Advanced Thyroid Ultrasound

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MSKCC

Objectives

- Fine needle aspiration
- Lymph node evaluation
- Parathyroid ultrasound

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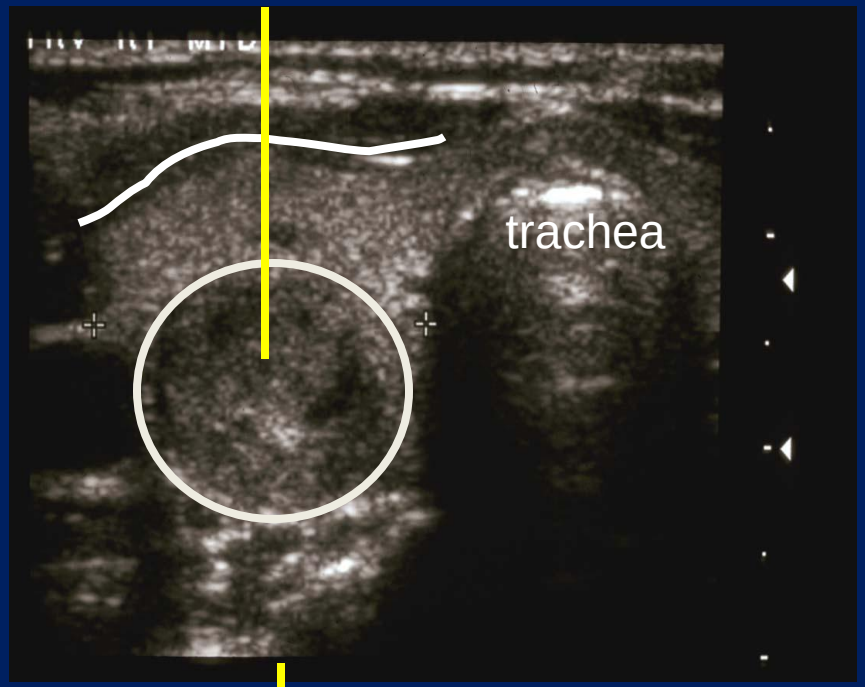
- Parathyroid ultrasound

American Thyroid Association 2009

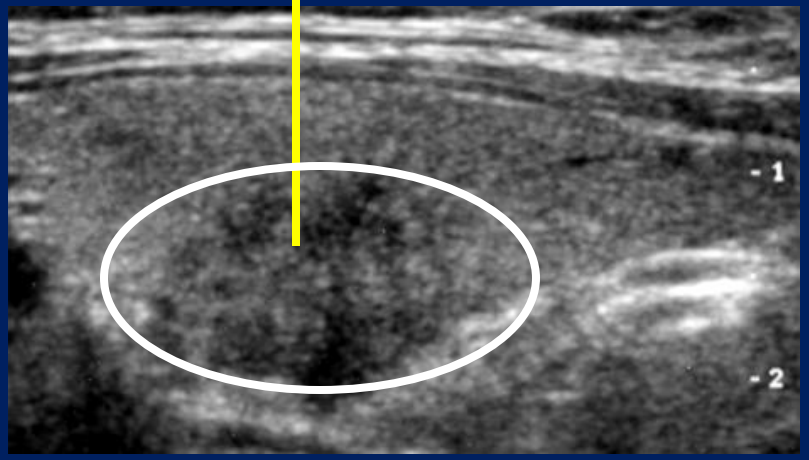
Nodule Sonographic / Clinical Features	Recommended nodule threshold size for FNA
High risk history with suspicious sonographic features	>5-9mm Recommendation A
High risk history without suspicious sonographic features	>5-9mm Recommendation I
Abnormal cervical lymph nodes	All*** Recommendation A
Microcalcifications present OR Solid *and* hypoechoic	≥1cm Recommendation B
Solid *and* iso- or hyperechoic	≥1-1.5cm Recommendation B
Mixed cystic/solid *and* any suspicious ultrasound feature**	≥1.5- 2.0cm Recommendation B
Predominantly cystic or spongiform nodule**** without suspicious ultrasound features	≥ 2cm Recommendation C
Purely cystic lesion	FNA not indicated Recommendation B

Indications for US guided FNA

- Difficult to palpate nodules
  - Nonpalpable (‘other’) nodules found on US that meet FNA criteria
  - POSTERIOR nodules EVEN if palpable
- Predominantly cystic nodules
- Nodules with nondx cytology from prior FNA
- Nodules with prior benign FNA that have grown



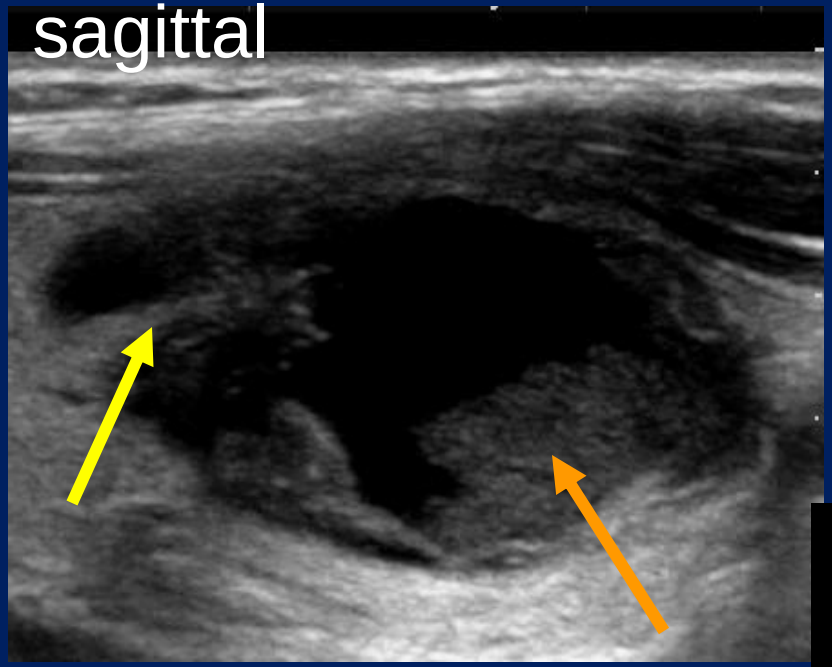
Posterior but palpable

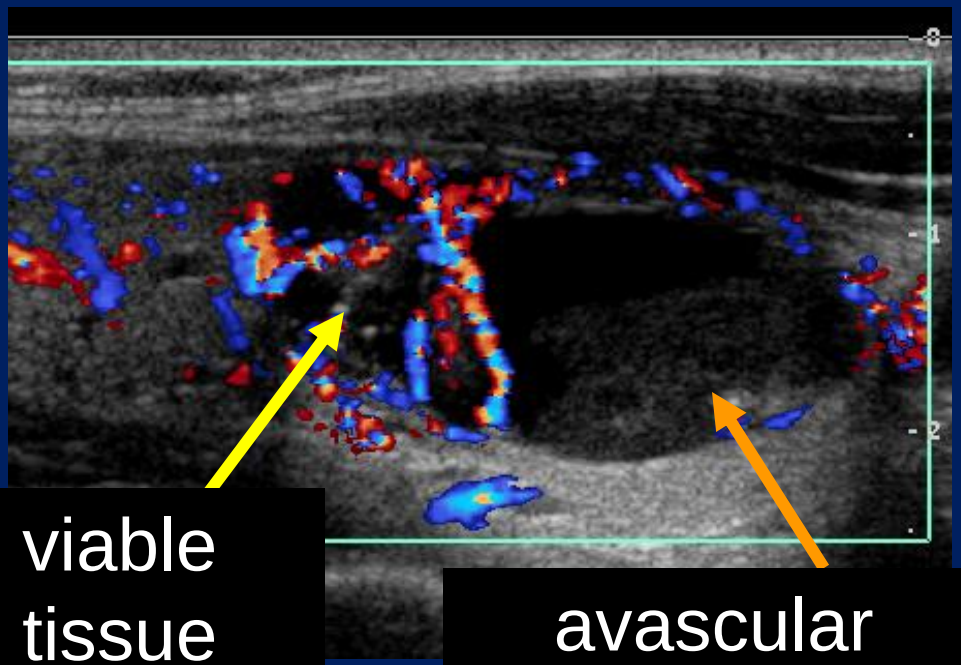


Posterior NOT palpable

Predominantly cystic nodules

Target vascular areas for FNA





viable tissue

avascular debris

False Negative Rates of Palpation FNA and US FNA

Retrospective reviews of clinical experience

	Palpation FNA	US FNA
Danese, 1998	2.3% (7/535)	0.6% (2/540)
Carmeci, 1998	0.5% (2/47)	0% (0/21)

False negative specimens due to sampling error (cystic lesions or nodule was not sampled)

