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Thyroid in a Nutshell

Dublin 2017

Catherine Kirkpatrick
Consultant Sonographer
ULHT

Acknowledgements

- Dr. Steve Colley
- Dr. Rhodri Evans
- Dr. Rhian Rhys
- Dr. Andrew McQueen

Aims

- Anatomy & Physiology
- Incidence of thyroid cancer
- Ultrasound signs of thyroid cancer
- Ultrasound scoring system for nodules
- Common misconceptions

Why do we scan the thyroid gland?

- To determine the nature of a clinically palpable mass
- To assess diffuse multi-nodular enlargement (goitre) and distinguish from other forms of diffuse enlargement (e.g. thyroiditis)
- Screen patients with increased risk of developing thyroid malignancies
- Evaluate a non-palpable thyroid lesion seen on other imaging modalities (e.g. hypermetabolic nodule noted on PET or incidental nodules noted on CT/MRI)
- Follow up Post Operative patients to exclude local or regional disease or regrowth of hyperplastic nodular thyroid tissue
- To Guide FNA or biopsy

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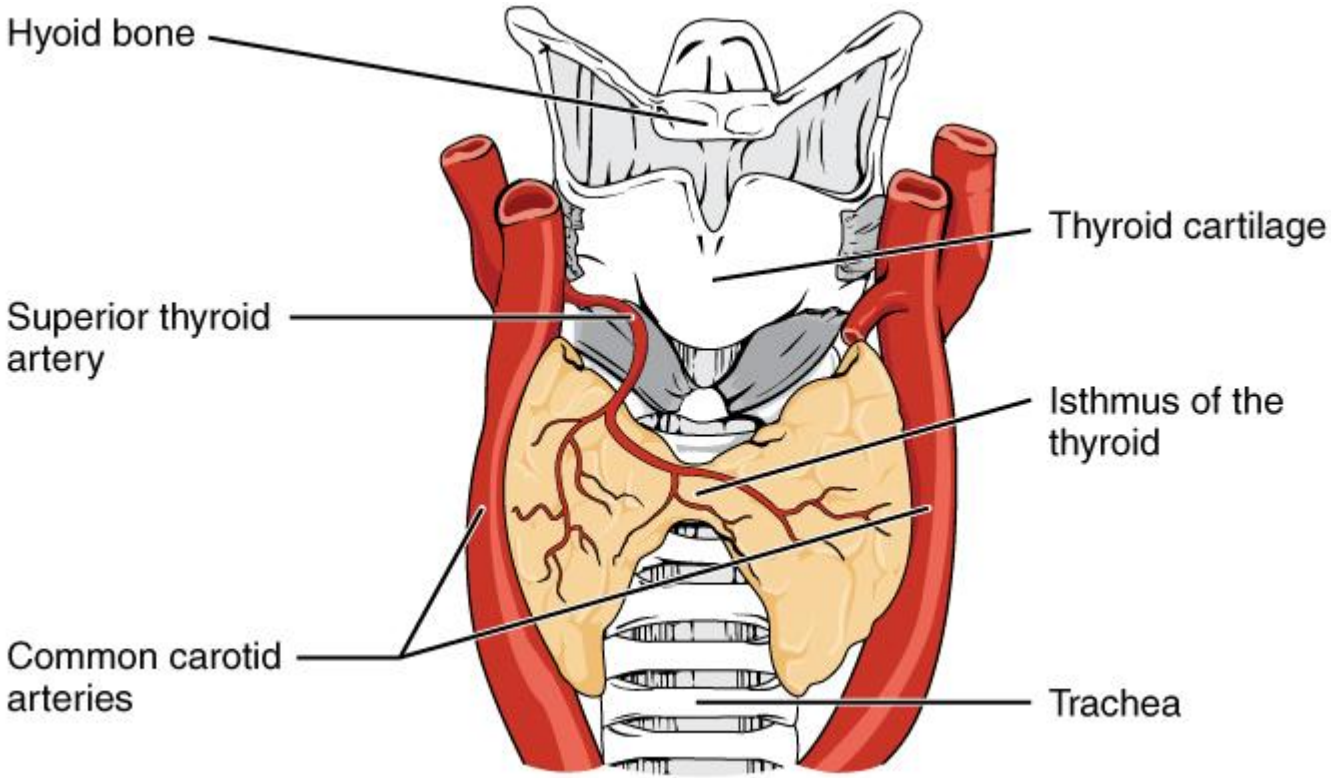
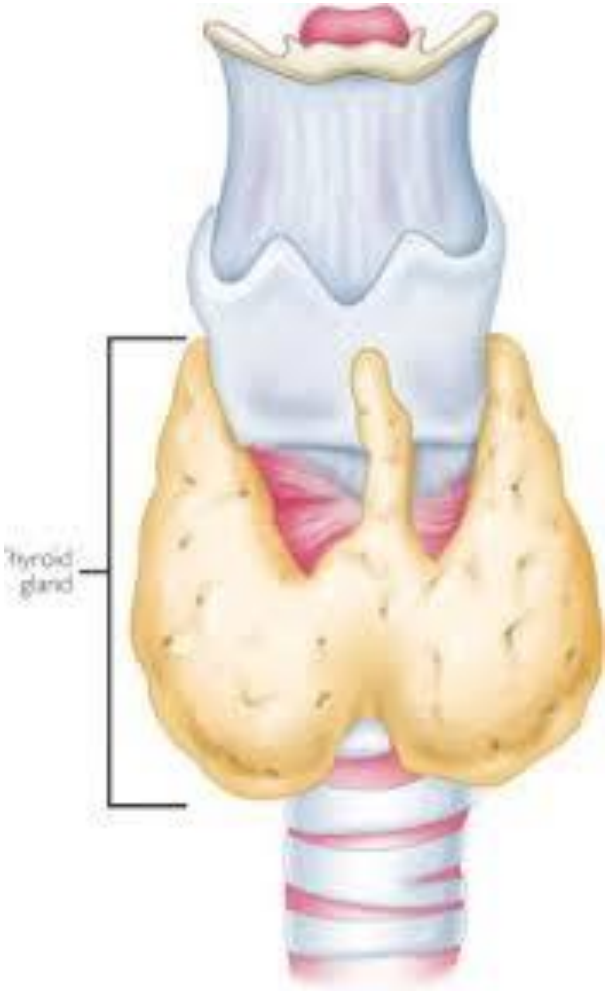
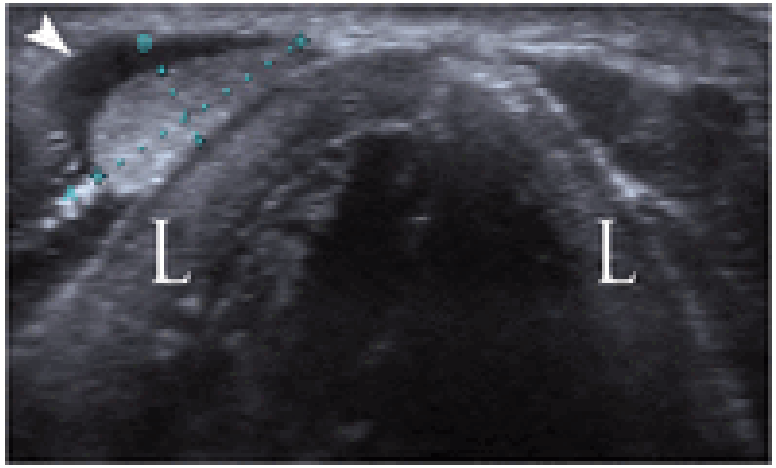
Anatomy



Anatomy





L= larynx

C Mortensen et al , 2014

Thyroid Physiology and Thyroid Function Tests

- Why?
- An understanding of the thyroid physiology and basic thyroid function tests (TFTs) may aid in the interpretation of thyroid imaging
- Here comes the science bit……concentrate

Thyroid Physiology and Thyroid Function Tests

- Thyrotrophin Releasing Hormone (TRH) is secreted by the hypothalamus. It stimulates the production of Thyroid Stimulating Hormone (TSH) by the anterior pituitary gland
- TSH then stimulates the production and release of thyroxine (T4) and tri-iodothyronine (T3) from the thyroid gland under the control of a negative feedback loop
- Thyroid autoantibodies may be increased in autoimmune diseases such Hashimoto's or Graves'

Thyroid Physiology and Thyroid Function Tests

Hormone Levels	Effect
↑ TSH ↓ T4	Hypothyroidism
↑ TSH = T4	Treated or subclinical hypothyroidism
↑ TSH ↑ T4	TSH secreting tumour or thyroid hormone resistance
↓ TSH ↑ T3 or T4	Hyperthyroidism
↓ TSH = T3 and T4	Subclinical Hyperthyroidism
↓ TSH ↓ T3 and T4	Sick euthyroid or pituitary disease

Ultrasound Assessment of Thyroid Nodules

- Sonographically, a thyroid nodule can be described as a discrete lesion distinguishable from the adjacent normal thyroid parenchyma.
- Thyroid nodules are palpable in 3-7% of the population
- Ultrasound detectable nodules in the population is between 30-70% (the percentages progressively increases with age)
- Managing Thyroid Nodules : February 2014
  - **All patients being investigated for possible thyroid cancer should undergo and US of the neck in secondary care by an experienced operator**
  - **The information derived from US of thyroid nodules should always be interpreted in the context of the individual patients clinical picture**

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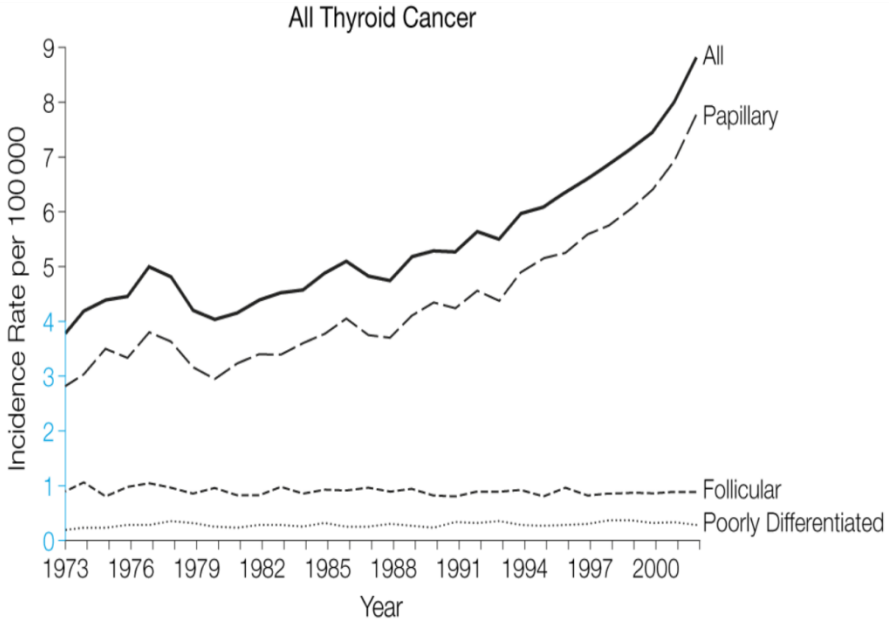
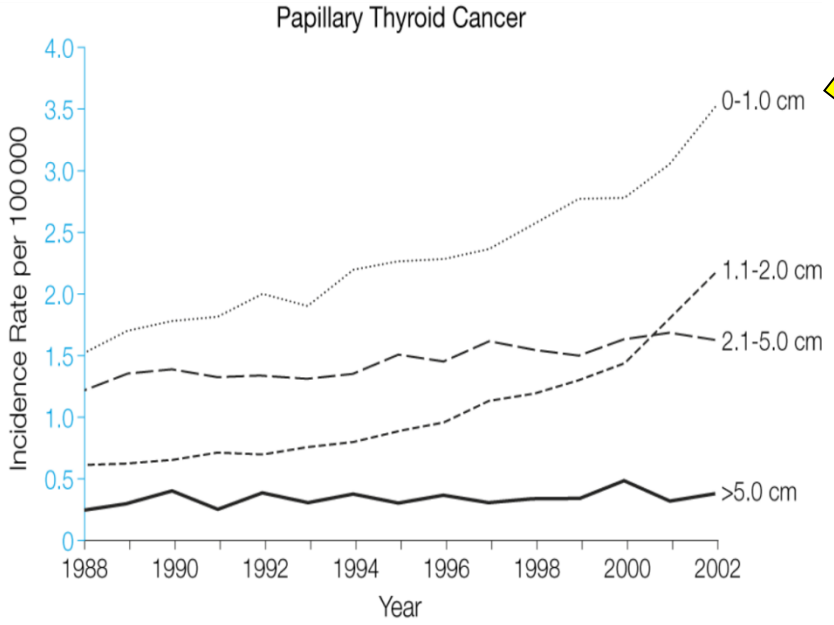
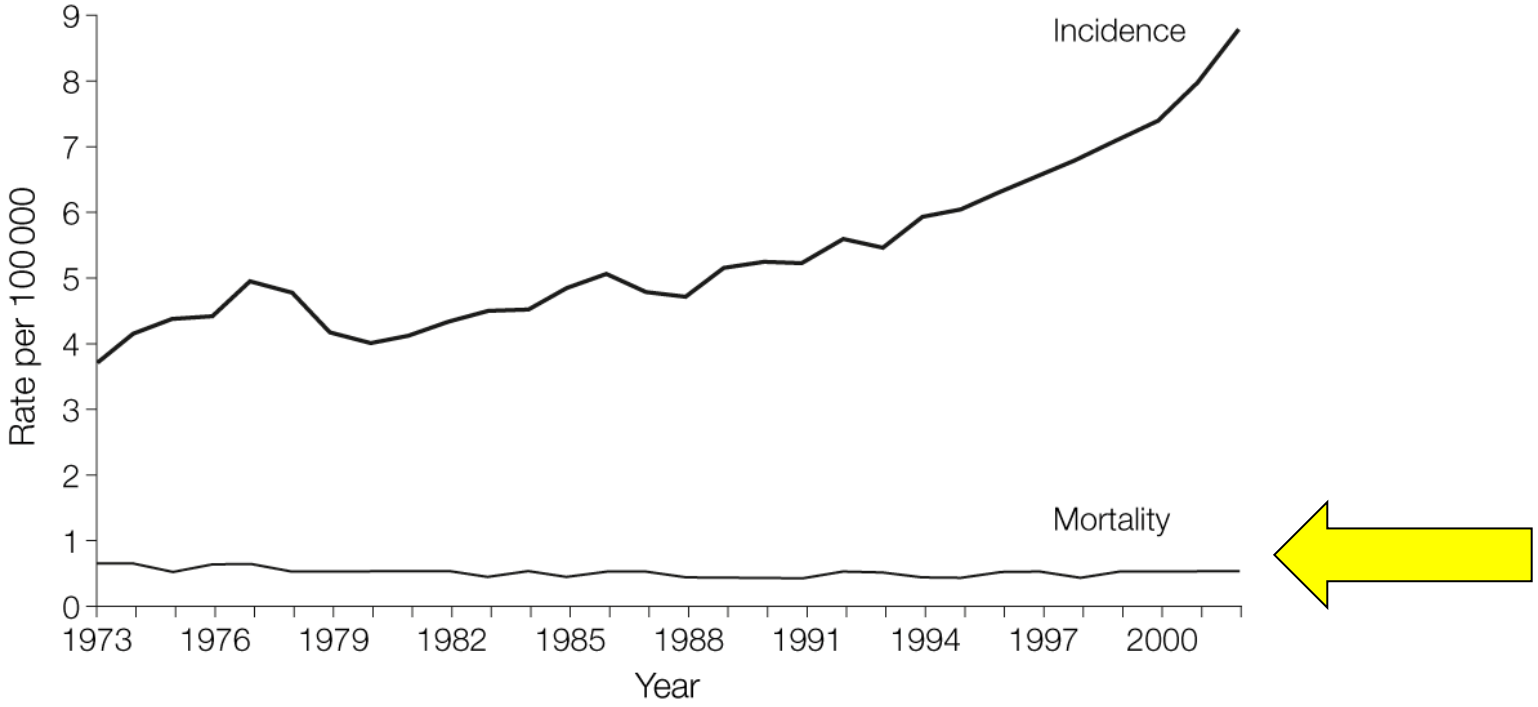


