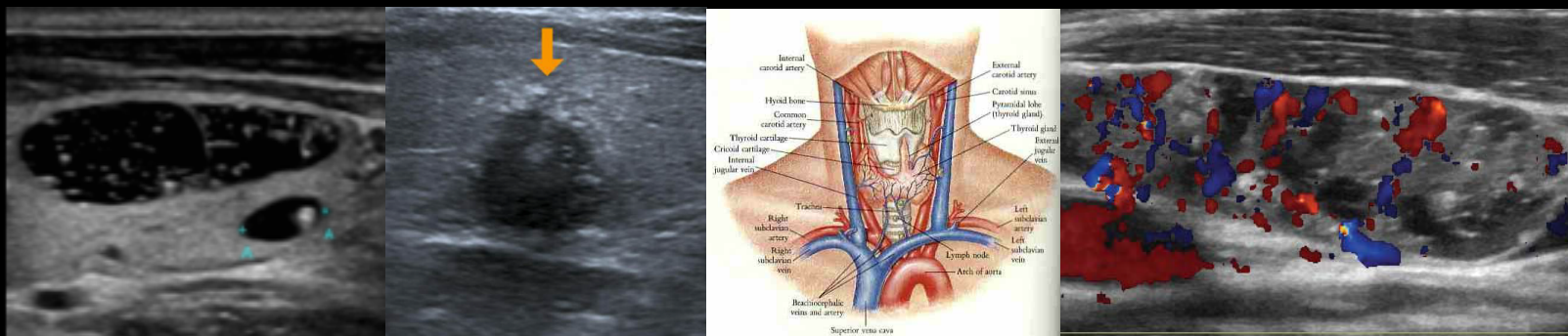




2016 CME SONOGRAPHER DAY

Thyroid & Neck Ultrasound: Maximizing Diagnostic Accuracy



Sharon Shin, M.D.

April 17, 2016

*All these slides will be posted on TNI
intranet website.*

Value in looking at the digital images for better
detail, especially regarding doppler imaging

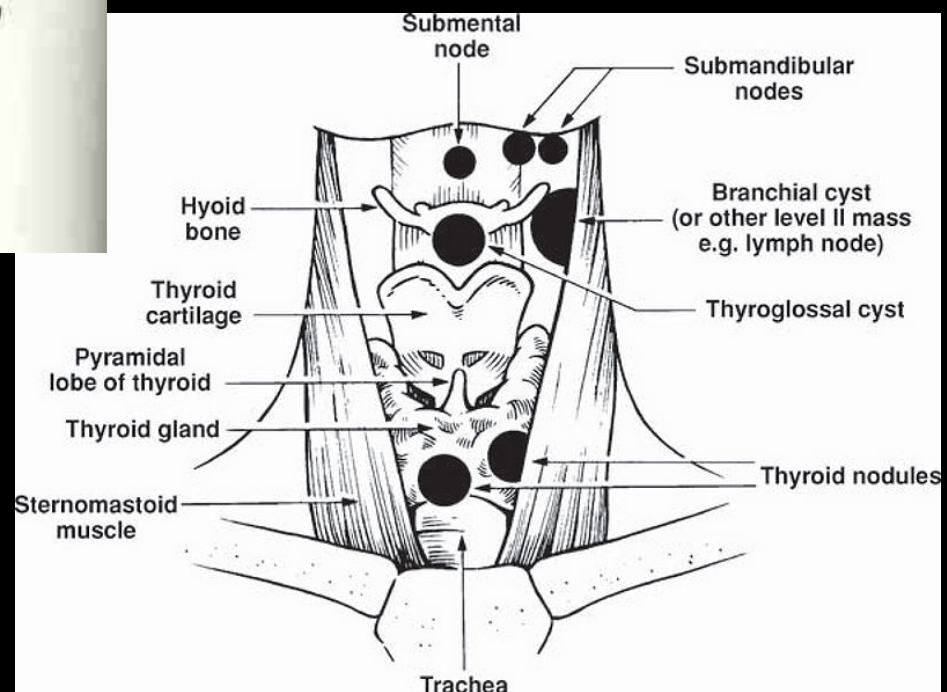
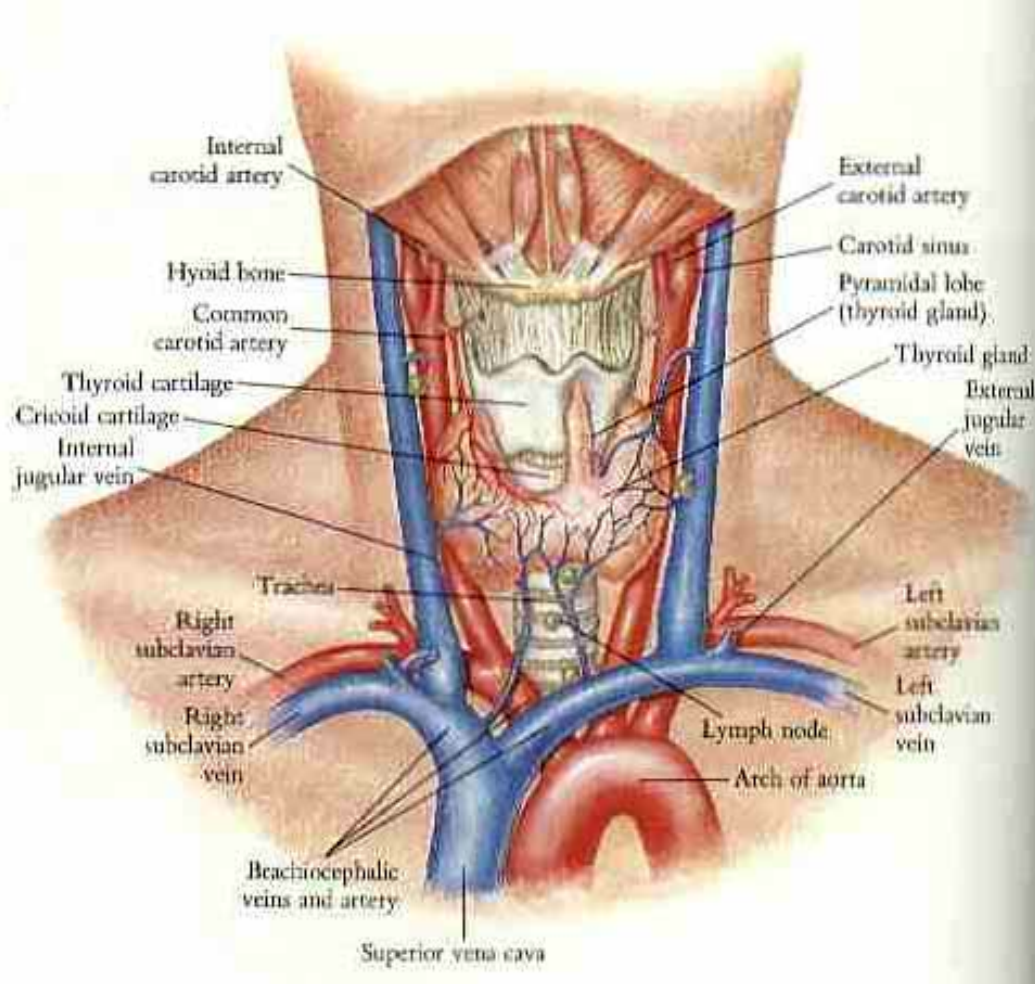
Goal for today

- Review basic principles of neck & thyroid ultrasound
- Review COMMON and IMPORTANT pathology
 - *“When you hear hoofbeats, think of horses not zebras”;*
“Common things are common”

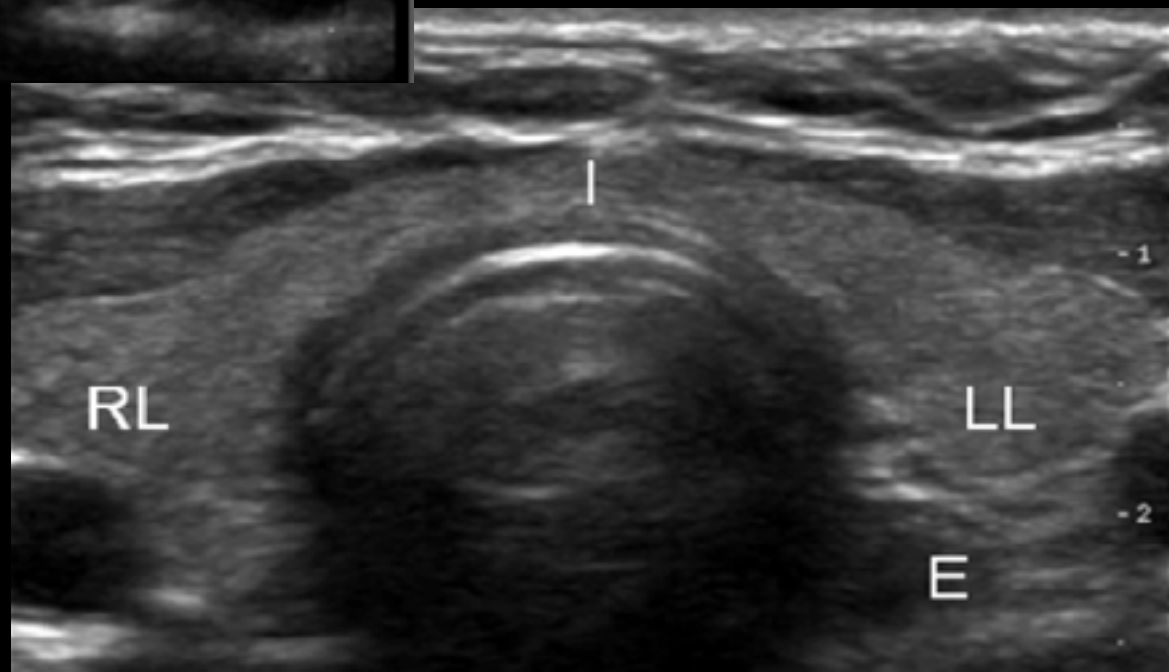
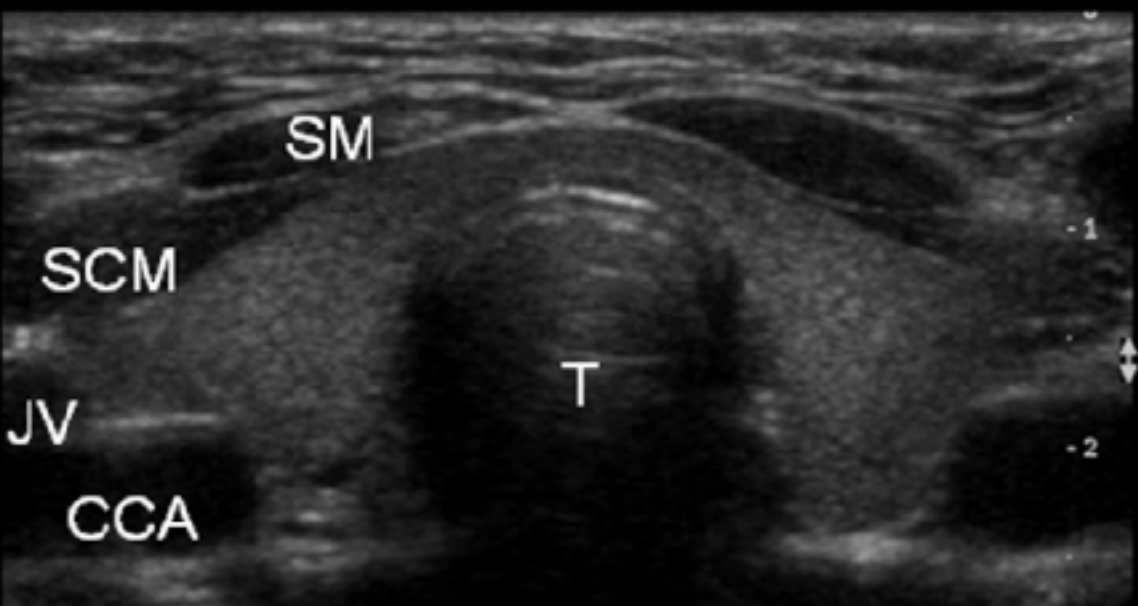


Neck US Protocol

- **IMAGE FOR EVERY PATIENT:**
- AOC *“neck lump / swelling”*
- Thyroid
- Bilateral Lymph node chain
- Salivary Glands



LL: left lobe. I: isthmus. E: esophagus. B. T: trachea. SM: strap muscles. SCM: sterno-cleido-mastoid muscle. JV: jugular vein. CCA: common carotid artery.



Protocol

- Neck in extension
 - towel/pad under shoulders
- AOC – Area of Concern/lump
 - 3 dimension measurements
 - doppler
 - lots of images to show margins, septation, nodularity

- **Thyroid**

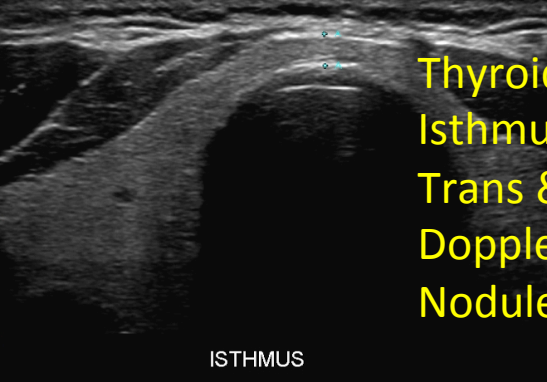
- Isthmus - TRANS
- TRANS through R & L lobes –sup, mid, low
- SAG through R & L lobes – 3 images –outer, mid, inner
- Measure thyroid gland (isthmus, R, L)
- Doppler of background gland parenchyma
- Thyroid nodules –location, size, margins, doppler

- **Lymph Nodes - bilateral**

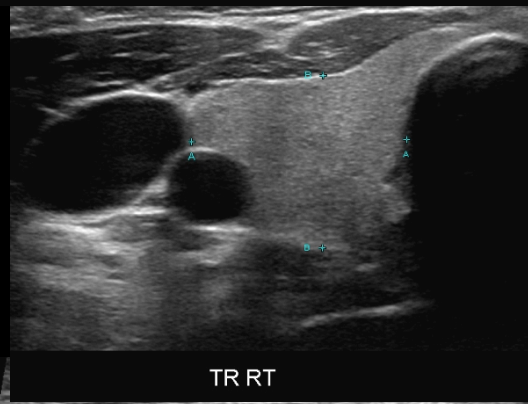
- Sweep in TRANS and SAG documenting pertinent LNs
- Doppler, measure in at least 2 Dimensions
- Document SAG image of carotid/jugular vessels

- **Parotid & Submandibular glands**

- Quick sweep



Thyroid:
Isthmus,
Trans & Sag-R & L
Doppler
Nodules

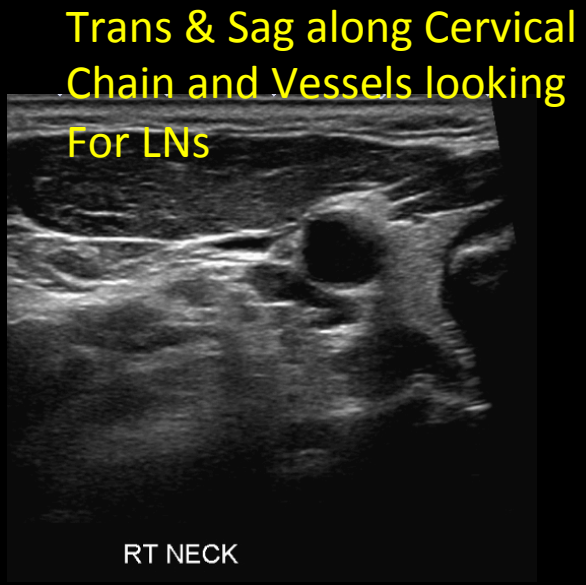
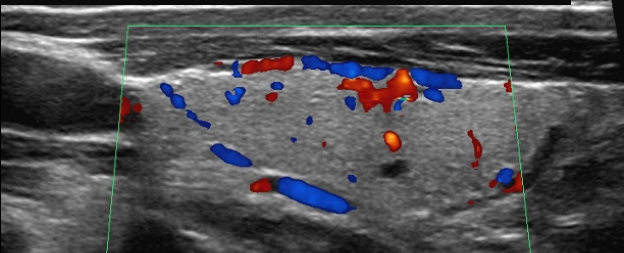


ISTHMUS

TR RT



SAG RT

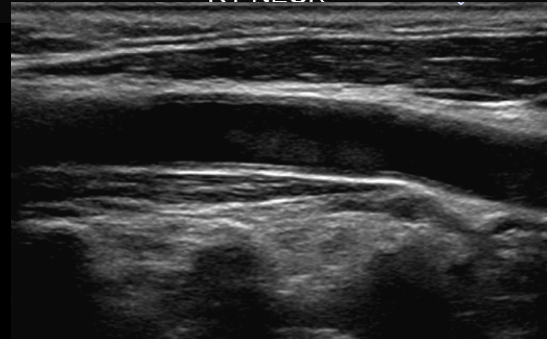


Trans & Sag along Cervical
Chain and Vessels looking
For LNs

RT NECK



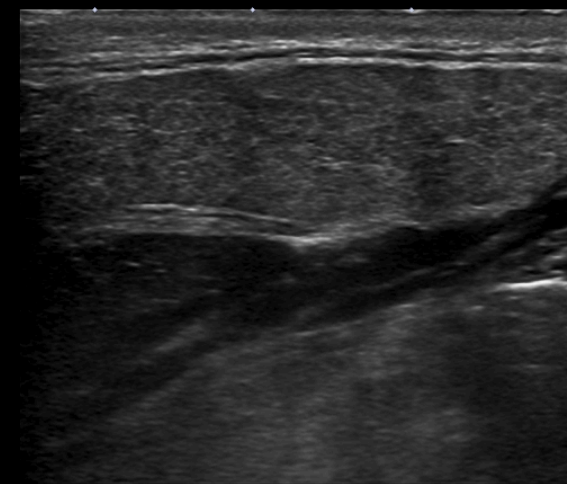
RT NECK



Salivary gland sweep

LT PAROTID

SAG



LT NECK

SMG

Overview

- Cyst vs Solid?
- Lymph nodes – “reactive” vs cancer
- Neck Lymph nodal stations
- Thyroid Cancer Nodule Ultrasound features
- Parathyroid glands
- Salivary Glands
 - Sialadenitis-Infection & Inflammation
 - Sialolithiasis – Salivary gland Stones
 - Salivary Gland tumors

Cyst vs Solid?

i.e. cyst vs necrotic LN??

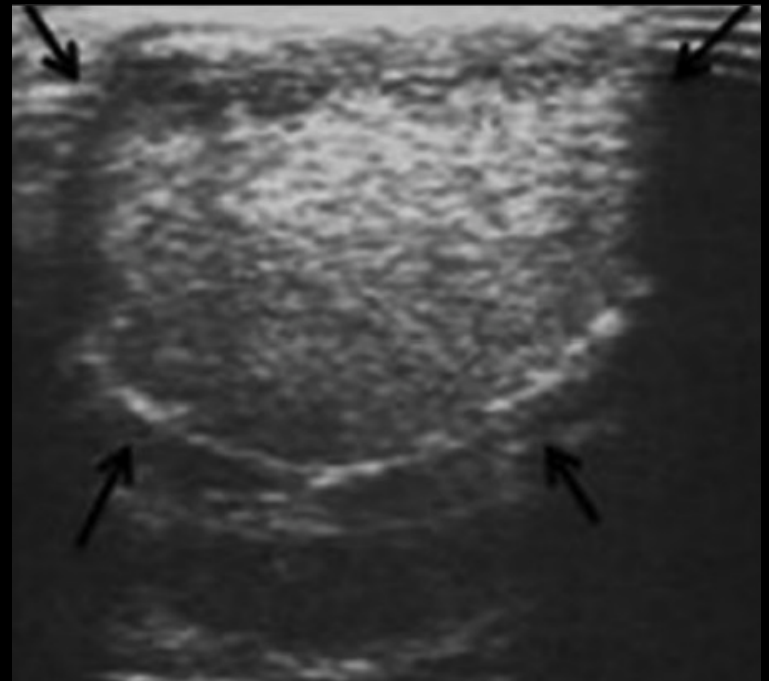
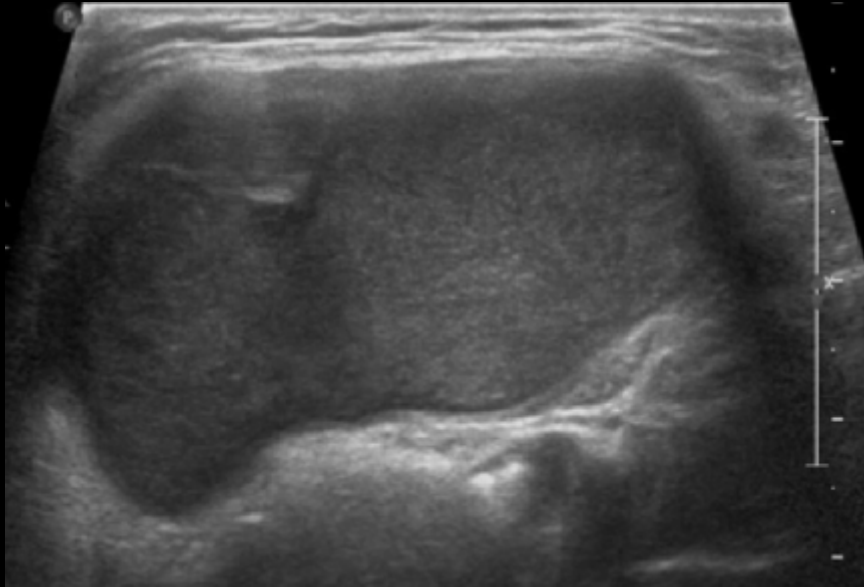
- CYSTS

- THYROGLOSSAL DUCT CYST (midline, at hyoid)
- 2ND BRANCHIAL CLEFT CYST (lateral to SMG, ant to SCM)
- EPIDERMAL INCLUSION CYST (aka Epidermoid cyst, sebaceous cyst
 - superficial, connects to dermis)

BUT

****80% of cystic neck masses in adults >40yo are necrotic LNs, usually from Thyroid cancer or ENT Squamous Cell Ca****

- Both thyroglossal duct cysts & 2nd Branchial cleft cysts often present when cyst becomes **infected** → **Often remain painless**, complicated with debris and can appear “**pseudosolid**”.

