

# Sonoelastography study in differentiation of thyroid nodules

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# Introduction

Sonoelastography is a new technology that allows for a better morphological evaluation in different fields. There are reports of sonoelastography clinical benefits in breast evaluation, but to our knowledge there are no clinical reports of different applications using sonoelastography in thyroid nodule evaluation. This paper will discuss the potential value of sonoelastography for the better characterization of thyroid nodules and present a series of cases demonstrating its clinical benefits.

# Technology

Elastography is a non-invasive dynamic ultrasound technique that can assess the elastic properties of tissues. It's based upon the principle that, under compression by external force, the softer parts of tissues deform easier than the harder parts.(6,7,8)

The strain images of soft and hard tissue are used to detect or classify different lesions. For example a tumor or a suspicious cancerous lesion is normally 5-28 times stiffer than the background of normal soft tissue. When a mechanical compression or vibration is applied, the tumor deforms less than the surrounding tissue. i.e. the strain in the tumor is less than the surrounding tissue.

This technique allows compression of the target tissue with the scanner probe and estimates the strain before and after tissue distortion, caused by this external force, showing the spatial distribution of tissue elasticity properties in a region of interest. The strain estimation is filtered and scaled to provide a smooth presentation when displayed, visualizing a chromatic map superimposed the eco image; this final result is able to deliver a tissues and lesions characterization.

During this case study, Eco examinations and Elastasonography evaluation have been performed by a GE LOGIQ P6 Premium employing a Matrix linear probe with frequency bandwidth from 6 to 15 MHz. The strain estimation and distribution is displayed by using a chromatic scale assigned from red(soft) to blue(hard/stiff) superimposed to B-Mode in a selected ROI. (this colour-scale can be changed as well). Qualitative elastasonography evaluation is based upon different scores as reported by Rubaltelli

- score 1: Elasticity over the entire nodule;
- score 2: Mainly elastic nodule with some anelastic areas;
- score 3: Presence of wide and anelastic areas or peripherally (a), or centrally (b) located;
- score 4: Completely anelastic nodule eventually with surrounding shadowing.

## Case presentation

This case presentation includes four cases admitted to our Hospital (Policlinico Umberto I, University Sapienza, Rome) for thyroidectomy.

The first patient is a 27 year-old-female patient who was admitted to the Department of Surgery because of a 7 mm thyroid nodule which at FNAC was characterized as Thyr 3. Baseline sonography shows a not-well marginated, iso-hypoechoic lesion (Fig.1a), with Pattern II at color (Fig.1b) and Power-doppler (Fig.1c) evaluation. At Sonoelastography evaluation, the lesion presents a score 2 thus suggesting the benignity of the lesion. (Fig. 1d)

At final histology the lesion was consistent with follicular hyperplasia.

