كلية الطب البشري
جامعة حماة
علم الأشعة Radiology

تصوير العنق
neck imaging

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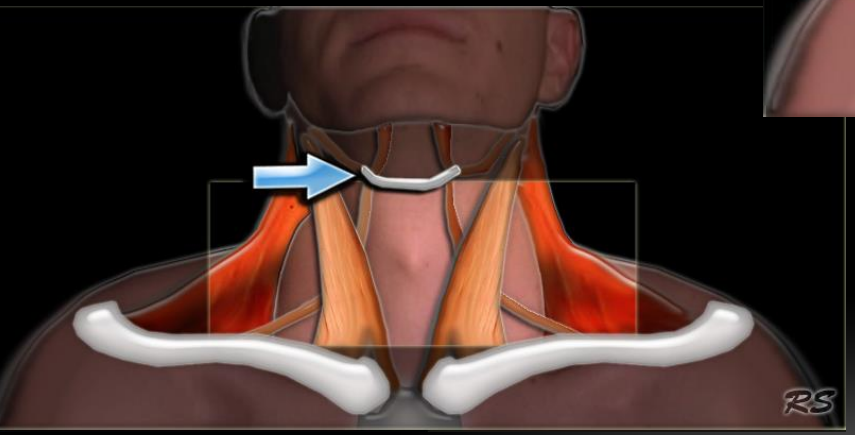
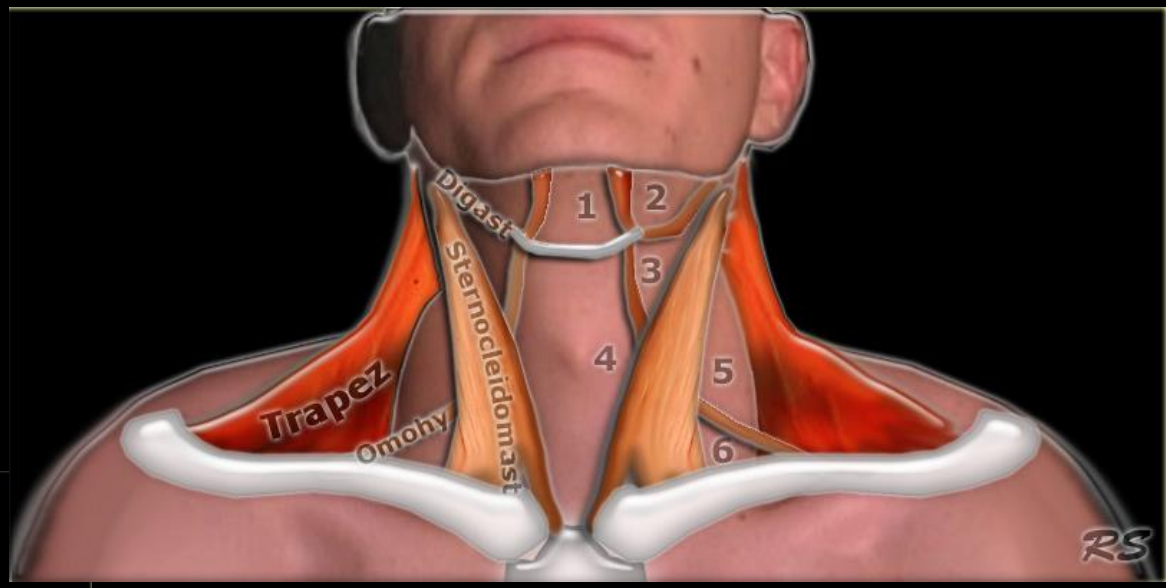
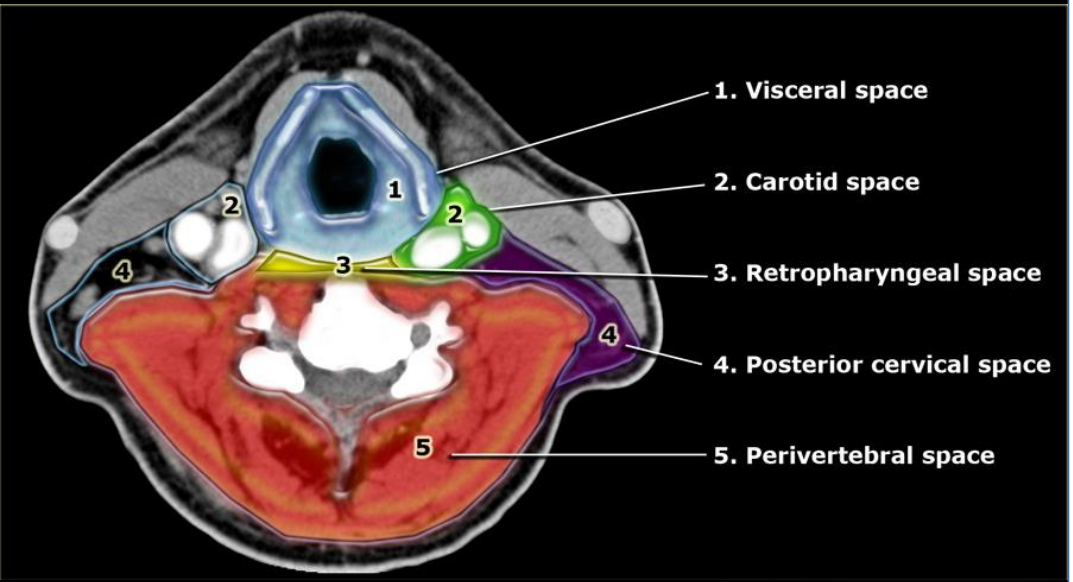
Infrahyoid neck
Normal anatomy and pathology





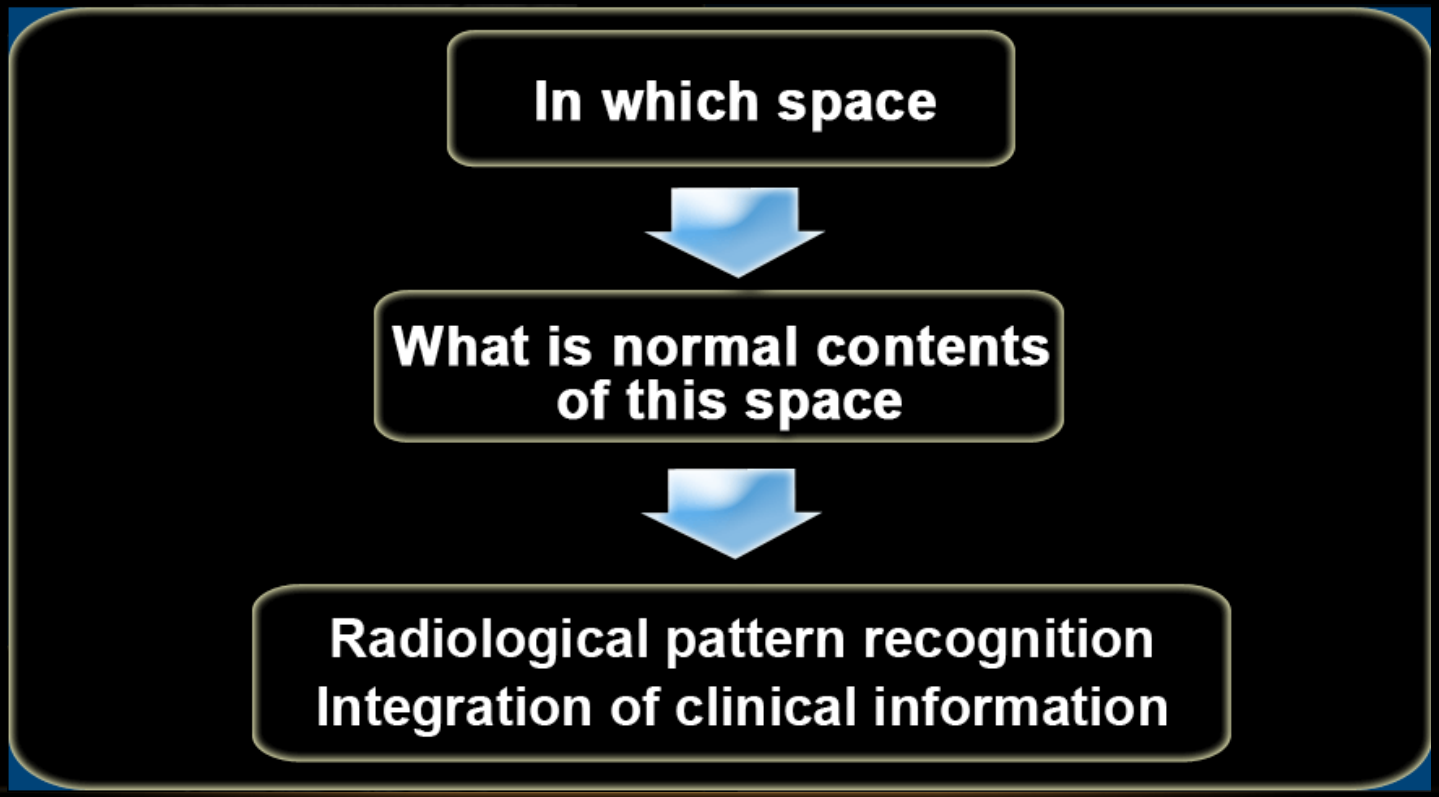


Spaces of the infrahyoid neck

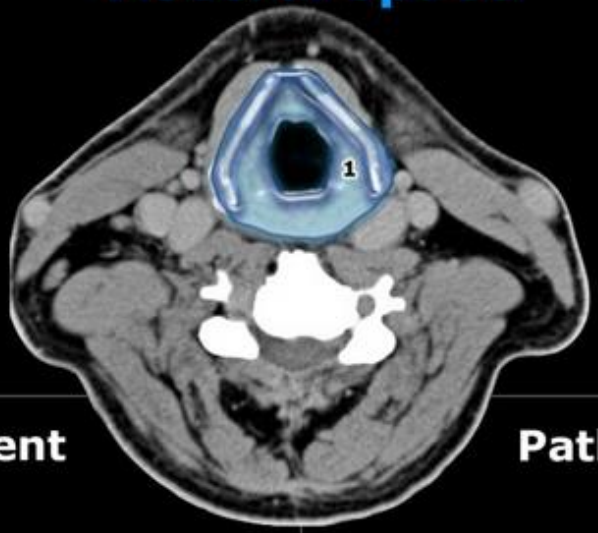
The infrahyoid neck is divided into 5 major anatomical compartments or spaces by the various layers of the cervical fascia (2).
These spaces are well recognized in the axial plane and therefore suited for analysis on axial CT or MR.

1. *Visceral space*
   Central compartment containing several viscera like the larynx, thyroid, hypopharynx and cervical esophagus.
2. *Carotid space*
   Paired space just lateral to the visceral compartment which contains the internal carotid artery, internal jugular vein and several neural structures.
3. *Retropharyngeal space*
   A small virtual space containing only fat continuous with the suprahyoid space and the middle mediastinum.
4. *Posterior Cervical Space*
   Paired space posterolateral to the carotid space. It contains fat, lymph nodes and neural elements.
5. *Perivertebral space*
   This large space completely encircles the vertebral body including the pre- and paravertebral muscles.

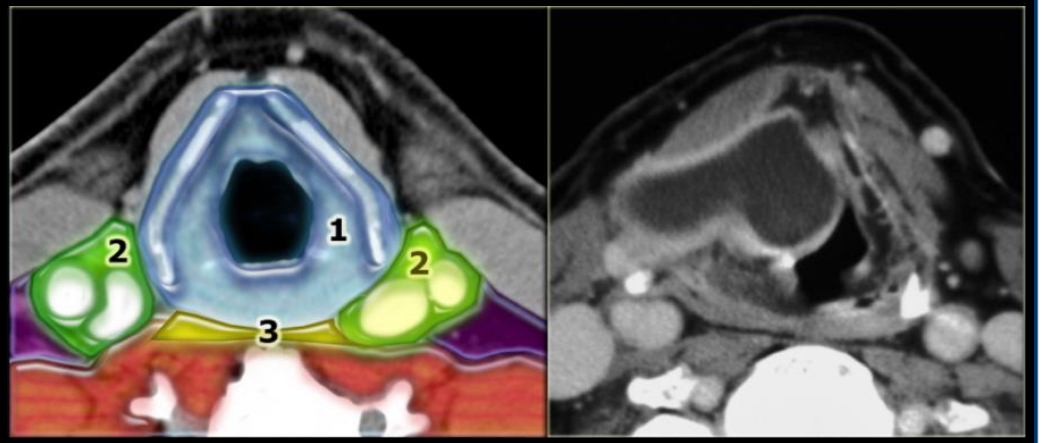
Systematic approach



Visceral space



Content	Pathology
Larynx	Laryngocele - Squamous cell ca Chondrosarcoma
Hypopharynx / Esophagus	Zenker's diverticulum Squamous cell ca
Trachea	Carcinoma Benign stenosis
Thyroid gland	Goiter, Colloid cyst, Carcinoma: papillary, follicular, anaplastic Hashimoto's thyroiditis
Parathyroid	Adenoma - Hyperplasia
Embryological remnants	Thyroglossal duct 3rd branchial cyst
Paratracheal lymphnodes	Metastases - Lymphoma
Recurrent nerve	Paralysis



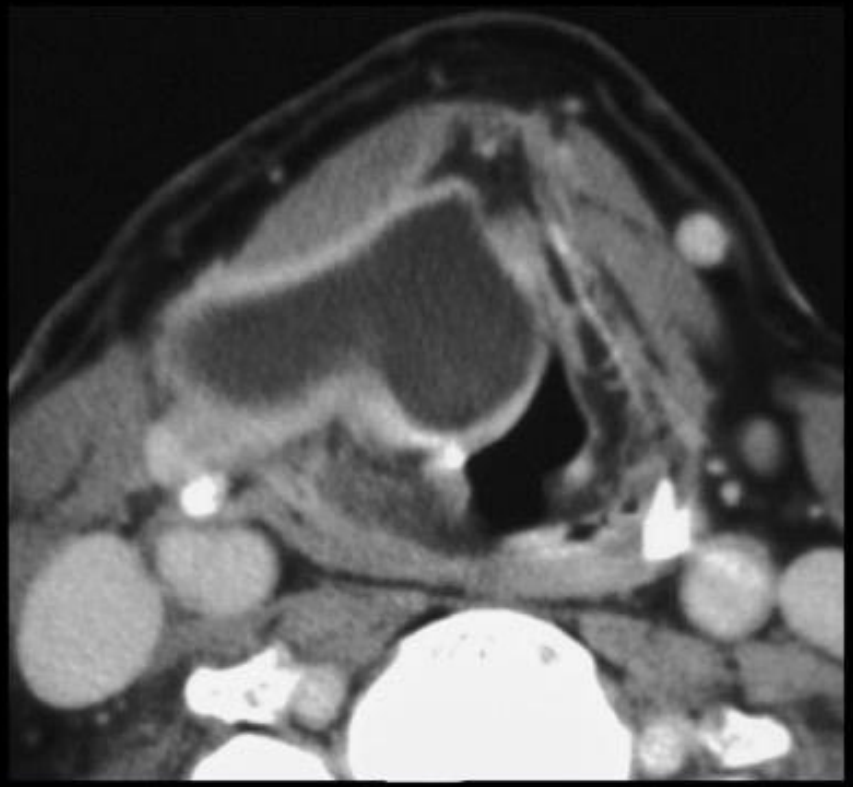
Laryngocele

Step 1: which space
On the left a patient with a swelling on the right side of the neck.
Study the image and decide in which space the lesion is located.
Then continue reading.

The swelling is centered within the borders of the thyroid cartilage.
Therefore this must be pathology arising in the visceral space.

