

FINE NEEDLE ASPIRATION (FNA) IS A MINIMALLY INVASIVE METHOD FOR SAMPLING FOCAL LESIONS THAT USES A SMALL GAUGE HYPODERMIC NEEDLE (20-24 GAUGE) TO OBTAIN CELLS FOR MICROSCOPIC ANALYSIS. THIS IS IN CONTRAST TO CORE BIOPSY WHICH OBTAINS A CORE OF TISSUE USING LARGER GAUGE CUTTING NEEDLES (14-18 GAUGE). BOTH FNA AND CORE BIOPSIES ARE CLASSIFIED AS CLOSED OR PERCUTANEOUS BIOPSIES AS OPPOSED TO OPEN BIOPSY THAT IS OBTAINED DURING SURGERY.

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ULTRASOUND-GUIDED THYROID FINE NEEDLE ASPIRATION

Ultrasound (US)-guided FNA lends itself particularly well to lesions in superficial organs such as the thyroid, lymph nodes and the breast. However, since it is less traumatic than core biopsy, it is safer for use in highly vascular organs such as the thyroid gland. Smaller nodules are more amenable to FNA, while larger nodules are better sampled with core biopsy.

FOCAL THYROID LESIONS

The Society of Radiologists in Ultrasound suggests that FNA should be considered for a thyroid nodule 1.0cm or more at the largest diameter if microcalcifications are present and for a nodule 1.5cm or larger if the nodule is solid or if there are coarse calcifications within the nodule.

In cases of multiple thyroid nodules, the risk of an individual nodule being cancerous is decreased but the prevalence of thyroid cancer does not differ between patients with a solitary nodule and those with multiple nodules. Recent literature indicates that patients with multiple thyroid nodules have the same risk

of developing thyroid malignancy as patients with solitary thyroid nodules. Therefore in the presence of multiple nodules, FNA is indicated. However a meticulous search for suspicious ultrasound features should be made in order to identify the more suspicious nodules as sampling of all nodules is frequently not practical.

US features that are suggestive of malignancy include microcalcifications (Fig 1), marked hypoechogenicity (Fig 2), an irregular or microlobulated margin (Fig 3), a longitudinal dimension larger than the transverse dimension (Fig 4), high intrinsic vascularity (Fig 5), direct tumor invasion of adjacent soft tissue (Fig 6), and metastasis to one or more lymph nodes (Fig 7).

In cases with multiple thyroid nodules, US characteristics are more useful than nodule size for identifying nodules that are likely to be malignant. If only the dominant or largest nodule is aspirated, a thyroid cancer may be missed (Fig 8 a, b). Diagnostic US therefore should be performed to characterize all thyroid nodules prior to considering which one(s) to biopsy.

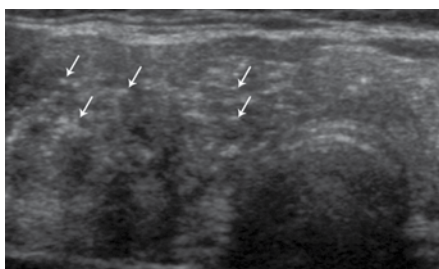


Figure 1. Transverse ultrasound scan through the right thyroid lobe and isthmus showing multiple microcalcifications (arrows) in an ill-defined hypoechoic lesion.

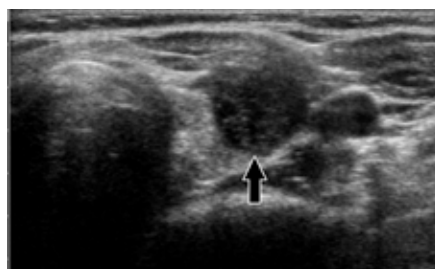


Figure 2. Transverse scan through the left thyroid lobe showing a lesion (arrow) that shows marked hypoechogenicity.

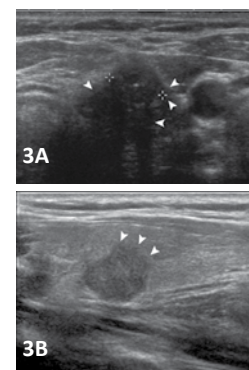


Figure 3. (a) Transverse scan through the left thyroid lobe showing a hypoechoic lesion with irregular microlobulated margins (arrowheads) and (b) longitudinal scan through the left thyroid lobe showing a moderately echogenic lesion with one ill-defined margin (arrowheads).

