THYROID AND NECK SONOGRAPHY

Special Attention To Focal Intrathyroid Lesions

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OBJECTIVES

- Review specific US features of focal thyroid lesions
- Discuss ACR TI –RADS Classification and Recommendations
- Neck Lymph node Evaluation
- Review pitfalls in thyroid imaging that can alter the interpretation
- Evaluation of Post Surgery Thyroid Bed

INTRODUCTION

- **Goiter** : enlarged thyroid gland

  (> 2 cm AP or transverse ; isthmus > 5 mm AP)

- **Thyroid nodules are common** ,prevalence increases:
  - = with age ; more in females
  - = wide application of ultrasound
  - = frequent incidental detection of nodules in other imaging procedures
- **Most patients with nodules are asymptomatic**
  - = found in 5 – 10 % of adults, by palpation
  - = found by means of ultrasound : 40 % - 76 %
  - = autopsy : 50 - 65 %

INTRODUCTION

- Most thyroid nodules are benign hyperplastic nodules

- Thyroid Ca incidence : range reported 1.6 % - 12 % of thyroid nodules

The purpose of thyroid nodule evaluation is to determine which nodules have features of malignancy, or require surgical attention

Thyroid and neck sonography should be performed in all patients :

- with known, or suspected thyroid nodules, or with recognized risk factors

- suspicious neck lymphadenopathy

- nodules incidentally seen in other modalities

- nodular goiter

NOTE : For MNG, cytologic sampling is focused on lesion with suspicious US features, rather than on larger, clinically dominant nodules

HISTORY AND PHYSICAL EXAM

Be aware of the high – risk patient (prevalence of CA is higher):

- prior head and neck irradiation
- family hx of thyroid CA (parent / sibling)
- MEN (multiple endocrine neoplasia)
- adults < 30 years ; > 60 years
- male patient
- children
- rapid growth of a neck mass

Physical findings suggesting possible malignancy :

- vocal cord paralysis
- cervical lymphadenopathy
- fixation of a nodule to surrounding tissues

THYROID NODULE EVALUATION

- A) **CLINICAL ASSESSMENT** (HX AND PHYSICAL EXAM)

- B**) DIAGNOSTIC STUDIES : initial evaluation**

  - **TSH** : serum thyrotropin
  - **Thyroid Ultrasound** : nodule characterization *
    neck lymph nodes

FNA, in conjunction with US, forms cornerstone of thyroid nodule evaluation ; molecular markers

THYROID and NECK SONOGRAPHY

US DEFINITION OF THYROID NODULE

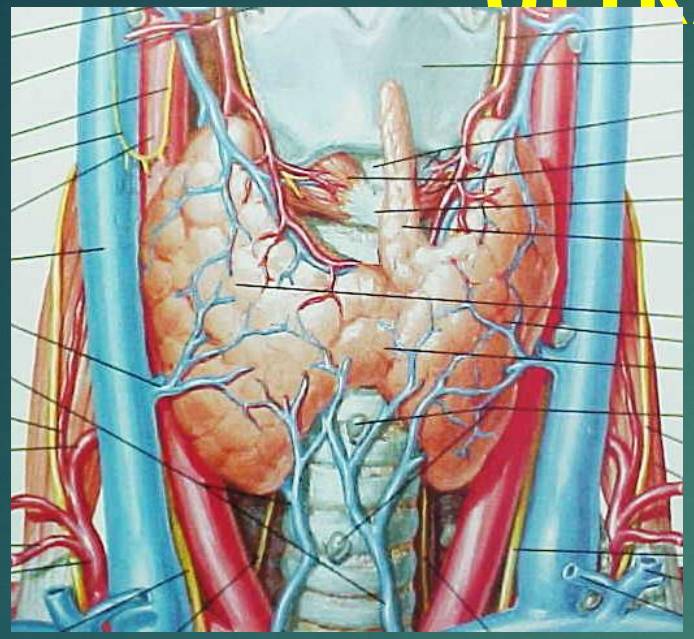
- Discrete measurable lesion within thyroid gland
- Distinct from surrounding parenchyma

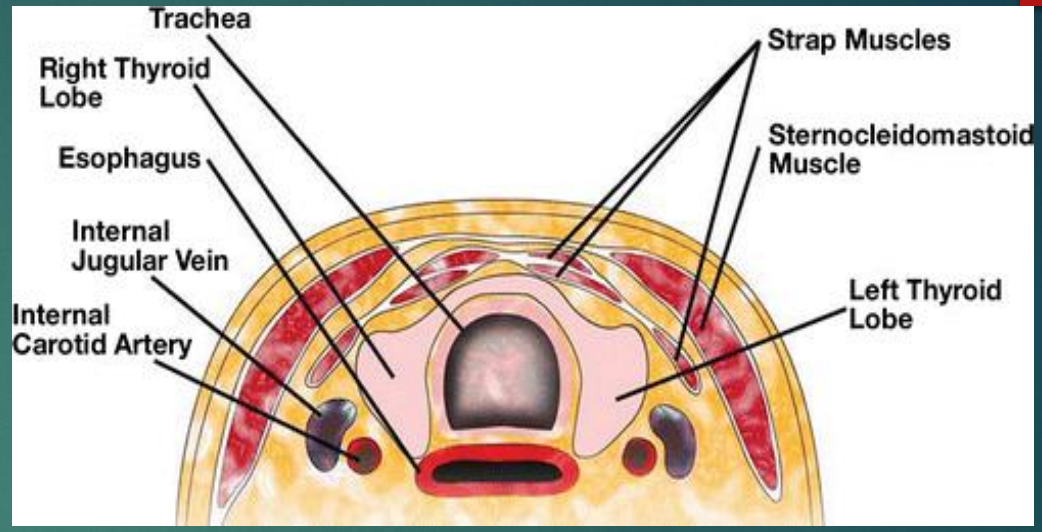
Some palpable lesions may not correspond to distinct radiologic abnormality

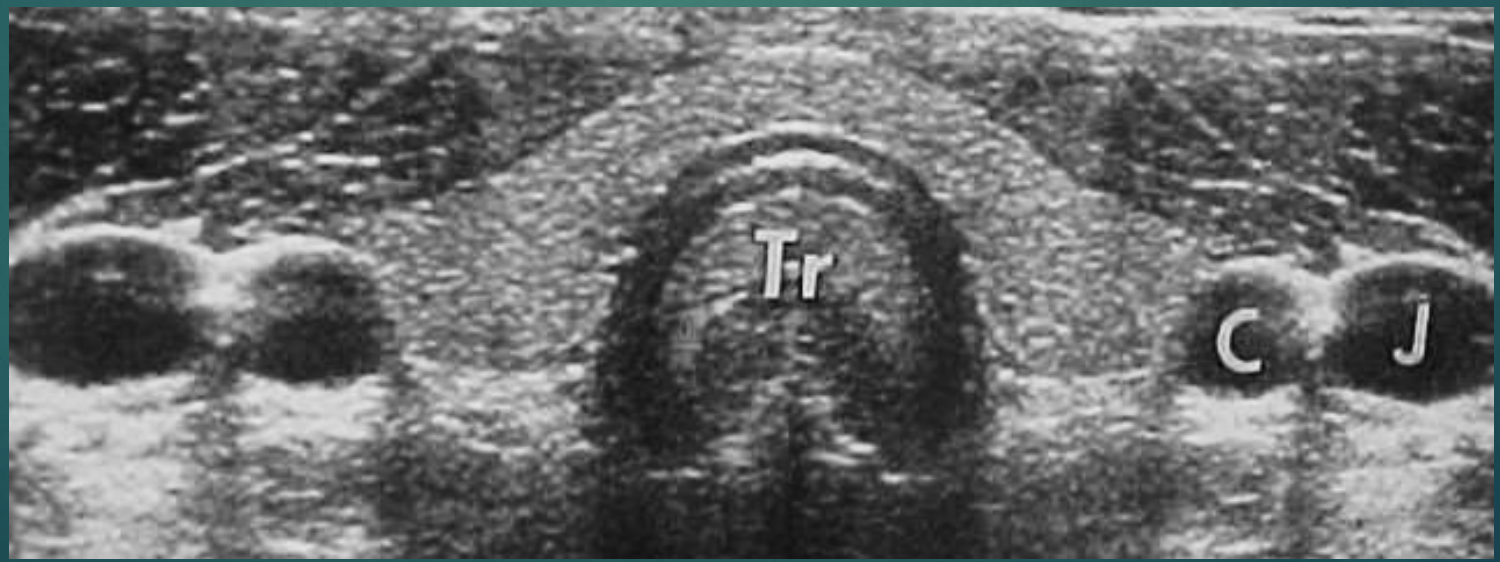
US IMAGING TECHNIQUE

- Patient in supine position
- Hyperextended neck, with pillow under shoulders
- Linear array transducer (high frequency > 7 mHz)
- Transverse views (upper , mid , lower) of each lobe ; and isthmus ; and longitudinal views (RT and Left lobes)
- Look for neck lymph nodes ; use Color Doppler

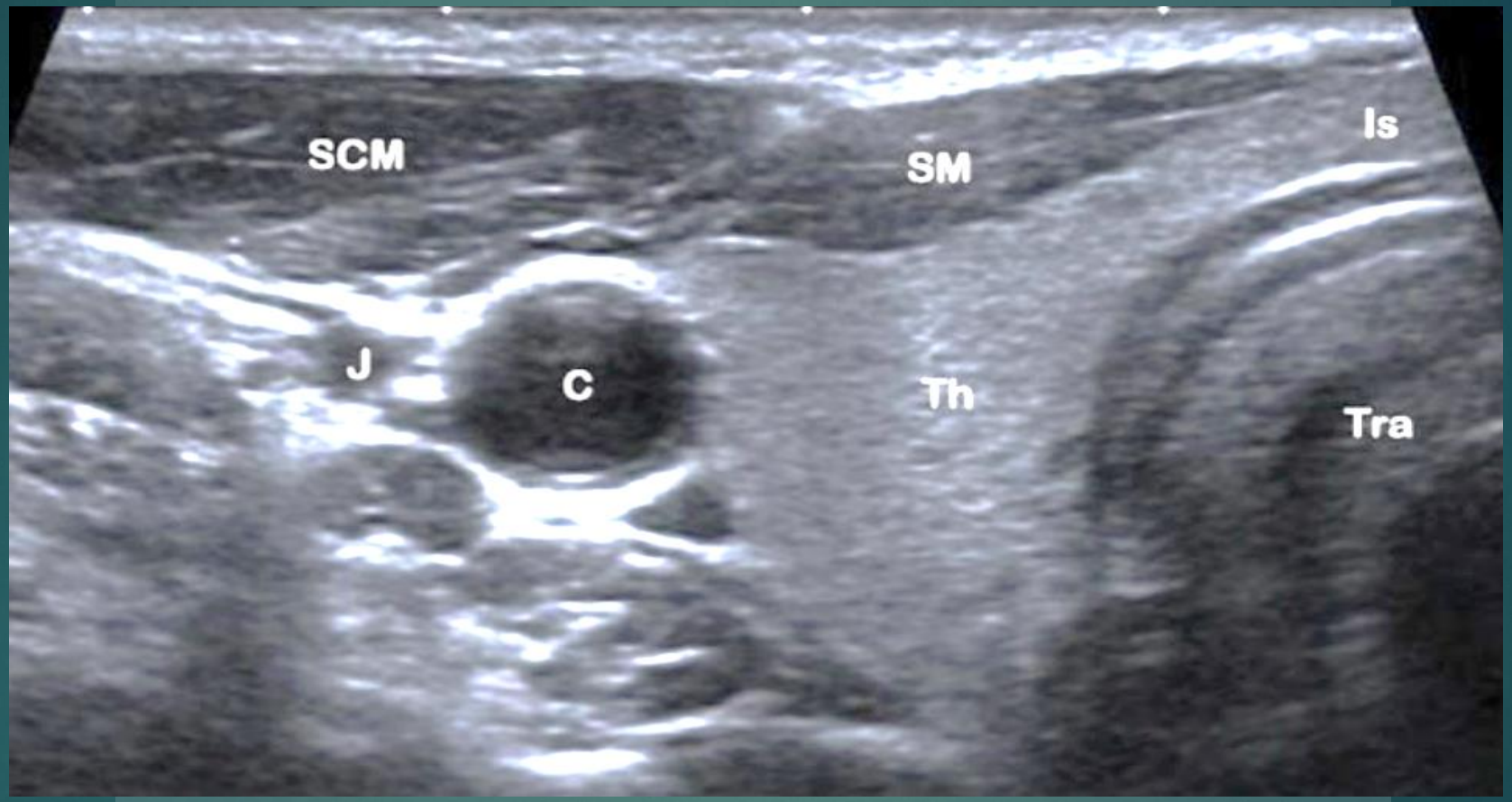
ULTRASOUND TECHNIQUE





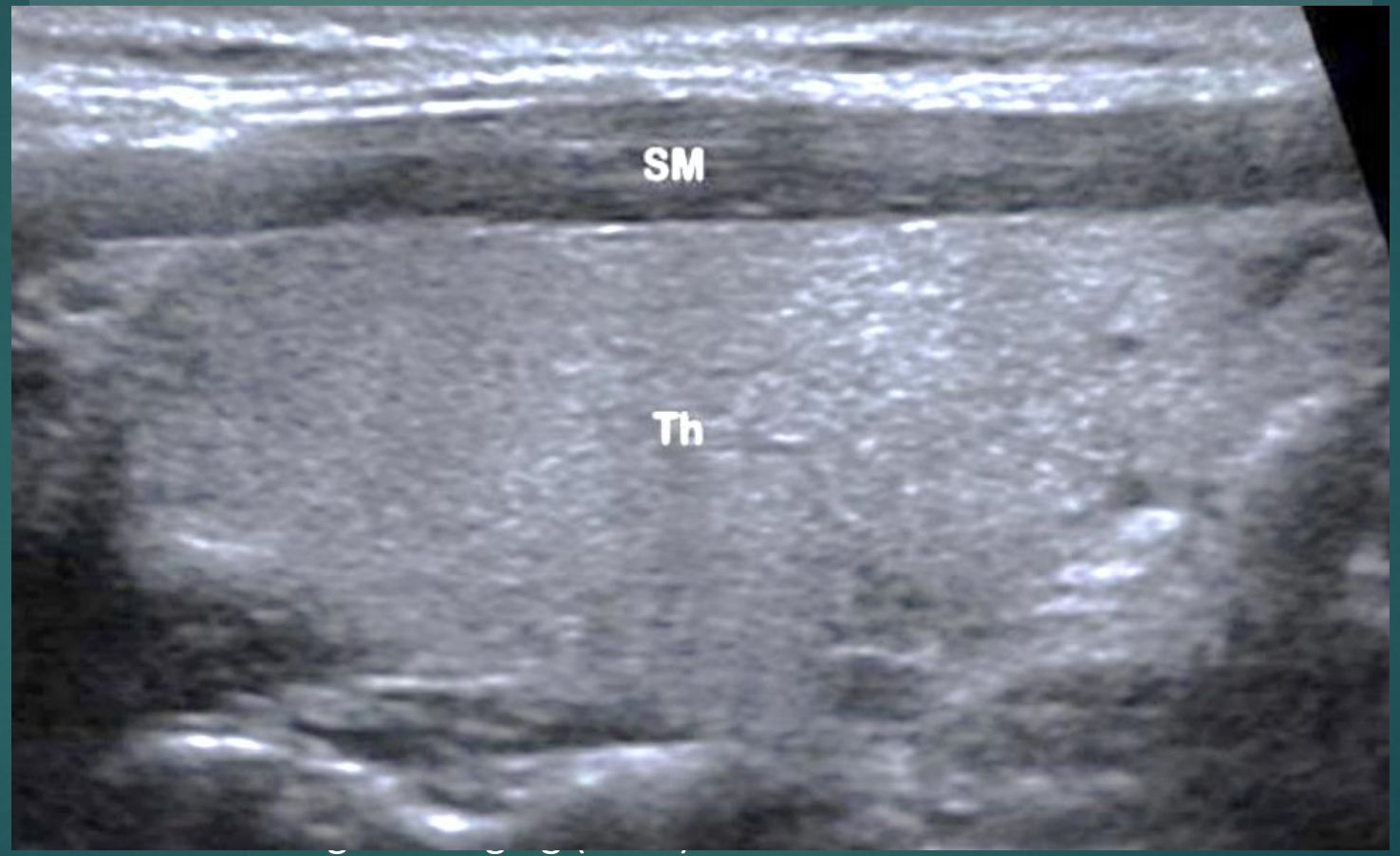


Anatomy of the Thyroid Gland Transverse



- C. Xie et al.Ultrasonography of thyroid nodules: a pictorial review. Insights Imaging (2016) 7:77–86.

Anatomy of the Thyroid Gland
Longitudinal view



Thyroid US should answer the following :

- Is there a true nodule ?

- Size (in 3 dimensions) and location in the lobe or isthmus

- Sonographic features

- Any suspicious lymphadenopathy ?

  = evaluation of cervical lymph nodes should be done whenever thyroid nodules are detected

  = although less common, palpable abnormal lymph node may be first manifestation of PTC

Role of the sonographer and / or physician in the Ultrasound assessment of the thyroid gland with focal lesions :

** try to differentiate the suspicious malignant nodule, from the more common benign group

** recognize US specific features and combined patterns

** help in the selection of nodules for FNA

American College of Radiology

- DEVELOPS A RISK - STRATIFICATION SYSTEM FOR CLASSIFYING THYROID NODULES (TI – RADS)

- BASED ON THEIR SONOGRAPHIC APPEARANCE

- RECOMMENDATIONS FOR BIOPSY OR F/UP

  BASED ON NODULE'S TI-RADS LEVEL AND

  ITS MAXIMUM DIAMETER

TI - RADS : Thyroid Imaging Reporting Data System

Modeled on the BI-RADS system for breast imaging reporting

- Goal : provide practitioners with evidenced – based recommendations for the management of thyroid nodules, on the basis of a set of well defined sonographic features on terms that can be applied to every lesion

- Objective : - practical standard lexicon for describing sonographic characteristics of thyroid nodules
  - method for practitioners to determine management

Nodule's total points determines risk level (from TR 1 - TR 5)
Nodule size used for FNA recommendation vs follow up

WHY USE TI- RADS ?

- In 2015, committees convened by the ACR, published white papers

= presented an approach to incidental thyroid nodules

= proposed standard terminology (lexicon) for ultrasound reporting

- System for risk stratification

= designed to identify most clinically significant malignancies

= while reducing the number of biopsies performed on benign nodules **

Tessler et al. ACR Thyroid Imaging, Reporting and Data System (TI-RADS): White Paper of the ACR TI-RADS Committee. Journal of the American College of Radiology 2017;14:587-595.

TIRADS Committee :

Radiologists with expertise in thyroid imaging

Selected Five (5) Final US Categories

1. Composition
2. Echogenicity
3. Shape
4. Margins
5. Echogenic foci

ACR TI-RADS

- Recommendations serve as guidance * **

- Decision to perform FNA (even if TI-RADS criteria are not met) :
  - referring physician's preference
  - patient's risk factors for thyroid cancer
  - anxiety, comorbidities, life expectancy, and other relevant considerations.

- Other societies, such as the American Thyroid Association (ATA) ; ACE ; AACE ; Korean Thyroid Radiology. etc have taken a slightly different, pattern-oriented approach, but with the same intent. **

Tessler et al. ACR Thyroid Imaging, Reporting and Data System (TI-RADS): White Paper of the ACR TI-RADS Committee. Journal of the American College of Radiology 2017;14:587-595.

