



Neuroradiology Procedures

Coding FIESTA 2023

October 28, 2023

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Assistant Clinical Professor
Neuroradiology

Outline

- Background – Road to neuroradiology
- Practice of Neuroradiology
- Imaging Modalities
- Procedural Terminology
- Case Presentations

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- Case Presentations

Road to neuroradiology

- Providence College
- Wake Forest University School of Medicine
- UF neurosurgery residency
- UF radiology residency
- UF neuroradiology fellowship



Road to neuroradiology

- Providence College
 - 2003-2007
 - Biochemistry and Philosophy
- Wake Forest University School of Medicine
- UF neurosurgery residency
- UF radiology residency
- UF neuroradiology fellowship



Road to neuroradiology

- Providence College
- Wake Forest University School of Medicine
 - 2008-2012
- UF neurosurgery residency
- UF radiology residency
- UF neuroradiology fellowship



Road to neuroradiology

- Providence College
- Wake Forest University School of Medicine
- UF neurosurgery residency
 - 2012-2016
 - Didn't want to be a neurosurgeon
- UF radiology residency
- UF neuroradiology fellowship



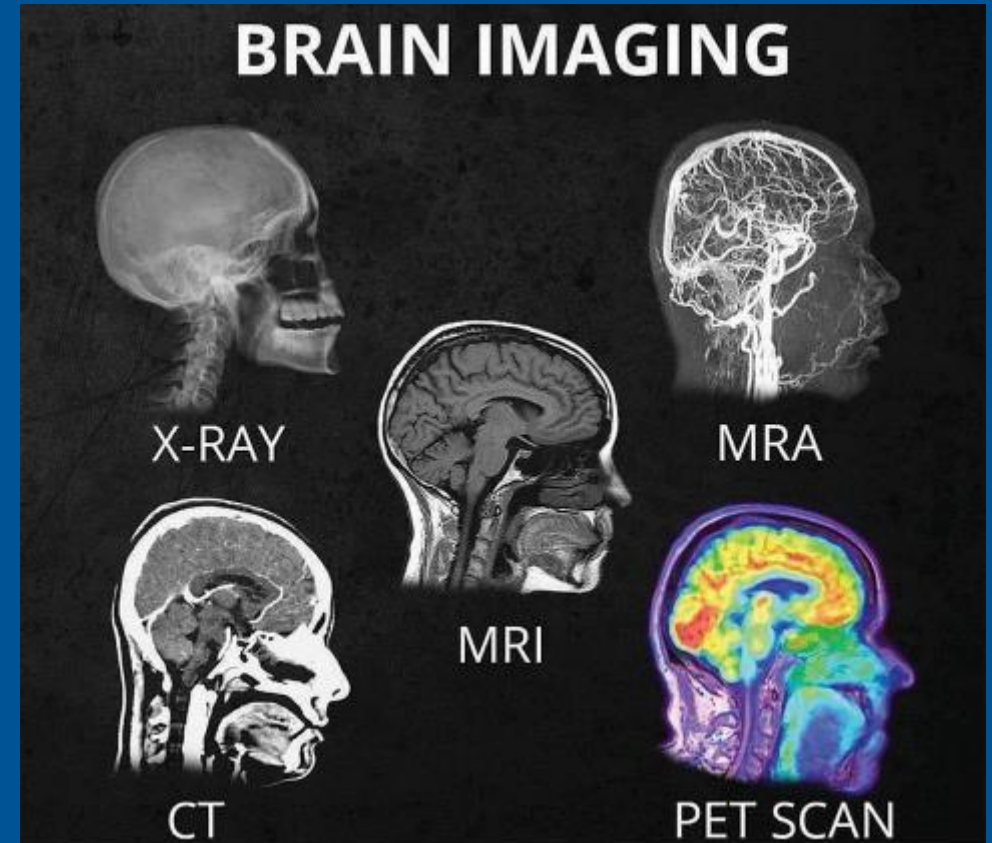
Road to neuroradiology

- Providence College
- Wake Forest University School of Medicine
- UF neurosurgery residency
- UF radiology residency
 - 2016-2020
- UF neuroradiology fellowship



Road to neuroradiology

- Providence College
- Wake Forest University School of Medicine
- UF neurosurgery residency
- UF radiology residency
- UF neuroradiology fellowship
 - 2020-2021



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Practice of Neuroradiology

- Physician trained in generation and interpretation of medical images of the brain, spine, face and neck, and peripheral nerves
- Medical images: x-rays, computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound
- Consult with treating clinicians – neurologists, neurosurgeons, otolaryngologists, etc...
- Minimally invasive diagnostic and therapeutic procedures in the head, neck, and spine

