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Evaluation Of Thyroid Nodules By Ultrasound Elastography Using Acoustic Radiation Force Impulse (Arfi) Imaging

[1]Nabin Kumar Yadav,[2]Farjana Afrin,[3]Bibha Yadav

[1]Lecturer,[2] Consultant Obstetrics & Gynecologist,[3]Medical Officer

Radiology Department

[1]Jalalabad State University, Jalalabad, Kyrgyzstan

Abstract: Thyroid nodules are widespread in the general population, and a sizable percentage of them are benign .Differentiating between benign and malignant nodules is crucial to preventing unnecessary treatments and ensuring timely treatment for malignancies .Thyroid nodule stiffness can be evaluated noninvasively with ultrasound elastography, most especially using Acoustic Radiation Force Impulse (ARFI) imaging .This article examines the concepts, procedures, diagnostic potential, and clinical applications of ARFI elastography in thyroid nodule assessment.

Index Terms **– AFRI, Thyroid, Elastography, Nodules, Ultrasonography,**

I. INTRODUCTION

Thyroid nodules are detectable or palpable abnormalities in the thyroid gland that affect approx. 4–10% of adults and up to 50% when high-resolution ultrasound is used. Approx. 5–15% of these nodules may be cancerous, but the majority of the nodules are benign. Although it is very sensitive in identifying thyroid nodules, conventional B-mode ultrasonography scan is not very good and enough for differentiating between benign and malignant tumors. For confirmatory diagnostic technique, fine-needle aspiration (FNA) is employed; nevertheless, it is invasive and occasionally yields equivocal results. In order to evaluate tissue stiffness, a feature of malignant tumors, ultrasound elastography has been developed as an addition to traditional ultrasound. One type of elastography called ARFI imaging uses acoustic radiation force to create shear waves inside tissues and tracks how far they travel to determine stiffness. The purpose of this paper is to give readers a thorough grasp of ARFI imaging in relation to thyroid nodule evaluation.

I. PRINCIPLES OF ARFI IMAGING

The ARFI elastography is the idea that different tissues have different levels of stiffness depending on their pathological condition. During ARFI Imaging the ultrasound transducer bursts of high energy sound waves (Pulses) that briefly push or displace the tissue in the area of being imagined. The resulting tissue displacement is subsequently measured by the system and translated into shear wave velocities (SWV). Shear wave velocities are higher in stiffer tissues, which are usually linked to malignancy, than in softer, benign tissues.

Key features of ARFI imaging include: Quantitative Analysis: ARFI enhances diagnostic accuracy by quantitatively measuring tissue stiffness through shear wave velocity SWV(m/s). in certain cases, this technique provides a safer alternatives to biopsy.

Real-Time Imaging: ARFI Real time assessment can be combined with traditional B-mode ultrasonography offering a more comprehensive evaluation.

Operator Independence: In strain elastography, ARFI minimizes the subjectivity associated with operator-dependent methods like manual palpation.

II. METHODOLOGY

In order to locate the thyroid nodule and choose the region of interest (ROI), the ARFI imaging procedure starts with a routine B-mode ultrasound scan. The ultrasound transducer generates targeted sonic pulses to induce tissue displacement after identification. The speed at which shear waves move through the tissue is then measured by the apparatus. Higher SWV values are associated with stiffer, possibly cancerous nodules, as shown in a color map.

III. EVALUATION & INTERPRETATION

Thyroid nodule standard diagnostic may include ARFI elastography and comparing the nodule's SWV values to the surrounding normal thyroid tissue is necessary to interpret ARFI results.

The following criteria are taken into consideration:

- **SWV in Benign Nodules**: Benign thyroid nodules, such as colloid or hyperplastic nodules, typically exhibit lower SWV values, and reflecting their softer tissue consistency.

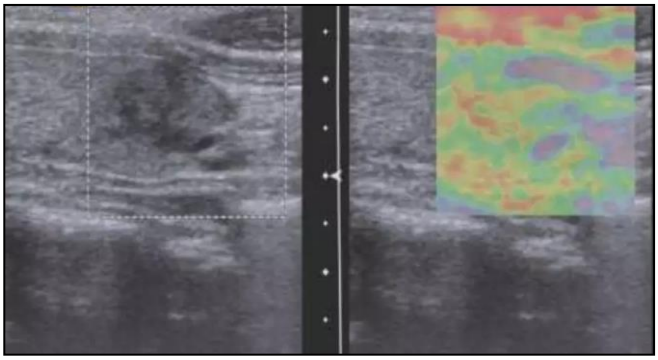
- **SWV in Malignant Nodules**: Malignant thyroid nodules, such as papillary thyroid carcinoma and follicular carcinoma, typically shows increased tissue stiffness and elevated SWV values. A threshold of approx 2-3 m/s is commonly suggested to differentiate benign from malignant nodulesalthough this value may vary slightly depending on equipment & operative expertise.

- **Combination with B-mode Features**:
  ARFI elastography works best when used together with regular ultrasound features like low brightness (hypoechogenicity) uneven edges (irregular margins) & tiny calcium deposits (microcalcifications). The combination enhances the diagnosis more accurate & reliable.

IV. DIAGNOSTIC PERFORMANCE

The diagnostic accuracy of ARFI imaging in thyroid nodule assessment has been assessed in a number of studies. When combined with FNA biopsy results ARFI has shown it very accurately about the difference between benign & malignant thyroid. The method may also help guide decision-making in situations that are unclear or suspicious, as well as decrease the number of needless biopsies performed on patients who have benign nodules. ARFI imaging does have some restrictions, though. SWV readings may be affected by the things like the size & depth of the nodule as well as the presence of calcifications of the nodule as well as the presence of calcifications. Also the skill & training of the person doing the test are very important for getting accurate results.

This is a USG Doppler study image of papillary thyroid cancer.



(Color Code: Red refers to Hard, Purple refers to Soft and Yellow refers between hard & Soft)
FNA Should Perform at Red Region

V. RESULTS:

Throughout the study, 100 patients were scanned. Among them, 79 patients i.e.(79%) had benign nodules, 15patients i.e.(15%) had malignant nodules, and 6 Patients i.e. (6%) had follicular lesions.

VI. CONCLUSION

This ARFI imaging, offers a quantitative and non-invasive way to measure tissue stiffness, is a potential development in the assessment of thyroid nodules. ARFI when combined with traditional Ultrasonography can reduce the need for invasive procedures & improve diagnostic accuracy, but it shouldn't replace FNA when a biopsy is needed. Its usefulness in clinical practice will be improved by additional study and protocol standardization.

ACKNOWLEDGMENT

We would like to sincerely thank the entire team of the radiology, endocrinology, and general medicine departments as well as other medical experts for their important support and guidance in completing this study. ARFI imaging is a promising technology. We would especially want to thank the patients who helped make this research feasible and the technical staff for their help with ARFI imaging. improvement in the assessment of thyroid nodules by offering a quantitative, non-invasive way to measure tissue stiffness. Its usefulness in clinical practice will be improved by additional study and protocol standardization.

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