

# IMAGING THYROID CANCER

PIERRE VASSALLO

There are four main types of thyroid cancer: papillary, follicular, medullary and anaplastic types. Papillary and follicular cancers are well-differentiated cancers that originate from the thyroid follicle. They are the more common types of thyroid cancer, accounting for 80% and 10% of cases, respectively.<sup>1</sup>

Most clinically and ultrasound-detected thyroid nodules are benign, many representing purely cystic lesions known as colloid cysts. Solid or partly solid nodules however, should be further investigated since approximately one in four will be malignant.

Although differentiated thyroid cancers are generally slow growing, lymph node metastases are present in 30-80% of cases at the time of first diagnosis.<sup>2</sup> The outcome of treatment is good with a 98% 5-year survival,<sup>3</sup> but these results depend on proper surgical treatment.

The presence of lymph node metastases is the most common cause of thyroid cancer recurrence. Since most recurrences occur within the first five post-operative years, they may likely result from inadequate detection and resection at the time of initial management.<sup>4</sup> Physical examination has shown poor accuracy in detection of lymph node metastases. Accurate staging of thyroid cancer depends on meticulous ultrasound evaluation and detailed reporting, which are crucial for accurate surgical planning.

## NECK ANATOMY

To ensure a clear communication between the radiologist and the surgeon, we share a common nomenclature for indicating the location of abnormal ultrasound findings. The neck is divided into seven levels as shown in figure 1. The aim is to standardise terminology related to surgical dissections for head and neck cancer.

Level VI is considered the central compartment and it contains the thyroid gland; it is bordered by the hyoid bone superiorly, the carotid arteries and sternocleidomastoid muscles laterally and the sternal notch inferiorly. This is the most common site for lymph node metastases and cancer recurrence.

The lateral compartment is mainly composed of levels II-VI with levels I and VI being less frequently involved; metastatic disease in this compartment is associated with a worse prognosis.

## SURGICAL TECHNIQUE

There are multiple surgical procedures that can be performed to treat thyroid cancer; the aim however is to excise all locations of disease, as surgical excision is the most effective mode of therapy.

All solid or partly solid nodules require biopsy. This consists of a fine needle aspiration (FNA) that is performed under ultrasound guidance. Biopsy-confirmed malignant nodules are excised and the surgical approach depends on the location and number of malignant nodules found.

Unilateral nodules  $\leq 1$ cm in diameter are treated with thyroid lobectomy, while nodules  $>4$ cm in diameter require a total thyroidectomy. For solitary nodules measuring 1-4cm in diameter with no lymph node metastases, a thyroid lobectomy is usually performed although some surgeons prefer to perform a total thyroidectomy. For bilateral malignant nodules and in the presence of regional or distant metastases a total thyroidectomy

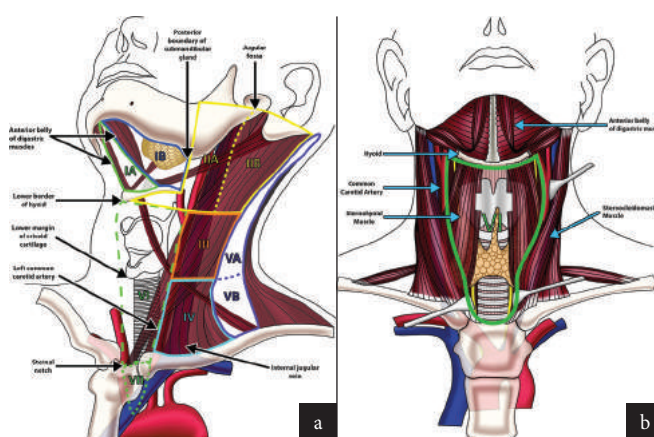
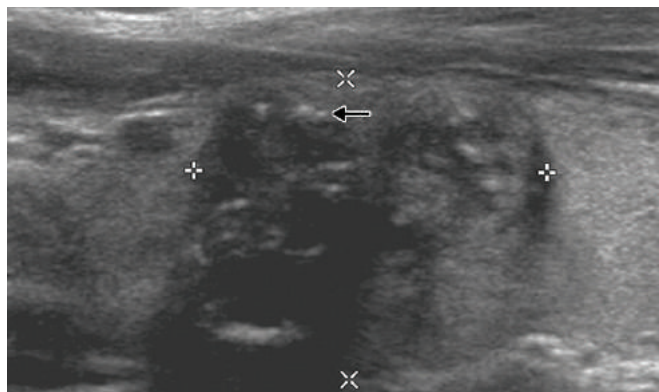


Figure 1a: Diagram shows the boundaries of the different levels of the neck. (b) An anterior view shows the boundaries between the central and lateral compartments.



**Figure 2.** Sagittal scan through the left thyroid lobe shows a papillary thyroid cancer seen as an ill-defined nodule (between callipers) containing microcalcifications (black arrow).

is required along with resection of any lymph node metastases. In the case of extracapsular invasion by thyroid cancer into adjacent structures (e.g. strap muscles of the neck), the involved structures must also be excised.

The risks of total thyroidectomy include bilateral recurrent laryngeal nerve paralysis and permanent hypocalcaemia due to parathyroid gland damage.