Radiology reading room



Radiology worklist

PowerScribe 360 | Reporting

File View Tools Speech Help

New Open Draft Reject Prelim Sign Discard Peer Review PA

00:00 - 00:00

Quick Search

Look for: Single Accession

Search

My Reports

- Signing queue
- Signed today
- Touched today
- Drafts
- Annotated

Worklists

Hot Worklist (46)

- U-Neuro
 - Call: Prelim Queue - Neuro
 - Neuro - (scheduled)
 - Neuro - All
 - Neuro - ENT

Browse

Status: All

Time Frame: Today

Modality: All

Anatomy: All

Section: All

Radiologist: All

Ordering: All

Patient Age: All

Gender: All

Location: All

Class: All

Priority: All

Reset Filters Browse

Worklist: Neuro - All

	Exam Date	Des...	Class	Procedure
1	11/3/2022 8:59 AM	04:07	Outpatient	MR BRAIN ROUTINE NCON WO/W
2	11/3/2022 11:21 AM	01:20	Outpatient	MR BRAIN ROUTINE NCON WO/W
3	11/3/2022 12:00 PM	01:20	Inpatient	MR BRAIN HYDROCEPHALUS (HASTE) NO NCON
4	11/3/2022 1:42 PM	00:19	Emergency	CT HEAD NO NCON
5	11/3/2022 1:51 PM	00:15	Emergency	CT HEAD NO NCON
6	11/3/2022 11:22 AM		Outpatient	MR THORACIC SPINE NO NCON
7	11/3/2022 7:58 AM		Outpatient	MR SELLA MACRO/SUPRASellar NCON WO/W
8	11/3/2022 9:14 AM		Outpatient	XR SPINE CERVICAL AP/LATERAL
9	11/3/2022 9:26 AM		Outpatient	CT MAXFACE IMAGE FUSION/STEALTH NO NCON
10	11/3/2022 9:50 AM		Outpatient	CT MAXFACE IMAGE FUSION/STEALTH NO NCON
11	11/3/2022 10:07 AM		Outpatient	MR SELLA MACRO/SUPRASellar NCON WO/W
12	11/3/2022 11:02 AM		Outpatient	MR BRAIN ROUTINE NCON WO/W
13	11/3/2022 1:00 PM		Outpatient	MR LUMBAR SPINE NO NCON
14	11/2/2022 5:22 PM		Outpatient	MR SINONASAL MASS/INFECTION/INFLAM NCON/W...
15	11/3/2022 8:07 AM		Outpatient	MR BRAIN ROUTINE NCON WO/W
16	11/3/2022 8:12 AM		Outpatient	MR BRAIN ROUTINE LESION PERF NCON WO/W
17	11/3/2022 9:00 AM		Outpatient	MR BRAIN ROUTINE LESION PERF NCON WO/W
18	11/3/2022 9:10 AM		Outpatient	MR BRAIN STEREOTACTIC W/IVCON
19	11/3/2022 9:41 AM		Outpatient	MR BRAIN STEREOTACTIC W/IVCON
20	11/3/2022 9:50 AM		Outpatient	CT BRW/RADIOSURGERY/CRW NO NCON
21	11/3/2022 9:50 AM		Outpatient	XR SPINE LUMBAR AP/LATERAL
22	11/3/2022 10:01 AM		Outpatient	MR BRAIN ROUTINE LESION PERF NCON WO/W
23	11/3/2022 10:09 AM		Outpatient	CT MAXFACE DTL AND NECK W/IVCON
24	11/3/2022 10:26 AM		Outpatient	XR SPINE CERV W/FLEX AND EXT
25	11/3/2022 10:38 AM		Outpatient	CT TEMPORAL BONE NO NCON
26	11/3/2022 10:43 AM		Outpatient	MR VESTIBULOCOCHLEAR CN 8 NCON WO/W
27	11/3/2022 11:04 AM		Outpatient	CT ANGIO NECK W/IVCON
28	11/3/2022 11:07 AM		Outpatient	MR BRAIN STEREOTACTIC W/IVCON
29	11/3/2022 11:20 AM		Outpatient	MR BRAIN ROUTINE NCON WO/W
30	11/3/2022 11:23 AM		Outpatient	XR SPINE LUMBAR W/FLEX/EXT
31	11/3/2022 11:36 AM		Outpatient	CTV HEAD NCON WO/W
32	11/3/2022 11:41 AM		Outpatient	CT NECK W/IVCON
33	11/3/2022 11:42 AM		Outpatient	XR SPINE LUMBAR AP/LATERAL
34	11/3/2022 11:48 AM		Outpatient	MR BRAIN ROUTINE NCON WO/W
35	11/3/2022 12:31 PM		Outpatient	CT STEALTH HEAD NO NCON
36	11/3/2022 12:40 PM		Outpatient	XR SPINE CERV W/FLEX AND EXT
37	11/3/2022 12:40 PM		Outpatient	XR SPINE LUMBAR AP/LATERAL
38	11/3/2022 12:43 PM		Outpatient	MR BRAIN ROUTINE NCON WO/W
39	11/3/2022 12:44 PM		Outpatient	XR SPINE LUMBAR AP/LATERAL
40	11/3/2022 12:44 PM		Outpatient	MR BRAIN STEREOTACTIC NCON WO/W
41	11/3/2022 1:02 PM		Outpatient	CT BRW/RADIOSURGERY/CRW NO NCON
42	11/3/2022 1:22 PM		Outpatient	CT STEALTH HEAD NO NCON
43	11/3/2022 1:26 PM		Outpatient	XR SPINE SCOLI PA AND LAT
44	11/3/2022 1:43 PM		Outpatient	XR SPINE THORACOLUMBAR AP/LAT
45	11/3/2022 1:51 PM		Emergency	CT HEAD AND C-SPINE TRAUMA NO NCON
46	11/3/2022 1:53 PM		Inpatient	CT HEAD NO NCON