Cameci, Thyroid 1998; Danese, Thyroid 1998

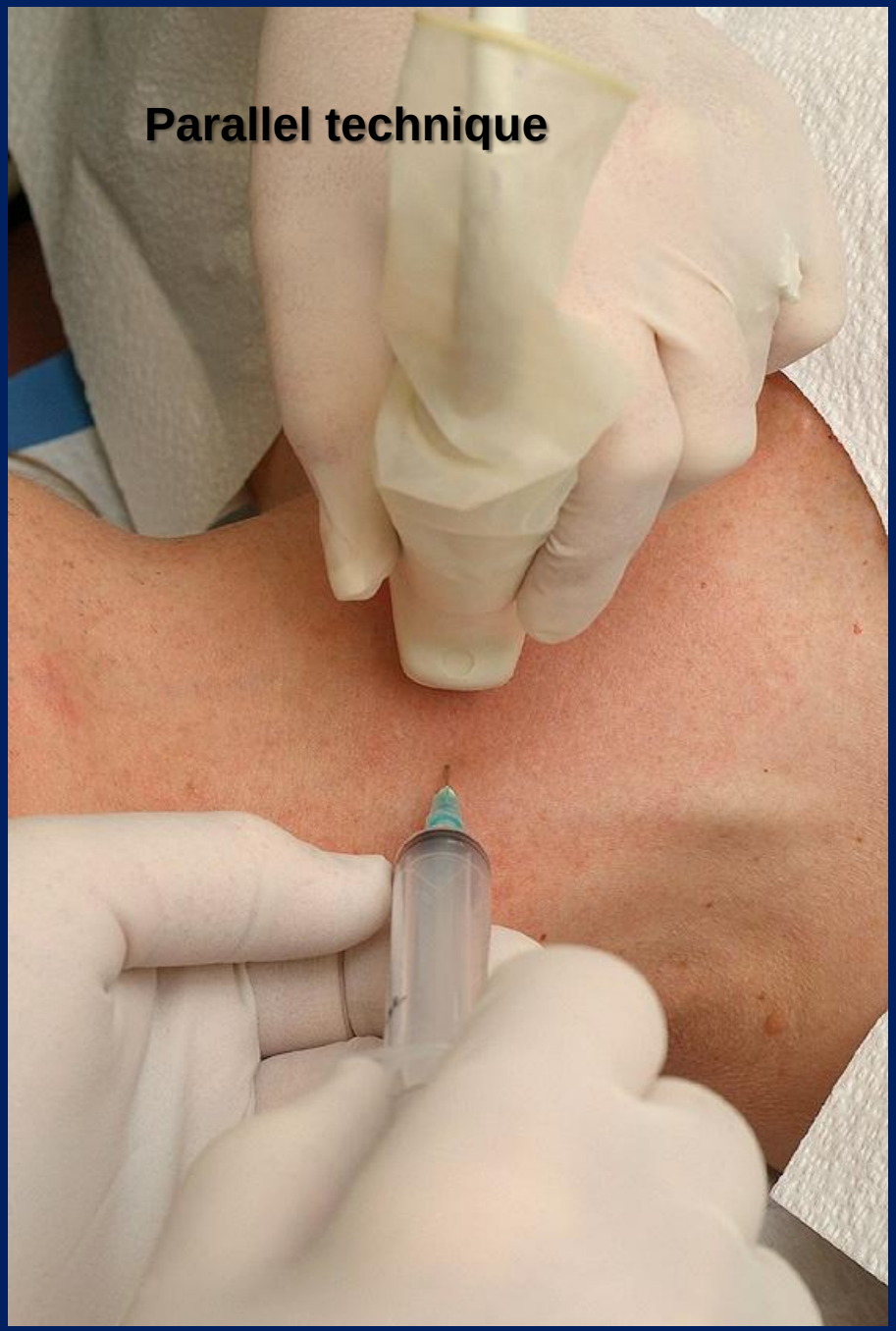
US Guided FNA

Real time visualization of needle during FNA

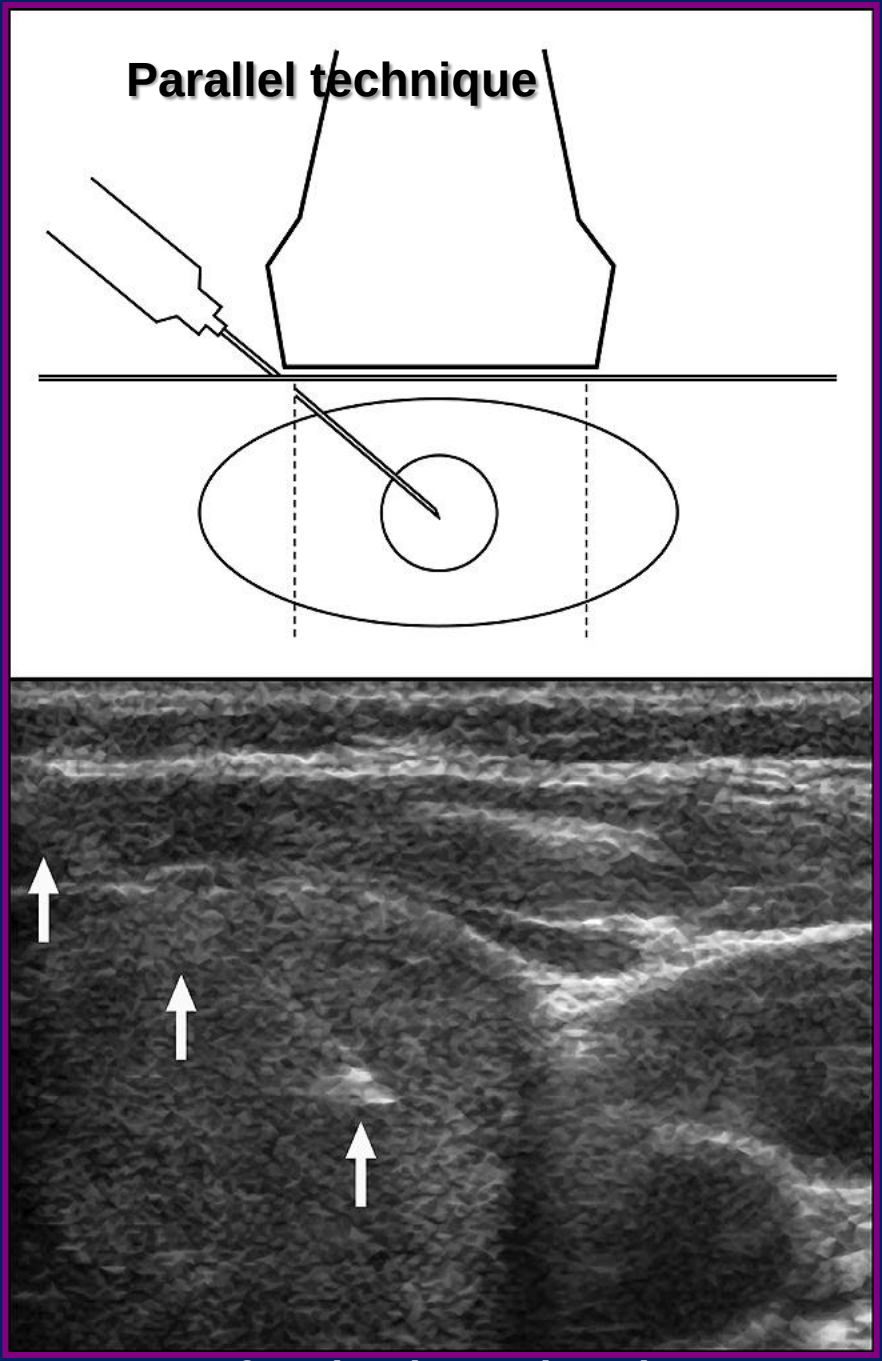
- One person: hold US probe in one hand and needle in the other hand while watching the US monitor
- Two people: one person holds US probe, the other person performs the FNA while watching the US monitor