قيلة حنجرية

Diff Diagnosis of lesion in supraglottic larynx



Mucosal lesion

Squamous cell carcinoma

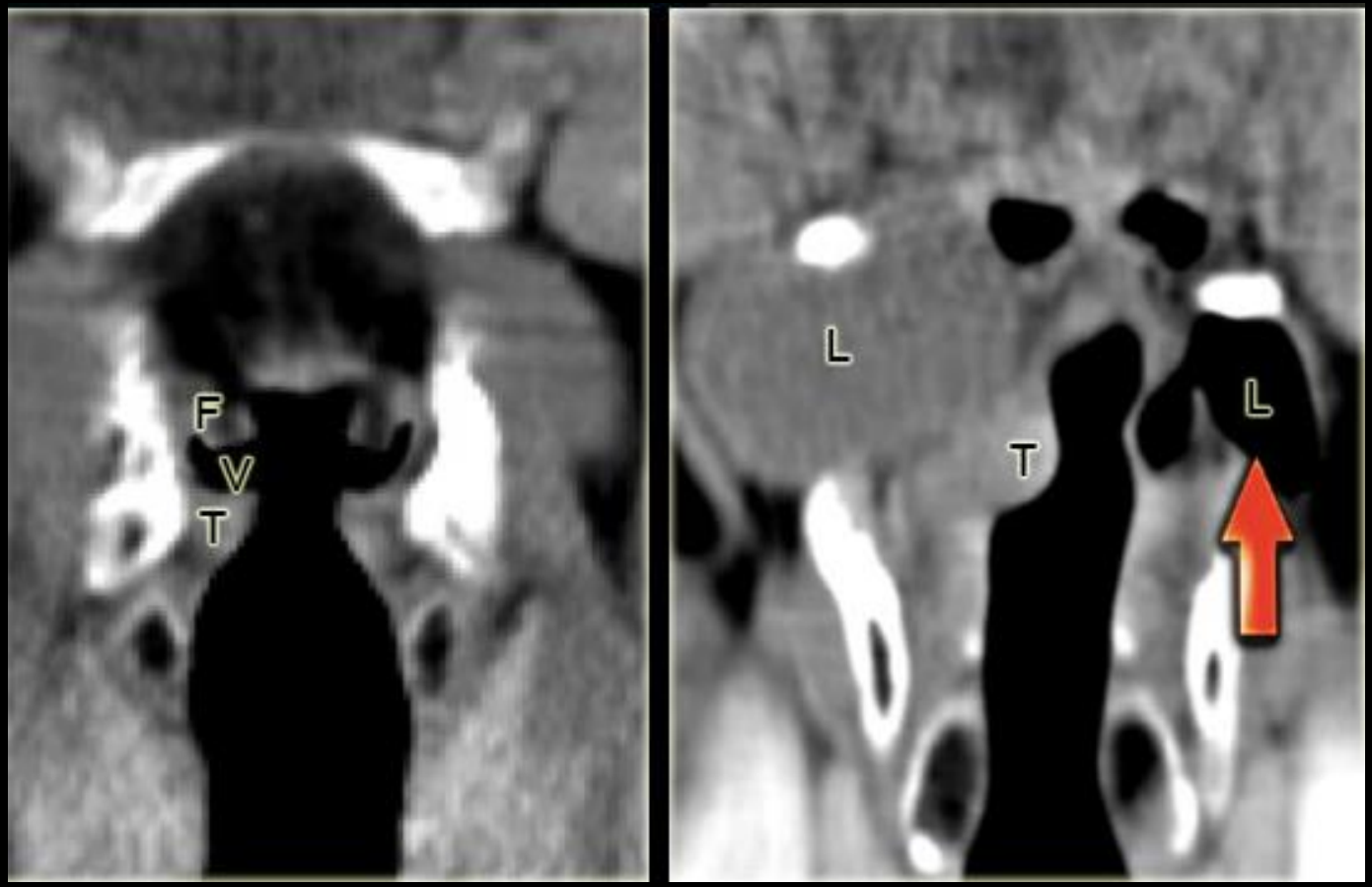
Submucosal lesion

Laryngocele

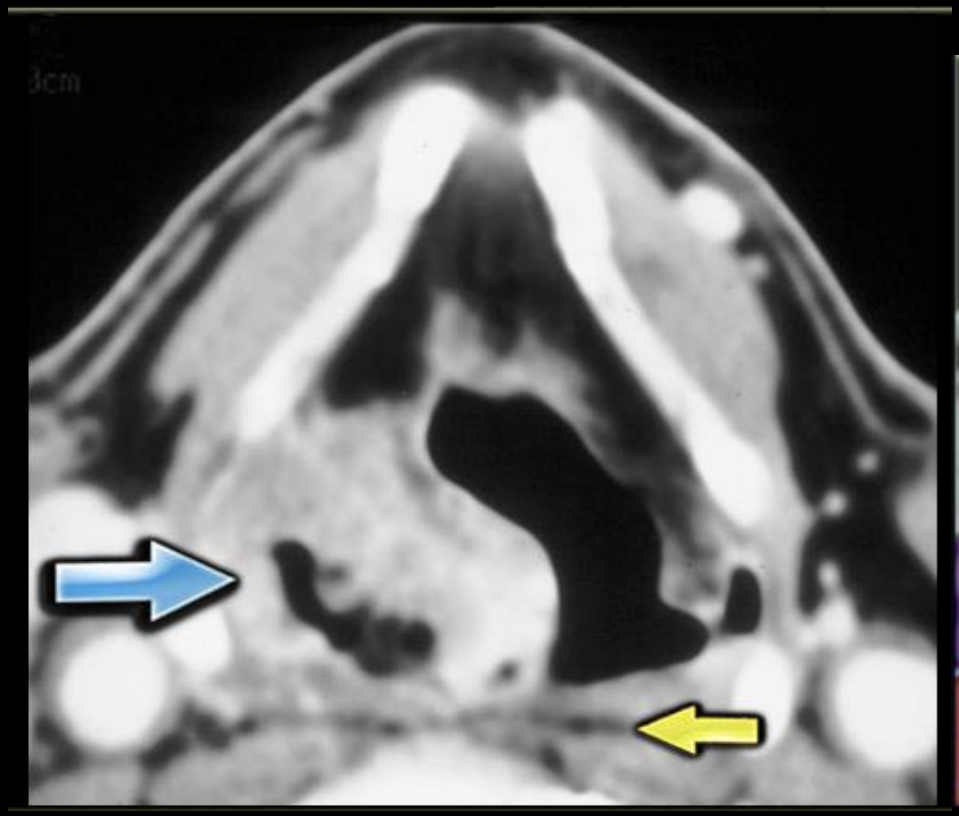
Chondrosarcoma

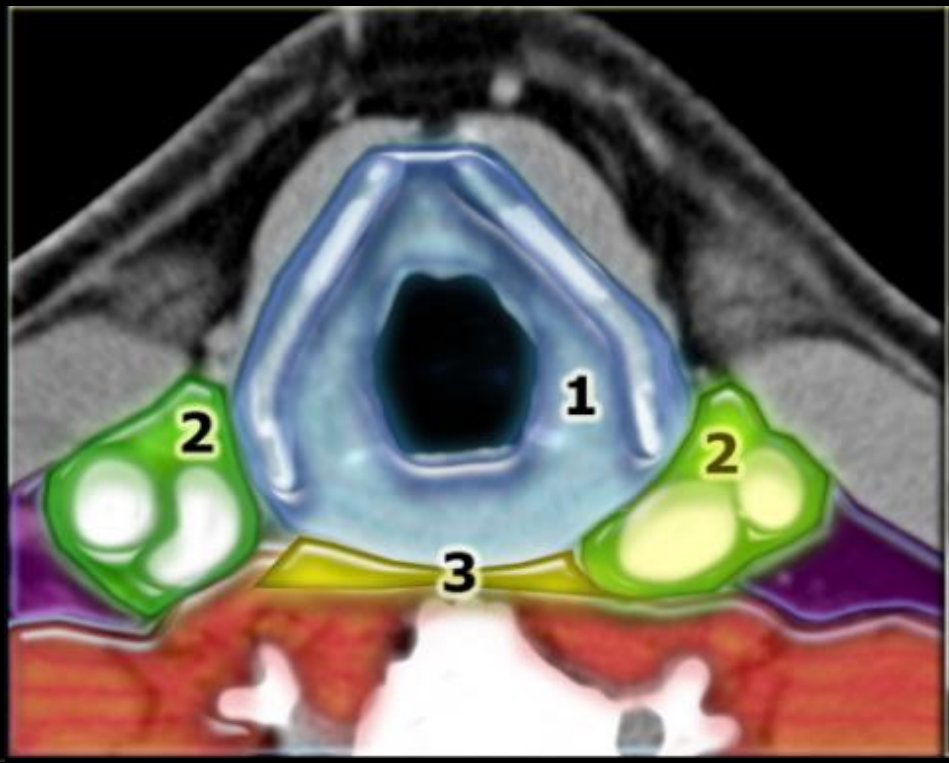
Paraganglioma

Schwannoma



LEFT: Coronal CT image through the larynx with normal anatomy: false cords (F), true cords (T) and ventricle in between (V)
RIGHT:Fluid-filled secondary internal and external laryngocele due to a small enhancing tumor in the laryngeal ventricle (T) obstructing the laryngeal ventricle. On the left side, an air-filled primary internal and external laryngocele.

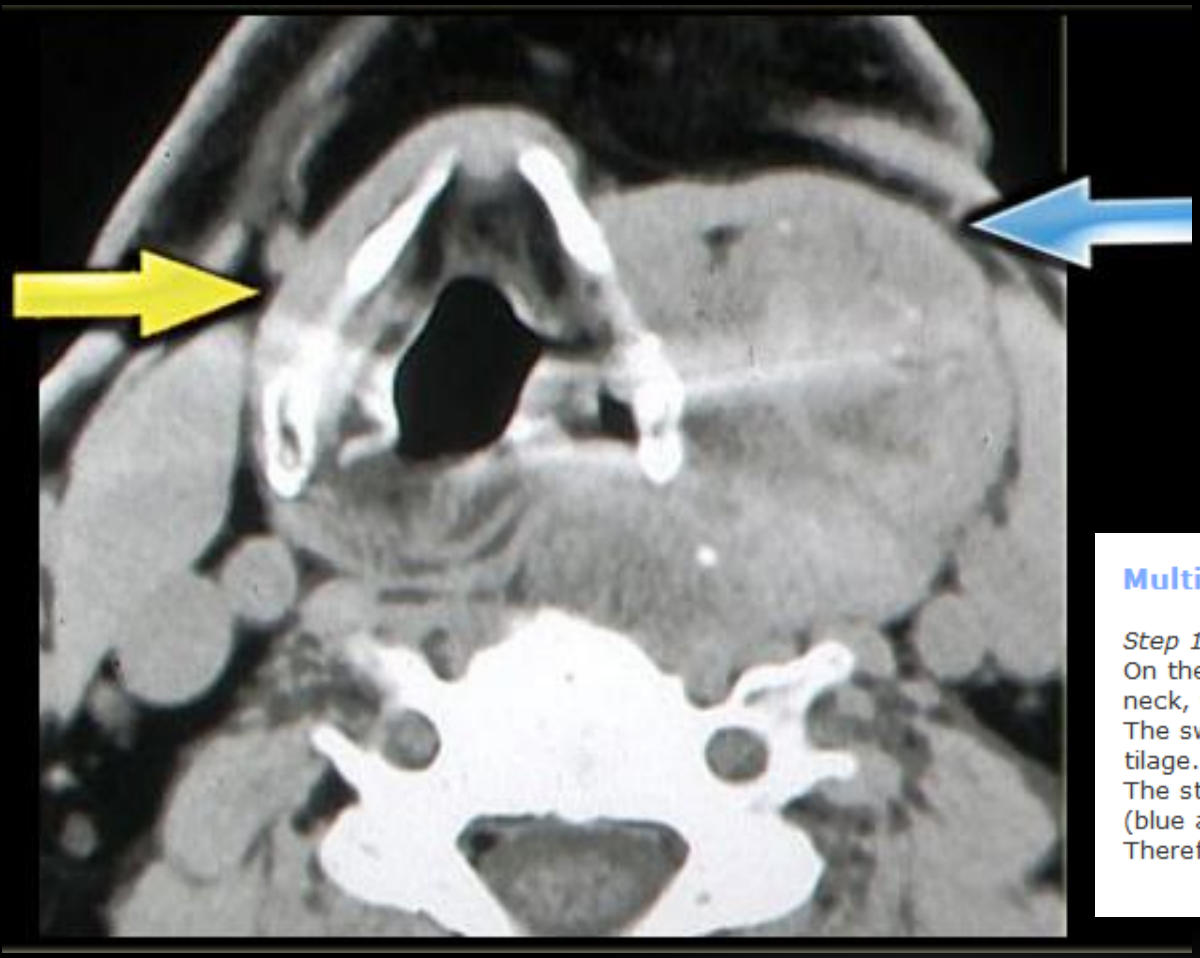




Squamous cell carcinoma

On the left, a CT-image at the level of the thyroid cartilage.
There is an irregular mass centered in the right piriform sinus.
This mass is in the visceral space.
In this region the most common tumor is a squamous cell carcinoma.
This was proven at biopsy.

Notice the retropharyngeal space (yellow arrow).
This is a virtual space containing only some fat.

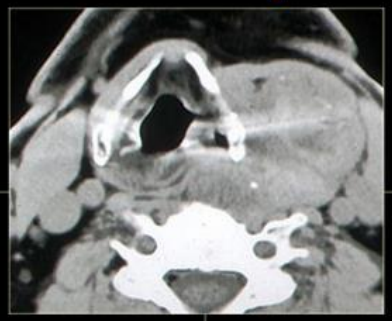


Multinodular goiter

Step 1: Which space
On the left a patient with a swelling on the left side of the neck, which has existed for years.
The swelling is adjacent to the left lamina of the thyroid cartilage.
The strap musculature seems to be draped over the lesion (blue arrow).
Therefore this lesion lies within the visceral space.

