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Review Article

Thyroid Lesions: Role of High Frequency Sonography in Diagnosis

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Abstract

Although Thyroid gland is vital for the living organism and that regulate body metabolism, thyroid nodules are a common occurrence in the general population. There are number of diagnostic screening for thyroid lesions, most widely used technique is ultrasound evaluation. Ultrasonography is the imaging technique of choice for estimating thyroid nodules/lesions because of its widespread availability, low cost, and lack of harm due to ionizing radiation. It is sensitive for the recognition of thyroid nodules. Ultrasound should be used to refine a differential diagnosis to arrive at specific diagnosis based on clinical history and physical examination. Ultrasound sonography used to identify normal as well as abnormal conditions of the thyroid gland. This is more suitable than the needle biopsy. Ultrasound distinguishes thyroid cysts (fluid-filled nodules) from solid nodules. It helps to determine location, severity, nature (benign or malignant) of the thyroid nodule. It has advantages such as identify non-palpable nodules, determine interval change in size, evaluate residual thyroid tissue after surgery and many more. In this review we are presenting insights on the use of ultrasound for the identification of thyroid lesions, uses and advantages. This will help to consider this method for the future diagnosis of thyroid lesions and decide on the treatment modalities.

Keywords: Thyroid,diet,worldwide.

Introduction

Thyroid nodules are exceedingly common, which caused by a simple overgrowth of normal thyroid tissue, fluid-filled cysts, inflammation (thyroiditis) or a tumor (either benign or cancerous). It is reported to have prevalent rate up to 68% in adults; amongst only 5% turn out to be malignant as evaluated by high-resolution ultrasound techniques.[1] In addition, new thyroid cancer cases are continuously arising with maximum mortality and many incidence of thyroid cancer was observed and has been increased 2.4 times over the last 30 years.[2]

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Most nodules symptoms of nodules are it causes the enlargement of b lymph nodes in the neck region, difficulty in swallowing along with normal speaking also progressively impaired in most of the cases.Diagnosis of toxic nodule might be a challenging task because nodules may have different anatomically and histologically. This is very difficult analysing to compare individual forms due to complexity, varying severity, therefore proper diagnosis has been important for their analysis as well as treatment. Number of techniques have been used for analysis. This includes physical exam, blood tests, ultrasound imaging and biochemical estimation of the markers using sample from thyroid tissue.Other imaging tests CT scan and MRI, genetic testing, fine needle biopsy, thyroid scan, ultrasound is more recent that gives close to perfect diagnosis of the tumors. Amongst which ultrasound technique are routinely used in wide complications of thyroid lesion. Thyroid ultrasound mostly use high-frequency sound waves pass through the skin and they

were reflected to create detailed images of the thyroid which clearly helps to examine the distinguished nodules as well as types of cysts (fluid-filled nodules) along with differentiation from solid nodules in thyroid.[3] Moreover, recent advances in ultrasonography helps to physicians not only indentify identify the nodules which are more likely to be cancerous but also the detection of a change in the size of the nodule. In this review we are compiled the information on the uses of high frequency sonography for the proper diagnosis of thyroid tumors.

Thyroid anatomy

Body metabolism is vitally regulated by thyroid gland. The gland is affected by a wide spectrum of pathologic conditions including benign and malignant lesions. Thyroid gland composed of right and left lobes is located superficially in the infrahyoid neck, where the two lobes joined centrally at their inferior thirds by the isthmus and anterior to the trachea. Anteriorly the gland is sandwiched between the strap and sternocleidomastoid musculature and the longus colli musculature is present posteriorly.4 In the evaluation of diseases of the thyroid gland the term “goitre” is commonly used for generalized thyroid enlargement that may result from a variety of disorders. Strictly however, goitre should only be used for thyroid enlargement which is neither neoplastic nor inflammatory. Hyperplasia which may be either nodular or diffuse is the most common cause.[4]

Thyroid Nodules

Nodules can be caused by a simple overgrowth of normal thyroid tissue, fluid-filled cysts, inflammation (thyroiditis) or a tumor (either benign or cancerous). Most nodules were surgically removed until the 1980s. In retrospect, this approach led to many unnecessary operations, since fewer than 10 percent of the removed nodules proved to be cancerous. Most removed nodules could have simply been observed or treated medically. Chronic thyroiditis (Hashimoto's disease) is an inflammation of the thyroid gland that develops slowly. It frequently leads to a decreased function of the thyroid (hypothyroidism). Thyroiditis occurs when the body's immune system destroys the cells in the thyroid gland. Chronic thyroiditis is most common in women and people with a family history of thyroid disease. The most common benign lesions of the thyroid are macrofollicular adenoma, colloid nodule and lymphocytic thyroiditis. The most prevalent malignant lesions are follicular thyroid cancer (FTC), MTC, anaplastic carcinoma, and high-grade metastatic neoplasms. Nodules can be caused by a simple overgrowth of normal thyroid tissue, fluid-filled cysts, inflammation (thyroiditis) or a tumor (either benign or cancerous).[5] Most nodules were surgically removed until the 1980s. In retrospect, this approach led to many unnecessary operations, since fewer than 10 percent of the removed nodules proved to be cancerous. Most removed nodules could have simply been observed or treated medically.