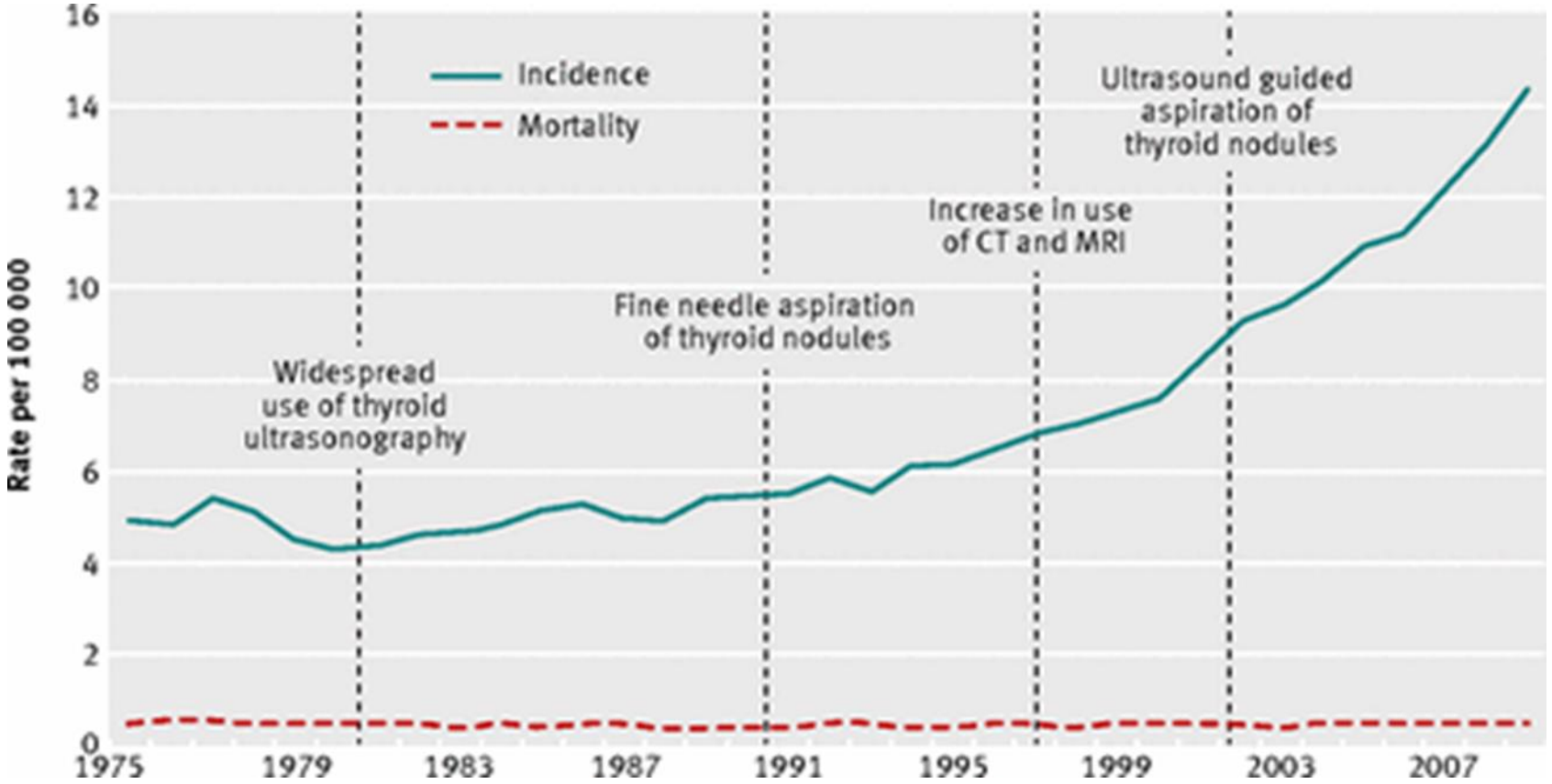


The JAMA Network

The JAMA Network

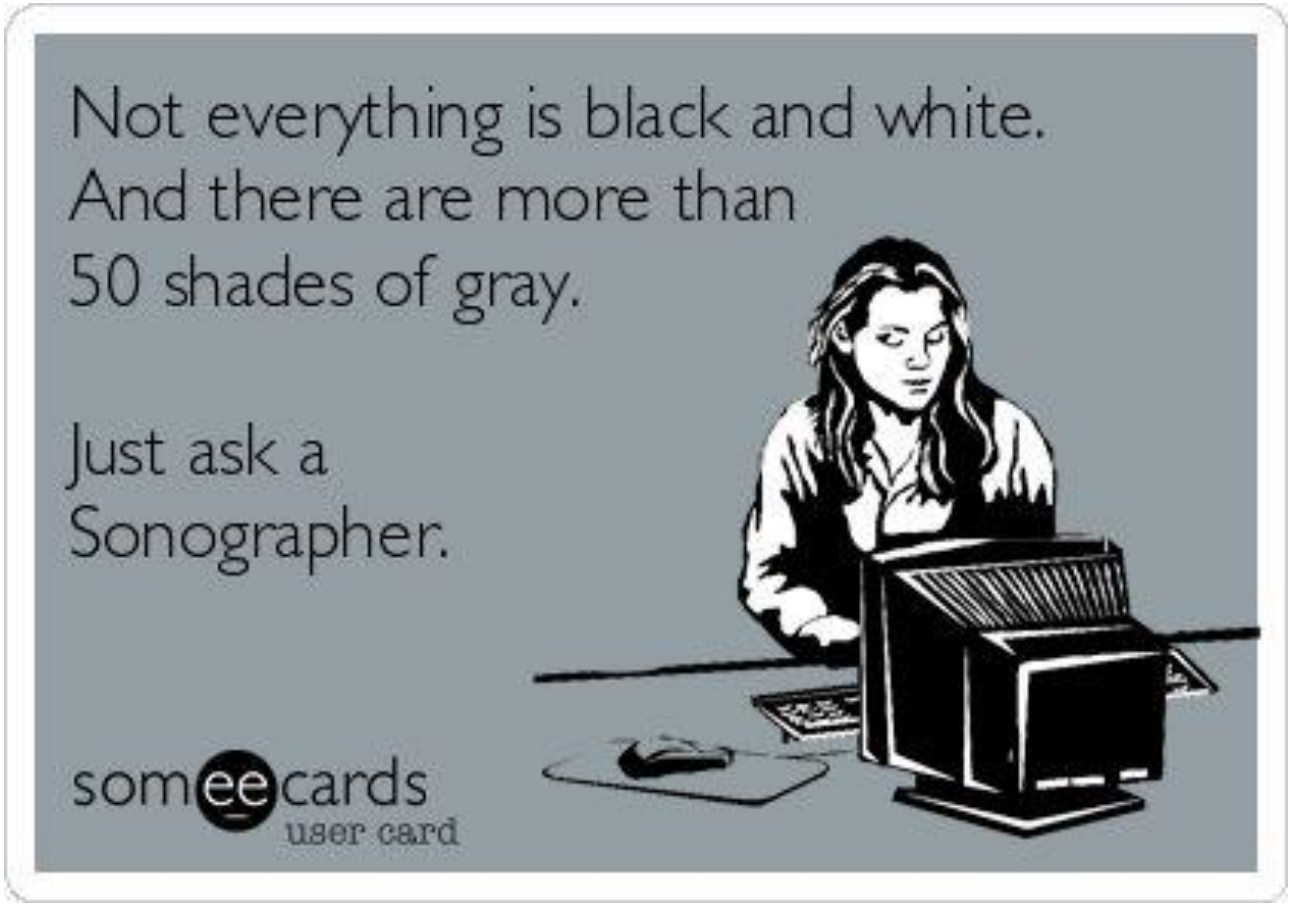


Thyroid cancer: zealous imaging has increased detection and treatment of low risk tumours.
Brito et al. BMJ 2013; 347: 18 – 21.



Ultrasound Signs Predictive of Cancer

	Sensitivity	Specificity
Micro-calcifications	40%	90%
Absence of halo	66%	46%
Irregular margins	64%	84%
Hypo-echoic	83%	49%
Intra-nodular flow	70%	65%
MicroCa. & irreg m.	30%	95%
MicroCa. & hypoechoic	28%	95%
Solid & hypoechoic	73%	69%


Not everything is black and white.
And there are more than
50 shades of gray.
Just ask a
Sonographer.
someecards
user card

Ultrasound Scoring Systems

- Mayo Clinic
- BTA Classification System

- Ultrasound based reporting systems for thyroid nodules improves patient management and cost-effectiveness by reducing unnecessary FNA

Horvath E et al. An ultrasonogram reporting system for thyroid nodules stratifying cancer risk for clinical management. *J Clin Endocrinol Metab* 2009; 94: 1748 - 1751

Almost Certainly Benign

No FNA

Cysts with bright echo | Cystic nodule | Sponge-like nodule

Cystic with debris | Large cystic nodule with septations | Cystic nodule with debris

Multiple isoechoic similar nodules (multinodular goiter) | Multiple discrete solid hypoechoic nodules with coarse parenchymal septations (Hashimoto's Thyroiditis)

Indeterminate

Solid with cystic component | Cystic with mural nodule

Solid, homogenous with thin halo | Solid, homogenous

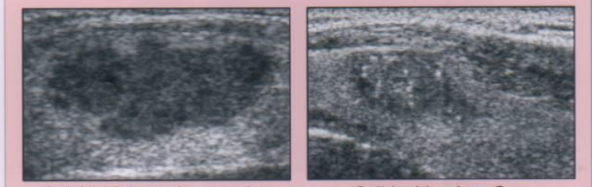
Most are benign, uncommonly follicular or papillary carcinoma

For Indeterminate Nodules Additional Relevant Factors That Would Encourage FNA

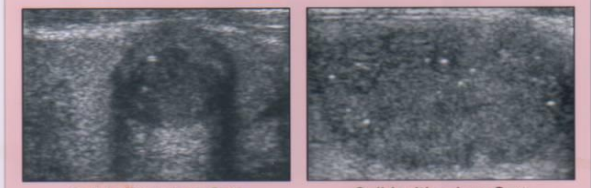
- Family history of thyroid CA
- Previous radiation exposure
- Younger age
- Larger size of nodule

Worrisome for Malignant

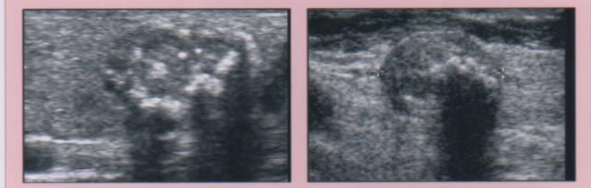
FNA



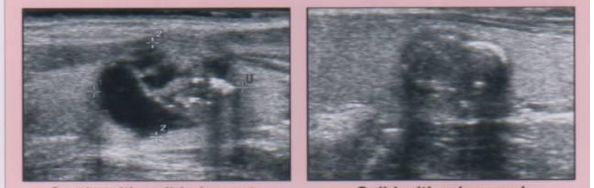
Solid with irregular margins | Solid with micro Ca++



