetence, hoarseness, breathlessness, ineffective cough and aspiration. Traditional treatments of vocal cord paralysis include intracordal injection, laryngeal framework surgery, thyroplasty and laryngeal re-innervation. Endolaryngeal vocal cord laterofixation<sup>43</sup> and transcutaneous intracordal silicon injection have been described.<sup>41</sup>

#### **Tracheomalacia**

Tracheal collapse following thyroidectomy results from prolonged compression of the trachea by a large, neglected goitre, particularly within the confines of the thoracic

inlet.<sup>31</sup> The incidence of tracheomalacia will depend on the frequency of this type of goitre. In a prospective study of 103 patients in Khartoum, five patients required tracheostomy for tracheomalacia.<sup>2</sup> It is a life-threatening complication,<sup>35</sup> which should be considered before extubation, and management strategies should be available. The absence of a leak around the deflated cuff of the tracheal tube should alert the anaesthetist to the possibility of tracheomalacia. After intubation, Sinha and colleagues measure the volume of air required to inflate the cuff of the tracheal tube so that an airtight seal is produced. A similar test is performed at the end of the procedure and tracheomalacia can be detected if there is any decrease in the volume required to inflate the cuff to an airtight seal at the end of the procedure.<sup>83</sup>

Management of tracheomalacia requires urgent re-intubation, possibly tracheostomy and some form of tracheal support<sup>31</sup> with, for example, ceramic rings.<sup>3</sup>

### **Laryngeal oedema**

Generalized myxoedema of hypothyroidism may involve the larynx, giving a characteristic hoarse voice. Laryngeal oedema has also been reported as an unusual presentation of thyroid lymphoma.<sup>97</sup> Laryngeal complications of tracheal intubation can be seen during the postoperative indirect laryngoscopy which is performed to identify recurrent laryngeal nerve damage. Oedema and traumatic lesions were noted in 4.6% of patients.<sup>51</sup>

While trauma to the larynx from the tracheal tube will cause minor swelling, laryngeal oedema is a rare cause of post-thyroidectomy respiratory obstruction. In the case reported by Bexton and Radford,<sup>12</sup> laryngeal oedema was associated with a large haematoma; it was postulated that the swelling was secondary to venous obstruction.

### **Hypocalcaemia**

The incidence of hypocalcaemia will depend on the type of surgery performed. After thyroidectomy for large multinodular goitre, temporary hypocalcaemia requiring calcium replacement occurred in 20% of patients. This usually occurs about 36 h postoperatively. Only 3.1% of patients remained permanently hypocalcaemic.<sup>30</sup> Unintentional parathyroidectomy occurred in 11% of a series of 414 thyroidectomies. This might be reduced by more careful inspection of the thyroid capsule.<sup>53</sup>

### **Wound complications**

Wound infection should be a rare complication and a well positioned incision should provide a good cosmetic result. Care should be taken during elevation of skin flaps to avoid damage to the anterior cutaneous nerve of the neck. Damage to this structure produces numbness, which could prove inconvenient, for example to men when shaving.<sup>74</sup>

### **Postoperative nausea and vomiting**

Patients undergoing thyroidectomy are at a high risk for the development of postoperative nausea and vomiting (PONV)<sup>84</sup> and therefore are often used to study the antiemetic properties of drugs. Granisetron,<sup>29</sup> lorazepam premedication,<sup>52</sup> propofol for maintenance of anaesthesia,<sup>84</sup> subhypnotic doses of propofol<sup>24</sup> and positive therapeutic suggestions during neurolept anaesthesia<sup>20</sup> have all been shown to be effective in reducing nausea and vomiting following thyroidectomy.

### **Postoperative pain**

Patients usually tolerate thyroidectomy very well and require minimal postoperative analgesia. They often complain of a stiff neck because of the position during surgery, rather than pain from the site of the incision.

### **Future developments**

There are various pressures upon clinicians to reduce bed occupancy. Thyroidectomy as an outpatient procedure has been described,<sup>56</sup> but patient selection, anaesthetic technique, careful observation before discharge, and community support are key factors in this situation. Interestingly, two of the 203 patients in this series required re-operation for postoperative bleeding.<sup>56</sup>

Minimally invasive techniques have been developed in many surgical subspecialties, including endocrine surgery. Laparoscopic adrenalectomy is widely practised and endoscopic parathyroidectomy has been reported.<sup>65</sup> What of the thyroid gland? Laser-induced reduction of thyroid tissue has been performed on an animal model,<sup>93</sup> but further work needs to be done before this can be used to treat hyperthyroid humans.

### **Summary**

In summary, disease of the thyroid gland is common. Anaesthetists will be required to manage patients with hypothyroidism and hyperthyroidism and those requiring thyroidectomy. Since anaesthesia for thyroidectomy provides many challenges of airway management, the anaesthetist should pay particular attention to preoperative assessment of the airway and should be able to deal with acute airway complications in the perioperative phase.

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