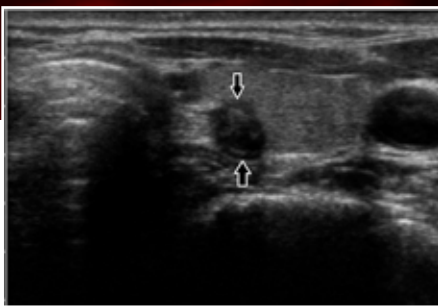


Figure 4. Transverse scan through the left thyroid lobe showing a hypoechoic lesion with a height measurement (arrows) greater than the width measurement.

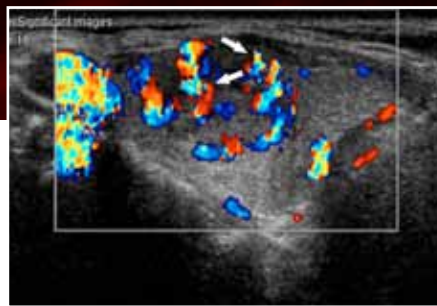


Figure 5. Longitudinal scan through a left thyroid lobe lesion showing marked intrinsic hypervascularity (arrows) on Colour Doppler imaging.

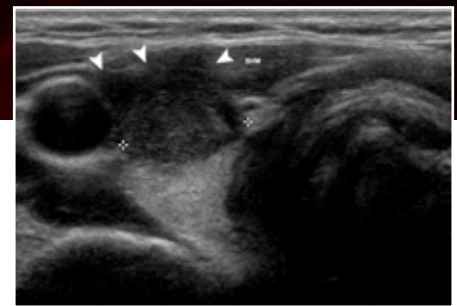


Figure 6. Transverse scan through the right thyroid lobe showing a hypoechoic lesion (between calipers) with direct invasion (arrowheads) of the adjacent sternohyoid muscle (SHM).

DIFFUSE THYROID LESIONS

Among patients with autoimmune diseases such as Hashimoto thyroiditis, the rate of thyroid malignancy is similar to that among patients with a non-symptomatic thyroid gland. In cases in which Hashimoto thyroiditis manifests as a nodular lesion mimicking a thyroid neoplasm, FNA must be performed to rule out lymphoma and papillary carcinoma, either of which may coexist with Hashimoto thyroiditis (Fig 9 a, b). FNA is also required in cases of diffuse rapid enlargement of the thyroid gland, especially in patients older than 50 years, to rule out anaplastic carcinoma, metastasis, and lymphoma (Fig 10 a, b).

HIGH RISK OF THYROID CANCER

The threshold for biopsy of a thyroid nodule in a patient with one or more risk factors for thyroid cancer is lower than that for biopsy in a patient without such risk factors. Risk factors for thyroid cancer include a family history of thyroid cancer, a history of head and neck irradiation, male gender, age of less than 30 years or more than 60 years, and a previous diagnosis of type 2 multiple endocrine neoplasia.

PROCEDURE FOR PERFORMING AN US-GUIDED THYROID FNA

Prior to performing thyroid FNA, the reasons for performing the procedure should be explained to the patient. These are (1) to reach a diagnosis and (2) possibly avoid surgery. The procedure for performing a thyroid FNA must be explained and informed consent obtained from the patient.

One should ask about known coagulation disorders and whether the patient is taking anticoagulation treatment; if no history of coagulation disorder or anticoagulation medication

exists, it is not necessary to perform coagulation studies prior to FNA. If core biopsy is contemplated, coagulation studies are best performed prior to the biopsy.

Significant complications are rare. Most frequent (but also rare) complications are subcapsular haematomas (Fig 11). Even rarer is extensive extracapsular bleeding into the neck. Both complications are treated conservatively.

At the start of the procedure, the patient is placed in the supine position with a pillow under the shoulders to improve neck extension. The skin is cleansed with chlorhexidine solution, which is also used as the US medium (replacing US gel). Local anaesthetic is administered to skin and subcutaneous tissues with 1-2mL 1% lidocaine hydrochloride solution.

Initial scanning in the horizontal plane is performed to locate the lesion and evaluation with Colour Doppler Ultrasound identifies the location of large blood vessels that need to be avoided to minimize the likelihood of blood contamination of the specimen. The patient is instructed not to swallow or speak while the needle is in the thyroid gland.

The probe is placed in the transverse plane with the needle/syringe parallel to the plane of the probe with a medio-lateral or latero-medial approach (Fig 12a). Having the needle parallel to the plane of the beam improves visualisation of the needle tip (Fig 12b).