Solid with micro Ca++ | Solid with micro Ca++

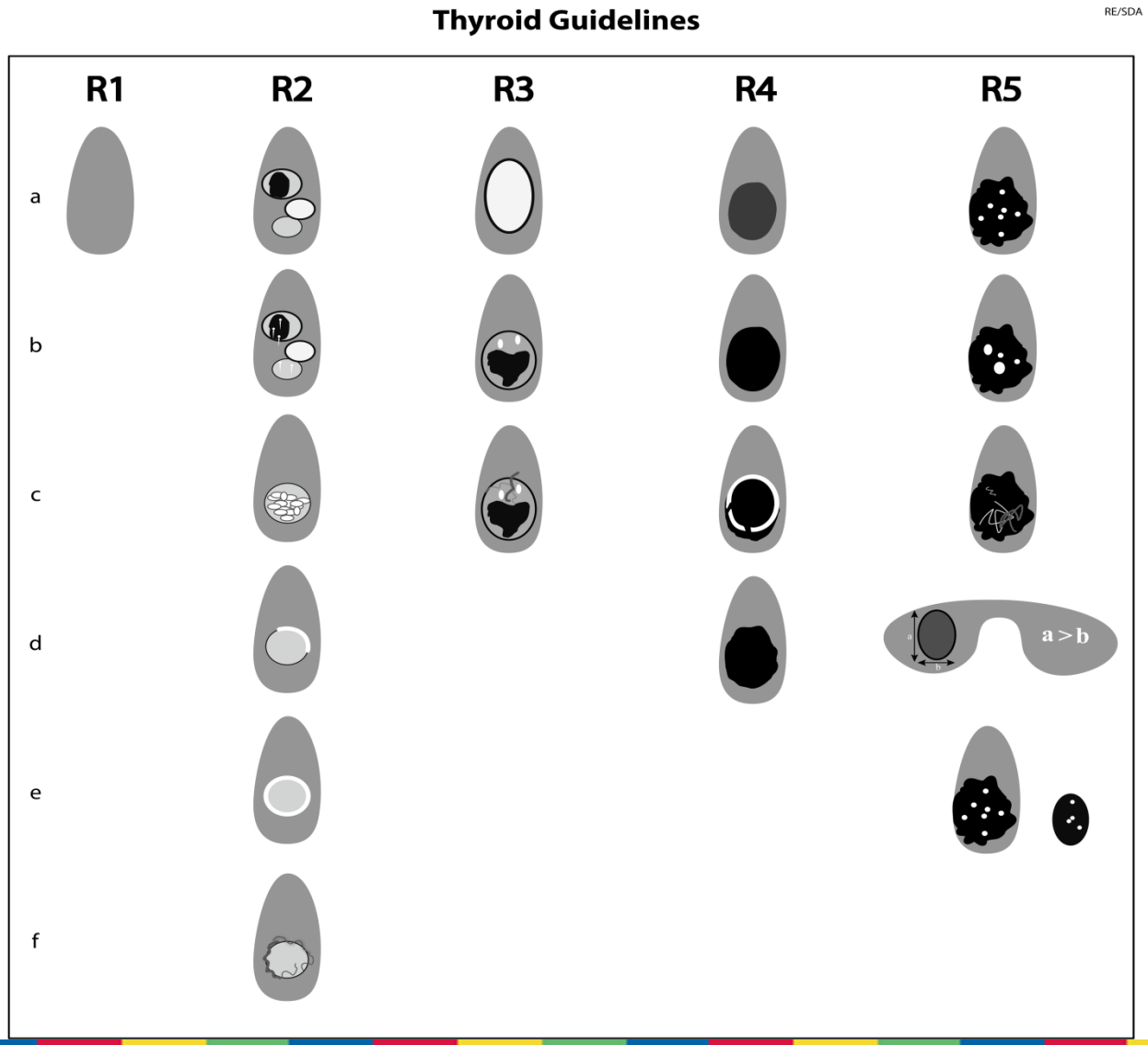


Fine and coarse Ca++ | Solid with Coarse Ca++



Cystic with solid elements and Ca++ | Solid with micro and peripheral Ca++

BTA Scoring System U1-U5



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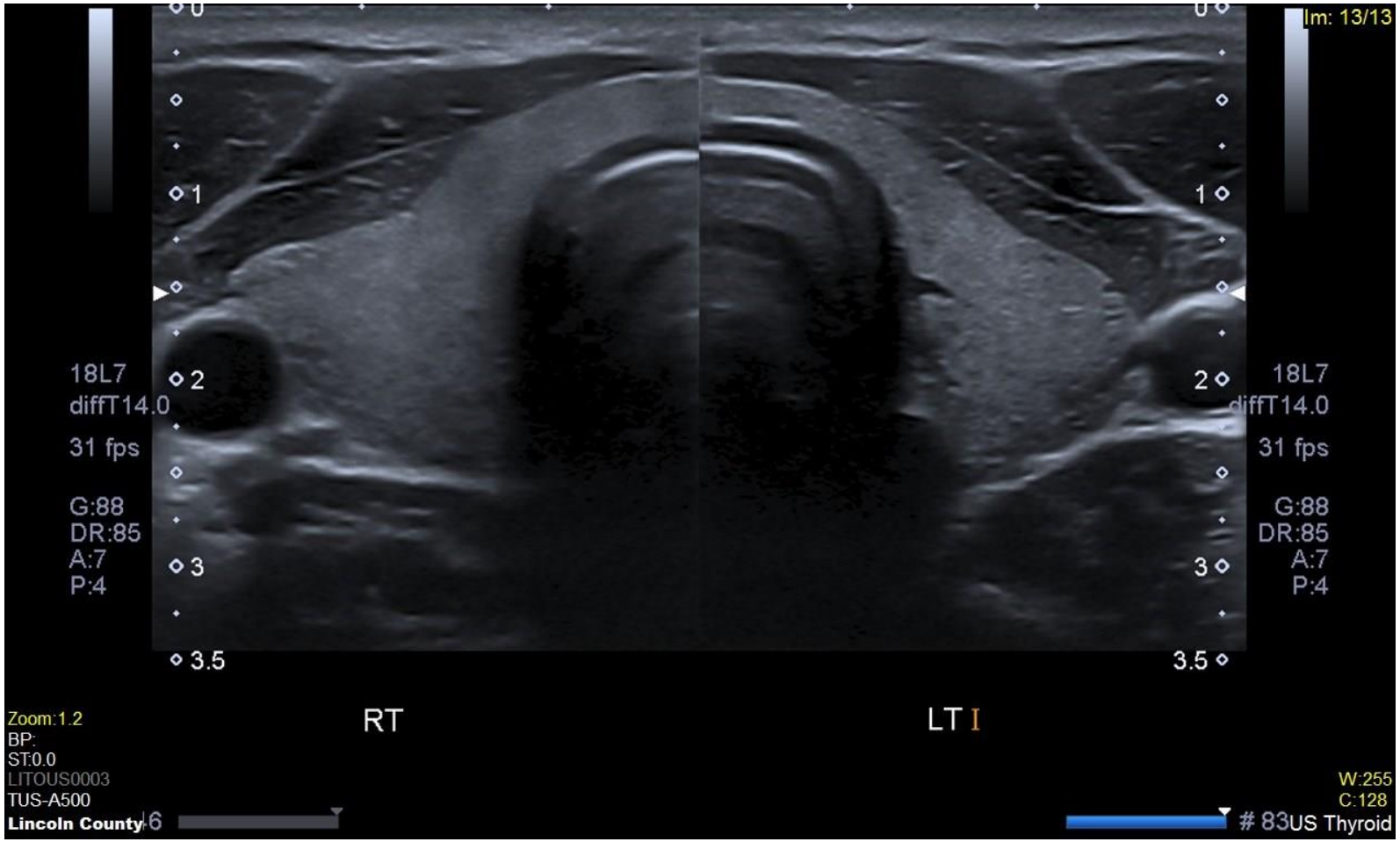
U1 -Normal



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U2 – Benign

Cyst

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U2 – Benign

Cyst with retracted clot

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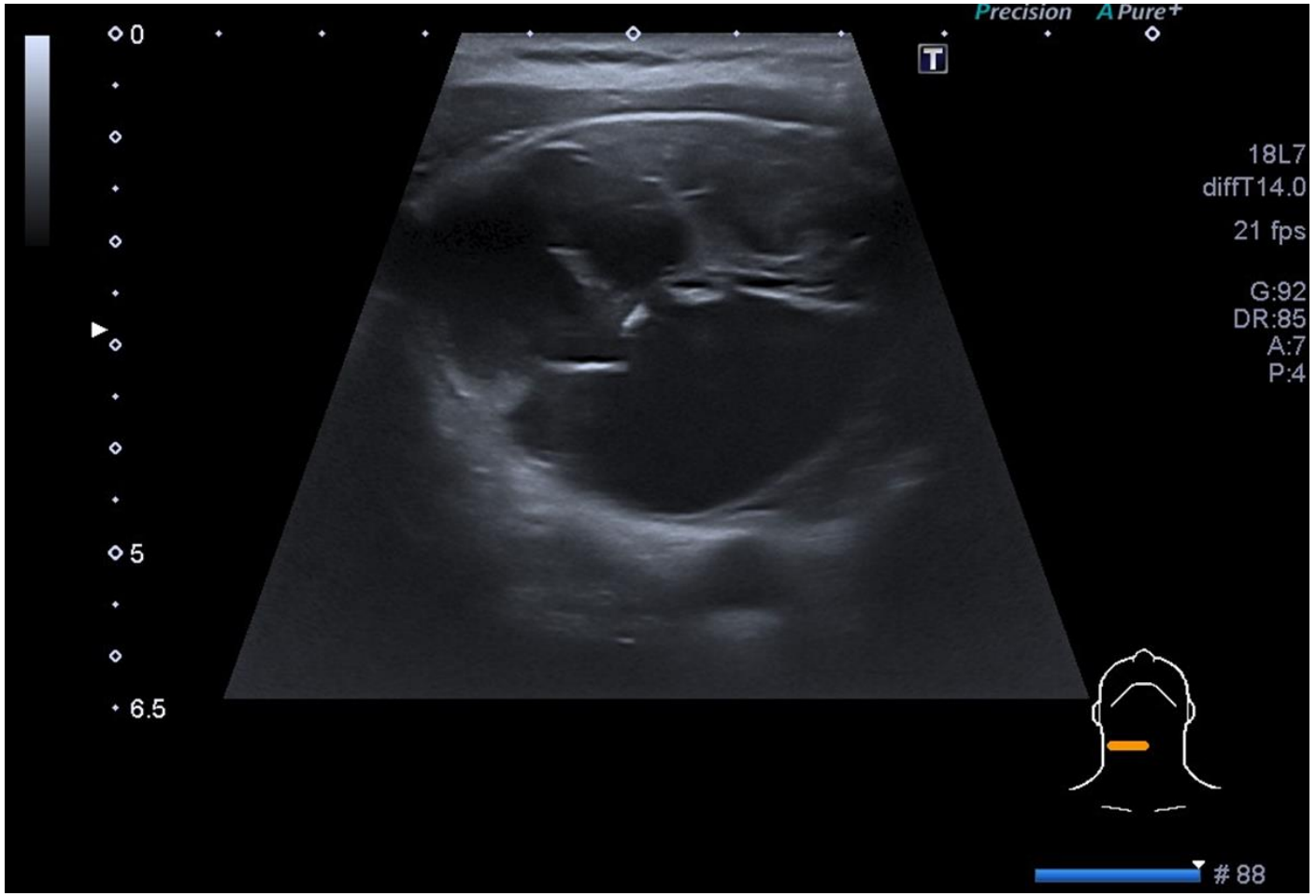
U2 Benign

Cyst with thick internal septations



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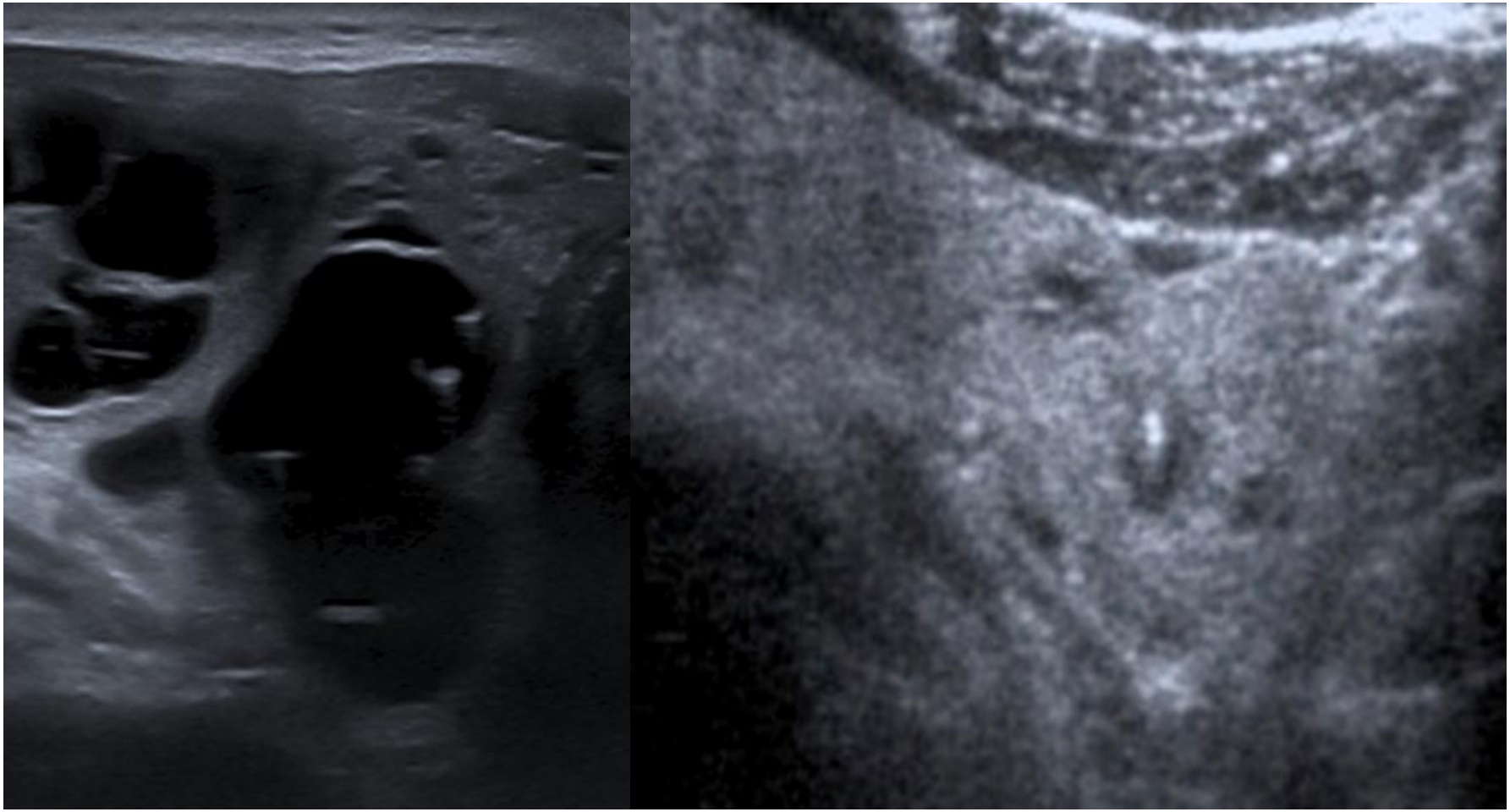
U2 Benign