Proper lymph node dissection is key for reducing the risk of recurrence. The nomenclature used for lymph node dissection depends on the extent of dissection performed. A radical lymph node dissection involves resection of level I-V lymph nodes, the sternocleidomastoid muscle, the jugular vein and the superficial accessory nerve, while an extended radical dissection includes excision of any further involved structures. If any structures are retained, such as the jugular vein, the procedure is called a modified (or selective) radical dissection.

The term central compartment neck dissection refers to removal of all involved structures and lymph nodes in level V, while a lateral compartment neck dissection includes dissection of involved structures and lymph nodes in levels II-V.

### ULTRASOUND TECHNIQUE

During the ultrasound scan, the whole thyroid gland and all potential areas of metastatic disease must be evaluated. All abnormalities must be described in detail based on their

Ultrasound Findings	Size (cm)	Malignancy Risk (%)
Nodule with microcalcifications	≥1	>70-90
Solid nodule		
Hypoechoic with suspicious features	≥1	>70-90
Hypoechoic without suspicious features	≥1	10-20
Isoechoic or hyperechoic	≥1.5	5-10
Mixed cystic and solid nodule		
Suspicious features in solid component	≥1	>70-90
Without suspicious features	≥1.5	5-10
Spongiform without suspicious features	≥2	<3

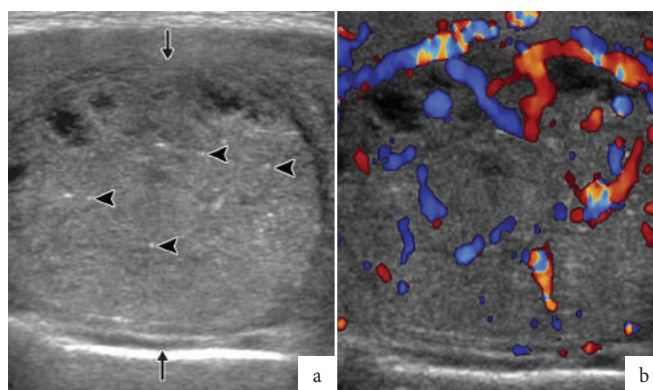
**Table 1.** Relation between suspicious features and malignancy risk

morphology and size, and their locations mapped according to the levels described above. Accurate description of the morphology and location of all foci of disease is crucial for guiding completed excision to reduce the risk of recurrence.

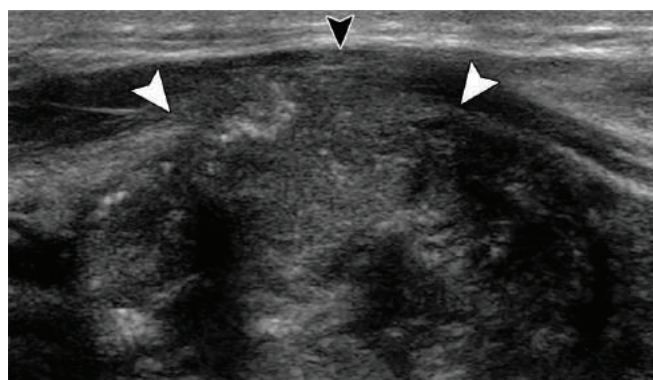
There are some features that increase the level of suspicion when assessing thyroid nodules. A purely cystic lesion with a thin wall and no solid component is benign and does not require any follow-up. All solid or partly solid nodules with suspicious features and measuring ≥1cm in diameter require FNA evaluation. Ultrasound must also identify bilateral location of nodules, extracapsular extension (e.g. strap muscles) and retrosternal extension. Retrosternal extension should be further evaluated with computed tomography (CT) to detect extent of direct extension and the presence of mediastinal lymph node metastases.

Suspicious features in a thyroid nodule include a size ≥1cm, solid components, a shape that is taller than wide, irregular or lobulated margins, microcalcifications, interrupted rim calcifications, extra-thyroid extension into adjacent structures and presence both peripheral and central vascularity.

The presence of microcalcifications is highly suggestive of malignant disease having a sensitivity of 89%, a specificity of 95% and an accuracy of 94% (Figure 2). Other features such as size, shape, irregularity of margins, extra-thyroid extension (Figure 3 and 4) and central vascularity are all important when planning FNA procedures. Table 1 shows how suspicious features relate to the risk of malignancy as taken from the American Thyroid



**Figure 3.** (a) Sagittal image through the left thyroid lobe containing a papillary thyroid cancer with well-defined margins (arrows), microcalcifications (arrowheads) and (b) central + peripheral vascularity.



**Figure 4.** Sagittal image of the right thyroid lobe showing extracapsular extension (between white arrowheads) of cancer into the anterior strap muscle (black arrowhead).



