Ultrasound Elastography In Assessment Of Thyroid Nodules

ESSAY

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ABSTRACT

Thyroid nodules are common in general population, their prevalence is being dramatically increased in iodine-deficient areas. The great majority of nodules are benign, less than 5% of them are malignant.

Ultrasound elastography is a newly developed technology that has been used in assessment of thyroid nodules. It can measure the degree of tissue stiffness as pathological tissues are usually harder than normal tissues. This can be represented through a colored map ranging between red and blue colors.

US elastography is non stressful for patients, easy to perform, and requires not more than a few minutes of additional examination time.

Key words:

Elastography – Ultrasound – Thyroid gland – Nodules.

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LIST OF ABBREVIATIONS

ARFI	Acoustic Radiation Force Impulse
C cells	Calcitonin-producing parafollicular cells
cAMP	Cyclic adenosine monophosphate
CCA	Common carotid artery
CT	Computed tomography
ES	Echographic Score
FNAC	Fine Needle Aspiration Cytology
hTg	Thyroglobulin
kPa	Kilo Pascal
MEN	Multiple endocrinal neoplasia
NHT	Nodular Hashimoto's thyroiditis
P1-4	Pattern 1-4
PKA	Protein kinase A
RF	Radiofrequency
ROI	Region of interest
RTE	Real time elastography
SEG	Sonoelastography
SI	Stiffness index
SR	Strain Ratio
SSI	Supersonic Shear Imaging
TSH	Thyroid Stimulating Hormone
TSHR	Thyroid Stimulating Hormone Receptor
US	Ultrasound

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INTRODUCTION

Thyroid nodules are common in people living in iodine sufficient areas, their prevalence being dramatically increased in iodine-deficient areas ***(Alam et al. 2008).***

The prevalence of thyroid nodules is about 3%-8% in the general population and is greater than 50% after age 65 years. The number of thyroid nodules being detected has increased because of improvements in medical imaging. Studies indicate a 5%-15% prevalence of malignancy for thyroid nodules ***(Utiger 2005).***

In the assessment of thyroid nodules, clinical evaluation is also very important. In particular, as reported by recent consensus, a firm or hard consistency is associated with an increased risk of malignancy. However, this clinical parameter is highly subjective and dependent on the experience of the examiner ***(Rago et al. 2007).***

In many cases, despite the difference in stiffness between the lesion and the surrounding normal tissue, the small size of a pathological lesion and/or its location deep in the body make its detection and evaluation by palpation difficult or impossible ***(Ophir et al. 2002).***

Thyroid cancer is the most common type of endocrine malignancy and accounts for the most of deaths due to endocrine cancers ***(Robbins et al. 1991).***

The great majority of nodules are benign, less than 5% of them being malignant. Cytological examination of material obtained by fine needle aspiration (FNA), due to its high sensitivity and specificity, is the best single test for differentiating malignant from benign thyroid lesions). Yet, a substantial proportion of nodules are not correctly diagnosed before surgical treatment, and histological examination is required ***(Rago et al. 2007).***

It is also an invasive procedure and is subject to sampling errors. Approximately 15 to 20 % of nodules yield an inadequate or non diagnostic cytology ***(Chow et al. 2001).***

Ultrasonographic (US) examination is an accurate method for detecting thyroid nodules, but its use in differentiating between benign and malignant thyroid nodules is relatively low ***(Takashima et al. 1995).***

US elastography is a newly developed dynamic technique that evaluates the degree of distortion of a tissue under the application of an external force. Because softer parts of tissue deform more readily than the stiffer parts, this technique enables objective evaluation of tissue stiffness from the deformation rate ***(Kagoya et al. 2010).***

Due to the accessibility of the thyroid gland, external deformation of the thyroid using the ultrasound transducer has been utilized by several groups. Deformations introduced from pulsations due to blood flow through the carotid artery has also been utilized as a deformation source ***(Bae et al. 2007).***

It is possible to distinguish between papillary carcinomas and other lesions with the thyroid stiffness index calculated from US elastography using carotid arterial pulsation ***(Richardson & Dubinsky 2008).***

The combination of highly specific elastography with highly sensitive conventional B-mode sonography has the potential to further improve the diagnosis of metastatic enlarged cervical lymph nodes ***(Alam et al. 2008).***

US elastography is non stressful for patients, easy to perform, and requires not more than a few minutes of additional examination time and is a very useful examination to avoid unnecessary procedures ***(Cooper et al. 2006).***

AIM OF WORK

The aim of this work is to review the role of ultrasound elastography in assessment of thyroid gland nodules and differentiation between benign and malignant conditions.