Colloid



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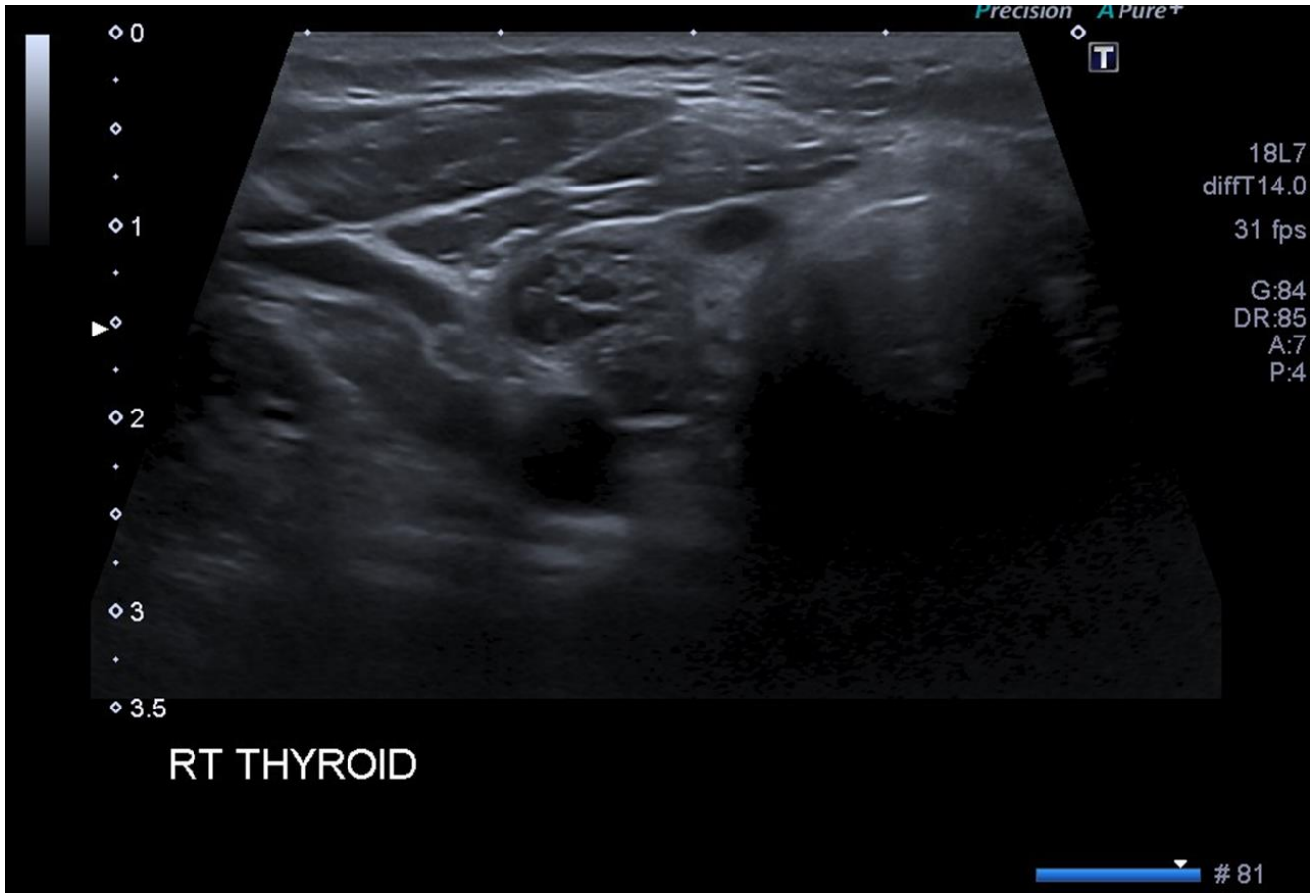
U2 Benign

Spongiform



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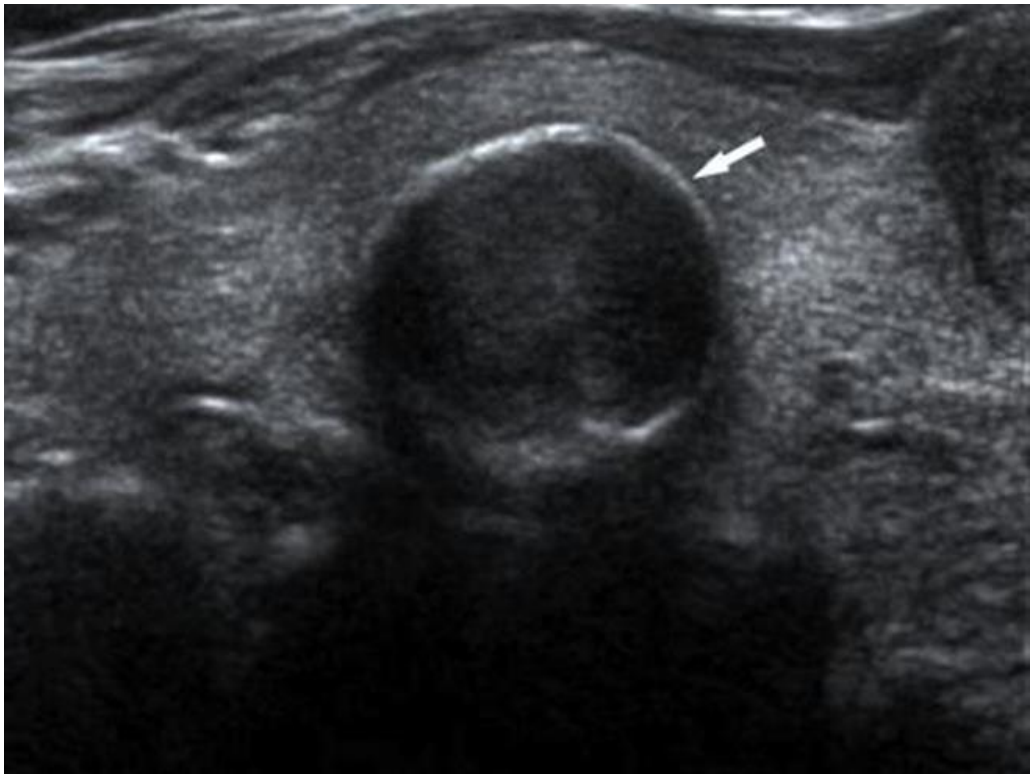
U2 Benign

Spongiform

U2 Benign



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U2 Benign

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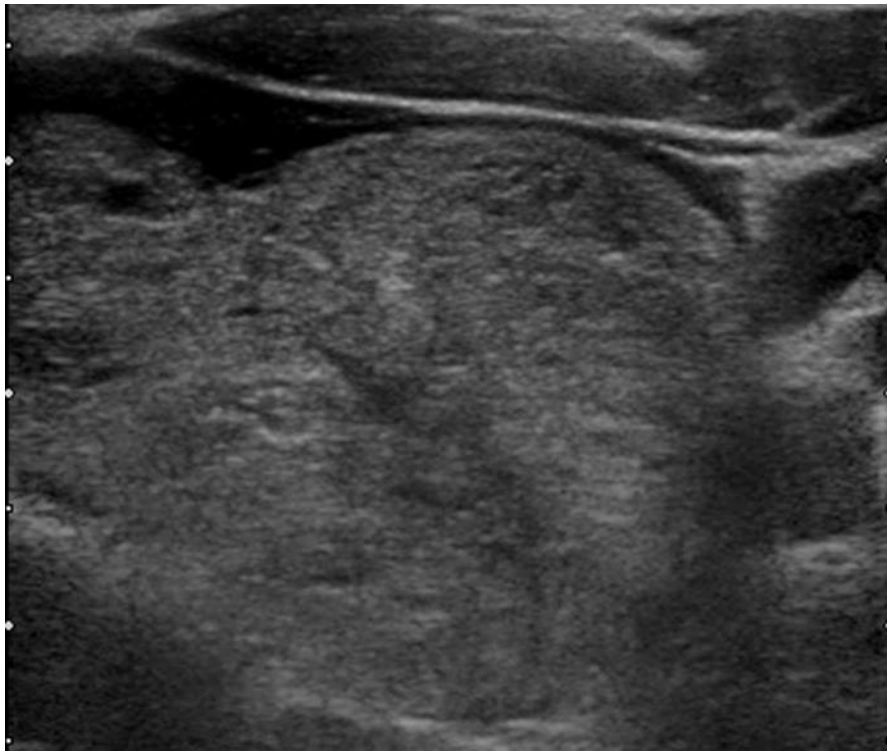
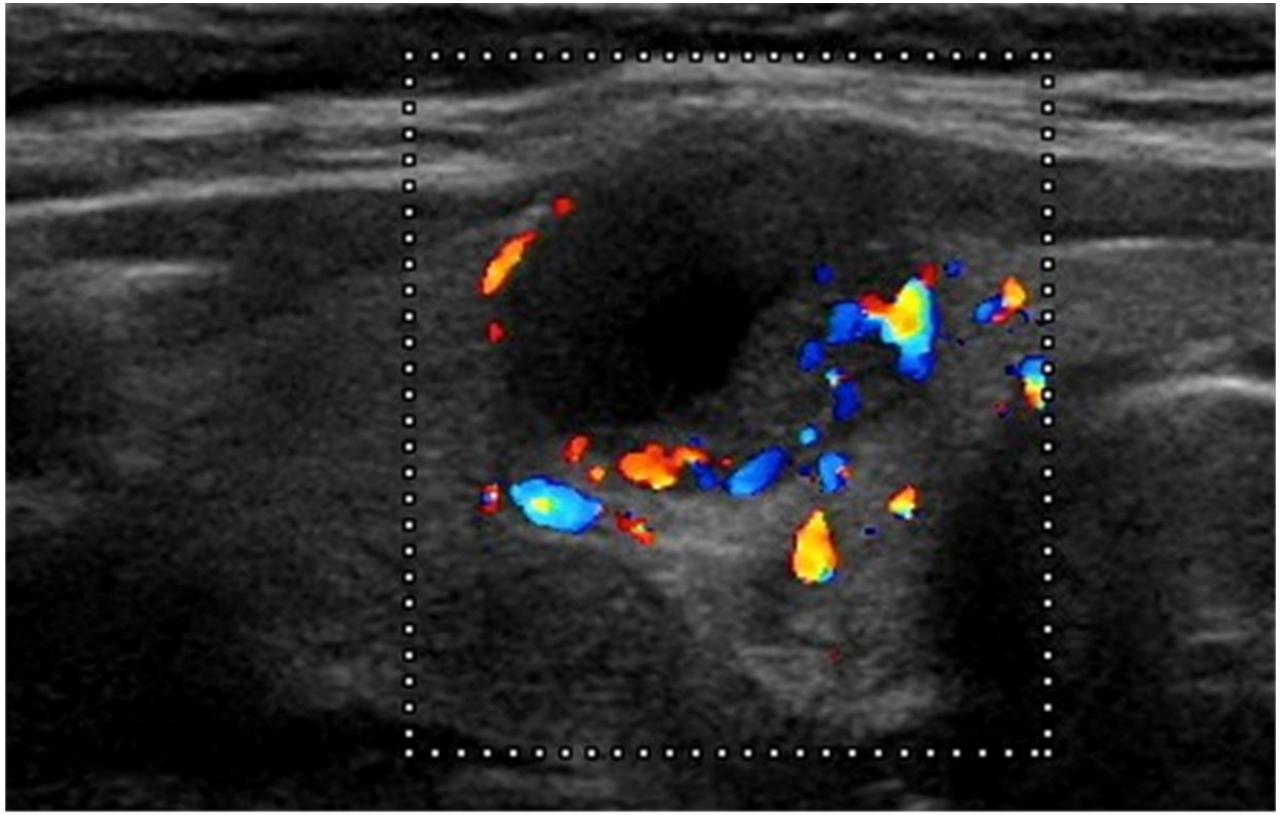
U2 Benign

