THYROID PATHOLOGY: EXPERIENCE FROM AN ENDEMIC GOITER AREA HOSPITAL WITH CLINIC-RADIO-PATHOLOGICAL CORRELATION

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Learning objectives

- To describe and illustrate the spectrum of ultrasound (US) findings in thyroid nodules, trying to differentiate between benign and malignant nodules.

- To determinate which nodules must be biopsiated and to describe the ultrasound guided thick needle biopsy technique in our hospital.

- To compare ultrasound results with those of histopathology and clinic history of the patient, trying to evaluate the diagnosis reliability and tumor detection of each one.

Background

Thyroid pathology, and in particular, thyroid nodules, present a high prevalence in areas of iodine deficiency.

Our hospital provides assistance to populations in Huesca Pyrenees, endemic area of thyroid pathology for iodine deficiency, so that the management of thyroid nodule is a common problem in daily practice.

Imaging findings OR Procedure details

A) THYROID ANATOMY

Thyroid gland is formed by two lobes, right and left, united in the midline by the isthmus. It is located in the visceral space of the infrahyoid neck, in front of the trachea Fig. 1 on page 10.

B) THYROID NODULE
Thyroid pathology, and in particular, thyroid nodules, present a high prevalence in areas of iodine deficiency.

Our hospital provides assistance to population in Huesca Pyrenees, endemic area of thyroid pathology for iodine deficiency, so that the management of thyroid nodule is a common problem in our daily practice.

Thyroid nodules may be palpable, suspected by laboratory abnormalities or discovered incidentally on imaging studies.

The incidence of palpable thyroid nodules is between 4 and 8% of cases in the adult population; by ultrasound prevalence rises, and they are detected by 19-67%.

Therefore, ultrasonography is significantly more sensitive than clinical examination in the detection of thyroid nodules.

Most of the nodules correspond to benign lesions or thyroid hyperplasia, while the incidence of malignant lesions is between 5 and 6%.

1.- Clinical suspicion of malignancy of thyroid nodule

There are clinical factors that increase the chances that the lesion is malignant:

- Younger than 20 years or over 70 years.

- Personal history of neck irradiation in childhood or adolescence or environmental radiation exposure.

- Family history of medullary thyroid carcinoma (MTC), Multiple Endocrine Neoplasia type II (MEN II), Gardner Syndrome, Familial Polyposis, Cowden Disease.

- Presence of dyspnea, hoarseness and dysphagia which are caused by invasión of the trachea or larynx, the recurrent laryngeal nerve, or the esophagus respectively.

- Fixed nodule palpation or have increased in size.

- Lymph node metastases.
- Laboratory: the elevation of calcitonin is indicative of MTC.

2.- **US features suggestive of malignancy.**

Ultrasound is the imaging modality of choice for evaluating thyroid nodules. Suspicious US features may be useful for selecting patients for biopsy when incidental nodules are discovered and when multiple nodules are present.

There are semiological criteria suggestive of a malignant lesion. Sonographic findings of thyroid nodules must be evaluated together to identify the nodules that are suspicious and must be biopsiated.

**Suspicious US features of malignancy:**

- Solid or hipoechoic nodules compared to the normal thyroid parenchima or the infrahyoid musculature. Fig. 2 on page 10

- Microcalcifications within the nodule. They appear as punctate hyperechoic foci without acoustic shadowing. They are related to psammoma bodies, and are one of the most specific US findings or a thyroid malignancy. Fig. 3 on page 11

- Coarse calcification in a solitary nodule (frequent in multinodular goiter) Fig. 4 on page 12

- Irregular margins that indicate adjacent glandular tissue infiltration.

- Ovoid morphology with anteroposterior diameter greater than the transverse.

- Centripetal pattern of vascularization with increased flow in the center against the periphery. Avascular nodule is very unlikely to be malignant.

- Lymph node metastases : increased size, rounded bulging shape, replaced fatty hilum, irregular margins, microcalcifications, heterogeneous echotexture, cystic areas or vascularity throughout the lymph node instead of normal central hilar vessels at Doppler
Imaging. Lymph node metastasis is a US feature that may be prognostic of thyroid carcinoma recurrence.

- Invasion of adjacent structures.

3.- **Correlation with pathologic diagnosis**

Histological study is important in the differential diagnosis of follicular adenoma and follicular carcinoma, as it depends on the invasion of the capsule or lymphovascular invasion.

In the case of thyroid hyperplasia or goiter, macroscopically shows an enlarged gland. Thyroid follicles under the microscope have irregular contours and are lined by columnar cells; the colloid material is low, and we will find vacuoles near the apex of the cells as well as stromal lymphocytic infiltration.