Multinodular goiter Strap muscles on right side (yellow arrow) and presumed position of strap muscles on the left (blue arrow)

Visceral space



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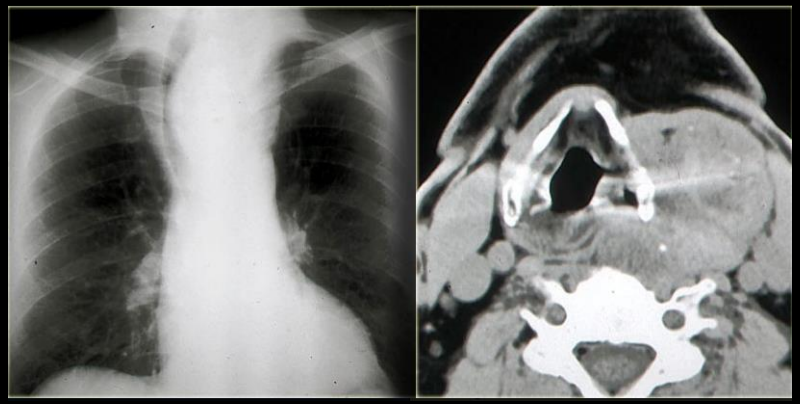
Embryological remnants	Thyroglossal duct 3rd brachial cyst
Paratracheal lymphnodes	Metastases - Lymphoma
Recurrent nerve	Paralysis

Step 2: Normal contents
Analysis of the normal anatomical contents of the visceral space rules out many possible tissues and organs from which this pathology may arise:

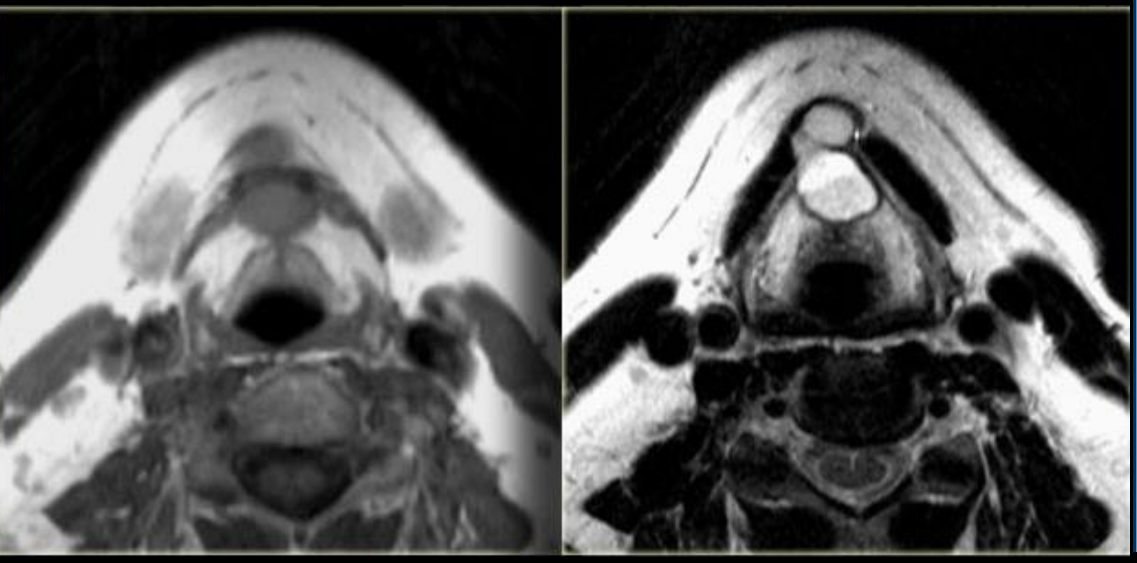
- Larynx and hypopharynx
  This mass is located outside of the larynx and hypopharynx.
  The hypopharynx is slightly displaced due to the retropharyngeal extension of the mass and the lesion lies cranial to the trachea.
- Embryological remnants
  Remnants like thyroglossal duct cyst can be considered but these lesions are usually cystic.
- Paratracheal lymph nodes
  These are located outside of the strap musculature.
- Recurrent laryngeal nerve
  This nerve is located within the tracheo-esophageal groove.

By exclusion we can say that this mass arises either from the thyroid gland or the parathyroid glands.



Step 3: Pattern recognition and clinical information
On the chest film we notice a displacement of the trachea to the right by an upper mediastinal mass.
So the mass is located within the visceral space and extends into the anterior mediastinum, since the trachea is located within the anterior mediastinum.
It is well-defined towards the surrounding fat and there are a few scattered coarse calcifications.
When we combine these findings, we recognize the radiological pattern of a benign multinodular goiter.
This diagnosis is compatible with the clinical information that the swelling in the neck has been present for years.

Multinodular goiter with intrathoracic extention

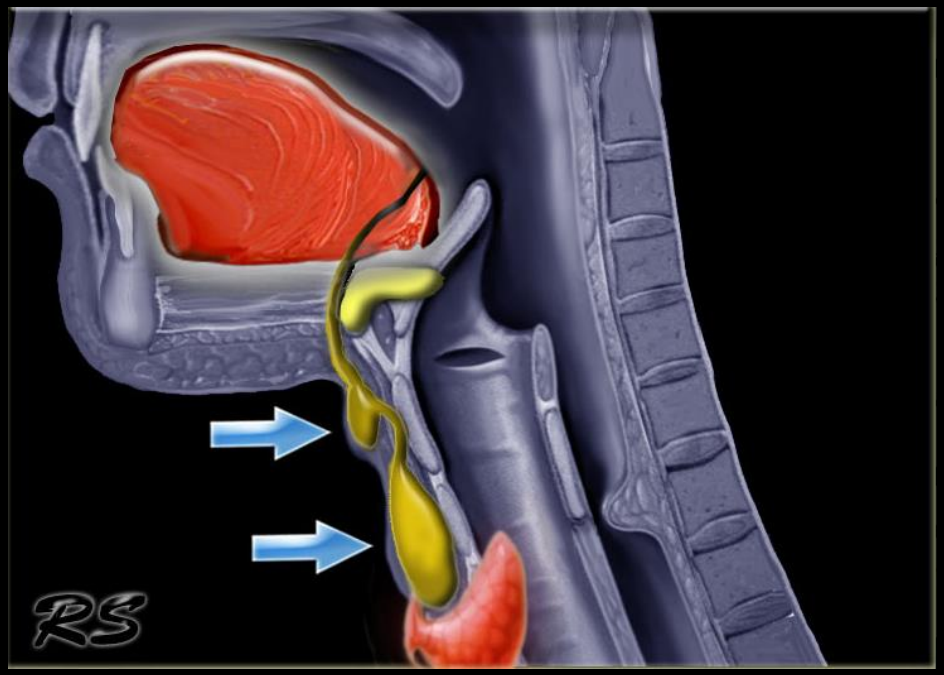


Thyroglossal duct cyst

On the left axial T1- and T2-weighted images at the level of the hyoid bone.
There was no enhancement on the post Gadolinium study (not shown)
It is a midline cystic lesion, party external and partly internal to the hyoid bone and located in the visceral space.
The lesion is embedded in the strap musculature.

It is unlikely that this lesion arises from the trachea, thyroid gland, parathyroid glands or recurrent laryngeal nerve, since these structures are located more caudally.
Lymph nodes are usually seen in the subcutaneous fat around the larynx.
By exclusion a thyroglossal duct cyst is the most likely diagnosis.

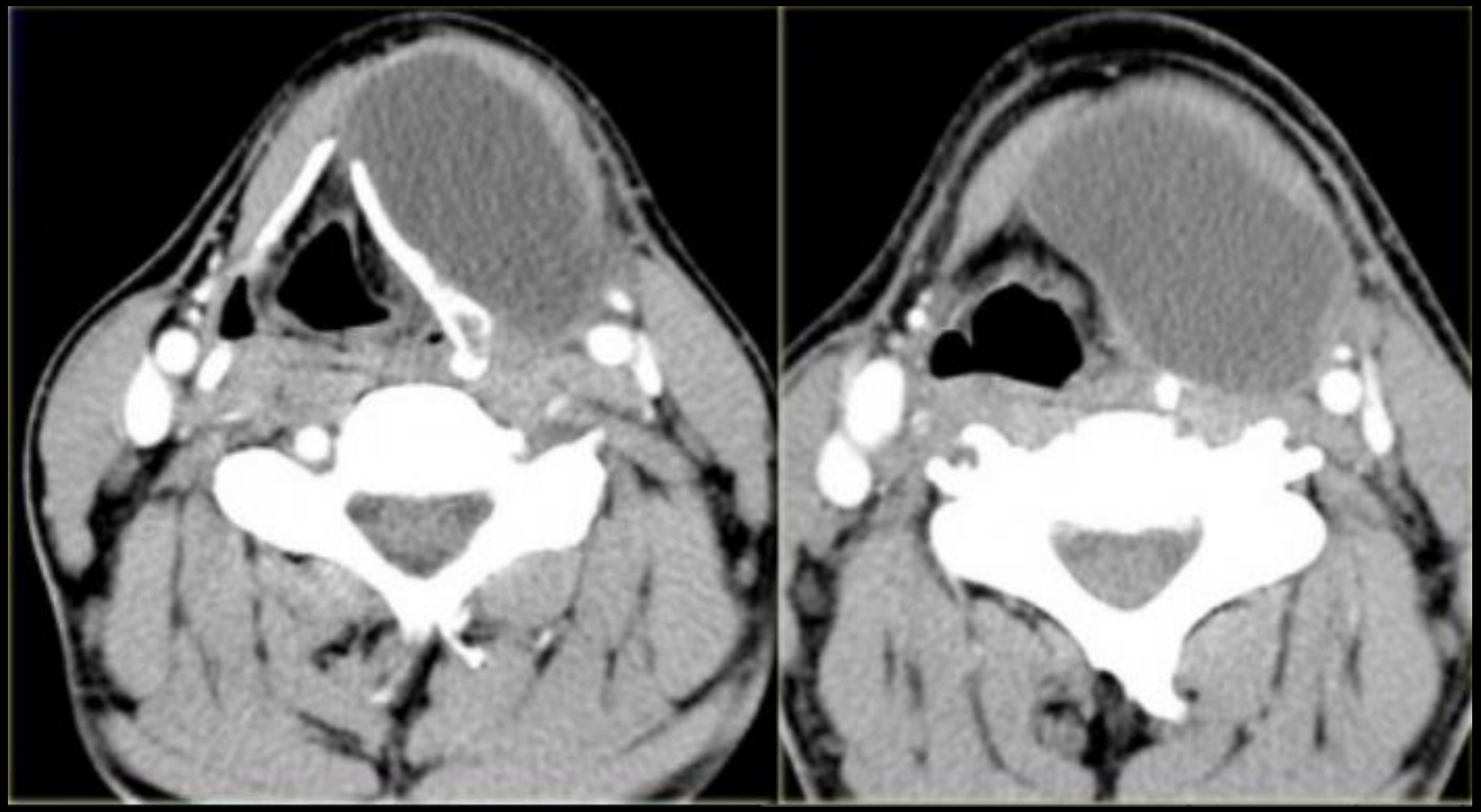
Thyroglossal duct cyst: axial T1- and T2-weighted images at the level of the hyoid bone



Thyroglossal duct cyst (2)

Key facts

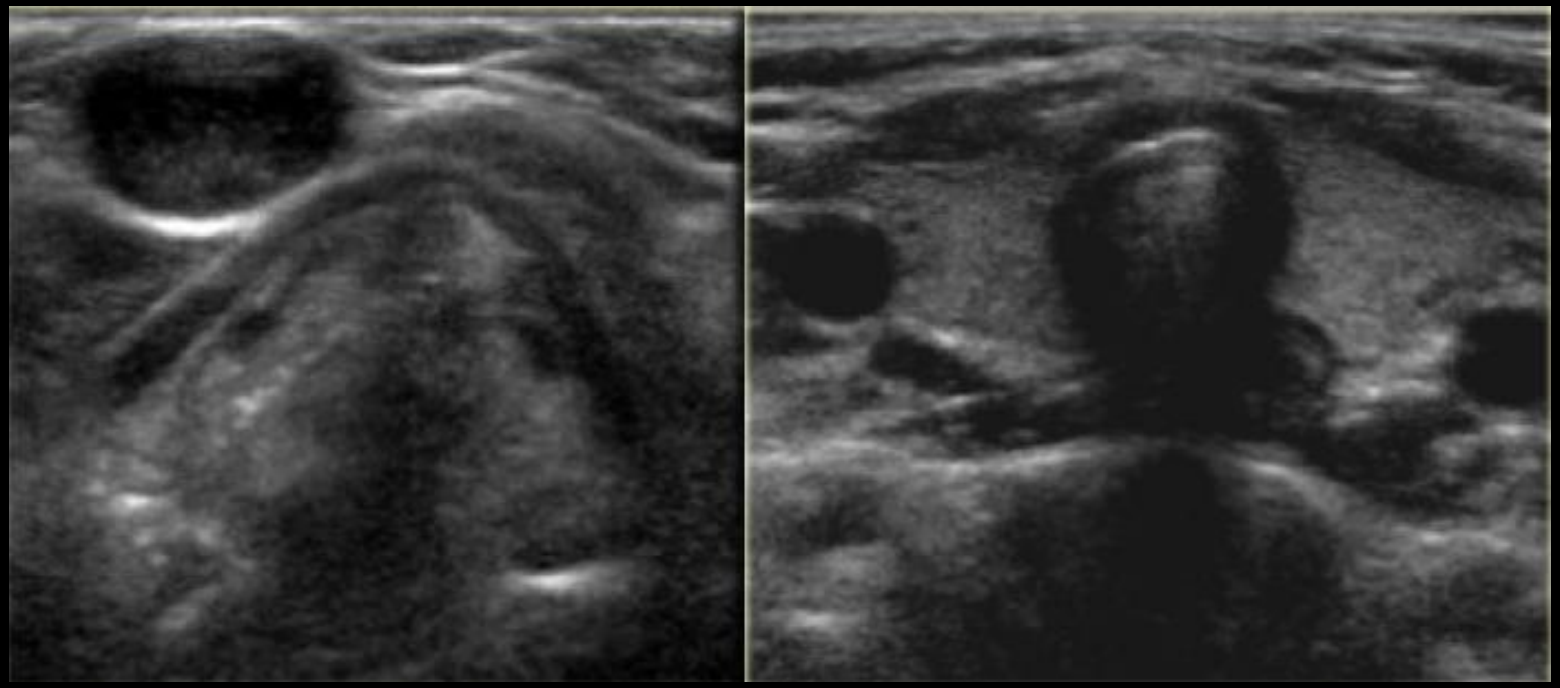
- The thyroglossal duct runs from the base of tongue at the foramen caecum to the thyroid gland.
- The embryonic thyroid gland or thyroid anlage travels through the duct to reach its final normal position. Normally, the thyroglossal duct then involutes, but when the duct persists, a thyroglossal duct cyst can develop anywhere along this tract (figure).
- The location is in the midline or paramedian.
- 65% are located infrahyoidal, 20% suprahyoidal and 15% at the level of the hyoid.
- Ddx: necrotic anterior cervical nodes and thrombosed jugular vein.



Paramedian thyroglossal duct cyst

On the left an example of a paramedian thyroglossal duct cyst.
This lesion not in the midline, but the key finding is that this lesion is cystic and embedded in the strap musculature.

Paramedian thyroglossal duct cyst



On the left images of a three-year old girl with a slowly enlarging tumor in the midline.
On ultrasound a hypoechoic ovoid smooth bordered lesion is seen at the level of the hyoid bone and slightly right off midline (left image).
During US examination, the lesion moves simultaneously with extrusion of the tongue.
Cystic nature and close relation to the hyoid bone makes thyroglossal duct cyst the most likely diagnosis.
Notice that a normal thyroid gland is present (right image).

On the left, a child with a lingual thyroid.
This is the only functioning thyroid tissue that this child has.
It would be a disaster if such a 'lesion' were to be excised.