Multiple Isoechoic Nodules



U3 -Indeterminate

- Cystic and solid nodule with Doppler signal



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U3

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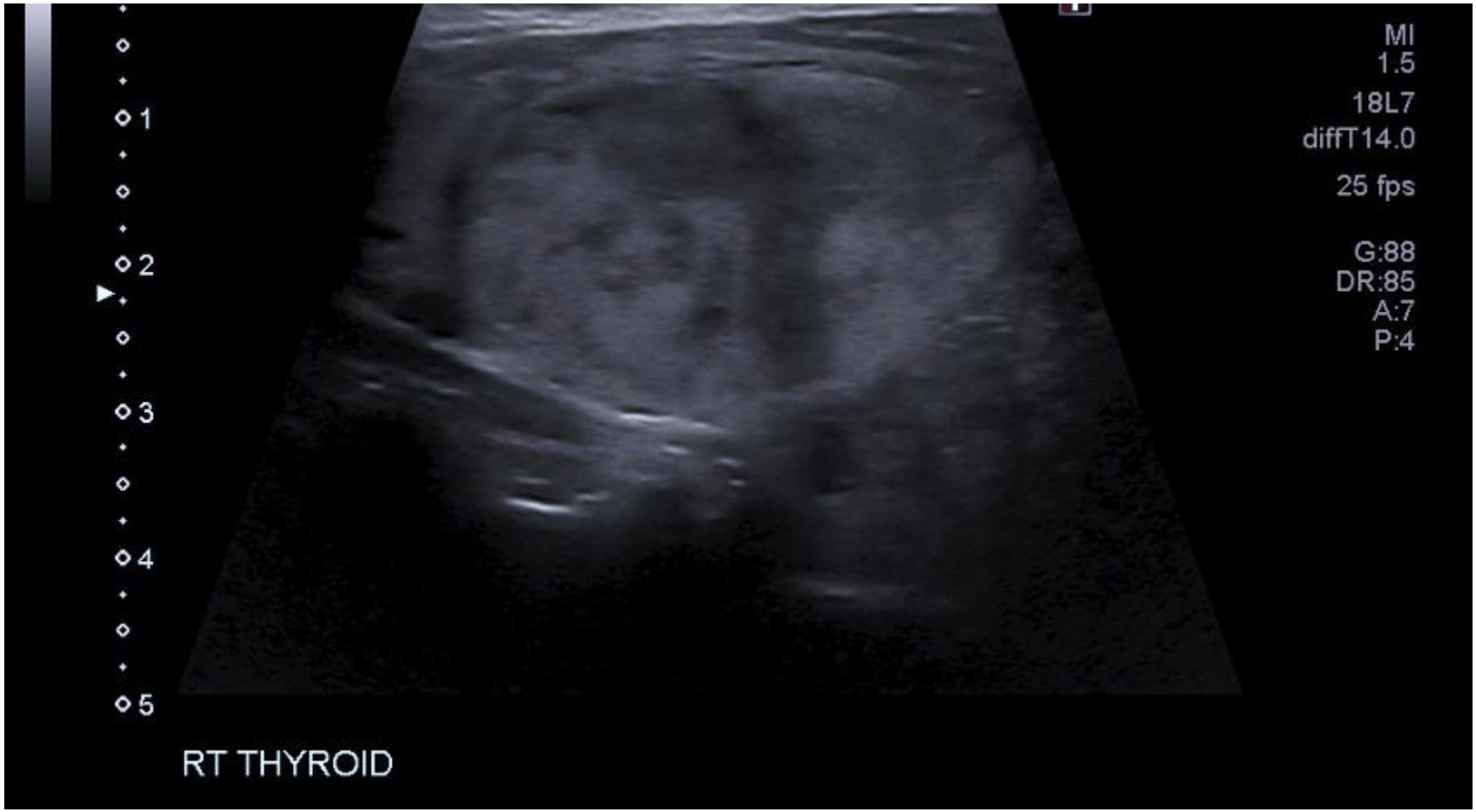
U3



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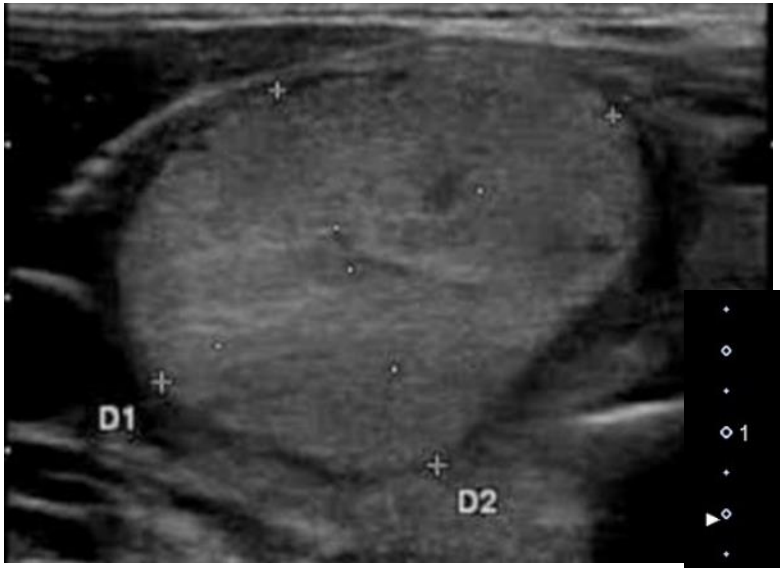
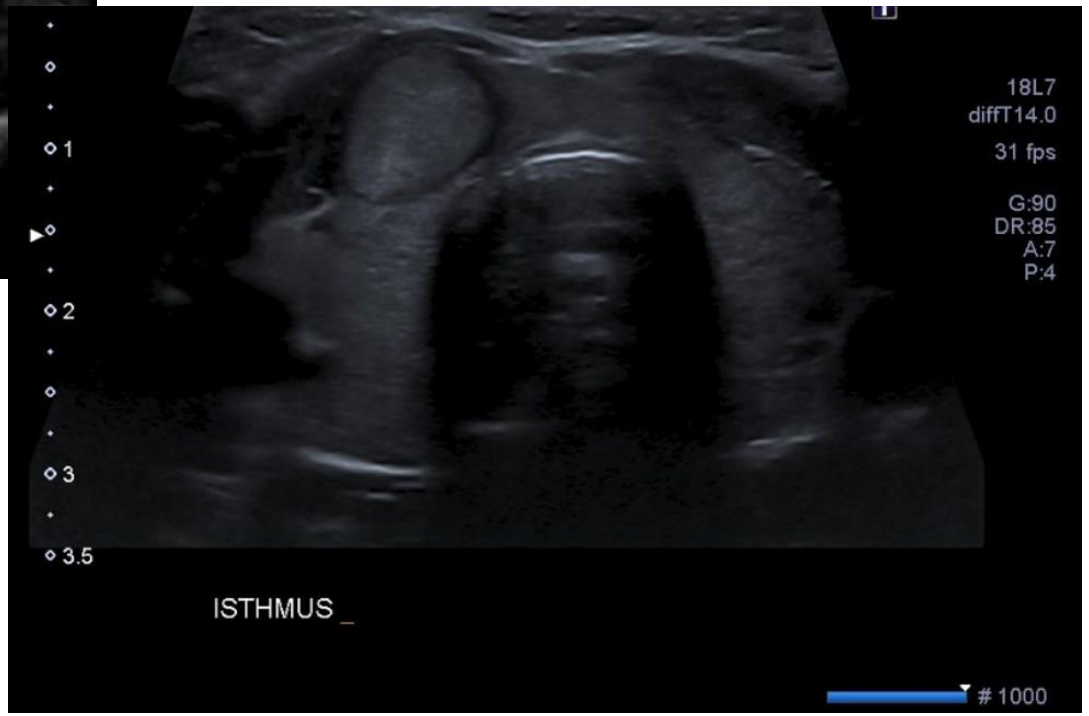
U3





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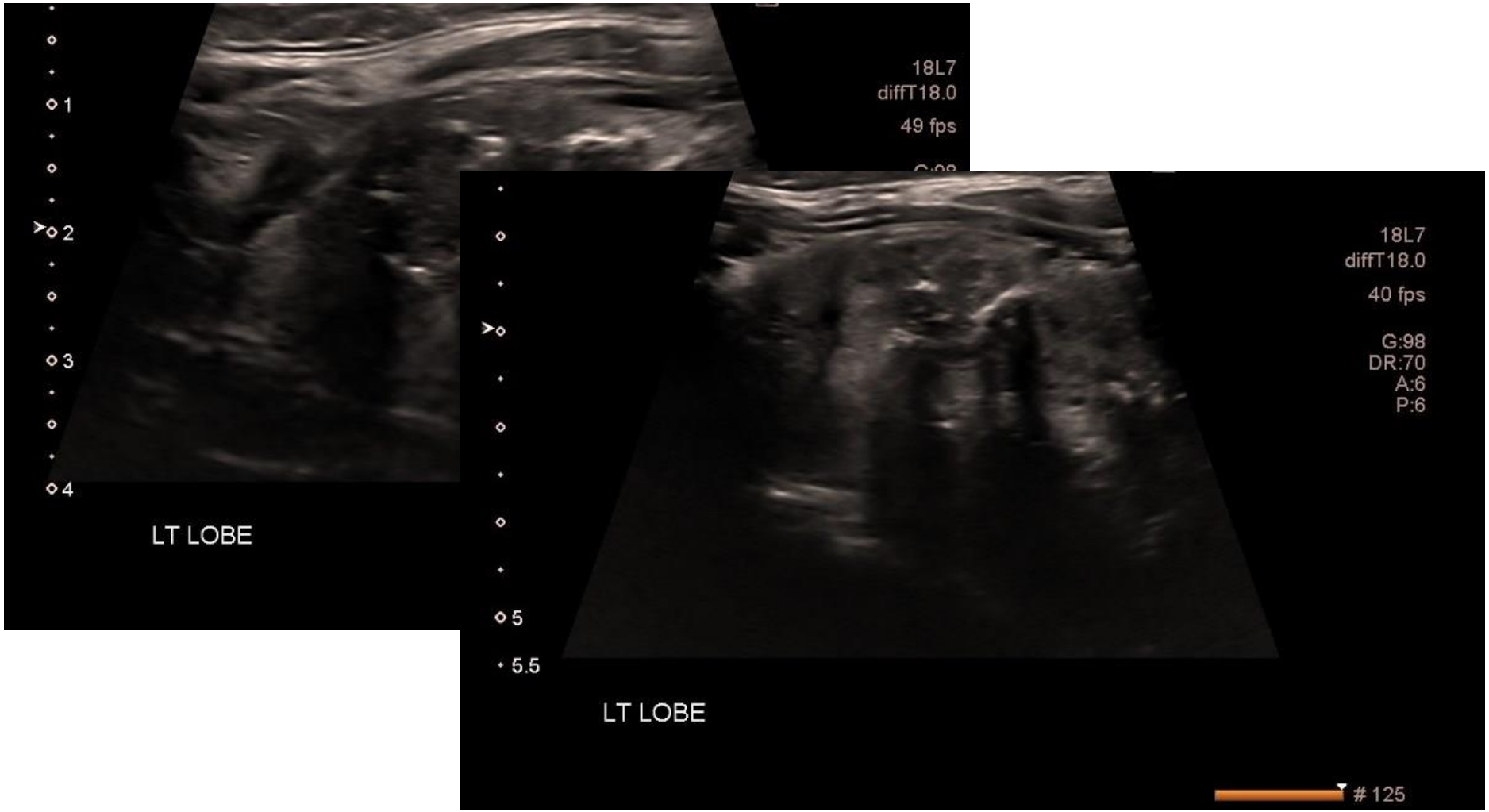
U4 - Suspicious



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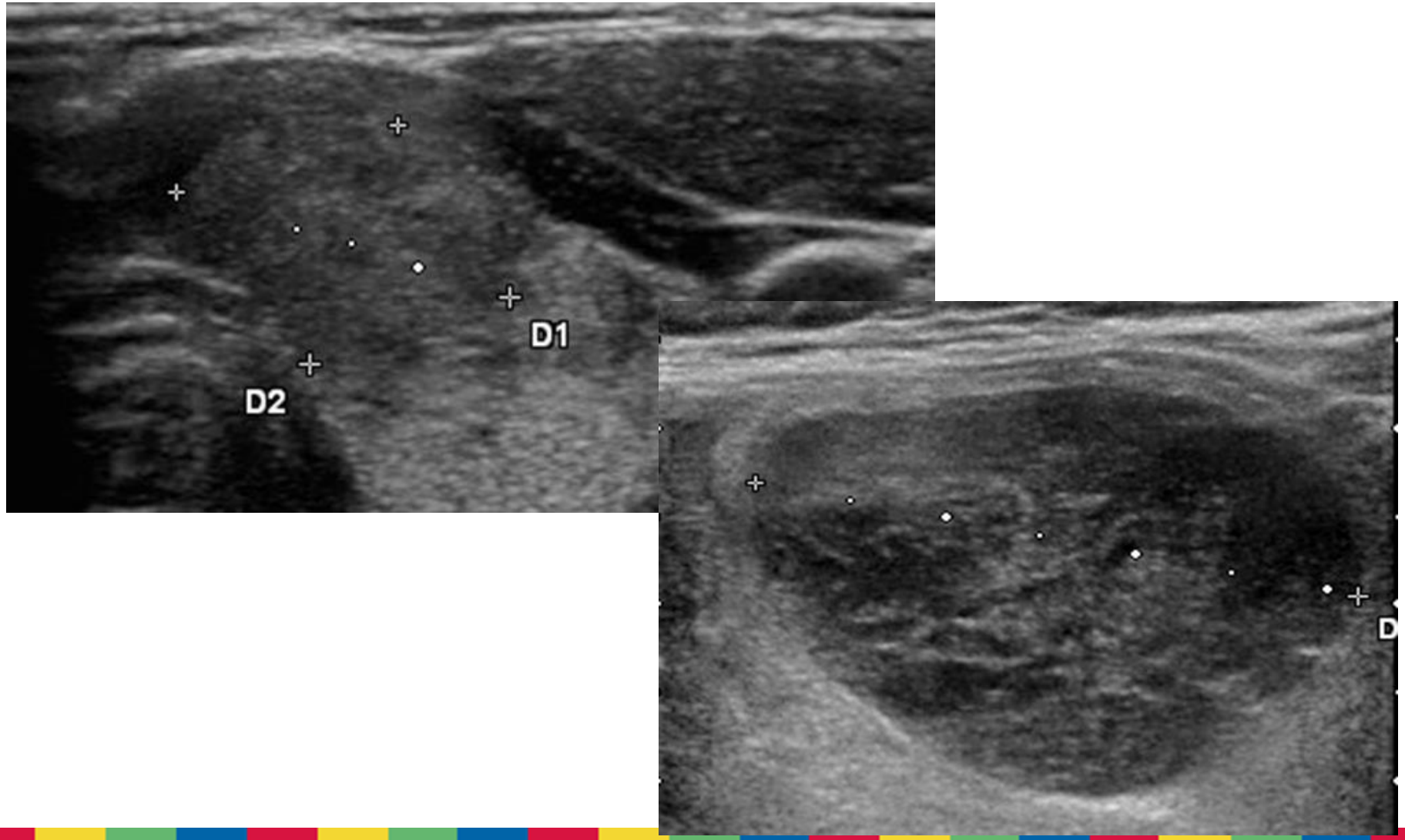
U4