Types of nodules

•Multinodular goiter is also called a nontoxic goiter. The word goiter means the thyroid gland has grown too large. This usually happens when the pituitary gland in the brain creates too much thyroid stimulating hormone. If the goiter is small, the problem may be treated with thyroid hormone pills. Surgery is needed if the goiter is large or does not stop growing after taking thyroid hormones. A large thyroid gland can press against the trachea (windpipe) or esophagus (food tube) and cause difficult breathing or eating.[6]

•Benign follicular adenomas. The word follicular means the cells look like a group of small circles under a microscope. If the follicular cells are contained within the nodule, the condition is called benign. If the cells have invaded the surrounding tissue, the diagnosis is cancer.[7]

•Thyroid cysts are nodules filled with fluid. If a nodule has both fluid and solid parts, it is called a complex nodule. They need to be surgically removed if they cause neck pain or difficulty swallowing.[8]

Diagnosis

Fine Needle Biopsy

A thyroid fine needle biopsy is a simple procedure that can be performed in the physician's office. Some physicians numb the skin over the nodule prior to the biopsy, but it is not necessary to be put to sleep, and patients can usually return to work or home afterward with no ill effects. This test provides information that no other test can offer short of surgery. A thyroid needle biopsy will provide sufficient information on which to base a treatment decision more than 85 percent of the time if an ultrasound is used.[9]Use of fine needle biopsy has drastically reduced the number of patients who have undergone unnecessary operations for benign nodules. However, about 10-20 percent of biopsy specimens are interpreted as inconclusive or inadequate, that is, the pathologist cannot be certain whether the nodule is cancerous or benign.[10] In such cases, a physician who is experienced with thyroid disease can use other criteria to decide about whether to operate.

Thyroid Scan

A thyroid scan is a picture of the thyroid gland taken after a small dose of a radioactive isotope normally concentrated by thyroid cells has been injected or swallowed. The scan tells whether the nodule is hyperfunctioning (a "hot" nodule). Because cancer is rarely found in hot nodules, a scan showing a hot nodule eliminates the need for fine needle biopsy. If a hot nodule causes hyperthyroidism, it can be treated with radioiodine or surgery.[11] Neither a thyroid scan nor radioiodine treatment should ever be given to a pregnant woman. Small amounts of radioactive iodine will be excreted in breast milk. Since radioiodine could permanently damage the infant's thyroid, breast-feeding is not allowed for women undergoing radioiodine treatment.

Ultrasound

In thyroid ultrasoundography, high-frequency sound waves pass through the skin and are reflected back to the machine to create detailed images of the thyroid. It can visualize nodules as small as 2-3 millimeters. Ultrasound distinguishes thyroid cysts (fluid-filled nodules) from solid nodules. Recent advances in ultrasonography helps physicians identify nodules which are more likely to be cancerous.[12] Thyroid ultrasonography is also used for guidance of a fine needle for aspirating thyroid nodules. Ultrasound guidance enables physicians to biopsy the nodule to obtain an adequate amount of material for interpretation. Even when a thyroid biopsy sample is reported as benign, the size of the nodule should be monitored. A thyroid ultrasound examination provides an objective and precise method for detection of a change in the size of the nodule.[13] A nodule with a benign biopsy that is stable or decreasing in size is unlikely to be malignant or require surgical treatment.

Ultrasound sonography for thyroid lesions

Ultrasonography is the imaging technique of choice for estimating thyroid nodules/lesions because of its widespread availability, low cost, and lack of harm due to ionizing radiation. This is superior that previously used scinti scanning. Ultrasound sonography have advantages like high resolution, correlation of true thyroid dimension with the image, less expensive and simple to do. This is helpful in detecting hypo echogenicity, solid composition, irregular margin, microcalcification, taller than wide shape, and altered blood flow which are commonly associated with an increased risk for thyroid cancer.[14] This involved no need for any radioisotope administration. Ultrasound should be used to refine a differential diagnosis to arrive at specific diagnosis based on clinical history and physical examination. The image must then be integrated into patient management and correlated precisely with the other data.