ACR TI-RADS

COMPOSITION (Choose 1)	
Cystic or almost completely cystic	0 points
Spongiform	0 points
Mixed cystic and solid	1 point
Solid or almost completely solid	2 points

ECHOGENICITY (Choose 1)	
Anechoic	0 points
Hyperechoic or isoechoic	1 point
Hypoechoic	2 points
Very hypoechoic	3 points

SHAPE (Choose 1)	
Wider-than-tall	0 points
Taller-than-wide	3 points

MARGIN (Choose 1)	
Smooth	0 points
Ill-defined	0 points
Lobulated or irregular	2 points
Extra-thyroidal extension	3 points

ECHOGENIC FOCI (Choose All That Apply)	
None or large comet-tail artifacts	0 points
Macrocalcifications	1 point
Peripheral (rim) calcifications	2 points
Punctate echogenic foci	3 points

Add Points From All Categories to Determine TI-RADS Level

0 Points	2 Points	3 Points	4 to 6 Points	7 Points or More
TR1 Benign — No FNA	**TR2** Not Suspicious — No FNA	**TR3** Mildly Suspicious — FNA if ≥ 2.5 cm; Follow if ≥ 1.5 cm	**TR4** Moderately Suspicious — FNA if ≥ 1.5 cm; Follow if ≥ 1 cm	**TR5** Highly Suspicious — FNA if ≥ 1 cm; Follow if ≥ 0.5 cm*

COMPOSITION	ECHOGENICITY	SHAPE	MARGIN	ECHOGENIC FOCI
Spongiform: Composed predominantly (>50%) of small cystic spaces. Do not add further points for other categories. *Mixed cystic and solid:* Assign points for predominant solid component. Assign 2 points if composition cannot be determined because of calcification.	*Anechoic:* Applies to cystic or almost completely cystic nodules. *Hyperechoic/isoechoic/hypoechoic:* Compared to adjacent parenchyma. *Very hypoechoic:* More hypoechoic than strap muscles. Assign 1 point if echogenicity cannot be determined.	*Taller-than-wide:* Should be assessed on a transverse image with measurements parallel to sound beam for height and perpendicular to sound beam for width. This can usually be assessed by visual inspection.	*Lobulated:* Protrusions into adjacent tissue. *Irregular:* Jagged, spiculated, or sharp angles. *Extrathyroidal extension:* Obvious invasion = malignancy. Assign 0 points if margin cannot be determined.	*Large comet-tail artifacts:* V-shaped, >1 mm, in cystic components. *Macrocalcifications:* Cause acoustic shadowing. *Peripheral:* Complete or incomplete along margin. *Punctate echogenic foci:* May have small comet-tail artifacts.

*Refer to discussion of papillary microcarcinomas for 5-9 mm TR5 nodules.

ACR TI-RADS Categories

- Composition - Choose 1
- Echogenicity - Choose 1
- Shape - Choose 1
- Margin - If more than one type, choose the most suspicious
- Echogenic foci - Choose all that apply

TI - RADS Category : Composition

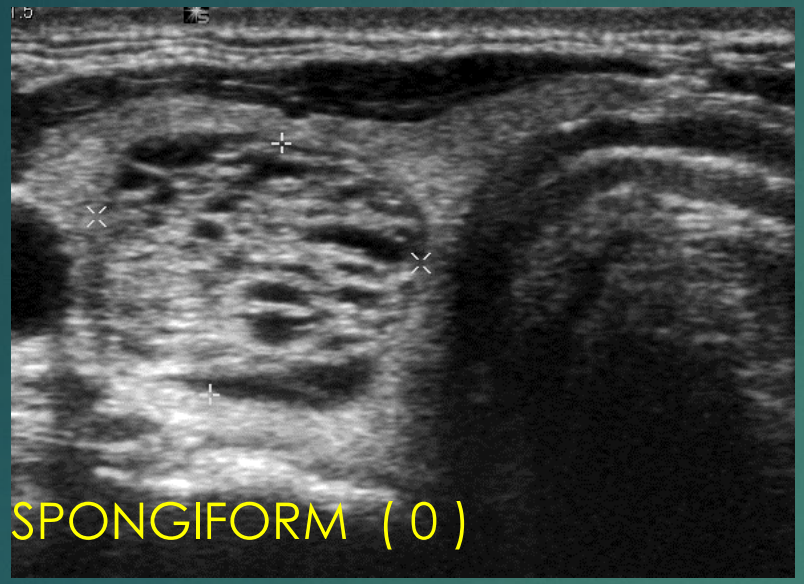
0 = cystic : entirely fluid filled or almost completely cystic

0 = spongiform : tiny cystic spaces (50%)

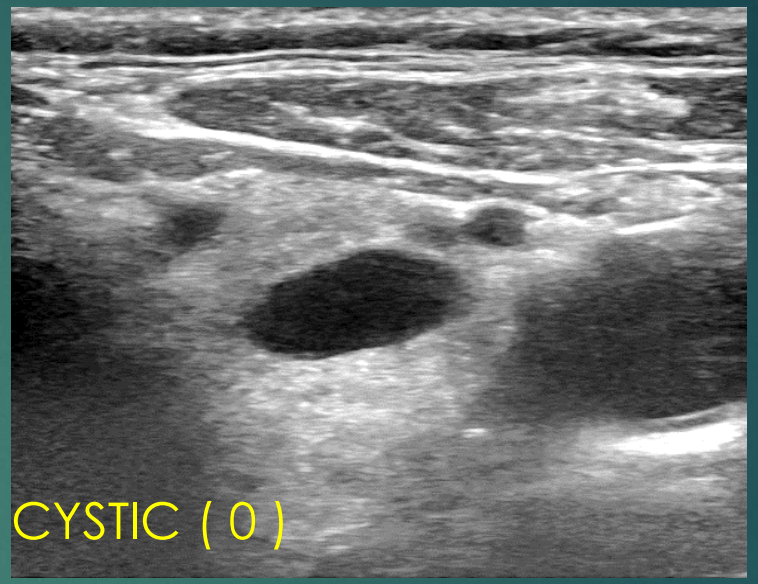
1 = mixed cystic and solid

2 = solid or almost completely solid

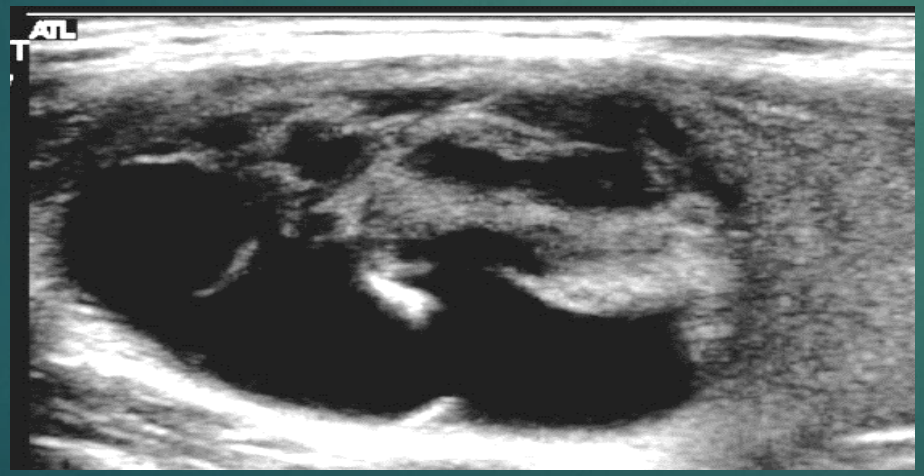
TI – RADS CATEGORY : COMPOSITION



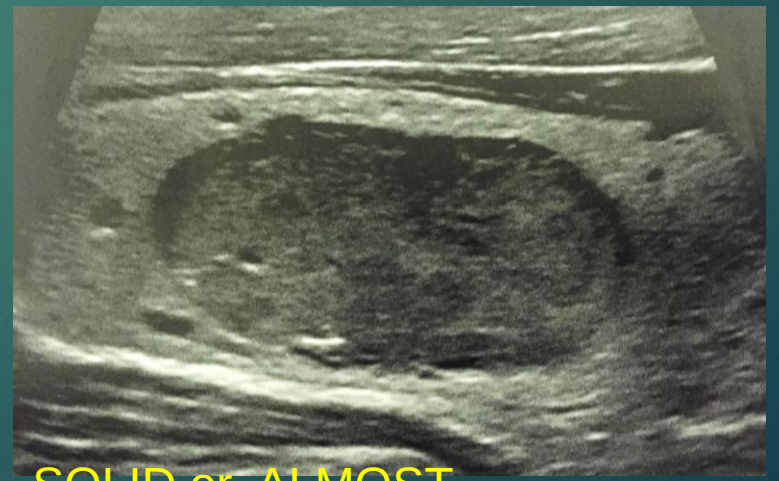
SPONGIFORM (0)



CYSTIC (0)



MIXED CYSTIC AND SOLID (1)



SOLID or ALMOST COMPLETELY SOLID (2)

COMMENTS : COMPOSITION

- Nodules should fit into one of the described categories
- PTC is most commonly solid ; but many solid nodules are benign
- A solid nodule has from 15 – 27 % of being malignant
- Purely cystic nodules or spongiform nodules have very low risk of malignancy
- Assign 2 points if composition cannot be assessed due to large calcification (with sound absorption)

TI - RADS Category : Echogenicity

0 = Anechoic

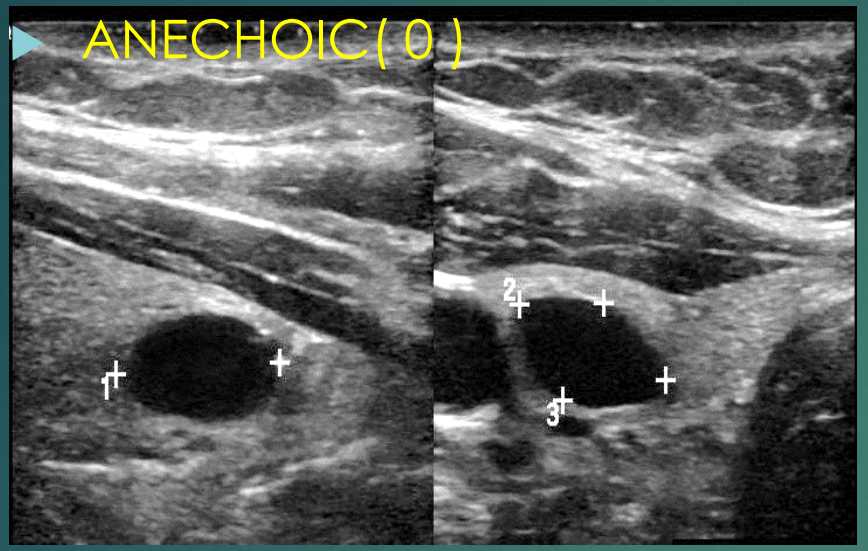
1 = Hyperechoic : Increased echogenicity relative to thyroid tissue

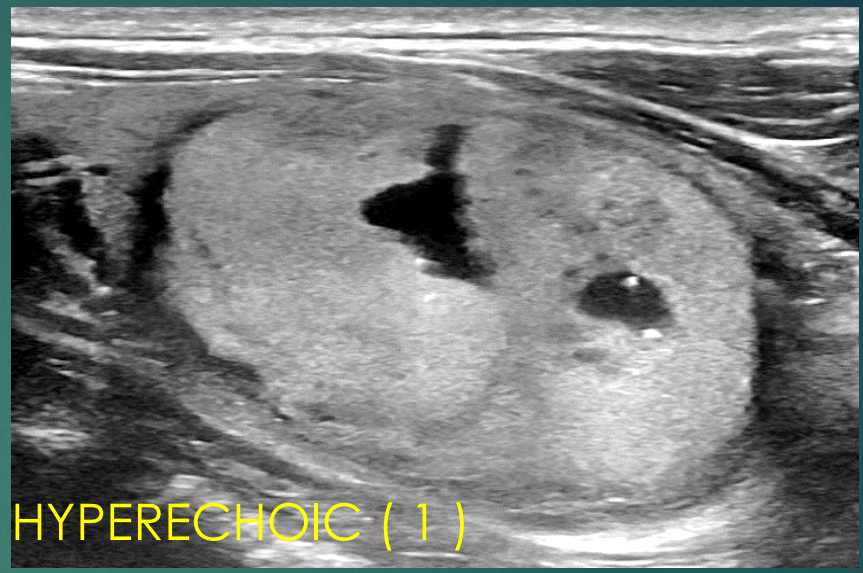
1 = Isoechoic : Similar echogenicity to adjacent parenchyma

2 = Hypoechoic : decreased echogenicity

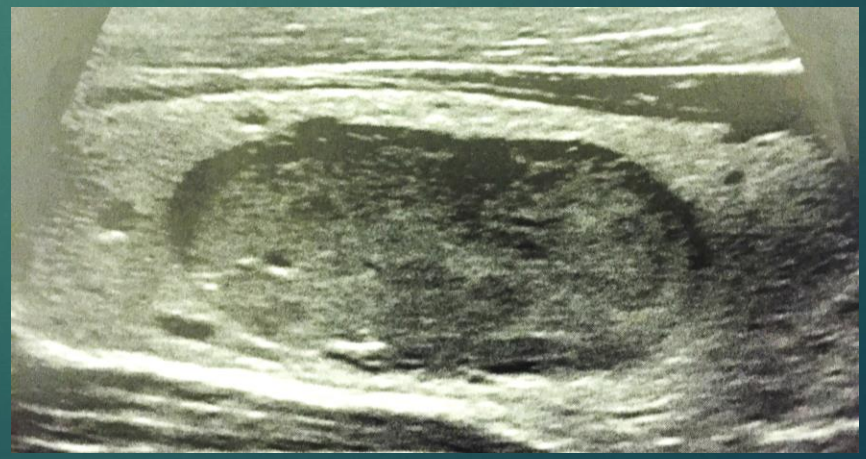
3 = Very hypoechoic : as neck muscles

TI-RADS CATEGORY : ECHOGENICITY





VERY HYPOECHOIC (3)

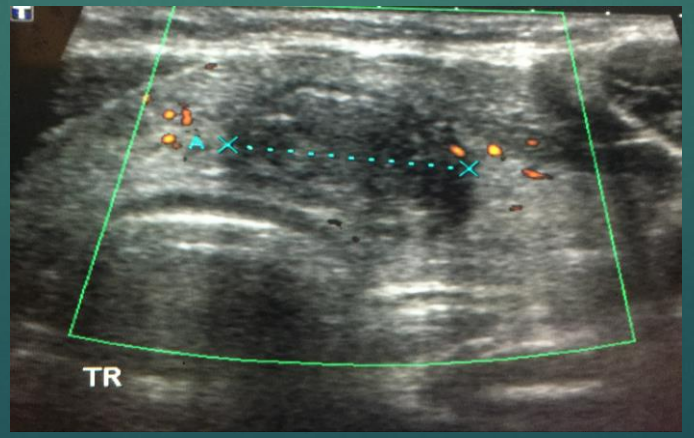


HYPOECHOIC (2)

COMMENT : Echogenicity

- Echogenicity of a nodule is compared to adjacent parenchyma

- If mixed echogenicity, describe which texture predominates : predominantly hyperechoic, isoechoic or hypoechoic

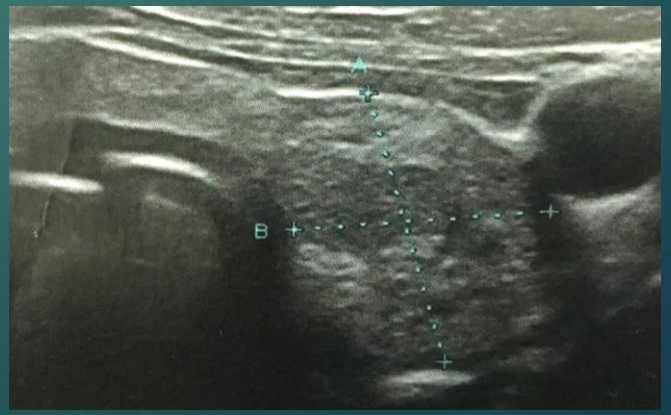


TIRADS CATEGORY : SHAPE

0 = Wider than taller

3 = Taller than wider : ratio > 1 in the AP diameter to the horizontal diameter when measured in the transverse plane

- No significant differences comparing transverse or longitudinal dimensions **



TI - RADS CATEGORY : MARGINS

0 = Smooth : well – defined

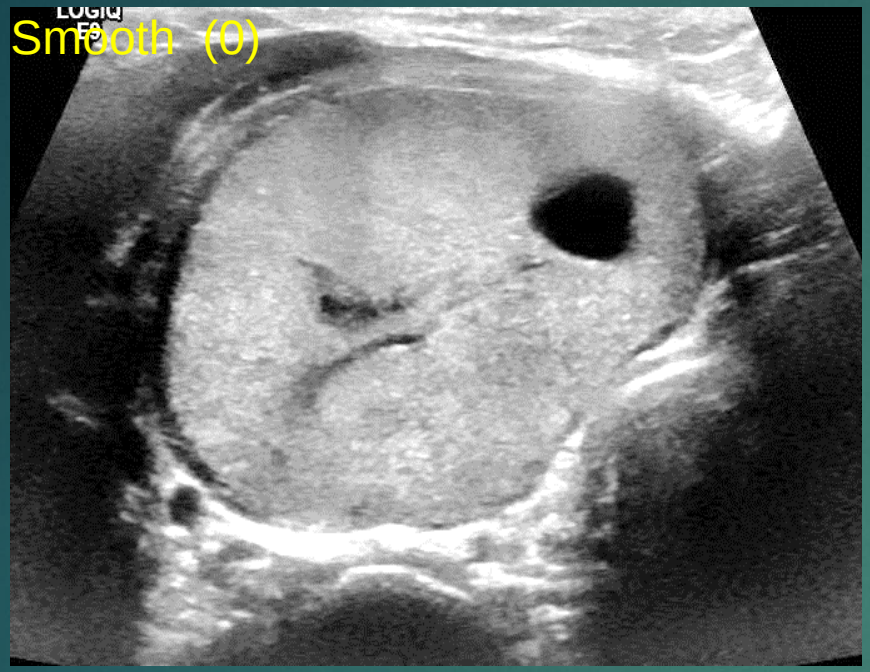
0 = Ill defined : unsharp nodule border

2 = Irregular margin /spiculated / lobulated

3 = Extrathyroidal extension : extends thru capsule

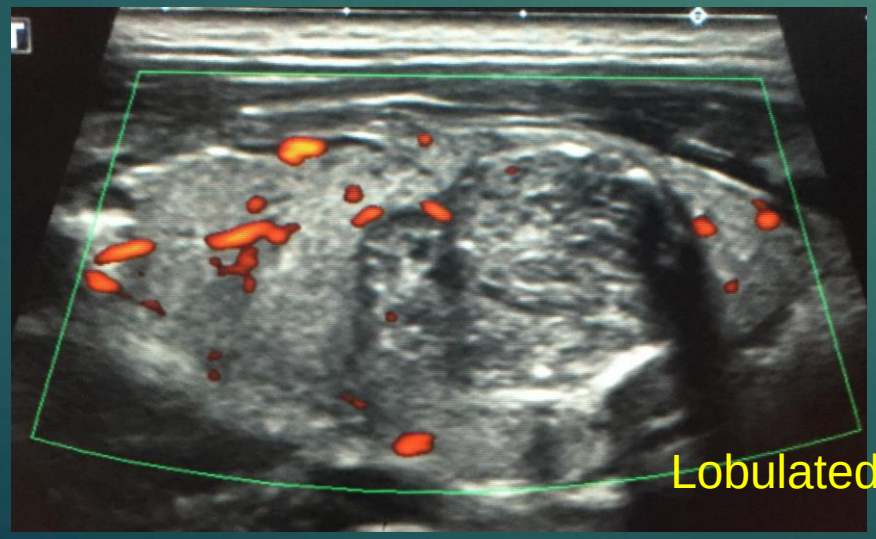
Halo : dark rim around the nodule ; true capsule or pseudocapsule (thin ; thick; irregular)

TI – RADS CATEGORY : MARGINS

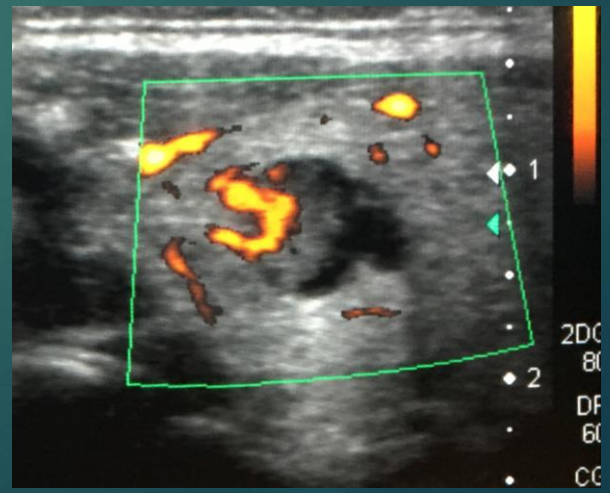


Smooth (0)

Extrathyroidal extension (3)



Lobulated / Irregular (2)



Comment : Margins

- Smooth border is more common in benign lesions
- But 33 – 93 % of malignancies may have smooth border

- Irregular / lobulated margins : suspicious for malignancy (represent aggressive growth)

- Ill-defined nodular margins : common in benign hyperplastic nodules and regions of thyroiditis

- Uniform halo suggest benign lesions; most thyroid CA are unencapsulated; but halos have been seen in 10-24% of carcinomas