ANATOMY OF THE THYROID GLAND

The normal thyroid gland is located in the anterior neck at the level of the thoracic inlet. The majority of the gland consists of two lateral lobes connected anteriorly by the isthmus. Approximately 50% of people have a pyramidal lobe, which is a remnant of the distal end of the thyroglossal duct ***(Amdur & Mazzaferri 2005).***

The location of the thyroid gland relative to important structures in the neck explains the presenting symptoms of locally advanced thyroid cancer, potential surgical complications, and the complexity of planning external beam radiotherapy. The main structures of interest are the recurrent laryngeal nerve, the trachea, the esophagus, the sympathetic trunk, the vagus and phrenic nerves and the carotid arteries. The parathyroid glands lie close to the posterior surface of the thyroid and vary in number and exact location ***(Bliss et al. 2000).***

The spinal cord is located in the midline, approximately 4 cm posterior to the thyroid gland. This distance, and the intervening muscles of the floor of the neck and bone of the vertebral column, makes it so that tumor rarely spreads directly from the thyroid area to the spinal canal. The proximity of the thyroid gland to the spinal cord is a major factor when planning external beam radiotherapy ***(Amdur & Mazzaferri 2005).***

RELATIONS OF THE LOBES:

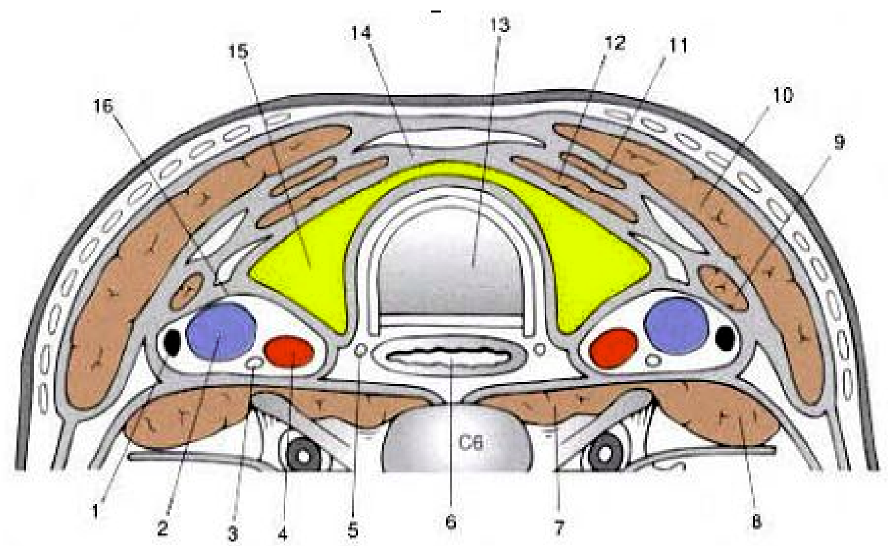

Fig. 1 Transverse section at the level of C6 showing anatomy of the thyroid. 1.cervical lymph node 2.internal jugular vein 3.vagus nerve 4.common carotid artery 5.recurrent laryngeal nerve 6.oesophagus 7.longus colli 8.Scalenus anterior muscle 9.Omohyoid muscle 10.Strenocleidomastoid 11.sternohyoid 12.sternothyroid 13.trachea 14.Paratracheal fascia 15.thyroid gland 16.Carotid sheath ***(Ahuja & Evans 2000).***

Superficially:

Strap muscles (sternothyroid & sternohyoid) and Sternocleidomastoid.

Posterolaterally:

Carotid sheath containing common carotid artery, internal jugular vein and vagus nerve.

Medially:

Larynx, trachea and esophagus.

Posteriorly:

Longus colli muscle and recurrent laryngeal nerve.