**C) MANAGEMENT OF THYROID NODULE. TO DETERMINE WHICH NODES ARE LIKELY TO BE BIOPSIED.**

It is one of the most controversial issues in thyroid pathology.

Ultrasonography is the technique of choice in the management of thyroid pathology, as it is a sensitive, safe, cheap and well tolerated technique. The problem is that US is frequently misperceived as unhelpful for identifying features that distinguish benign from malignant nodules, so the histological assessment of these lesions is necessary.

US guided fine needle aspiration biopsy (FNAB) has proved to be a more effective technique than palpation guided biopsy to reach a correct pathologic diagnosis. The problem is that between 5 and 10% of the samples obtained by this technique will be insufficient or non-diagnostic; well due to lack of cells in the material obtained or for not being sufficiently representative. In this case we must repeat the FNA biopsy as the nodule can be malignant or perform a US guided core needle biopsy to obtain a more accurate histological result.

In our hospital we perform US guided core needle biopsy as technique of choice because it increases the diagnostic efficacy of the puncture, while it is easy, cheap and a well tolerated technique for patients, with a low incidence of complications.
1.- To describe the US guided core biopsy technique in our hospital.

1.1- US-guided core needle biopsy, When ?

Solitary solid nodule

- Solid and marked hipoechoic nodules. Malignant nodules, both carcinoma and lymphoma typically appear solid and hypiechoic when compared with normal thyroid parenchima. The combination of these two US features has a high sensitivity for the detection of thyroid malignancy but a low specificity and positive predictive value, as this appearance is present in 55% lof benign nodules (3) Fig. 5 on page 13

- A size of more than 1 cm. Although the size of a nodule is not helpful for predicting or excluding malignancy.

- Nodules of less than 1 cm with clinical or US features suspicious for malignancy or patient with familiar history of thyroid carcinoma.

- Nodule that has increased in size from the latest follow-up.

- Nodule with microcalcifications or coarse calcifications.

- Heterogeneous echotexture with solid and cystic areas. Fig. 6 on page 14

Multiple Thyroid Nodules

The selection of a nodule for biopsy is recommended to be based primarily on US characteristics rather than nodule size.

One or more nodules may be selected for biopsy. The nodule or nodules are selected on the basis of the clinical assessment, the presence of suspicious US features, and the patiente´s risk factors.
1.2. To describe how we do it.

- Preprocedural planning: informed consent and a screening test for coagulation are obtained. The procedure is discussed with the patient.

- We perform the US-guided core biopsy in the ultrasound room, with radiologist and nursing staff. A high resolution (7-12 MHz) linear-array transducer with a sterile cover placed over its head is used.

The patient is placed in a supine position with the neck slightly extended. After the lesion is localized, the overlying skin is cleansed with a povidone-iodine solution. US gel is not necessary because the solution used for skin sterilization serves as a coupling agent. Fig. 7 on page 15

- We use a local anesthetic: 5 cc of 1% lidocaine hydrochloride solution injected into the skin and superficial subcutaneous tissue at the predetermined site.

- Before the puncture, scanning is performed in the transverse and longitudinal plane for lesion localization, followed by color Doppler mapping to depict any large blood vessels in and around the nodule so that vascular injury can be avoided during the procedure.

- We standard use a 18-gauge biopsy needle. We usually obtain 3-4 good quality core samples. Fig. 8 on page 16

If the nodule has a cystic component we will do a fine needle aspiration biopsy of this area after the core needle biopsy of the solid one.

- After puncture is performed we locally apply manual pressure on the biopsy site to minimize bleeding. The area is now explored with US to see if complications are present.

- Specimen is sent to Pathological Anatomy Service on a glass bottle with saline solution, where an histological cut and staining with hematoxylin-eosin are done.

1.3. Limitations of the technique. Special cases.
The only limitation we have for core needle biopsy are patients with anticoagulant therapy. In this case, to avoid excessive bleeding, anticoagulation therapy should be discontinued three days before the puncture. Prophylaxis regimen with low-molecular weight heparin (LMWH) is performed:

- 3 days before core biopsy: discontinuation of anticoagulant therapy
- 2 days before core biopsy: LMWH 40 mg/24 h subcutaneous.
- The day of the biopsy: introduce anticoagulant therapy alter the puncture and LMWH 40 mg subcutaneous.
- During three days after core biopsy: anticoagulant therapy + LMWH.
- 4th day after core biopsy: discontinuation of LMWH.