TI-RADS CATEGORY : ECHOGENIC FOCI

0 - None / or seen with large comet tails

1 - Macrocalcifications

2 - Peripheral rim

3 - Punctate echogenic foci

TI - RADS CATEGORY ECHOGENIC FOCI

0 = None, or large comet tail artifacts

NOTE : Comet tail artifacts : small < 1mm : 15 % malignant

large > 1 mm : more associated with benignity

1 = Macrocalcifications : posterior shadowing ; more association with malignancy

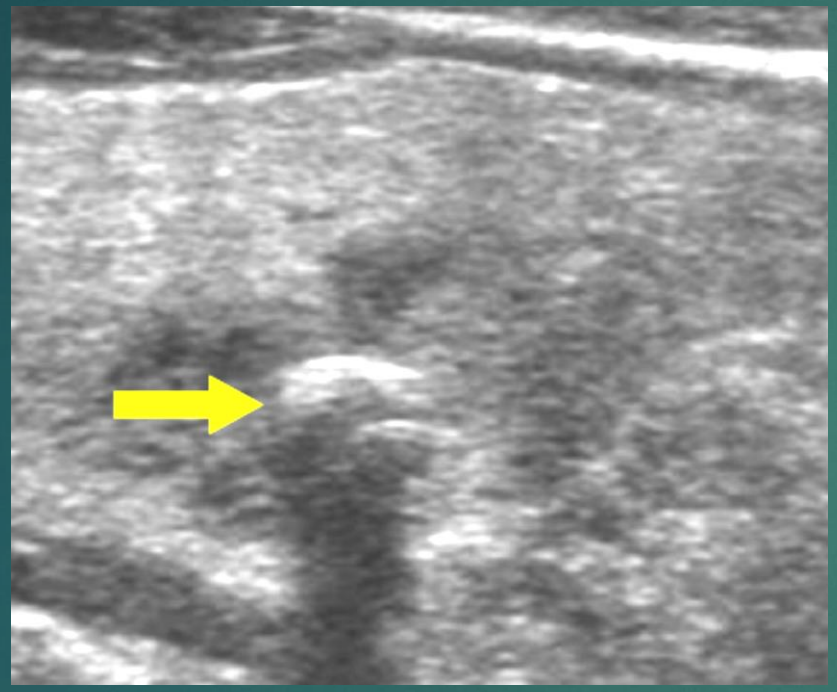
3 = Punctate echogenic foci : dot like ; < 1 mm ; no shadows

** microcalcifications is a misnomer **

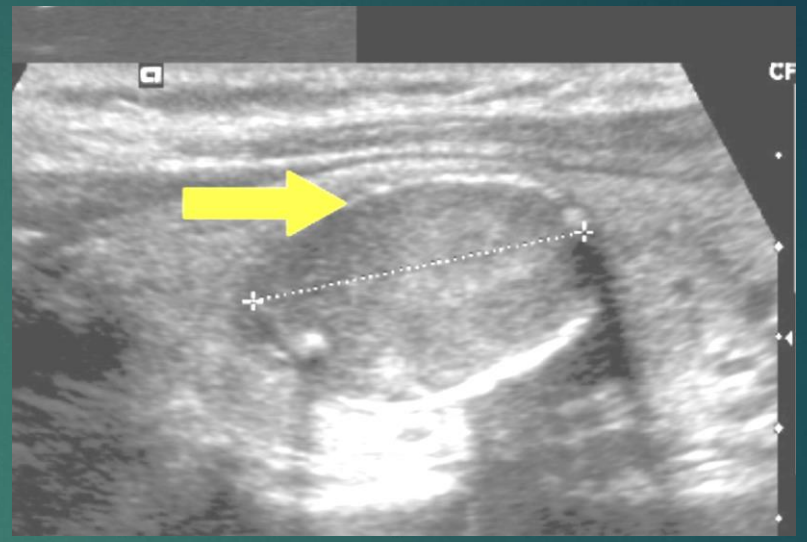
- majority of these punctate foci are seen in benign nodules *
- seen also in malignant lesions

ECHOGENIC FOCI

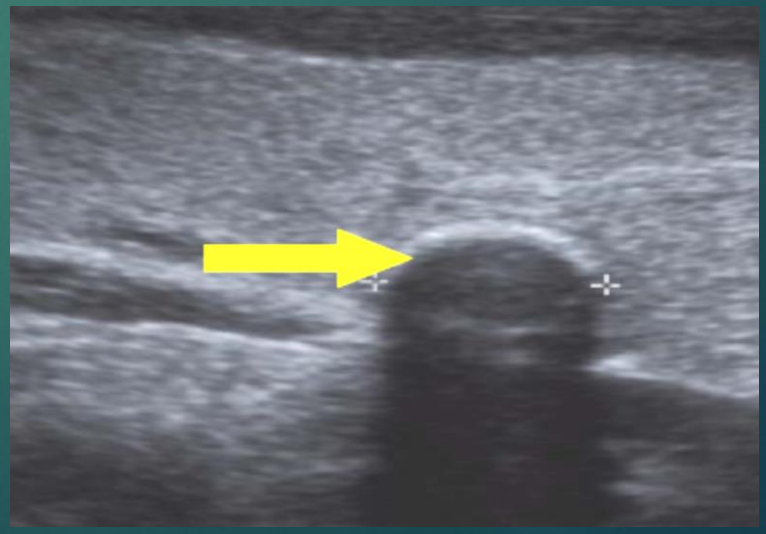
Choose all that apply



Macrocalcification (1)



Peripheral rim calcifications (2)



Echogenic Foci in Thyroid Nodules: Significance of Posterior Acoustic Artifacts

OBJECTIVE. This study was undertaken to define and evaluate echogenic foci and their posterior acoustic artifacts in thyroid nodules. Whether these findings were indicative of benignity or malignancy was assessed.

MATERIALS AND METHODS. Echogenic foci were classified into five types: no posterior artifact, large comet-tail artifact, small comet-tail artifact (≤ 1.0 mm), and posterior shadowing (subdivided into internal versus peripheral). Nodules were also classified into four parenchymal patterns: hypoechoic, hyperechoic, > 50% solid, and cystic. Results were compared with the cytologic or surgical findings.

RESULTS. A total of 704 nodules had echogenic foci; 246 did not. The prevalence of malignancy ranged between 15.4% and 19.5% for all types of foci except large comet-tail artifacts (3.9%). Foci without posterior artifacts had a 21.9%

AJR 2014 ; 203 ; 1310 – 1316
Univ . Southern California

Echogenic Foci in Thyroid Nodules : 950 nodules

704 with echogenic foci
- 110 malignant
- 594 benign

- DESCRIPTION OF ECHOGENIC FOCI
  = punctate **
  = clumped calcifications **
  = peripheral calcifications **

- 246 without echogenic foci
  - 30 malignant
  - 216 benign**

Comet tails artifacts
- small < 1 mm **
  = with punctate echogenic foci
  = malignancy risk increase

- large > 1 mm **
  = V- shaped
  = associated to colloid
  = benign

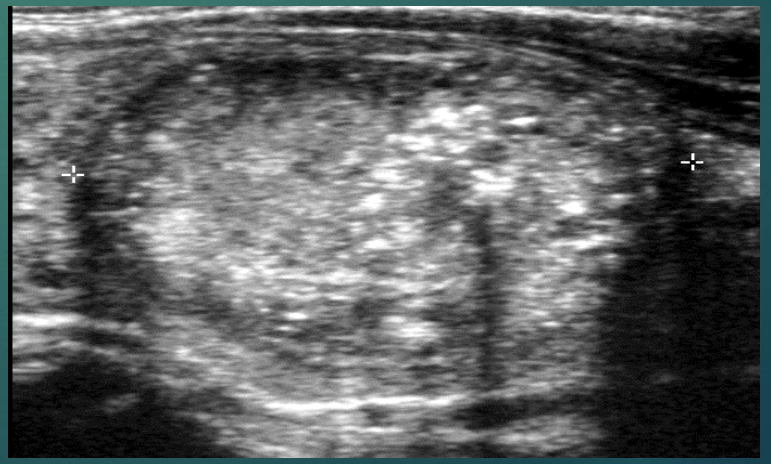
AJR 2014 ; 203 ; 1310 – 1316
Univ . Southern California

Punctate echogenic foci w/o posterior artifact

- more common (seen in 89 % of nodules evaluated)
- frequently seen with other calcifications
- found in 526 of benign nodules ***

Misnomer : “microcalcifications” * ; use term echogenic foci **

True microcalcifications (psammomatous calcifications) : not expected in such a high group of benign lesions



Comet tails : reverberation artifacts

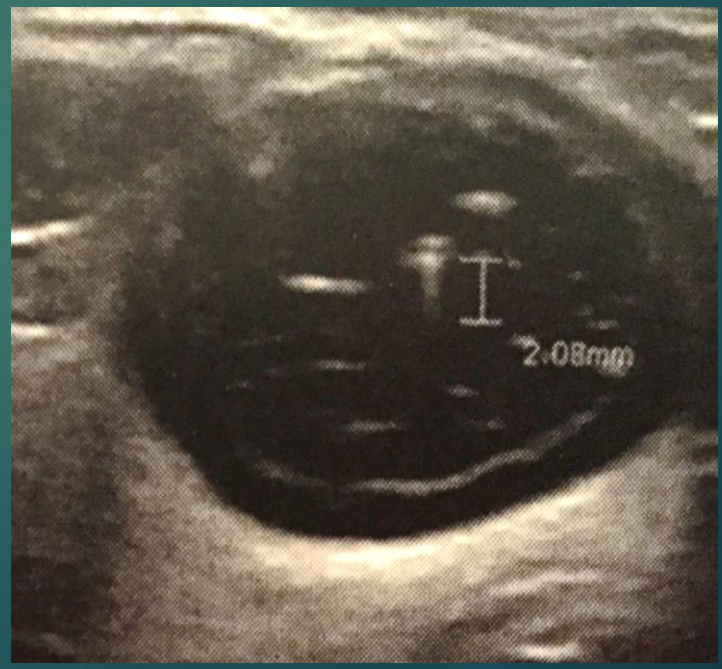
Small tails < 1mm

= if seen in cystic nodules, are more benign

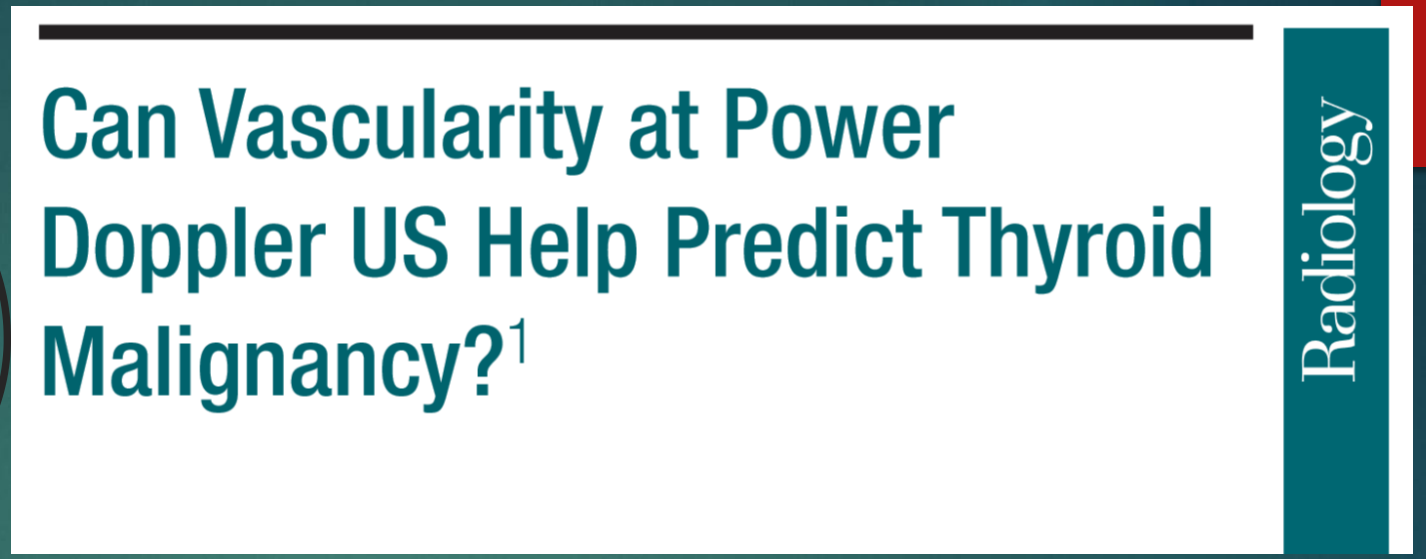
= high prevalence of malignancy when found in hypoechoic nodules **

Large tails > 1 mm

= more associated with benign nodules **



Intranodular vascularity was frequently seen in benign nodules and no vascularity was frequent in malignant nodules



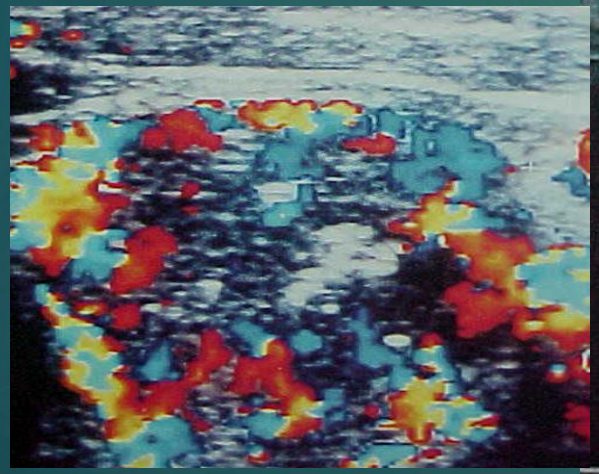
- Vascularity itself or a combination of vascularity and grayscale US features was not as useful as the use of suspicious gray-scale US features alone, for predicting thyroid malignancy.

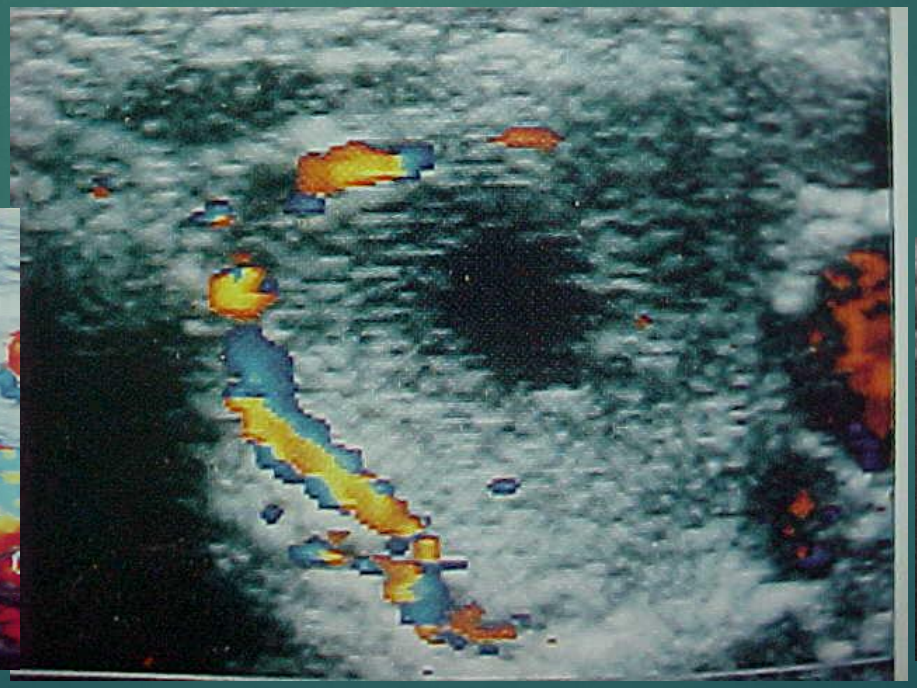
Moon HJ et al. 2010 Can vascularity at power Doppler US help predict thyroid malignancy? Radiology 255:260–269.

Nodule vascularity patterns

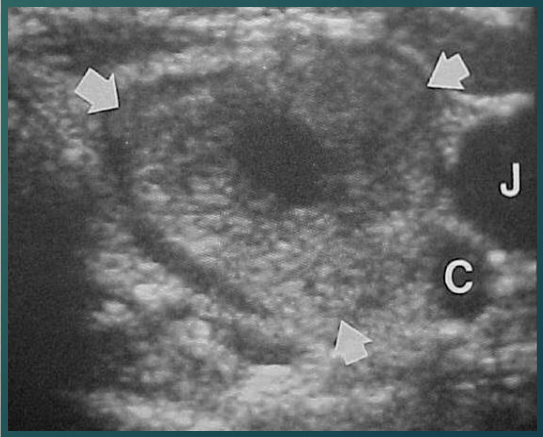
Type I : complete absence of flow signal within the nodule
Type II : exclusive perinodular flow signals
Type III : intranodular flow with multiple vessels chaotically arranged

- Types I and II are more commonly seen in benign hyperplastic nodules
- Type III was generally associated with malignancy * *





Type III (intranodular)



Type II (perinodular)

Value of Nodule Vascularization : Limited in the assessment of risk of thyroid carcinoma

- **Absence of clear – cut differences between benign and malignant lesions ****

- Most malignant lesions show a rich intranodular pattern

  (Ex : follicular carcinoma)

However, this finding may also be present in benign nodules ***

- Benign nodules have a scanty or preferential perinodular pattern

- 20% of thyroid CA may show a peripheral vascular ring

PTC microcarcinoma : may appear completely avascular

Thus, use of Color and Power Doppler in thyroid nodule evaluation only provides complementary information **

ACE / AACE guidelines 2016

NODULE SIZE

Multiple studies have suggested that nodule size is not an independent predictor of malignancy risk in PTC

= tiny nodules can harbor malignancy

= large nodules are often benign

No bx in most nodules < 1 cm

Due to uncertainty between nodule size and malignancy; compared to other US features:

= size is not included in ACR TI - RADS scoring system

= however, size is used for recommendations *

Based on US criteria (ACR TI – RADS) ; follow up sonography may be recommended , to assess stability and to evaluate growth :

= 1-2 yr intervals ; then 3-5 yrs , if no significant nodule growth occurs

= Growth is not synonymous with malignancy ; benign hyperplastic nodules may have slow constant growth ; and PTMC may be stable for years **

= measurement of major nodule diameter in long axis is not reliable (interobserver variability)

= Nodule volume is more accurate : Long x AP x Transverse (0.52)
(50% increase in volume is minimum threshold for nodule growth)

If change in US features and increase in size occurs, then FNA **

Management Guidelines on Thyroid Nodules (AACE/ ACE/ ATA)

- Guidelines 1st edition was in 2006 ; updated in 2010 and 2016
- Proposed Recommendations for FNA based on **US Patterns :**

- **High risk lesion 50 - 90%** (markedly hypoechoic, taller than wider , irregular, lobulated margins , pathologic adenopathy; microcalcifications ; extrathyroidal growth)

- **Intermediate risk 5 - 15 %** (hypo or isoechoic nodules ; indeterminate hyperechoic spots, macro or continuous rim calcifications ; elasto stiffness)
- **Low risk lesion 1 %** (cysts ; spongiform nodules

Classification is similar to US features described in ACR TI – RADS **

Management Guidelines on Thyroid Nodules (AACE/ ACE/ ATA)

- **Nodules < 5 mm** : monitored rather than BX ,regardless of US features
- **Nodules 5 – 10 mm** : associated with suspicious US signs, either FNA, or watchful wait (based on clinical setting and patient preference)
- **Nodules > 10 mm** : associated with suspicious US signs, FNA always recommended
- **Nodules > 20 mm** : isoechoic, hypo or hyperechoic , ovoid or round; with smooth or ill-defined margins ; FNA is recommended
- **Spongiform or dominantly cystic nodules** without suspicious US findings, FNA is recommended only when nodules are > 20 mm

Comparison of Performance Characteristics of American College of Radiology TI-RADS, Korean Society of Thyroid Radiology TIRADS, and American Thyroid Association Guidelines

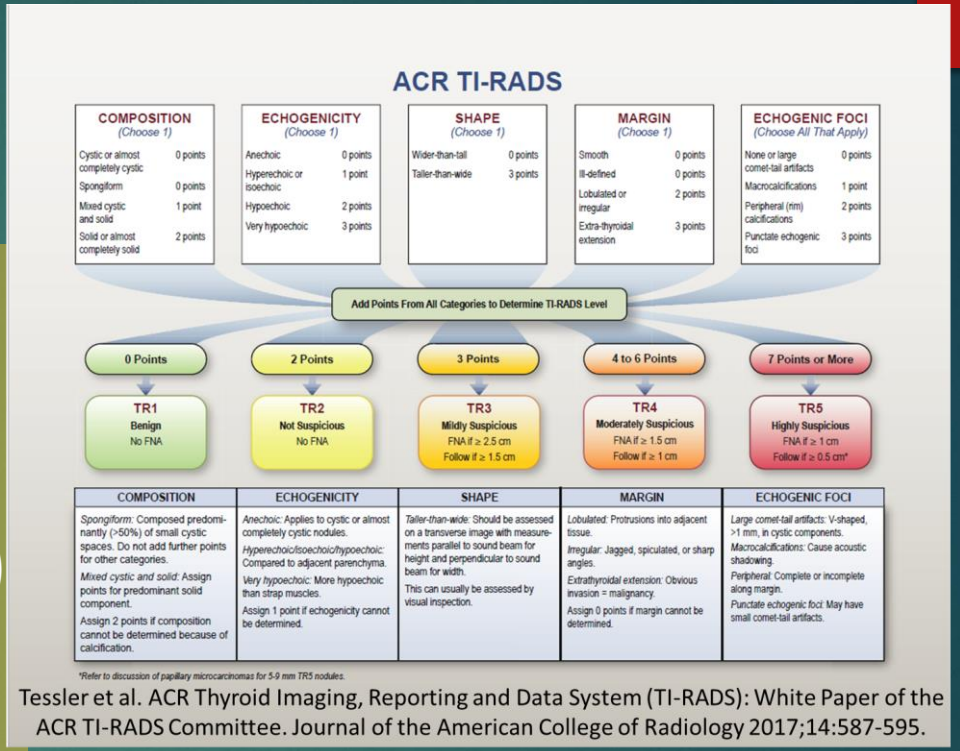
- Compare:
  - ACR TI-RADS system
  - Korean Society of Thyroid Radiology (KSThR) Thyroid Imaging Reporting and Data System (TIRADS)
  - American Thyroid Association
- Using 3422 thyroid nodules for which pathologic findings were available.

