Imaging in endocrinology

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Abstract

Imaging is increasingly becoming an integral part of the management of endocrine disease. Many endocrine conditions require a combination of biochemical investigations, anatomical imaging (ultrasound, computed tomography, magnetic resonance imaging) and/or functional imaging (scintigraphy, positron emission tomography) to fully evaluate the patient and plan therapeutic interventions. Here, we present an overview of the techniques employed and give a brief summary of the indications for each. The significance of the imaging findings described in radiological/nuclear medicine reports is also highlighted.

Keywords Adrenal; endocrine imaging; MRCP; parathyroid; pituitary; thyroid

Key points

- Endocrine imaging requires close liaison between clinical teams, radiologists and nuclear medicine physicians for optimal results
- The high prevalence of incidental thyroid and adrenal nodules discovered by chance means a careful risk-based assessment is required, rather than surveillance or sampling in every case
- Multimodal imaging is often required to determine the functional and anatomical characteristics of a lesion

Introduction

The imaging of endocrine disease has advanced significantly in recent years, and it is important for clinicians to be familiar with the indications for imaging, and the possibilities and limitations of each technique.

Thyroid imaging

Thyroid nodules are easily studied using ultrasound, which can provide important clues to the likelihood that a lesion is benign or malignant. The British Thyroid Association has published an ultrasound classification of thyroid nodules (Table 1)[1] to guide management (Figure 1).[1] Under this classification, grade U1 and U2 nodules do not require fine needle aspiration (FNA) or follow-up imaging in the absence of concerning clinical features. Grade U3 and above nodules require further investigation, typically with FNA and cytology.

Thyroid scintigraphy plays an important role in providing functional information in various thyroid disorders. ^{99m}Technetium pertechnetate is the most common radionuclide tracer in clinical use. ^{123}Iodine has a higher specificity and sensitivity for thyroid imaging but is not widely used because of the high cost. ^{131}Iodine is used mainly for the treatment of thyroid carcinoma; imaging can be performed concurrently to assess residual thyroid tissue. A hot nodule (Figure 2) on a scintigram favours a benign nature (>90% of patients), whereas a non-cystic cold nodule (Figure 3) should prompt sampling.

Parathyroid imaging

In recent years, minimally invasive parathyroidectomy has become the surgical operation of choice for patients with hyperparathyroidism caused by a solitary parathyroid adenoma. Imaging is an integral part of the preoperative assessment to

Ultrasound (U) classification of thyroid nodules

U1 (normal)
- No nodules

U2 (benign)
- Hypoechoic or isoechoic with a halo
- Cystic change with ring-down artefact (colloid)
- Microcystic or spongiform appearance
- Peripheral eggshell calcification
- Peripheral vascularity

U3 (indeterminate)
- Solid, homogenous, markedly hyperechoic nodule with halo (follicular lesions)
- Hypoechoeic with equivocal echogenic foci or cystic change
- Mixed or central vascularity

U4 (suspicious)
- Solid hypoechoic (compared with thyroid)
- Solid very hypoechoic (compared with strap muscles)
- Hypoechoic with disrupted peripheral calcification
- Lobulated outline

U5 (malignant)
- Solid hypoechoic with lobulated or irregular outline and microcalcification — papillary carcinoma
- Solid hypoechoic with lobulated or irregular outline and globular calcification — medullary carcinoma
- Intranodular vascularity
- Taller than wide axially (AP>TR)
- Characteristic associated lymphadenopathy

Adapted from Perros et al.[1]