D) MATERIAL AND METHODS

A retrospective review was conducted between 2008 and 2009 in patients presented in our Radiologic Service for a US guided biopsy. All of them had a previous ultrasound study in which the nodule was identified and described, and a diagnosis was given.

Afterwards we search in the clinical history of the patient for a clinic impression and the histologically result after the biopsy.

In some cases surgery was performed, and we have an histologically diagnosis of the surgery specimen.

We compared ultrasound findings with histological diagnosis and with the clinical impression in terms of diagnostic reliability and detection of malignancy.

US-guided core-needle biopsy was performed to 96 patients (81 females and 15 males)

- 90 patients had a previous clinic diagnosis of goiter (as we said before, our hospital is located in an area of iodine deficiency). In all of them a US-guided core needle biopsy was performed in one nodule or more than one (following the biopsy criteria for solid nodules: size of more than 1 cm, increased size since last follow-up, microcalcificationes, heterogeneous echotexture. If none of the nodules meets these criteria, we performed core needle biopsy of the dominant nodule if it was not done before).
In 89 of the patients the histological diagnosis was multinodular goiter.

Fig. 9 on page 17

One patient had the histological diagnosis of follicular adenoma and Hashimoto thyroiditis and total thyroidectomy was performed with the same diagnosis in the surgical specimen. Fig. 10 on page 18

- 3 patients showed the histological diagnosis of follicular adenoma.

They were clinical palpable and painful nodules in patients without previous clinical history of goiter.

At ultrasounds two of them were solitary solid nodules, hipoechoic and larger than 1 cm in size. For these reasons US-guided core needle biopsy was performed.

The third patient had a multitabicated cystic nodule. Fig. 11 on page 19

In none of the three cases malignancy was clinical or US suspected.

The development of adenomas relates to iodine deficiency and with an alteration in the synthesis of thyroid hormones. They predominantly affect women.

At ultrasounds they appear as solid nodules, with homogeneous and well-defined margins. But they can also appear as heterogeneous nodules with hemorrhagic areas and calcifications. Biopsy is always needed to make differential diagnosis with follicular carcinoma (it depends on capsular, lymphatic or vascular invasion). Fig. 12 on page 20 Fig. 13 on page 21

- Only in one of our cases the phisician clinical impression was of malignancy. It was a painful and deeply attached nodule. Ultraounds showed a solid mass that crosses the midline. B-cell lymphoma was showed in the histopathologic diagnosis. Treatment with chemotherapy and radiotherapy was performed.

Thyroid lymphoma, usually of the non-Hodgkin type, is uncommon (5% of thyroid tumors). It may occur as part of generalized lymphoma or as a primary tumor, usually in the setting of Hashimoto thyroiditis. It is difficult to differentiate between thyroiditis and lymphoma while the mass is confined to the gland.

Lymphoma has three radiological patterns of presentation: as a mass, multiple nodules or diffuse increased size of the thyroid gland. Lymphoma is an homogeneous lesion, without necrosis or calcifications.
- In two patients US was performed in a palpable nodule, without clinical history of goiter. The sonographic and histopathological diagnosis was of multinodular goiter.

- We did not have any case of **thyroid carcinoma** suspected by ultrasounds. And no histological diagnosis of carcinoma.

**Images for this section:**

**Fig. 1:** Normal Thyroid Gland
(a and b) Transverse and longitudinal sonogram of the left lobe of the thyroid show a solid nodule, hypoechoic compared to the normal thyroid parenchima. It is greater than 1 cm in diameter.

Woman with clinical history of multinodular goiter. She currently has dysphagia. Ultrasound shows that the solid nodule has increased in size compared to the last follow-up. US-guided core needle biopsy is performed, with the pathological diagnosis of multinodular goiter.

**Fig. 2:** Solid Nodule
Fig. 3: Microcalcifications

**Microcalcifications. Follicular adenoma.**

Transverse sonogram of the right lobe of the thyroid demonstrates punctate echogenic foci without posterior acoustic shadowing, findings indicative of microcalcifications (arrows).

Thyroid calcifications are psammoma bodies. They are one of the most specific features of thyroid malignancy (papillary thyroid carcinoma), but their occurrence has been described as well in benign conditions such as follicular adenoma and Hashimoto thyroiditis.
Fig. 4: Calcifications

Patient with known history of multinodular goiter. He presents an enlarged thyroid gland with multiple solid nodules in both thyroid lobes.