US-guided FNA
Materials

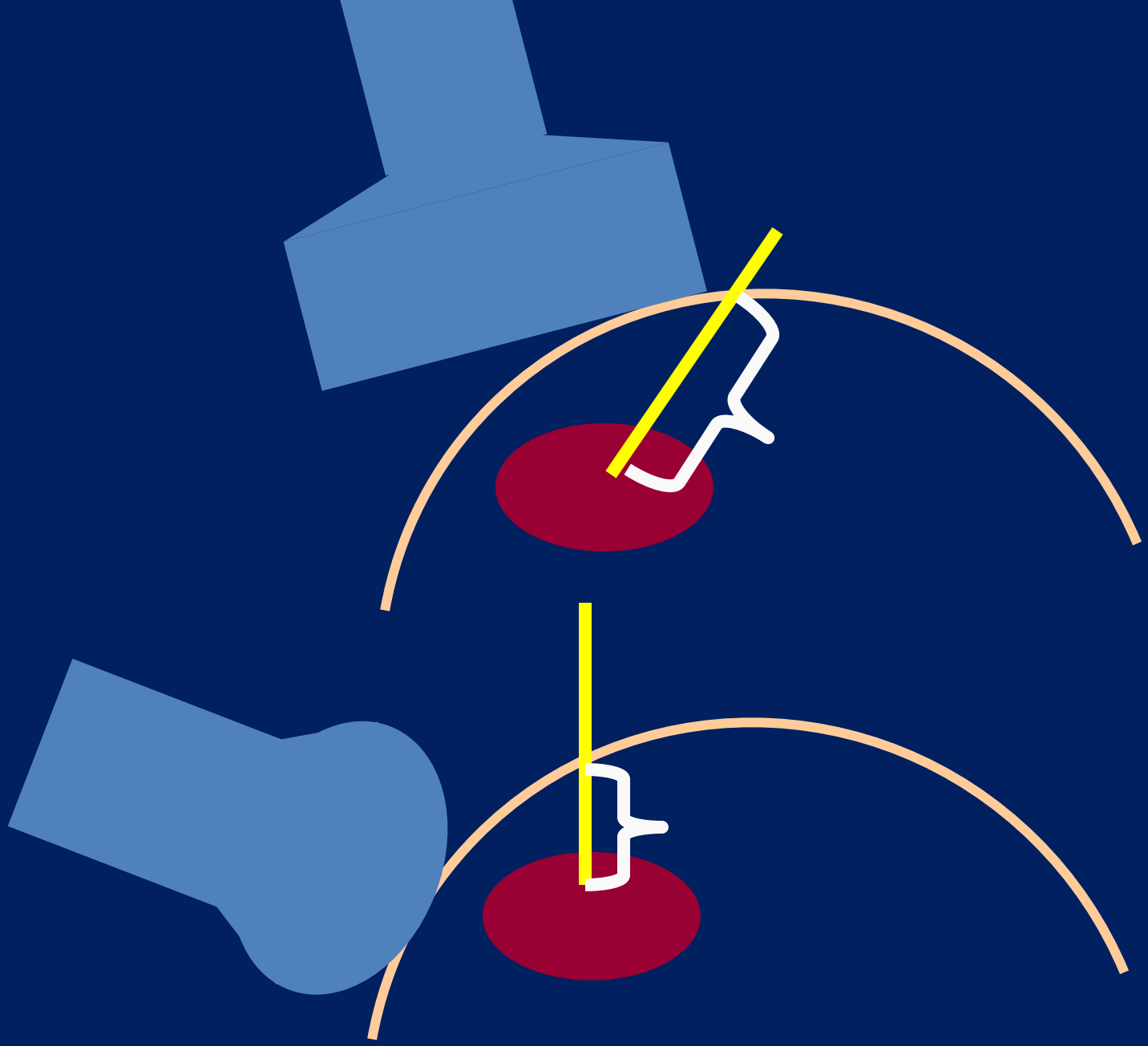
- Special “echogenic” needles are NOT required, a 1.5 inch 23-27 gauge needle is used (B-D)
- Needle is attached to a 10 cc Luer lock syringe containing 2-3 cc of air, or free needle without syringe
- A probe cover and sterile gel should be used if the technique chosen requires that the needle is inserted adjacent to the probe footprint
- Alcohol is used to clean the needle entry site
- Free hand technique, guide not required
- US-guided FNA is a 3D process


Parallel technique


Perpendicular technique

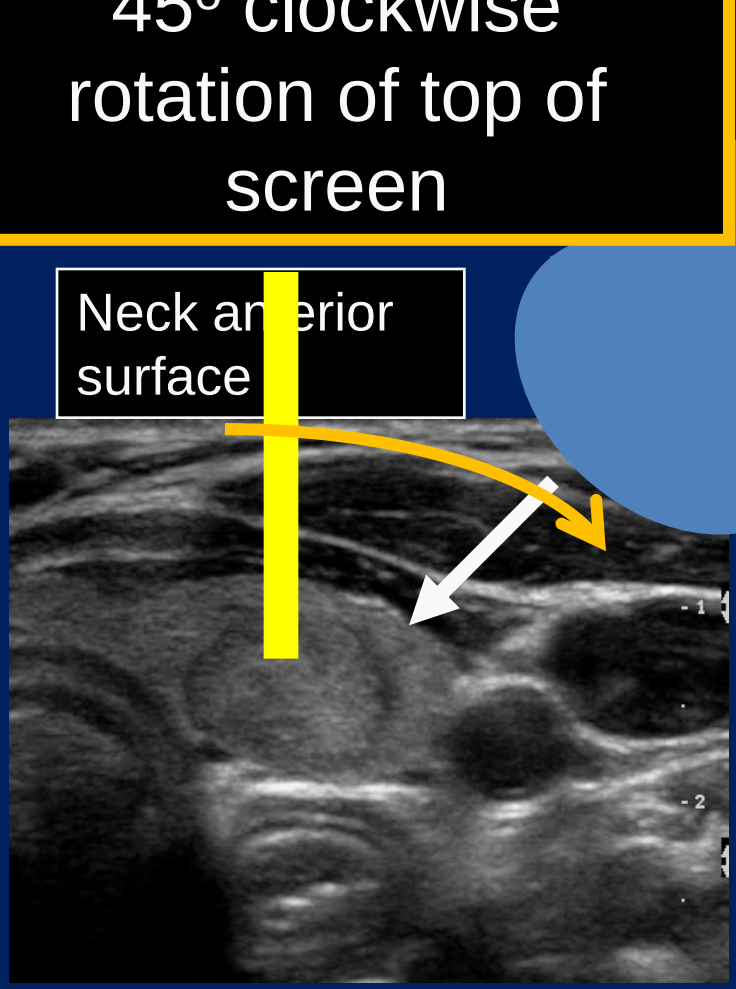


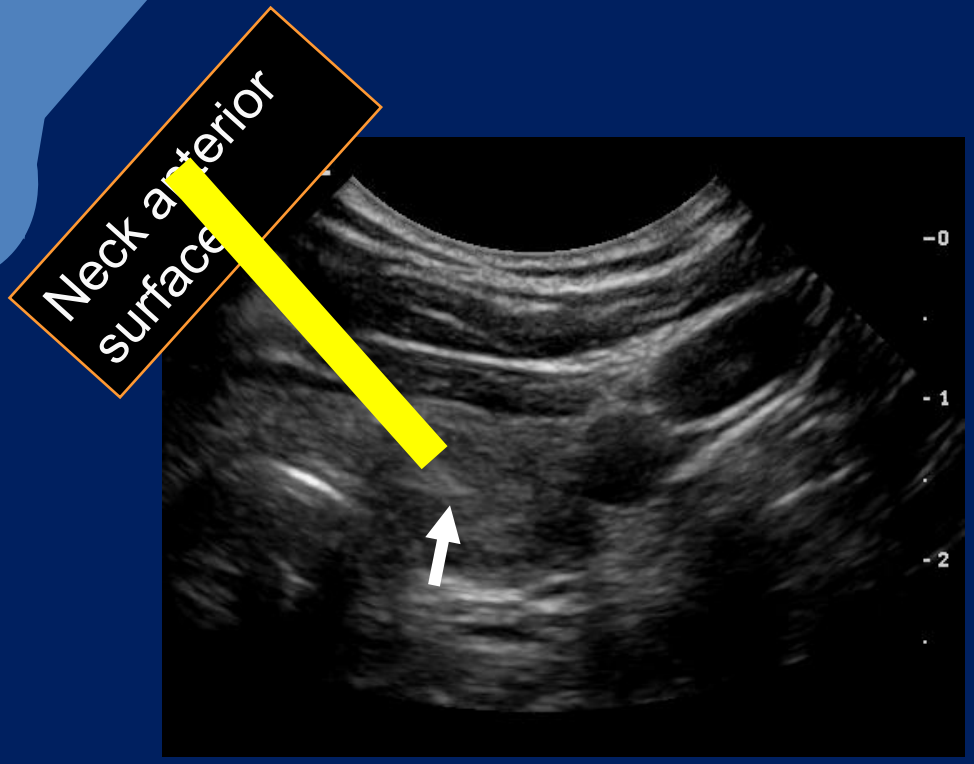
Courtesy of Endocrine University



FNA with a curvilinear probe

45º clockwise rotation of top of screen





Objectives

- **Fine needle aspiration**
- **Lymph node evaluation**
- Parathyroid ultrasound

Lymph Node Metastases at Diagnosis

- 42% of patients present with LN mets at diagnosis
- 21% of patients present with macroscopic LN mets at diagnosis
- 22% of PTC patients in the SEER database with LN mets at diagnosis

Mazzaferri Am J Med 1994, Bardet Eur J Endo 2008, Zaydfudim Surgery 2008

Preoperative LN Evaluation

Preoperative neck US for the contralateral lobe and cervical (central and especially lateral neck compartments) lymph nodes is recommended for all patients undergoing thyroidectomy for malignant cytologic findings on biopsy. US-guided FNA of sonographically suspicious LNs should be performed to confirm malignancy if this would change management.