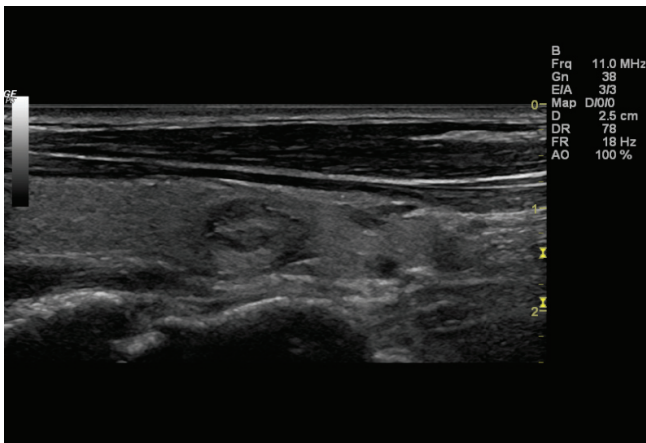


Fig. 1a

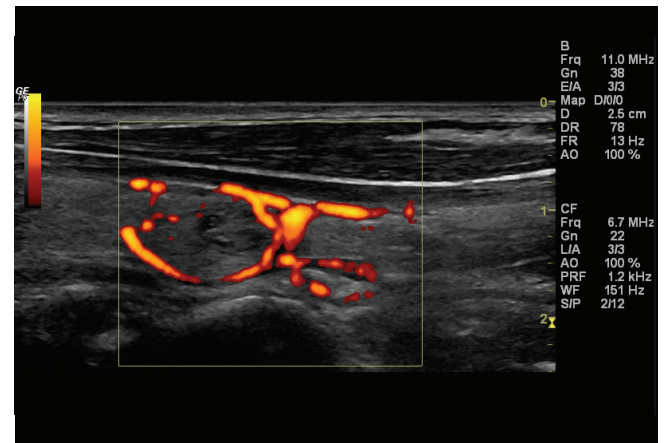


Fig. 1c

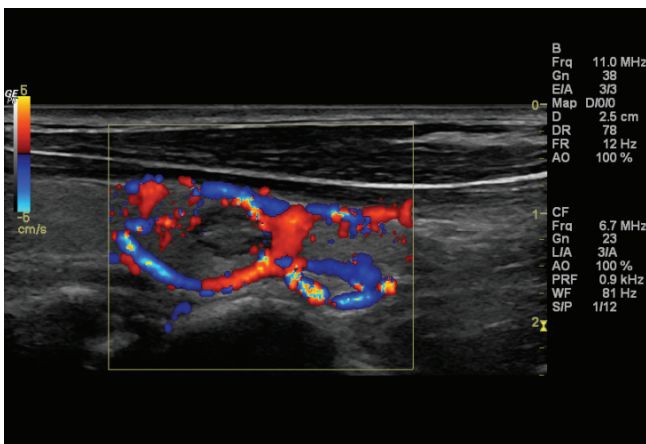


Fig. 1b

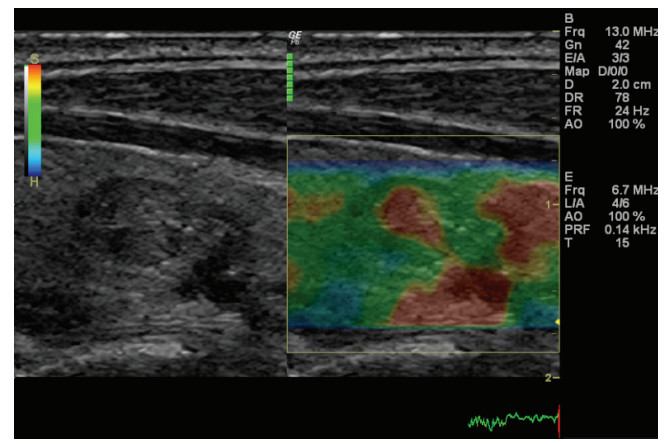


Fig. 1d

The second one presents a small ( 5 mm) nodule, which is iso-hypoechoic (Fig.2a), with calcified peripheral margins. The lesion shows Pattern III at color-Doppler evaluation (Fig. 2b). After sonoelastography this lesion shows score 4, thus suggesting the malignancy (Fig. 2c). Histology confirms that the lesion is a follicular carcinoma.