Longitudinal sonogram of the right and left lobes of the thyroid shows nodules with coarse calcifications within the nodule that leave posterior acostic shadowing (calcium).
Fig. 5: Solid Nodule. US-guided core needle biopsy


Transverse sonogram of the right lobe of the thyroid obtained at annual follow-up shows that the nodule has increased in size more than 1 cm since the last US control. Patient also refers dysphagia. We perform a US-guided core needle biopsy with the pathological diagnosis of follicular adenoma and diffuse Hashimoto thyroiditis. Surgical thyroidectomy was performed. Indications for thyroidectomy in patients with a multinodular thyroid include hyperthyroidism, local compression symptoms, cosmesis and concern about malignancy.
**Fig. 6:** Solid and Cystic Nodule. US-guided core needle biopsy
US-guided core needle biopsy.

Clinical photograph illustrates how we perform the biopsy in the ultrasound room, with the radiologist and nursing staff. A high resolution (7-12 MHz) linear-array transducer with a sterile cover placed over its head is used.

The patient is placed in a supine position with the neck slightly extended.

Fig. 7: How we do it
Fig. 8: Biopsy Devices
**Fig. 9: Complex Nodule**

Multinodular goiter.

Patient without thyroid pathology. He starts with right neck pain and swelling. A palpable, mobile and not painful nodule was presented.

Transverse sonogram of the right lobe of the thyroid shows a cystic nodule with a solid component. In the solid area we observe hyperechoic foci with posterior acoustic shadowing are presented (calcifications).

US-guided core needle biopsy of the solid area was performed, afterwards, fine needle aspiration of the cystic component.

The histopathological result was multinodular goiter.
**Hashimoto Thyroiditis**

Chronic lymphocytic thyroiditis (Hashimoto) is an autoimmune disease in which thyroglobulin and peroxidase enzyme antibodies are produced. This leads to a progressive thyroid gland destruction and hypothyroidism.

Autoimmune thyroid disease is a risk factor for a thyroid malignancy. Hashimoto thyroiditis is associated with an increased incidence of lymphoma, leukemia and papillary carcinoma.

Patient with clinical and analytical hypothyroidism.

Transverse sonogram shows a solid nodule, is isoechoic compared with normal thyroid parenchyma. It has an hypoechoic halo rim around, that is highly suggestive of benignity.

US-guided core needle biopsy is performed with the histopathological diagnosis of Hashimoto thyroiditis.

**Fig. 10**: Hashimoto Thyroiditis
Follicular adenoma and multinodular goiter.
Patient with a painful palpable cervical nodule.
Transverse sonogram of the right lobe of the thyroid shows a multitabicated cystic nodule of more than 1 cm of diameter.
US-guided core needle biopsy was performed with the histopathological diagnosis of Follicular adenoma on the setting of multinodular goiter.

Fig. 11: Multitabicated Nodule
Fig. 12: Nodule with Heterogeneous Echotexture

Solitary nodule with cystic and solid areas. US-guided core needle biopsy was performed with the histopathological diagnosis of Follicular Adenoma.

a. Transverse sonogram of the left lobe of the thyroid shows a solitary nodule with cystic and solid areas. It has no calcifications.

b. Transverse color Doppler sonogram shows perinodular flow around the nodule.
Young patient without clinical history of thyroid pathology. He notices a cervical tumor and goes to the physician. At physical examination a painful and mobile nodule was palpable.

Transverse sonogram of the isthmus of the thyroid shows an hypoechoic nodule compared to normal thyroid parenchyma. Solid, avascular and without calcifications, it was higher than 1 cm in diameter and painful, so US-guided core needle biopsy was performed.

Histopathological diagnosis was **Follicular Adenoma.**

**Fig. 13:** Solid Nodule
Fig. 14: Non-Hodgkin Lymphoma

Non-Hodgkin Lymphoma (B-cell). Patient with palpable nodule of 1–1.5 months of evolution. It is a palpable, painful and attached to deep planes nodule. It clinically suggests malignancy.

a. Transverse ultrasound of the right lobe of the thyroid shows a solid mass that crosses the midline and has a marked intrinsic hypervascularity.

b. Axial contrast-enhanced CT image shows a solid mass in the right lobe of the thyroid that crosses the midline and produces compression of the trachea.
Conclusion

- Ultrasounds are significantly more sensitive than clinic in the detection of thyroid nodules, however, it is important to know the limitations of this technique.

- Sonographic features have a low reliability to predict malignancy, for this reason, it is necessary an histological valuation of this lesions through ultrasound guided biopsy.

- Ultrasounds are an excellent diagnostic tool in the presurgical valuation and in the postsurgical follow-up of thyroid cancer. It is the more sensitive imaging technique in the diagnosis of the local recurrence.

Personal Information


Hospital San Jorge, Huesca, España.

References


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