

The role of elastography in the assessment of thyroid nodules and its future direction

INTRODUCTION:

Nodular thyroid disease reportedly affects 33% of the working population¹. Currently, ultrasound (US) is the frontline modality charged with assessing nodular thyroid disease. Commonly, this is in order to differentiate between benign or malignant disease and to determine which nodules should undergo fine-needle aspiration biopsies (FNAB). US examinations are predominantly comprised of B-mode imaging, with colour doppler assessment increasing diagnostic confidence, however recent advancements in technology have allowed US assessments to be broadened with the addition of elastography. Elastography at present does not have a definitive role in thyroid assessments, however, this is likely to change as it becomes a more complete and therefore valued addition to conventional thyroid US examinations. This work intends to demonstrate the current role of thyroid nodule elastography and how it may be used in future practice, alongside the known strengths and limitations.

STRENGTHS:⁵

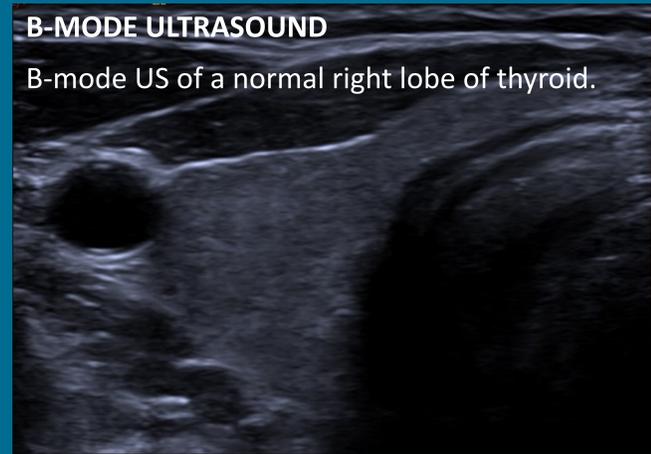
- Rapid technique
- Imaging adjunct to B-mode US – increases both sensitivity and specificity
- May prevent unnecessary biopsy
- High predictive value of benign pathology
- Operator independent (SWE)
- Quantitative malignancy predictor (elasticity index/threshold value) (SWE)
- Faster diagnostic pathway

LIMITATIONS:⁵

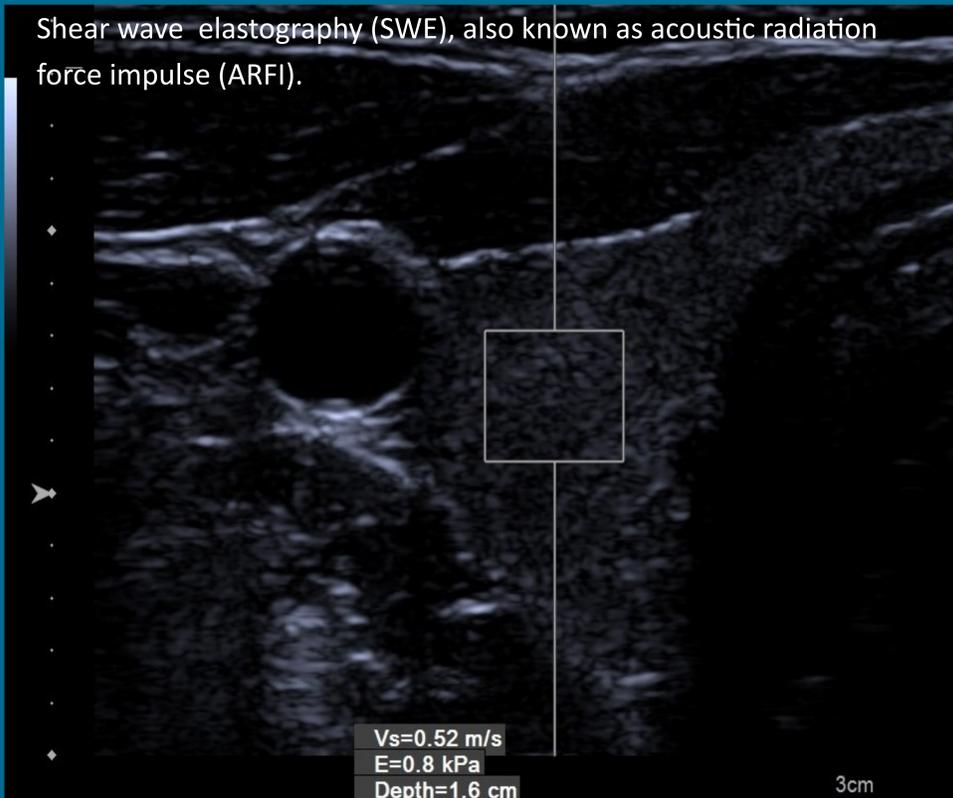
- Nodule characteristics (calcifications/cystic components) – requires selective use of appropriate nodules
- No standardised method
- Unable to confidently assess nodules <5mm
- Inter/intraoperator dependency – high operator skill dependency (strain elastography)
- Subjective analysis (strain elastography)

B-MODE ULTRASOUND

B-mode US of a normal right lobe of thyroid.



Shear wave elastography (SWE), also known as acoustic radiation force impulse (ARFI).



