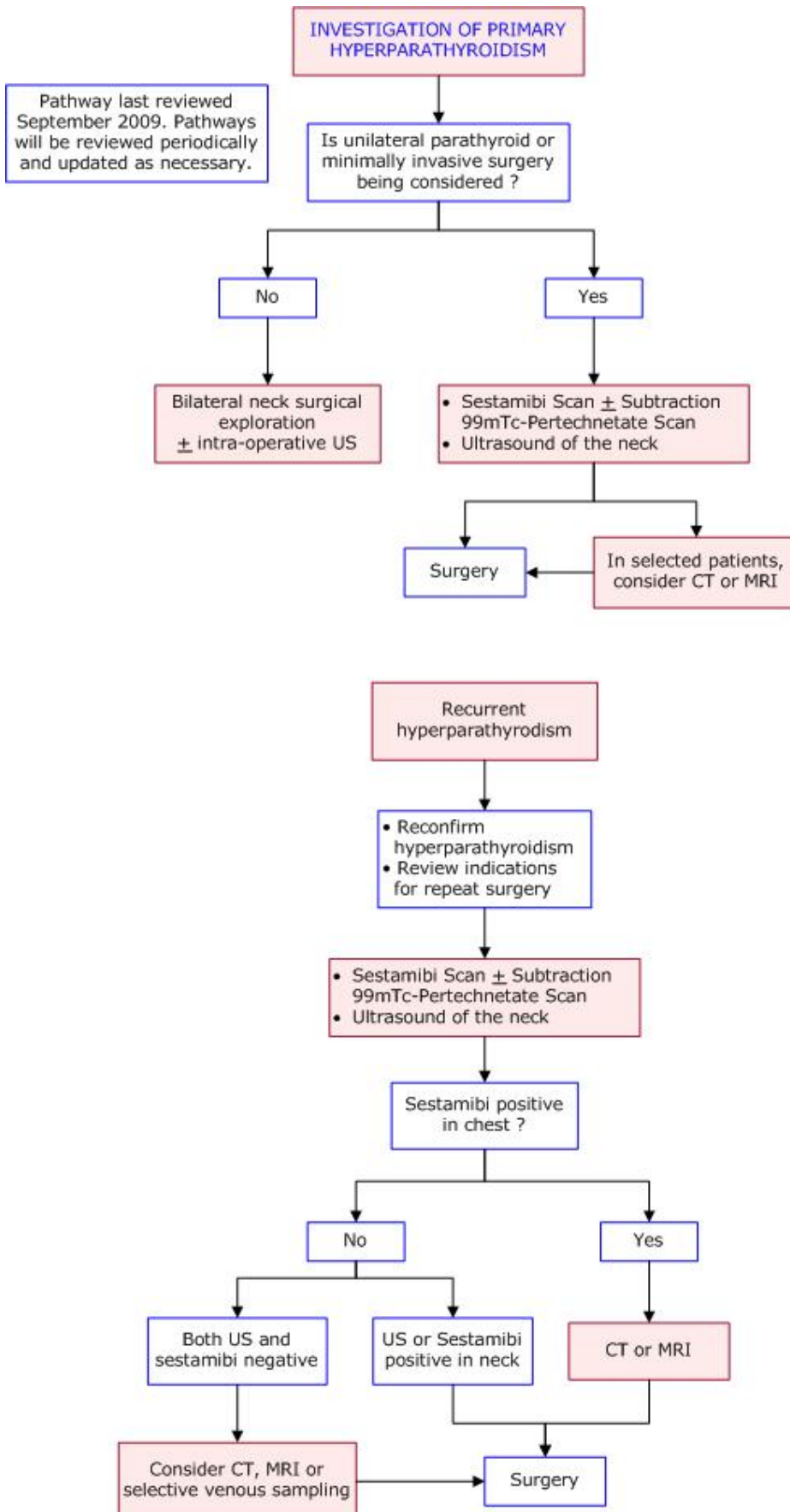




## DIAGNOSTIC IMAGING PATHWAYS

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## PRIMARY HYPERPARATHYROIDISM

- Primary hyperparathyroidism is an endocrine disorder resulting from the autonomous functioning of one or more parathyroid glands. [1](#)
- The causes of primary hyperparathyroidism include a single parathyroid adenoma (80-85%), parathyroid hyperplasia (10-15%), multiple adenomas (2-3%), and very rarely, parathyroid adenocarcinoma (<1%). [1](#)
- The role of imaging for preoperative localisation of the parathyroid glands remains controversial. [1](#)
- Traditionally, bilateral neck exploration with direct visualisation and evaluation of all four parathyroid glands has been the primary surgical method for treating primary hyperparathyroidism, with success rates >95% in experienced hands. Therefore, pre-operative localisation studies were not usually necessary. [2](#)
- Increasingly, surgeons prefer pre-operative imaging, especially when considering minimally invasive surgery. [1,2](#)
- Imaging is usually required when there is recurrent disease as the success rates for repeat bilateral neck exploration after an initial failed surgery may be as low as 60%. In such cases of recurrent or persistent hyperparathyroidism, localisation studies have improved the ability to identify the site of the remaining abnormal parathyroid tissue. [3,4](#)
- The main advantages of pre-operative imaging are:
  - The potential to reduce the time in surgery. [5,6](#)
  - The ability to limit surgical exploration to the affected side. [7,8](#)
  - The detection of ectopic abnormal parathyroid glands. [9](#)
- Technetium Tc-99m sestamibi imaging and sonography have been the most widely used imaging techniques for the localisation of parathyroid adenomas. [1](#)
- Invasive procedures such as selective venous sampling and selective angiography are expensive and technically difficult and therefore rarely used. [10](#)
- Image-guided biopsy is performed in cases where percutaneous ethanol ablation as a first line therapy is considered or when the results of imaging procedures are equivocal. [11](#)
- **Note:** It is important to consider and exclude Familial Hypocalcaemic Hypercalcaemia (FHH) in mild cases of primary hyperparathyroidism. FHH does not require surgery and is a major cause of "failed" neck exploration in primary hyperparathyroidism.