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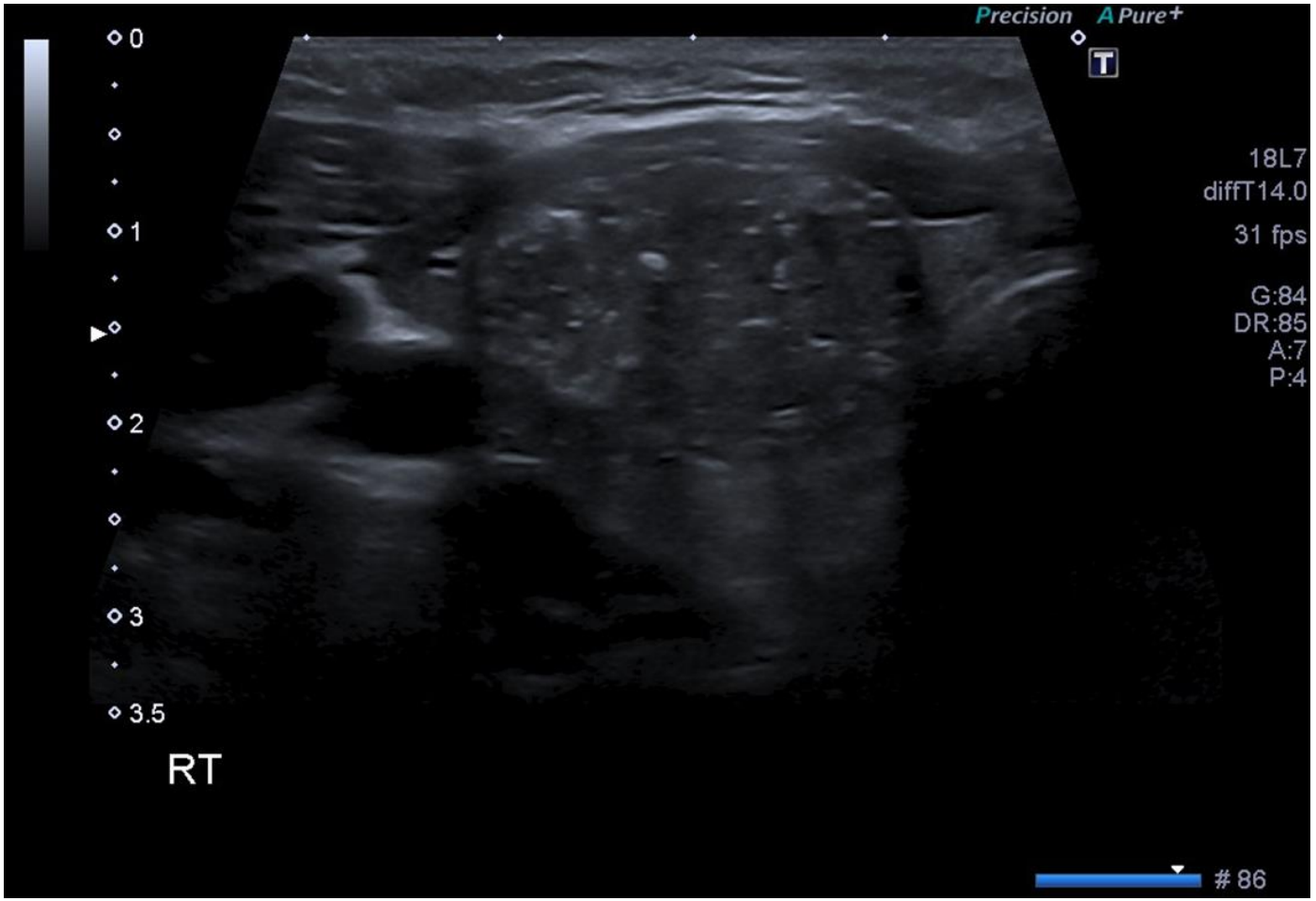
U5



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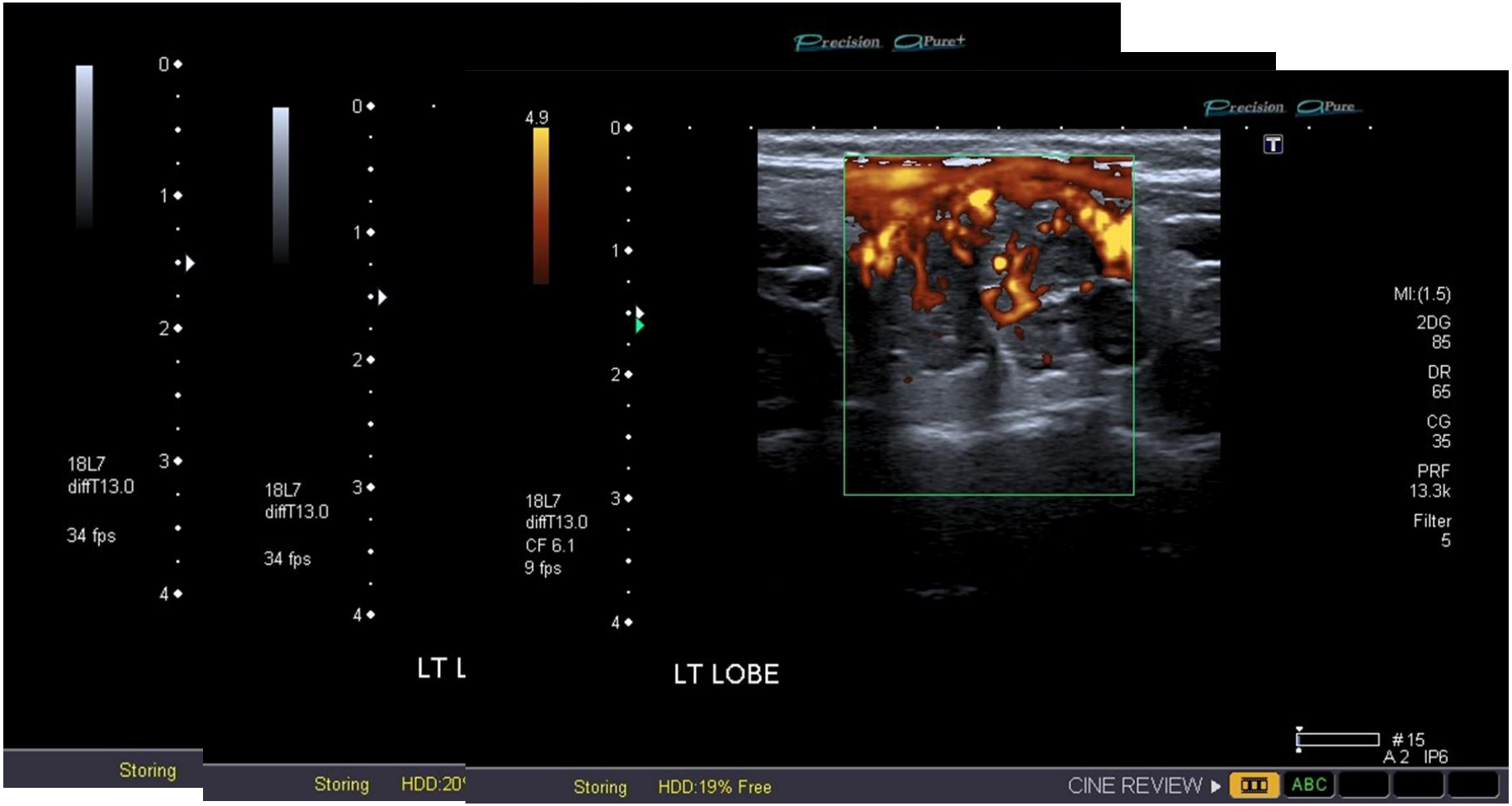
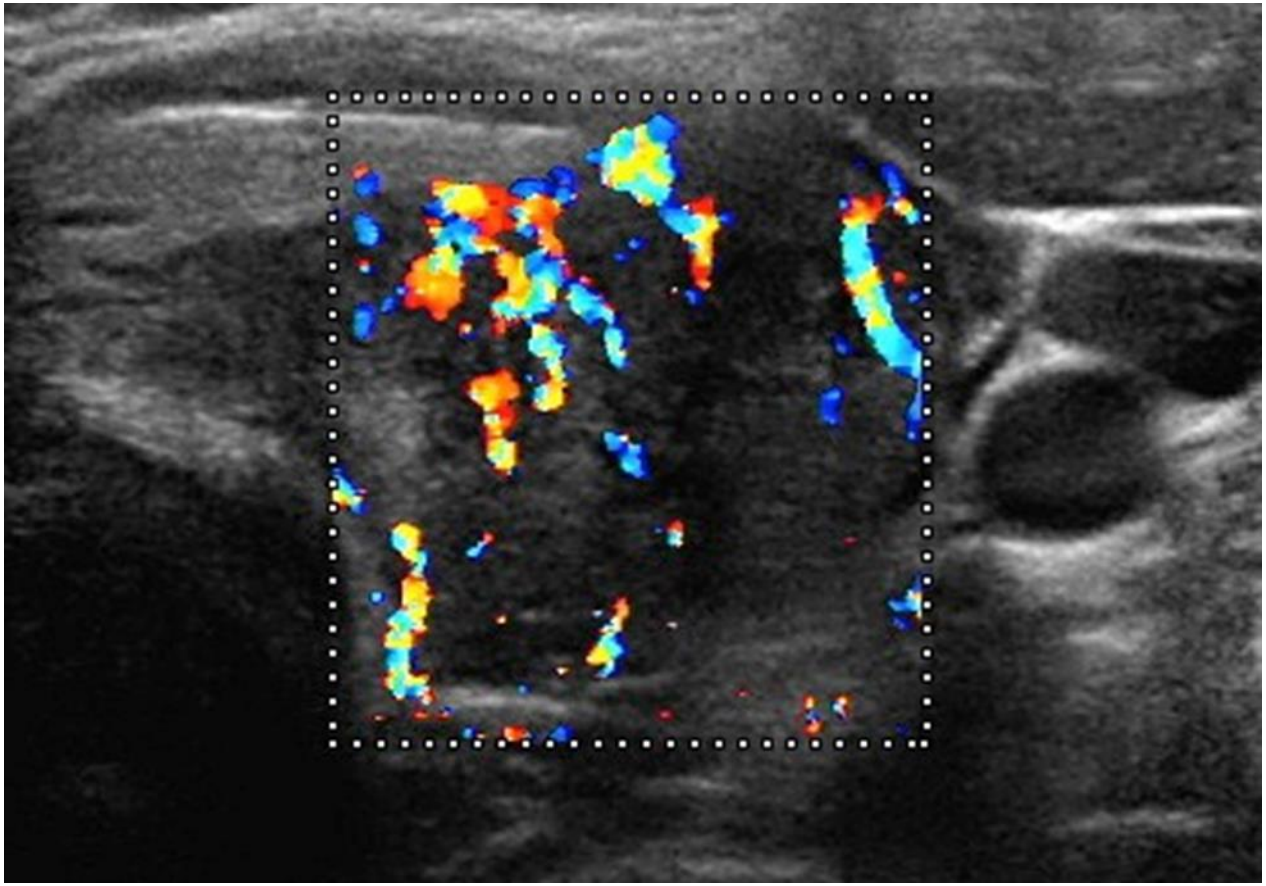
U5