Shear wave elastography (SWE)/ARFI/Quantitative assessment:

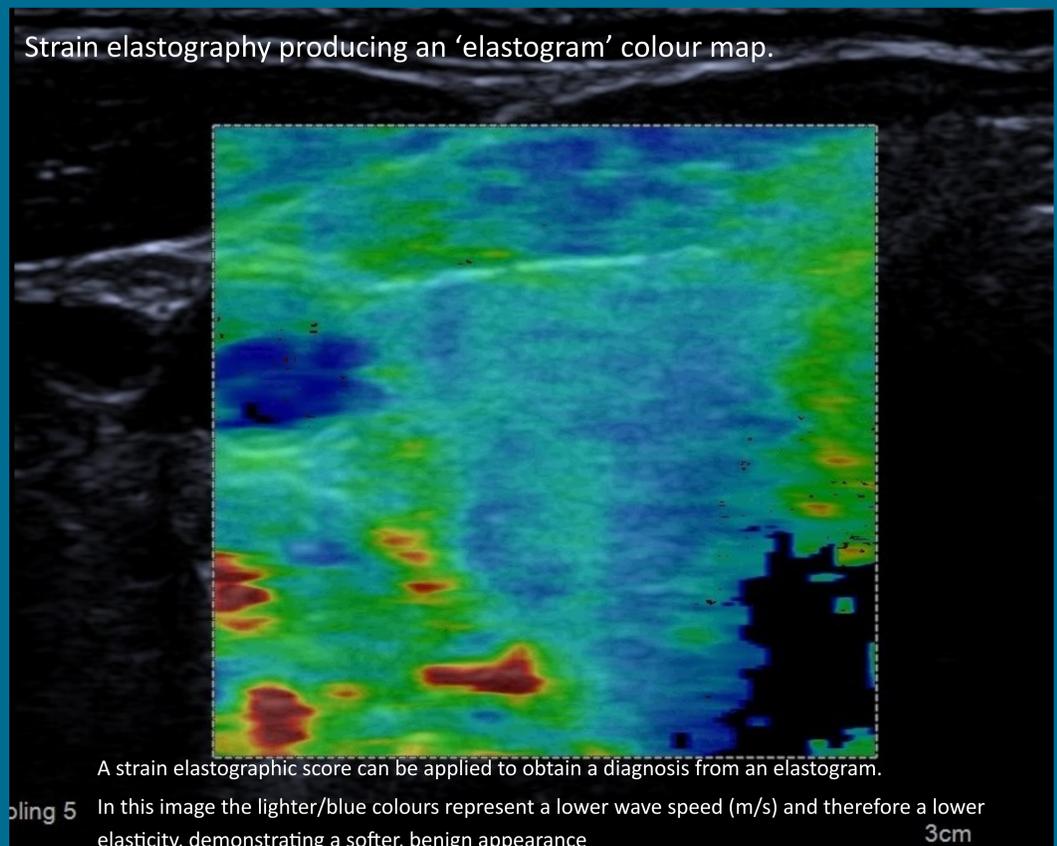
Shear-wave elastography (SWE) may be used quantitatively, with a 'threshold' value employed based on the elasticity index (EI), which allows a numerical value to determine a benign or malignant result. Sebag et al,² first studied if elastography alone could be utilised as a predictor of malignancy and compared this with conventional US. The results demonstrated an increased sensitivity from 51.9% on US alone, to 81.5% when a combined technique was applied - the EI for this study was 65kPa. There is currently a lack of consensus between studies as to what EI value is the most accurate predictor of malignancy. Comparisons of further quantitative elastography studies found differing values from 34.5kPa⁴ to 66kPa³.

In order for quantifiable SWE to play a leading role in the evaluation of thyroid nodules, a reliable and agreed EI is fundamental. Until there is a unifying guideline threshold value, the role of quantifiable elastography will remain somewhat limited.

STRAIN ELASTOGRAPHY – ELASTOGRAM:

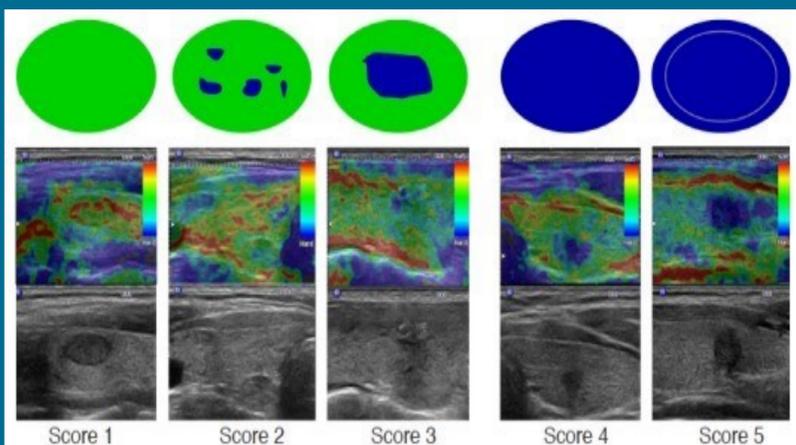
Colour mapping of a thyroid and any nodules within is a qualitative and often subjective assessment. It evaluates the stiffness of tissue through real-time strain elastography, resulting in a 'map' of stiffness projected onto the US image. This grants the ability to visualise stiffness in a larger area than the SWE gate. A detailed interrogation of regions within a single nodule is therefore allowed (FNAB guidance and a reduction in false negatives/biopsy sample errors can be predicted). It can also be used for targeting with ARFI for the highest kPa in a specific nodule to give a more accurate virtual biopsy. The ability to assess and compare multiple nodules simultaneously is also granted. The future of strain elastography is strongly related to its usefulness in guiding biopsies and utilizing an agreed scoring ratio.

Strain elastography producing an 'elastogram' colour map.



A strain elastographic score can be applied to obtain a diagnosis from an elastogram.

In this image the lighter/blue colours represent a lower wave speed (m/s) and therefore a lower elasticity, demonstrating a softer, benign appearance



Example of a strain elastographic scoring ratio⁶. Note, this scoring system is inverted when compared to the image on the right.

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