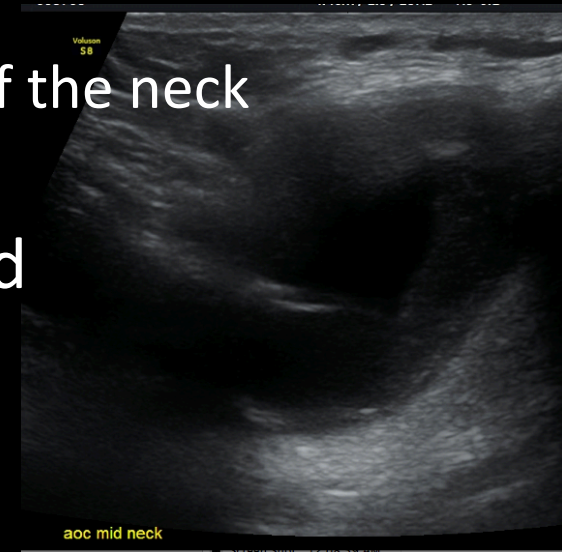


- Other Rare Neck cysts (i.e. rare “zebras”)
 - Lymphangioma, Thymic cyst, Laryngocele, Ranula, Neurogenic tumors (schwannoma)

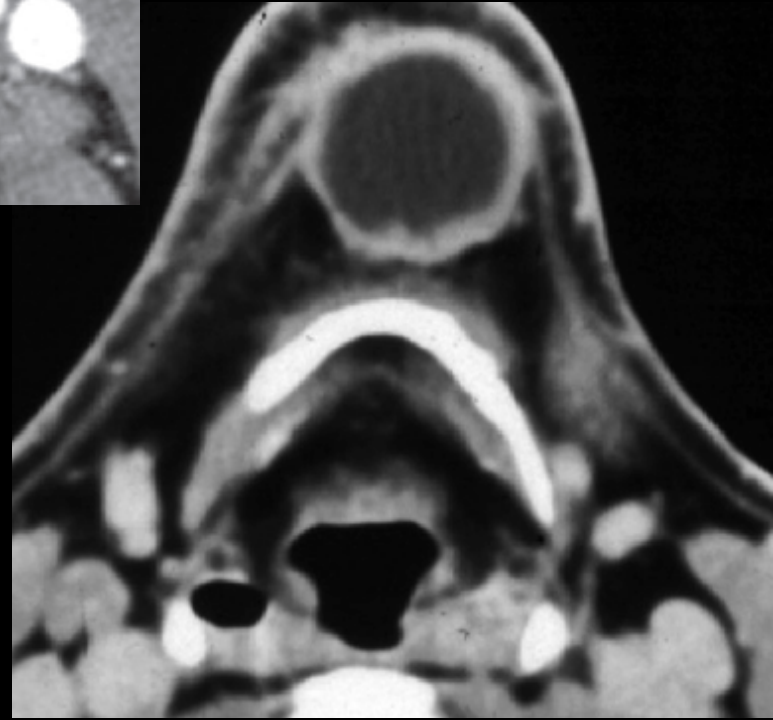
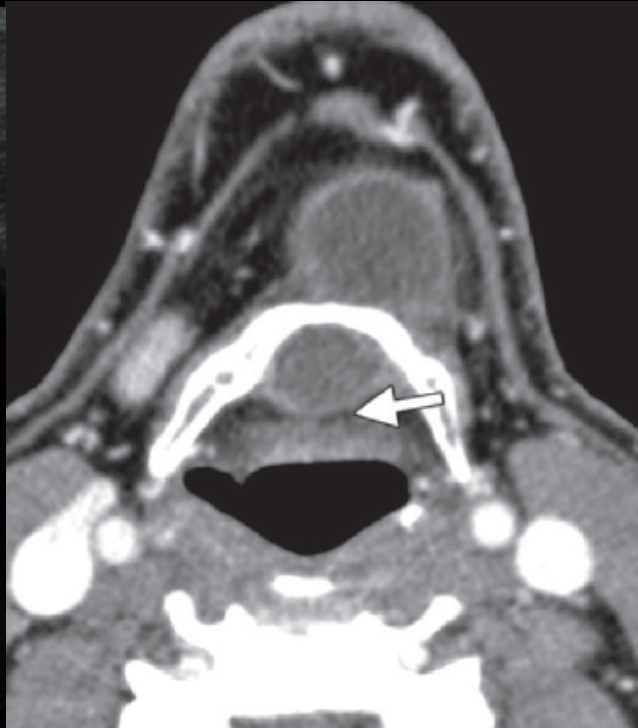
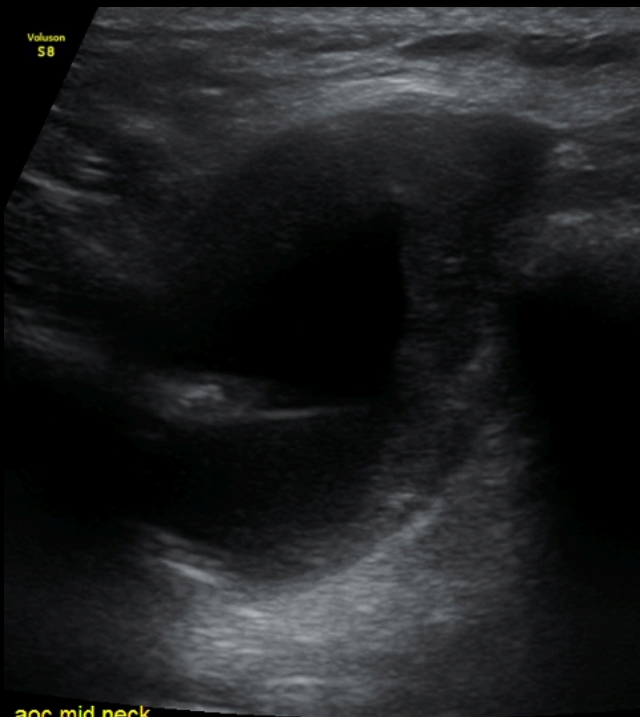
Thyroglossal Duct Cyst



- Midline, most at level of hyoid bone (60-80%)
 - Thyroglossal cysts and ectopic thyroid tissue can occur anywhere from base of the tongue to thyroid
 - Often embedded in strap muscles
- “Stick out your tongue” or “Swallow” → thyroglossal duct cyst moves up & down/vertically
 - Most common (70%) congenital mass of the neck
 - 50% present by age 20
- Tx= Resection, since risk of infection and papillary thyroid ca



Thyroglossal duct cyst

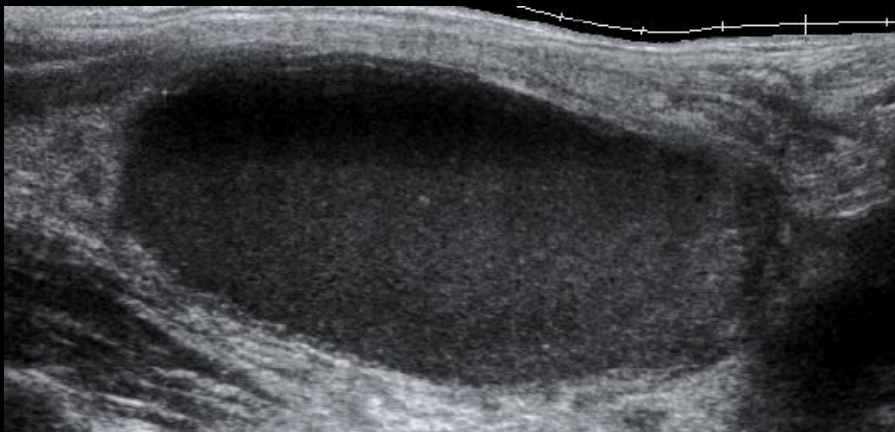


Look-a-like!
SCC necrotic LN metastasis

2nd Branchial cleft Cyst

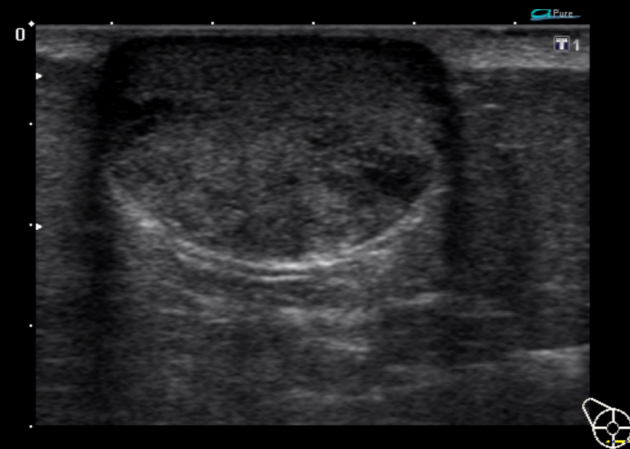


- Angle of the jaw, anterior to the Sternocleidomastoid muscle, lateral to carotid
- 'tail' of cyst extends between the ICA & ECA at Carotid bifurcation
- Tx=Resection



Epidermal Inclusion Cyst

- Superficial, underlying dermis
- Sometimes can demonstrate sinus tract to skin
- If FNA: thick white keratin material



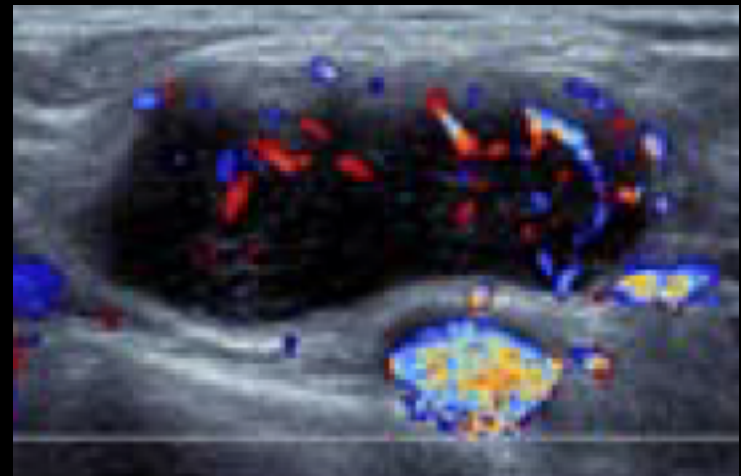
Cyst?

- Clinical History: supraclavicular lump



Cyst? → No, Lymphoma LN

- Clinical History: supraclavicular lump

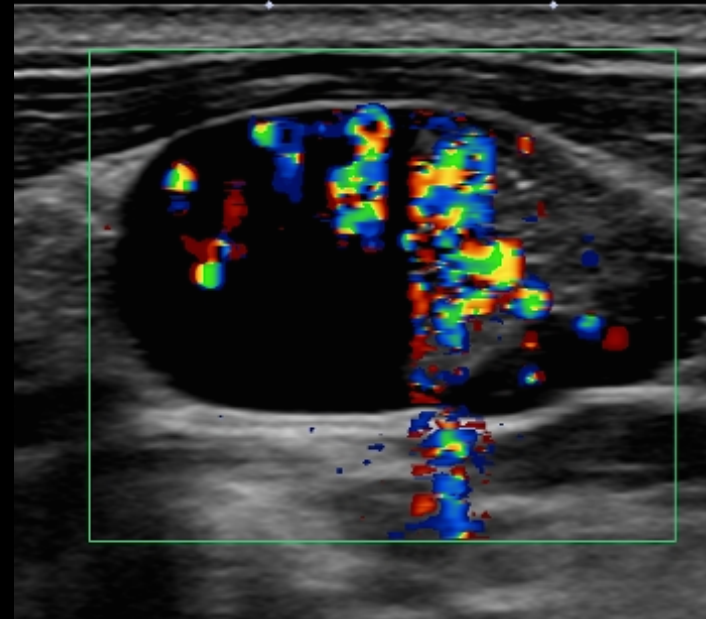


Lymphoma LNs are often very Hypoechoic, almost ANECHOIC, mimicking cysts

→ Use DOPPLER TO show solid

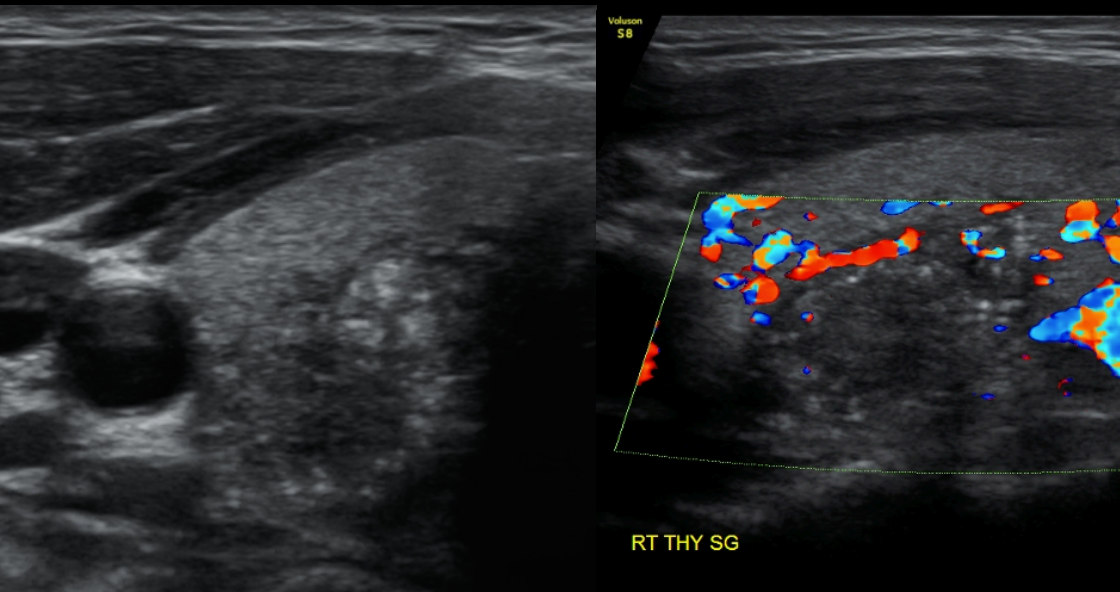
Cyst?

- Clinical hx – 42 yo F, right neck lump



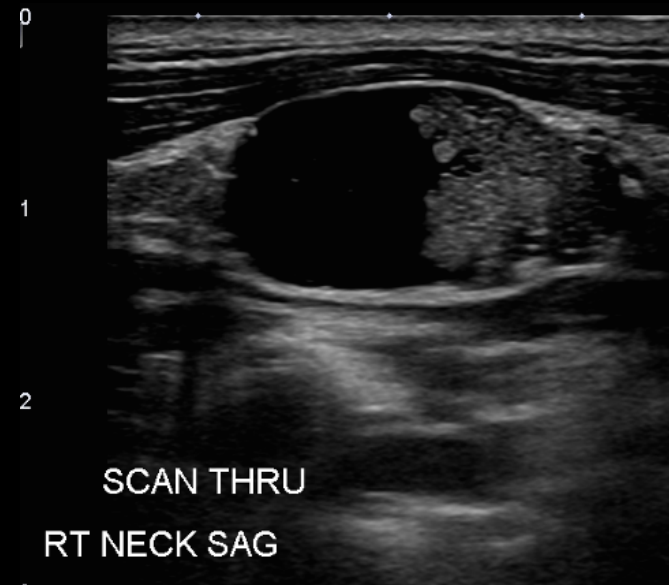
Sonographer imaged ONLY the right neck lump. Diagnosed as “Complex Cyst” with intracystic mobile echoes & doppler artifact

- Patient returns a year later...



Papillary Thyroid Cancer Nodule

-irregular margins, microcalcs, markedly hypoechoic, taller-than-wide



The “Complex Cyst” was necrotic thyroid Cancer LN

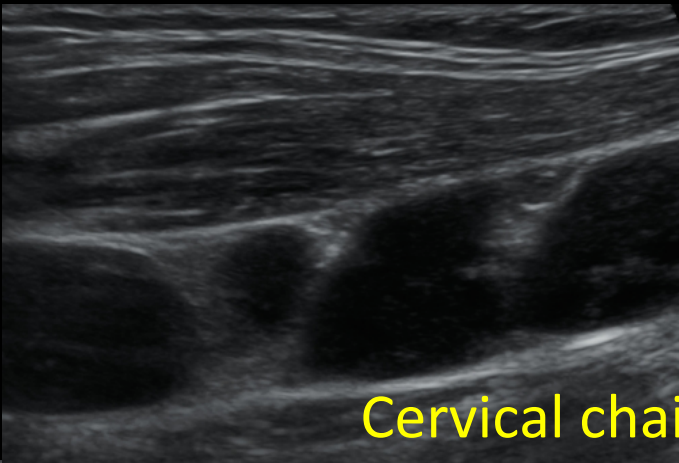
Metastasis...*should have scanned the thyroid*

LEARNING POINT:

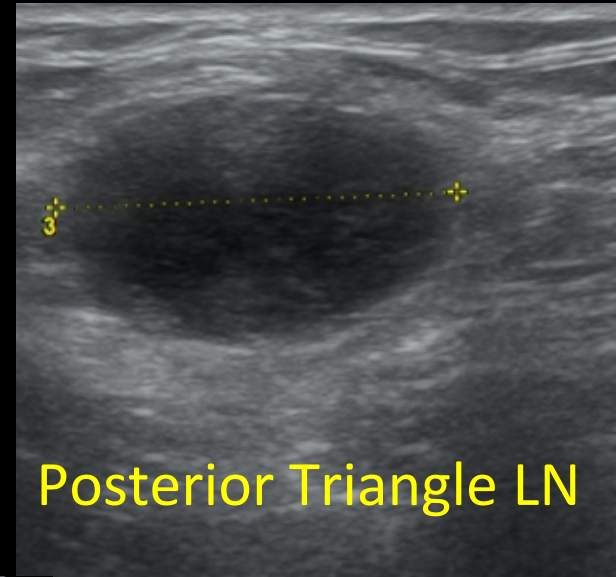
IMAGE THE WHOLE NECK (AOC, thyroid, LNs, Saliv g), even and especially when pt comes for a “neck lump”

Neck Lesions – ‘Cystic’ or solid

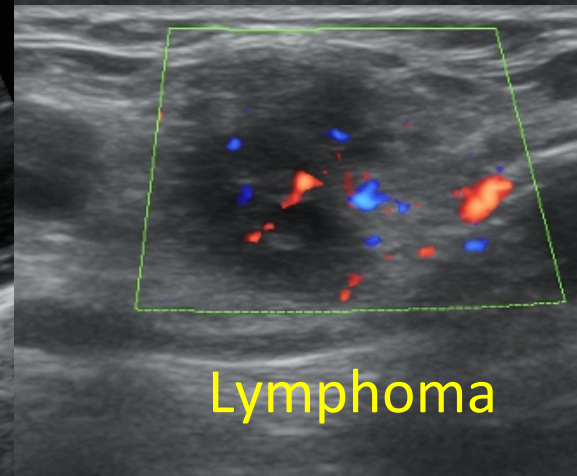
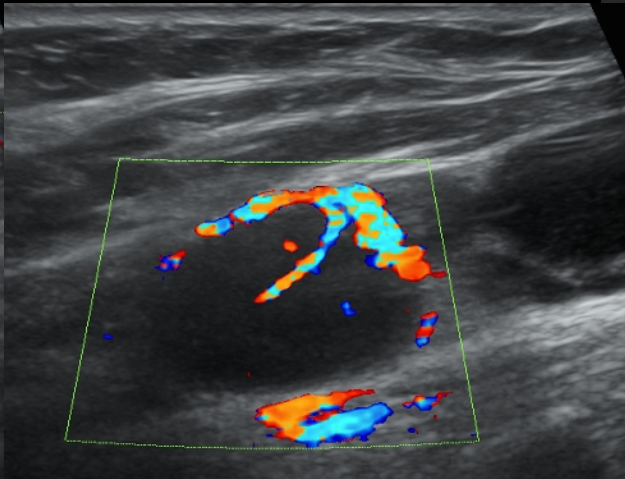
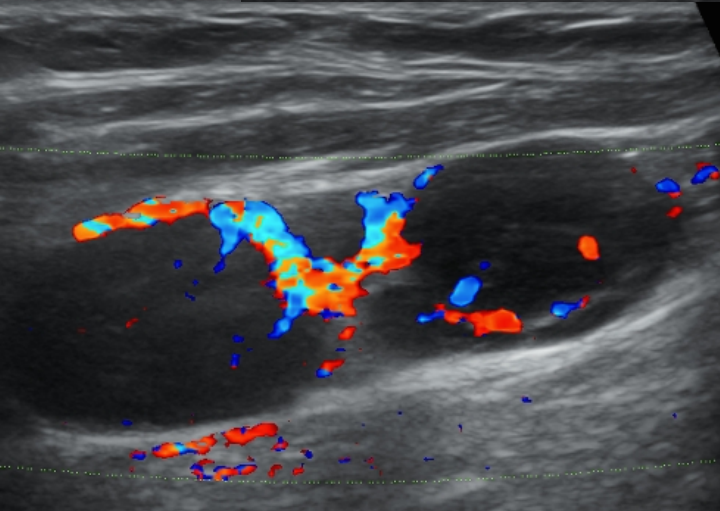
- Apply doppler