U5



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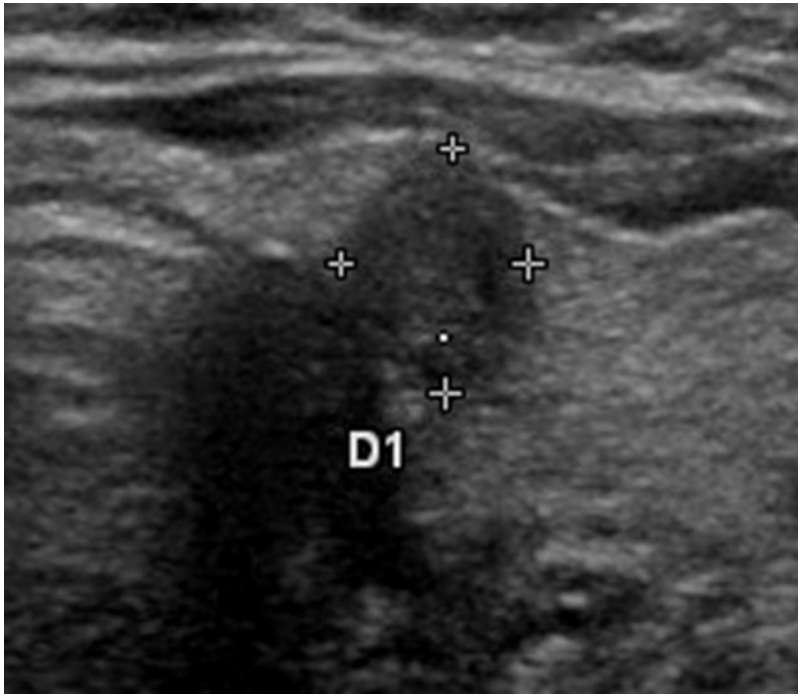
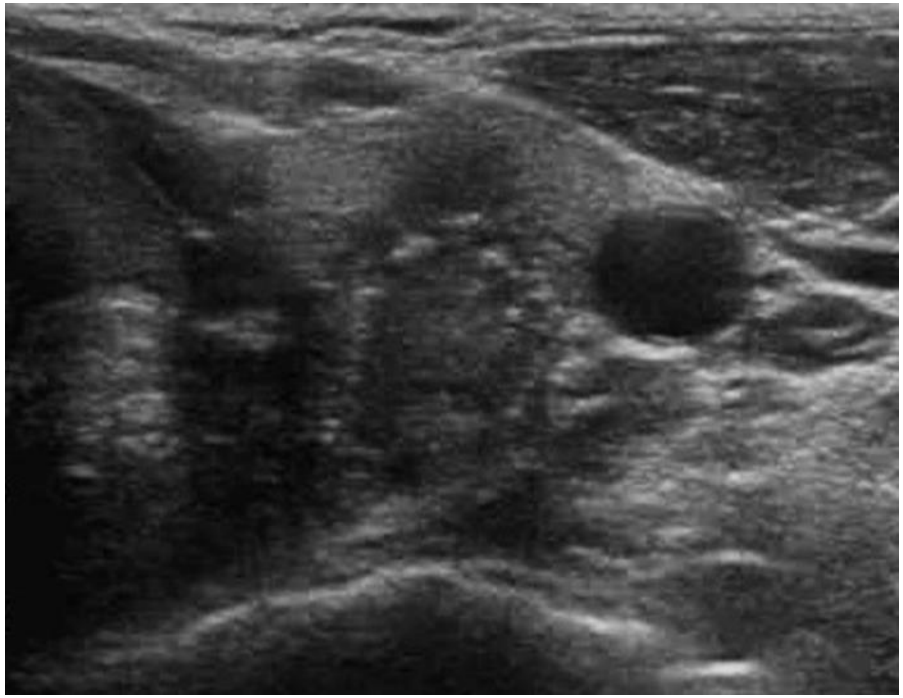
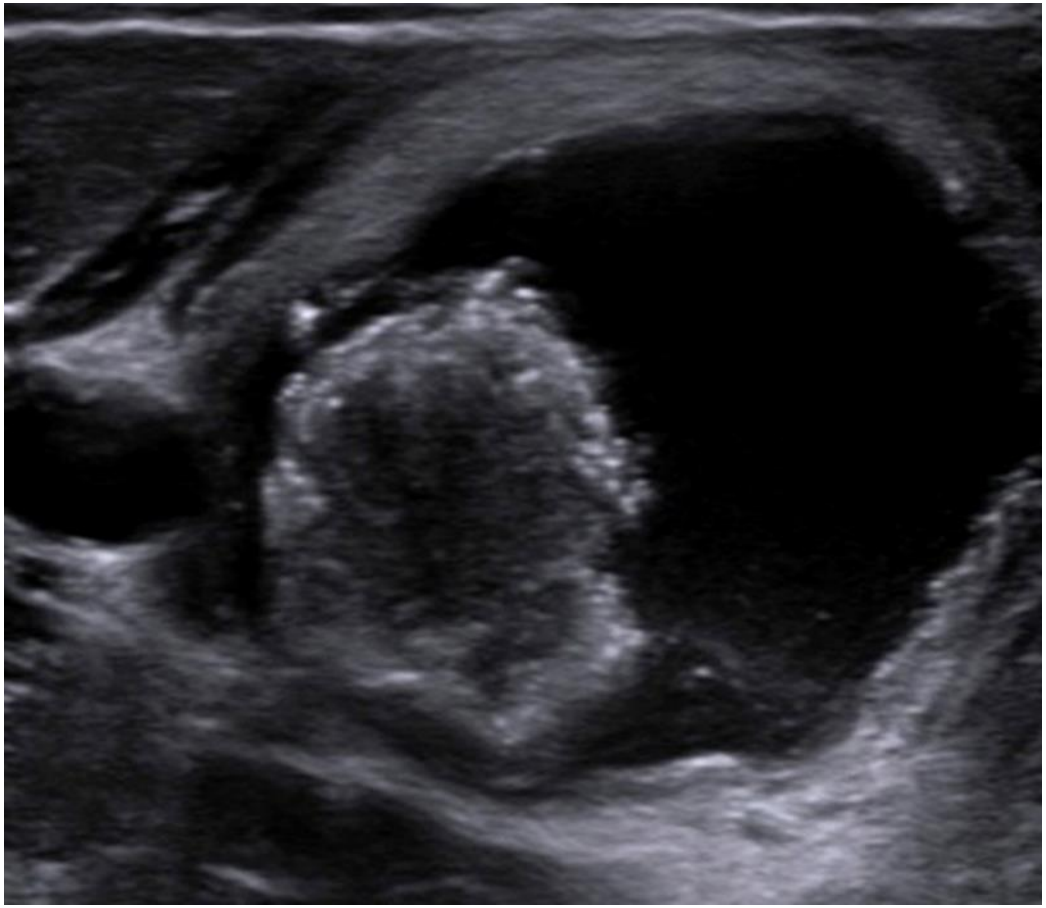




TALLER THAN WIDE IN THE TS PLANE

U5



CYSTIC PAPILLARY CARCINOMA

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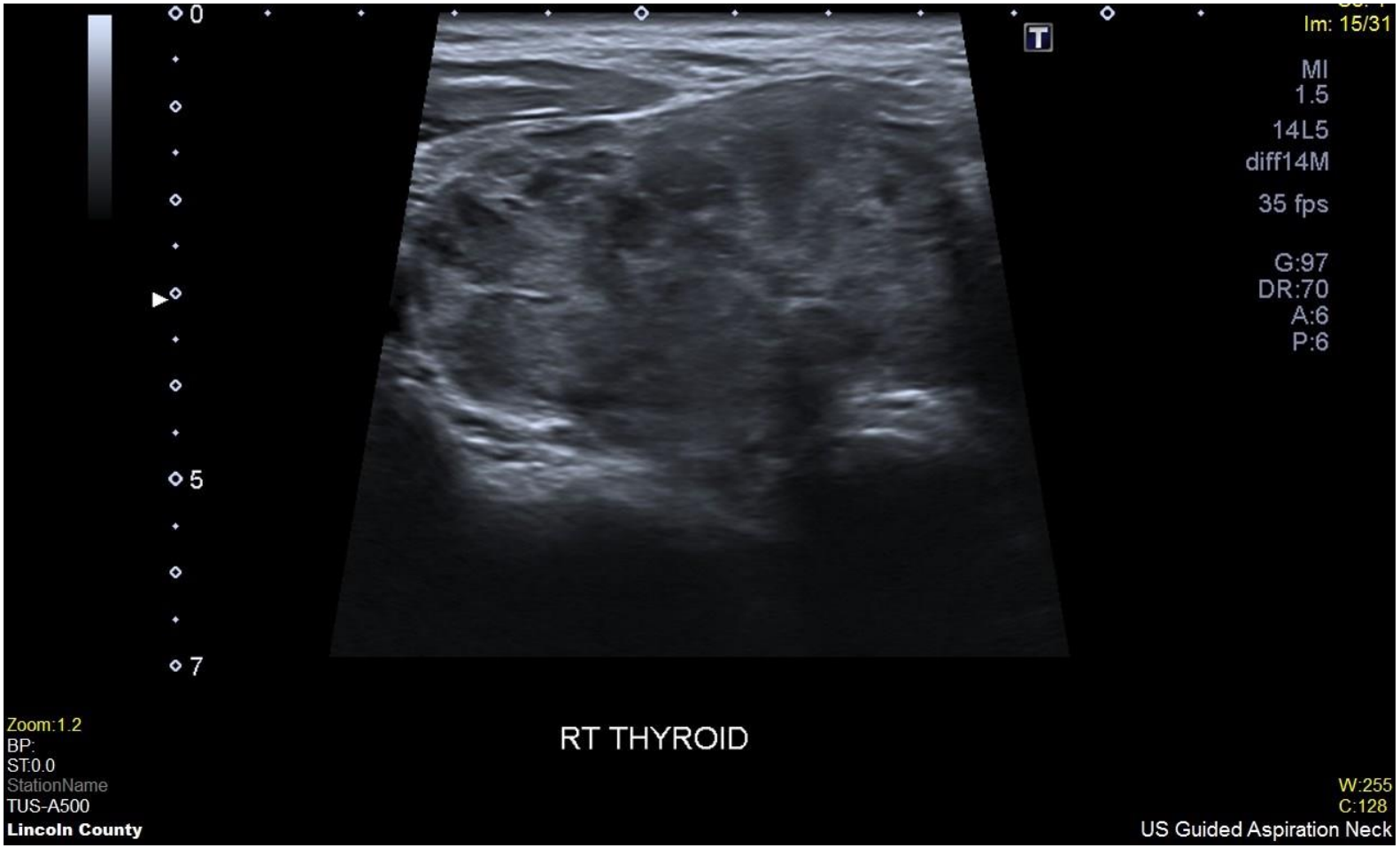
U5

Anaplastic



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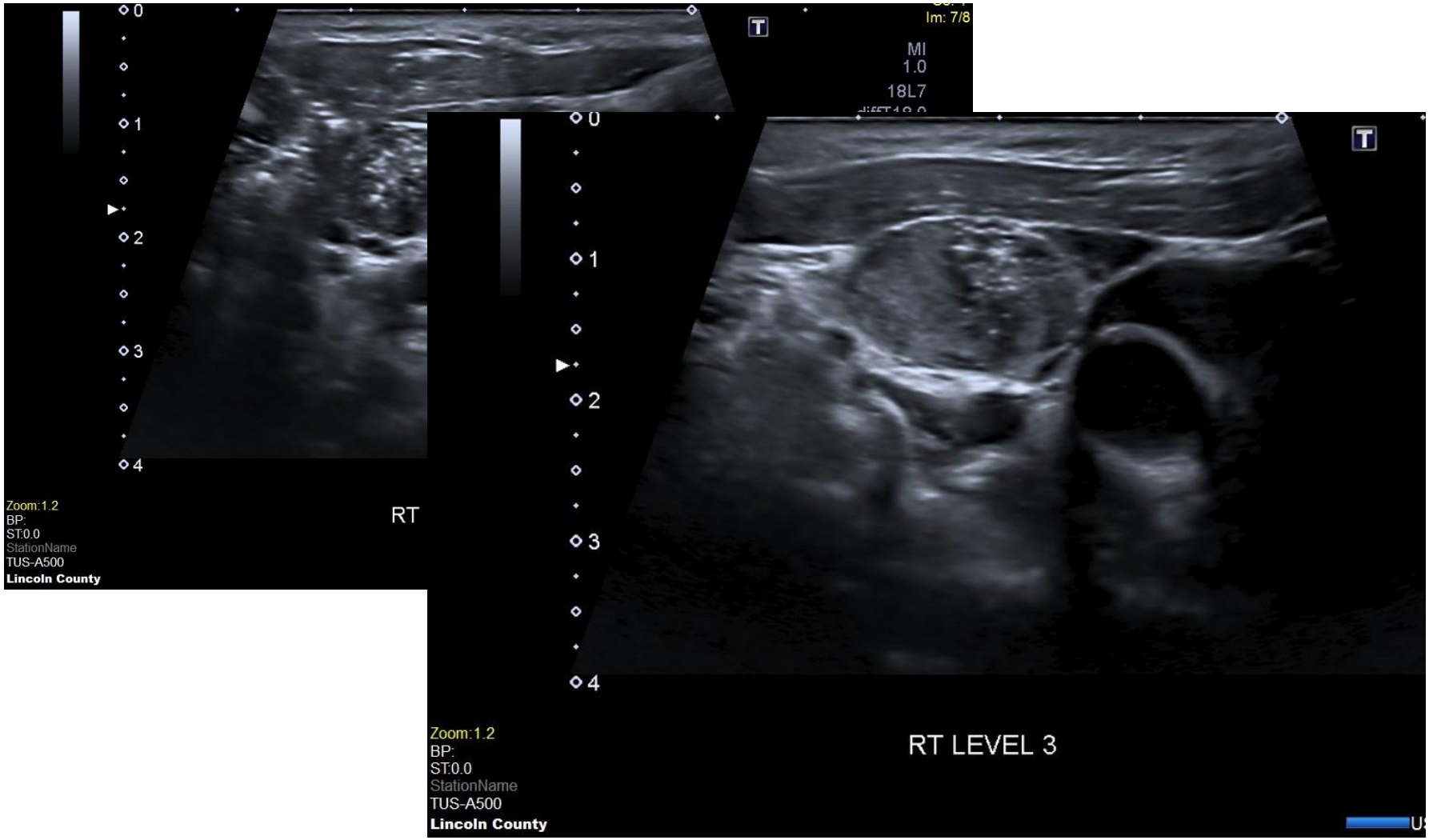
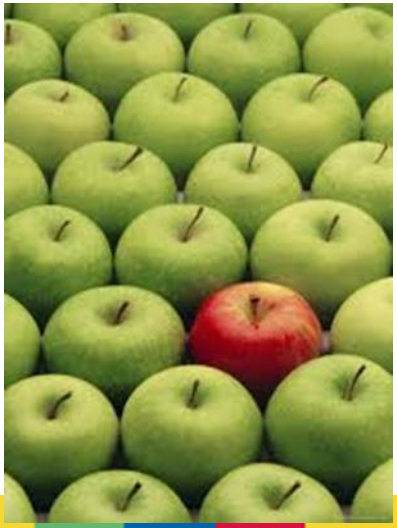
U5 nodes



Does size matter?

- Dominant Nodule
- Current thinking states we should now not use the term “dominant nodule”
- Whilst size of the tumour has major consequences in staging and prognosis of thyroid cancer, the size of the thyroid nodule correlates poorly with the risk of malignancy



Ultrasound Assessment of Thyroid Nodules

- U1. Normal.

- U2. Benign:

(a) halo, hyper- / iso-echoic

(b) cystic change +/- ring down sign (colloid)

(c) micro- cystic / spongiform

(d & e) peripheral egg shell calcification

(f) peripheral vascularity.

- U3. Indeterminate/Equivocal:

(a) homogenous, iso-/hyper- echoic, solid, halo (follicular lesion).

(b) ? hypo-echoic, equivocal echogenic foci, cystic change

(c) mixed/central vascularity.