- Categorization was based on the sonographic features for each of the systems.
- An additional category was created for nodules that could not be categorized.
- Once categorized, an assessment was made as to whether that system recommends:
  - FNA
  - Follow-up

Middleton et al. Comparison of Performance Characteristics of American College of Radiology TI-RADS, Korean Society of Thyroid Radiology TIRADS, and American Thyroid Association Guidelines. AJR:210, May 2018

Comparison of Performance Characteristics of American College of Radiology TI-RADS, Korean Society of Thyroid Radiology TIRADS, and American Thyroid Association Guidelines

- ACR TI-RADS category based on the point total obtained from each nodule:
- TR1 0 points BENIGN, No FNA
- TR2 2 pts No FNA (Not suspicious)
- TR3 3 pts. FNA = or > 2.5 cm
- TR4 4-6 pts. FNA = or > 1.5 cm
- TR5 7 or more pts ; FNA = or > 1 cm



Tessler et al. ACR Thyroid Imaging, Reporting and Data System (TI-RADS): White Paper of the ACR TI-RADS Committee. Journal of the American College of Radiology 2017;14:587-595.

Middleton et al. Comparison of Performance Characteristics of American College of Radiology TI-RADS, Korean Society of Thyroid Radiology TIRADS, and American Thyroid Association Guidelines. AJR:210, May 2018

- **ATA guidelines, each nodule was categorized as:**
  - High
  - Intermediate
  - Low
  - Very low
  - Benign.

Middleton et al. Comparison of Performance Characteristics of American College of Radiology TI-RADS, Korean Society of Thyroid Radiology TIRADS, and American Thyroid Association Guidelines. AJR:210, May 2018

B. R. Haugen et al. 2015 American Thyroid Association Management Guidelines for Adult Patients with Thyroid Nodules and Differentiated Thyroid Cancer. THYROID Volume 26, Number 1, 2016.

Comparison of Performance Characteristics of American College of Radiology TI-RADS, Korean Society of Thyroid Radiology TIRADS, and American Thyroid Association Guidelines

Sonographic pattern	*US features*	*Estimated risk of malignancy, %*	*FNA size cutoff (largest dimension)*
High suspicion	Solid hypoechoic nodule or solid hypoechoic component of a partially cystic nodule ***with*** one or more of the following features: irregular margins (infiltrative, microlobulated), microcalcifications, taller than wide shape, rim calcifications with small extrusive soft tissue component, evidence of ETE	>70–90[a]	Recommend FNA at ≥1 cm
Intermediate suspicion	Hypoechoic solid nodule with smooth margins ***without*** microcalcifications, ETE, or taller than wide shape	10–20	Recommend FNA at ≥1 cm
Low suspicion	Isoechoic or hyperechoic solid nodule, or partially cystic nodule with eccentric solid areas, ***without*** microcalcification, irregular margin or ETE, or taller than wide shape.	5–10	Recommend FNA at ≥1.5 cm
Very low suspicion	Spongiform or partially cystic nodules ***without*** any of the sonographic features described in low, intermediate, or high suspicion patterns	<3	Consider FNA at ≥2 cm Observation without FNA is also a reasonable option
Benign	Purely cystic nodules (no solid component)	<1	No biopsy[b]

Comparison of Performance Characteristics of American College of Radiology TI-RADS, Korean Society of Thyroid Radiology TIRADS, and American Thyroid Association Guidelines

- **KSThR TIRADS, each nodule was categorized as:**
  - High
  - Intermediate
  - Low suspicion category
  - Benign

Table 2. Malignancy Risk Stratification According to Korean Thyroid Imaging Reporting and Data System (K-TIRADS) and FNA Indications

	Category	US Feature	Malignancy Risk (%)	Calculated Malignancy Risk (%), Overall (LV, HV)	Calculated Sensitivity for Malignancy (%), Overall (LV, HV)	FNA[§]
5	High suspicion	Solid hypoechoic nodule with any of 3 suspicious US features*	> 60	79.3 (60.9, 84.9)	51.3 (35.9, 56.7)	≥ 1 cm (> 0.5 cm, selective)
4	Intermediate suspicion	1) Solid hypoechoic nodule without any of 3 suspicious US features* or 2) Partially cystic or isohyperechoic nodule with any of 3 suspicious US features*	15–50	25.4 (15, 33.6)	29.5 (29.9, 29.4)	≥ 1 cm
3	Low suspicion	Partially cystic or isohyperechoic nodule without any of 3 suspicious US features*	3–15	7.8 (6, 10.3)[†]	19.2 (34.2, 13.9)	≥ 1.5 cm
2	Benign[‡]	1) Spongiform 2) Partially cystic nodule with comet tail artifact 3) Pure cyst	< 3 < 1	0 0	0 0	≥ 2 cm NA
1	No nodule	-	-	-	-	NA

Results:

- Using 3422 thyroid nodules for which pathologic findings were available.

Comparison of Performance Characteristics of American College of Radiology TI-RADS, Korean Society of Thyroid Radiology TIRADS, and American Thyroid Association Guidelines

	ACR TI-RADS	KOREAN TI-RADS	ATA guidelines
% that could not be classified	0%	3.9 %	13.9% (9.4% M)
Biopsy yield of malignancy	14.2%	10.2%	10%
% of Malignant nodules Biopsied	68.2% (21% F/U)	78.2%	75.9%
% of Benign nodules that would be Biopsied	47.1%	79.7%	78.1%

LYMPH NODE EVALUATION

- **Lymph node mets :**

A) **Central level VI lymph nodes are most commonly involved**

B) ***Mets to levels II-V are less common; but may be associated with worse prognosis***

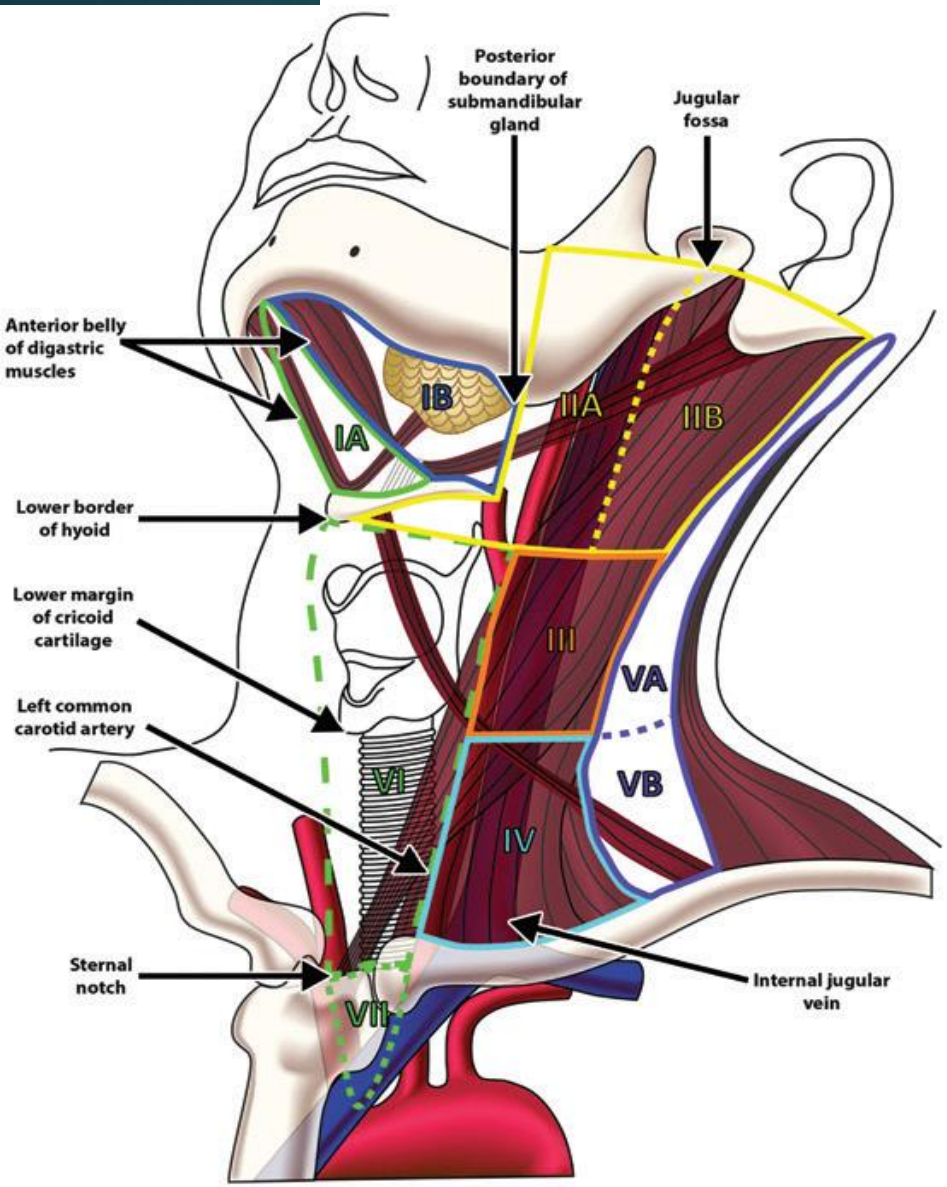
Abnormal lymph node features :

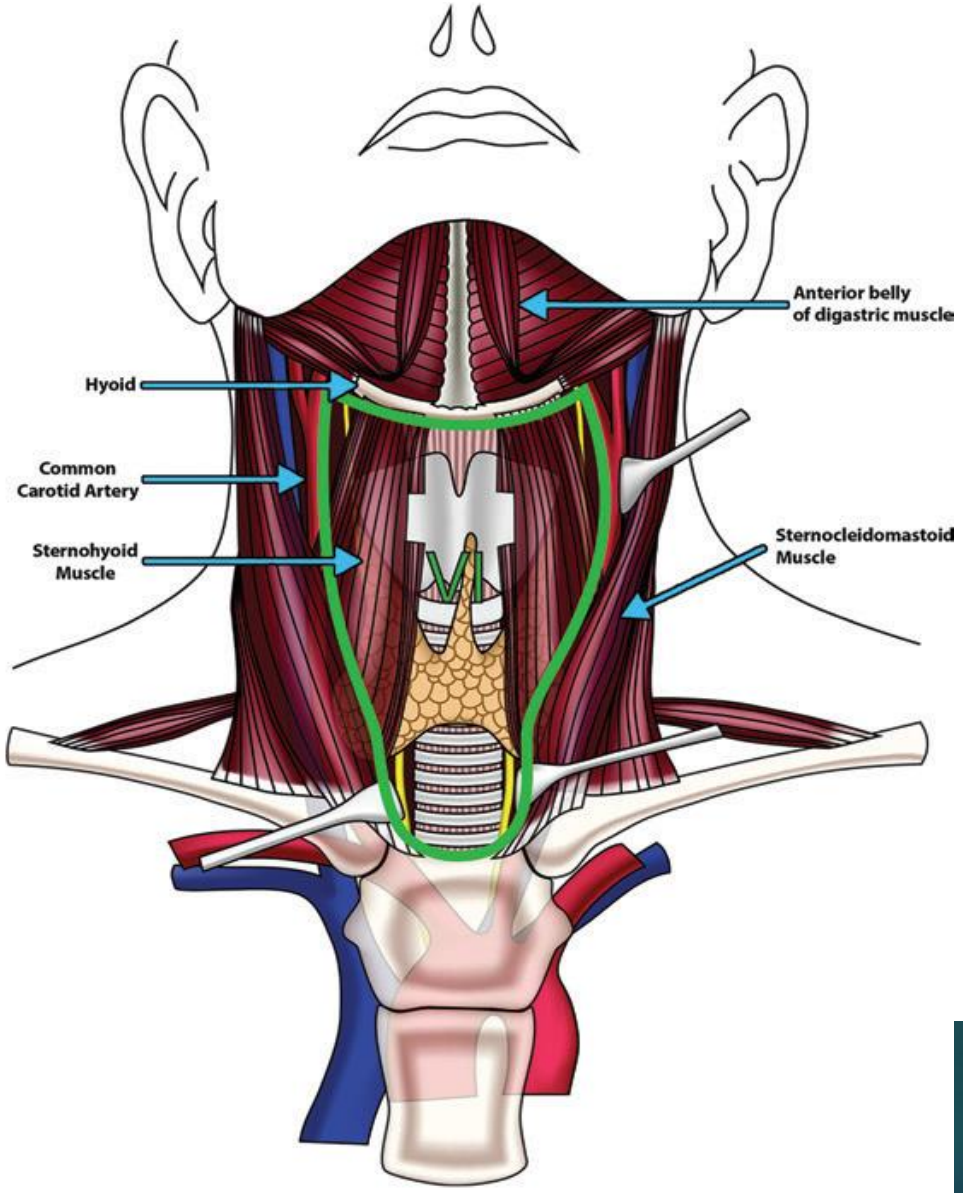
- roundish, bulging shape
- replaced fatty hilum
- cystic areas
- calcifications
- increased vascularity
- focal, scattered echogenic regions

Surgical procedures depend on size of malignant nodules; as well as presence or absence of contralateral thyroid nodules

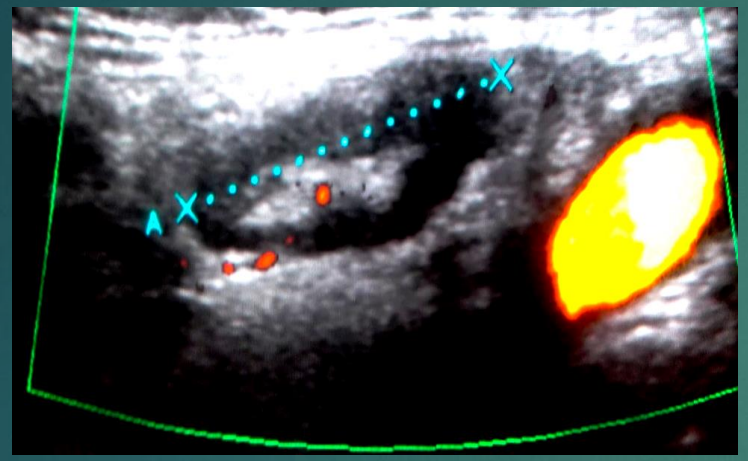
ASSESSMENT OF CERVICAL LYMPH NODES

Levels IA, IB, IIA, IIB, III, IV, VA, VB, VI, VII





ASSESSMENT OF CERVICAL LYMPH NODES



Normal lymph nodes :

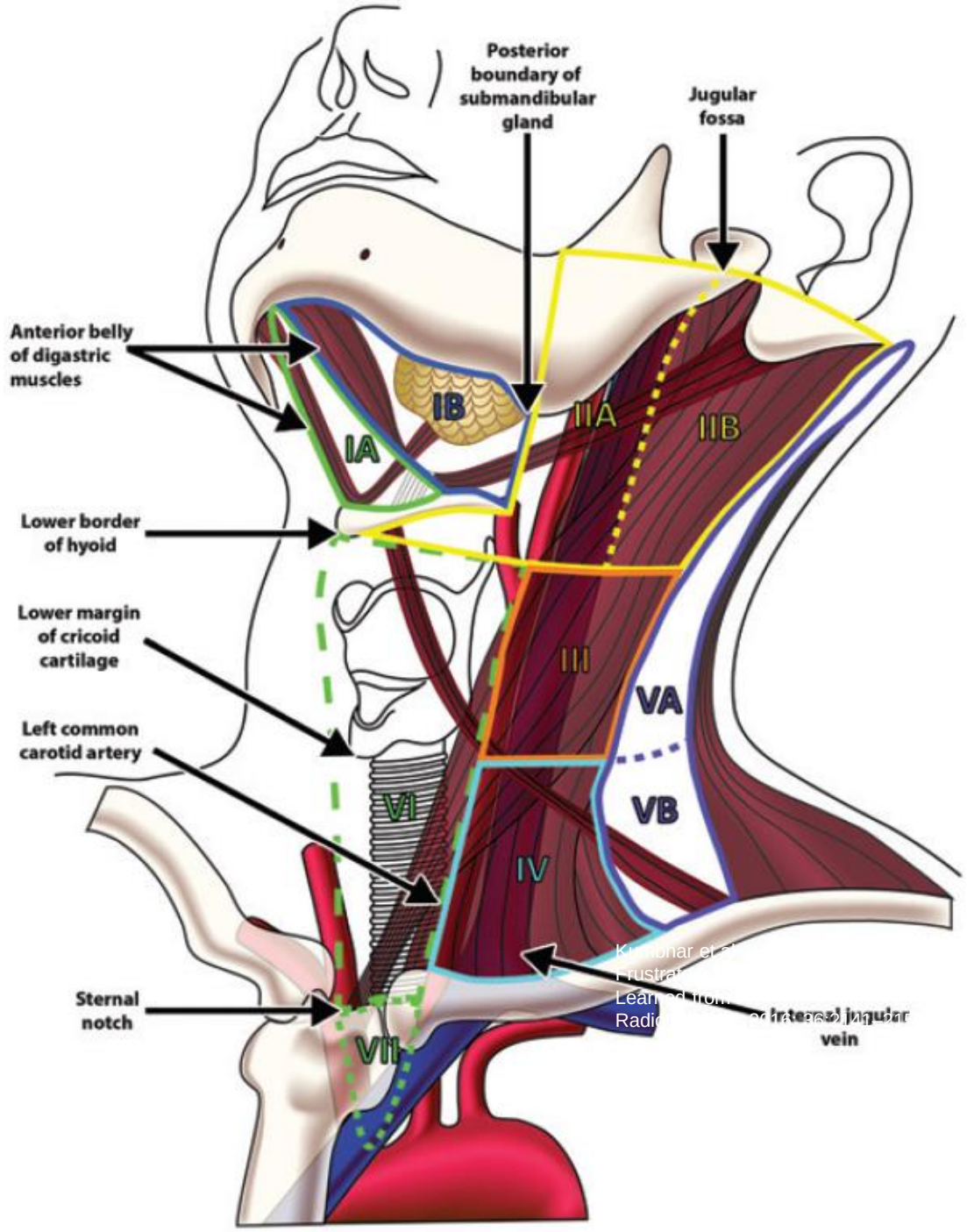
= oval shape

= internal echogenic fat

= vessels thru hilum

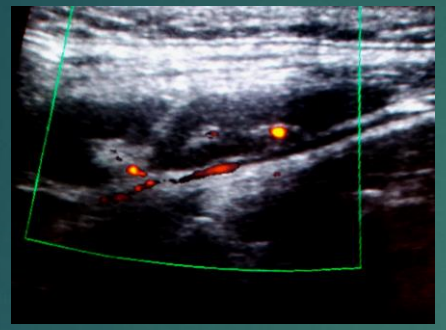
= hypoechoic peripheral walls

= no calcifications

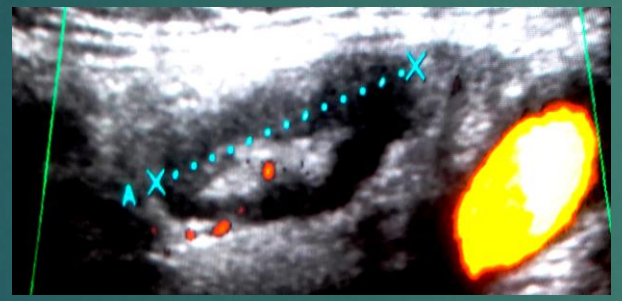


Which of these lymph nodes are worrisome ?