Cervical chain LNs



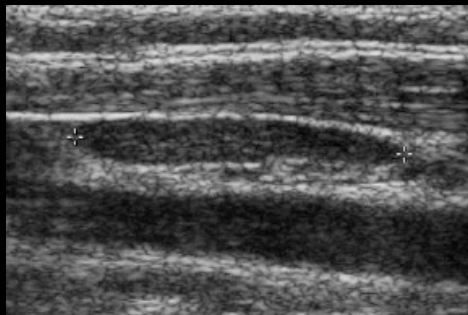
Posterior Triangle LN



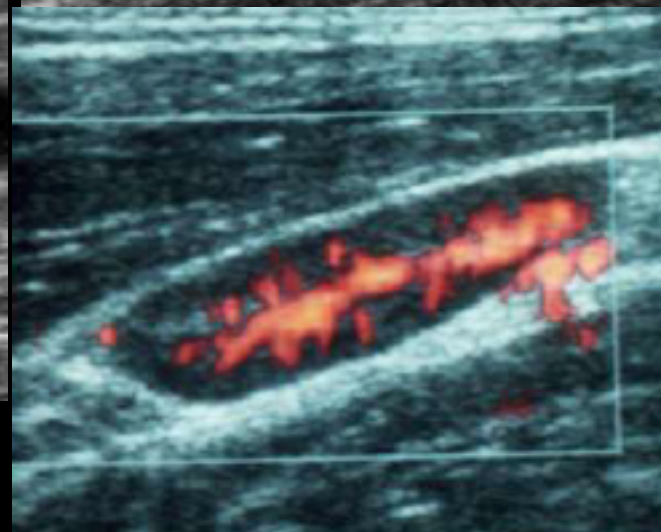
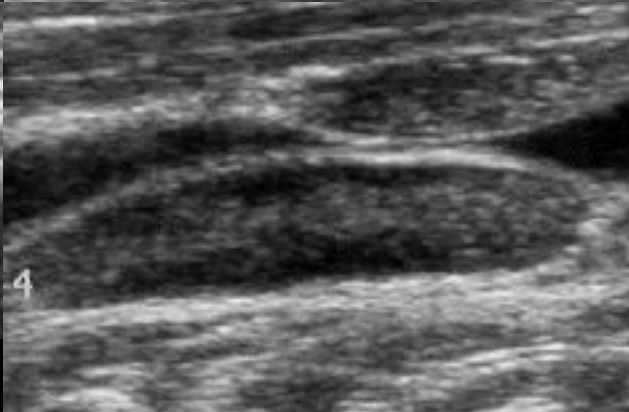
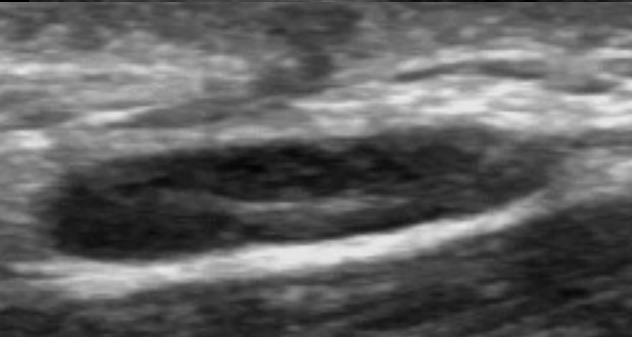
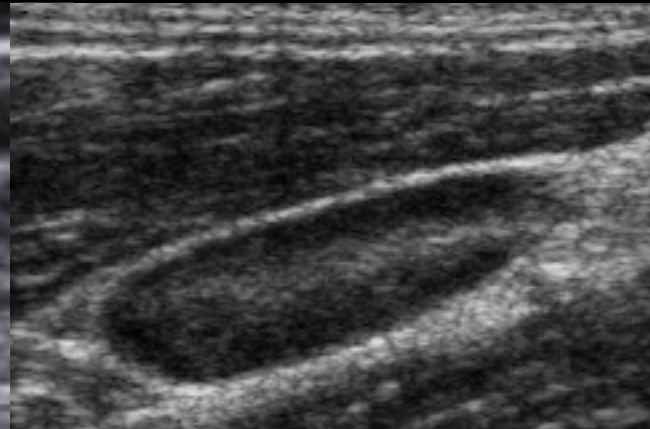
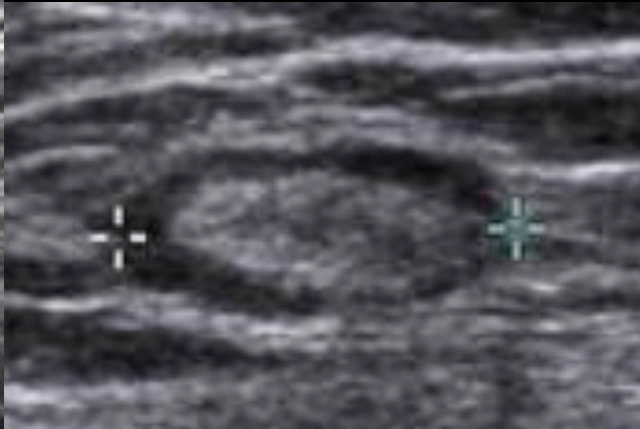
Lymphoma

Neck Lymph Nodes

- “Normal” Neck LN
 - Preserved fatty hilum
 - Thin cortex
 - Homogenous cortex
 - Elongated (“long & skinny”), NOT round
 - Can have HILAR doppler flow, NOT cortical flow

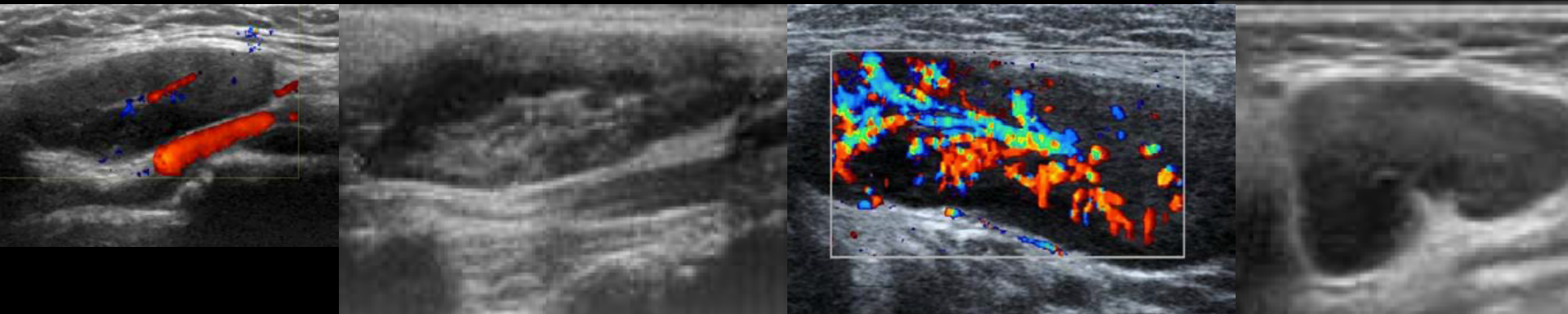


Normal LNs



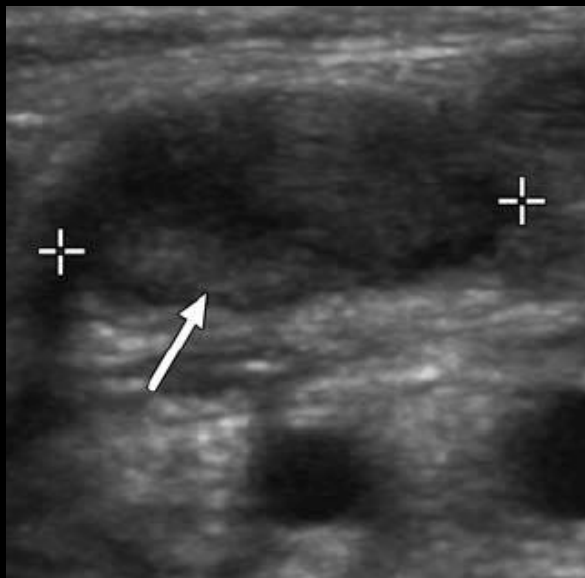
Reactive LNs

- “Reactive” = benign reactive hyperplasia
 - From infection or inflammation
 - Can be MORPHOLOGICALLY ABNORMAL, and not malignant
 - Typically do not have calcs, cystic portions, or peripheral cortical hyperemia (malignant)

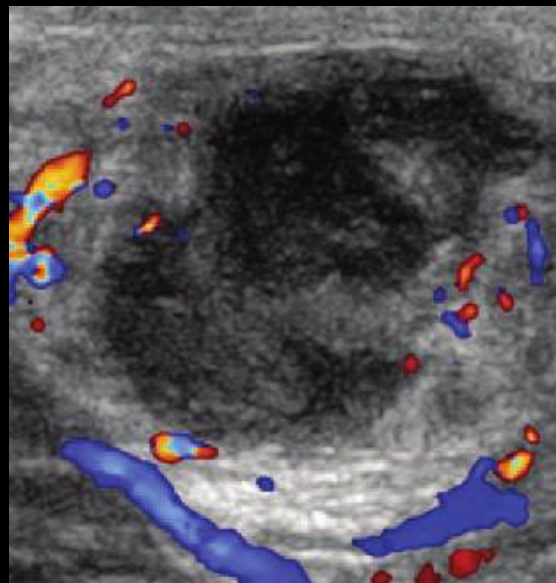


PEDIATRIC – usually Reactive LNs

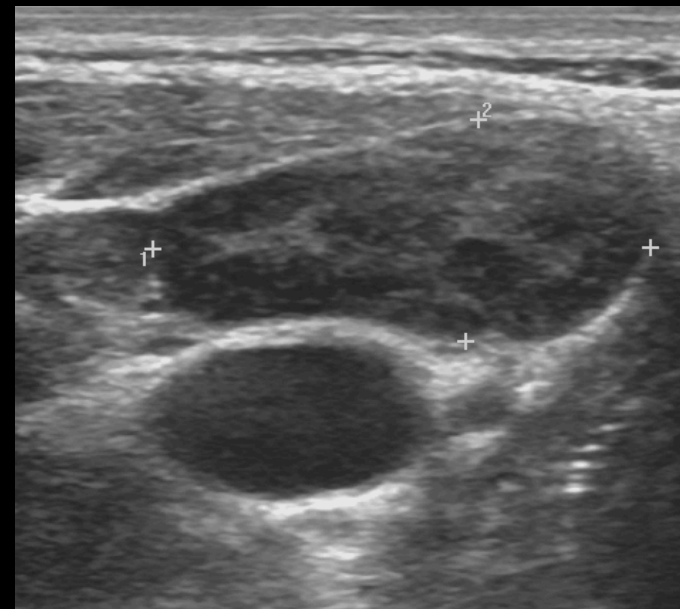
- #1 cause of neck mass in kids = LNs
- Most causes of neck lymphadenopathy in kids are benign, reactive to infection or inflammation
 - *Eg. Bacteria (staph, strep throat, Cat-scratch disease), Virus (URI “the cold”, EBV/Mononucleosis, CMV), TB*
 - i.e. even if morphologically AbN LN, still benign
 - Usually tender, mobile, soft (not fixed firm)
 - **Recommend followup US in 4 wks** if not resolved clinically
 - Unless there are suspicious clinical features or markedly abnormal LN morphology
 - Malignancy in Peds Neck LNs: #1 Lymphoma, #2 Rhabdomyosarcoma



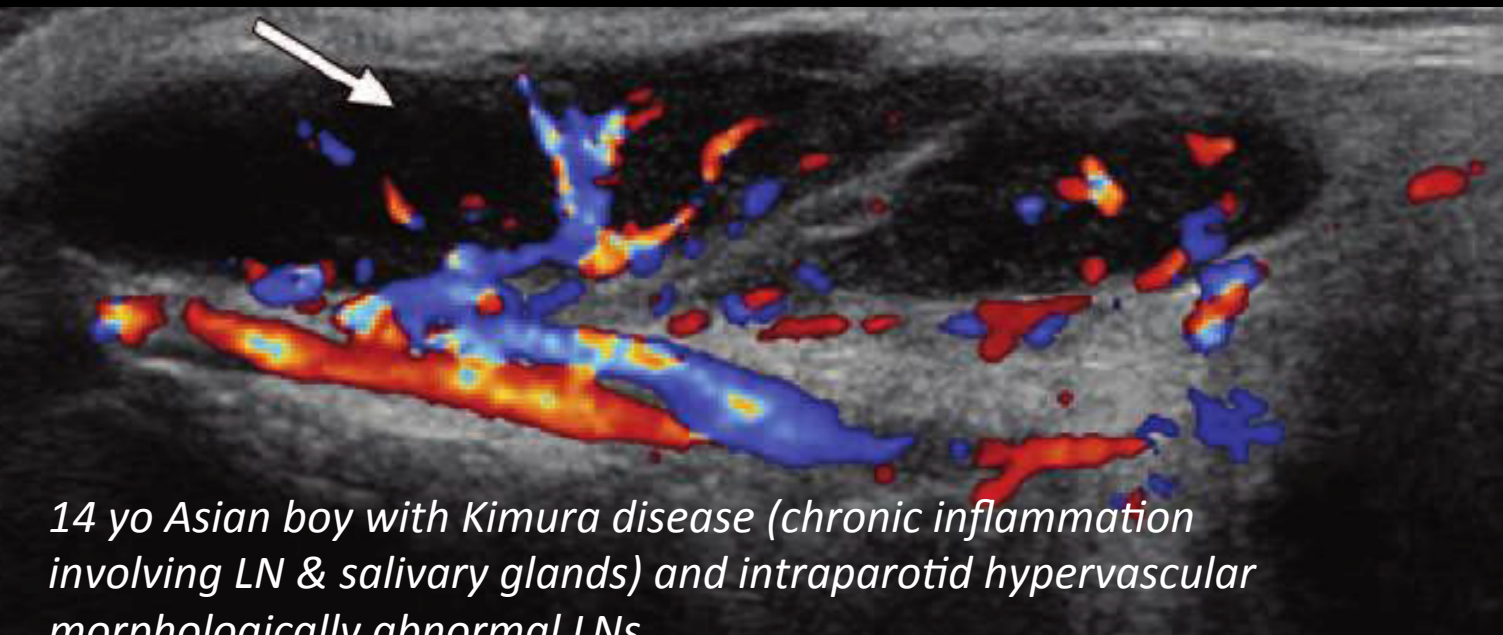
*8 yo boy with
Strep throat*



*6 yo boy with Staph
infection*



17 yo boy with tonsillitis



*14 yo Asian boy with Kimura disease (chronic inflammation
involving LN & salivary glands) and intraparotid hypervascular
morphologically abnormal LNs*

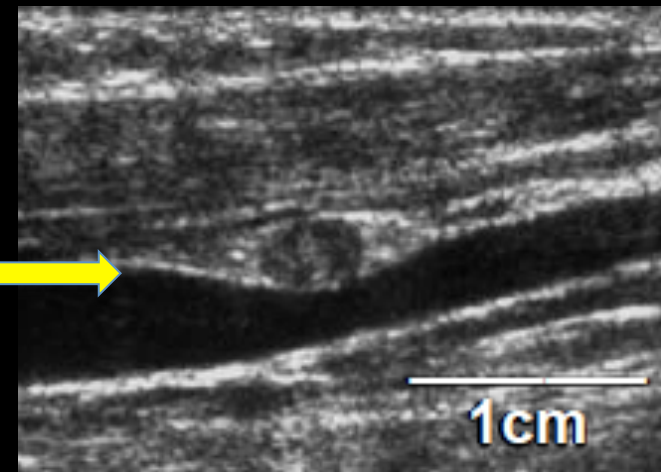
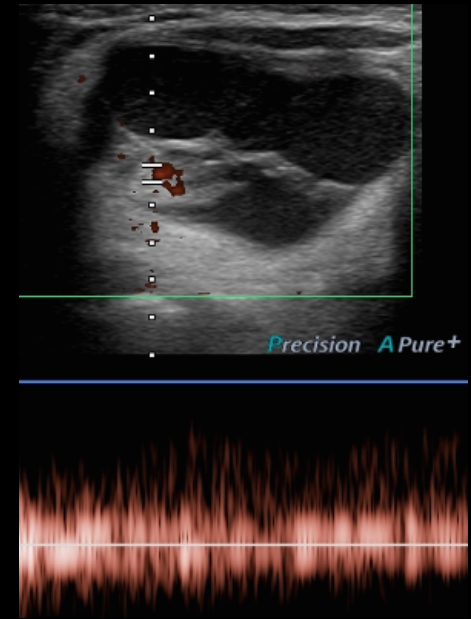
ADULT Reactive LN?

- If LNs look only mildly enlarged or mildly abnormal morphologically, esp if tender, probably reactive
 - Recent URTI/cold? On antibiotics?
 - Ask how long has the lump been present?
 - Recommend followup US in 4-6 wks
- Do not follow SUSPICIOUS LNs in Adults → instead refer to ENT + CT + FNA biopsy
 - *Eg Suspicious LNs with calcifications, cystic change*
 - *Thyroid or SCC mets, lymphoma*

- **LEARNING POINT:**
- Neck lymphadenopathy highly likely to be benign in kids and those <30yo
- Have a higher level of suspicion with increasing age (i.e. > 40yo)

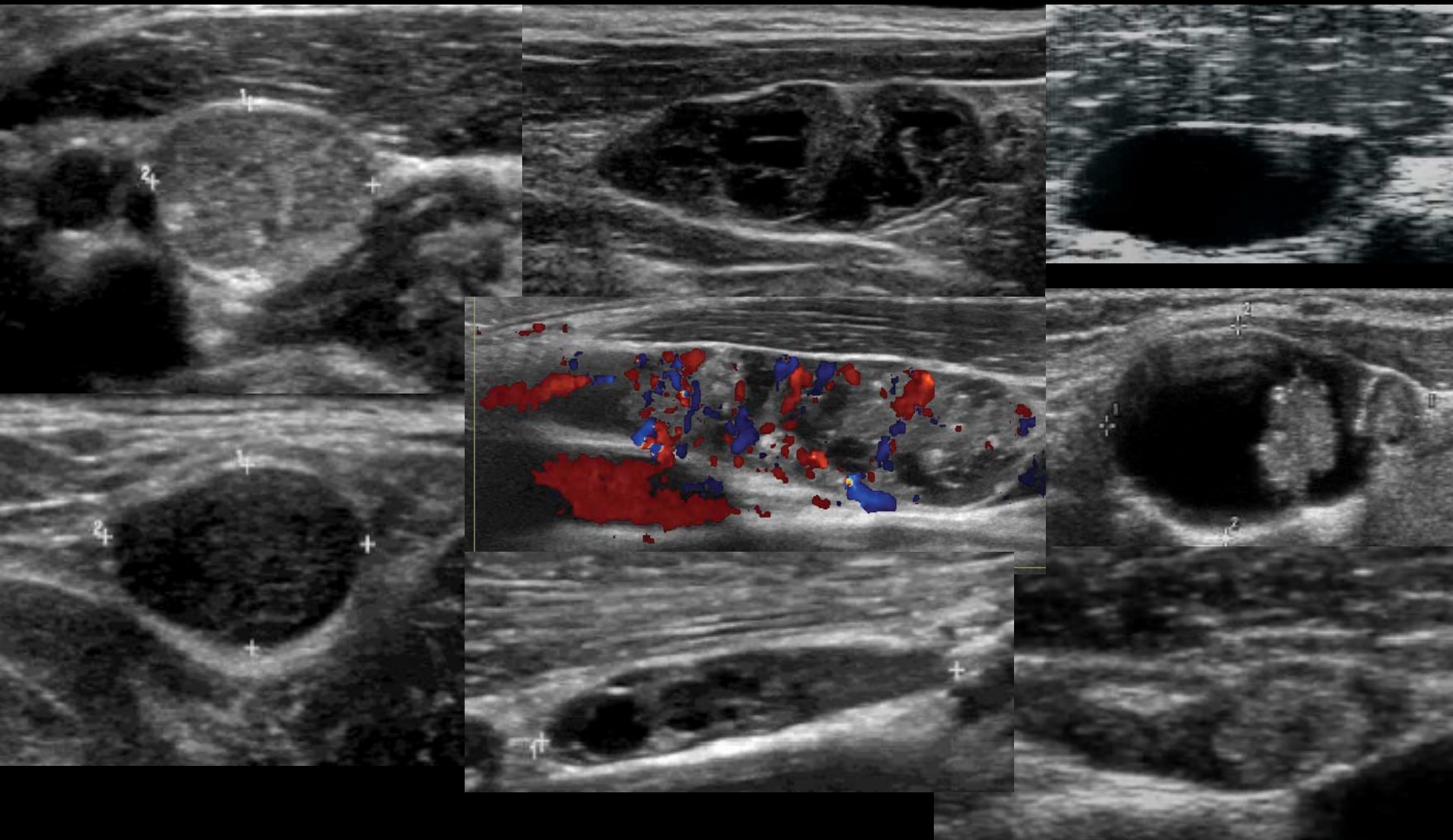
Suspicious LNs

- Round
- Loss of fatty hilum
- Heterogeneous cortex
- CORTICAL /PERIPHERAL doppler flow
- Microcalcifications (from thyroid ca mets)
- Cystic areas
- Mass effect on adjacent structures
 - Eg . Carotid a. or jugular v.