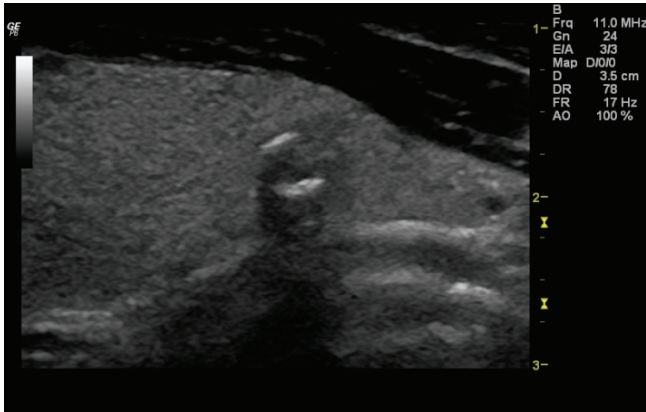


Fig. 2a

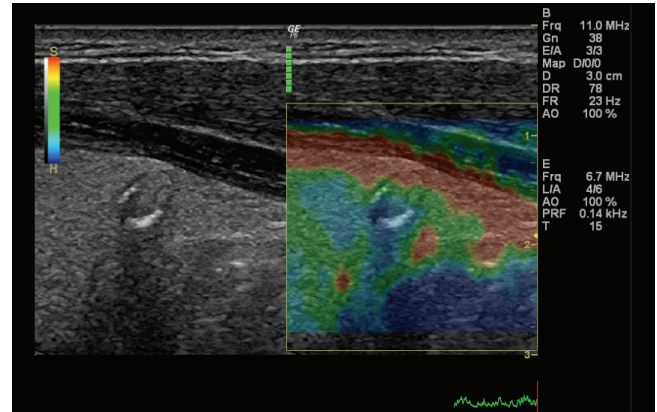


Fig. 2c

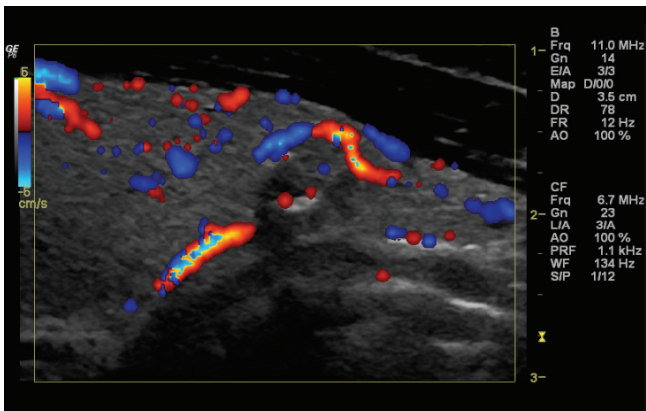


Fig. 2b

The third patient is a 45 year old man presenting a Hashimoto thyroiditis with a nodule, measuring 1.4 cm, characterized by mild hypoechoogenicity and hypoechoic halo (Fig. 3a). At Power Doppler evaluation it shows peripheral and internal color-flow signals (Pattern III) (Fig. 3b). At sonoelastography the lesion shows score 3. (Fig. 3c).

Histology shows that the nodule was a follicular adenoma.