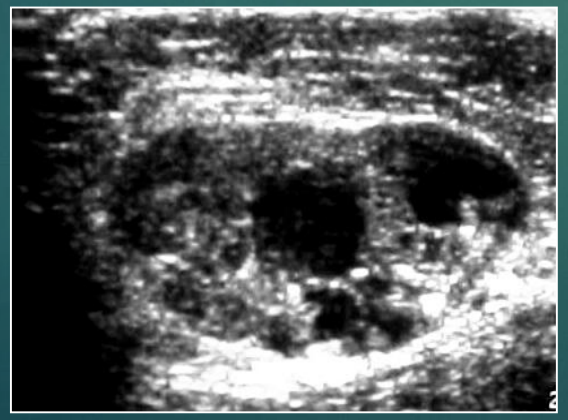
A



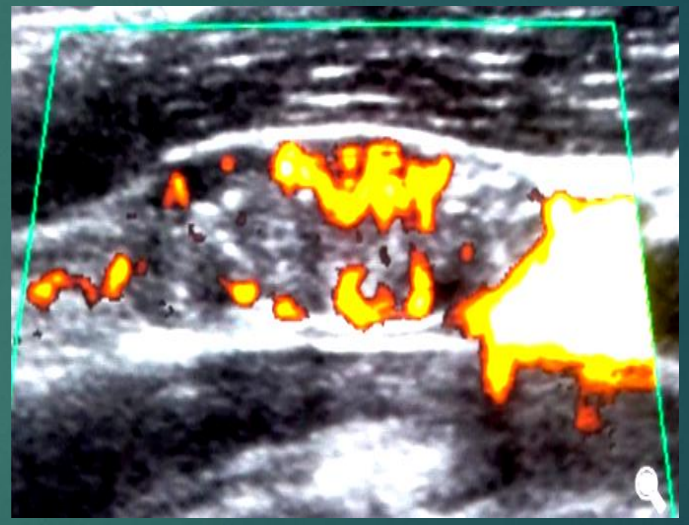
B



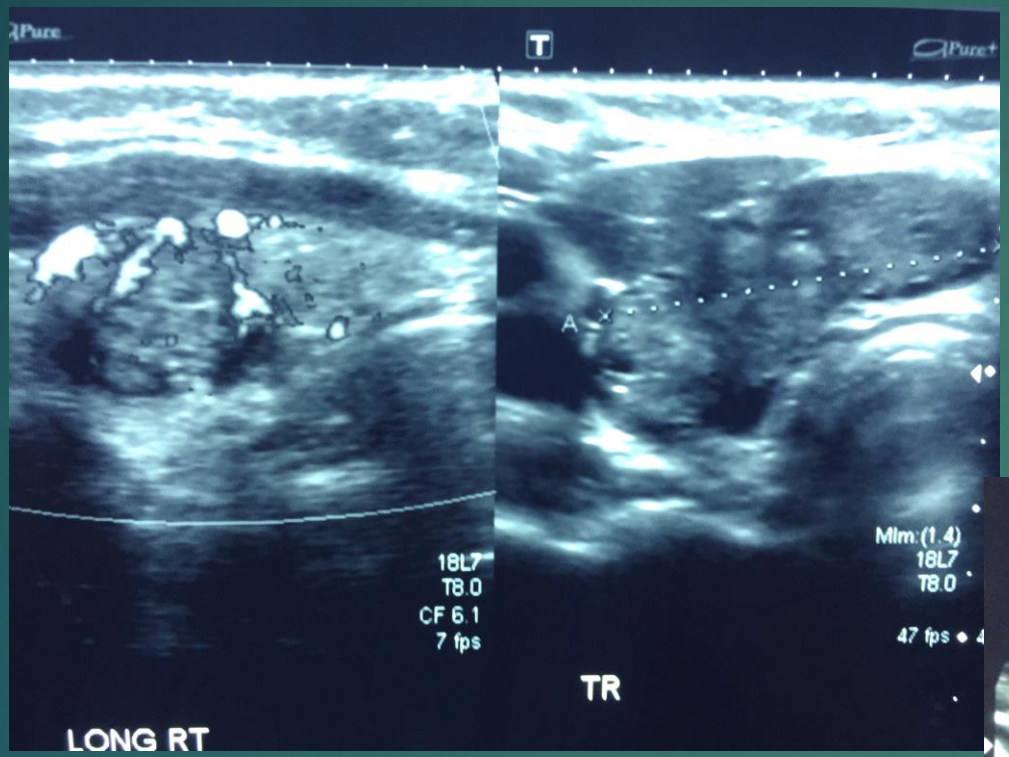
C

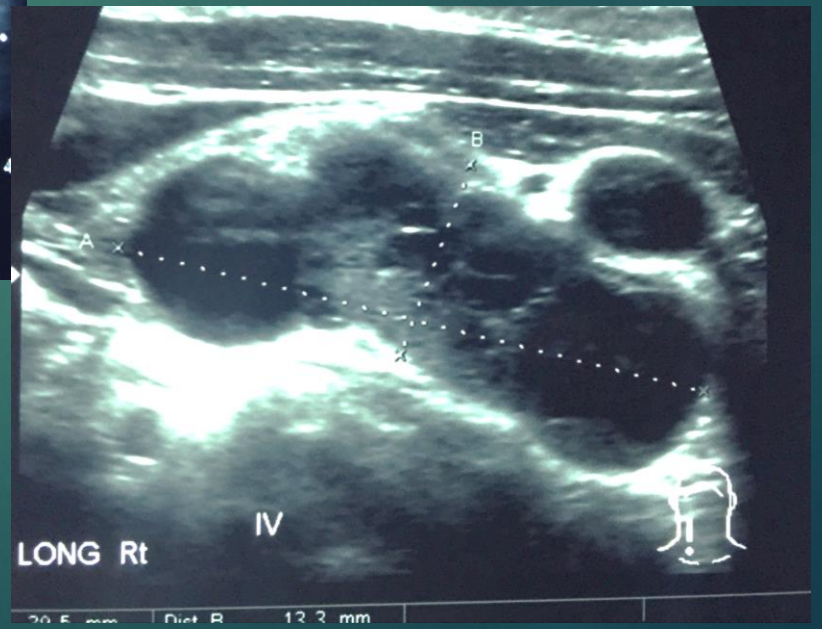


D



36 y/o female





FNA confirmed PTC with
Right neck lymph node mets

WHY THYROID SURGEONS ARE FRUSTATED WITH RADIOLOGISTS; : LESSONS LEARNED FROM PRE AND POST-OP US REPORTS

S.S. Kumbhar et al ; Dept Radiology and Surgery , University of Washington Seattle,WA; Radiographics 2016 ; 36 (2141- 2153)

DEFICIENCY IN RADIOLOGY PERFORMED THYROID US

Carneiro,et al ; World J. Surgery 2014; 38 (3) 622 -627

- **Pre - op US is the most sensitive method for detecting lymph nodes with mets ; thus, recommended as part of the standard pre-op work up ****

- Missed findings may lead to inadequate surgical management, predisposing to residual disease post - op; higher risk for recurrence , repeat surgery

- **Residual metastatic lymph nodes are the most common source of persistent or recurrent disease, which may reflect incomplete pre-op imaging**

DEFICIENCY IN RADIOLOGY REPORTS , etc

- **Surgical and endocrinology literature has shown that radiologist performed pre- op staging US is less accurate, when compared to surgeon performed US**

- Kumbhar et al :

Central compartment, level VI nodes not reported 17/20 (85%)

Missed abnormal lateral compartment lymph nodes 11/12 (92%)

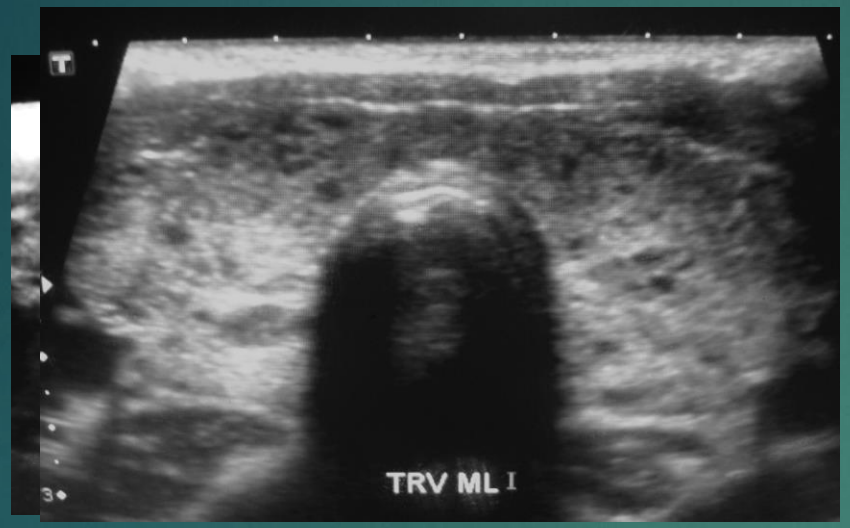
Failure of mentioning cervical lymph node status 85/ 115 (74 %)

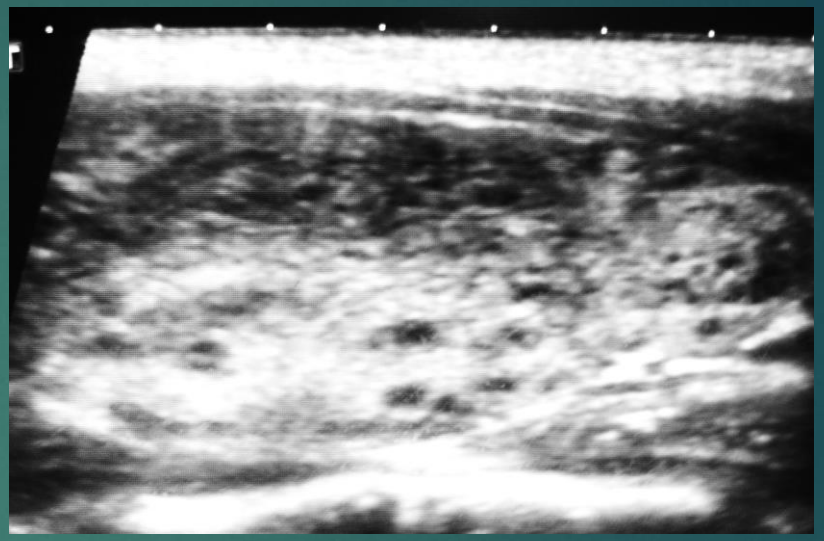
Recommendations : PRIOR to surgical procedure

- Evaluate all levels of neck (mainly central level VI ; and lateral II - V levels)
- Identify if bilateral suspicious thyroid nodules are present
- Extracapsular extension (obvious or subtle)
- Retrosternal extension : demonstrate lower margin of thyroid lobes when suspicious nodule is seen inferiorly; if margin not seen, suggest extension : Thoracic CT recommended

PITFALLS

PITFALL : In patients presenting with the micronodular pattern of chronic Hashimoto's thyroiditis





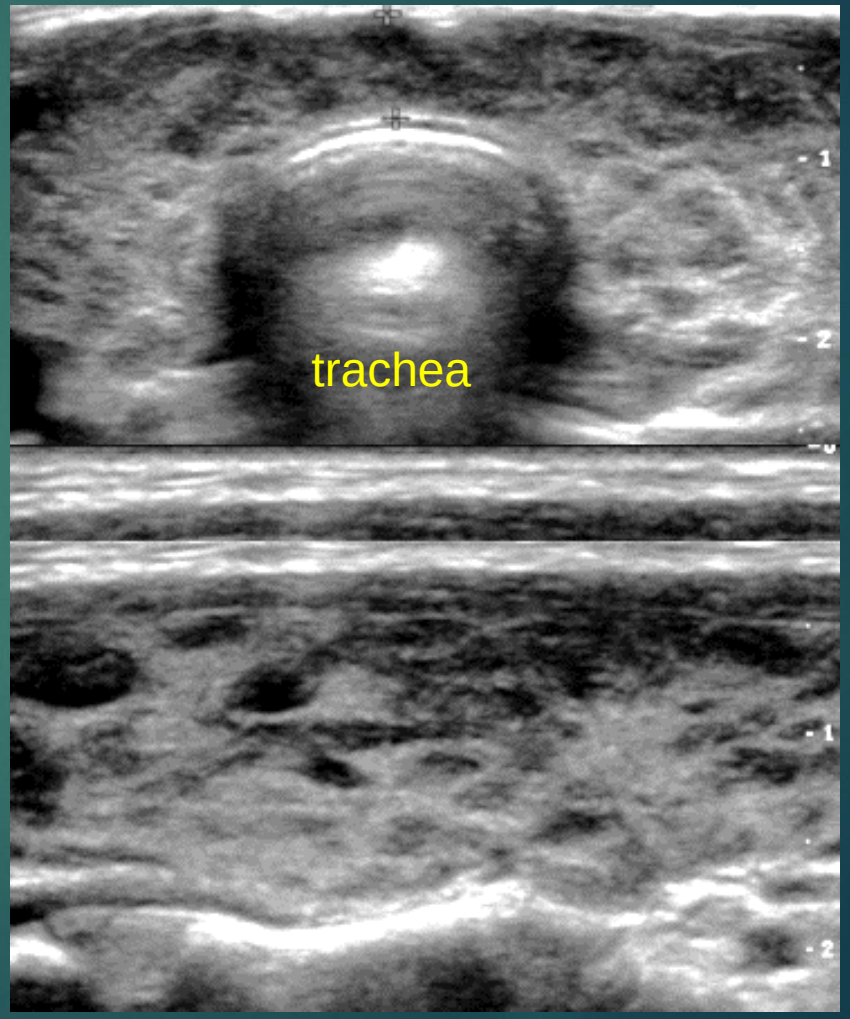
Do not measure each micronodule as a separate entity . ***

This is a **diffuse pattern**, of ill - defined, small scattered regions of less echogenicity

Focal regions of more lymphocytic infiltration can present as larger hypo or echoic areas ; to be followed, to assess interval change

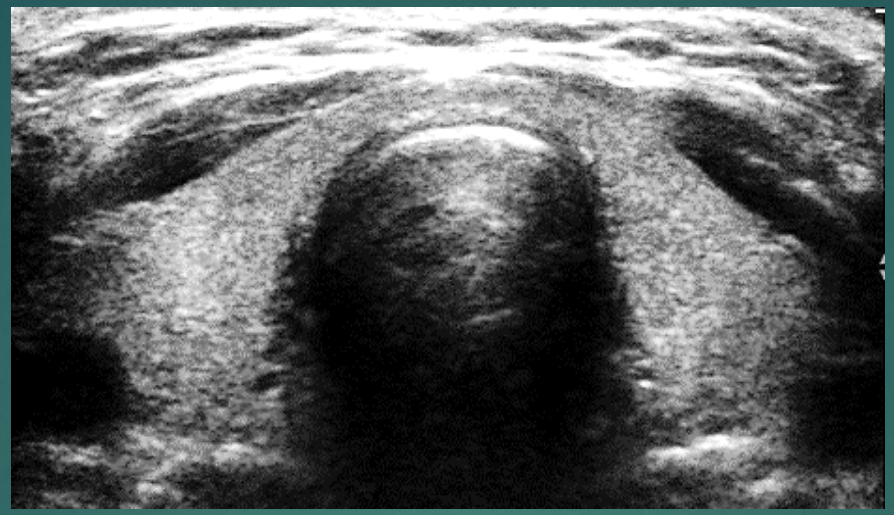
Pseudonodules of Hashimoto's thyroiditis

"Giraffe pattern"

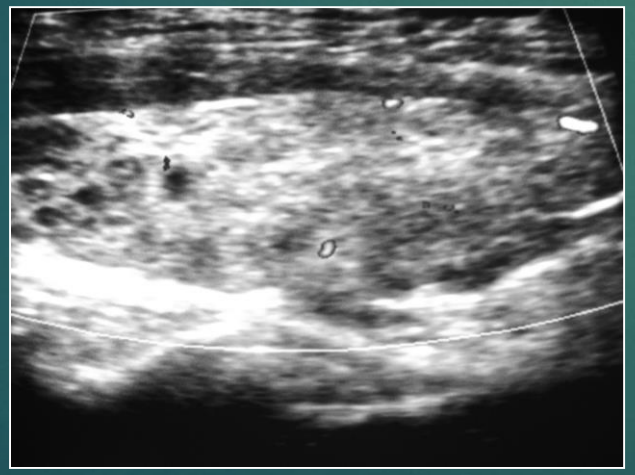


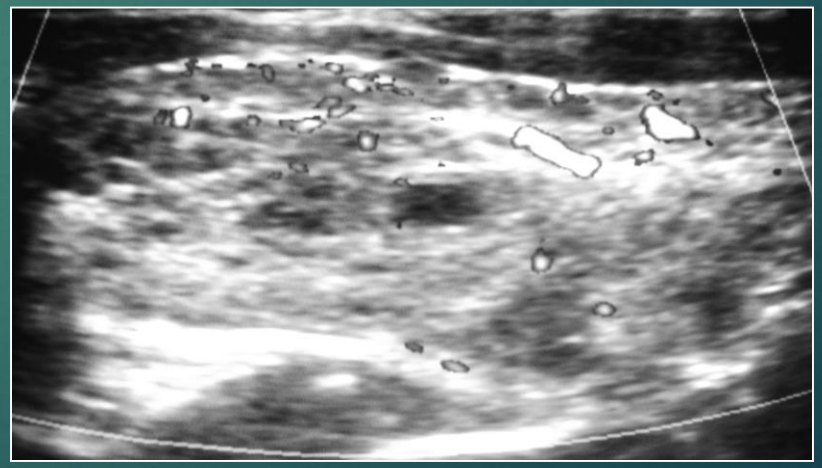
Comparison

Normal homogeneous thyroid texture



Hashimoto's thyroiditis

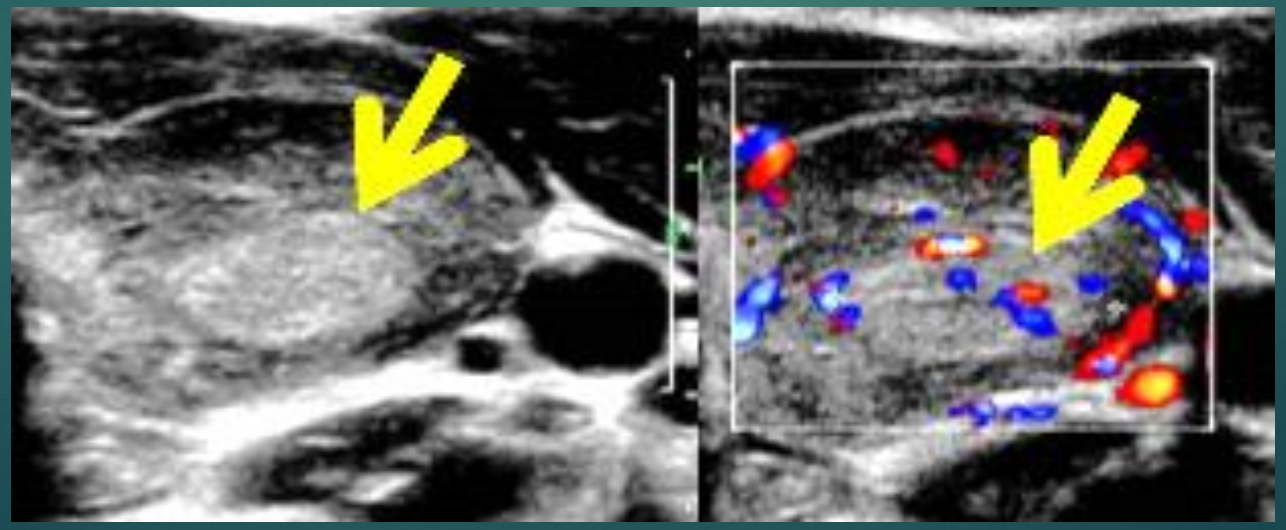




Inhomogeneous texture : ill defined patchy areas of decreased echogenicity seen with chronic Hashimoto's thyroiditis