- U4. Suspicious:

(a) solid, hypo-echoic (cf thyroid)

(b) solid, very hypo-echoic (cf strap muscle)

(c) disrupted peripheral calcification, hypo-echoic

(d) lobulated outline

- U5. Malignant

(a) solid, hypo-echoic, lobulated / irregular outline,

micro-calcification. (? Papillary carcinoma)

(b) solid, hypo-echoic, lobulated/irregular outline, globular calcification (? Medullary carcinoma)

(c) intra-nodular vascularity

(d) shape (taller >wide)

(e) characteristic associated lymphadenopathy

- **Relevant Nodule Size**
- **Nodule Composition:** Solid, cystic, mixed solid /cystic, microcystic/
- spongiform.
- **Cystic Component:** ? Ring down sign - colloid
- **Echogenicity:** Markedly hypo-echoic, hypo-echoic, iso-echoic, hyperechoic
- **Calcifications:** Micro-calcification, macro-calcification, rim / egg shell
- **Margin:** Well defined, irregular/lobulated, spiculated
- **Taller than Wide:** AP > TR: Y / N
- **Halo:** Regular / continuous, interrupted, absent
- **Colour flow:** Central, peripheral, mixed, none
- **Extent:** Retrosternal extension / tracheal deviation
- **Classification:** Benign (U2), equivocal / indeterminate (U3),
- suspicious (U4), malignant (U5)
- **Lymphadenopathy:** Suspected malignancy – ? metastases: anatomical

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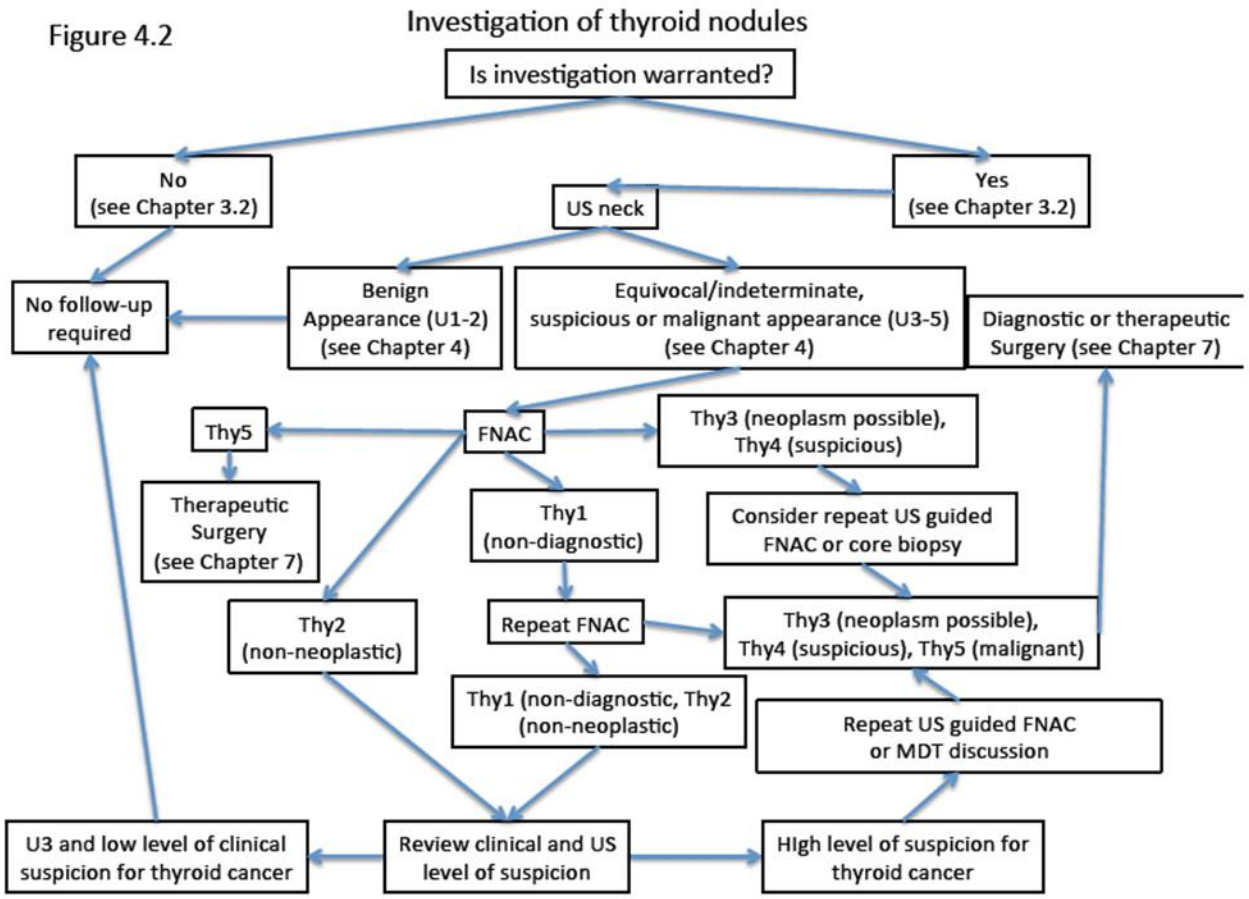
Why is our report important?

Figure 4.2



Why is our report important?

- The classification of the nodules allows the targeting of U3-5 nodules for ultrasound guided FNA or biopsy
- Identifies nodules to be targeted as FNA of a dominant nodule is common but mistaken practice

Should we follow nodules up?

- Long term follow up of thyroid nodules
  - Increase demand on the ultrasound service
  - Increase FNA's
  - But…. There is no improvements in malignancy rates

Lee S, Skelton TS, Zheng F. Biopsy proven benign thyroid nodule: is long term follow up necessary. *J Am Coll Surg* 2013, 217(1): 81 – 8.

Should we follow nodules up?

- 294 / 330 nodules enlarged
- Average 15% growth
- 74 nodules had significant growth (≈ 69%)
- Re-FNA showed cancer in only 1 / 74.

Alexander EK et al. Natural History of Benign Solid & Cystic Thyroid Nodules. *Ann Int Medicine* 2003; 138: 315 – 318

Growth of nodules in benign disease is expected and not a predictor of malignancy

Should we follow nodule up?

Value of US Correlation of a Thyroid Nodule with Initially Benign Cytologic Results[1]

Jin Young Kwak, MD
Hyeryoung Koo, MD
Ji Hyun Youk, MD

Radiology

Purpose: To investigate the value of ultrasonographic (US) features in thyroid nodules with initially benign cytologic results.

Radiology 2010. 254 (1): 292 - 300

1343 nodules with US, FNA, pathological correlation

Total:	Benign 98.1%	Malignant 1.9%
Benign initial US + Thy 2 FNA:	**Benign 99.4%**	**Malignant 0.6%**
Suspicious initial US + Thy 2 FNA:	**Benign 79.6%**	**Malignant 20.4%**

Should we follow nodules up?

- Presence or absence of growth is not an indicator of malignancy or benignity

- Interval growth has low PPV for malignancy

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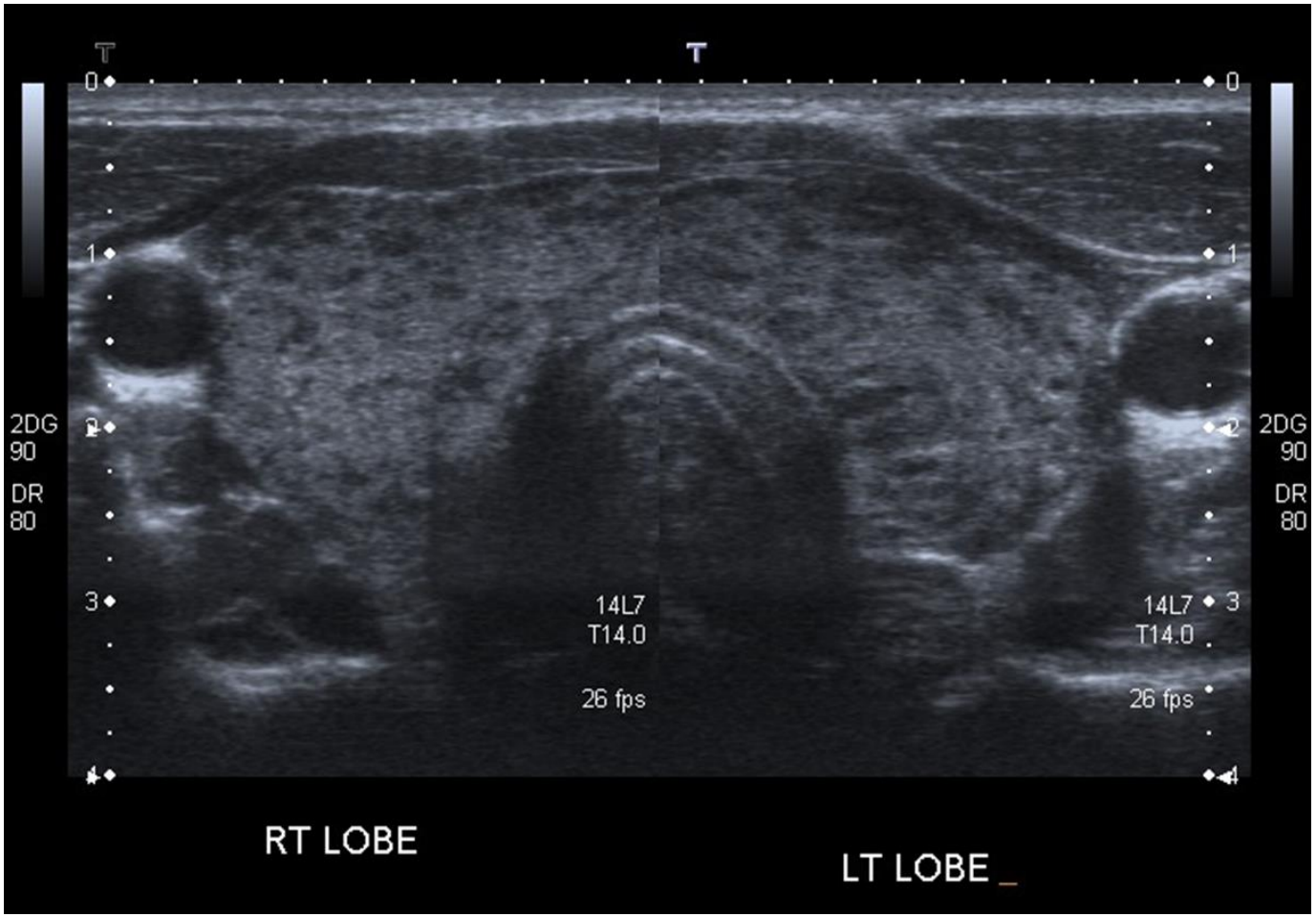
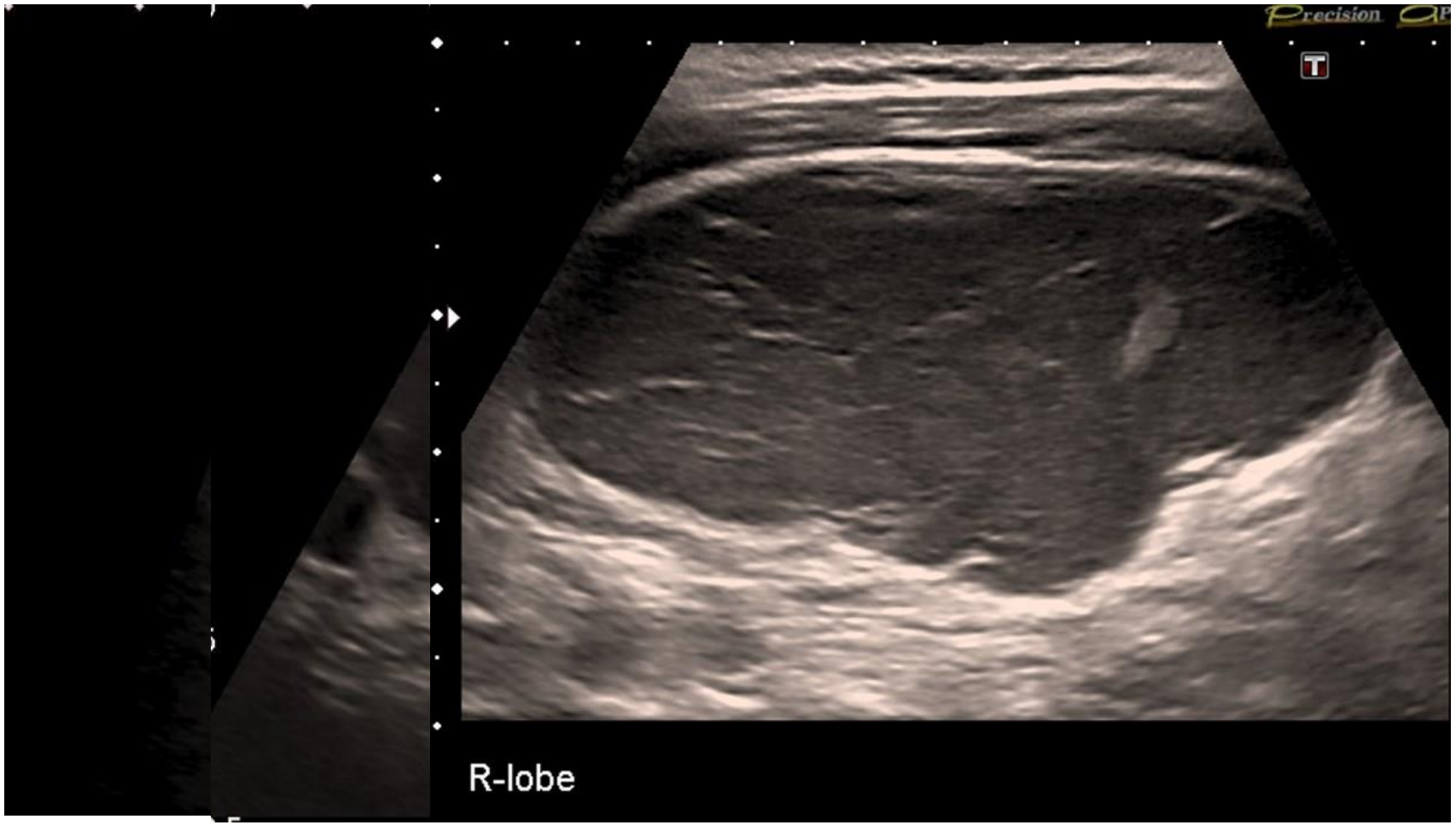
Pitfalls



Pitfalls



Conclusion

- Thyroid scanning – not too bad! ☺
- Reporting thyroids – complex ☹
- Made easier by the U scoring system ☺
- Don’t pay attention to dominant nodules only!

Questions?


BMUS
Ultrasound 2017
6 - 8th December 2017
Cheltenham Racecourse