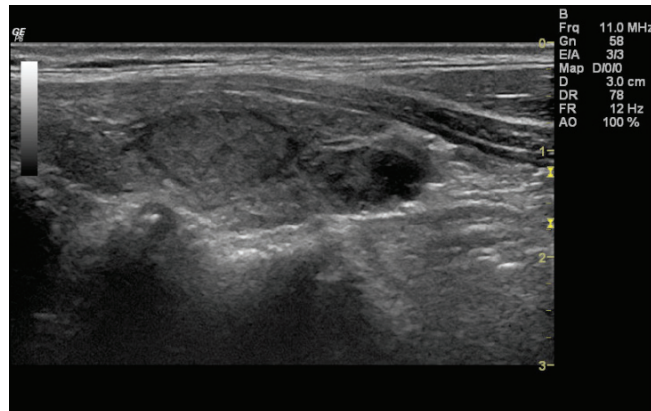


Fig. 3a

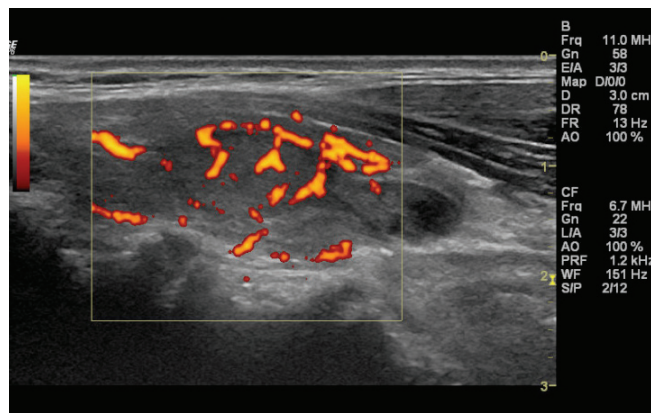


Fig. 3b

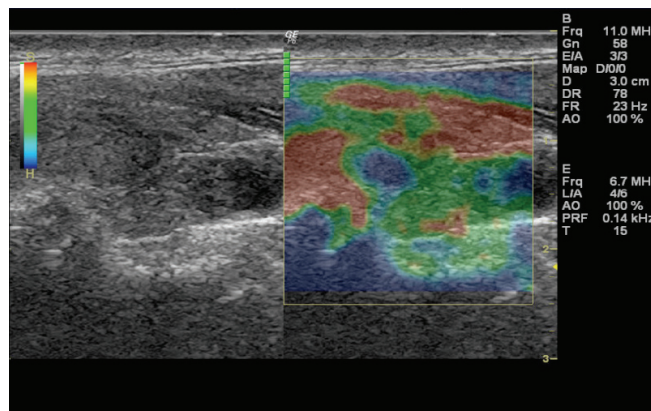


Fig. 3c

The fourth one is a young female patient of 26 year-old submitted to our observation because of a 3.6 cm isoechoic lesion with large hypoechoic areas, characterized by well-marginated, hypoechoic halo (Fig.4a).

The lesion shows Pattern III at color-Doppler (Fig. 4b).

After sonoelastography this lesion shows score 2 (Fig.4c).

Histology shows that the lesion is follicular hyperplasia.

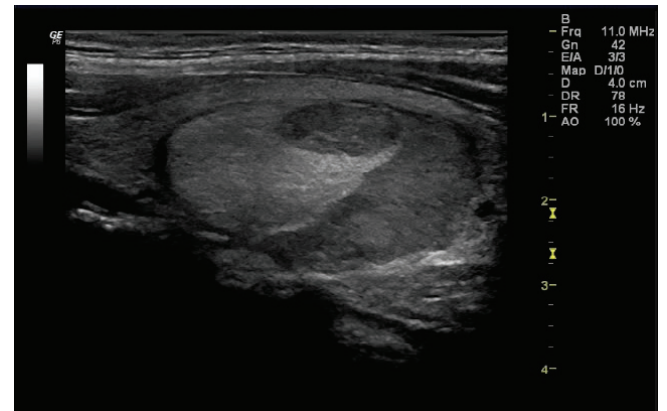


Fig. 4a

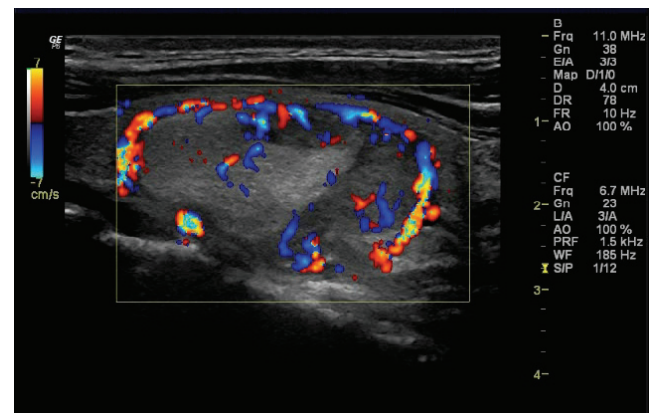


Fig. 4b

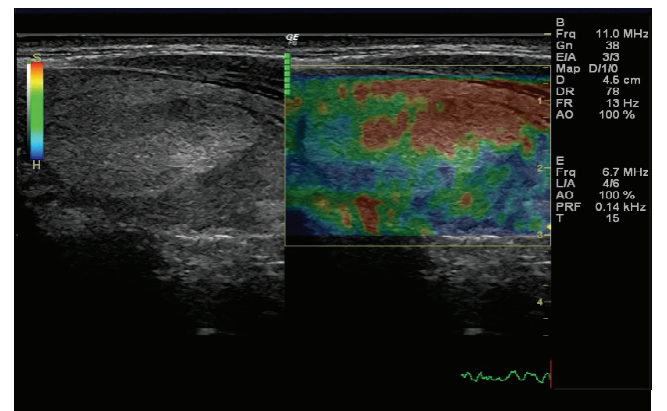


Fig. 4c

# Discussion

Thyroid nodules are rather common since it has been estimated that about 4% of the general population has a palpable thyroid nodule, and over 50% has a small nodule detectable at ultrasound.<sup>2,6</sup> However, only less than 5% of palpable thyroid nodules are malignant, in spite of the reported increasing incidence.<sup>3,7</sup>