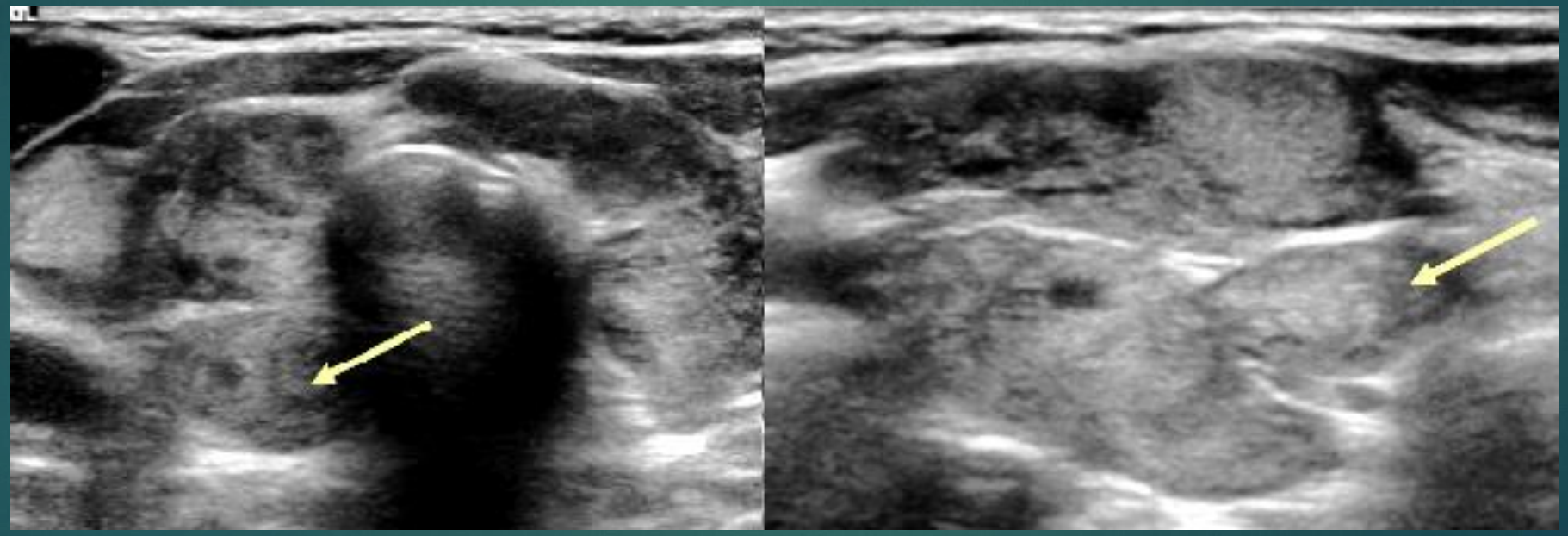
"White knight" of Hashimoto's thyroiditis

- Uniformly **hyperechoic nodule** in a hypoechoic, background of Hashimoto thyroiditis
  - Sharp margins
  - Isovascular with rest of thyroid
  - No calcifications
- Large f/up study with >800 nodules
  - White knight nodules had 100% specificity for absence of malignancy



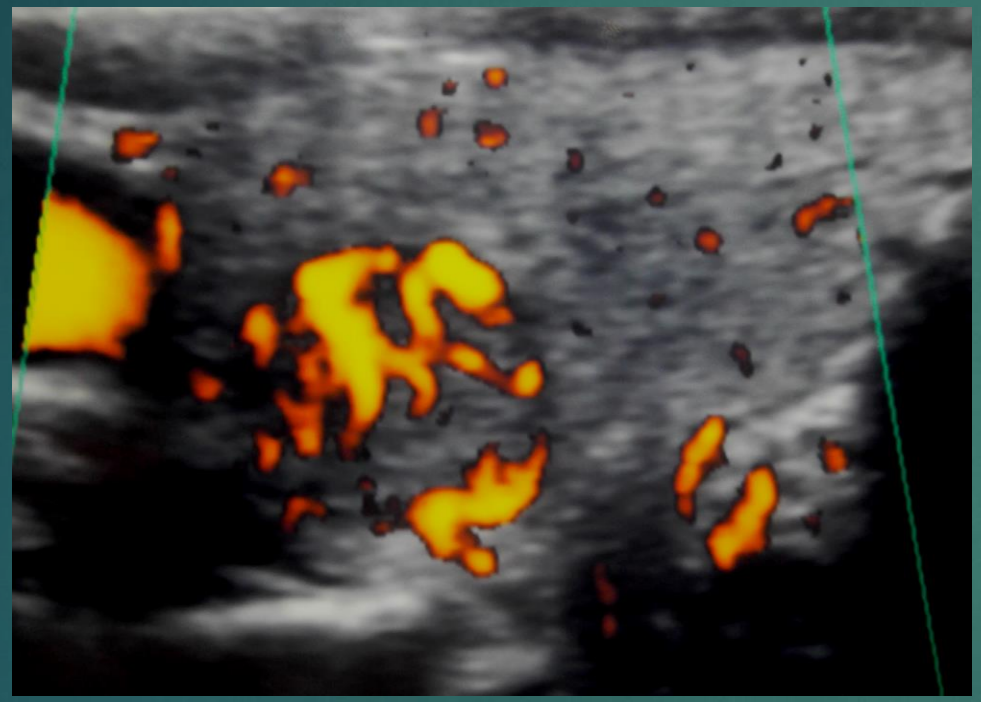
“Cleft sign” of Hashimoto’s thyroiditis : pseudonodule

- The echogenic fibrous septations surround segments of parenchyma and simulate nodularities

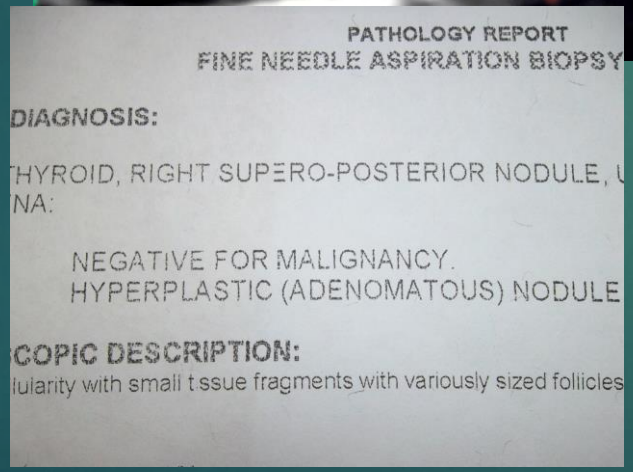


FEW CASES

Does this 1 cm nodule meet FNA criteria ?



Solid (2) ; hypoechoic (2) ; smooth margin (0)
wider than taller (0) ; no echogenic foci (0) Total pts : 4
TI-RADS 4 (FNA if = or > 1.5 cm ; o/w, f/up between
1-1.4 cm, in 1, 2, 3 and 5 years



PATHOLOGY REPORT
FINE NEEDLE ASPIRATION BIOPSY

DIAGNOSIS:

THYROID, RIGHT SUPERO-POSTERIOR NODULE, U
NA:

NEGATIVE FOR MALIGNANCY.
HYPERPLASTIC (ADENOMATOUS) NODULE

COPIC DESCRIPTION:
ularity with small tissue fragments with variously sized follicles

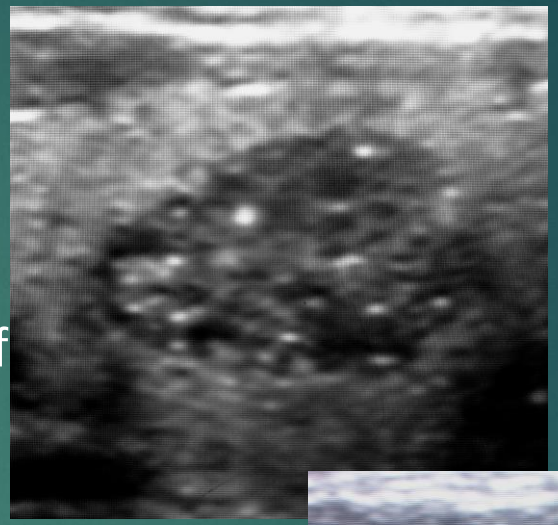
NO FNA needed at this time

However, FNA was done ; due to vascularity

Benign FEATURES

= Spongiform appearance

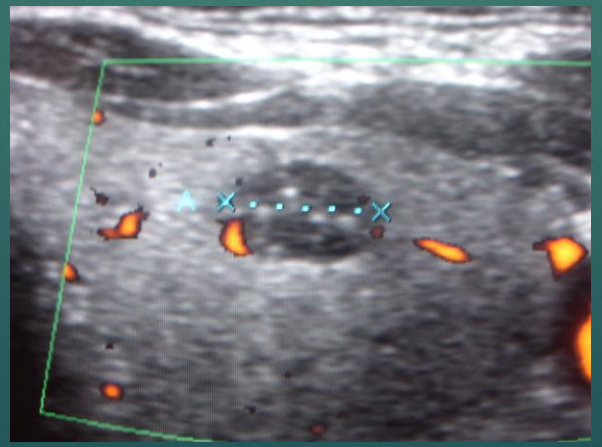
- multiple microcystic spaces occupying more than 50% of the nodule volume

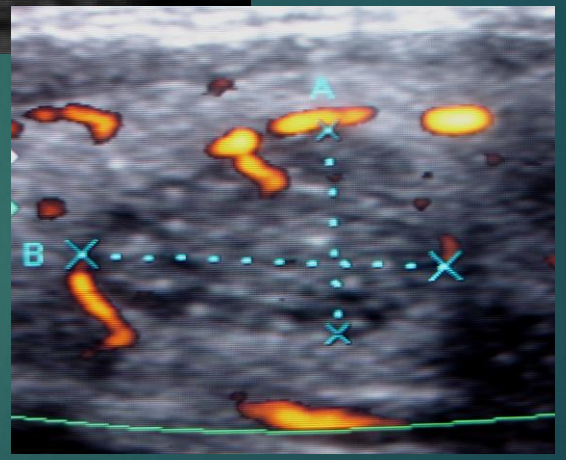


Punctate Echogenic Foci can Be seen

- can be left alone

No FNA

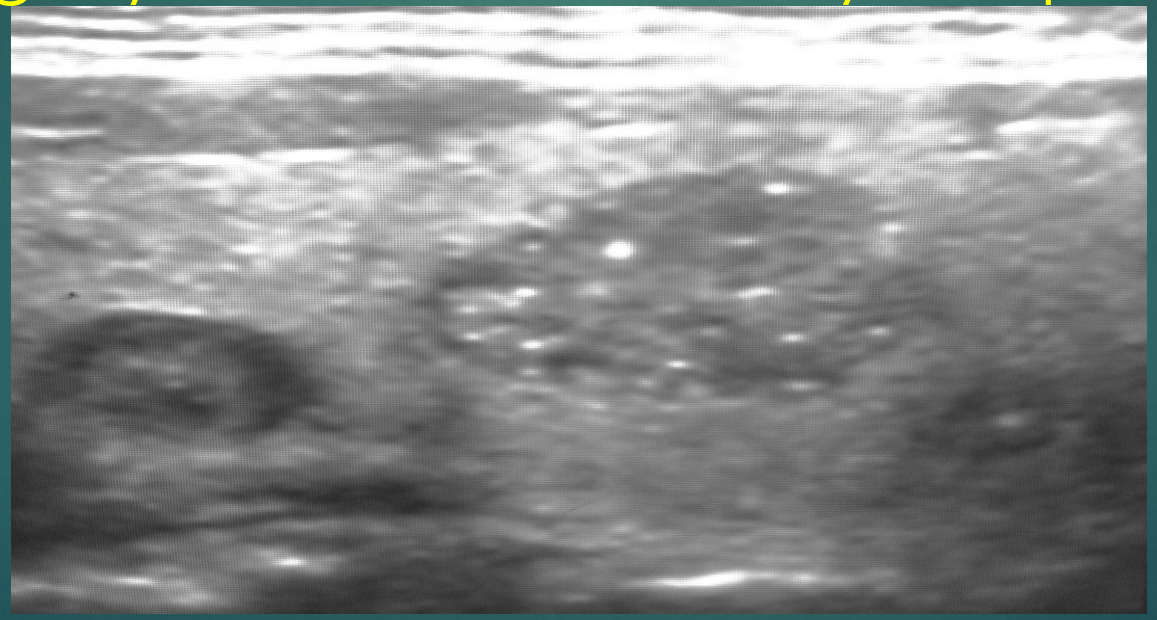




Multiple nodularities in same patient

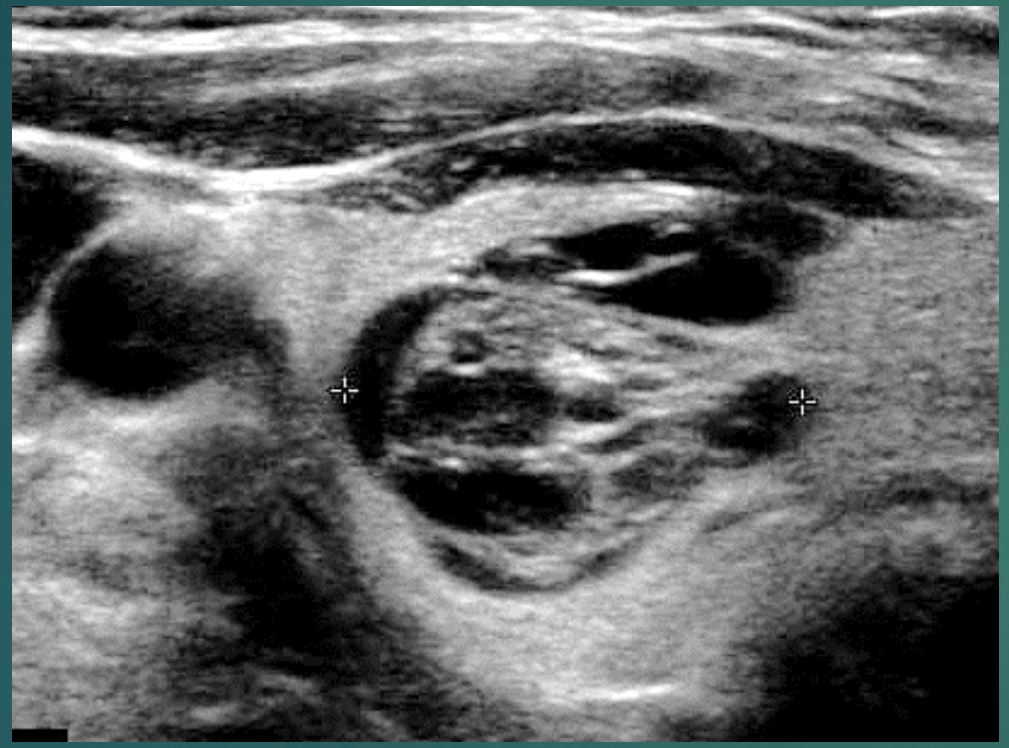
These are echogenic foci related to colloid particles and /or posterior walls of cystic spaces in spongiform nodules …

Magnify to see the small cystic spaces



Do not interpret as “ microcalcifications “

Spongiform nodule … TI-RADS 1 Benign (hyperplastic adenomatous nodules)



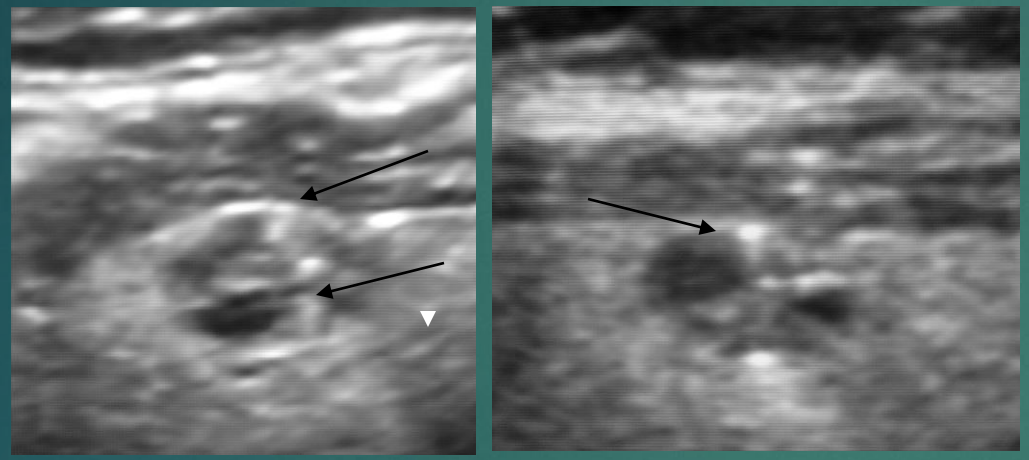
Well -defined

Cystic spaces in more than 50% of nodule

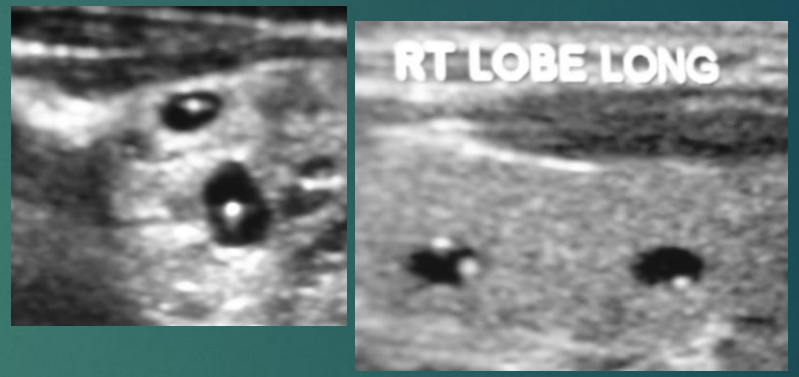
No points added from other categories **