A 24-gauge needle is inserted into the solid portion of the nodule under US visualisation and when the needle tip is in position, it is moved vigorously in and out while being rotated to dislodge as much tissue as possible from the nodule into the needle bore. This is ideally performed until a small amount of tissue is seen in the hub of the needle. Aspiration may or may not be

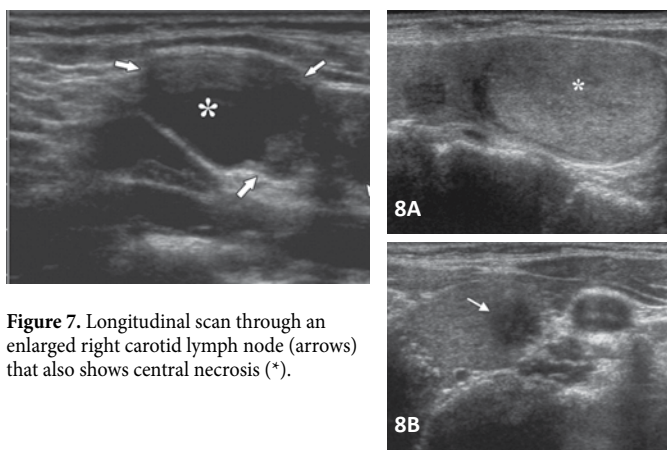


Figure 7. Longitudinal scan through an enlarged right carotid lymph node (arrows) that also shows central necrosis (*).

Figure 8 (a) & (b). Sagittal scan through the left thyroid lobe showing the clinically palpable thyroid mass as a 2.5-cm well-circumscribed isoechoic nodule (* in a), a finding suggestive of a benign nodule. Superior to the said nodule however, was an 0.8cm non-palpable hypoechoic mass with a height exceeding its width (arrow in b). FNA confirmed papillary carcinoma in the non-palpable mass and adenomatous hyperplasia in the palpable mass.

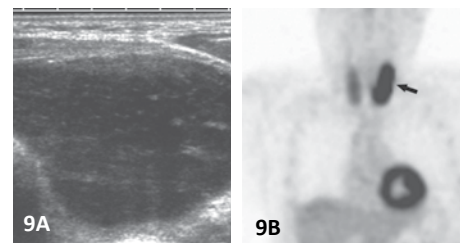


Figure 9. A rapidly growing mass was seen in the left thyroid lobe in a man with chronic Hashimoto thyroiditis. (a) Transverse US scan shows a diffusely enlarged and heterogeneously hypoechoic thyroid gland. (b) Coronal PET-18FDG scan shows increased uptake in the left thyroid lobe (arrow). FNA biopsy showed findings characteristic of diffuse large B-cell lymphoma.

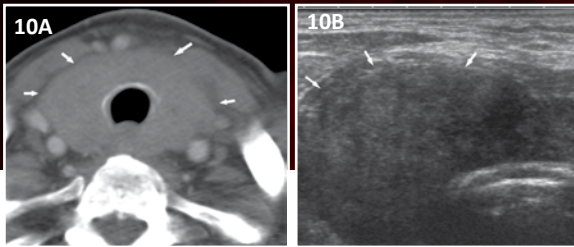


Figure 10. Diffuse enlargement of the thyroid gland in a patient with a history of colon cancer. (a) Axial CT scan shows a diffusely enlarged thyroid gland (arrows). (b) US scan shows a diffusely enlarged and heterogeneously isoechoic thyroid gland (arrows). FNA biopsy analysis showed a poorly differentiated adenocarcinoma with features identical to those seen in an earlier colon cancer specimen.



Figure 11. A subcapsular haematoma following FNA (arrows).

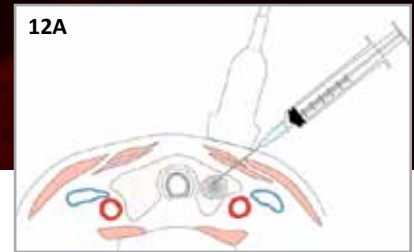
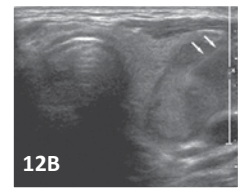


Figure 12. Needle inserted parallel to ultrasound beam (a) allows visualisation of the full course of the needle (arrows in b).



performed during the to-and-fro movement, but is best avoided in very vascular lesions as it is likely to cause specimen contamination with blood.

During the procedure, the needle tip should be placed into different parts of the nodule avoiding blood vessels; this will improve sample quality and reduces the sample inadequacy rate. Aspiration should not be performed while the needle is withdrawn.

The procedure may be repeated especially if the sample obtained appears bloody.