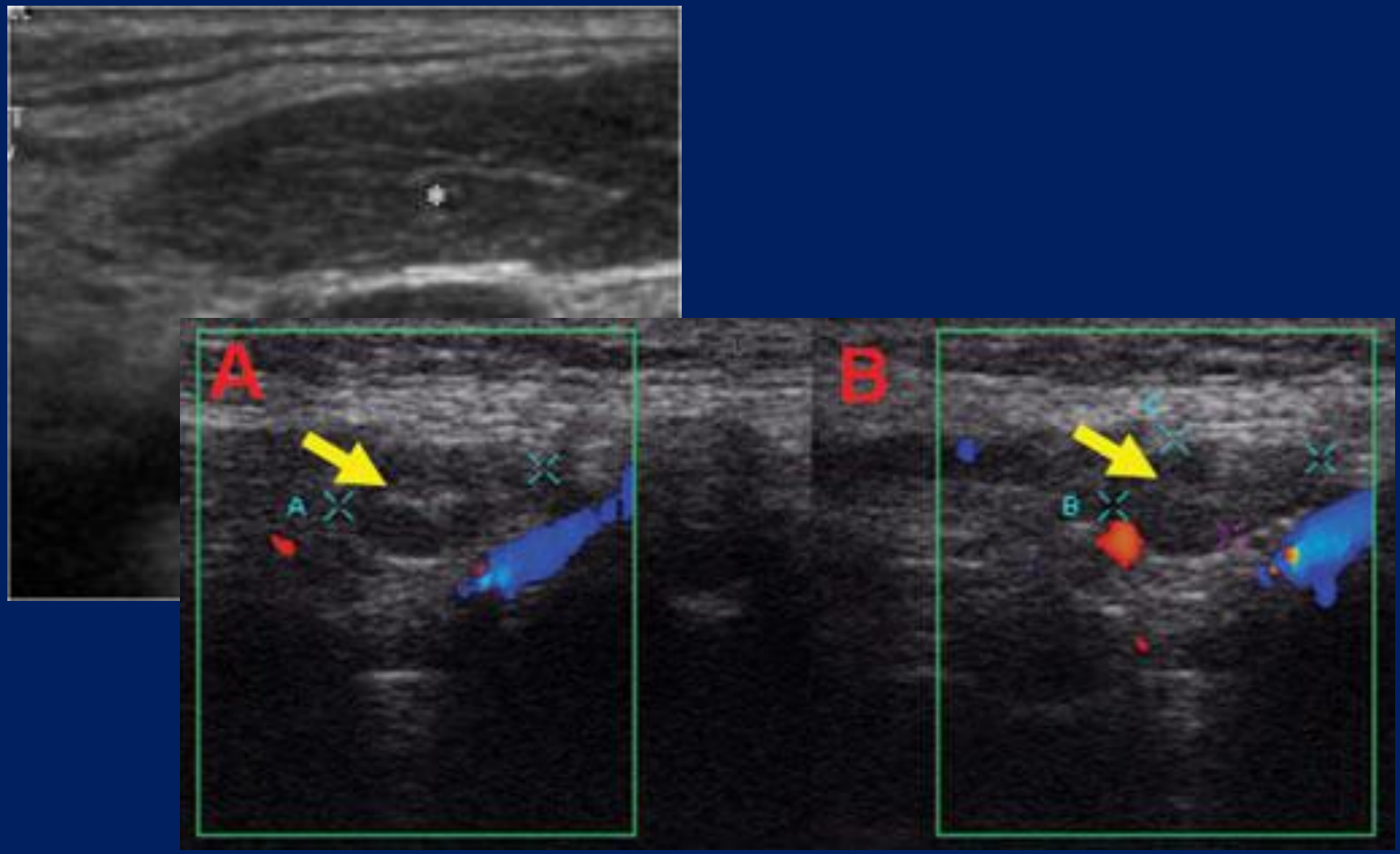
Recommendation rating: B

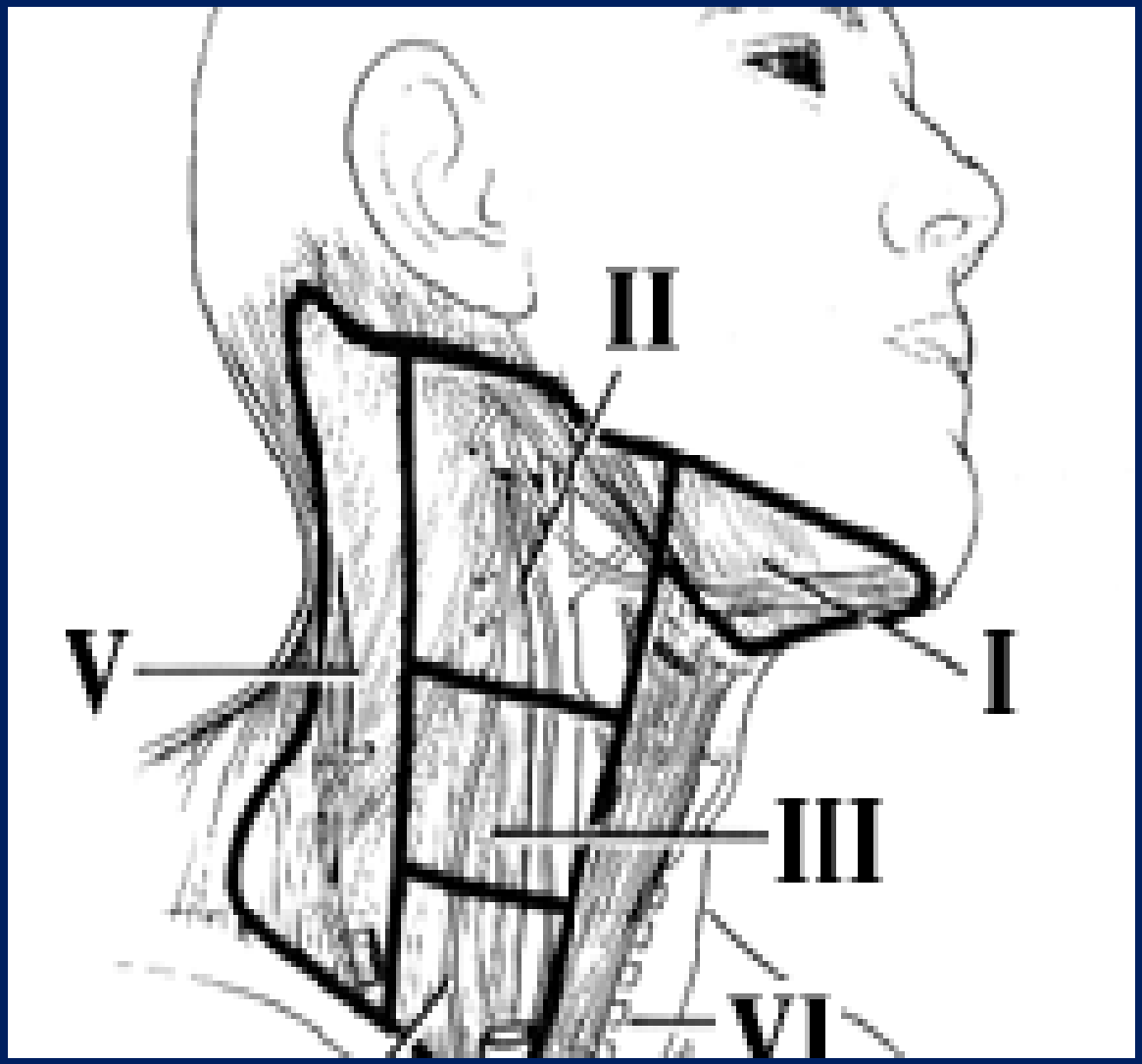
Cooper, Thyroid 2009

US of normal cervical LNs

- Shape
  - Oval
- Echogenic hilus
  - Consists of fatty tissue, sinuses, intranodal vessels
- Vascularity
  - Hilar vascularity or avascular

