Parathyroid surgery

Introduction

Prolonged exposure to raised parathyroid hormone and serum calcium can lead to a multitude of systemic symptoms (*Table 1*). It is important to consider hyperparathyroidism in the differential diagnosis of patents with hypercalcaemia. Parathyroid surgery can cure patients with primary hyperparathyroidism and lead to prolonged life expectancy. Surgery can be challenging but safe, with low morbidity and mortality when undertaken by surgeons who specialize in parathyroid surgery.

Table 1. Symptoms and signs of primary hyperparathyroidism

Cardiovascular	Hypertension
	Arrhythmias
Gastrointestinal	Abdominal pain
	Constipation
	Peptic ulcer
	Pancreatitis
Musculoskeletal	Bone pain
	Osteopaenia
	Osteoporosis
	Pathological fractures
	Subperiosteal bone erosions
	Osteoclastoma (brown tumour)
	Osteitis fibrosa cystica
Neuropsychiatric	Fatigue and mood change
	Anxiety
	Depression
	Dementia
	Diminished quality of life
Renal	Renal calculi
	Nephrocalcinosis
	Hyperuricaemia
	Polyuria
	Polydipsia

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The parathyroid glands

Knowledge of the anatomy and embryology of the parathyroid glands is essential to the endocrine surgeon. Their position can be highly variable.

Most individuals have four parathyroid glands, two on each side of the neck. These have a total mass of between 120 and 150 mg and are derived embryologically from the third and fourth branchial pouches, migrating caudally with the thymus gland during development. The superior glands, from the fourth branchial pouch, are located cephalad to the inferior thyroid artery and the inferior glands are caudal.

Primary hyperparathyroidism

Primary hyperparathyroidism is caused by excess production of parathyroid hormone from the parathyroid glands. Its incidence is reported as being between 3 and 30/100 000 people and it is 2–3 times more common in women than men. Primary hyperparathyroidism is rare in children and the incidence peaks between 40 and 70 years.

Clinical presentation varies widely from the asymptomatic to those with severe hypercalcaemia and hypercalcaemic crisis. The symptoms of hypercalcaemia, listed in *Table 1*, are ingrained in medical students with the mnemonic 'bones, stones, moans and abdominal groans'. The commonest presentation is that of an incidental raised serum calcium level on biochemical screening. Diagnosis of primary hyperparathyroidism is confirmed by elevated serum calcium and parathyroid hormone levels; hypophosphataemia is also a common finding. However, there is a small group of patients with primary hyperparathyroidism who have normal serum calcium levels.

Primary hyperparathyroidism can be the result of a solitary parathyroid adenoma (87%), multiple adenomas (3%), parathyroid hyperplasia (9%) and rarely parathyroid carcinoma (1%). Primary hyperparathyroidism can also be found in hereditary syndromes such as multiple endocrine neoplasia.

There is general consensus among endocrine surgeons that surgery is indicated in patients with primary hyperparathyroidism who are less than 50 years of age, have a history of renal calculi, have markedly decreased bone density, have a serum calcium level greater than 2.85 mmol/litre, or are symptomatic. Knowing that long-term exposure to elevated parathyroid hormone and serum calcium is harmful, the threshold for carrying out surgery on asymptomatic patients is being lowered.

Primary hyperparathyroidism and multiple endocrine neoplasia

Familial hyperparathyroidism is seen in multiple endocrine neoplasia types 1 and 2a. Multiple endocrine neoplasia 1 is associated with tumours of the anterior pituitary and pancreas, and 95% of patients with multiple endocrine neoplasia 1 will develop primary hyperparathyroidism. Parathyroid disease is less common in those with multiple endocrine neoplasia 2a, it occurs with medullary cancer of the thyroid and phaeochromocytoma.

Secondary hyperparathyroidism

Secondary hyperparathyroidism is the excess production of parathyroid hormone as a result of factors external to the parathyroid glands; patients are commonly normo-calcaemic. The most common cause in the UK is chronic renal failure and the phenomenon is sometimes called 'renal hyperparathyroidism'.

Many patients are asymptomatic. Symptomatic patients may present with osseous lesions, pruritus and metastatic calcification.

Treatment of secondary hyperparathyroidism is primarily medical and parathyroid surgery is indicated in those refractory to medical management.

Tertiary hyperparathyroidism

Tertiary hyperparathyroidism is rare. It occurs in patients with chronic renal failure who have undergone renal transplant. Parathyroids, previously driven by constant hypocalcaemia secondary to the hyperphosphataemia of chronic renal failure, continue to autonomously produce excess parathyroid hormone.

After transplantation hypercalcaemia resolves in 50% of patients within 1 month,

85% within 6 months and 95% after 6 months. Surgery is only indicated in those with persistent hypercalcaemia lasting more than 12 months.

Imaging and localization

Bilateral neck exploration has traditionally been the gold standard in surgery for primary hyperparathyroidism, curing 95% of cases when undertaken by an experienced surgeon.