Overview of Thyroid ultrasound sonography

Ultrasonic (Latin: Ultra = ‘beyond’ or ‘excess’ and sonic = ‘sound’) sound are the sounds of frequencies beyond audible range. Unlike conventional X-ray and CT which make use of transmitted energy for imaging, ultrasound makes use of reflected energy for imaging. In thyroid ultrasonography, high-frequency sound waves pass through the skin and are reflected to the machine to create detailed images of the thyroid. It can visualize nodules as small as 2-3 millimeters.[15] Ultrasound distinguishes thyroid cysts (fluid-filled nodules) from solid nodules. Recent advances in ultrasonography helps physicians identify nodules which are more likely to be cancerous. Thyroid ultrasonography is also used for guidance of a fine needle for aspirating thyroid nodules. Ultrasound guidance enables physicians to biopsy the nodule to obtain an adequate amount of material for interpretation.[16] Even when a thyroid biopsy sample is reported as benign, the size of the nodule should be monitored. A thyroid ultrasound examination provides an objective and precise method for detection of a change in the size of the nodule. A nodule with a benign biopsy that is stable or decreasing in size is unlikely to be malignant or require surgical treatment.[17]Disorders of thyroid gland are very common in clinical practice. Thyroid diseases are most common among all the endocrine diseases in India. Ultrasonography is relatively cheap, easily accessible, rapidly performed and has advantage of no exposure to ionizing radiation. Since the thyroid gland is superficially located, high resolution real time gray scale, sonography can demonstrate normal thyroid anatomy and pathologic conditions with remarkable clarity. As a result, this technique has come to play an increasingly important role in the diagnostic evaluation of thyroid diseases. Neoplasm of thyroid may be benign or malignant. Ultrasonography of the thyroid helps in measuring the tumour size, diagnosing multinodularity and excluding contralateral disease. Ultrasonography can also suspect malignancy in a lesion based on certain sonographic characteristics and further categorize it into papillary, follicular, anaplastic.

Basic use of sonography for the evaluation of nodular thyroid is to;[18]

- Determine location of palpable neck mass example thyroid or extrathyroid.
- Characterize benign or malignant nodulefeatures.
- Detect acute nodule in a patient with history of head and neck irradiation or MEN IIsyndrome.
- Determine extent of known thyroidmalignancy.
- Determine residual or recurrent and meta-staticcarcinoma.
- Guide fine needle aspiration of thyroid nodule or cervical lymphnode.

The advantages of ultrasound examination of thyroid include:[11]

- i.The ability to identify non-palpable nodules
- ii.Accurately measure nodule and detect any interval change in size
- iii.Differentiate thyroid from non-thyroid nodules (lymph nodes, thyroglossal cyst, cystic hygroma, vascular malformations etc)
- iv.Identify cervical lymphadenopathy and characterize enlarged nodes into benign and malignant
- v.Stratify thyroid nodules according to probability of malignancy
- vi.In MNG select nodules for FNAC
- vii.Evaluate residual thyroid tissue after surgery
- viii.Evaluate diffuse thyroid changes
- ix.Guide needle tip placement for FNAC

Ultrasound sonography is also classified based on its use in evaluation of thyroid gland.[18]

- •Ultrasound classification (U1) for the normal thyroid
- •Ultrasound classification (U2) for the benign thyroid nodule
- •Ultrasound classification (U3) for the indeterminate/ equivocal
- •Ultrasound classification (U4) for the suspicious thyroid nodule
- •Ultrasound classification(U5) for the malignant thyroid nodule

A careful ultrasound assessment to demonstrate solid component with vascularity or microcalcifications will be of help in differentiating these lesions. Cystic or calcified lymph node metastases adjacent to the thyroid gland may be mistaken for benign nodule in multinodular thyroid disease. Incomplete rim of thyroid parenchyma around the mass and lack of movement of the mass with the thyroid gland during swallowing favors extra thyroid lymph nodal metastasis. Diffusely infiltrative hyper vascular thyroid carcinoma like papillary or follicular carcinoma may be mistaken for autoimmune thyroid disease; similarly multifocal carcinoma may be mistaken for benign multinodular goiter. As described earlier, diffuse thyroid enlargement with multiple nodules of similar US appearance and with no normal intervening parenchyma is highly suggestive of benignity. US features that suggest malignancy include irregular or nodular enlargement of the thyroid gland, local invasion and nodal metastases. Co-existing autoimmune thyroid disease and thyroid Carcinoma can further complicate the situation.[19]

Discussion

US provides a safe and speedy method for the examination of thyroid nodules. These thyroid nodules are common but remain impractical to biopsy every nodule to confirm diagnosis. We trust that the ready recognition of benign, suspicious and malignant sonographic features will assist radiologists and clinicians in the subsequent management of thyroid nodules. Overall, ultrasound sonography helps in guiding diagnostic and therapeutic interventional procedure in various thyroid disorders. Recent advances in thyroid ultrasound had further improved the diagnostic accuracy.

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