Table 1

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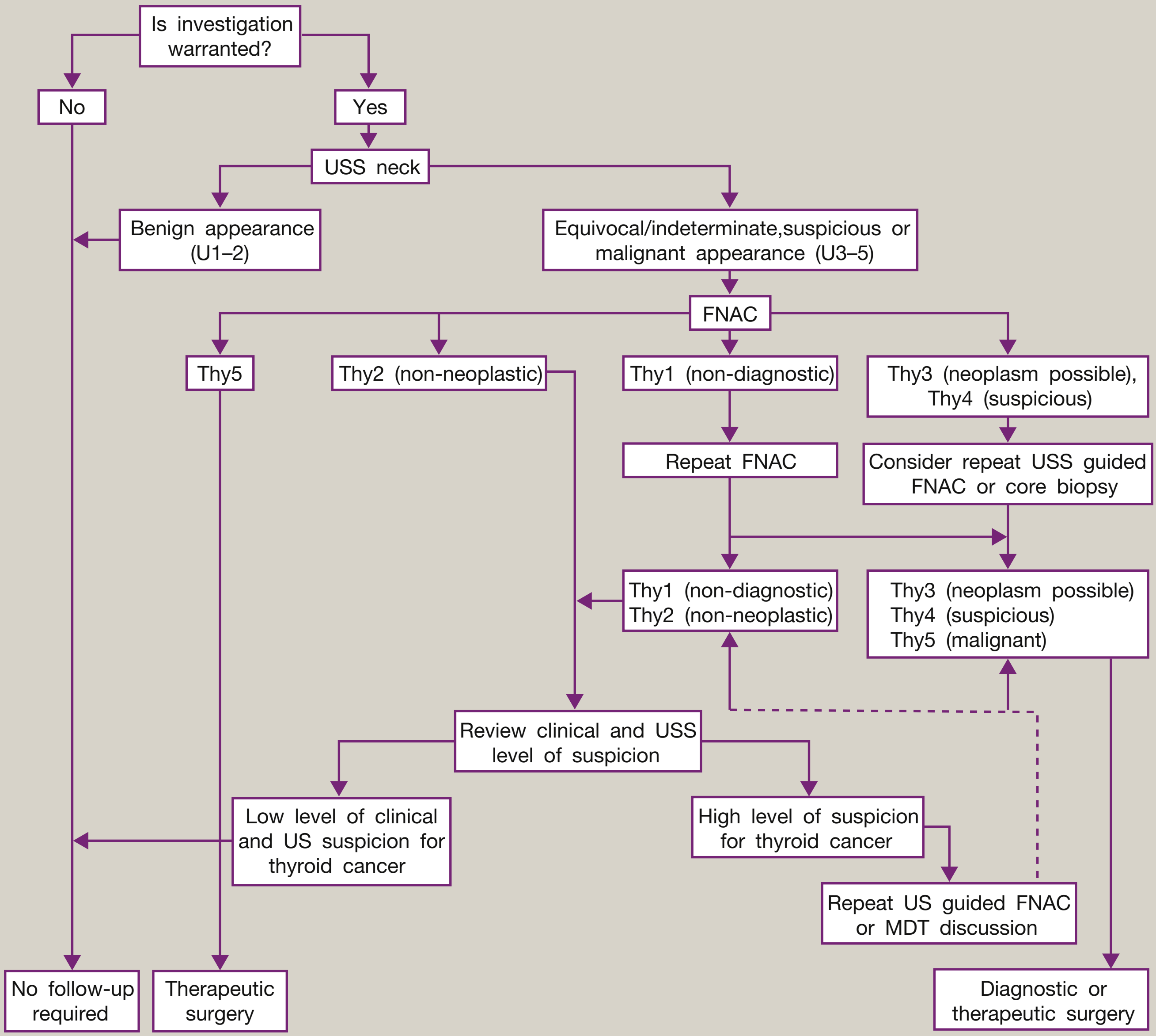
Flow diagram describing investigation and management of thyroid nodules



MDT, multidisciplinary team; FNAC, FNA and cytology; USS, ultrasound.
Source: Adapted from Perros et al.[1]

Figure 1

identify the exact location of the adenoma. However, it is important to note that currently no single imaging modality reliably identifies or excludes multiglandular disease.

Dual phase ^{99m}Tc-sestamibi (MIBI) is the most commonly employed technique. This images the neck and mediastinum at two time points (10 and 120 minutes) after tracer administration (Figure 4). The use of single photon emission computed tomography (SPECT) has improved the accuracy of this method, especially when combined with computed tomography (CT) as SPECT-CT.

The sensitivity of this modality to detect a solitary parathyroid adenoma ranges from 68% to 95%. However, the sensitivity for detecting parathyroid hyperplasia and multiglandular disease is much lower, at around 44% and 30%, respectively. SPECT-CT fusion imaging can further improve anatomical localization of the lesion (88–93%) (Figure 5).

Positron emission tomography (PET)-CT using ^{11}carbon-labelled methionine has been used in parathyroid imaging. Its sensitivity is comparable to MIBI SPECT-CT, and it can be used in a complementary role if MIBI SPECT-CT is inconclusive. As with

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