Lingual thyroid (courtesy: Tony Hasso)

Carotid space

Content	Pathology
Carotid artery	Aneurysm -Thrombosis Dissection
Internal jugular vein	Thrombosis - Thrombophlebitis
Vagus nerve (X)	Schwannoma - Neurofibroma
Sympathetic plexus	Paraganglioma
Lymph nodes (Level 2-4)	Lymphoma Metastases of squamous cell ca or thyroid ca
Congenital remnants of second branchial cleft	Second branchial cleft cyst

Differential diagnosis fo nerve tumors

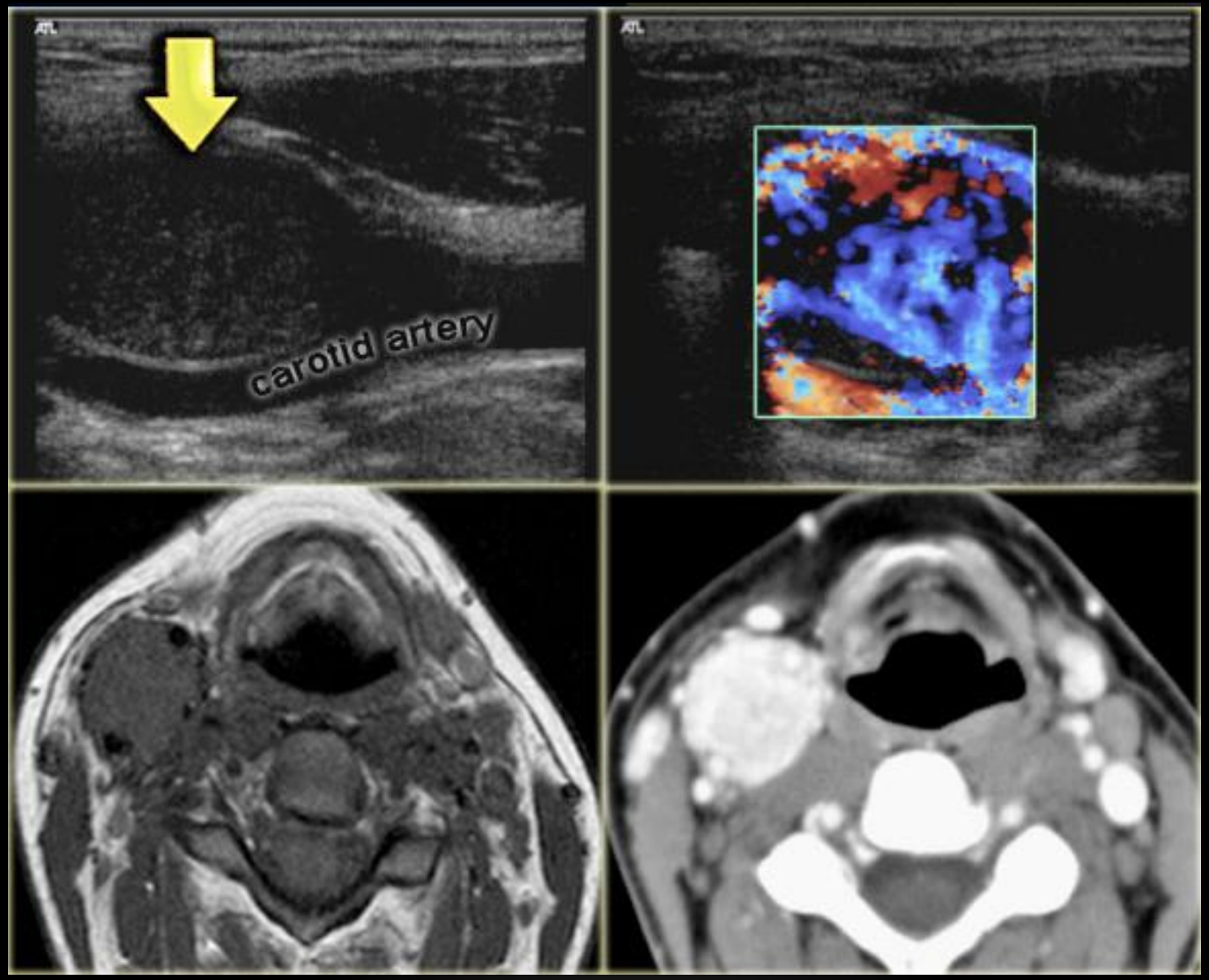
Vagus nerve

Schwannoma

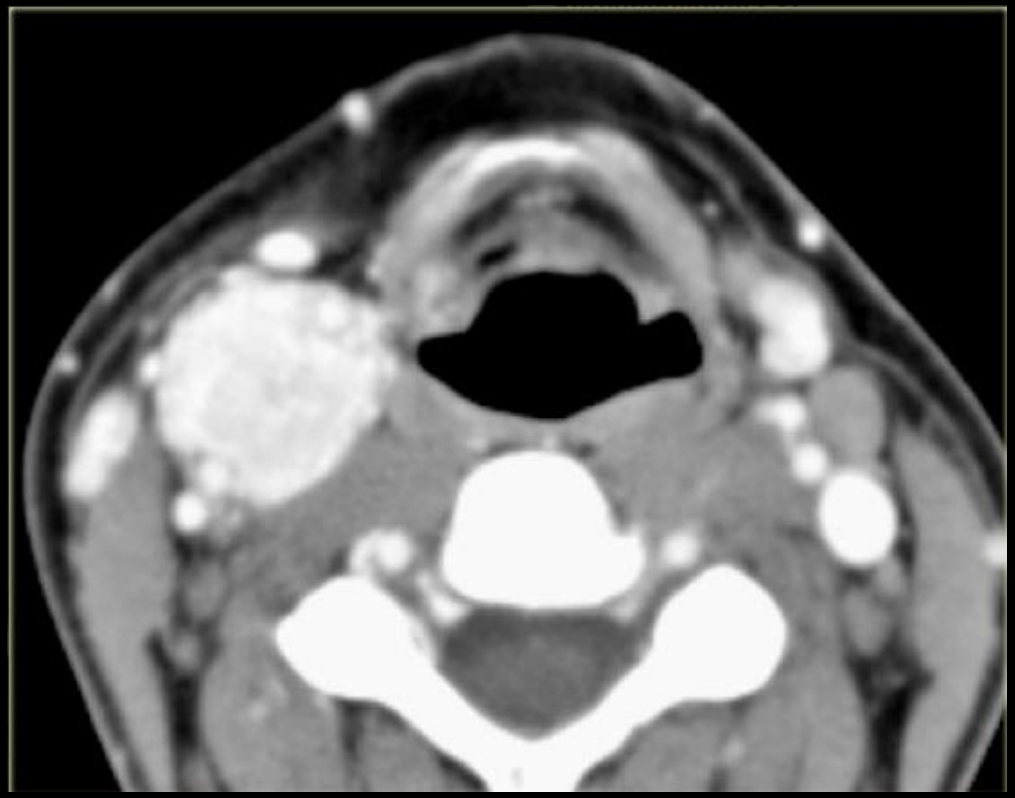
Neurofibroma

Sympathetic plexus

Paraganglioma
or Carotid body tumor



Paraganglioma: Ultrasound with color doppler, T1-weighted non-contrast MR and CECT



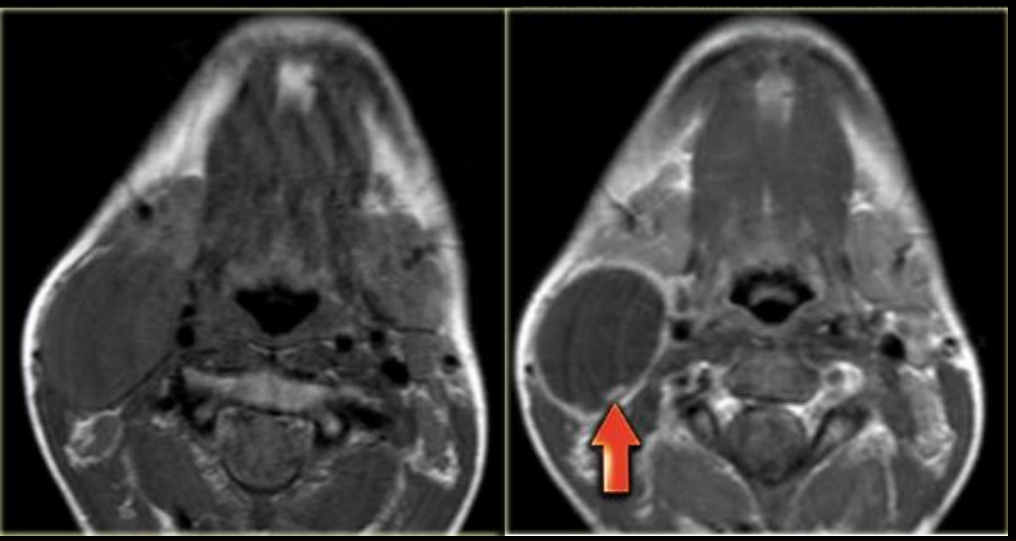
Paraganglioma (3)

Key facts

- Also called carotid body tumor.
- Multiple in 4% of patients.
- 25% have a positive family history.
- Intense enhancement on CT and MR.
- Flow voids are frequently present.

Schwannoma: axial T2-weighted image and angiogram

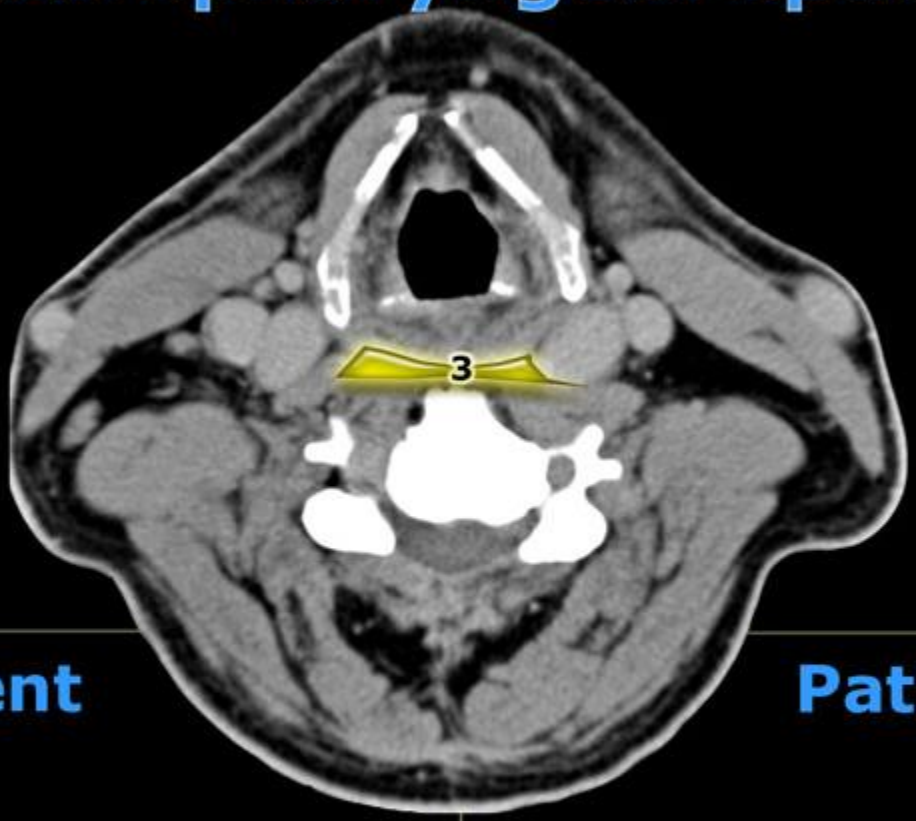
Thrombosis of jugular vein



Second branchial cleft cyst

Second branchial cleft cyst: high signal intensity on STIR

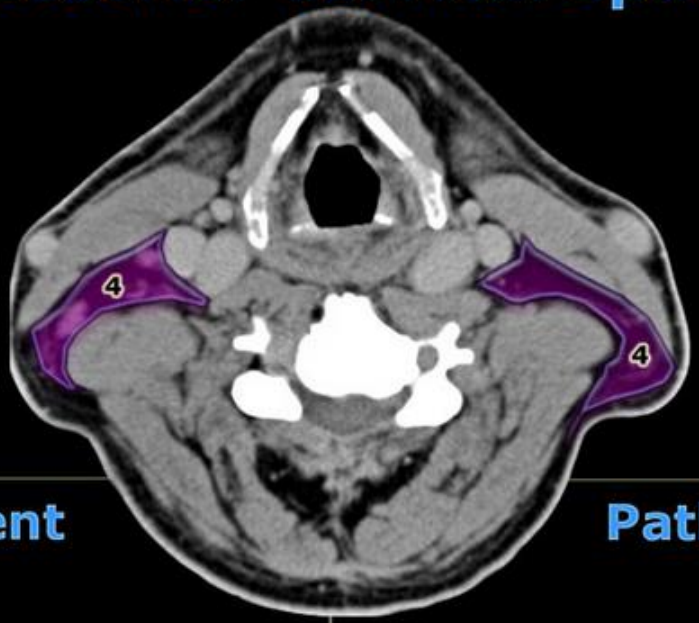
Retropharyngeal space



Content	Pathology
Fat	Lipoma-liposarcoma

Channel for infection and tumor to travel to mediastinum

Posterior cervical space



Content	Pathology
Fat	Lipoma - liposarcoma
Accessory nerve XI	Schwannoma - Neurofibroma - MPNST
Brachial plexus	Schwannoma - Neurofibroma Direct invasion of apical lungca - breastca - lymphoma
Lymp nodes	Lymphoma - metastases - TB
Primitive embryonic lymph sacs	Cystic hygroma - Lymphangioma
Remnants 3rd branchial	3rd branchial cleft cyst

Lymphoma

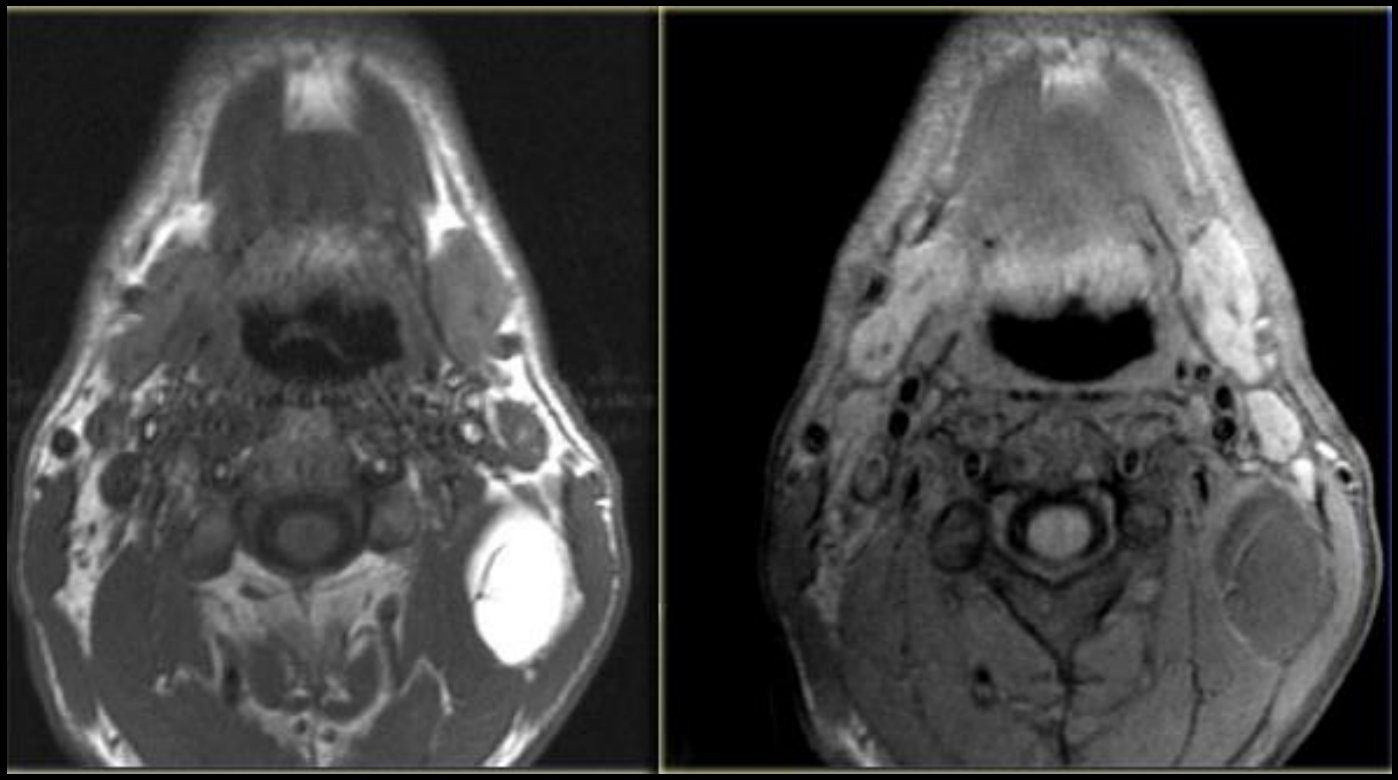
Lymphoma (2)
On the left images of a 67-year old woman who had a history of Non-Hodgkin lymphoma.
She had recently noticed a swelling on the left side of the neck.

Step 1
CT image at the level of the true vocal cords shows a mass, which is clearly located in the posterior cervical space.

Step 2
The mass is well-defined and isodense to muscle.
Coronal reformation shows the mass to be elongated and extending towards the axilla following rhe course of the cervico-brachial plexus..
Continue with the MR images.

