

Research Article

The role of MRI Diffusion in differentiation between benign and malignant thyroid nodules correlated with fine needle aspiration cytology “FNAC”

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Abstract

Introduction: Thyroid nodule is a discrete lesion within the thyroid gland that is palpable and /or sonographically distinct from the surrounding thyroid parenchyma. **Aim of the Work:** To evaluate the diagnostic value of the MRI diffusion in differentiation between benign and malignant thyroid nodule in correlation with fine needle aspiration cytology. **Patient And Methods:** This study will be conducted in the department of diagnostic and interventional Radiology, Faculty of Medicine, Minia University starting from May 2019 and after being ethically approved by department committee.

Keywords: benign,malignant thyroid, fine needle aspiration cytology

Introduction

Thyroid nodule is a discrete lesion within the thyroid gland that is palpable and/or sonographically distinct from the surrounding thyroid parenchyma.^{(1),(2)}

Palpable thyroid nodules are found in about 5% of world population in non-endemic areas with iodine supplement, and a higher correlation with sex (prevalence in women), age, abnormal intake of iodine and ionizing radiation exposure.^{(3),(4)}

The differential diagnosis of thyroid nodules requires additional diagnostic methods in addition to the clinical examination. A history of radiation exposure, firm thyroidal mass, airway compression, dysphagia, hoarseness, and cervical lymphadenopathy are strong indicators of a thyroid malignancy.⁽⁵⁾

Different imaging modalities are used in diagnosis of thyroid nodules, they include:

- **Ultrasound using high-resolution ultrasound transducers** is the most important method to assess thyroid morphology. Structural disease of the thyroid can almost be ruled out in a gland of normal size, homogenous echo structure and normal vascularization. However, thyroid function can only be determined by indirect criteria in ultrasound (size of the gland, vascularization of the gland or single nodules, echo structure).^{(6),(7)}

Several US features, such as marked hypo echogenicity, irregular margin, micro calcifications, and a taller-than-wide shape have been introduced as potential predictors for the presence of thyroid malignancies.⁽⁸⁾

Micro calcification is a common finding in patients with palpable thyroid papillary carcinoma. It is not often seen in a non palpable nodule.

An irregular or micro lobulated margin is a general finding of malignancy. Micro lobulation is more common than an ill-defined margin in non palpable thyroid malignancy, and it may be associated with smaller mass and a less invasive character.⁽⁹⁾

- **The thyroid gland can have variable CT scan findings, such as** calcifications, single or multiple nodules, cysts, or diffuse enlargement. Thyroid calcifications on a CT scan can be seen in both benign and malignant thyroid lesions. On CT scans, a malignant lesion is suspected when the margins are ill-defined and there is extra-thyroid extension, lymph node involvement, or invasion of the surrounding structures.

The absence of these features does not exclude malignant tumors, especially papillary, follicular, and medullary thyroid carcinomas.^{(10),(11)} Notably, malignant nodules were normally characterized by having a completely solid

composition, internal calcification, ill-defined margin, an unclear or incomplete capsule, while benign nodules were more likely to have peripheral calcification, well-defined margins and an intact capsule. In addition, the size of the benign nodules was significantly larger than the malignant nodules.⁽¹²⁾

Diffusion-weighted imaging relies on the detection of the random microscopic motion of free water molecules known as Brownian movement. With the development of new magnetic resonance (MR) imaging technologies and stronger diffusion gradients, recent applications of diffusion-weighted imaging in whole-body imaging have attracted considerable attention, especially in the field of oncology.

When used in conjunction with apparent diffusion coefficient mapping, diffusion-weighted imaging provides information about the functional environment of water in tissues, thereby augmenting the morphologic information provided by conventional MR imaging.

Detected changes include shifts of water from extracellular to intracellular spaces, restriction of cellular membrane permeability, increased cellular density, and disruption of cellular membrane depolarization.