(Ahuja & Evans 2000)

ARTERIAL SUPPLY:

Superior thyroid artery:

Arises as the first branch from the anterior aspect of the external carotid artery supplies the upper thyroid pole. It lies on the outer surface of the inferior constrictor muscle of the larynx, with the superior laryngeal nerve situated only a little higher up. So this nerve may be included in ligation of the superior thyroid artery unless care is exercised ***(McVay & Anson 1984).***

Inferior thyroid artery:

Arises from the subclavian artery by way of the thyrocervical trunk, most of its branches penetrate the posterior aspect of lateral thyroid lobe, closely associated with the recurrent laryngeal nerve ***(McVay & Anson 1984).***

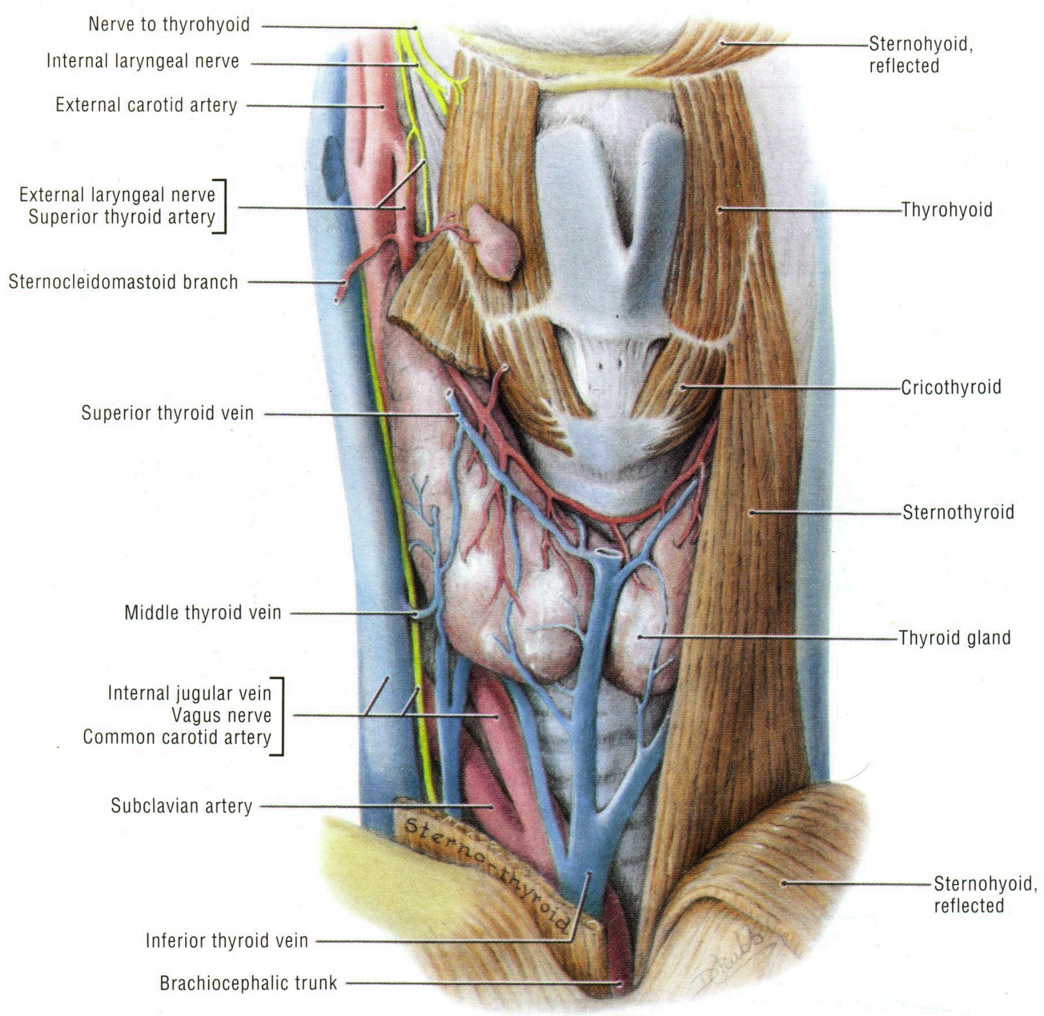

Fig. 2 Thyroid arteries & veins (Young 2011)**.**

VENOUS DRAINAGE:

Superior thyroid vein:

One on each side, runs with superior thyroid artery and ends in the internal jugular vein ***(Standring 2008).***