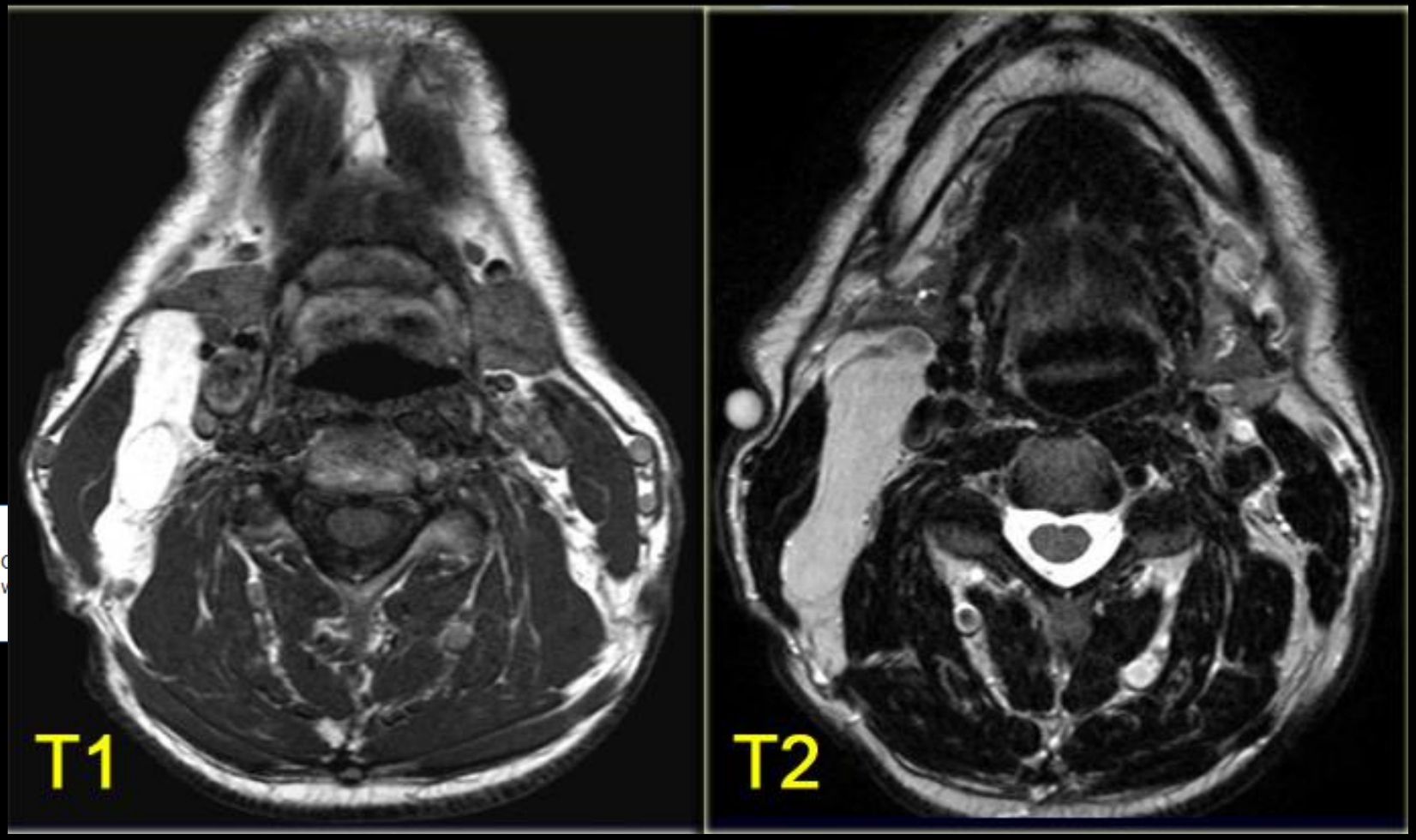
The lesion originates at the left neural foramina and grows along the course of the brachial plexus (red arrow).
In fact, we are looking at a grossly thickened plexus.

Step 3
The radiological pattern confirms the neurogenic origin of the mass.
Combined with the history the final diagnosis is diffuse infiltration of the left brachial plexus by recurrent NHL.



Lipoma

On the left images of a patient with a swelling posteriorly on the left side of the neck.
MR image at the level of the hyoid bone.
The lesion is located in the posterior cervical space.
Analysis of the normal anatomical components of the posterior cervical space can be short in this case.
The mass has the signal intensity of fat on a T1-weighted image and the signal is completely suppressed with fat suppression.
There was no enhancement (not shown), so we can conclude that this is a lipoma.

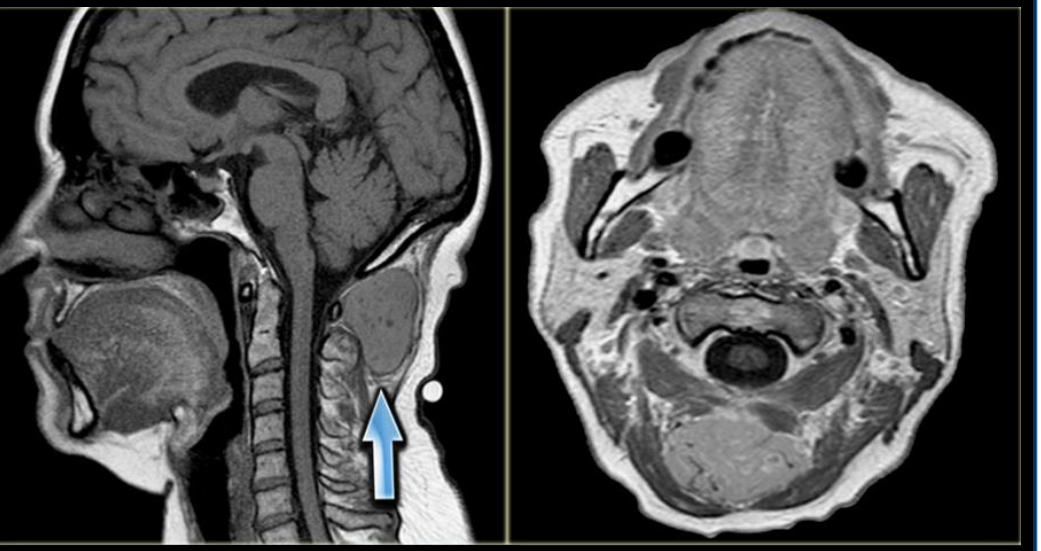


Lipoma in the right posterior cervical space

Perivertebral space

Content	Pathology
Vertebra	Osteomyelitis Prim bone tumor - metastasis
Muscles	Myositis - Abscess - Sarcoma Fibromatosis
Brachial plexus	Schwannoma - neurofibroma MPNST Malignant Peripheral Nerve Sheath Tumo
Vertebral artery and vein	Aneurysm Dissection - Thrombosis

Sarcoma



Benign fibrous tumor

On the left a 75-year old male with a slowly enlarging midline mass.

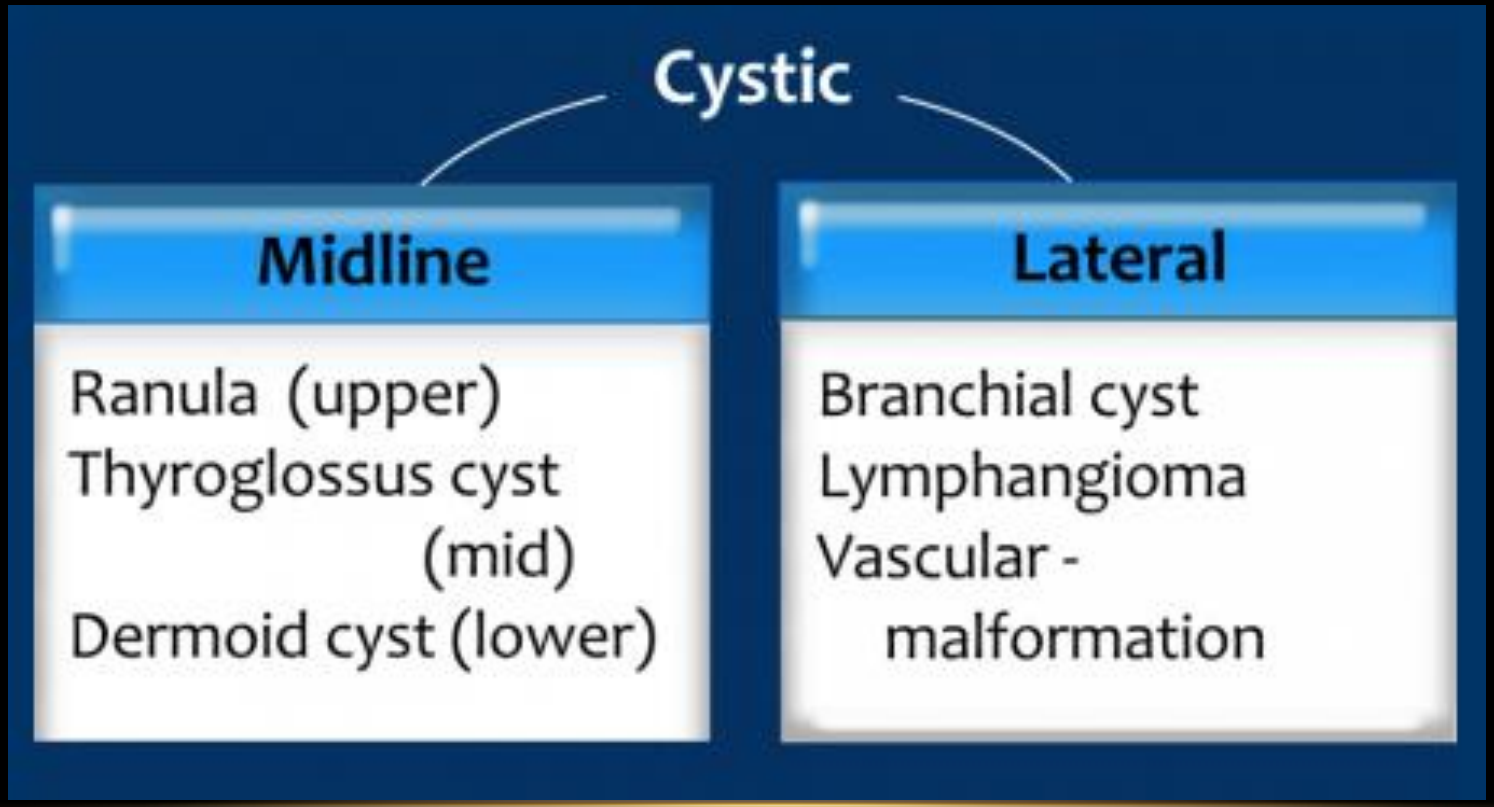
Step 1
The lesion is located in the perivertebral space.

Step 2
The vertebral body and vertebral vessels are not involved.
Lesions coming from the cervico-brachial plexus are expected to be found in more paraspinal locations.
There is vivid enhancement of the mass.
Centrally flow voids are present, indicating a hypervascular nature.
The imaging characteristics are otherwise non-specific.

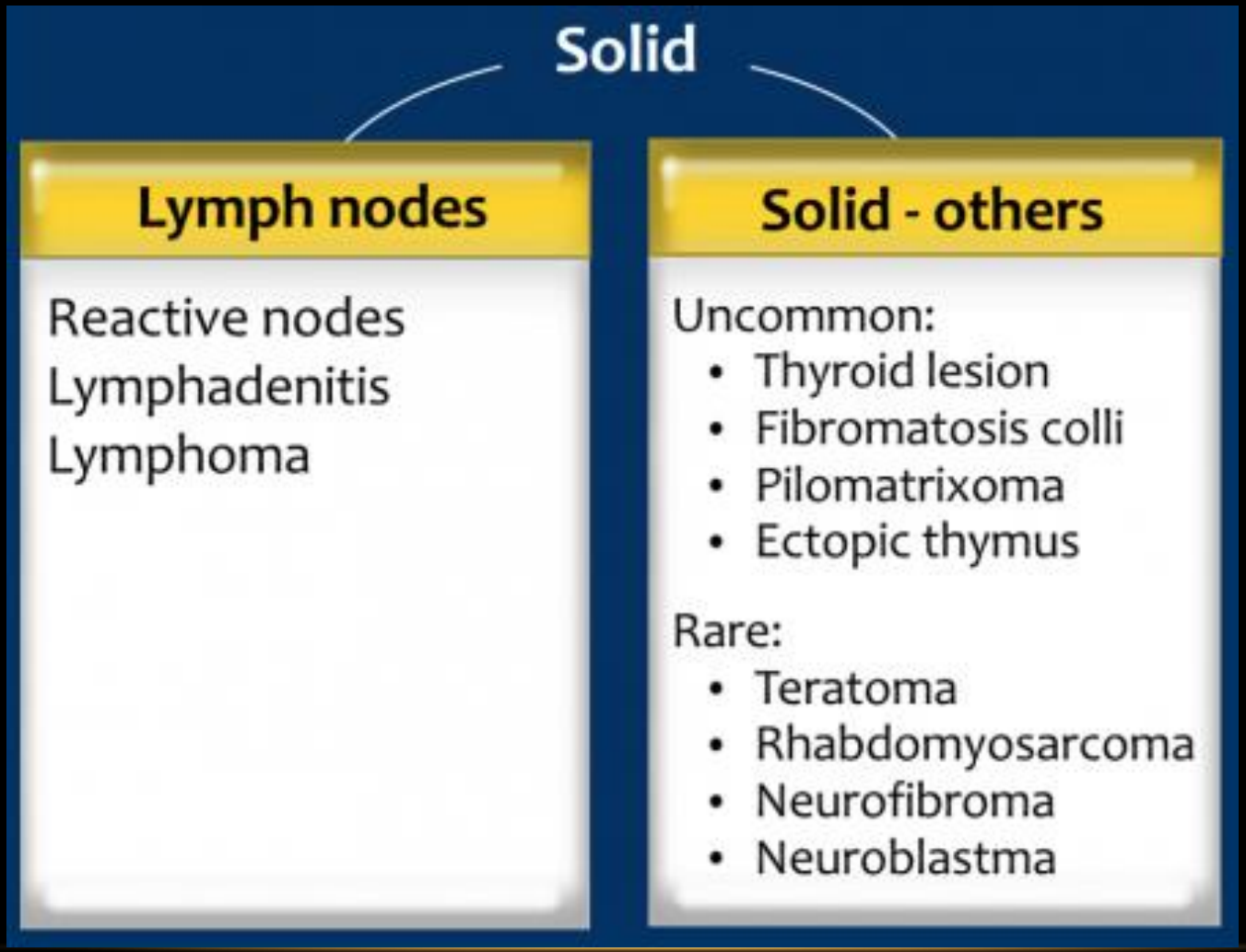
Step 3
The clinical information of a slow-growing mass favors a malignant process.
A biopsy taken before excision revealed a benign fibrous tumor.