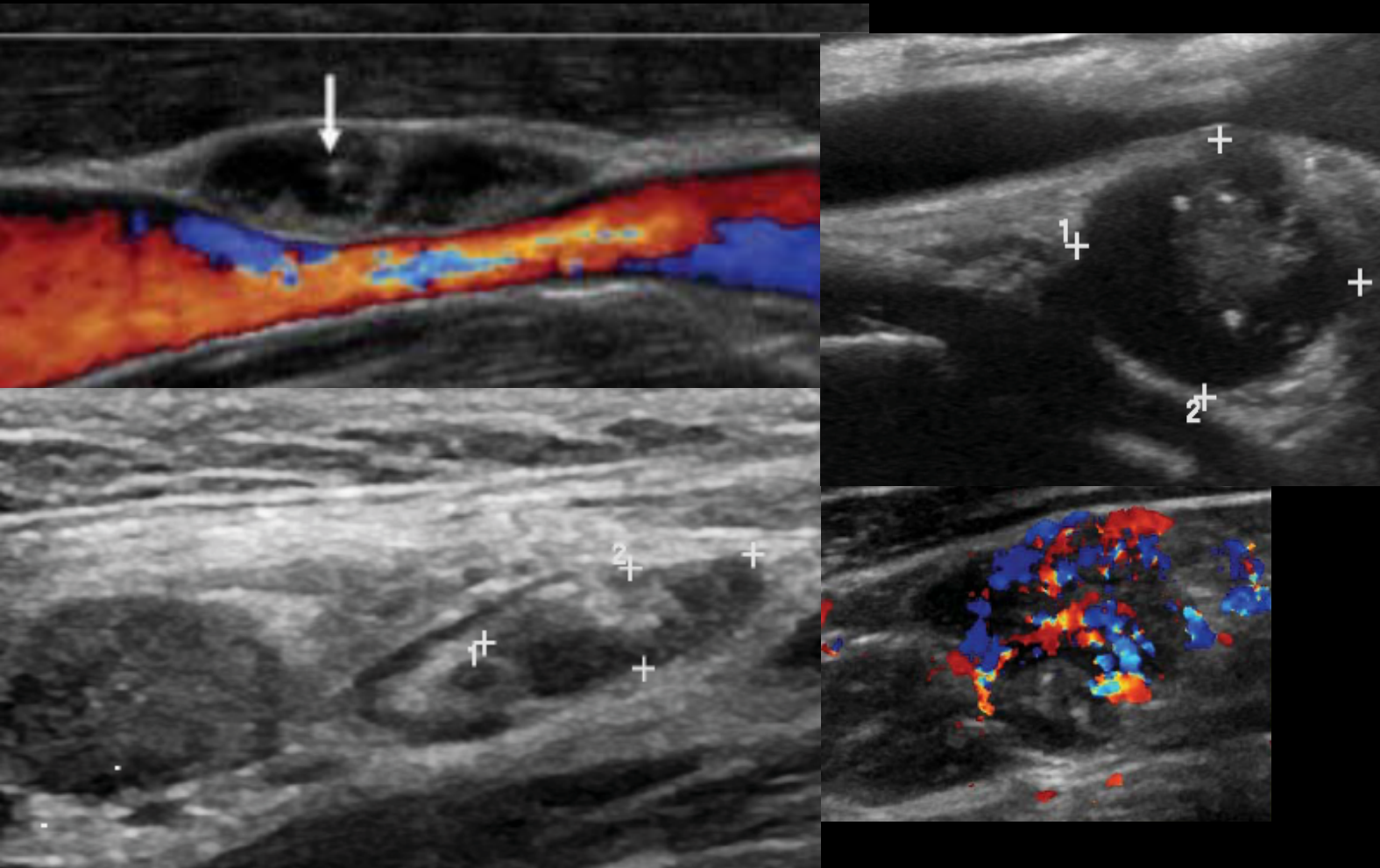


- *(size does not matter as much [unless markedly enlarged], can be tiny and still suspicious, large and benign/normal)*

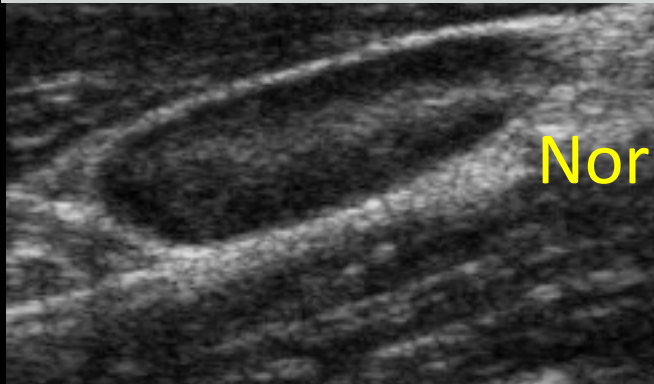
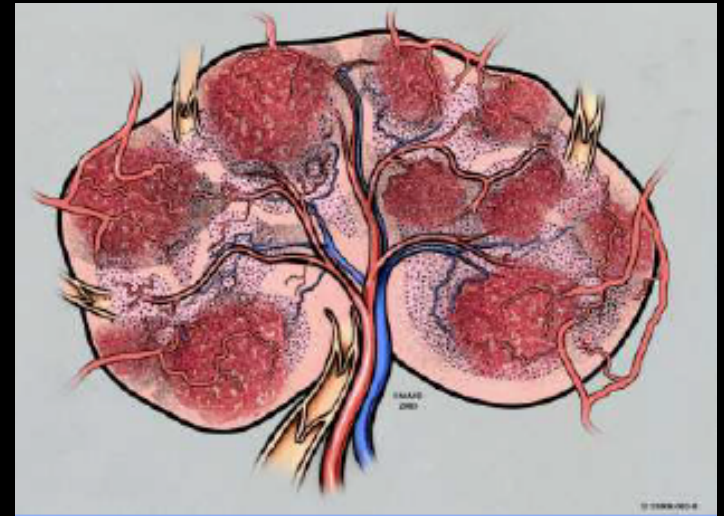
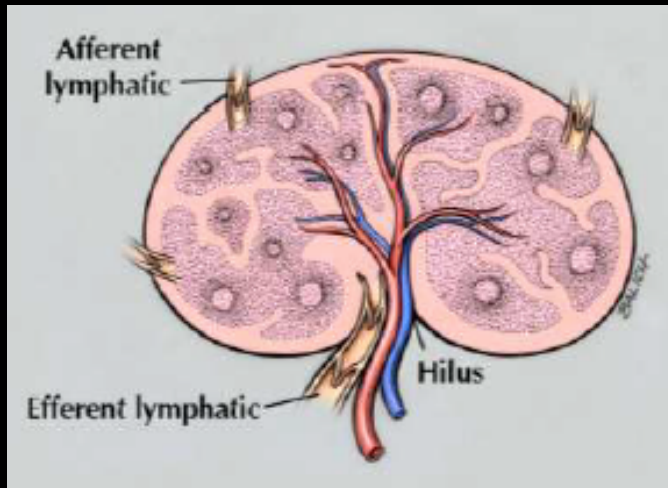
Suspicious LNs



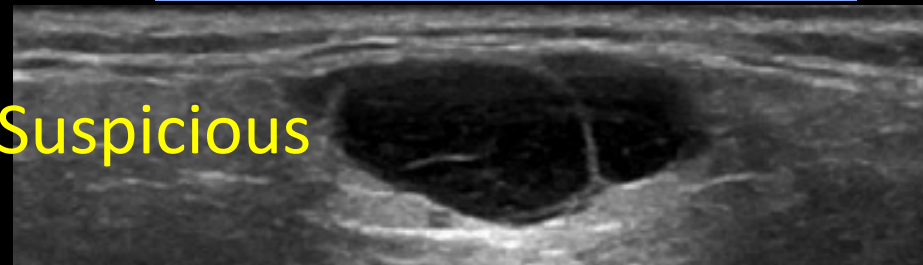
Suspicious LNs



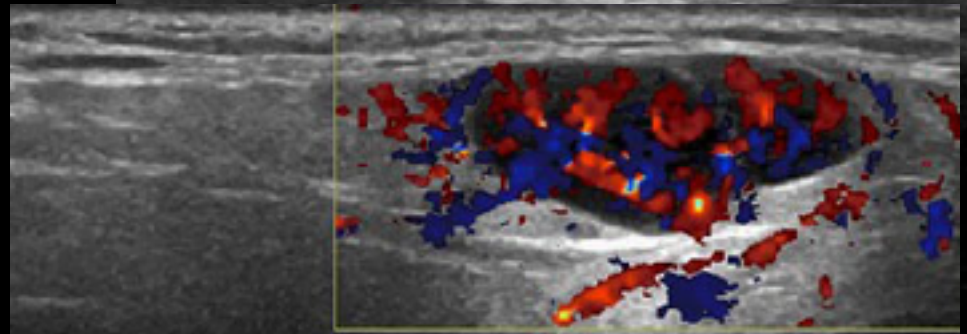
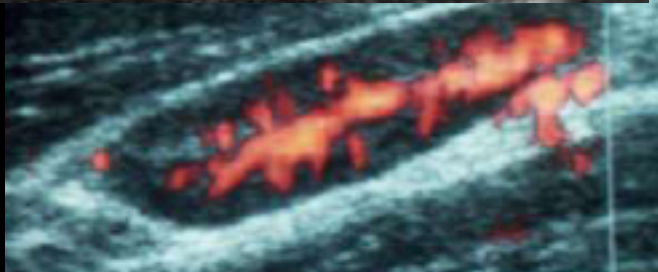
Hilar vs Peripheral Doppler flow

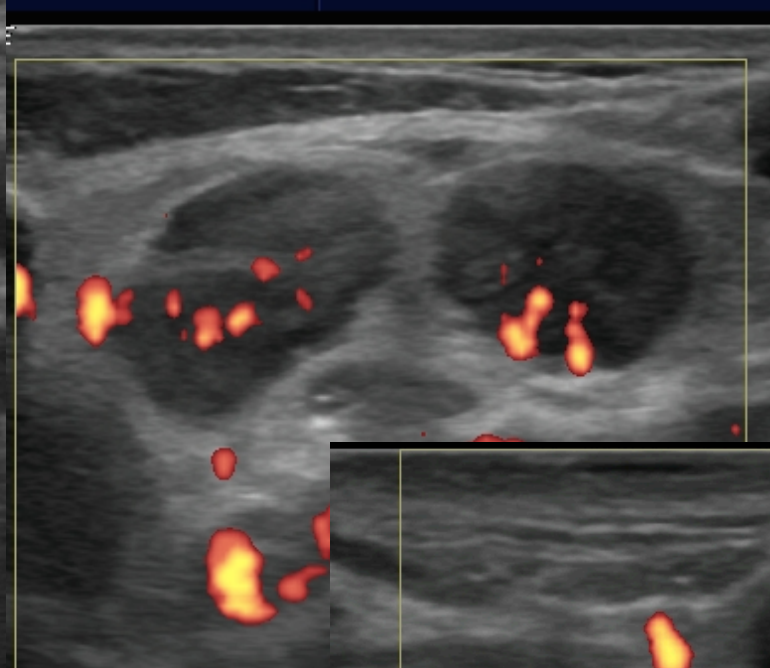
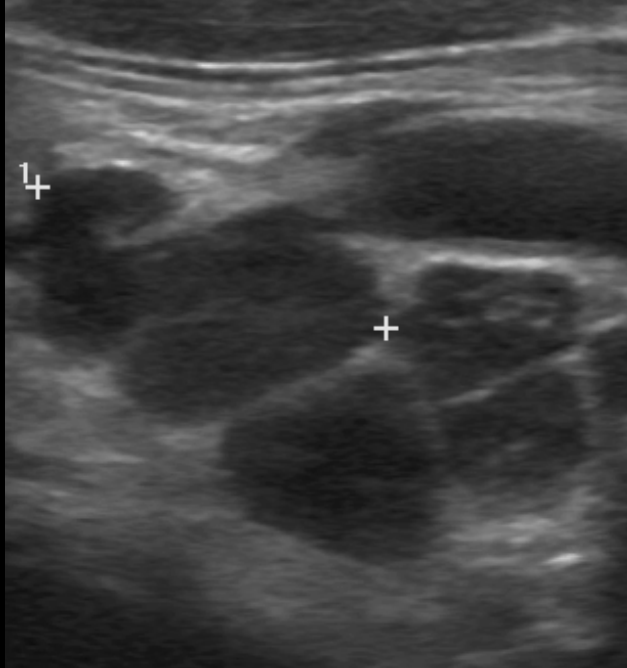


Normal

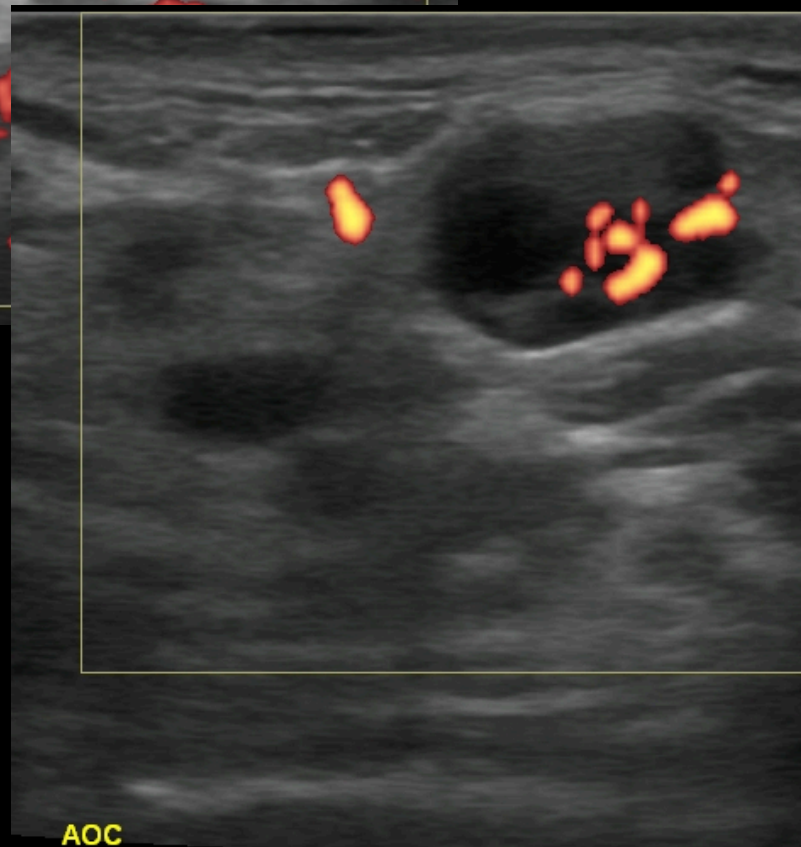
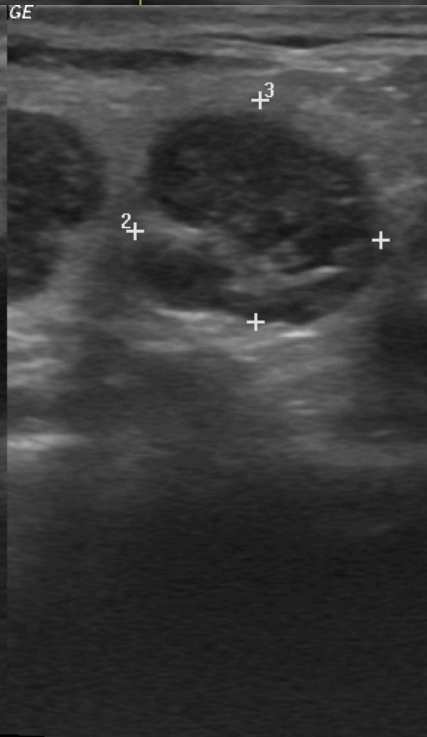
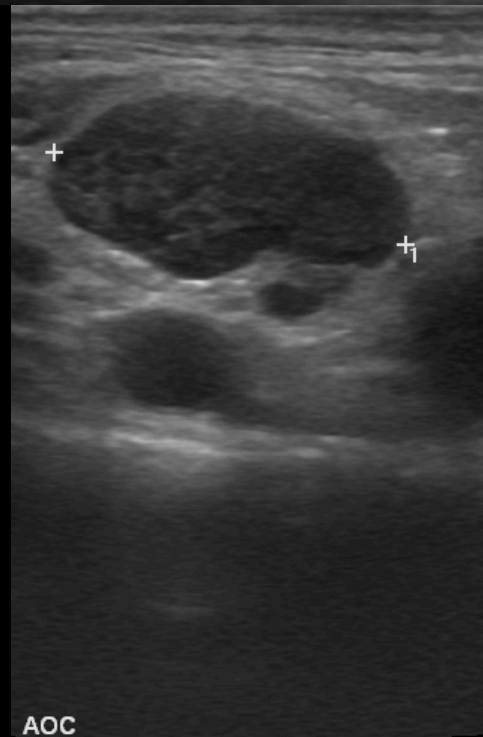


Suspicious





68 yo F "neck pain & swelling" → pathology:
widespread lymphoma
(neck, chest, abdo,
pelvis)

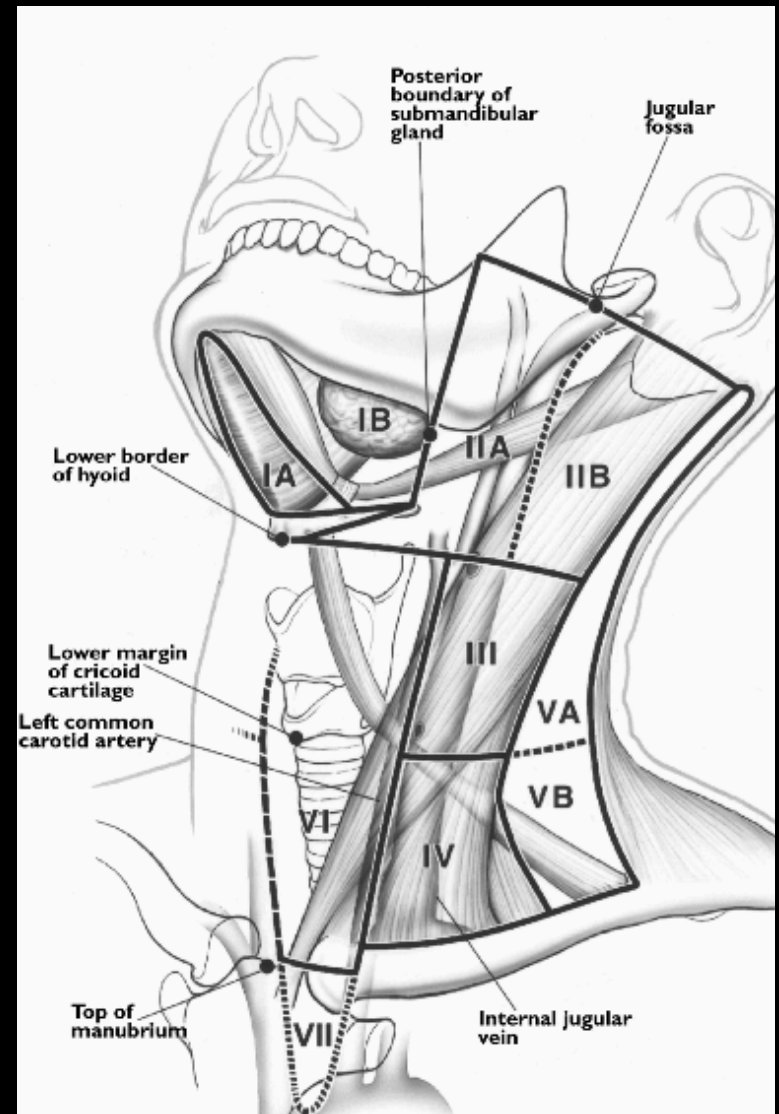
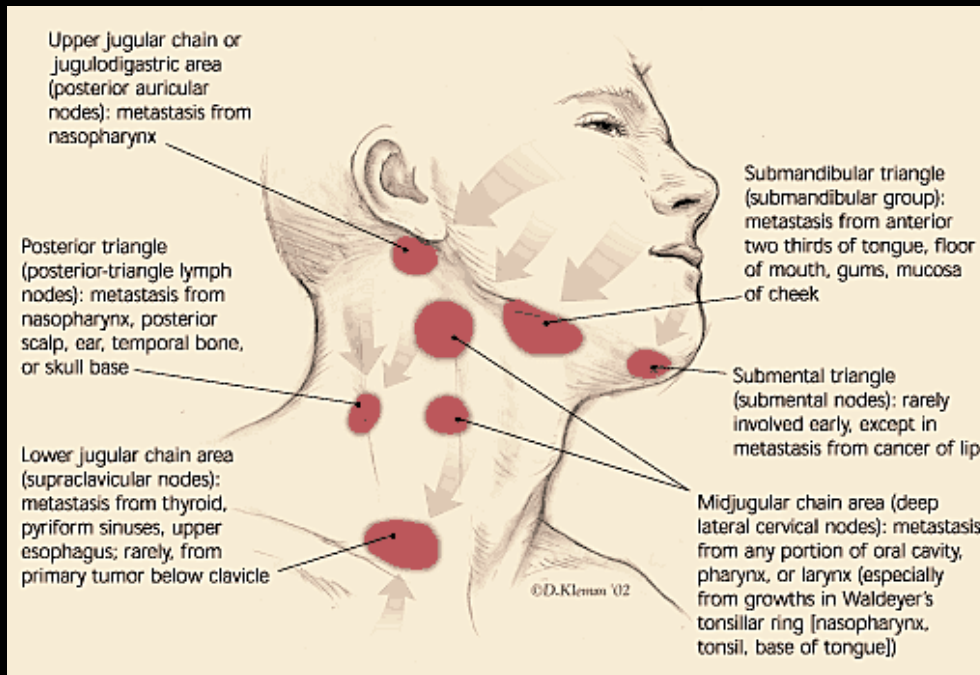


AOC
LT NECK LWR LATERAL SUPRA CLAV SAG

AOC
LT NECK LWR SUPRA CLAV

Neck Lymph Nodal Stations

- **Thyroid LN mets** → III, IV, VI, VII
(mid to lower cervical chain & central neck)
- **Squamous Cell Ca (nose, throat, mouth)** LN Mets → II, III, IV (cervical chain)