## SESTAMIBI AND SUBTRACTION PERTECHNETATE SCAN

- Used for pre-operative localisation of abnormal parathyroid glands in the following cases:
  - Where minimally invasive surgery is intended. [13,14](#)
  - Recurrent or persistent hyperparathyroidism. [3,12](#)
  - Difficult cases. [15](#)
- Includes the neck and the mediastinum for detection of ectopic abnormal parathyroid glands. [9](#)
- High sensitivity (50-75%) and specificity (>90%) for the detection of abnormal parathyroid glands. [16-19](#)

- Correlating the functional imaging provided by sestamibi scan with a technique with superior anatomical resolution such as SPECT, SPECT-CT, US, CT or MRI improves the sensitivity for detection of abnormal parathyroid tissue. [12,13,16,17,22,23](#)
- Sestamibi accumulates in both parathyroid tissue and thyroid nodules and anatomical localisation of the abnormality is based on washout properties. [21](#)
- <sup>99m</sup>Tc-pertechnetate is a thyroid selective radioisotope that can be used in combination with sestamibi. It is especially useful in patients with suspected or known thyroid disease or previous thyroid surgery. Digital subtraction methods can be used as an aid in identifying sestamibi accumulation due to abnormal parathyroid tissue. [21,22,23](#)
- Limitations:
  1. Relatively poor image resolution and anatomical information (compared to US, CT or MRI). [17](#)
  2. False negatives can occur in patients with small adenomas and with hyperplasia. [16](#)

## ULTRASOUND

- Used for identification and localisation of parathyroid adenomas in patients with primary hyperparathyroidism who undergo minimally invasive surgery. [7,8,13](#)
- Its sensitivity for detecting parathyroid neoplasms ranges between 36% to 78%. [8,13,16,17](#) In view of this, many authors now propose the use of ultrasound in combination with another imaging modality, most commonly scintigraphy. [24](#)
- Advantages: [20](#)
  - Superior anatomical resolution (provides more detailed information of adenoma characteristics and relationships to other structures in the neck).
  - Useful in evaluation of thyroid abnormalities.
  - Relatively inexpensive.
  - Does not emit ionising radiation.
- Limitations: [20,24](#)
  - Inability to localise the small percentage (2%) of parathyroid adenomas, particularly intrathyroidal, deeply located and ectopic mediastinal lesions.
  - Low sensitivity in recurrent or persistent primary hyperparathyroidism.
  - Operator dependent and subjective.

## INTRAOPERATIVE ULTRASOUND

- May be useful in difficult cases and may limit the extent of dissection in a previously operated field. [11](#)
- Inexpensive, noninvasive and reproducible option in the operating room if expert sonographers are available. [25](#)

## COMPUTED TOMOGRAPHY AND MAGNETIC RESONANCE IMAGING

- CT and MRI of the neck and mediastinum are generally considered second line investigations in the assessment of primary hyperparathyroidism, following on from equivocal or negative ultrasound or nuclear medicine studies. [24](#)
- Their main advantage is superior spatial resolution and the detailed anatomical localisation of ectopic mediastinal lesions for surgical planning. [24](#)
- The sensitivity of CT for preoperative localisation of abnormal parathyroid tissue ranges from 78% to 86%. [25-27](#)
- MRI demonstrates similar sensitivity ranging from 71% to 92%. [28-30](#)
- These modalities are particularly useful for persistent or recurrent hyperparathyroidism when more detailed surgical planning is required to minimise the risks associated with repeat surgery and to improve the chances of successful treatment. [31](#)
- The disadvantages of these studies include:
  1. Exposure to ionising radiation with CT
  2. The use of intravenous contrast

## SELECTIVE VENOUS SAMPLING

- Selective venous sampling is an invasive procedure which is generally only considered in the preoperative localisation of abnormal parathyroid tissue for recurrent or persistent hyperparathyroidism when non-invasive imaging methods have failed. [33](#)
- It involves selective cannulation of cervical and mediastinal veins to sample venous PTH levels. Local elevations of serum PTH compared to peripheral levels allow target areas to be defined for surgery (at least a two-fold gradient is required). Therefore, the effectiveness of this procedure depends upon production of PTH by the parathyroid glands and not on their size. [33](#)
- In the setting of recurrent or persistent hyperparathyroidism, the sensitivity for the localisation of abnormal parathyroid tissue ranges from 80 to 94% and the specificity from 85 to 100%. [33-34](#)
- The disadvantages of selective venous sampling include its
  1. Invasiveness with risks of haemorrhage and infection
  2. Exposure to ionising radiation and intravenous contrast

## RECURRENT HYPERPARATHYROIDISM

- The incidence of persistent or recurrent disease following surgery for hyperparathyroidism is 5-10%. [31](#)
- In such cases, the diagnosis of primary hyperparathyroidism should be re-confirmed and the indications for surgery should be reviewed. [31](#)
- Preoperative localisation is required in patients being considered for repeat surgery to more precisely define the site of abnormal parathyroid tissue and to minimise the risks associated with repeat surgery due to fibrosis.
- Preoperative localisation improves the success rate from 60 to more than 95%. [32](#)
- It is still debated which combination of imaging modalities represents the optimum assessment. However, most agree that at least two modalities should be performed, one of which should be a sestamibi scan. [31](#)

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### Website

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