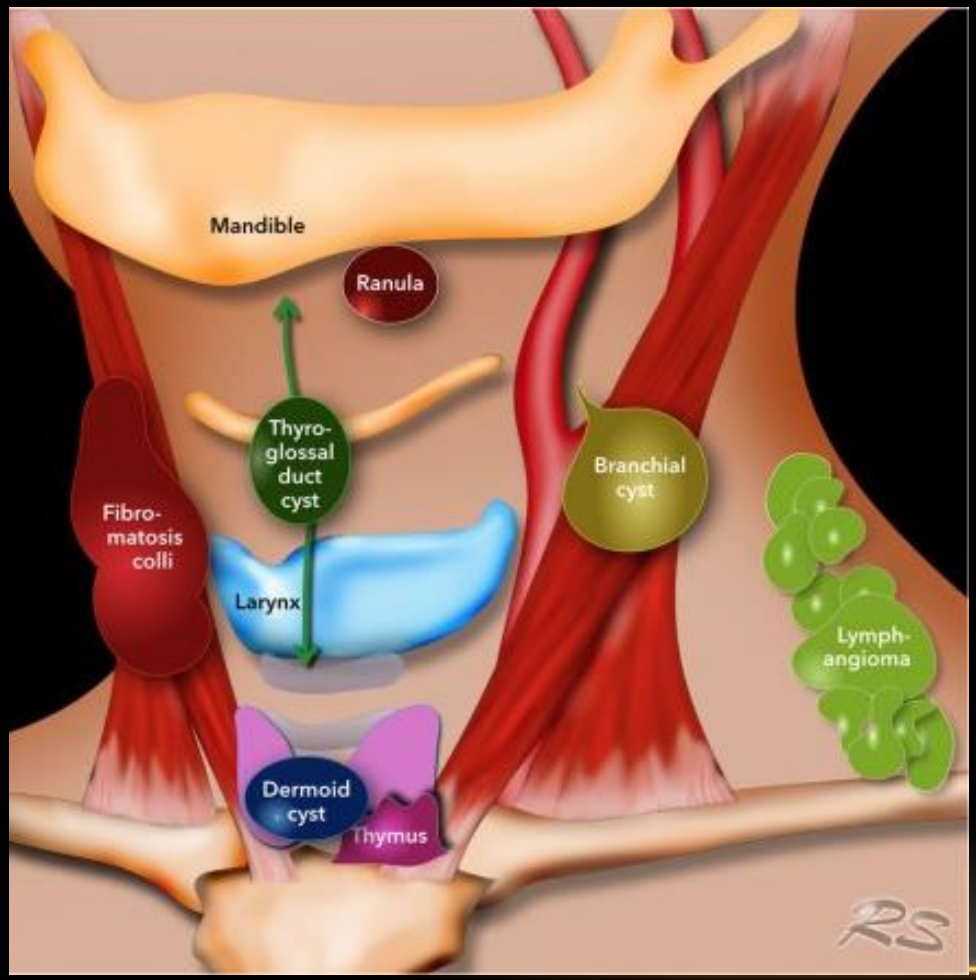
Sagittal T1-weighted image and axial image post-Gadolinium

Neck Masses in Children



Neck Masses in Children



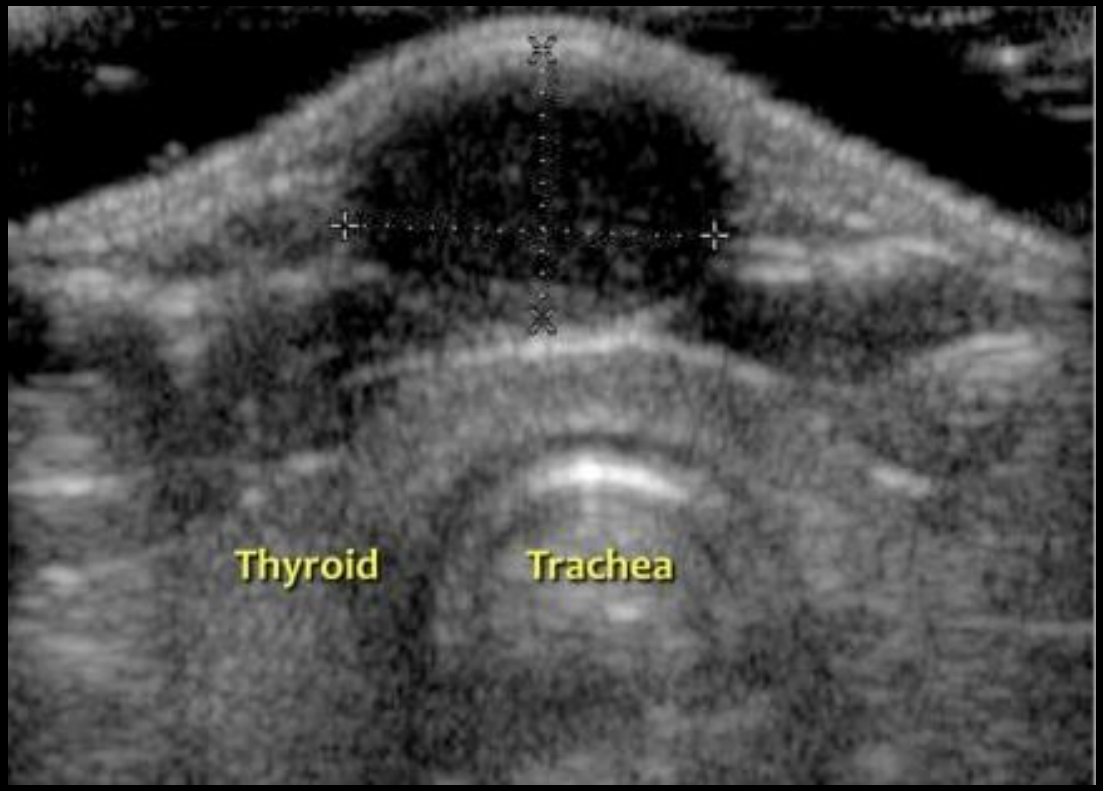


Location of cystic lesions

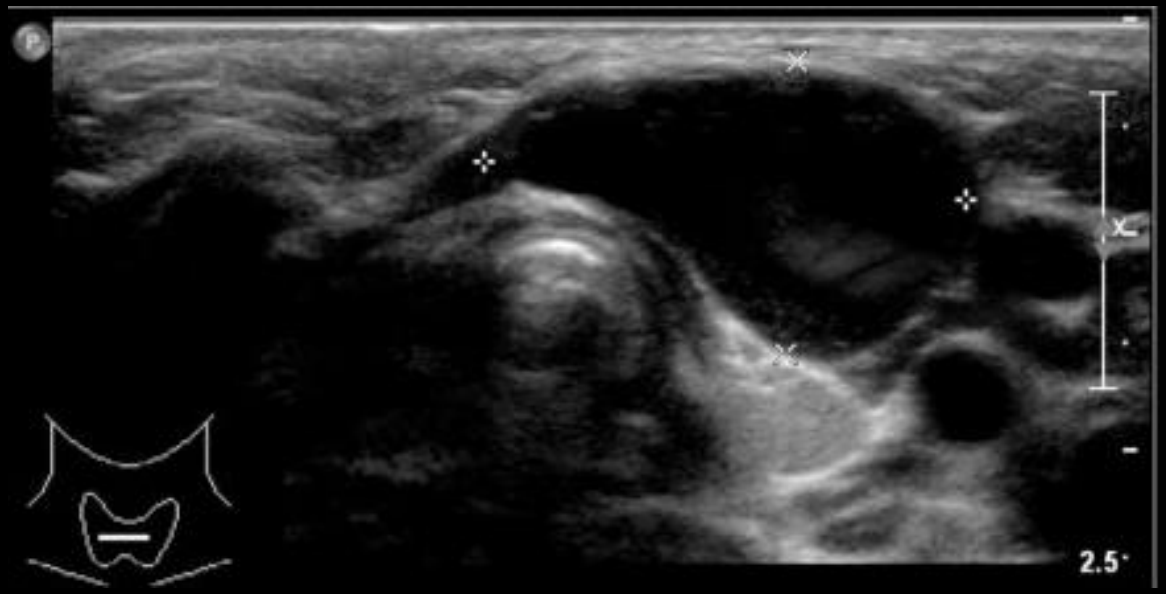
Once you have decided that the lesion is cystic its location will often point to its nature (figure).

Midline lesions
Midline lesions are either thyroglossal duct cysts, dermoid cysts or ranulas.
Older children can be asked to protrude their tongue.
A thyroglossal duct cyst will move upward with the hyoid bone.
Ranulas have a typical location in the floor of the mouth.

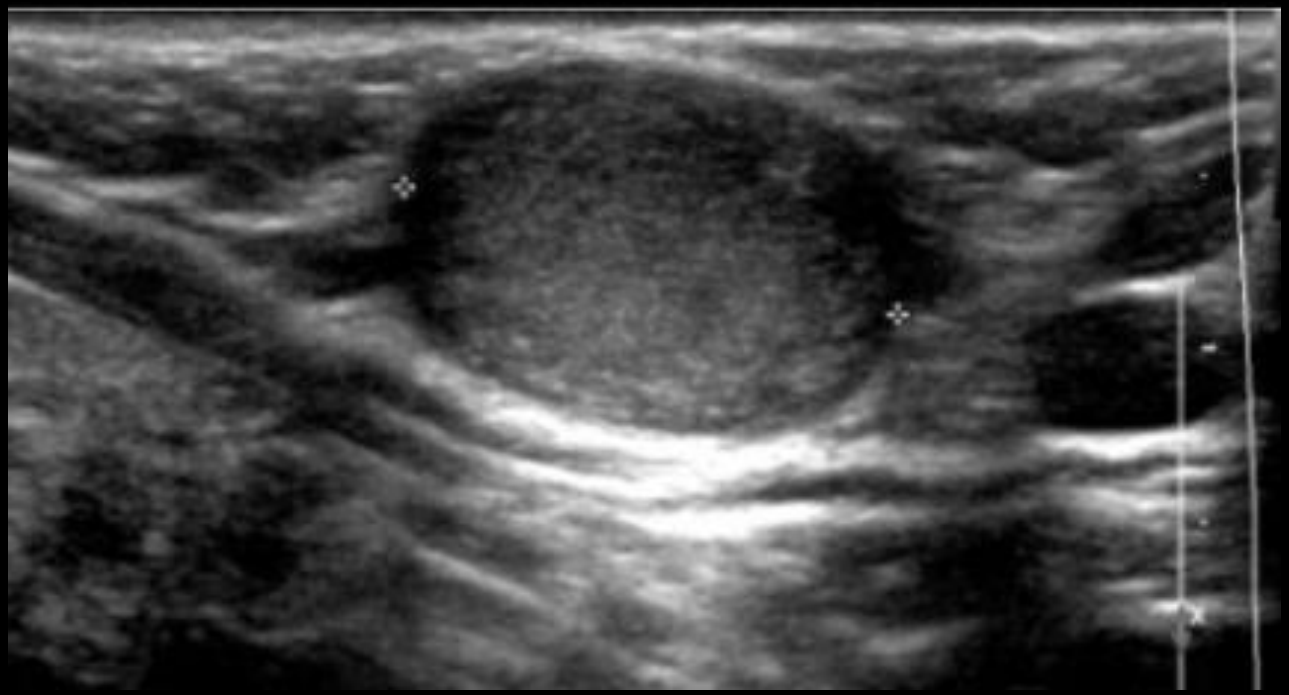
Off-midline lesions
Off-midline lesions can be branchial cleft cysts or lymphangiomas.
Branchial cleft cysts often contain debris.
Anteriorly located lymphangiomas are often multicystic.
In the posterior neck they are often single.



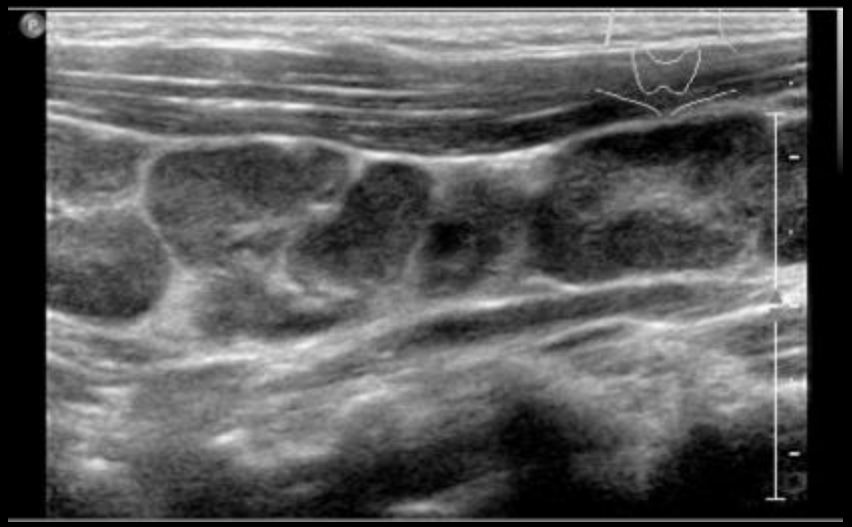
Thyroglossal duct cyst



Thyroglossal duct cyst



Typical hyper-echoic dermoid cyst in the suprasternal notch.



Reactive lymph nodes

Reactive lymph nodes are a reaction to nearby inflammation. They are slightly enlarged and more hypoechoic than normal with a broader echogenic center.

Here a six-year-old boy with weight loss, fatigue and lymphadenopathy.
On ultrasound a string of enlarged lymph nodes with preservation of a echogenic hilum was seen.
Excision biopsy showed reactive lymph nodes.

Bacterial or viral lymphadenitis

A bacterial or viral lymphadenitis is an infection of the node itself.
Bacterial lymphadenitis is often caused by Staphylococcus aureus or B-hemolytic Streptococcus.
The nodes, which are frequently located in the submandibular region, are painful and the skin is warm and red.
Bacterial lymphadenitis has an acute onset and is usually unilateral.

The ultrasound image is of a one-year-old boy with a swelling in the neck for three weeks.
A partly liquefied lymphnode is seen with infiltration of the surrounding subcutaneous fat.
The swelling disappeared on antibiotic treatment.

Malignant lymphoma

Malignant lymphoma presents with painless lymphadenopathy. In Hodgkin lymphoma the cervical nodes are most commonly involved, while in non-Hodgkin lymphoma the nodes of the Waldeyer ring are often involved.

On ultrasound the affected nodes are round, homogeneously hypoechoic and the normal echogenic hilum is absent.

The diagnosis is made by ultrasound-guided biopsy or excision. PET/CT will demonstrate the extension of the disease.

The images are of a fourteen-year-old boy with a painless swelling in the left neck.
The ultrasound shows several enlarged hypoechoic lymhnodes, that lack an hyper-echoic hilum.

A coronal STIR image shows the pathologic lymph node masses similar to the PET-CT.

The diagnosis was Hodgkin's lymphoma.