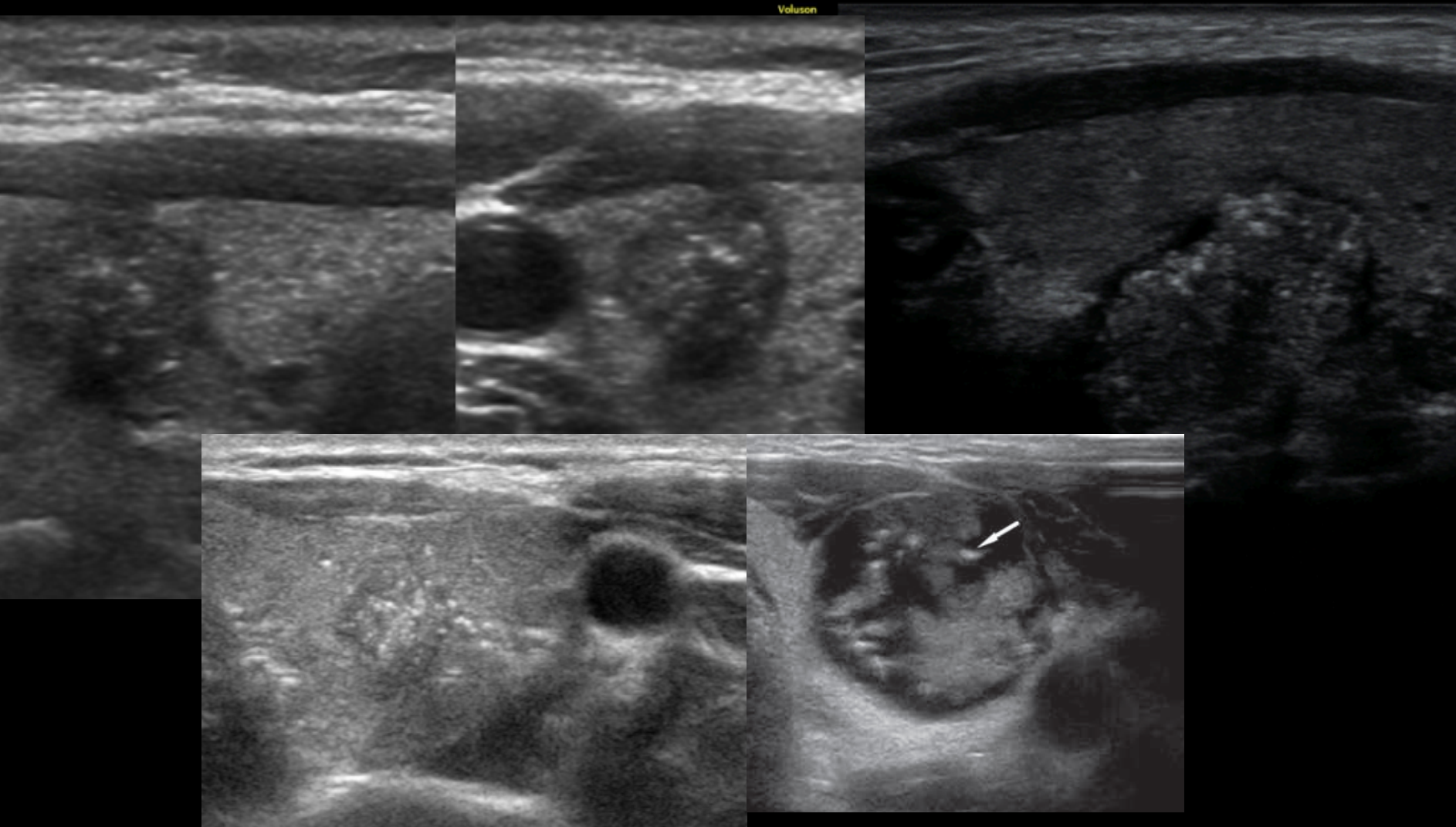
Thyroid Cancer

Suspicious Nodule US features

- **Microcalcifications**
 - punctate
- **Hypoechoic** (compared to strap muscle)
 - esp those markedly hypoechoic
- **Irregular, Indistinct, Microlobulated Margins**
- **Taller-than-Wide orientation**
- **Thyroid contour bulge by nodule**
- **ABSENT hypoechoic halo**

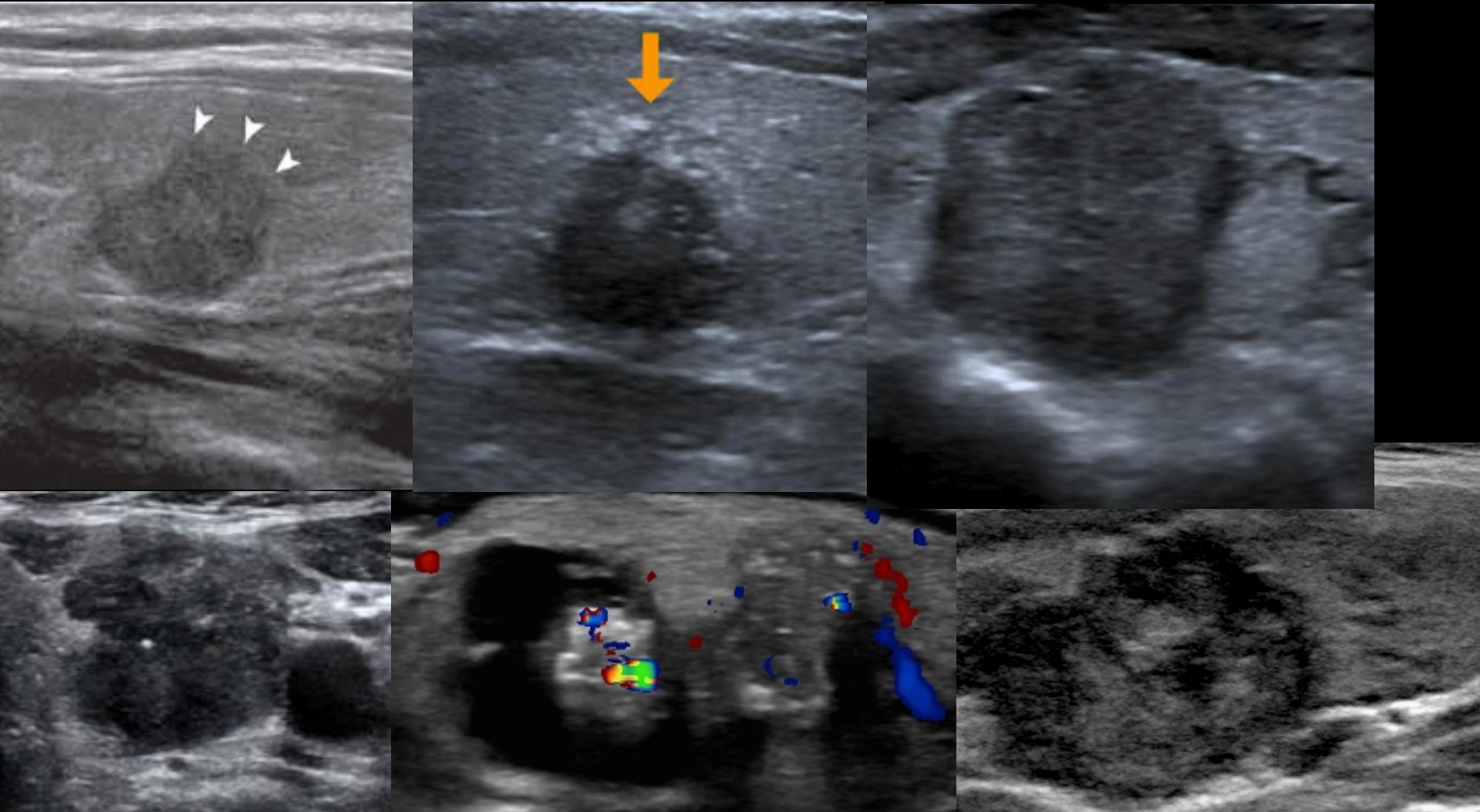
Papillary Thyroid cancer

Microcalcifications



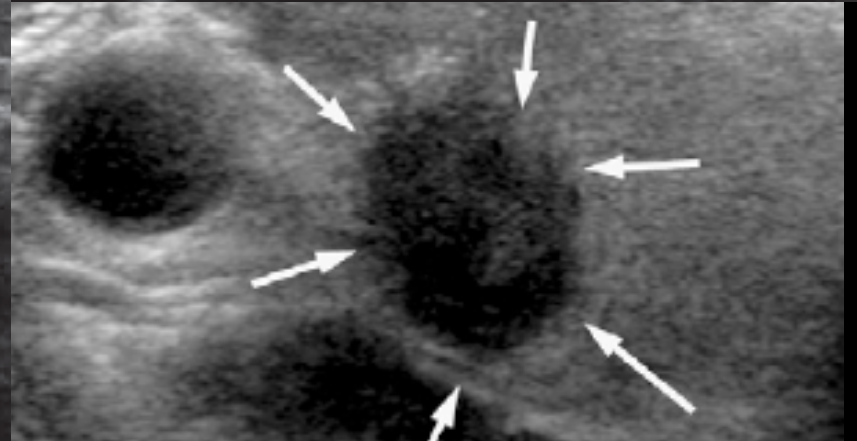
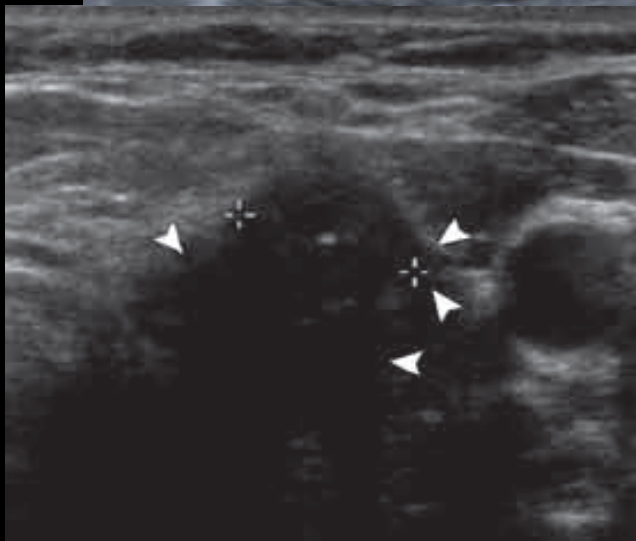
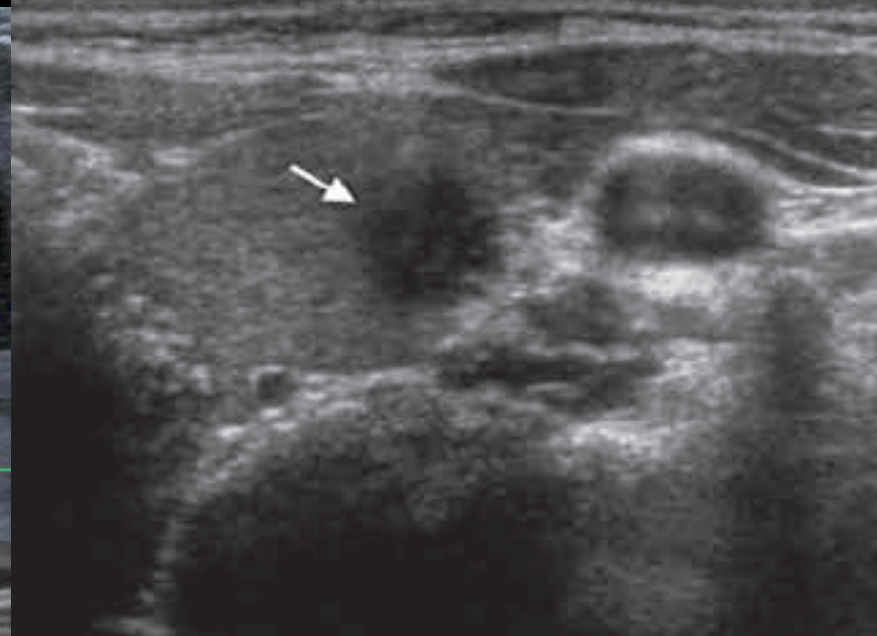
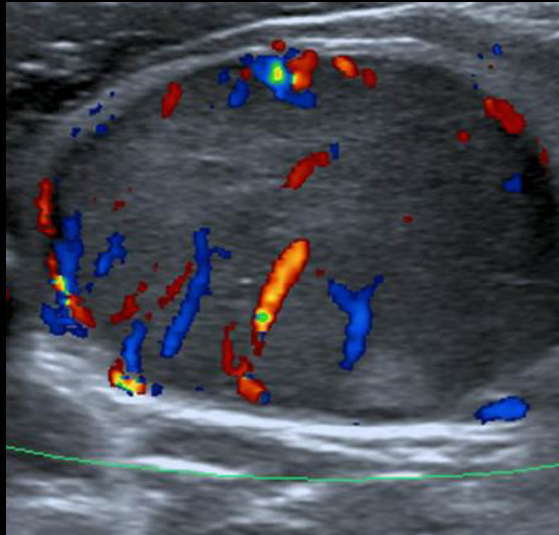
Thyroid cancer

Irregular, Indistinct, Microlobulated Margins



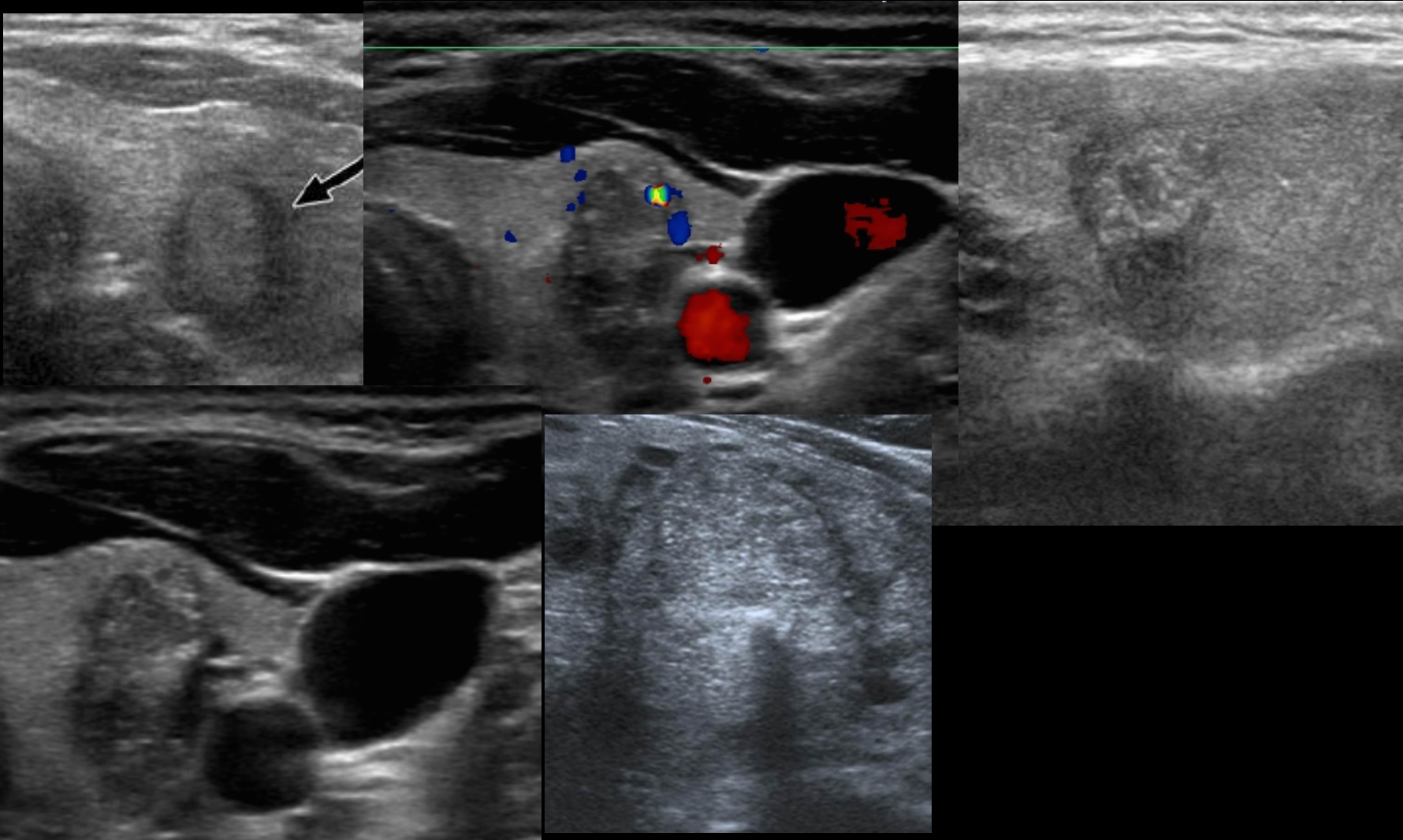
Thyroid cancer

Hypoechoic (esp markedly hypoechoic)



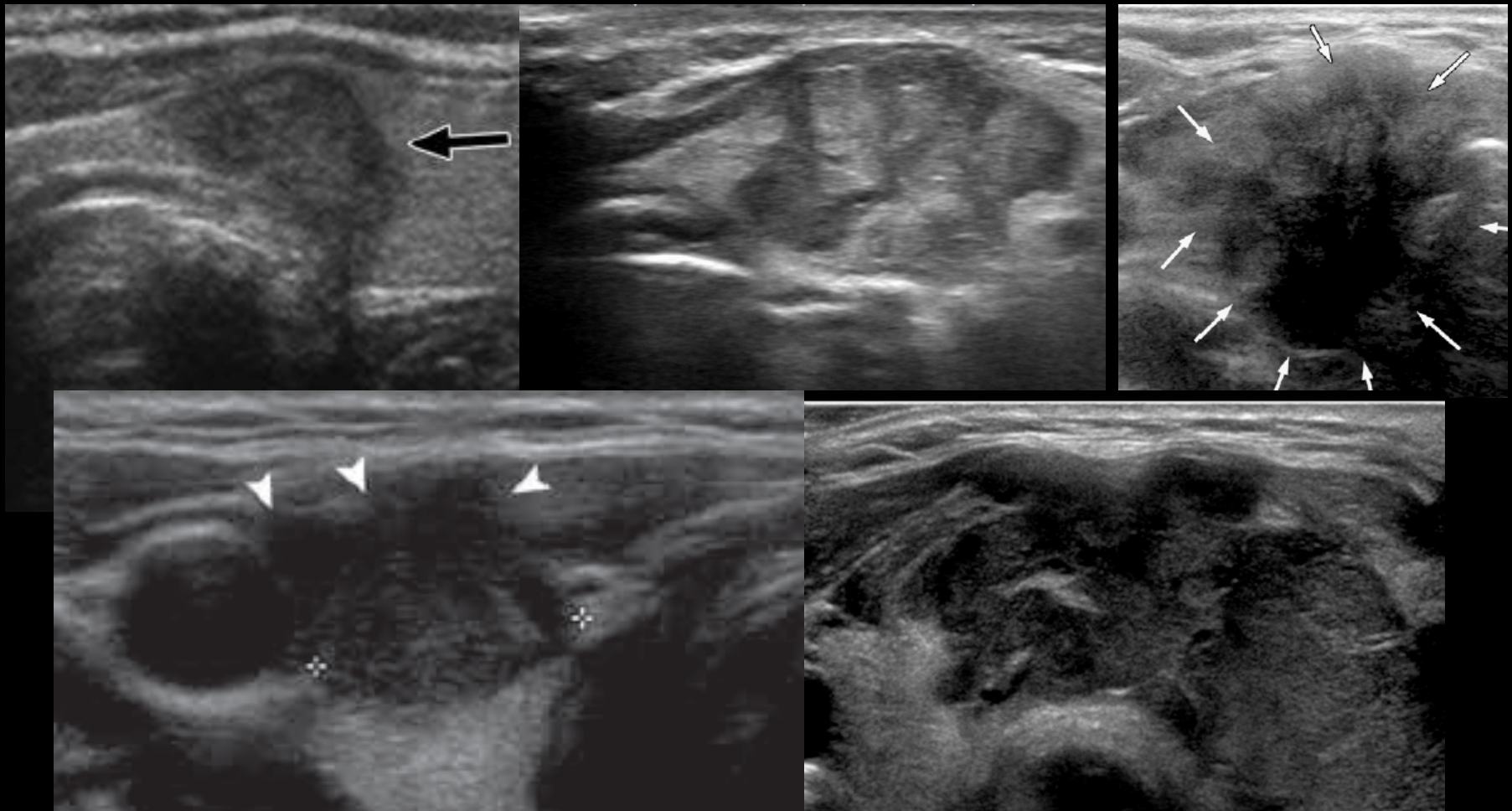
Thyroid cancer

Taller-than-Wide orientation



Thyroid cancer

Thyroid contour bulge by nodule (extracapsular invasion)