Tiny bright echoes in well - defined spongiform nodules : colloid particles

- **Look for "comet tails" (large > 1 mm : benign)**



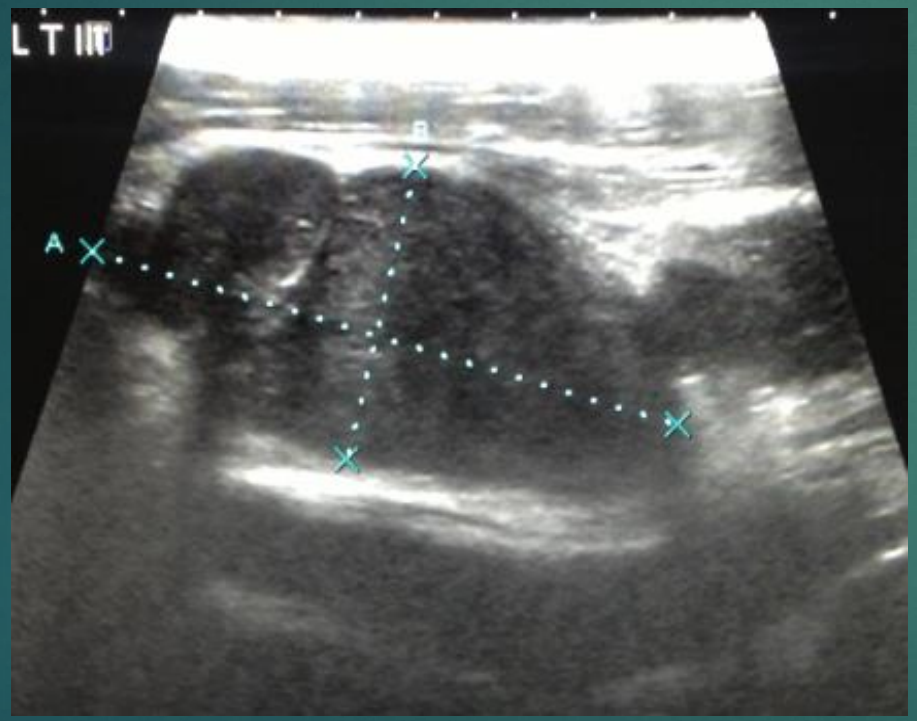
Seen in colloid follicles/cysts

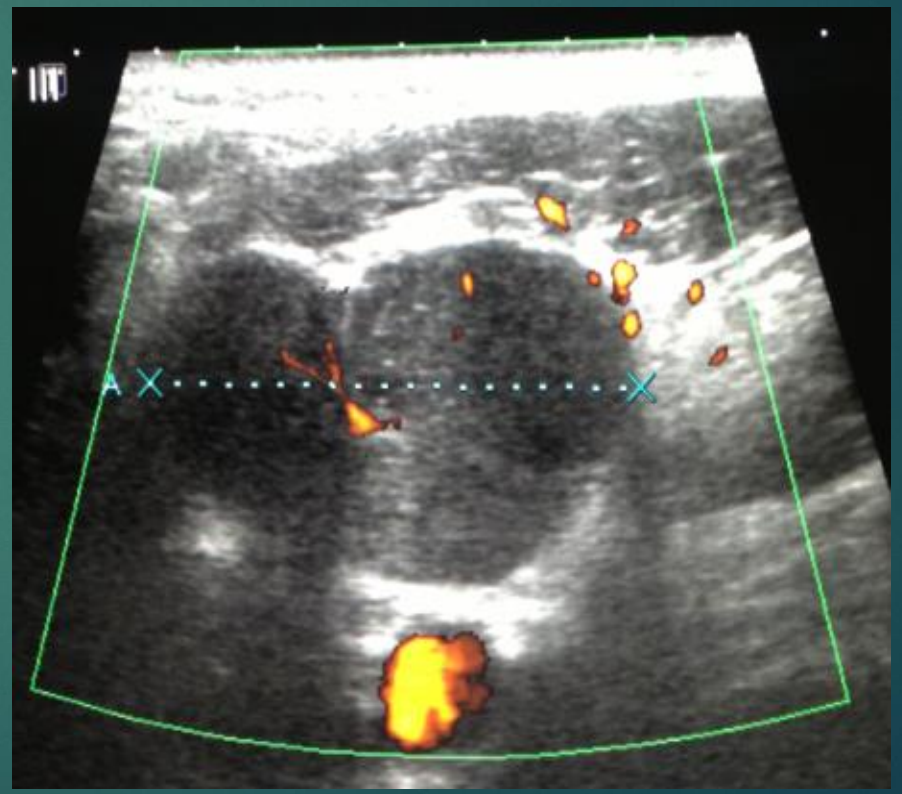


- FNA was done in this case, since finding in larger nodule had been reported as "microcalcifications"

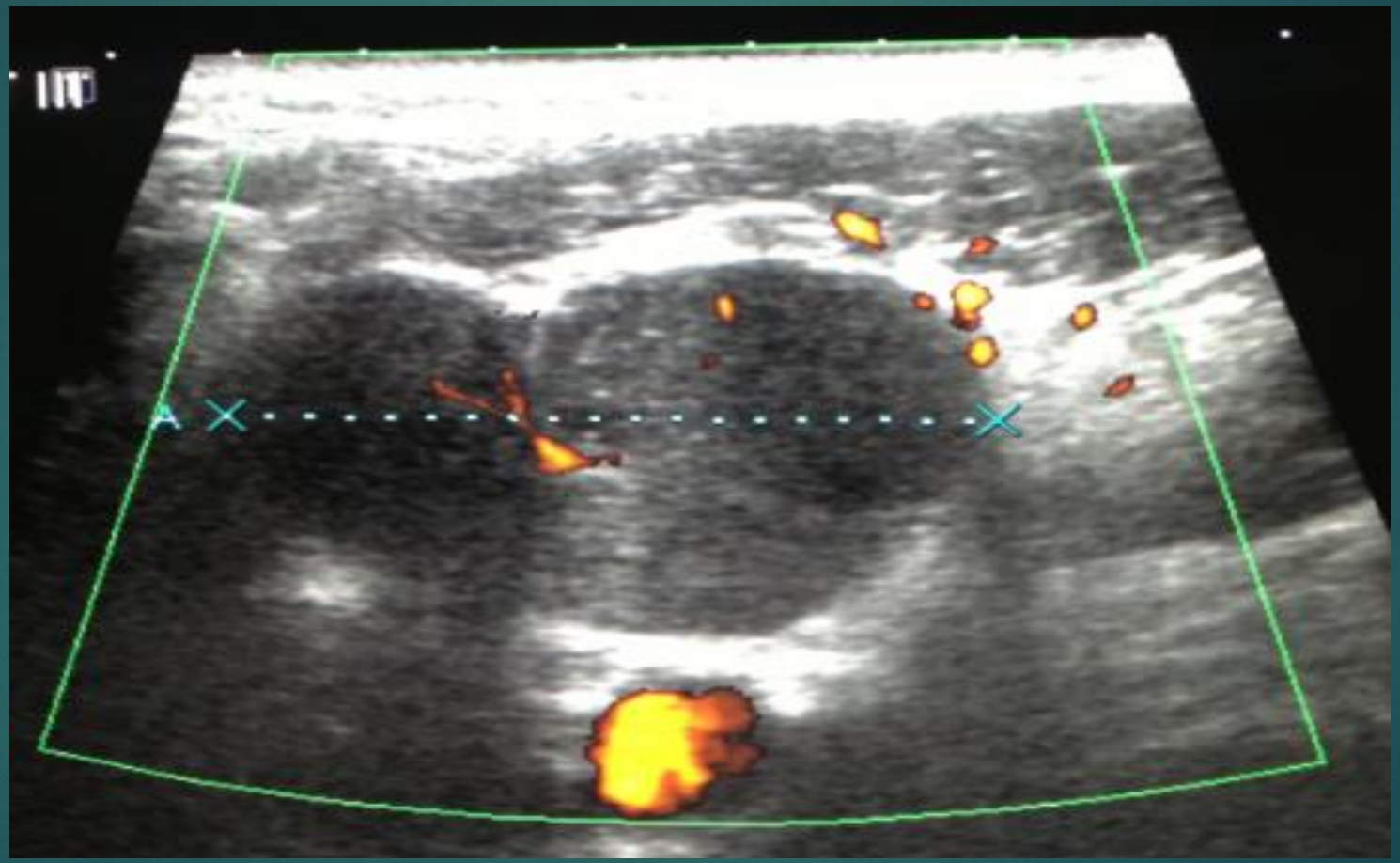
- **Path. Report** : Bilateral hyperplastic adenomatous nodules

Abnormal lymph node FNA Indicated …

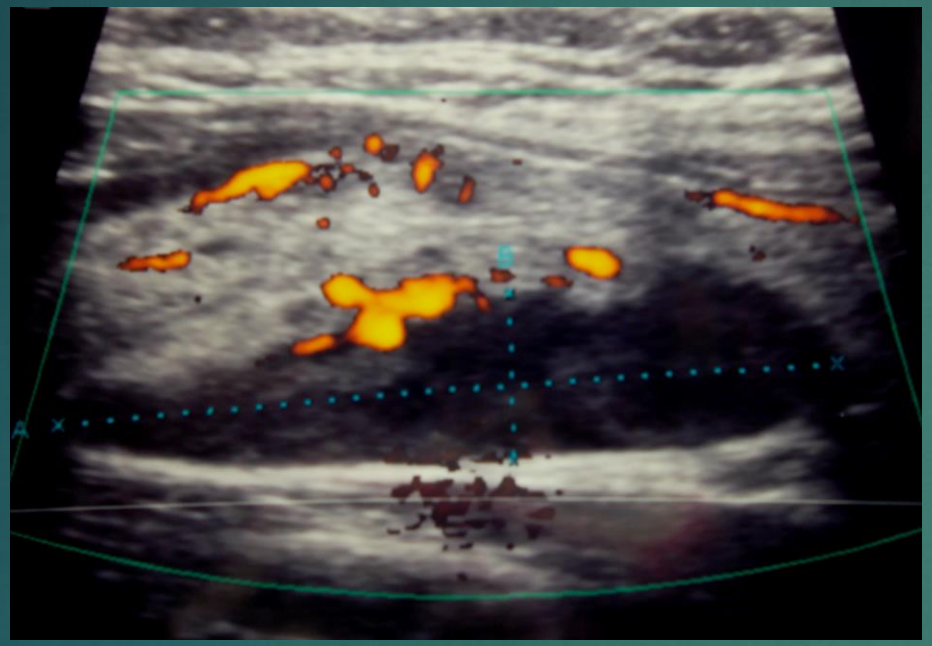




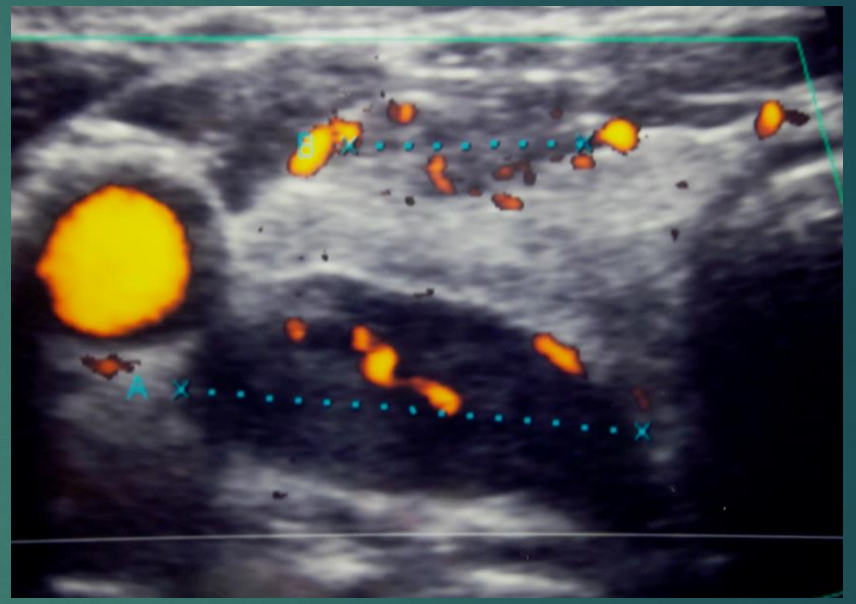
Squamous cell CA / mets



POSSIBLE LYMPH NODE ??...



long



transverse

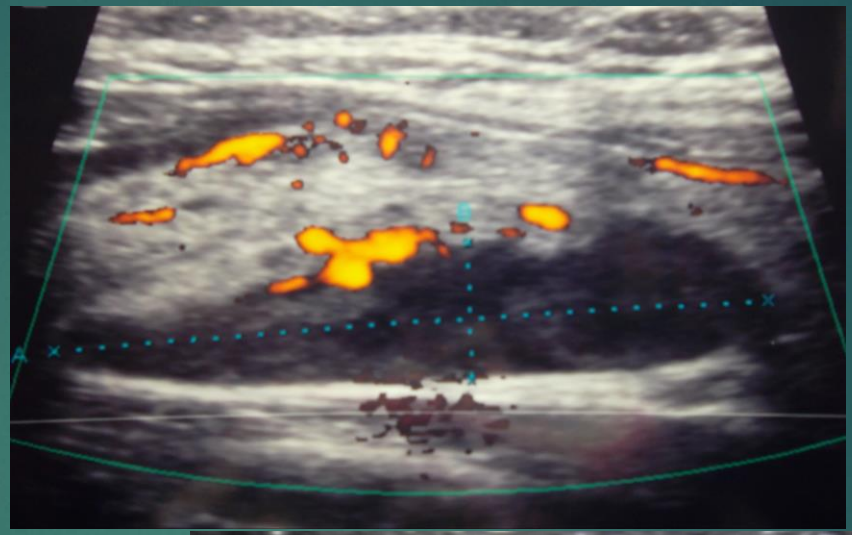
Parathyroid adenoma : pertinent history needed

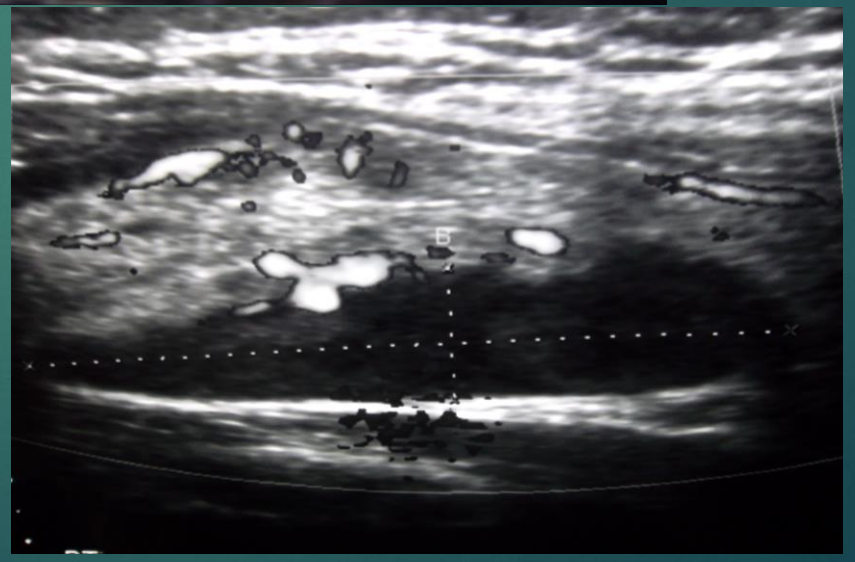
S. calcium

PTH levels

Sestamibi scan

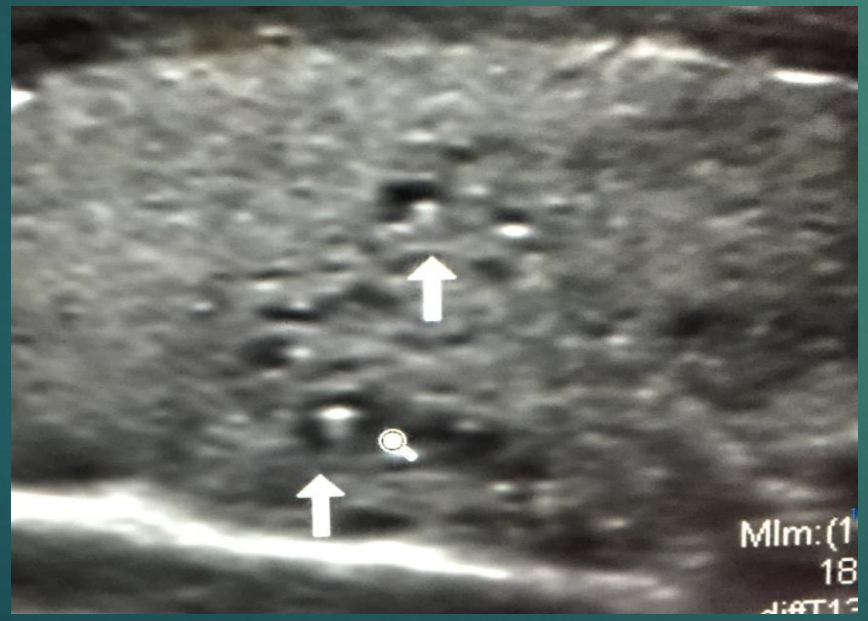
Contrast enhanced
4- D CT of neck

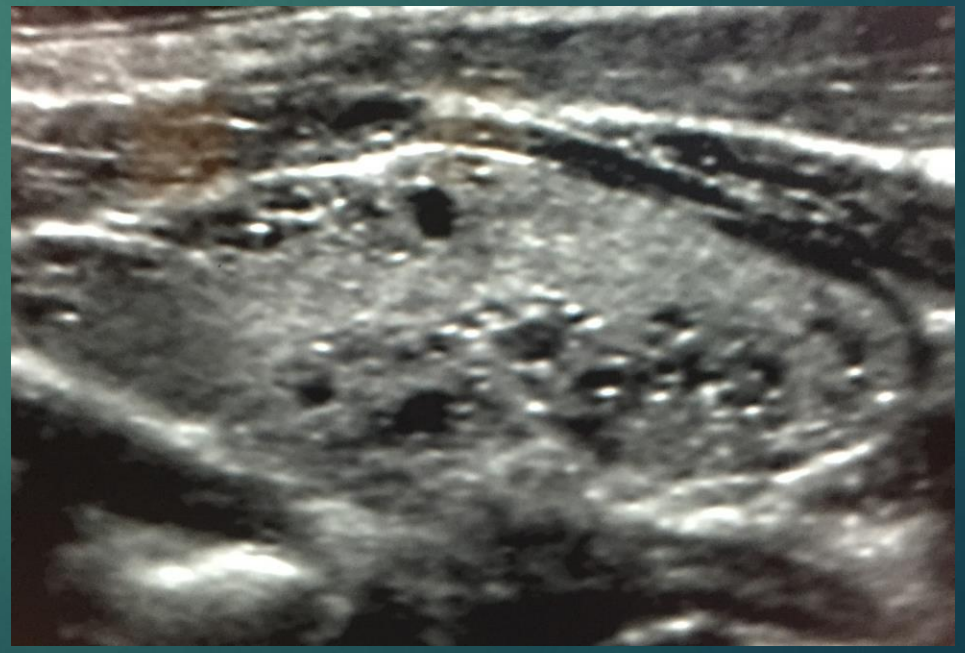




Any worrisome features in this case ?

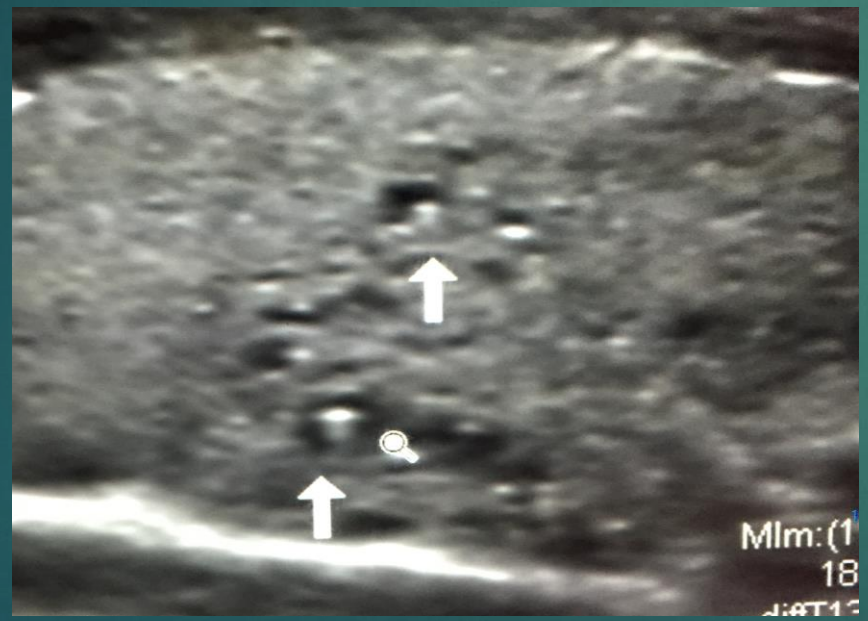
FNA recommendation ?