After the procedure, adhesive plaster is applied, and the patient should be instructed to manually compress the skin entry site for a minimum of 30 minutes. The patient should be instructed to contact hospital staff or visit the emergency room if neck swelling occurs on the way home or at home.

If a lesion contains both cystic and solid components, the solid component should be sampled (Fig 13). If the lesion contains a large fluid component, this is best to aspirate the fluid first and then perform a FNA on the remaining solid component (Fig 14).

A repeat FNA biopsy should be considered if there is discordance between the findings at imaging and those at cytologic analysis (Fig 15), a growing mass, a recurrent cyst, or an inadequate FNA sample. At least 3 months should be allowed to elapse after the initial FNA biopsy. The 3-month time lag before repeat FNA is recommended to avoid problems in cytologic interpretation that may be posed by reparative cellular atypia (e.g. marked nuclear chromatin clearing, grooves, or inclusions that may be mistaken for evidence of papillary carcinoma).

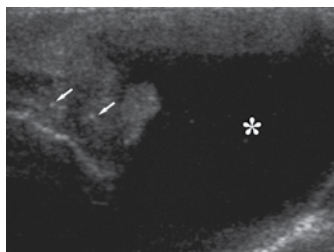


Figure 13. Transverse scan of the left thyroid lobe shows a large lesion with mixed echogenicity, consisting of a predominant cystic portion (*) and a mural nodule containing microcalcifications (arrows). Approximately 3mL of haemorrhagic fluid were aspirated from the nodule at palpation-guided FNA biopsy and the cytologic results were non-diagnostic. Results of subsequent US-guided FNA biopsy of the mural nodule showed papillary carcinoma.

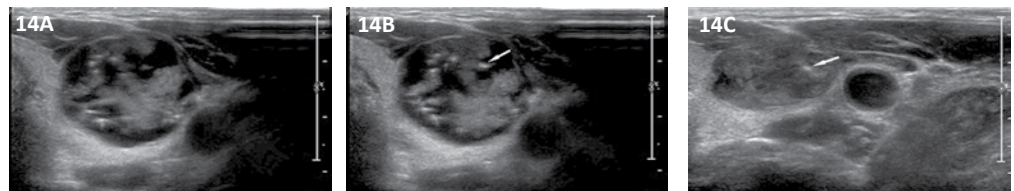


Figure 14. Optimal needle biopsy technique in a largely cystic papillary carcinoma. (a) US image shows a mass with mixed echogenicity. (b) US image obtained at FNA shows the needle tip as an echogenic dot (arrow) during initial aspiration of the fluid component of the cystic mass. (c) Subsequent US image shows the needle tip (arrow) placed in the remaining solid portion of the lesion from which the cytologic sample is obtained.

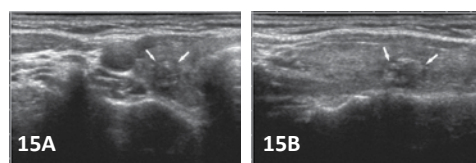


Figure 15. Transverse (a) and longitudinal (b) US images show a 1cm-diameter, microlobulated, heterogeneous hypoechoic thyroid mass (arrows) with a height that exceeds its lateral dimension and with internal microcalcifications. Cytologic analysis of an initial FNA specimen showed clusters of follicular epithelial cells, a finding suggestive of adenomatous hyperplasia. Due to the discordance between the imaging appearance and cytologic findings, surgery was performed. A 1.1cm papillary carcinoma was found.

For follow-up of thyroid nodules with an initial benign cytologic diagnosis and without clinical or radiologic findings suggestive of malignancy, imaging surveillance is recommended rather than repeat US-guided FNA biopsy. If nodule size is stable, the interval before the next follow-up clinical examination or US evaluation may be prolonged.

CONCLUSION

US-guided FNA is useful for the diagnosis of palpable or non-palpable thyroid nodules. The routine use of this biopsy procedure has caused profound changes in the management of thyroid nodules. FNA biopsy allows prompt identification and treatment of thyroid malignancies and avoidance of unnecessary surgery in patients with benign lesions, thereby improving the overall quality of life for patients with thyroid nodules. Furthermore, FNA helps guide treatment and helps reduce the cost of care.

The adequacy of cytologic specimens depends on several factors, including the nodule characteristics and the FNA technique used. As the person performing FNA gains experience and as lesion targeting and localization with US become more accurate, the rate of sample inadequacy should decrease.

To optimize the usefulness of FNA, every centre should strive to attain and maintain a high level of expertise in all aspects of aspiration and interpretation and, toward that end, should establish clinical guidelines tailored to its patient population and FNA biopsy results. ❄️