Normal Lymph Node

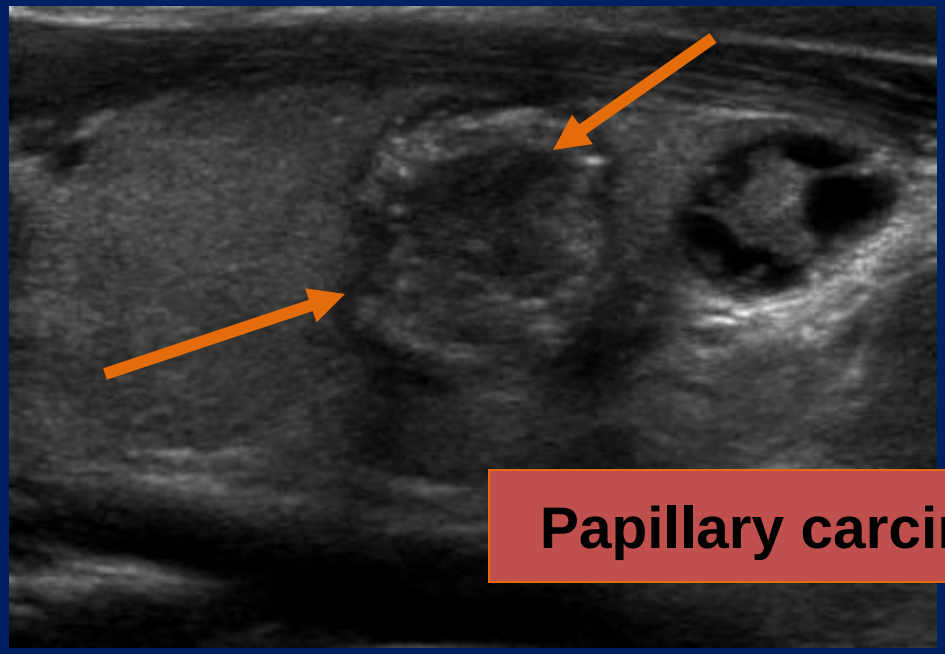



II
V
I
III
VI

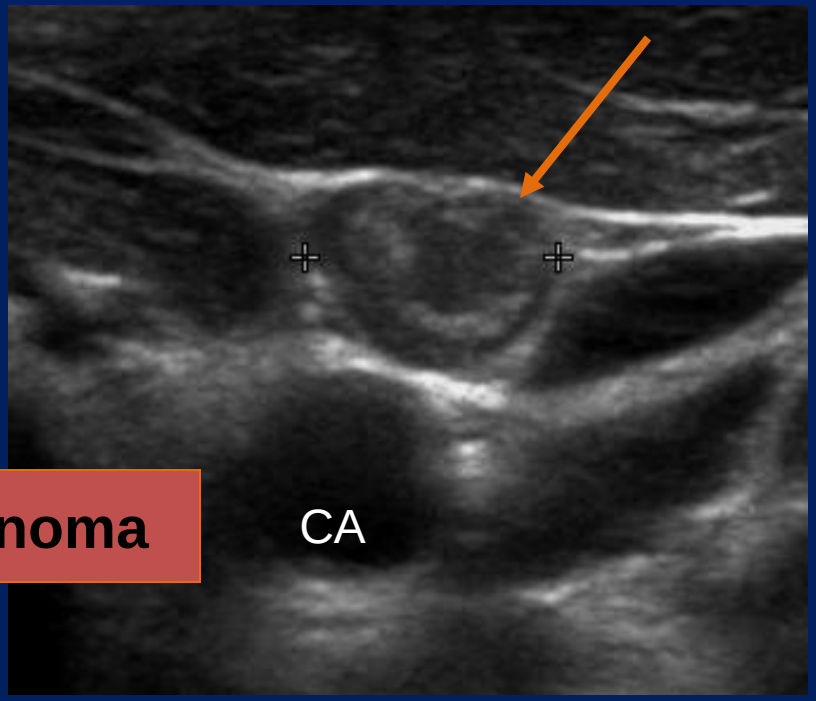
US of abnormal cervical LNs

- Shape
  - Round
- Echogenicity
  - Metastatic PTC LNs may be hyperechoic compared to surrounding strap muscles
- Absence of Hilus
  - Tumor infiltration of sinuses
- Cystic change
- Calcifications
- Vascularity
  - Increased vascularity in both peripheral and central zones

Suspicious thyroid nodule with abnormal LN on US



Sagittal Left lobe

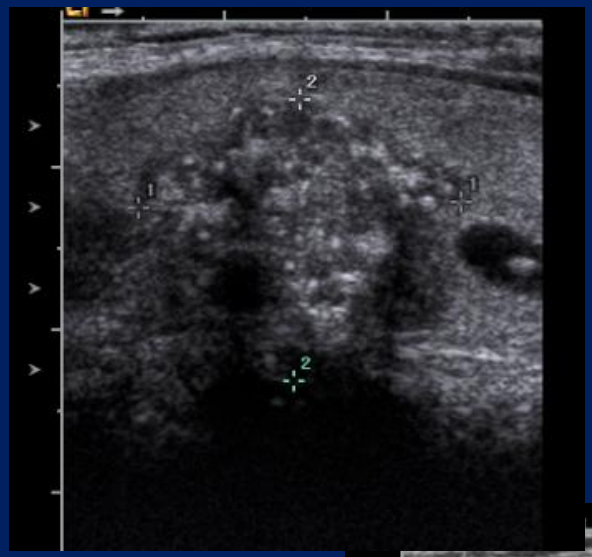


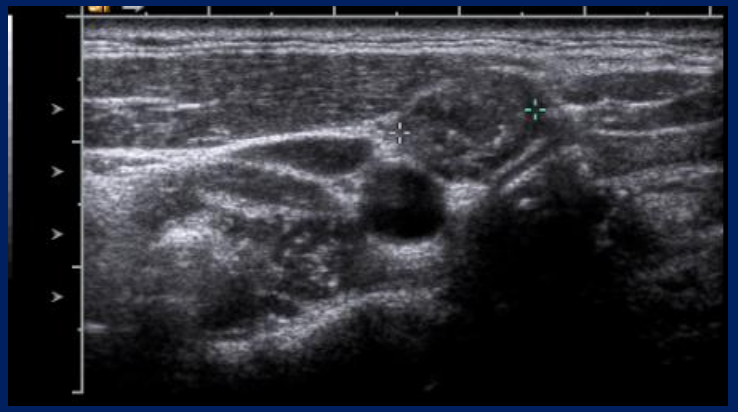
Transverse left lateral neck

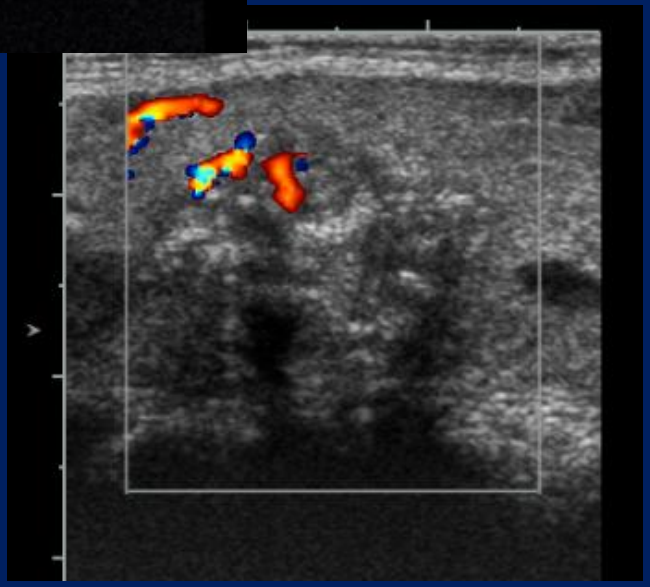
Papillary carcinoma

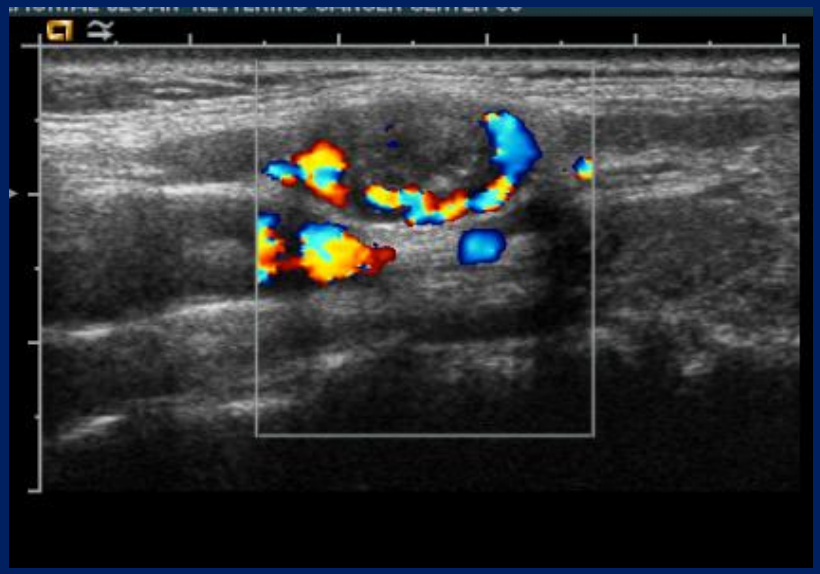
Lymph Node is Round, Hyperechoic, lacks fatty hilus

Suspicious thyroid nodule with abnormal cervical lymph node









Suspicious thyroid nodule with abnormal cervical lymph node

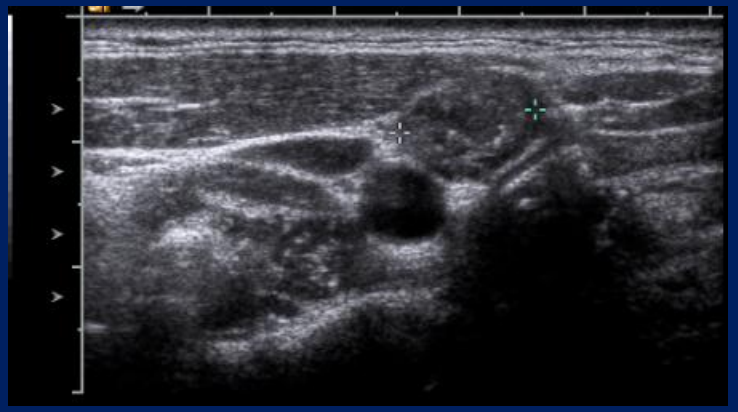
Lymph Node:

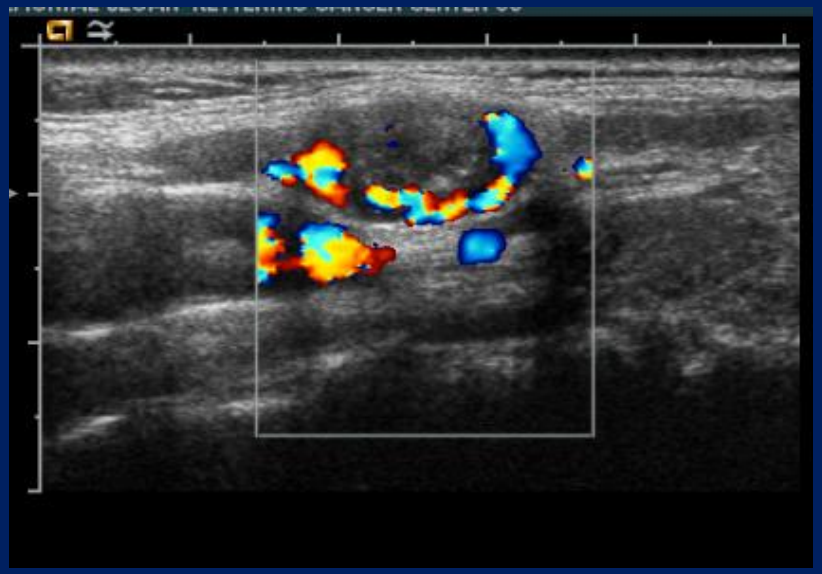
Round

Lacks fatty hilus

Microcalcifications

Peripheral vascularity





What do we do when US detects an abnormal LN?

If a positive result would change management, ultrasonographically suspicious LNs greater than 5-8mm in the smallest diameter should be biopsied for cytology with thyroglobulin measurement in the needle washout fluid.

Recommendation A

Cooper, Thyroid 2009

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- **Fine needle aspiration**
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- **Parathyroid ultrasound**

Primary Hyperparathyroidism: Indications for Surgery

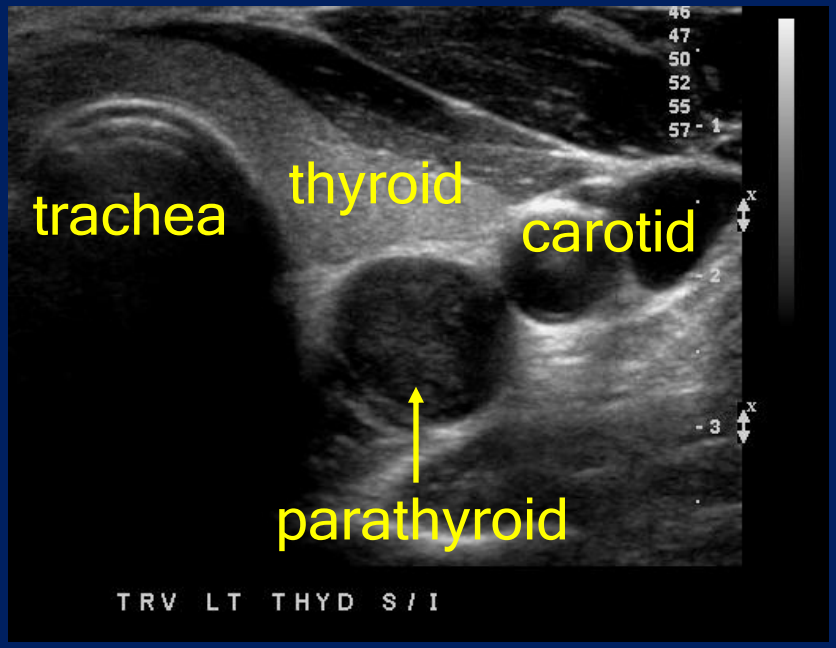
measurement	1990	2002	2009
Serum calcium	1-1.6mg/dl	1.0 mg/dl	1.0 mg/dl
24 hr urine calcium	>400 mg/d	>400 mg/d	Not indicated
Creatinine clearance	Reduced by 30%	Reduced by 30%	Reduced to <60 ml/min
BMD	Z-score<-2.0 in forearm	T-score<-2.5 at any site	T-score<-2.5 at any site and/or previous fracture
Age	<50	<50	<50

Bilezikian, JCEM 2009

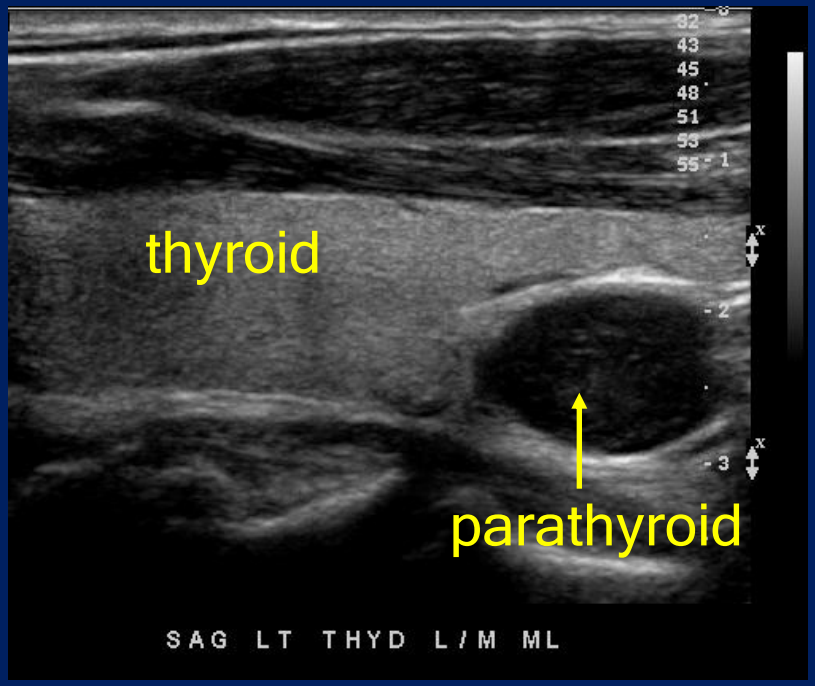
Minimally Invasive Parathyroidectomy

- Unilateral targeted excision of parathyroid adenoma with intraoperative PTH monitoring
- Benefits
  - Shorter surgery time
  - Smaller incisions
  - Fewer complications
    - Post-op hypocalcemia
- Disadvantages
  - Requires accurate preoperative localization of parathyroid adenoma
  - May miss multiglandular disease