The improved sensitivity and specificity of localization studies, along with the use of intraoperative parathyroid hormone assays, allows a more focused approach to surgery. *Figure 1* demonstrates a classically positioned parathyroid adenoma while *Figure 2* shows the benefit of preoperative localization. The localization tools that can be used are listed in *Table 2*.

Preparation for surgery

Preoperative management is dependent on the degree of hypercalcaemia and pre-existing co-morbidities. Patients with severe hypercalcaemia (>3 mmol/litre) should be treated with intravenous fluid rehydration and bisphosphonates. Pre-existing vocal cord palsy should be documented by performing nasendoscopy on all patients undergoing parathyroid surgery.

Conventional approach to the parathyroids

The patient is positioned on the table with the neck extended with a head ring and a 'sand bag' placed between the shoulder blades.

A transverse collar incision is made, preferably in a natural skin crease, superior to the suprasternal notch.

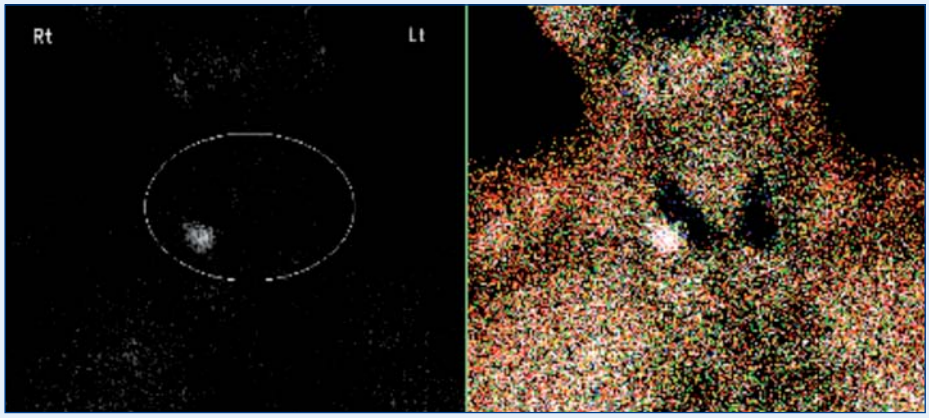

Figure 1. Sestamibi scan of a solitary parathyroid adenoma located at the lower pole of the right thyroid lobe.

Table 2. Parathyroid localization modalities

Modality	Advantages	Disadvantages
Ultrasound	Cheap Readily available	Operator dependent Poor for ectopic glands
Technetium-sestamibi scan (Sestamibi)	Best localization modality Localization of ectopic glands	Poor in hyperplasia
Thallium-technetium scan	Lower radiation than sestamibi	Poor anatomical detail
Single proton emission computed tomography	Greater anatomical detail than sestamibi	Availability
Magnetic resonance imaging	Localization of ectopic glands No need for radiation or contrast	Expensive
Parathyroid angiography and selected venous sampling	Precise anatomical localization Good in hyperplasia and multiple adenomas	Invasive Contrast nephropathy

Skin and platysmal flaps are raised to the level of the thyroid notch superiorly and the suprasternal notch inferiorly. The pretracheal fascia and strap muscles are divided in the midline and dissected off the underlying thyroid lobes. The middle thyroid veins may need to be divided with medial traction on the thyroid lobes aiding in identification of the inferior thyroid artery and recurrent laryngeal nerve before localization of the parathyroid glands (*Figure 3*). *Figure 4* show the parathyroid adenoma after excision.

Figure 5 shows a management strategy based upon the surgeon's findings.

Intraoperative frozen section can help identify parathyroid tissue but will not differentiate adenoma from hyperplastic glands. Intraoperative parathyroid hormone assay techniques can help confirm successful parathyroidectomy.

Figure 2. Sestamibi scan of an ectopic parathyroid adenoma within the left mediastinum.

Figure 3. Intraoperative image of a right lower parathyroid adenoma immediately lateral to the recurrent laryngeal nerve.

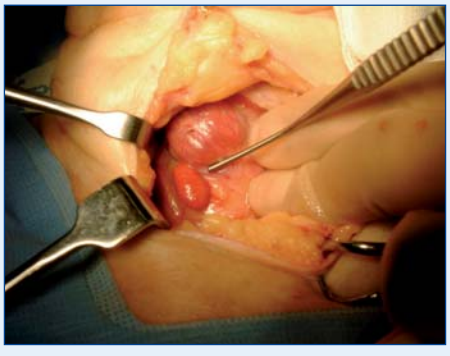

Figure 4. Solitary parathyroid adenoma.