Escape from the reading room!



CT-guided biopsy

Ultrasound-guided biopsy



Practice of Neuroradiology

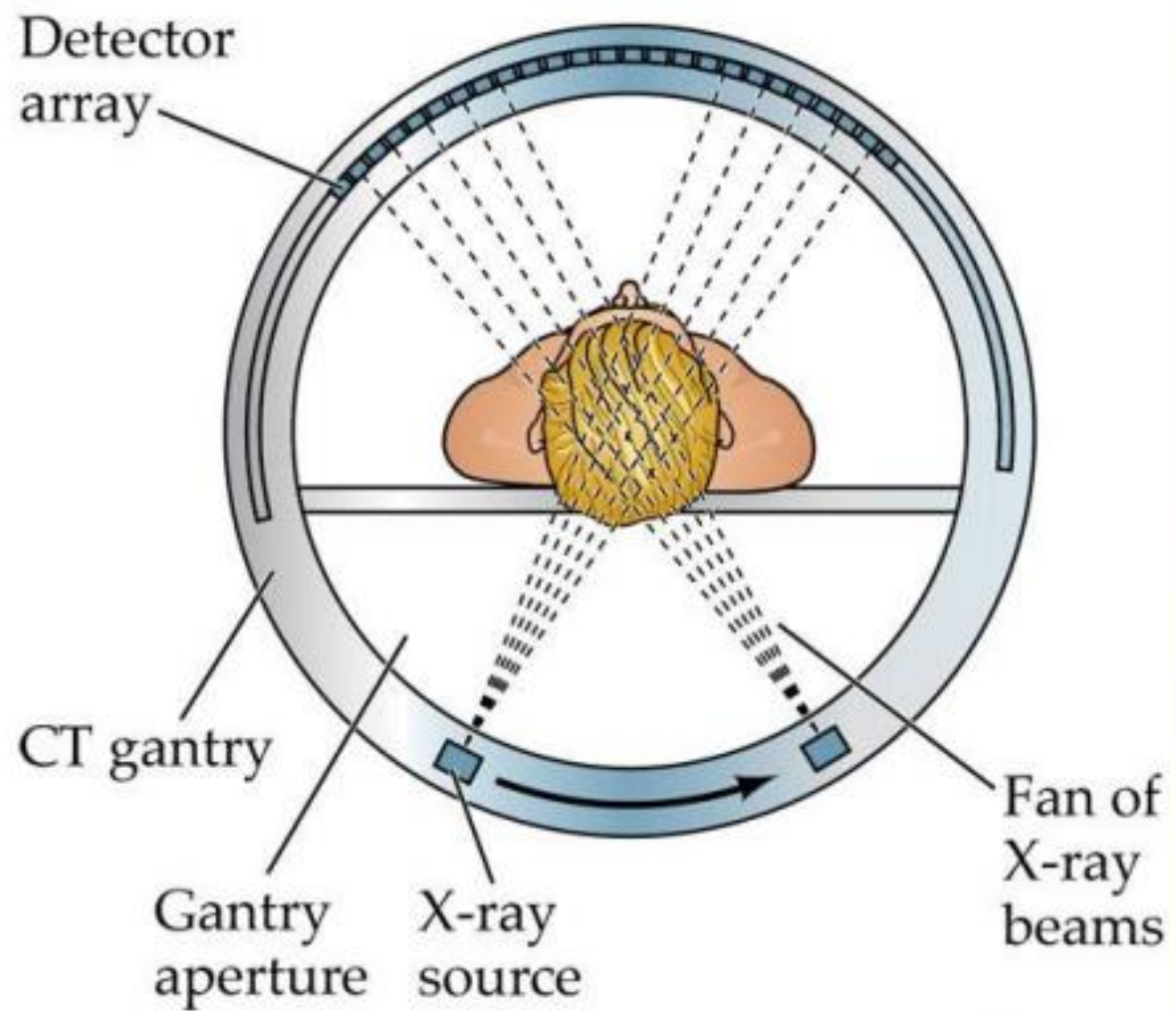
- Diagnostic neuroradiology
 - Over 41,000 diagnostic exams annually!
 - Combination of xray, ultrasound, CT, and MRI
 - Head/brain, neck, spine, and peripheral nerves
- Neuroradiology procedures
 - Over 900 image-guided neuroradiology procedures annually
 - ~250 CT and ultrasound guided procedures
 - ~650 fluoroscopy/x-ray guided procedures