Typical Parathyroid Adenoma

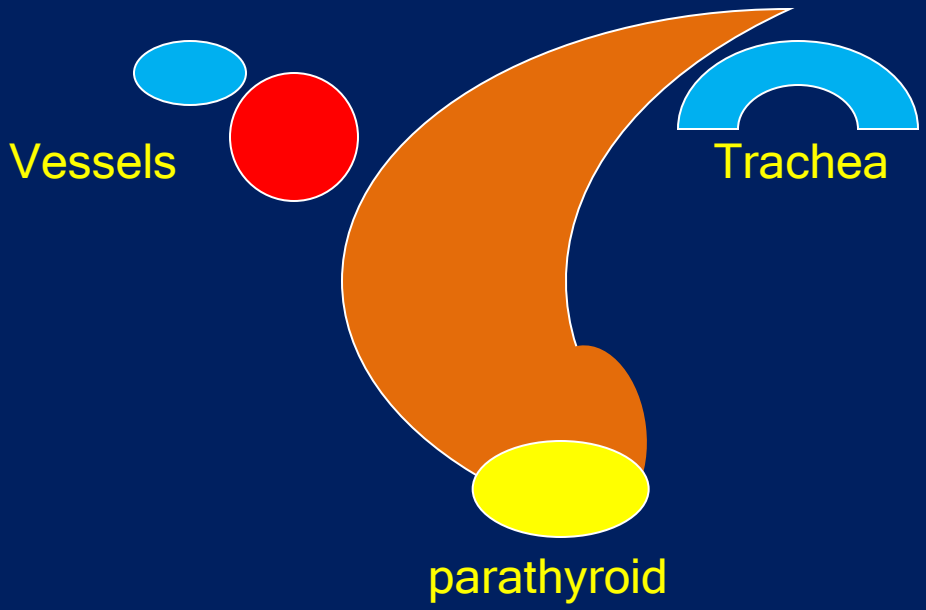


Transverse

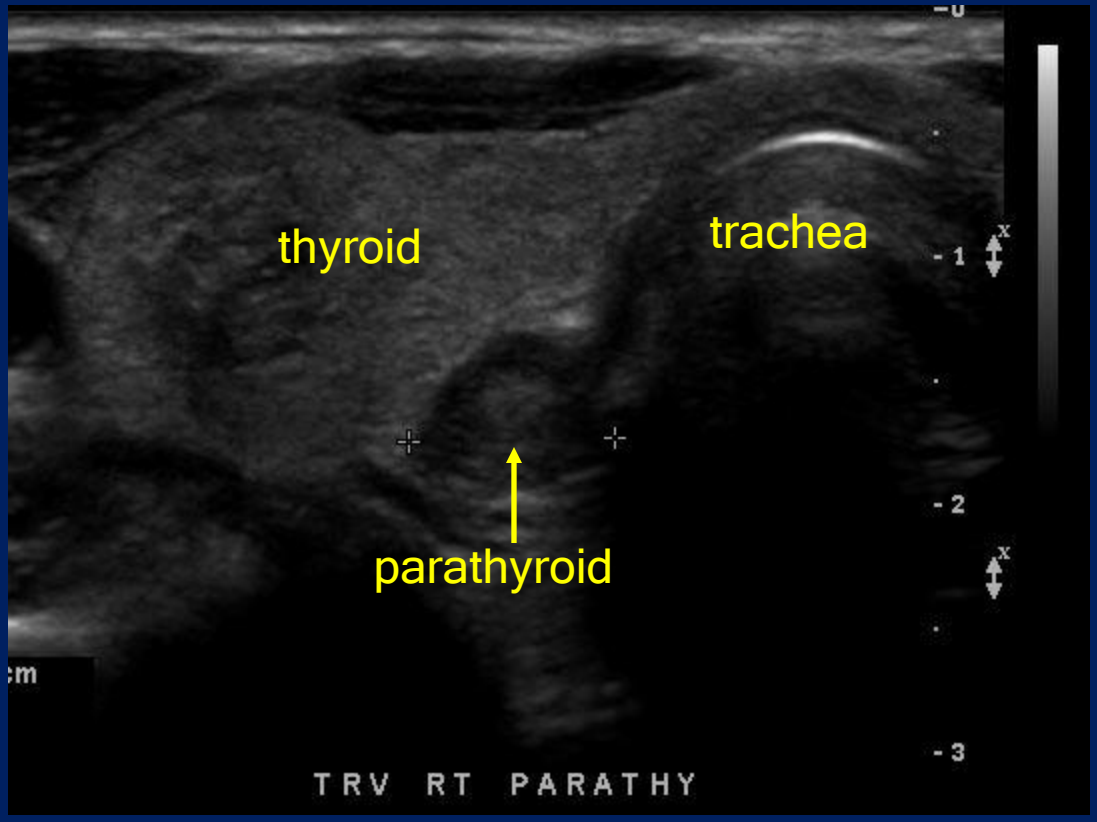


Longitudinal

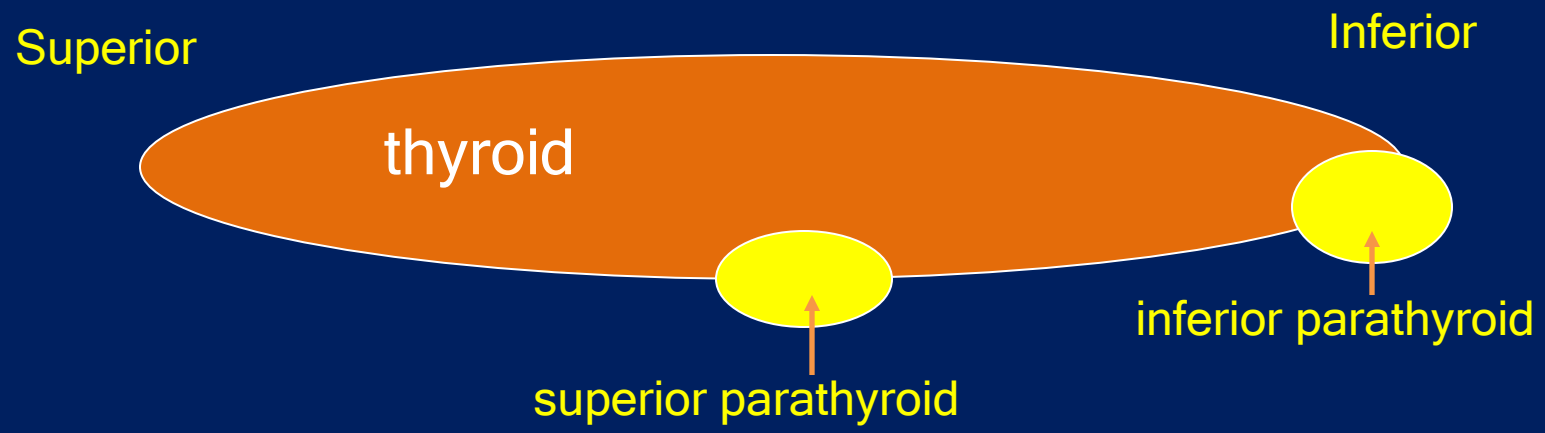
Transverse Parathyroid Ultrasound



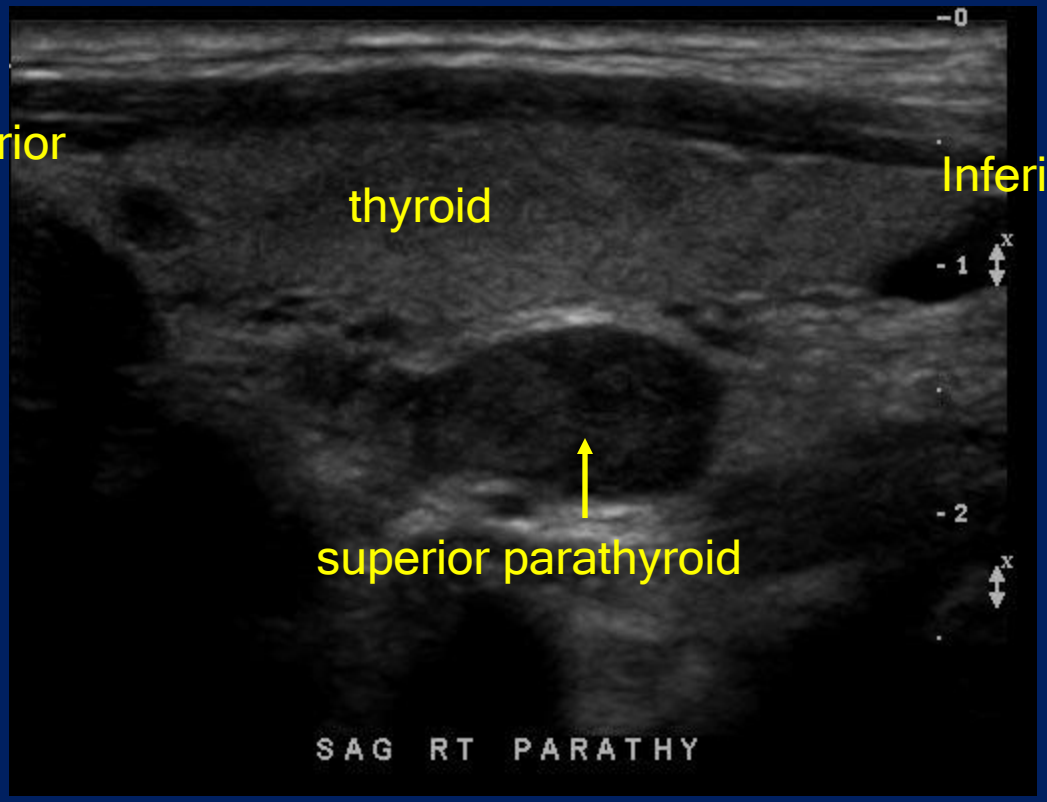
Transverse Parathyroid Ultrasound



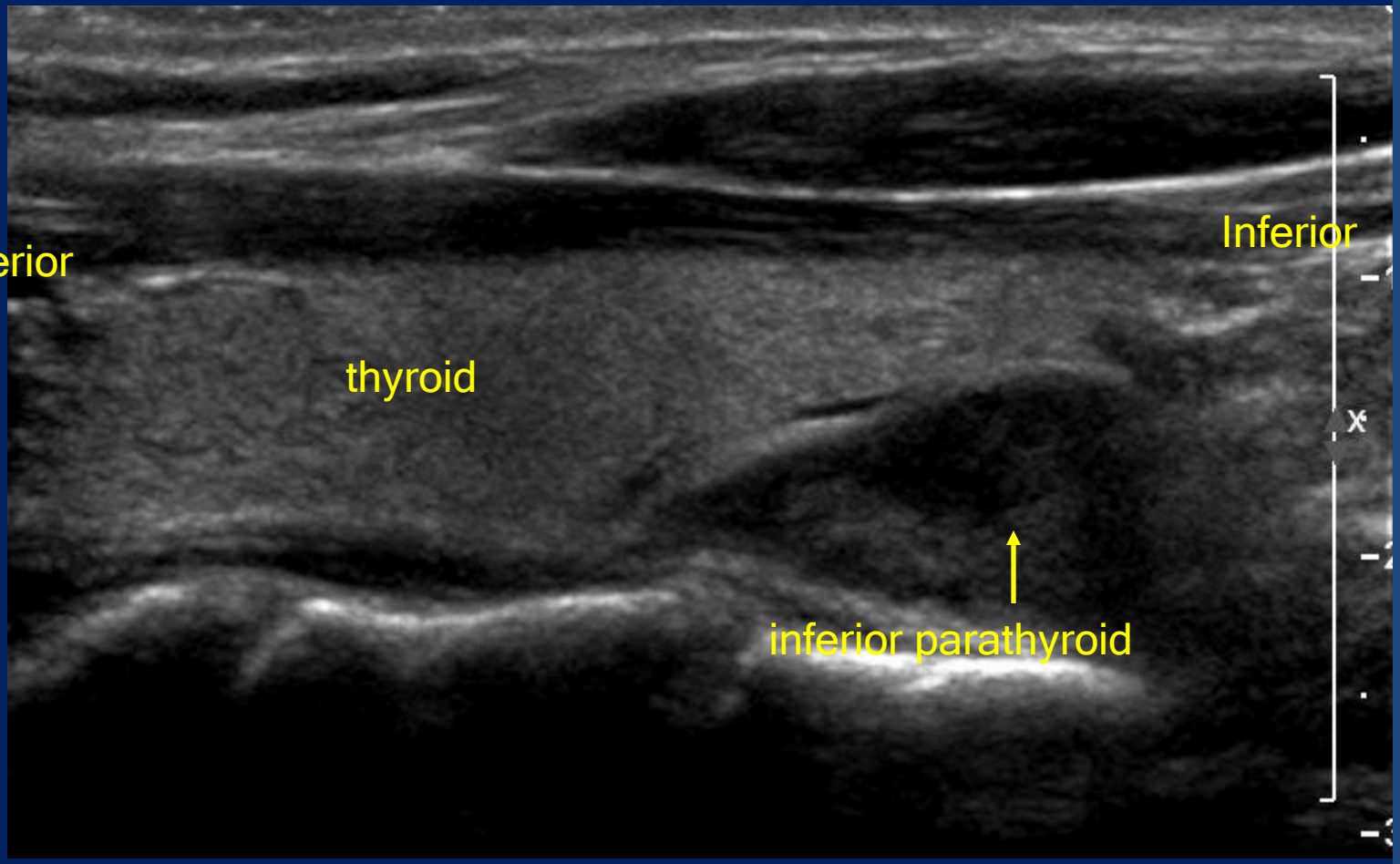
Longitudinal Parathyroid Ultrasound



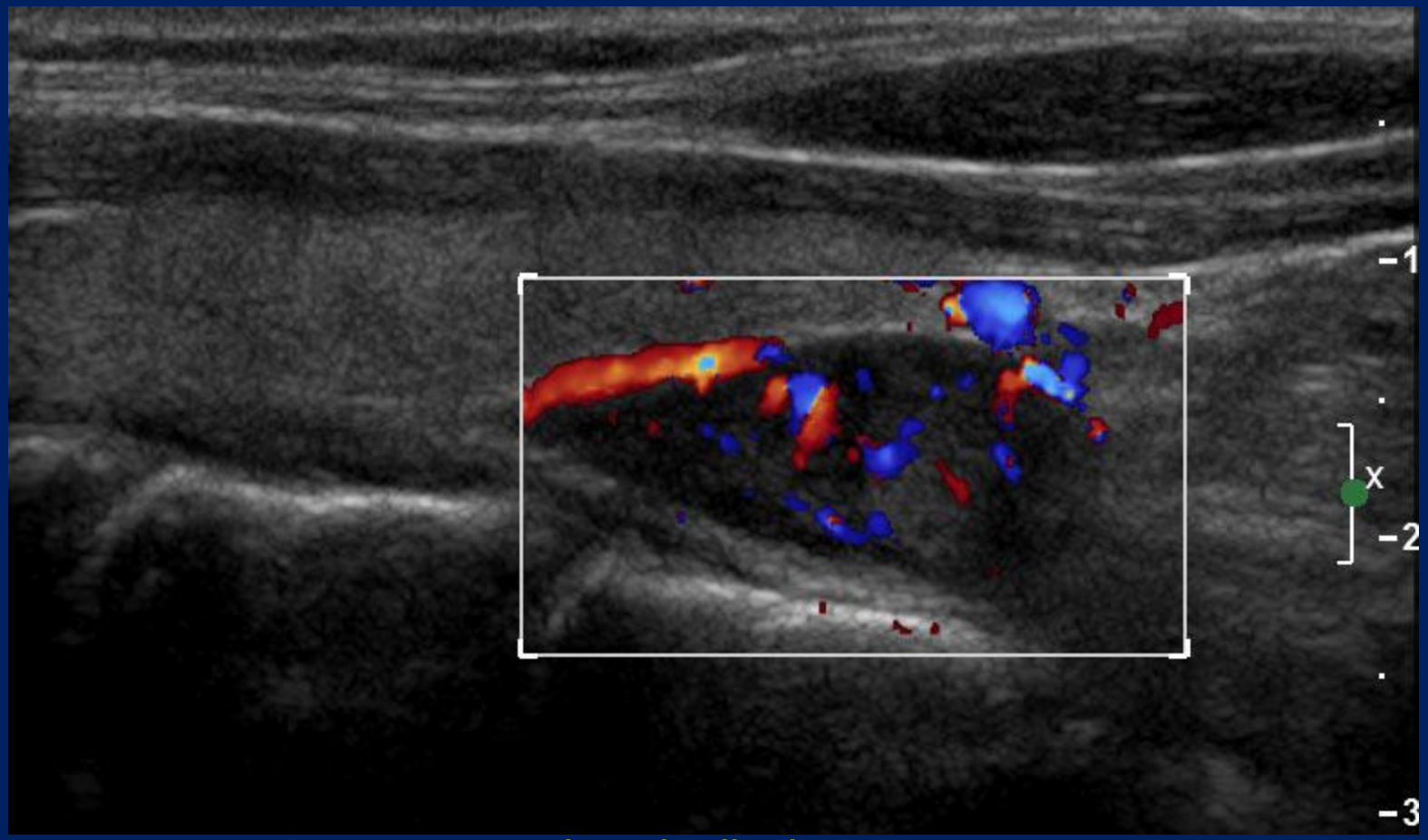