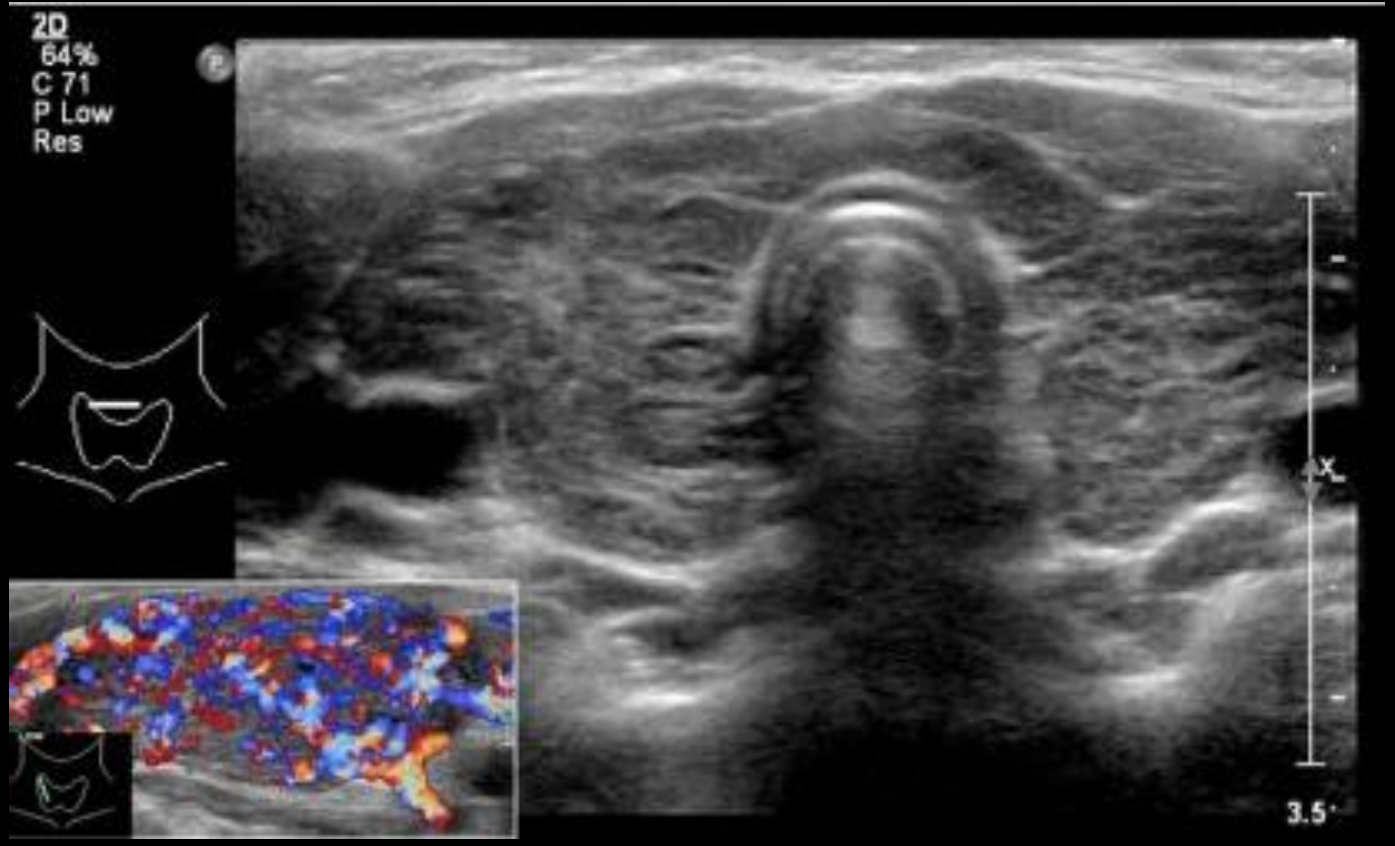
Thyroid lesions

Congenital anomalies

The most common anomalie is a partial or complete agenesis of the gland.

In partial agenesis the gland is ectopic and located anywhere between the base of the tongue and the thyroid cartilage. Mostly near or in the tongue, a lingual thyroid.

Here an image of a newborn with an abnormal thyroid test. No thyroid gland is visible in the neck, neither in its usual position nor higher up in the neck.



Hashimoto's thyroiditis: An enlarged thyroid gland with a diffuse inhomogeneous structure and hyperemia is seen in a ten-year-old girl

TI-RADS (Thyroid Imaging Reporting and Data System): Are We There Yet?

	Description	Risk of malignancy
TIRADS 1	Normal thyroid gland	0
TIRADS 2	Benign	0
TIRADS 3	Probably benign	<5%
TIRADS 4A	Suspicion for malignancy	5-10%
TIRADS 4B	Intermediate suspicion for malignancy	10-80%
TIRADS 5	Highly suggestive of malignancy	>80%
TIRADS 6	Biopsy proven malignancy	

THE SONOGRAPHIC CRITERIA

Size (equal or larger than 5 mm)

Composition (according to the ratio of the cystic portion to the solid portion):

- **solid** (≤ 10% cystic)
- **predominantly solid** (> 10% cystic and ≤ 50% cystic)
- **predominantly cystic** (> 50% cystic)
- **spongiform appearance**

Echogenicity of the solid portion was classified as: **Hyper-** or **isoechogenicity**, **hypoechogenicity**, or **marked hypoechogenicity** (decreased echogenicity compared to the strap muscles).

Orientation **Non-parallel** (taller than wider) or **parallel**.

Shape **Ovoid**, **round**, and **irregular** (when a nodule was not ovoid to round).

Margins **Well-defined smooth**, **microlobulated** **(spiculated)**, or **ill-defined.**

Calcifications **Microcalcifications** (calcifications ≤1 mm in diameter), **macrocalcifications**, or **none**. When the nodules had both types of calcifications (macrocalcifications including rim calcifications intermingled with microcalcifications), the nodule was considered to have microcalcifications.

	Suspicious US feature	Score
M	Marked hypoechogenicity	6
S	Spiculated (microlobulated) margins	5
M	Microcalcifications	2
I	Ill-defined borders	1
T	Taller than wider (non-parallel orientation)	1
H	Hypoechogenicity	2

ANALYSIS OF RESULTS:

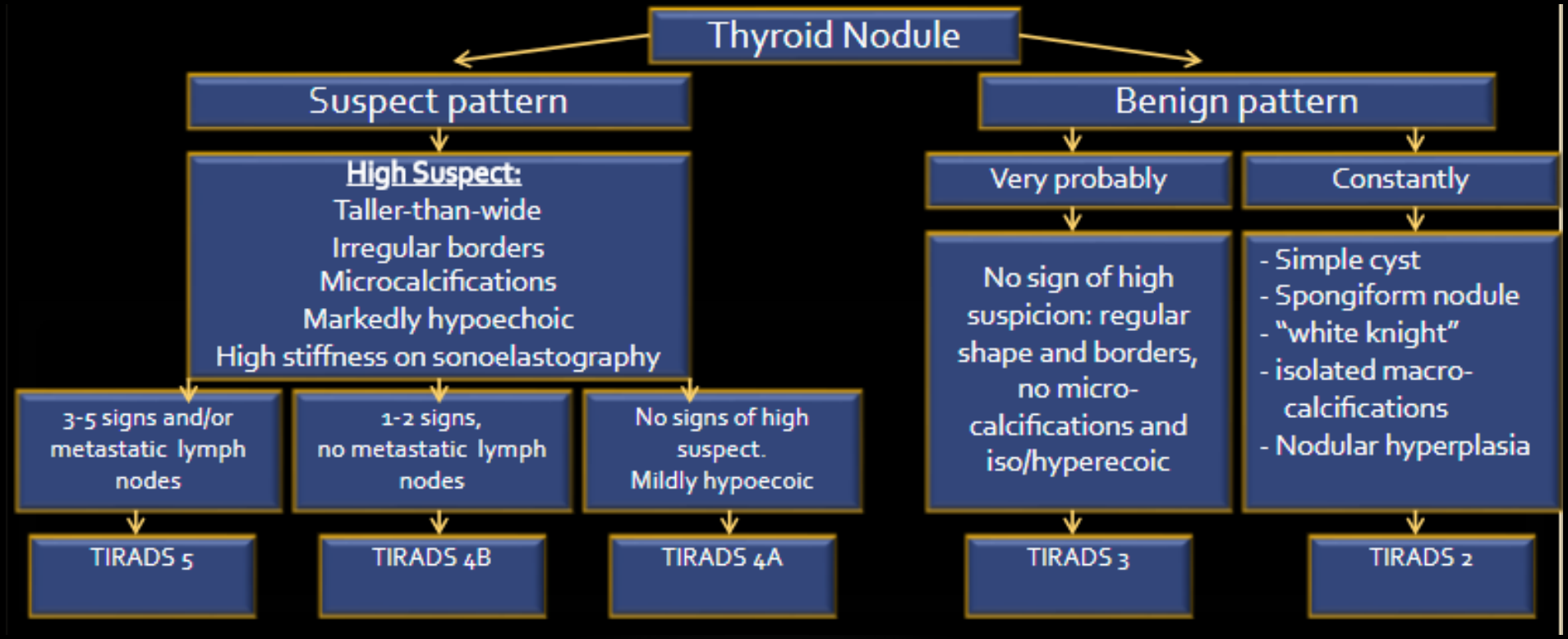
1. Thyroid nodule without any malignant features associated with risk of malignancy 6.2%.

2. Steep increase risk malignancy after score >2 (from 13% to 31%) and >6 (from 35% to 61%).

3. Microcalcifications gives 2 points immediately increasing the risk of malignancy at least by 13%.

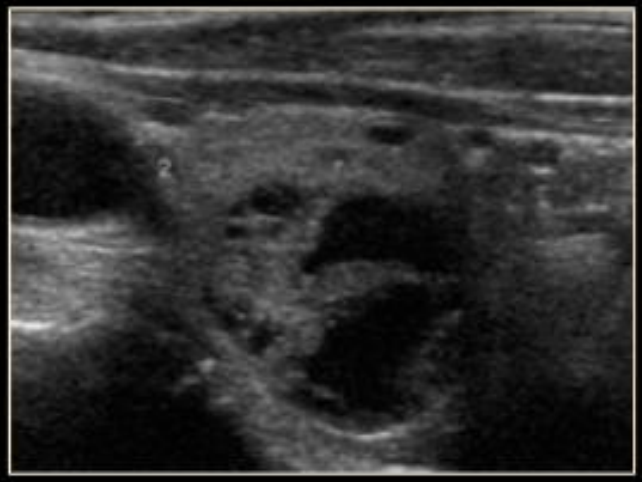
4. Microlobulated (spiculated) margins: 5 points brining up the risk of malignancy at least by 33%.

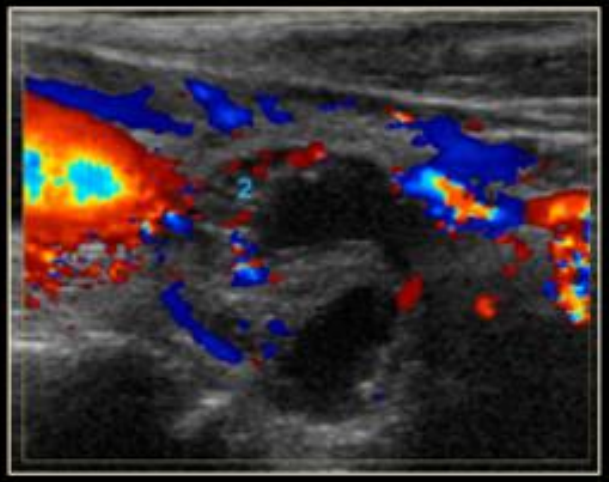
5. Marked hypoechogenicity: 6 points increasing the risk of malignancy at least by 34%


Thyroid Nodule
Suspect pattern
Benign pattern
High Suspect:
Taller-than-wide
Irregular borders
Microcalcifications
Markedly hypoechoic
High stiffness on sonoelastography
Very probably
Constantly
3-5 signs and/or metastatic lymph nodes
1-2 signs, no metastatic lymph nodes
No signs of high suspect. Mildly hypoecoic
No sign of high suspicion: regular shape and borders, no micro-calcifications and iso/hyperecoic
- Simple cyst
- Spongiform nodule
- "white knight"
- isolated macro-calcifications
- Nodular hyperplasia
TIRADS 5
TIRADS 4B
TIRADS 4A
TIRADS 3
TIRADS 2

Nodule # 1 out of 6

Thyroid Nodule: 1.7 cm, mixed solid and cystic, isoechoic, circumscribed, vascular, wider than tall, no microcalcifications

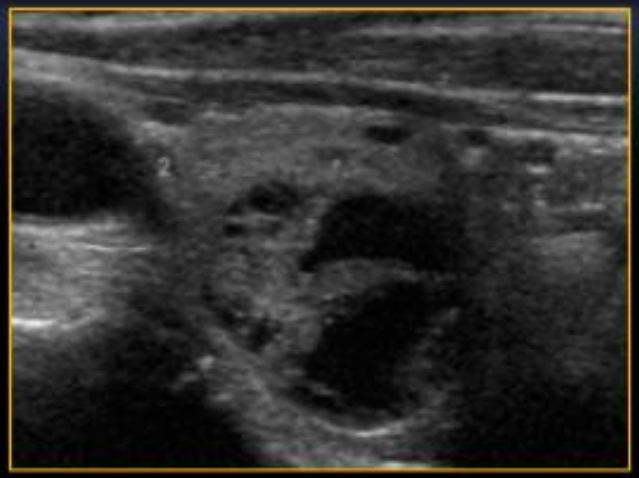


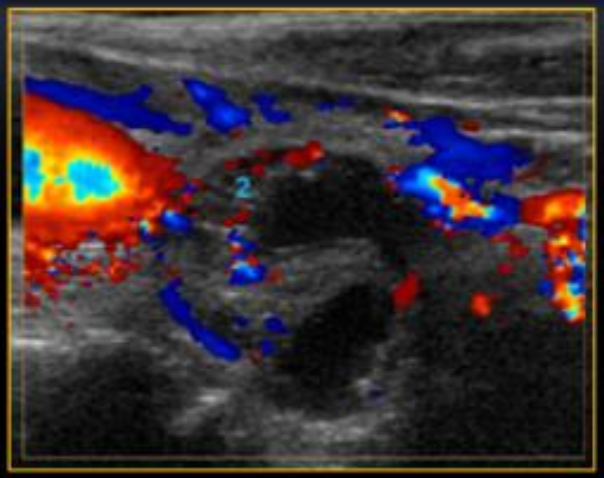


Would you biopsy this nodule?
What do guidelines say?

Stay tuned for answers!

Thyroid Nodule #1: 1.7 cm, mixed solid and cystic, isoechoic, circumscribed, vascular, wider than tall, no microcalcifications



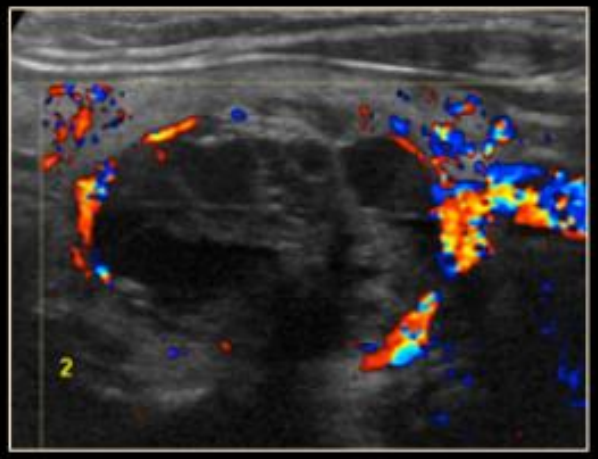


Organization	US Feature/TIRADS score	Recommendations
American Thyroid Association	Mixed solid and cystic, hypervascular, ≥ 1.5-2 cm	Biopsy (Recommendation B)
Society of Radiologists in Ultrasound	Mixed solid and cystic, < 2 cm	No biopsy
TIRADS Russ (2013)	TIRADS 3 – Very probably benign (isoechoic, no signs of high suspicion)	No biopsy (PPV 0.25%)
TIRADS Kwak (2011)	TIRADS 4A – 1 suspicious feature (solid component)	Biopsy (Risk of malignancy 3.3%)
Image Reporting and Characterization System by Kwak et al. (2013)	Score 0 – no malignant features	N/A (Risk of malignancy 6.2%)

FNA of the noduleBethesda class 2– benign: nodular hyperplasia with cystic degeneration

Nodule # 2 out of 6

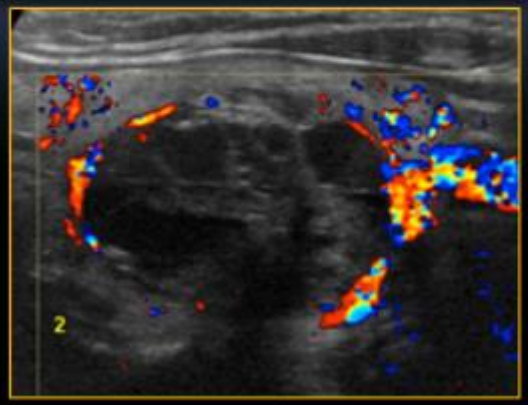
Thyroid Nodule: 3.5 cm, spongiform, isoechoic, circumscribed, peripheral vascularity, wider than tall, no microcalcifications



Would you biopsy this nodule?
What do guidelines say?

Stay tuned for answers!