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CT (computed tomography)...“CaT scan”

- Uses radiation...beams of x-rays
- Images made based on density of the different tissues in the body
 - Low density: air, fat, water
 - Middle density: soft tissue
 - High density: bone, metal



CT scan image

- Density

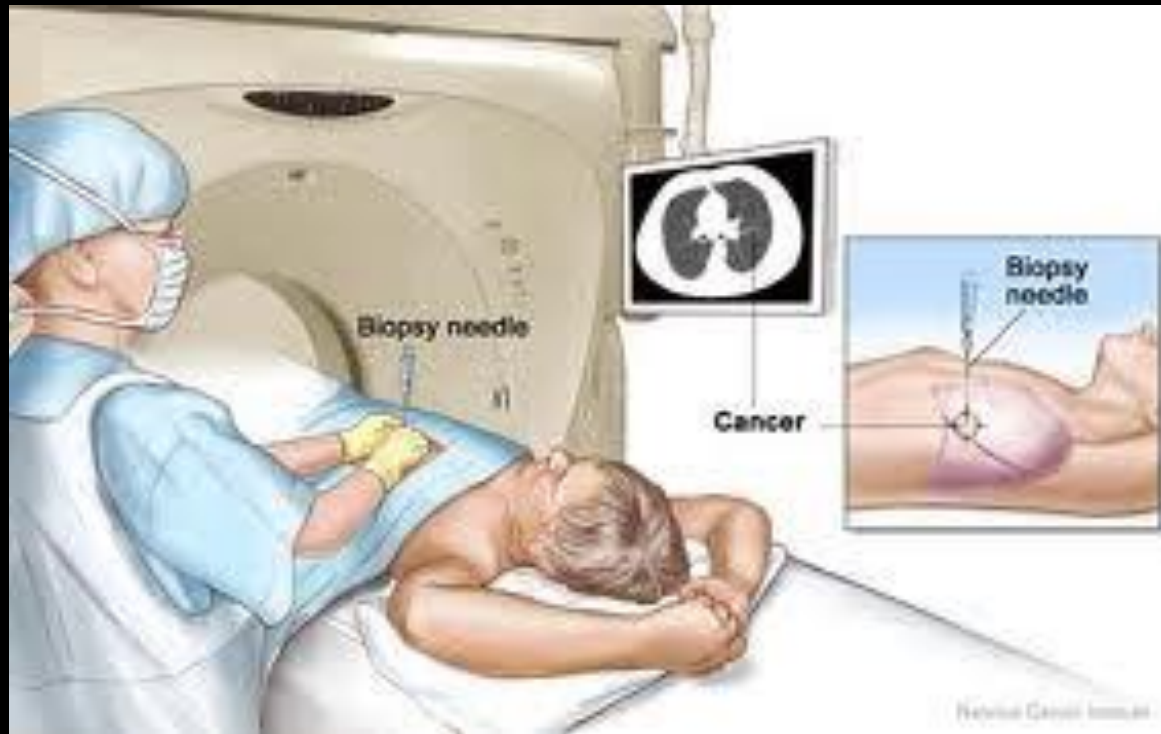
- High

- Middle

- Low



CT guided biopsy



Ultrasound (US)