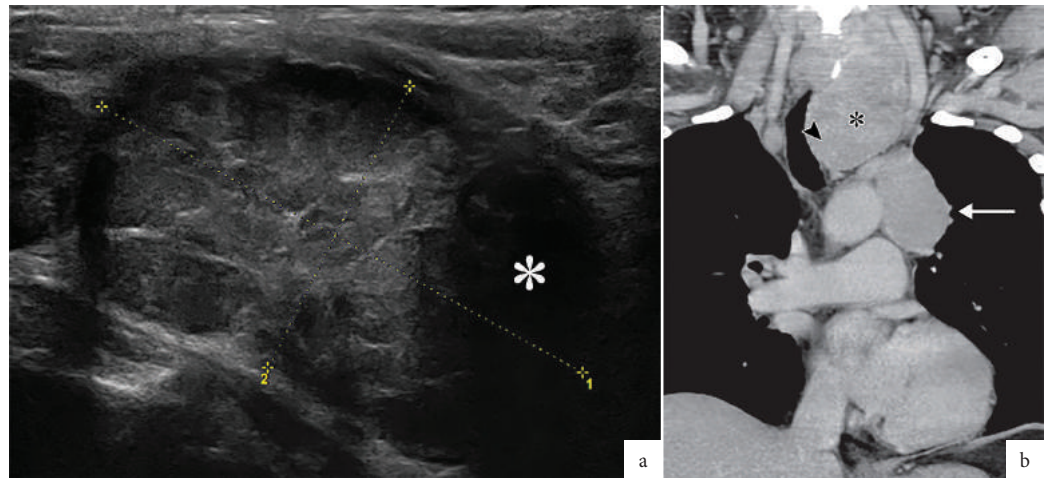
Association consensus report of 2015.<sup>5</sup> Detailed evaluation of lymph nodes at all neck levels is required. Size is not a reliable criterion for excluding metastatic disease; normal cut-off size is <0.8cm in level II and <0.5cm in levels III-VII. Microcalcifications and cystic degeneration within a lymph node are strongly suggestive of metastatic disease with a high degree of accuracy (Figure 5). Increased peripheral vascularity is also indicative of metastatic disease. Additional suspicious features include echogenicity greater than adjacent muscle, a rounded shape (long-to-short-axis ratio <2) and loss of the central fatty hilum.

During thyroid surgery, the central compartment is always exposed, while the lateral compartment is only exposed if FNA-proven lymph node metastases are present. Thus, accurate pre-operative mapping of all ultrasound detected sites of disease is required to guide the surgical approach.

### POST-OPERATIVE ULTRASOUND EVALUATION

In the immediate post-operative period, numerous nodules may be seen in the thyroid bed that are benign. In fact, 90% of nodules measuring up to 11mm in diameter seen in the immediate post-operative period are benign.<sup>6</sup> Post-operative assessment with ultrasound should not be performed earlier than three months after surgery.

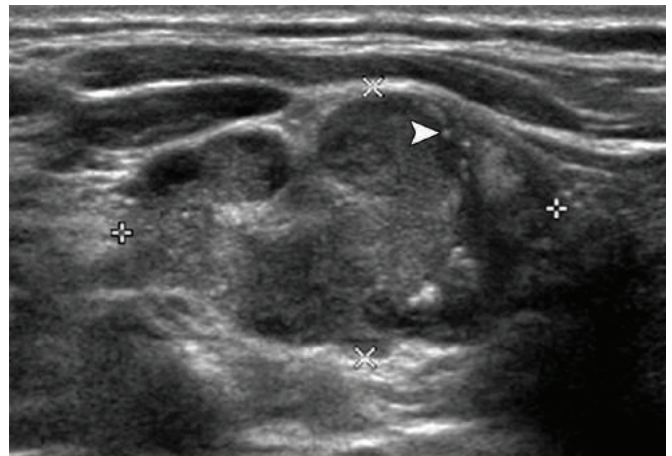
Residual thyroid tissue may be noted on post-operative scans as iso- or hyperechoic nodules. Hypoechoic nodules should raise suspicion for malignant disease. An increasing serum thyroglobulin level (repeated 6-12 months after surgery) is also suggestive of recurrence.



**Figure 5.** (a) Sagittal image of a large left thyroid nodule (callipers) showing intrathoracic extension (\*). (b) CT image shows intrathoracic extension (\*) with tracheal compression (arrowhead) and mediastinal lymph node metastases (arrow).

### CONCLUSION

Complete surgical excision is the most effective treatment for thyroid cancer. Detailed analysis and mapping of all sites of disease and clear communication with the surgeon are crucial for preventing recurrence. ❄️



**Figure 6.** Transverse image through level III showing an enlarged lymph node disease (callipers) with no central fatty hilum and microcalcifications (arrowhead).

REFERENCES CAN BE ACCESSED ON [THE-SYNAPSE.NET](http://THE-SYNAPSE.NET)

**Thank you!**  
TO OUR PEER REVIEW BOARD

- Judge Giovanni Bonello
- Prof. Liberato Camilleri
- Prof. Janet Mifsud
- Prof. Simon Attard
- Prof. Victor Grech
- Mr Alex Manché
- Dr Charmaine Gauci
- Dr Lawrence Scerri
- Dr Kelvin Cortis
- Dr Alexander Borg
- Dr Pierre Schembri-Wismayer
- Dr Caroline Gouder
- Dr Peter Ferry
- Dr Bridget Ellul