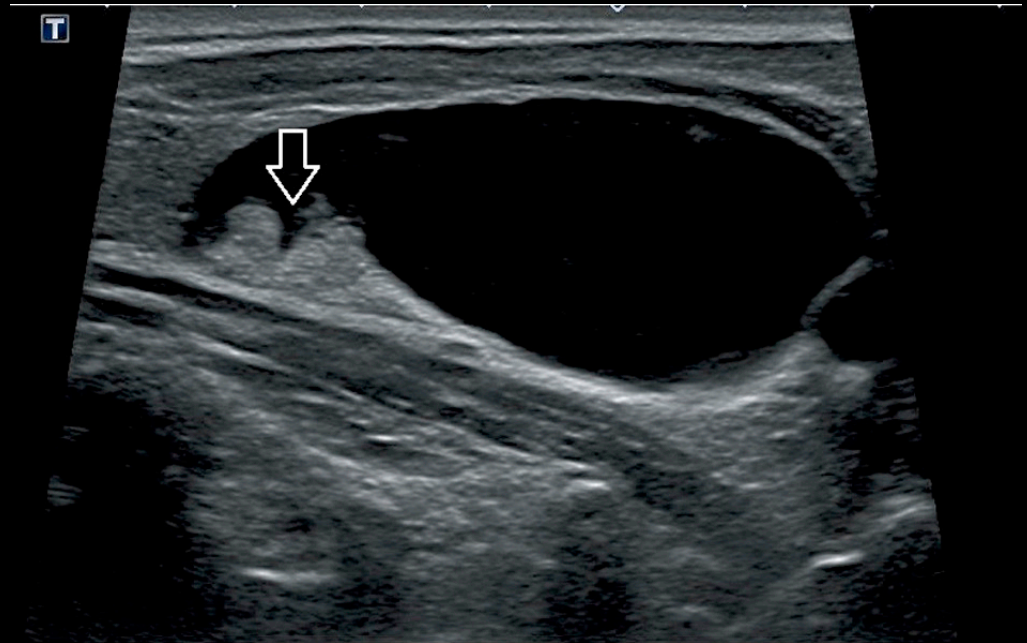
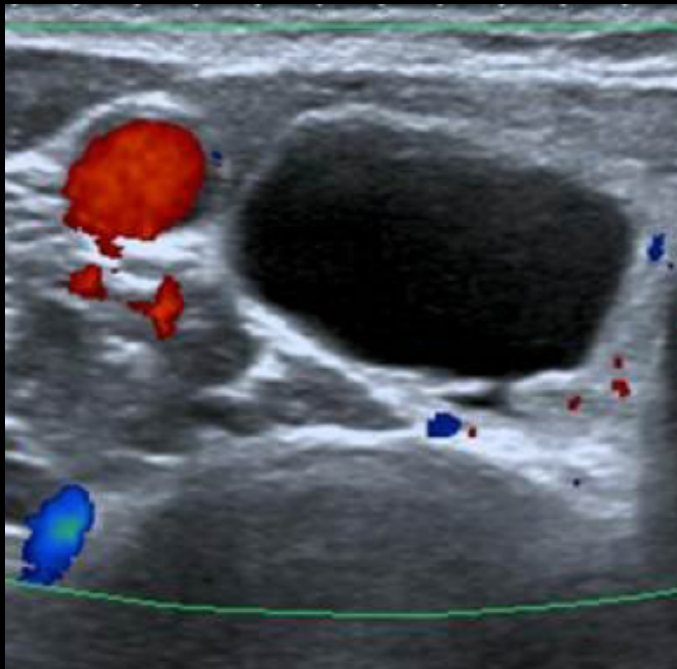


Benign Thyroid Nodule US Features

- **Almost entirely Cystic** (no significant solid component)
- **Colloid cyst**
 - Comet-tail artifact
 - beware comet-tail in a solid nodule → can be seen in cancer!
- **Spongiform** (like honeycomb, or 'cluster of microcysts' in the breast)
- **Well-defined Thin Hypoechoic Halo** (in thyroid, unlike malignant 'target lesions of metastases in LIVER)

Benign Features

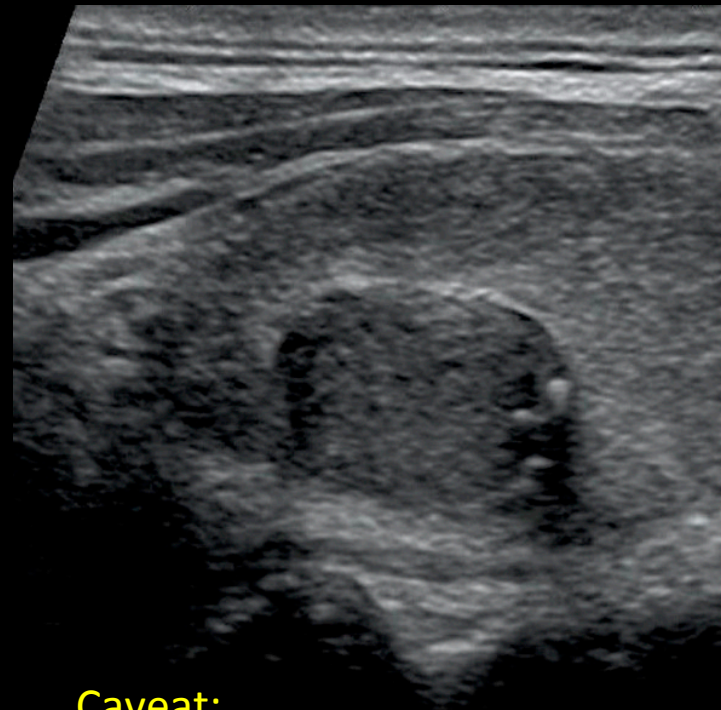
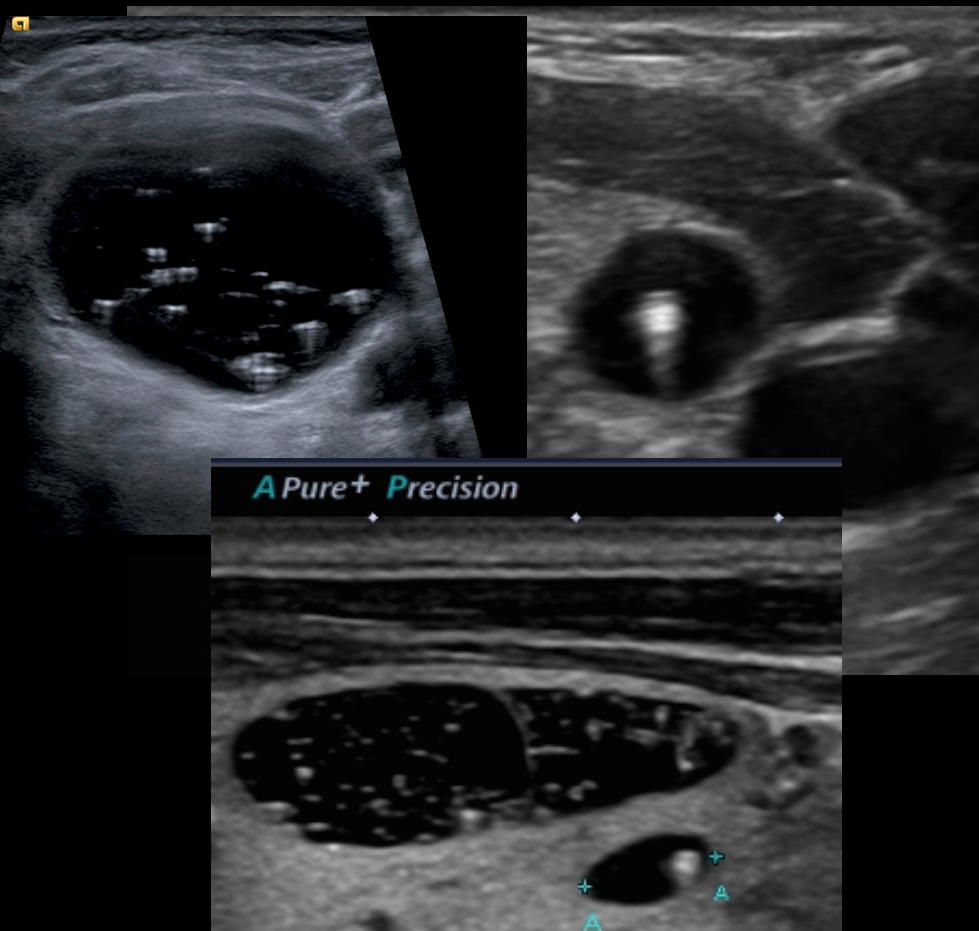
Almost Entirely cystic



Benign Features

Colloid cyst – comet tail artifact

*(has to be long CT artifact,
and better if more cystic)*

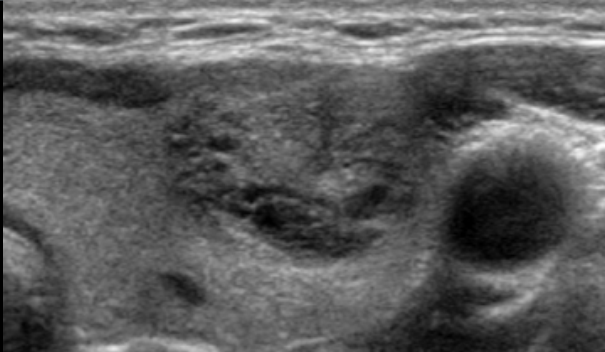
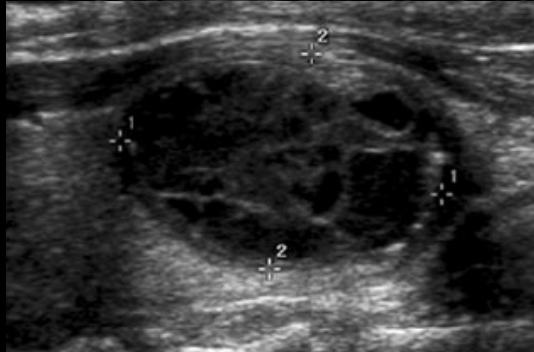
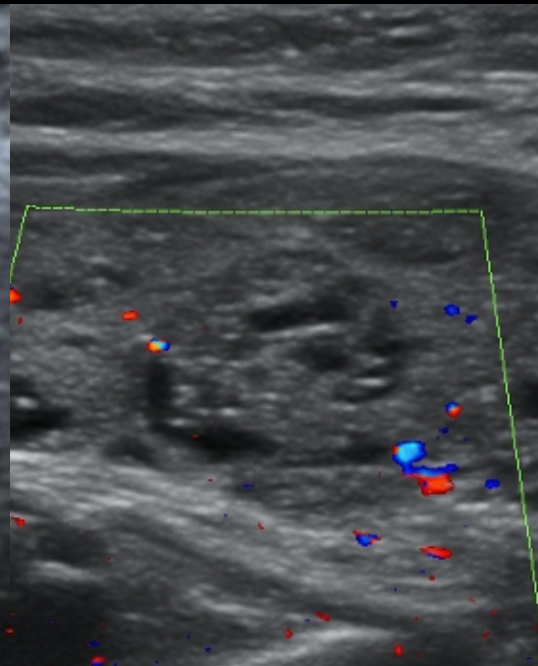
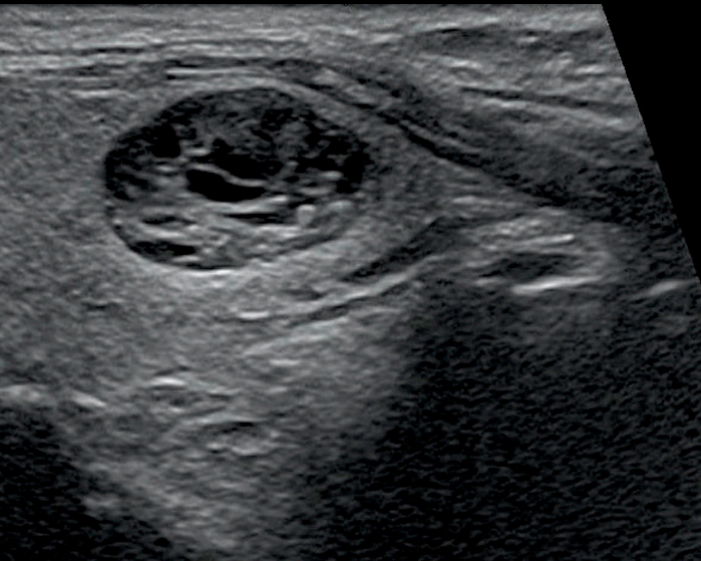


Caveat:
Papillary Thyroid Cancer,
Despite short comet tail artifact

Benign Features

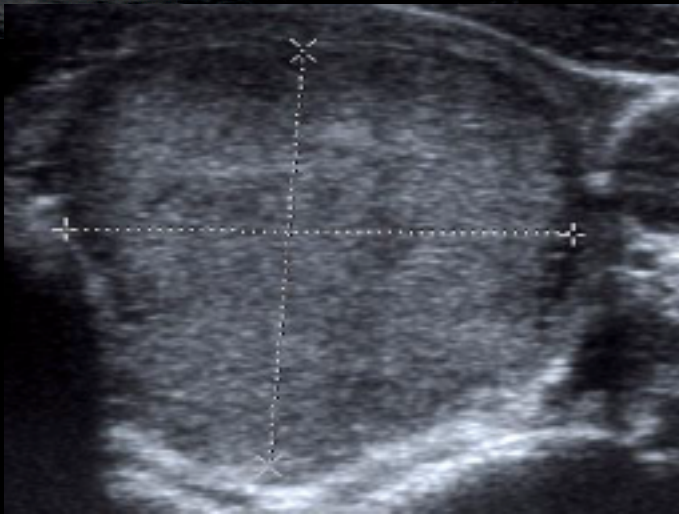
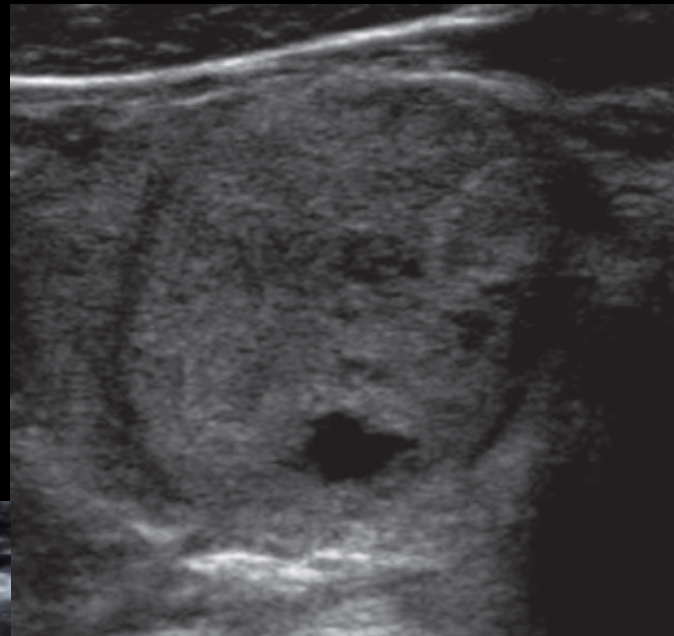
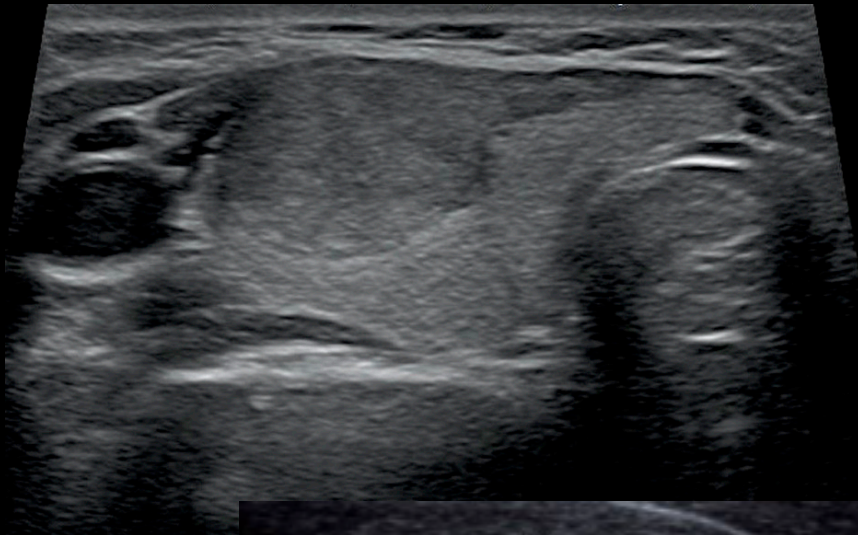
Spongiform

(aka honeycomb, microcystic)



Benign Features

Well-defined THIN hypoechoic halo



Thyroid FNA guidelines are changing...

- Society of Radiologist in US (SRU) 2005
 - FNA bx if >1 cm with microcalcs
 - >1.5 cm hypoechoic
 - >2 cm partially cystic, partially solid

- American Thyroid Association (ATA) 2015

- FNA bx if >1 cm SHOULD with suspicious features (microcalcs, irreg, taller, etc)
>1 cm CONSIDER with intermediate features (solid hypoechoic)
>1.5 cm low suspicion (iso- or echogenic solid)
>2 cm very low suspicion (spongiform or partially cystic)
Don't FNA mostly cystic nodules
- High risk pt? FNA at smaller size (eg <1cm)
 - Eg. hx irradiation as child, Family Hx of thyroid cancer

- ACR White papers Dec 2015/TIRADS

(like BIRADS classification in the breast)

- TIRADS scoring system slow to be adopted. (idea of TIRADS started 2011)
- ACR revision of TIRADS in progress.
- For now, better just to describe nodule and if suspicious features, FNA

Thyroid nodules

Overdiagnosis? Overbiopsy?

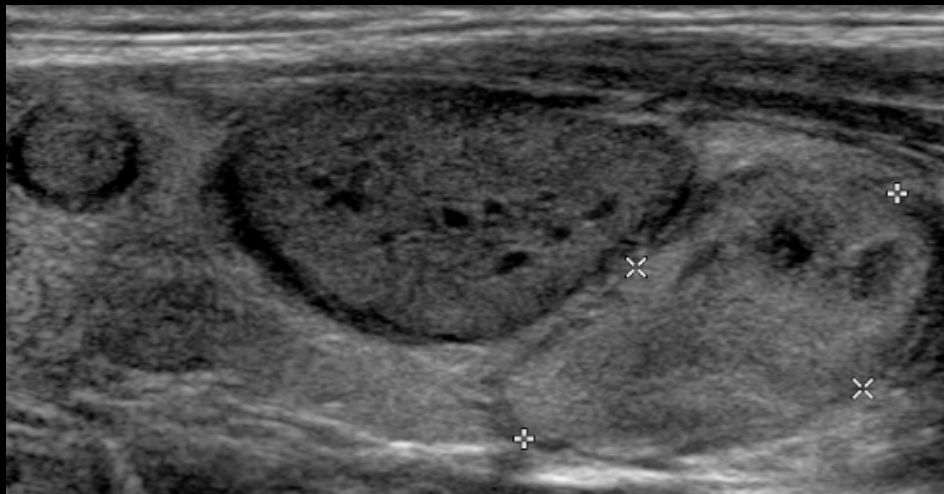
- 5-10% of people have PALPABLE thyroid nodules
- Up to 25-50% of people have thyroid nodules on imaging, increases with age
- Only 1 in 10 nodules is thyroid cancer
- 80-90% of thyroid cancers are papillary cancers, which are often slow-growing
(vs more aggressive follicular, anaplastic, medullary cancers)

Importance to TNI sonographers?

- By best demonstrating on your images the thyroid nodule characteristics, you maximize accuracy of radiologist interpretation and recommendation for FNA
 - *Solid vs cyst, echogenicity, calcifications, margins, taller-than-wide, size*
- Scan bilateral neck LN stations to exclude any abnormal LNs
 - (i.e. Suspicious LN? then level of suspicion for any thyroid nodule increases)

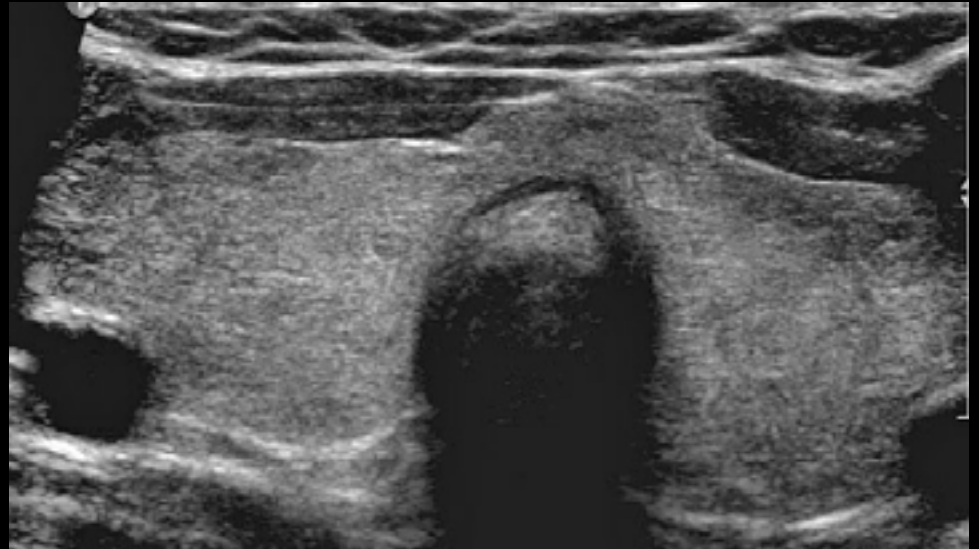
Multinodular Goiter (MNG)

- **Most common** condition of the thyroid
- Most of the nodules are **hyperplastic or adenomas**, with varying degrees of **cystic and colloid degeneration**
- Each nodule in MNG has same probability of being malignant as for solitary nodule (10%)
- **Most nodules iso-to-echogenic, hypoechoic halo, spongiform, colloid**



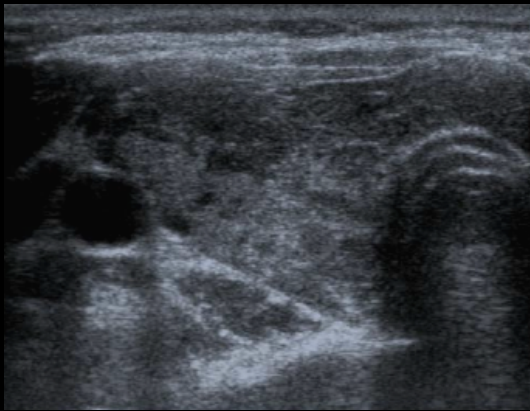
Thyroid Size

- Goiter = Enlarged thyroid
- Normal:
 - Isthmus < 0.5 cm AP
 - AP diameter < 2.0 cm
 - Lobe length 4 – 6 cm