- Uses high-frequency sound waves
- Images made based on how the body tissues reflect or absorb the sound waves



MRI and Fluoroscopy

MRI

- Not used for neuroradiology procedures
- Utilized for some breast biopsies



Fluoroscopy

- Uses plain x-rays to make images
- Utilized in many image guided procedures

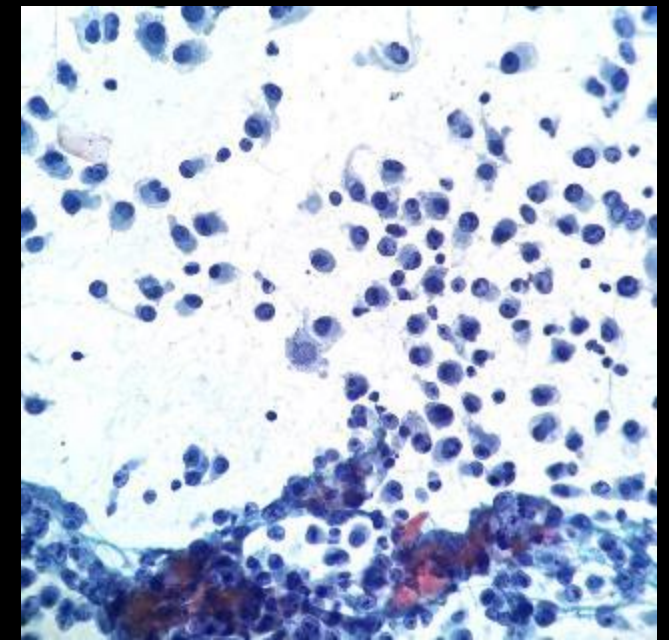
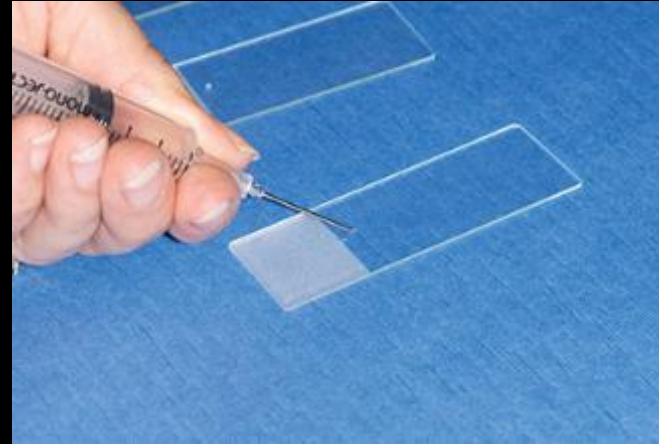
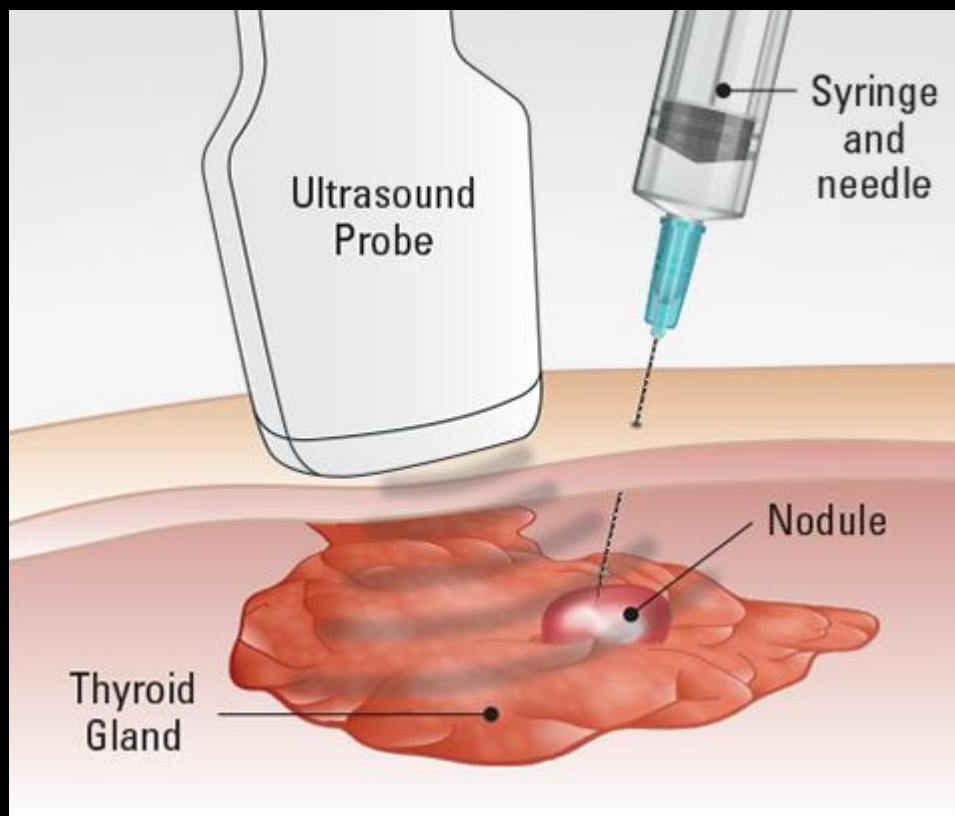