Thyroid Nodule #2: 3.5 cm, spongiform, isoechoic, circumscribed, peripheral vascularity, wider than tall, no microcalcifications

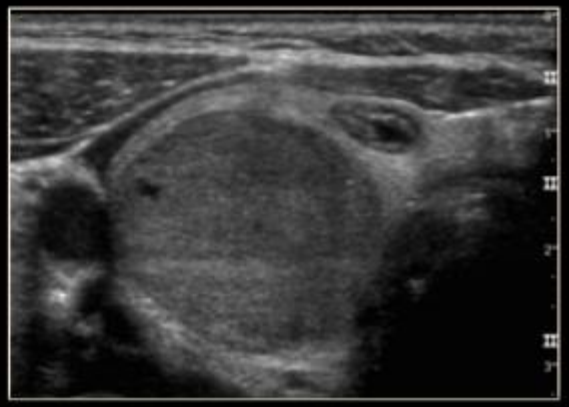


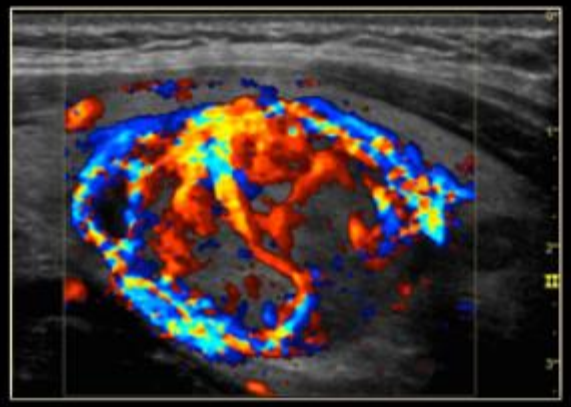
Organization	US Feature/TIRADS score	Recommendations
American Thyroid Association	Spongiform, > 2 cm	Biopsy (Recommendation C)
Society of Radiologists in Ultrasound	Mixed solid and cystic, ≥ 2 cm	Biopsy
TIRADS Russ (2013)	TIRADS 2 – Benign pattern (spongiform)	No biopsy (PPV 0.25%)
TIRADS Kwak (2011)	TIRADS 4A – 1 suspicious feature (solid component)	Biopsy (Risk of malignancy 3.3%)
Image Reporting and Characterization System byKwak et al. (2013)	Score 0 – no malignant features	N/A (Risk of malignancy 6.2%)

FNA of the nodule: Bethesda class 2 – benign: nodular hyperplasia with cystic degeneration

Nodule # 3 out of 6

Thyroid Nodule: 2.7 cm, predominantly solid, hypoechoic, circumscribed, marked vascularity, wider than tall, no microcalcifications

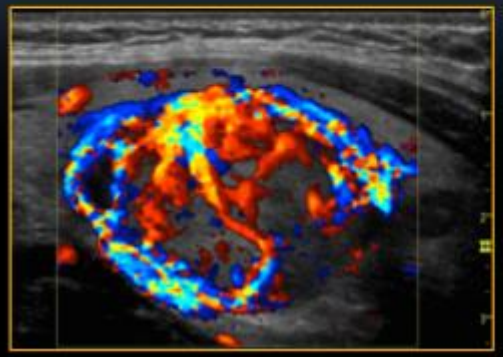




Would you biopsy this nodule?
What do guidelines say?

Stay tuned for answers!

Thyroid Nodule #3: 2.7 cm, predominantly solid, hypoechoic, circumscribed, marked vascularity, wider than tall, no microcalcifications

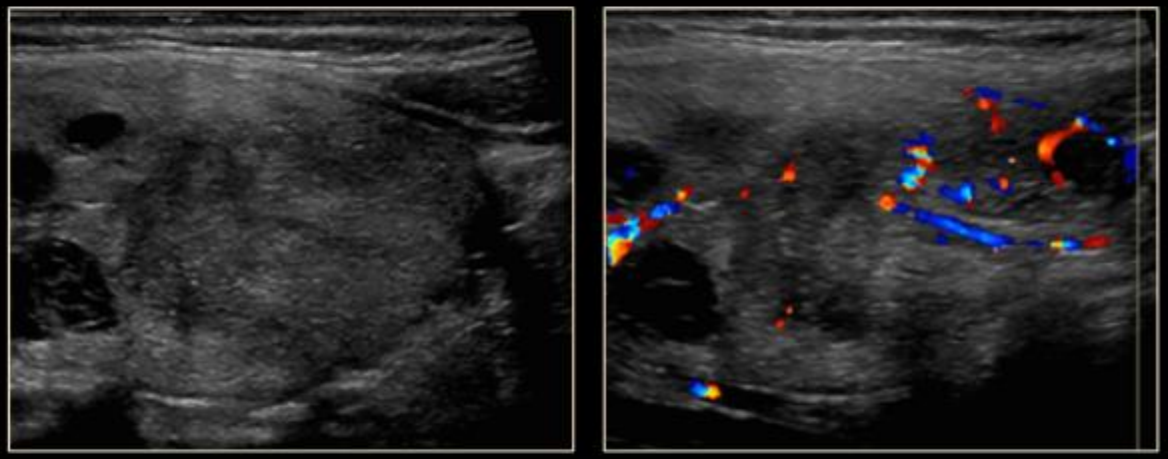


Organization	US Feature/TIRADS score	Recommendations
American Thyroid Association	Mixed, hypoechoic, increased vascularity, >1.5 cm	Biopsy, Level B
Society of Radiologists in Ultrasound	Predominantly solid, hypoechoic, >1.5 cm	Biopsy
TIRADS Russ (2013)	TIRADS 4A – mildly suspect (mildly hypoechoic, no sign of high suspicion), >1 cm	Biopsy (PPV 6%)
TIRADS Kwak (2011)	TIRADS 4B – 2 suspicious features (solid component, hypoechoic)	Biopsy (Risk of malignancy 9.2%)
Image Reporting and Characterization System by Kwak et al. (2013)	Score 2 – hypoechoic	N/A (Risk of malignancy 8.6%)

FNA of the nodule: Bethesda class 4 – suspicious for Hurtle cell neoplasm

Nodule # 4 out of 6

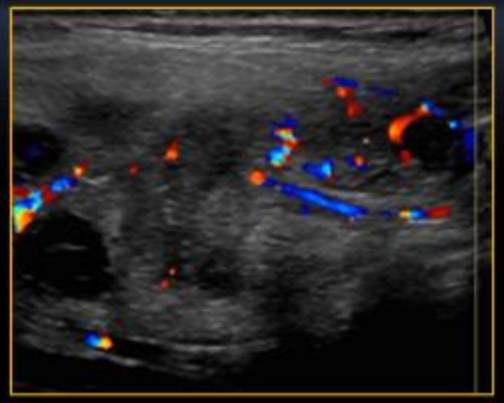
Thyroid Nodule: 2.5 cm, solid, hypoechoic, microlobulated margin, vascular, wider than tall, no microcalcifications



Would you biopsy this nodule?
What do guidelines say?

Stay tuned for answers!

Thyroid Nodule #4: 2.5 cm, solid, hypoechoic, microlobulated margin, vascular, wider than tall, no microcalcifications

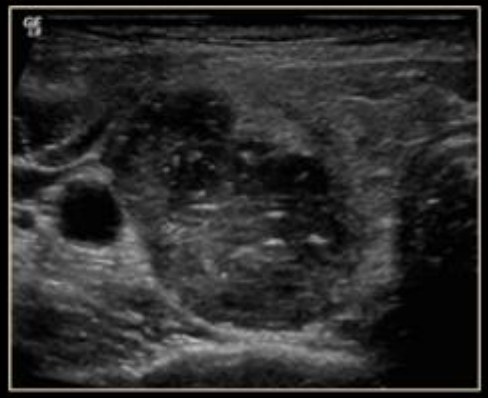


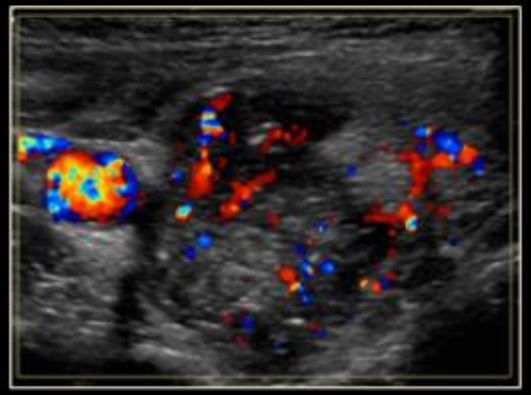
Organization	US Feature/TIRADS score	Recommendations
American Thyroid Association	Solid, hypoechoic, > 1 cm	Biopsy (Recommendation B)
Society of Radiologists in Ultrasound	Solid, ≥ 1.5 cm	Biopsy
TIRADS Russ (2013)	TIRADS 4B – Highly suspect (irregular margin)	Biopsy (PPV 69%)
TIRADS Kwak (2011)	TIRADS 4C – 3 suspicious features (solid component, hypoechogenicity, microlobulated margin)	Biopsy (Risk of malignancy 44.4–72.4%)
Image Reporting and Characterization System by Kwak et al. (2013)	Score 7 – hypoechoic, microlobulated	N/A (Risk of malignancy 60.6%)

FNA of the nodule: Bethesda class 5– suspicious for malignancy; highly suspicious for papillary carcinoma

Nodule # 5 out of 6

Thyroid Nodule: 2.2 cm, solid, hypoechoic, irregular margins, vascular, taller than wide, with microcalcifications

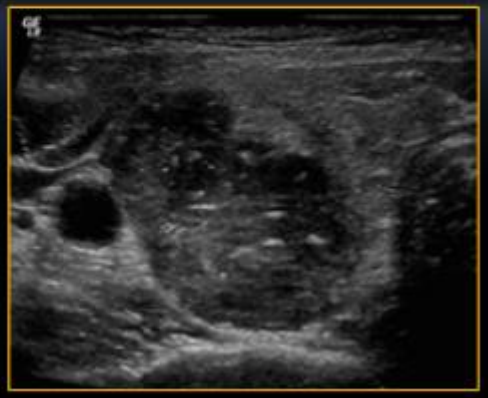


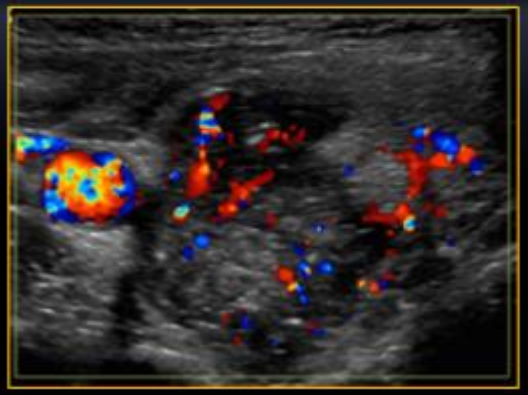


Would you biopsy this nodule?
What do guidelines say?

Stay tuned for answers!

Thyroid Nodule #5: 2.2 cm, solid, hypoechoic, irregular margins, vascular, taller than wide, with microcalcifications



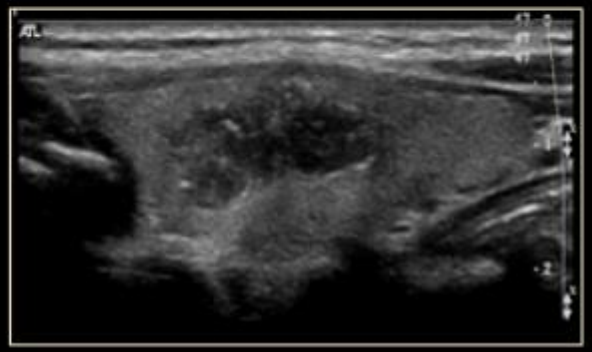


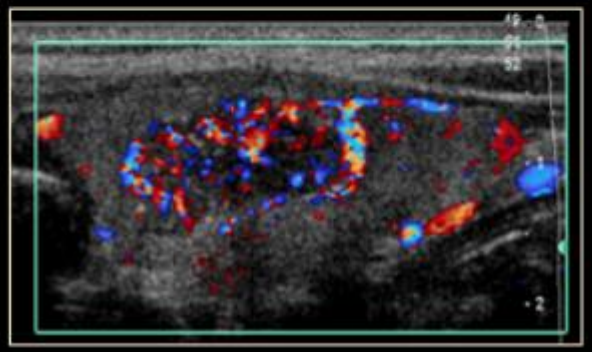
Organization	US Feature/TIRADS score	Recommendations
American Thyroid Association	Solid, hypoechoic, > 1 cm	Biopsy (Recommendation B)
Society of Radiologists in Ultrasound	Microcalcifications, ≥ 1 cm	Biopsy
TIRADS Russ (2013)	TIRADS 5 – Highly suspect (taller than wide, microcalcifications, irregular margins)	Biopsy (PPV 100%)
TIRADS Kwak (2011)	TIRADS 5 – 5 suspicious features (solid, hypoechoic, irregular margins, taller than wide, microcalcifications)	Biopsy (Risk of malignancy 87.5%)
Image Reporting and Characterization System by Kwak et al. (2013)	Score 10 – markedly hypoechoic, irregular margins, taller than wide, microcalcifications	N/A (Risk of malignancy 93.8%)

FNA of the nodule: Bethesda class 6 – malignant: papillary carcinoma

Nodule # 6 out of 6

Thyroid Nodule: 1.7 cm solid, hypoechoic, irregular margins, marked vascularity, wider then tall, and microcalcifications

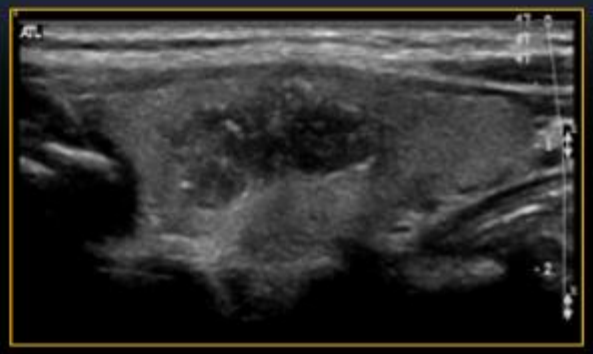


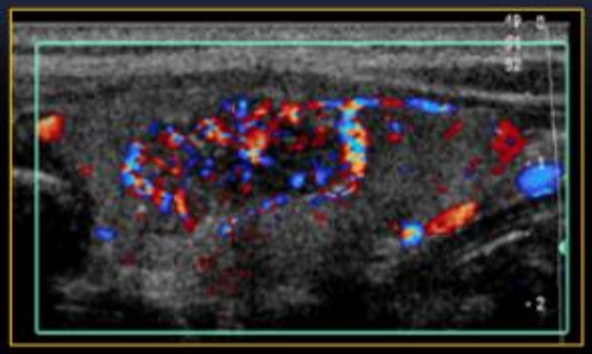


Would you biopsy this nodule?
What do guidelines say?

Stay tuned for answers!

Thyroid Nodule #6: 1.7 cm solid, hypoechoic, irregular margins, marked vascularity, wider then tall, and microcalcifications





Organization	US Feature/TIRADS score	Recommendations
American Thyroid Association	Solid, hypoechoic >1 cm	Biopsy, Level B
Society of Radiologists in Ultrasound	Solid, microcalcifications >1 cm	Biopsy
TIRADS Russ (2013)	TIRADS 5 (solid, hypoechoic, irregular margin, microcalcification)	Biopsy (PPV 100%)
TIRADS Kwak (2011)	TIRADS 4c (solid, markedly hypoechoic, irregular margin, microcalcification)	Biopsy (Risk of malignancy 44-72%)
Image Reporting and Characterization System by Kwak et al. (2013)	Score 9 (solid, markedly hypoechoic, irregular margin, microcalcification)	Biopsy (Risk of malignancy 79%)

FNA of this nodule Bethesda class 6 Malignancy (papillary thyroid carcinoma)

الحمد لله رب العالمين