

# Thyroid disease and thyroid surgery

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## Abstract

Thyroid disease remains very common. Knowledge of the implications of these diseases is essential for all anaesthetists as these patients are frequently encountered and may be at risk of complications at any stage, preoperatively, intraoperatively or postoperatively. This article focuses on disorders of thyroid function and their management, thyroid malignancy, surgery of the thyroid gland and the perioperative anaesthetic management of patients undergoing thyroidectomy.

**Keywords** Difficult airway; hyperthyroidism; hypothyroidism; thyroid; thyroid cancer; thyroid function tests; thyroid surgery; thyroidectomy

**Royal College of Anaesthetists CPD Matrix:** 1A01, 1C01, 1C02, 2A01, 2A03

Disease of the thyroid gland has been recognized in history for many thousands of years. Goitres were first described by the Chinese as early as 1600 BC and they were using burnt sponge and seaweed to treat goitres. The first documented evidence of thyroid surgery occurred in Italy in the 12th century but with exceptionally poor results. In 1849, Nikolai Pirogoff first used general anaesthesia for thyroid surgery. This became common practice by the 1920s, yet it was not until the 1940s that general anaesthesia, often combined with local anaesthesia, was successfully established as safe, routine practice for thyroid surgery.

## Thyroid function tests

Thyroid function tests include measurement of serum thyroid-stimulating hormone (TSH), total T4 or T3 and free T4 or T3 concentrations. They can be used to screen for thyroid disease as well as assessing adequacy of levothyroxine therapy and evaluate the treatment of hyperthyroidism. Interpretation of thyroid function tests may be complex and first-line choice of these tests and normal ranges will vary with local arrangements and laboratory protocols. A guide to interpretation is provided in [Table 1](#).

## Hyperthyroidism

In iodine-sufficient areas, thyrotoxicosis occurs in approximately 1.3% of the general population, affecting up to 2% of females compared to 0.2% of males. Disease severity can range from the more common subclinical hyperthyroidism to a life-threatening

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## Learning objectives

After reading this article you should be able to:

- describe the classical features of hyperthyroidism and hypothyroidism
- list five indications for thyroid surgery
- discuss different methods to anaesthetize a patient for thyroid surgery
- discuss six postoperative complications of thyroid surgery and their management

thyroid storm. The clinical manifestations of hyperthyroidism result from excessive tissue and circulating thyroid hormones and an increased sensitivity to circulating catecholamines ([Figure 1](#)).

## Aetiology

Correct diagnosis of the underlying aetiology of hyperthyroidism is essential to the appropriate management of the condition. A normal or high 24-hour radioiodine uptake indicates de novo synthesis of thyroid hormones, primary hyperthyroidism. Primary hyperthyroidism occurs when thyrotoxicosis arises due to an abnormality within the thyroid gland itself and accounts for the majority of cases. The three most common causes include:

- **Graves' disease:** seen most commonly in younger women, this autoimmune disorder accounts for about 75% of cases in the UK. Thyroid-stimulating autoantibodies stimulate thyroid gland growth, hormone synthesis and release and are responsible for thyroid ophthalmopathy and pretibial myxoedema.
- **Toxic multinodular goitre** is the second most common cause in the UK. This occurs as a result of diffuse follicular cell benign hyperplasia that secretes excess thyroid hormone independent to the normal TSH regulation. People at risk are those over 60 years old and living in iodine-deficient areas.
- **Toxic adenoma** approximately accounts for 5% of cases. This occurs as a result of focal follicular cell benign hyperplasia that secretes excess thyroid hormone. This suppresses TSH production that results in suppression of the contralateral thyroid lobe.

Hyperthyroidism with absent radioiodine uptake indicates either extra-thyroidal production or thyroid inflammation and resultant release of hormones as seen in post-radiation or pharmacologically induced thyroiditis which can last up to 1 year post-cessation of amiodarone due to the long half-life. Additionally, long-term lithium treatment can cause hyperthyroidism.