Conventional ultrasound (US) provides information regarding characteristics associated with malignant nature of thyroid nodules, such as echogenicity, margins, presence of microcalcifications, and vascular flow. However, none of the ultrasonographic features has both high sensitivity and specificity.<sup>1,2,3,4,5</sup>

Up till now, therefore, FNAC (fine needle aspiration cytology) is still considered the gold standard for thyroid nodules characterization. Recently sonoelastography, which is a more sophisticated method of imaging, gained a prominent role in diagnosis.

Measuring the amount of distortion of the US beam occurring when a tissue is subjected to external pressure, sonoelastography provides information on the elastic properties of the tissue, which rely on the composition and structural organization of macromolecules. Applying the Elastasonographic score grade classification, we evaluated different thyroid lesions and compared against histological results.

These case series shows that sonoelastography is a feasible tool which increases the accuracy in the characterization of thyroid nodules.

### **The possible advantages of this technique are:**

High frame rates; no high acoustic energy; easy to understand; relatively easy to train.

### **The disadvantages to be addressed are:**

User dependence; it is not a quantitative tool but it offers qualitative evaluation

In conclusion, the results of the present study suggest that sonoelastography is a valuable tool in the characterization of thyroid nodules and it seems to be effective to reduce the number of FNAC.

These findings as well as those of previous studies support its use to better select patients who are candidates for surgery.

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Born in Lagonegro (PZ), Italy, August 20, 1974.

Graduated in Medicine at University La Sapienza of Rome in 1999 cum Laude. Chief Resident, completed in 2003 the Residency in Radiology at University La Sapienza cum Laude. Visiting Fellow at the Johns Hopkins Hospital in Baltimore; attended AFIP in Walter Reed

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In 2002 and 2003 awarded at ECR with the EURORAD prizes. Top 50 presenter at ESGAR 2003, in Budapest. In 2007 he won the EFSUMB Young Investigator Award at Euroson 2007 in Lipsia. At RSNA 2008, coauthor of a poster awarded with certificate of merit.

At Euroson 2009, Edinburgh, he won the second Poster Prize. From 2004 employed in the Department of Radiology, II Chair, University La Sapienza, as Full-Time Staff Radiologist and Instructor in Radiology. Completed the PhD in Cardiovascular and Thoracic Physiopathology, Imaging and Surgery at the University La Sapienza of Rome in 2009. From 2004 he is coordinator of Color-Doppler sonography didactic Courses at the Department of Radiological Sciences at Policlinico Umberto I.

From 2005 to date, Temporary Professor at School of Residency in Diagnostic Radiology and at School for Radiological Technicians at University Sapienza.

From 2009 Temporary Professor at School of Residency in Surgery at University Sapienza, Rome. Co-coordinator of some research projects. In 2006 nominated secretary of Contrast media Section of SIUMB and in 2008 nominated secretary of Contrast media of SIRM.

From 2008, nominated President of Contrast MEDIA Section of SIUMB. Research interest mainly focused on US contrast media in abdominal and non-abdominal applications in correlation with multislice-CT and enhanced-MRI.

Wrote as first author or co-author 50 papers published on Italian or International peer-reviewed Journals as reported in PUBMED. Co-author of more than 15 chapters of International Books. Presented more than 120 oral presentations, 30 scientific exhibits, 50 invited lectures and 30 chairmanships. Member of organization committees of more than 20 Italian or international Meetings. Member of SIRM (Società Italiana di Radiologia Medica), SIUMB (Società Italiana di Ultrasonografia in Medicina e Biologia), ESR (European Society Radiology), ESGAR (European Society of Gastrointestinal Radiology) (actually he is a Fellow). Member of the Editorial Board of Journal Ultrasound from 2006. He is reviewer of European Radiology, European Journal of Radiology, Radiologia Medica and Ultraschall in Medicine.

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