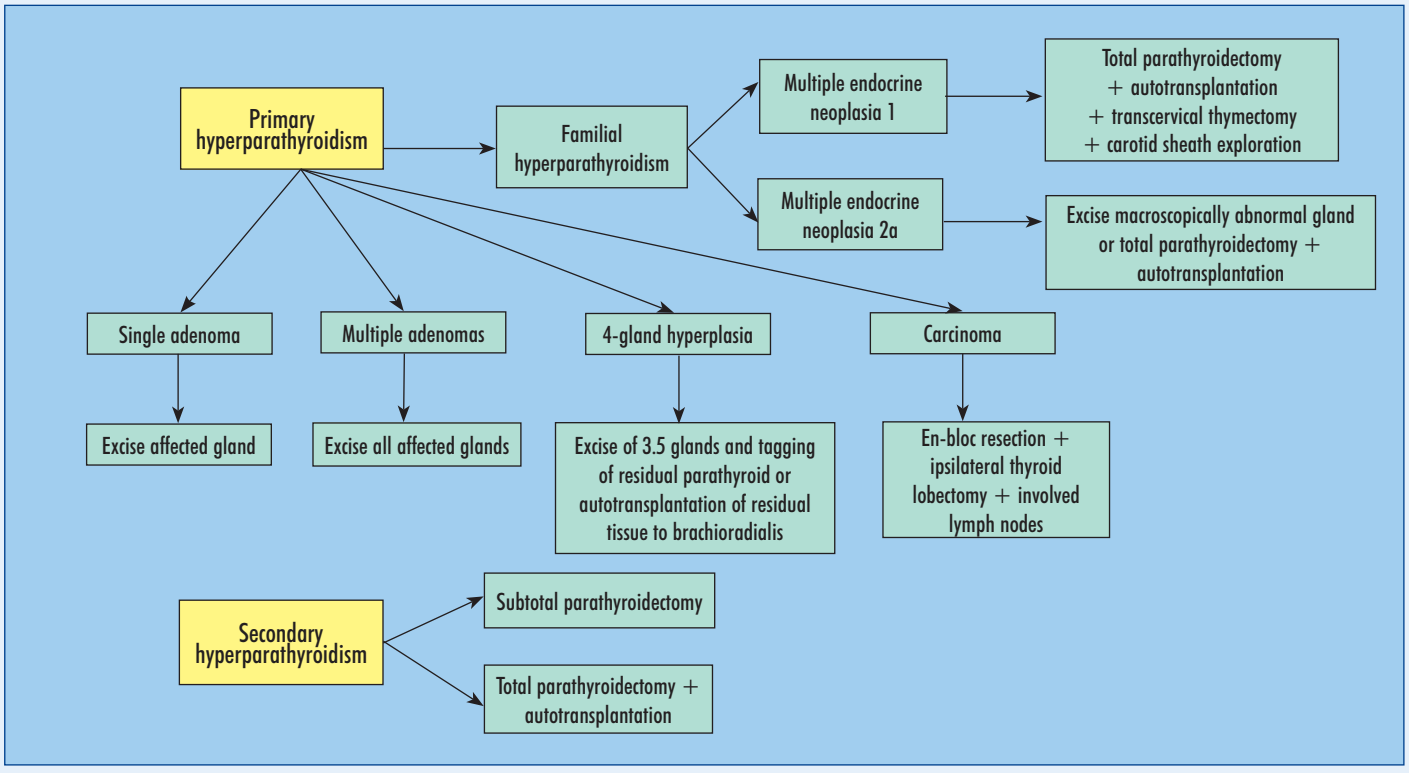

Figure 5. Surgical management of primary and secondary hyperparathyroidism.

If the surgeon fails to identify an abnormal parathyroid gland or fewer than four glands are found then ectopic glands are searched for. The common sites examined are: posterior and lateral to the oesophagus, thyrothymic ligament, thymus, carotid sheath and within the thyroid gland.

Focused approaches to the parathyroids

These are becoming increasingly popular and involve localization and targeting of a specific gland.

In open minimally invasive parathyroidectomy a 2–4 cm incision is made. The superior parathyroids can be approached via the anterior border of the sternocleidomastoid and the inferior glands at the level of the suprasternal notch.

For minimally invasive radio-guided parathyroidectomy the use of an intraoperative gamma probe following radio-isotope injection determines the position of incision.

Endoscopic parathyroidectomy can use several endoscopic approaches and parathyroidectomy has been successfully performed in the neck and mediastinum. Ports can be placed strategically in the neck, axilla or anterior chest wall.

Complications

Parathyroid surgery is generally a safe procedure with potential complications listed in *Table 3*. It is important to remember that postoperative haematoma can lead to acute respiratory distress and the assessing clinician should be prepared to remove the sutures or clips on the ward if there is not time to return the patient to theatre.

It is common to achieve a cure at the first operation. Re-operative parathyroid surgery is technically more demanding and referral to a surgeon experienced in this should be considered.

Conclusions

Parathyroid surgery can be curative in patients with primary hyperparathyroidism, improving quality and quantity of life. The risks of surgery are acceptably low when carried out by a specialist surgeon. BJHM

Table 3. Complications of parathyroid surgery

Recurrent laryngeal nerve injury
Postoperative haemorrhage
Failure to achieve biochemical cure
Keloid or hypertrophic scarring
Permanent hypoparathyroidism
Recurrent hyperparathyroidism

Conflict of interest: none.

Further reading

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KEY POINTS

- Surgery in hyperparathyroidism can be curative.
- Treatment of hyperparathyroidism can increase life expectancy.
- Morbidity and mortality of surgery is low.
- Localization can be very helpful in managing hyperparathyroidism.
- Re-do parathyroid surgery should be undertaken by a surgeon experienced in this field.