## Management

The mainstay of the therapeutic approach for hyperthyroidism consists of symptomatic relief, decreasing the production of thyroid hormones and in certain circumstances thyroidectomy.

- **Carbimazole** is a prodrug and is rapidly metabolized to methimazole. It acts to inhibit thyroid peroxidase and block oxidation of iodide to iodine. Side effects may include

## Interpreting abnormal thyroid function tests

Serum thyroid-stimulating hormone (TSH) concentration Normal range 0.4–4.5 mU/litre	Serum free T4 concentration Normal range 9.0–25.0 pmol/litre	Serum free T3 concentration Normal range 3.5–7.8 pmol/litre	Common differential diagnoses
Raised	Normal	Normal	Subclinical autoimmune hypothyroidism
Low	Normal	Normal	Subclinical hyperthyroidism Thyroxine ingestion
Raised	Low	Low	Primary hypothyroidism – Chronic autoimmune (Hashimoto's) thyroiditis – Post-radioiodine  – Post-thyroidectomy  – Post-partum, lymphocytic, post-viral transient thyroiditis (late hypothyroid-phase)
Low/normal	Low	Low	Non-thyroid illness Post-drug therapy for hyperthyroidism
Raised/normal	Raised	Raised	Interfering antibodies to thyroid hormones Familial dysalbuminaemic hyperthyroxinaemia Amiodarone Intermittent T4 therapy or T4 overdose Resistance to thyroid hormone TSH-secreting pituitary tumour Acute psychiatric illness
Low	Raised	Raised	Primary hyperthyroidism – Graves' disease – Multinodular goitre – Toxic adenoma Post-partum, lymphocytic, post-viral transient thyroiditis (early hyperthyroid-phase)

Table 1

agranulocytosis, bone marrow suppression, rashes and arthralgia. A euthyroid state is achieved within 3–8 weeks.

- **Propylthiouracil** is used as a second-line agent to those intolerant to carbimazole or those in the first trimester of pregnancy. It inhibits iodination of tyrosine residues in thyroglobulin and inhibits thyroidal conversion of T4 to T3. Side effects may include thrombocytopenia, aplastic anaemia, agranulocytosis and hepatitis.
- **$\beta$ -blockers:** propranolol attenuates symptoms caused by increased  $\beta$ -adrenergic tone and inhibits peripheral conversion of T4 to T3. Side effects may include negative inotropy and chronotropy, bronchospasm, and hypoglycaemia.
- **Radioiodine:** although iodine is required for normal thyroid function, excessive doses of iodine induce damage to DNA leading to thyroid cell death. Following treatment, patients have to follow radioprotection measures that include avoiding contact with pregnant woman and children for 3 weeks. A beneficial preoperative side effect is the reduction in vascularity of the thyroid gland. In severe or recurrent disease radioactive iodine is used to ablate the thyroid.

TSH may remain low after pharmacological treatment for several weeks. Calcium supplementation is recommended to reduce fracture risk.

## Thyroid storm

Although a rare presentation, a thyroid storm may occur in those with long-standing disease precipitated by an acute event such as thyroid or non-thyroidal surgery, trauma, infection, iodine or parturition. Presentation is characterized by severe cardiac, neurological and gastrointestinal symptoms of hyperthyroidism, diaphoresis and pyrexia. With a mortality rate of 10–30% therapeutic management requires prompt recognition, the treatment of any precipitating factors, effective  $\beta$ -blockade (e.g. esmolol), initiation of a thionamide and glucocorticoid (e.g. hydrocortisone 100 mg) and subsequent treatment with iodine. Supportive critical care management, intravenous fluids, active cooling and plasmapheresis may also be considered. Magnesium may be useful in reducing the incidence of cardiac arrhythmias.

## Anaesthesia in hyperthyroidism

In specific circumstances thyroid or urgent non-thyroid surgery may be indicated in patients with uncontrolled hyperthyroidism, as follows.

- If anti-thyroid drugs are poorly tolerated or contraindicated, then surgery may be the preferred first-line option.

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