These findings are commonly associated with malignancies; therefore, diffusion-weighted imaging has many applications in oncologic imaging and can aid in tumor detection and characterization and in the prediction and assessment of response to therapy.⁽¹³⁾

Apparent diffusion coefficient (ADC) values obtained from DWI can be taken as a quantitative parameter to assess malignant tumors from benign lesions of the thyroid. Quantitative diffusion-weighted magnetic resonance imaging (MRI) has the potential to serve as a great diagnostic tool in addition to thyroid sonography and ultrasound-guided fine-needle aspiration cytology (FNAC) for the characterization of thyroid nodules.⁽¹⁴⁾

FNAC is easy to apply, has a low complication rates and high diagnostic value and is a cost-effective test used in the diagnosis of thyroid nodules.^{(15),(16),(17)}

In recent years, the role of fine-needle aspiration cytology (FNAC) is increasing regarding the management methods as well as its role in detection of malignancy potentials of thyroid nodules.⁽¹⁸⁾

Aim of the Work

To evaluate the diagnostic value of the MRI diffusion in differentiation between benign and malignant thyroid nodule in correlation with fine needle aspiration cytology.

Patient And Methods

This study will be conducted in the department of diagnostic and interventional Radiology, Faculty of Medicine, Minia University starting from May 2019 and after being ethically approved by department committee.

Thirty patients who have solid thyroid nodule will be referred from department of surgery at Minia University Hospital to be recruited in the study.

The patients will be subjected to:

1- Full history taking.

2- Superficial Ultrasonography of thyroid gland

The superficial ultrasound is an ideal imaging modality for detection and assessment of a thyroid nodule. It detects the site and structure of the thyroid nodule. The use of high frequency transducers has significantly improved the spatial and contrast resolution in evaluating superficial structures including the thyroid gland.

Equipment and technique:

An advanced ultrasound machine "Toshiba" Xario 300 with a high frequency transducer (7.5-12MHz) is the basic equipment will be used. High frequency transducers allow superior near field resolution and form the basis of characterization of benign and malignant thyroid nodules.

Results

Table (1): Age distribution of the studied patients (N=30)

| Age (years) | Total = 30 |
|---------------|-------------------|
| Mean \pm SD | 41.70 \pm 13.77 |
| Range | 20 - 80 |
| Median/IQR | 41(29.8-52) |

A total of 30 patient with their age range, 20 – 80 years; mean age, 41.70 \pm 13.77years; median /IQR 41(29.8-52)

Table (2): Sex distribution of the studied patients (N=30)

| Sex | No. of cases | Percentage % |
|--------|--------------|--------------|
| Male | 7 | 23.3% |
| Female | 23 | 76.7% |

All patients were identified in 7males ,represent 23.3% and 23 females represent 76.7%.

Table (3): Sonographic findings of the studied cases (N=30)

| Sonographic findings of the thyroid nodules | No. of cases | Percentage (%) |
|---|--------------------|----------------|
| Size | | |
| Mean \pm SD | 3.29 \pm 1.27 cm | |
| Range | 1.5- 8 cm | |
| Shape | | |
| Wider | 28 | 93.3% |
| Taller | 2 | 6.7% |
| Margin | | |
| Smooth | 19 | 63.3% |
| Lobulated | 10 | 33.3% |
| Illdefined | 1 | 3.3% |
| Echogenicity | | |
| Hypoechoic | 15 | 50% |
| Hyperechoic | 15 | 50% |
| Echogenic foci | | |
| No | 24 | 80% |
| Yes | 6 | 20% |
| Composition | | |
| Solid | 26 | 86.7% |
| Mixed | 4 | 13.3% |

A total of 30 solid thyroid nodules (maximal diameter range, 1.5-8cm; mean [\pm SD], 3.29 \pm 1.27cm). According to the shape of the thyroid nodules, 93.3% of the nodules were wider than taller, 6.7% were taller than wider. 63.3% of the nodules had smooth margins, 33.3% had lobulated margins and 3.3% had illdefined margins.

As regarding the echogenicity of the thyroid nodules, 50% were hypoechoic and 50% were hyper echoic. 80% of the throid nodules had echogenic foci and 50% had no echogenic foci. 86.7% were solid and 13.3% were of mixed echogenicity.

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