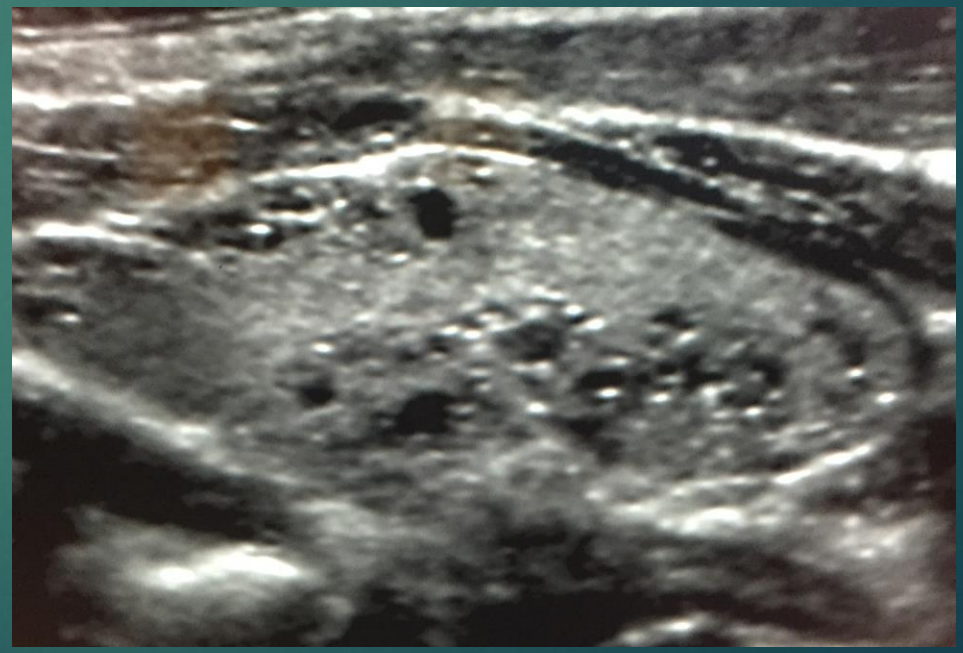




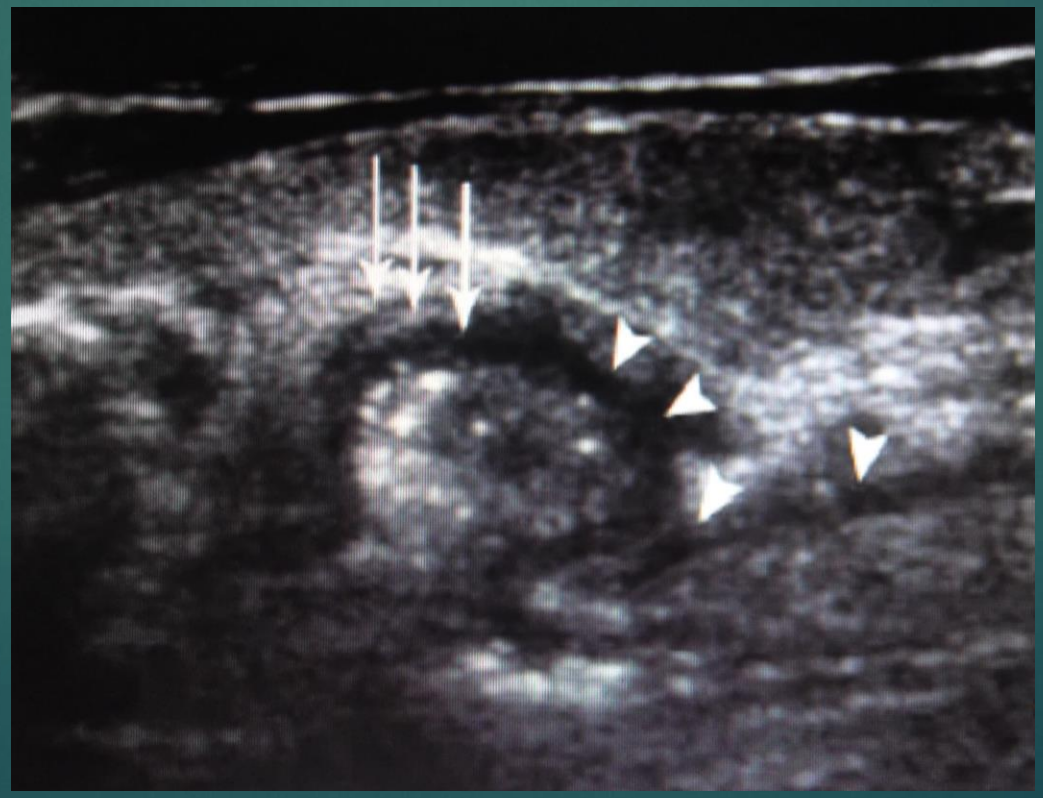
No worrisome features ; no FNA

Clusters of colloid follicles, with long comet tails

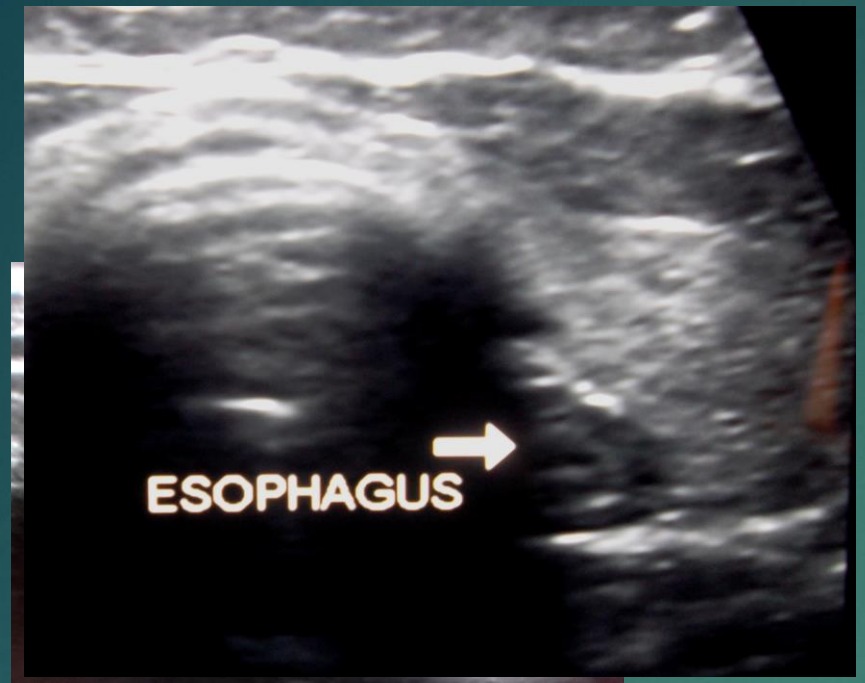


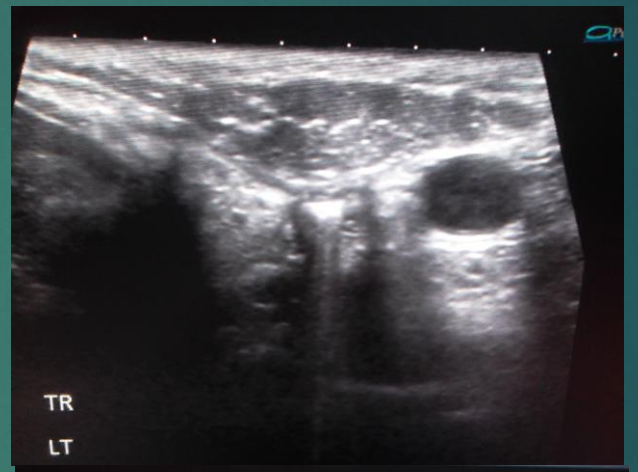


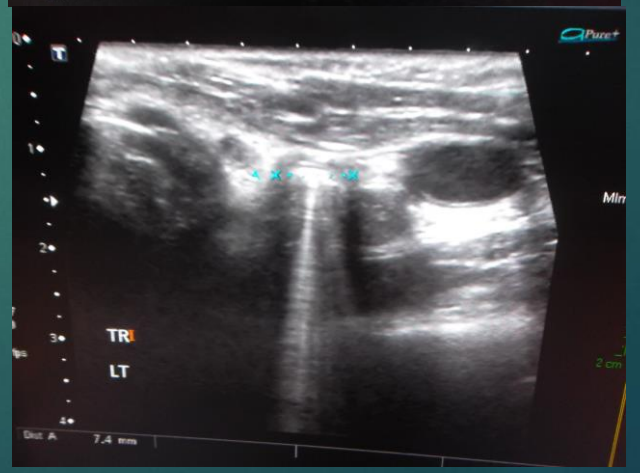
Would you recommend FNA for this "left lobe lesion"" ?



Look carefully for other features …



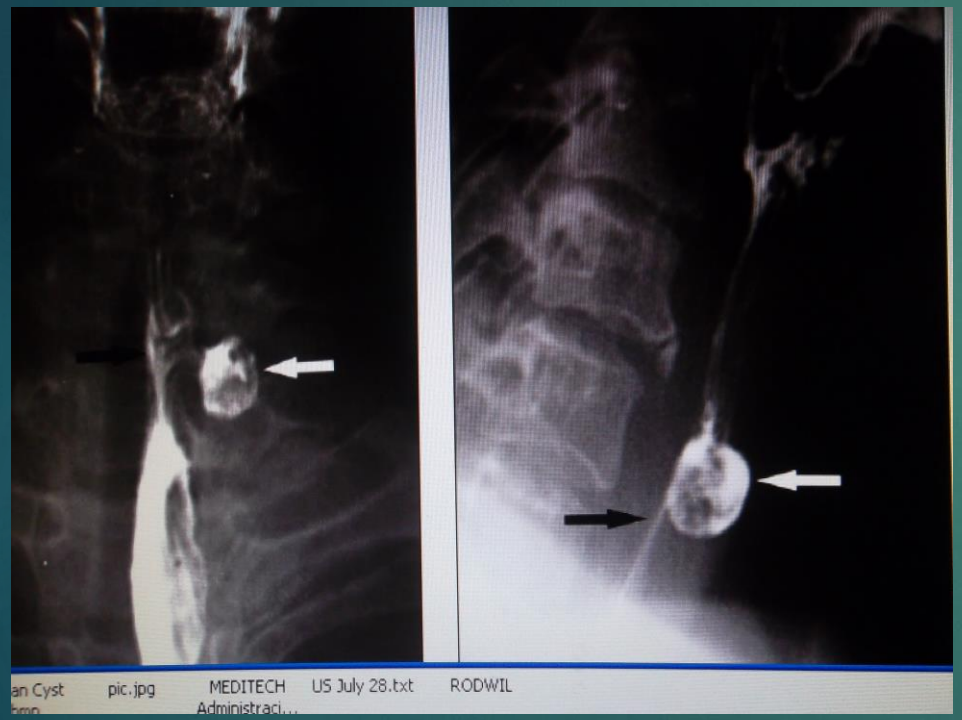


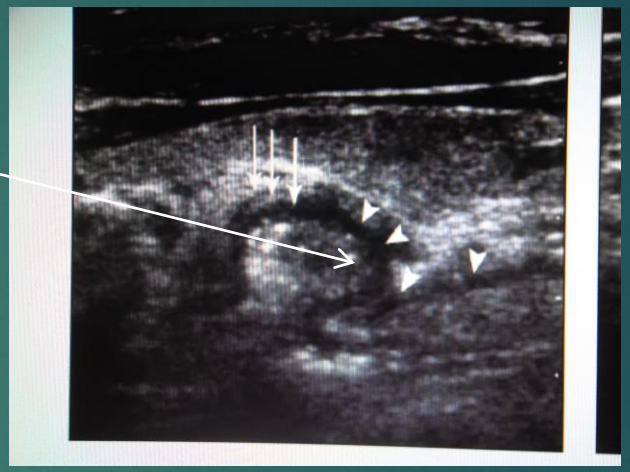


Trans views of the left lobe

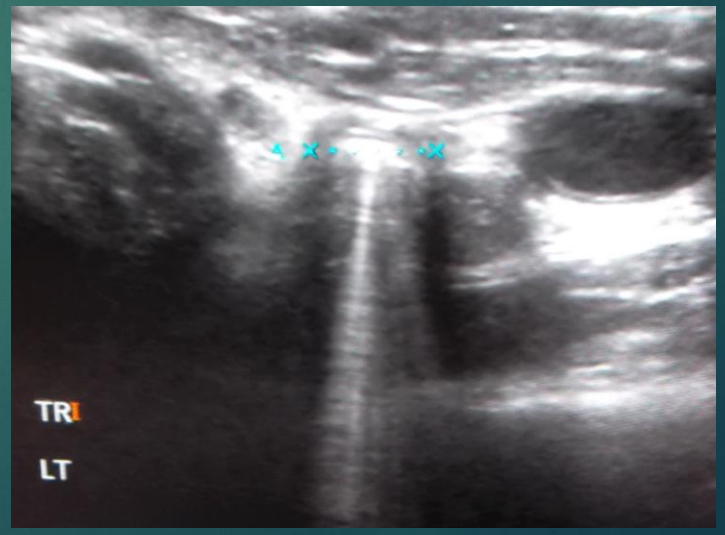
This is a typical Killean - Jamieson anterolateral esophageal diverticulum

Air artifact : dirty shadow





Gut signature



Ba swallow showing the diverticulum

THYROID BED and NECK POST OP EVALUATION

- **Recurrent or residual disease occurs most frequently in :**
  = cervical and mediastinal lymph nodes (74 %)
  = thyroid bed (20 %)
  = peritracheal muscles (6 %)

- Non palpable; subcentimeter lesions

- **Post – op thyroid bed hypoechoic nodularities < 10 mm can occur in 1/3 of patients ; 90% not malignant, do not progress**

- Recommendation (European Thyroid Association) : wait 3 months post-op before imaging the thyroid bed

THYROID BED and NECK POST OP EVALUATION

- **Fibrofatty echogenic tissue can be seen in thyroid beds**

- **Residual tissue or recurrent CA present as hypoechoic nodules**

(US features are commonly similar to those described with original thyroid nodules with CA) **

- **If recurrent disease detected :**

  = "line diagram" recommended to assess site of finding

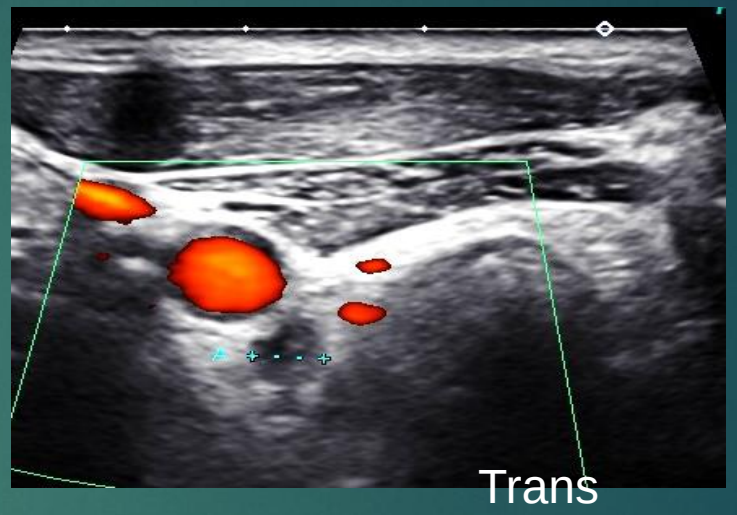
  = Alternatives : correlation with pertinent labs; FNA ; repeat surgery and/or active surveillance

THYROID BED and NECK
POST OP EVALUATION

- Residual or recurrent thyroid cancer - hypoechoic nodule ; D/D :
  = residual tissue with thyroiditis
  = post op granuloma
  = reactive lymph node
  = parathyroid adenoma

- Thyroid bed nodule, malignancy features (level VI):
  = increased vascularity ; echogenic foci ; cystic components
  = taller than wide ; irregular margins

Thyroid Bed and Neck POST - OP US Evaluation



Right thyroid bed ; level VI

Right Level IV lymph nodes

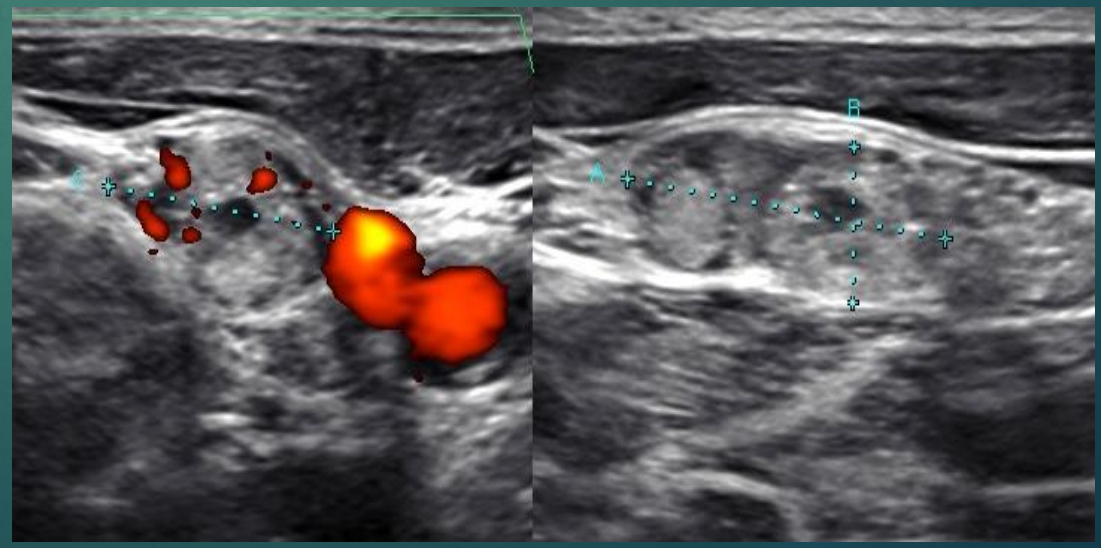
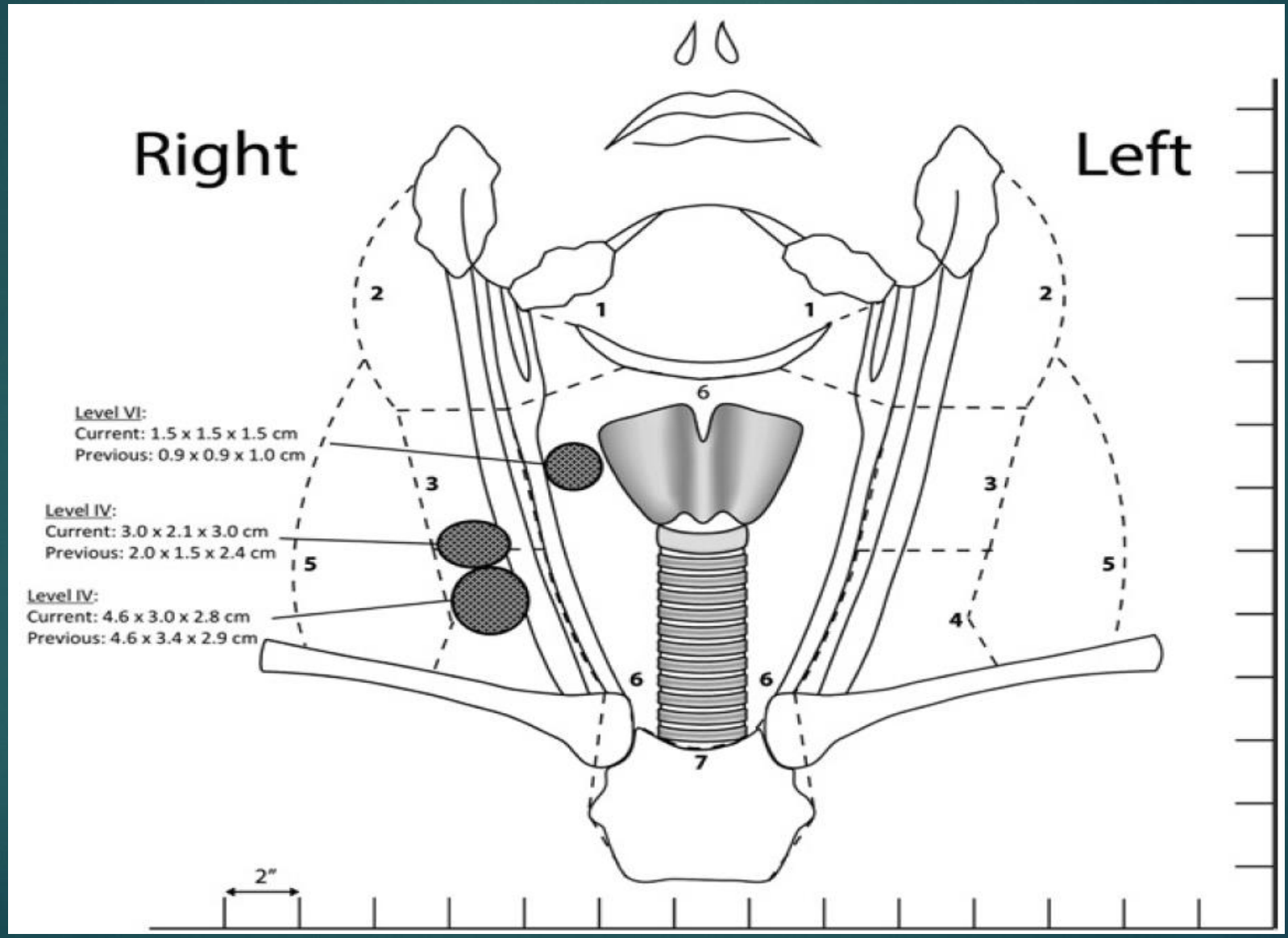


Diagram : Sites of Findings



OBJECTIVES

- Review specific US features of focal thyroid lesions
- Discuss ACR TI –RADS Classification and Recommendations
- Neck Lymph node Evaluation
- Review pitfalls in thyroid imaging that can alter the interpretation
- Evaluation of Post Surgery Thyroid Bed