Hashimoto's thyroiditis

aka Chronic lymphocytic thyroiditis

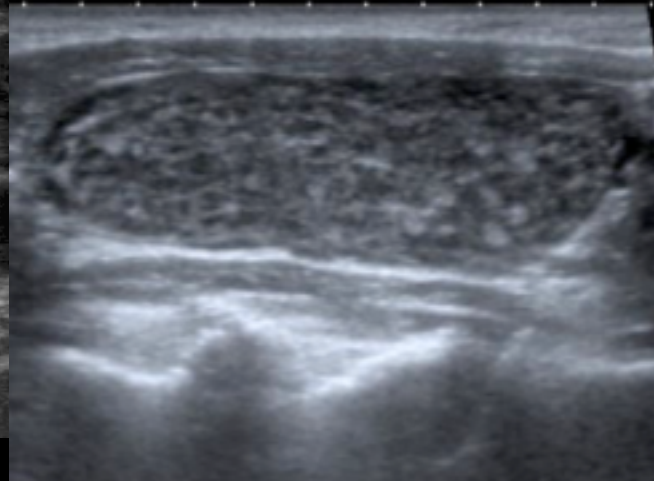
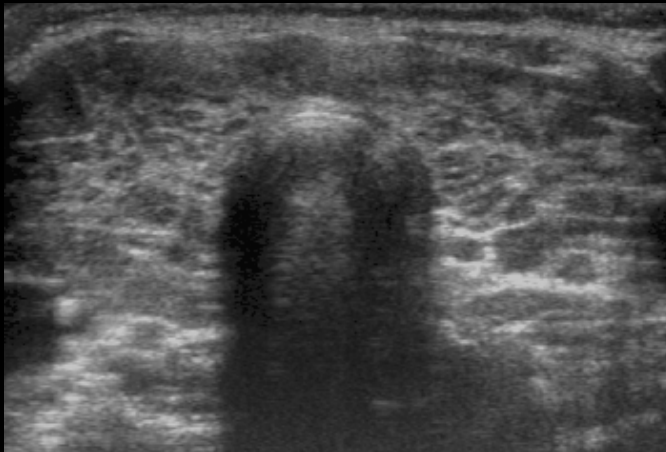


Hypothyroid

Diffuse autoimmune thyroiditis

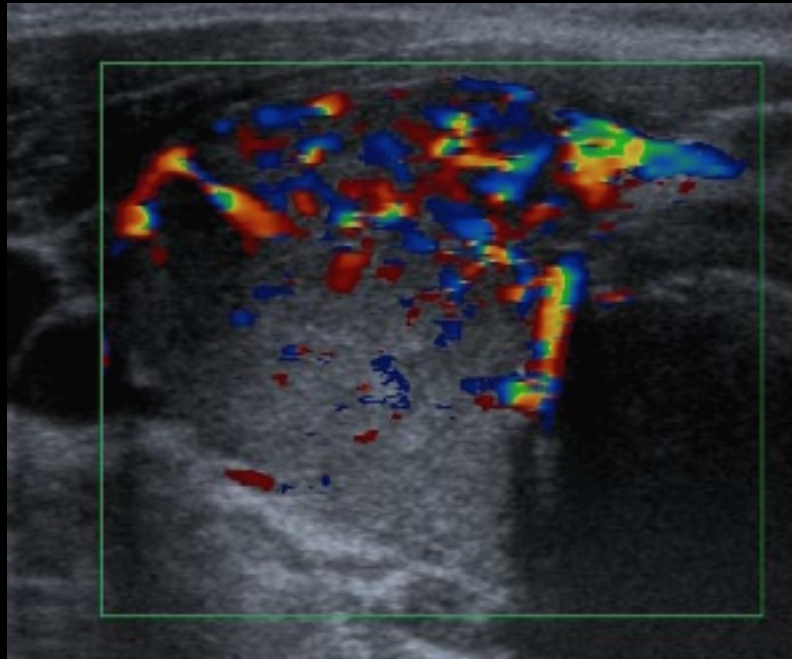
-early in disease, often only portion of thyroid hypoechoic

-later, lobulated, hypoechoic w/ striations



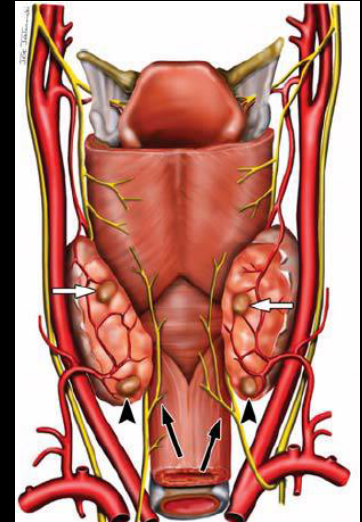
Graves Disease

- Hyperthyroid
- **Hypervascular** thyroid parenchyma
 - (but any thyroiditis incl Hashimoto's can be hypervascular too)

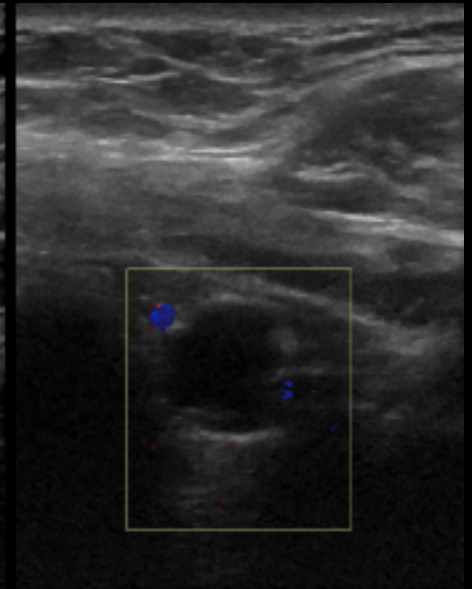
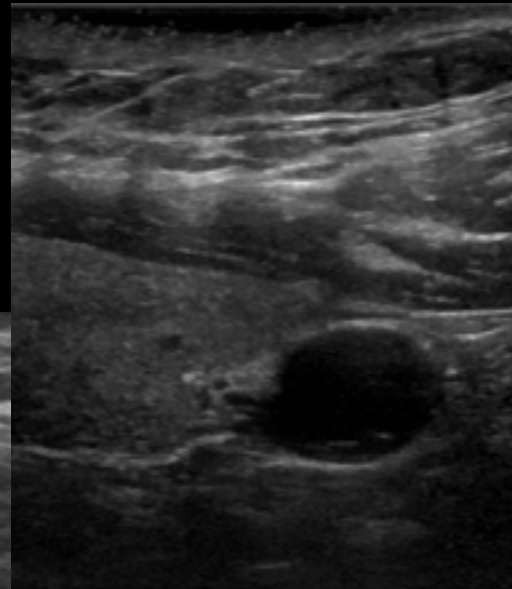
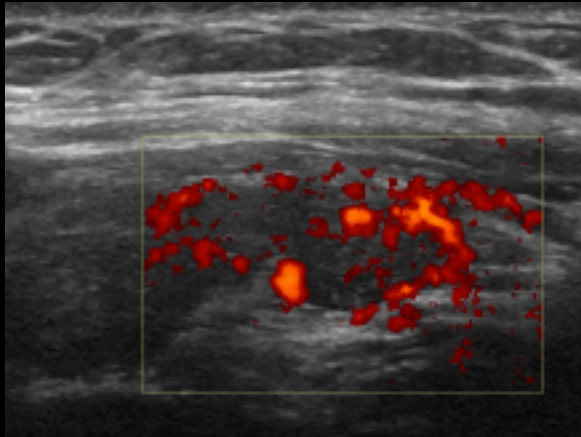


Parathyroid Glands

- Typically posterior to thyroid, usually 4
(2 on each side – superior & inferior)
- Anywhere from carotid bifurcation to thoracic inlet,
- History: hypercalcemia, hyperparathyroidism/elevated PTH
 - 90% from parathyroid adenoma
 - 10% from gland hyperplasia
 - <1% parathyroid carcinoma
- Typically markedly hypoechoic
- Use doppler! **Polar feeding vessel sign**
 - look for PERIPHERAL FEEDING VESSEL ARC, to differentiate from cervical LN with Central HILAR doppler flow)
 - Be careful to differentiate PT adenoma from posterior THYROID nodule

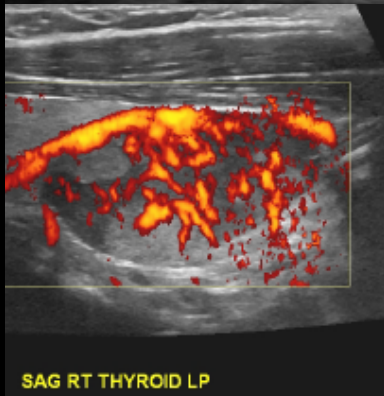


Parathyroid Adenomas

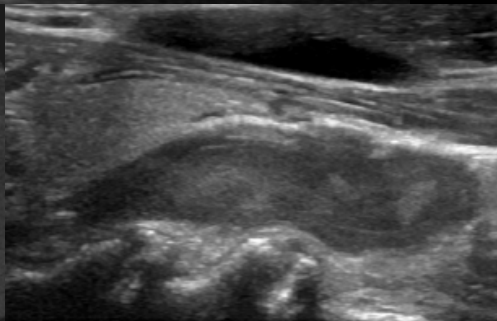


SAG LT LOWER POLE

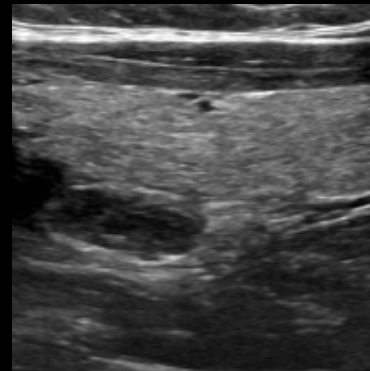
TRN LT LOWER POLE



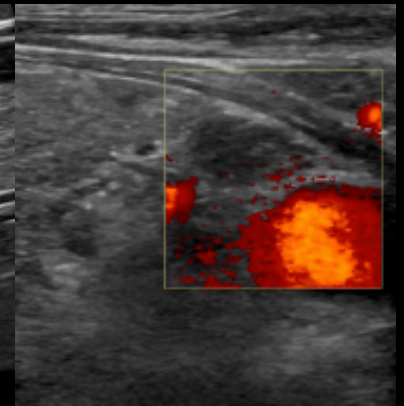
SAG RT THYROID LP



SAG LEFT THYROID LOWER

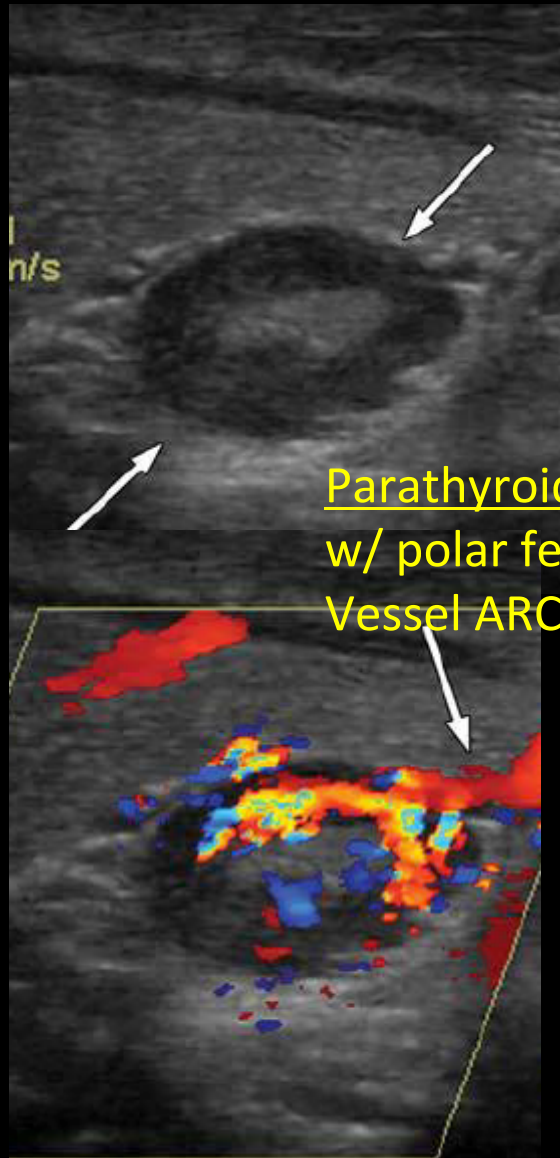


LEFT THYROID UP POST

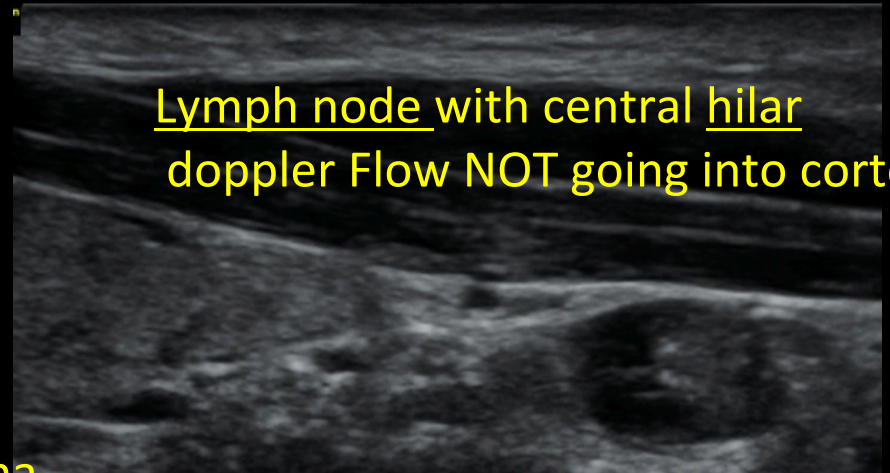


SAG RT THYROID LP

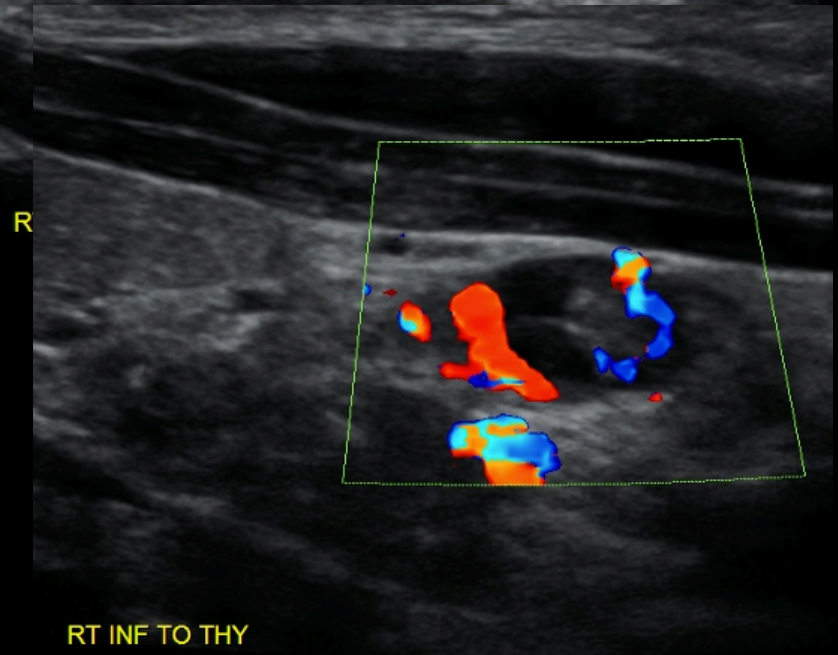
Parathyroid Adenomas



Parathyroid Adenoma
w/ polar feeding
Vessel ARC



Lymph node with central hilar
doppler Flow NOT going into cortex



RT INF TO THY

Salivary Glands

- Parotid Gland
- Submandibular gland
- Sublingual gland
 - All are fairly echogenic and homogenous

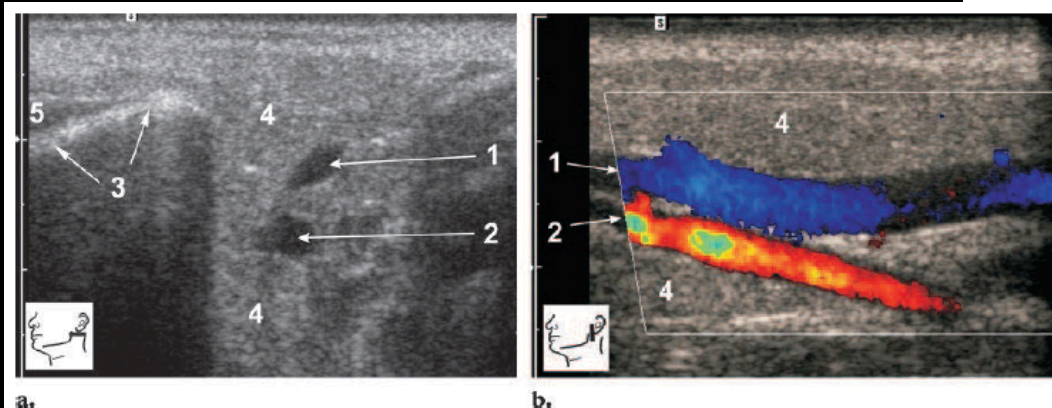
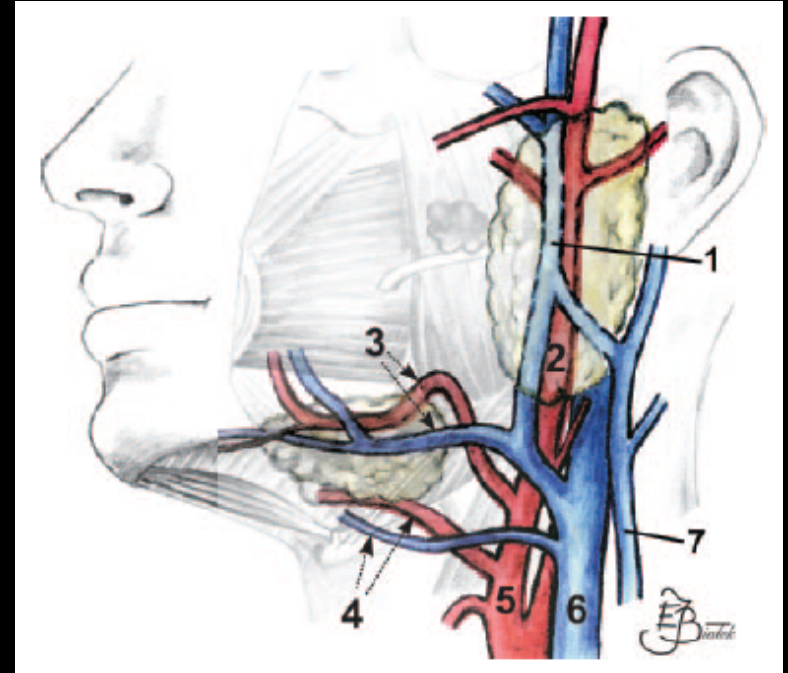
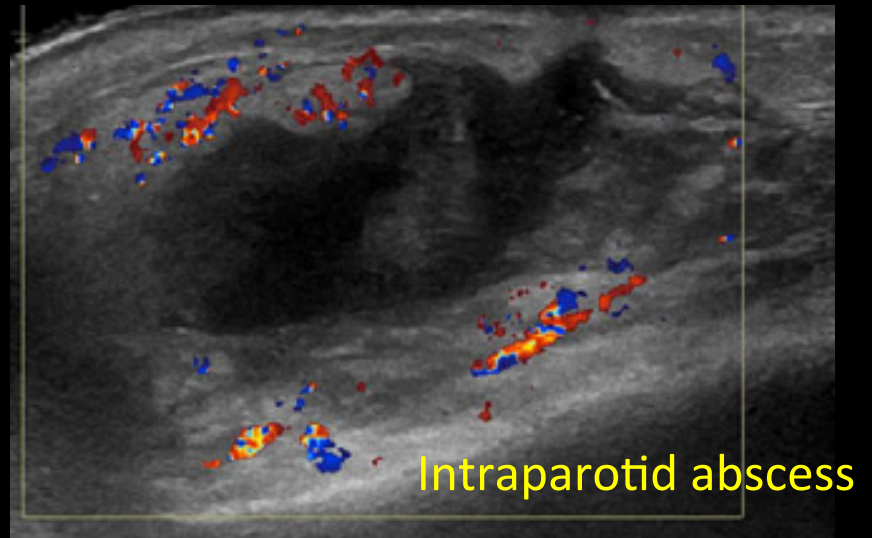
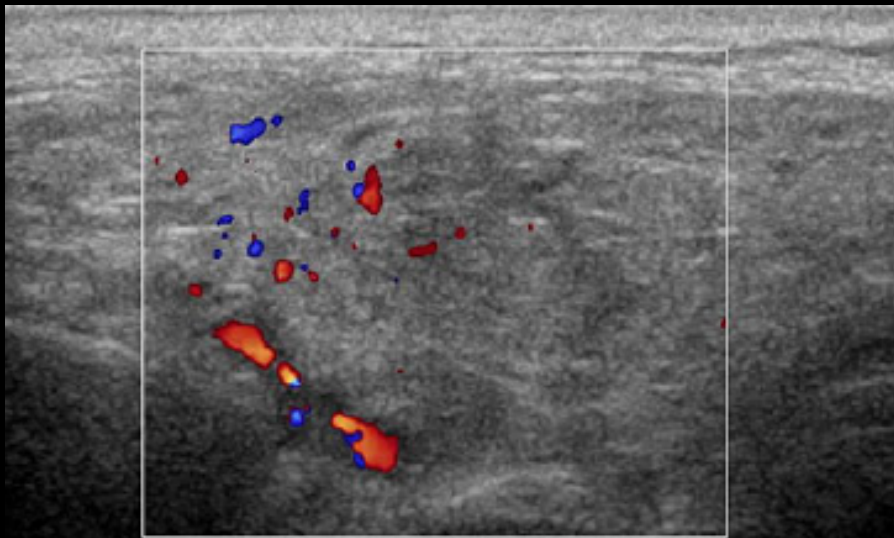
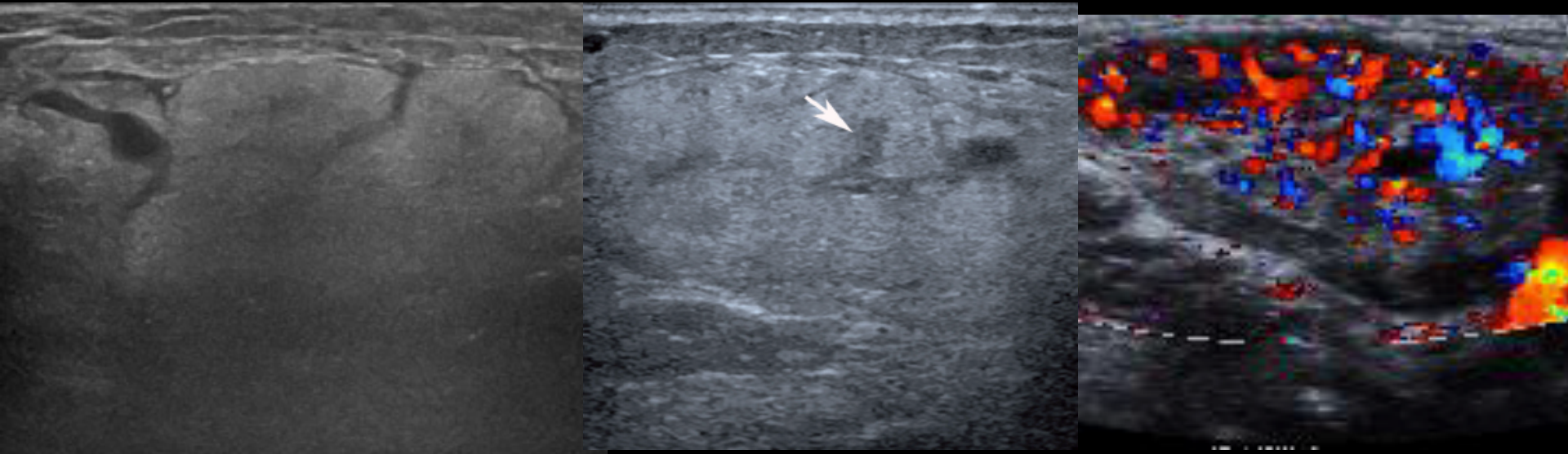


Figure 3. Transverse (a) and longitudinal (b) US images show the normal anatomy of the left parotid gland. The positions of the US probe are shown in the inset diagrams. 1 = retromandibular vein, 2 = external carotid artery, 3 = echo from the surface of the mandible, 4 = parotid gland, 5 = masseter muscle.