Longitudinal Parathyroid Ultrasound



Longitudinal Parathyroid Ultrasound

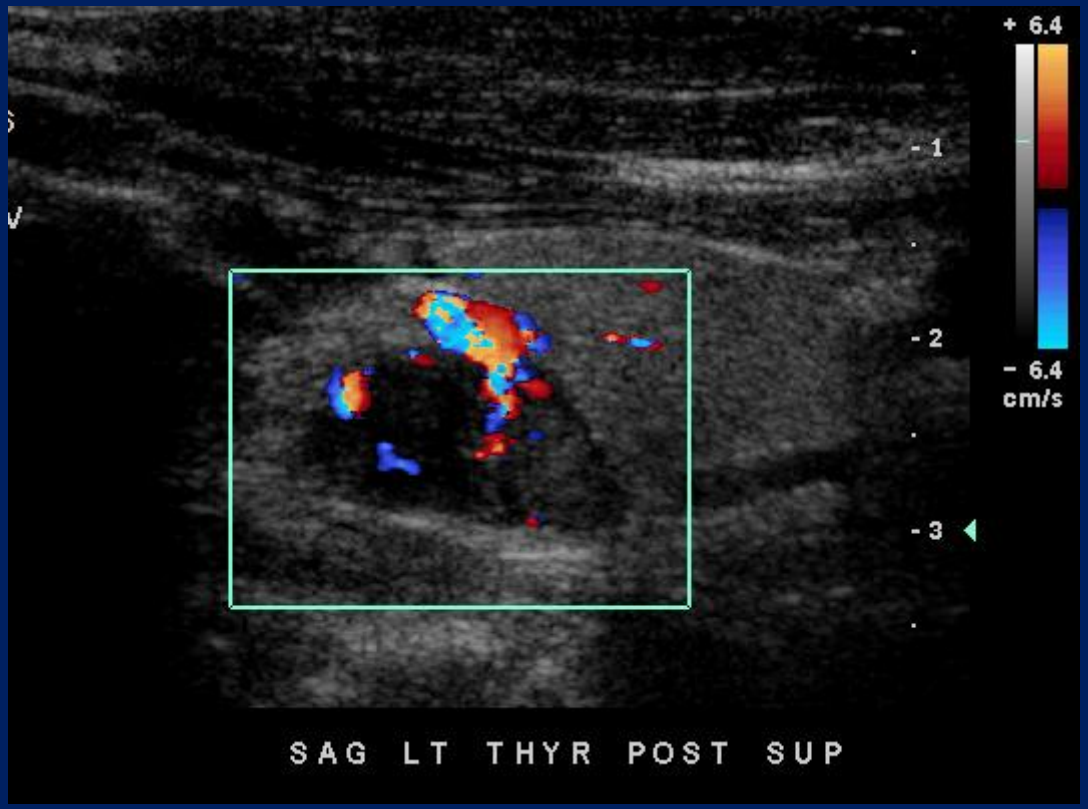


Polar Vascular Pattern



Longitudinal

Polar Vascular Pattern



Longitudinal

Keys to Parathyroid Ultrasound

- Appearance
  - Oval, homogeneous, hypoechoic
- Location
  - Superior: posterior to the midportion of thyroid
  - Inferior: inferior to the lower pole of thyroid
- Vascularity
  - Polar vascularity
- Experience