Sialadenitis

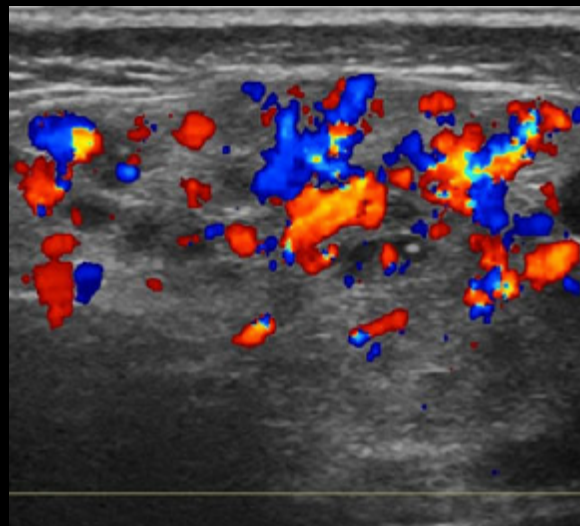
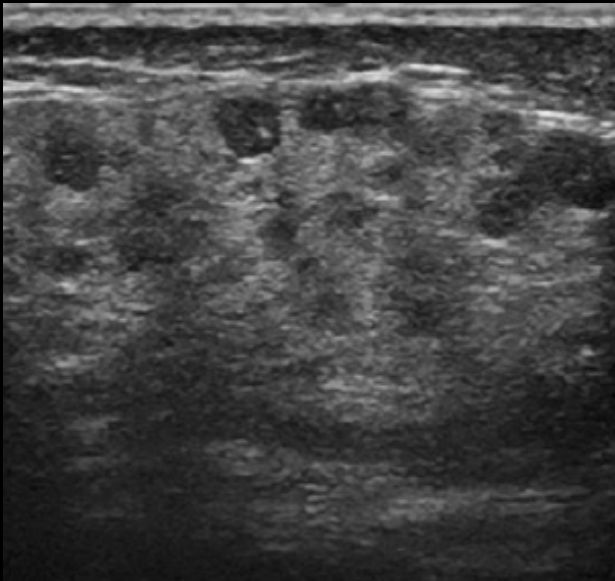
- Infection or Inflammation
 - most common salivary gland pathology
 - ACUTE: enlarged hypoechoic, edematous, hyperemic gland, PAIN
- Bacterial = Suppurative Sialadenitis
 - Assess for abscess
- Viral Sialadenitis, esp Kids
 - Usually bilateral
 - Eg. Mumps, Mononucleosis (EBV), Cat scratch disease in kids

ACUTE Sialadenitis/parotitis



Chronic Sialadenitis/Inflammation

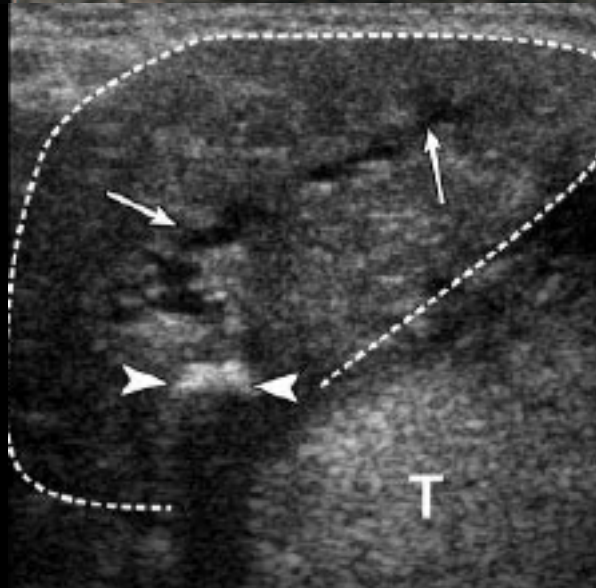
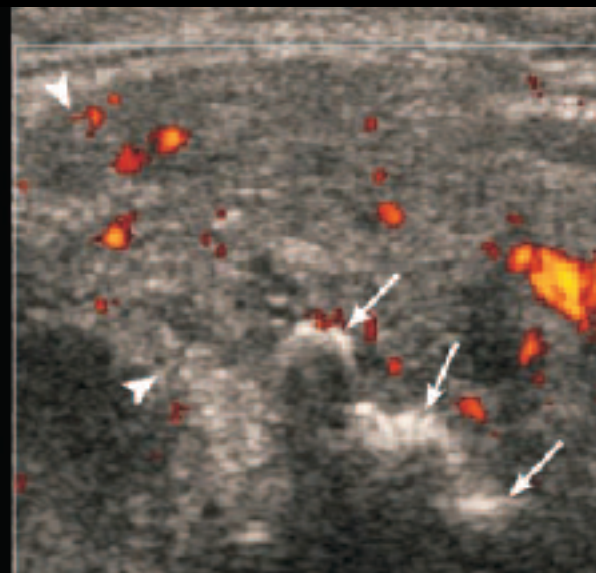
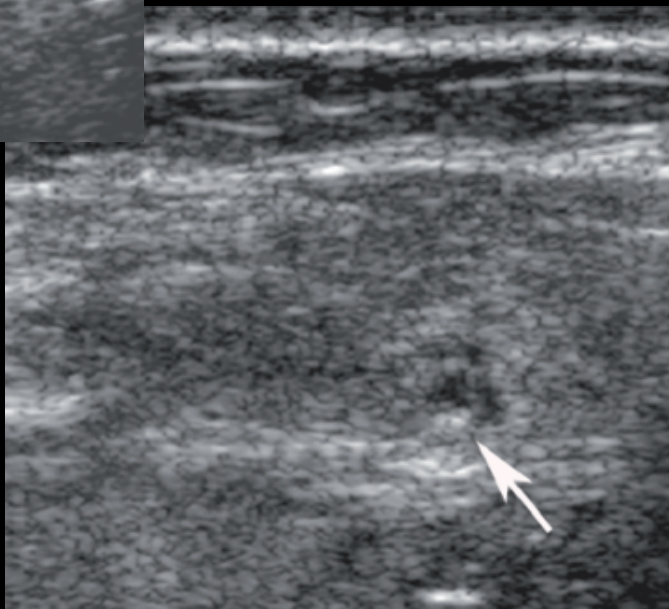
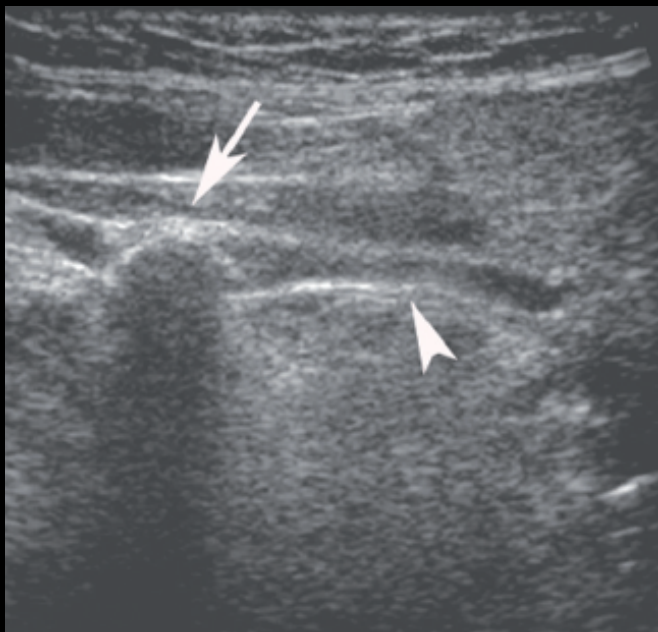
- Smaller gland (due to gland atrophy & fibrosis), often with hypoechoic nodules
- eg,. Sarcoidosis, Sjogren's disease



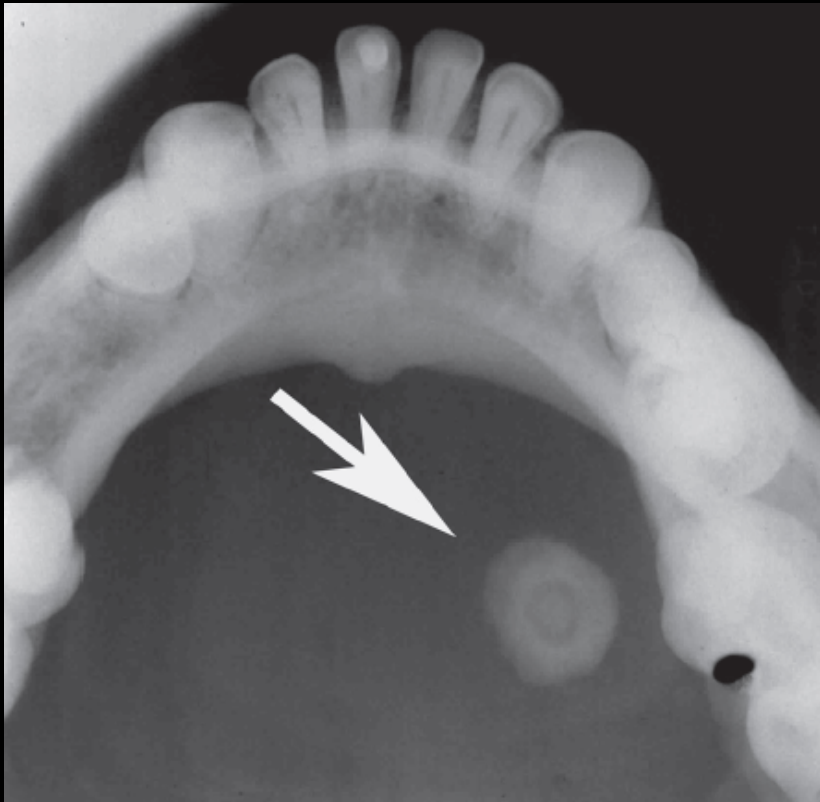
Sialolithiasis - Stones

- Stones
 - 80% will be in Submandibular gland
 - <20% in parotid gland
 - If <2mm stone, may not shadow
 - Look for dilated duct
 - Gland is usually edematous, hypoechoic, swollen
 - 80-90% can be seen on radiograph also

Sialolithiasis – Submandibular Stones

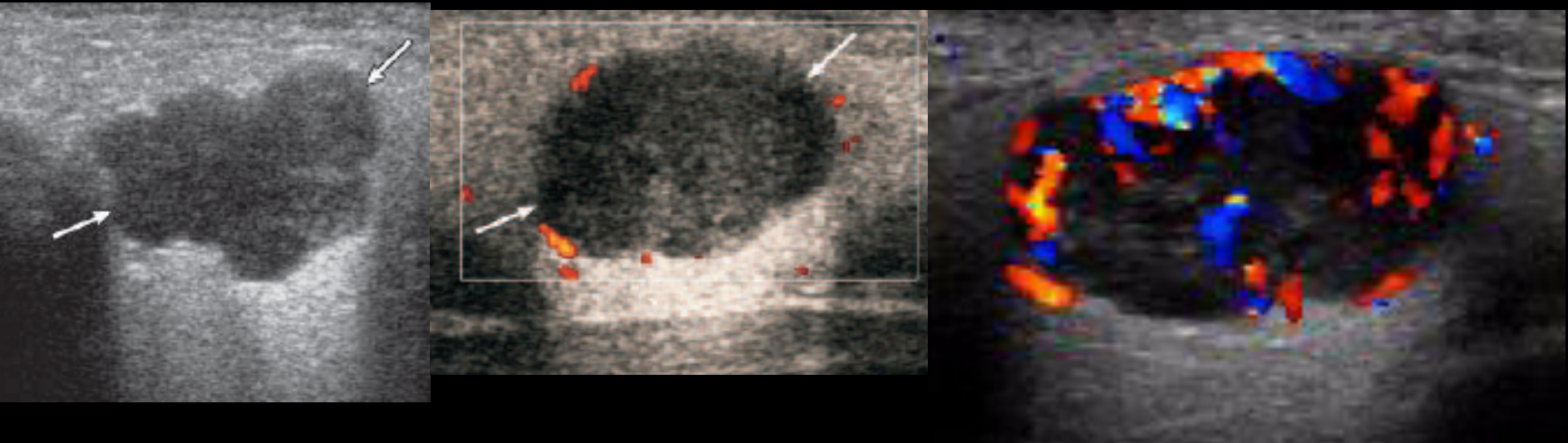


Sialolithiasis – Submandibular Stones



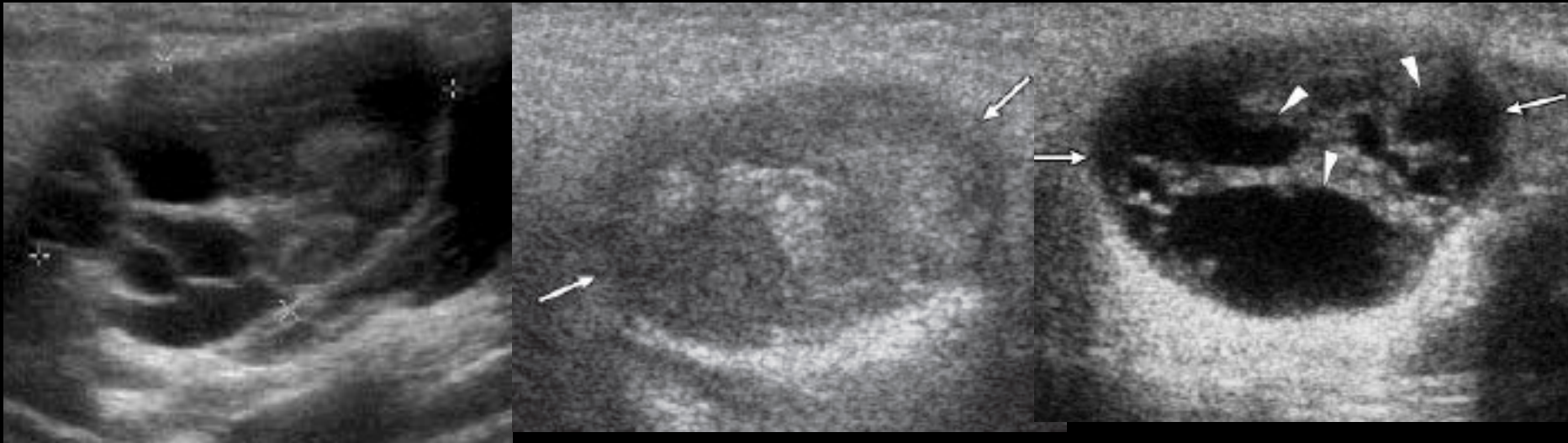
Salivary Gland Tumors

- Majority benign
- Majority (80%) in parotid
- **Pleomorphic adenoma** - Most common tumor
 - Benign, lobulated, homogenously hypoechoic



Salivary Gland Tumors

- Others: **Warthin tumor** (only in parotid gland, benign, often bilateral, with cystic or calcs)



Salivary Gland Tumors

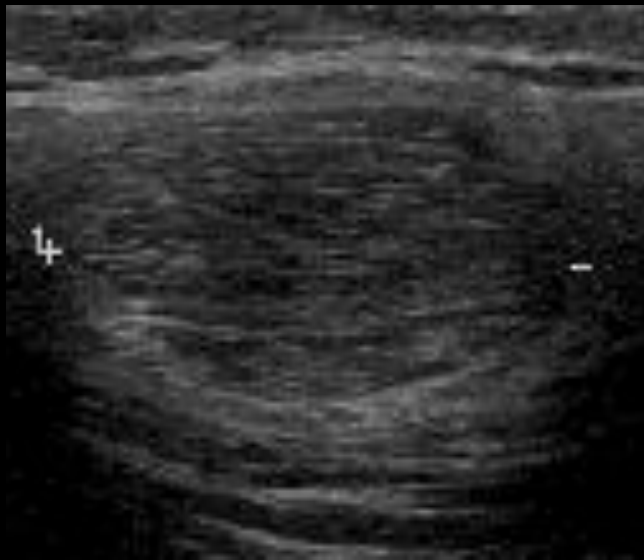
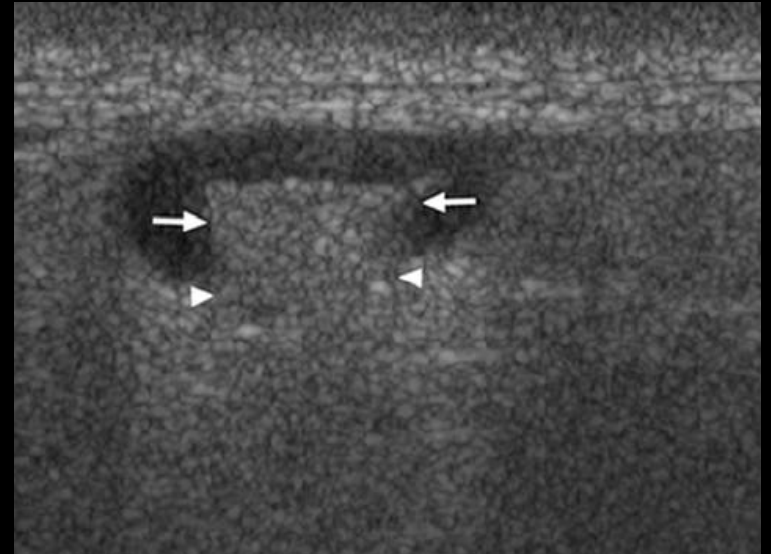
- **Malignant** incl mucoepidermoid or adenocystic ca-- irregular borders, large, hypervascular



- **TAKE HOME POINT:** cannot reliably differentiate between benign vs malignant salivary mass lesions on imaging. ALL require biopsy

Salivary Gland Miscellaneous

- Intra-gland LNs
 - Maintain fatty hilum
 - eg. in parotid or SM gland
- Intraparotid lipoma



Overview

- Cyst vs Solid?
- Lymph nodes – “reactive” vs cancer
- Neck Lymph Nodal stations
- Thyroid Cancer Nodule Ultrasound features
- Parathyroid adenomas
- Salivary Glands
 - Sialadenitis-Infection & Inflammation
 - Sialolithiasis – Salivary gland Stones
 - Salivary Gland tumors

Neck lump clinical work-up

- Generally:
 - In ADULTS >40yo, if a neck mass (whether solid or cystic) persists after 4-6 wks, recommend ENT referral + CT neck + FNA biopsy
 - Since many benign lesions (such as branchial cleft cyst, thyroglossal duct cyst, salivary gland benign tumors have malignant mimics such as necrotic thyroid or SCC LNs
 - If first time seeing the patient, could recommend a follow-up US in 4-6 wks

Summary

3 things to ask yourself for every neck US that you do, including History – “neck lump”:

1. Cyst vs Solid?

- ** Is it possible this ‘cyst’ could be a necrotic LN? **

2. Did I apply power doppler?

- *Vascularity? N= Hilar vs AbN= Cortical Hypervascularity?*
- *Helps decide if LN is concerning*

3. Did I scan whole neck: thyroid, lymph node groups and salivary glands?

- *Scan the WHOLE BILATERAL NECK for every pt*
- *Show thyroid nodule & LN characteristics well*

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