Outline

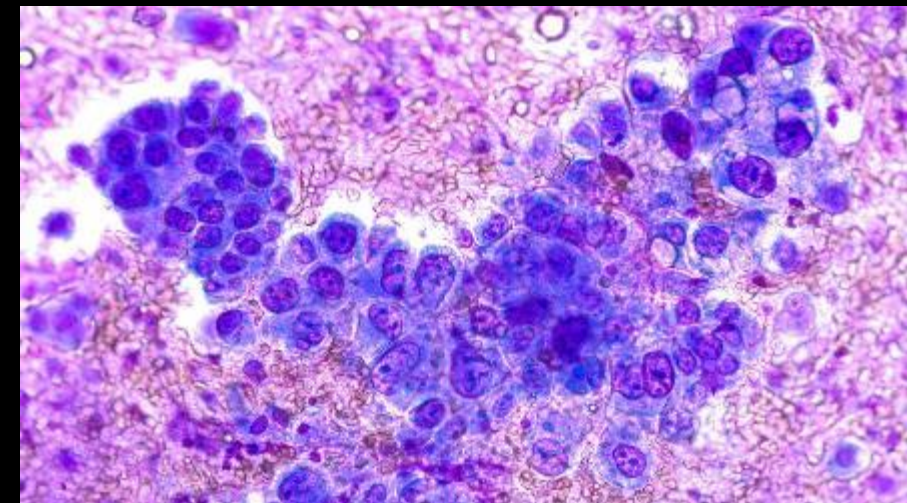
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Fine Needle Aspiration (FNA)

- Tissue sampling using a very thin needle
- Cells are removed from the lesion as the thin needle passes through
- Cells are disorganized and no longer maintain the architecture they originally had in the lesion
- Sample is placed on a glass slide and viewed under microscope
- Cellular morphology evaluated by a Cytopathologist



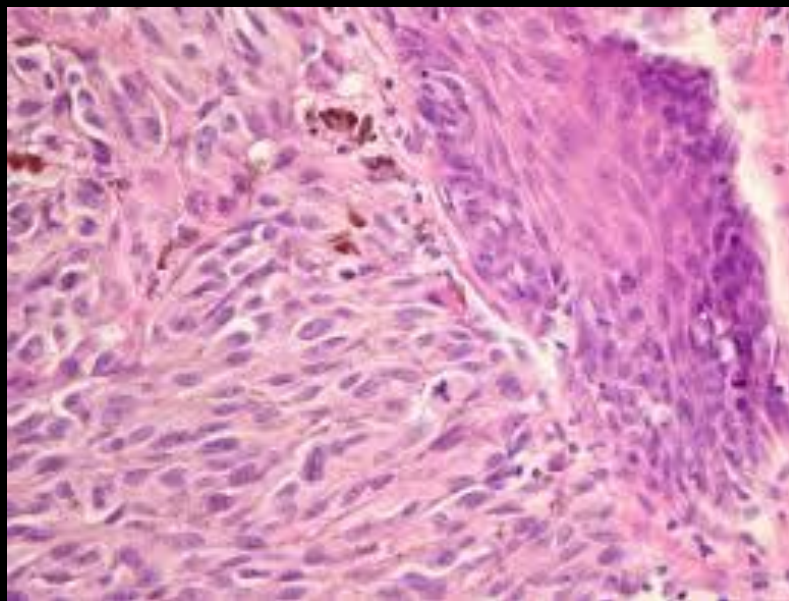
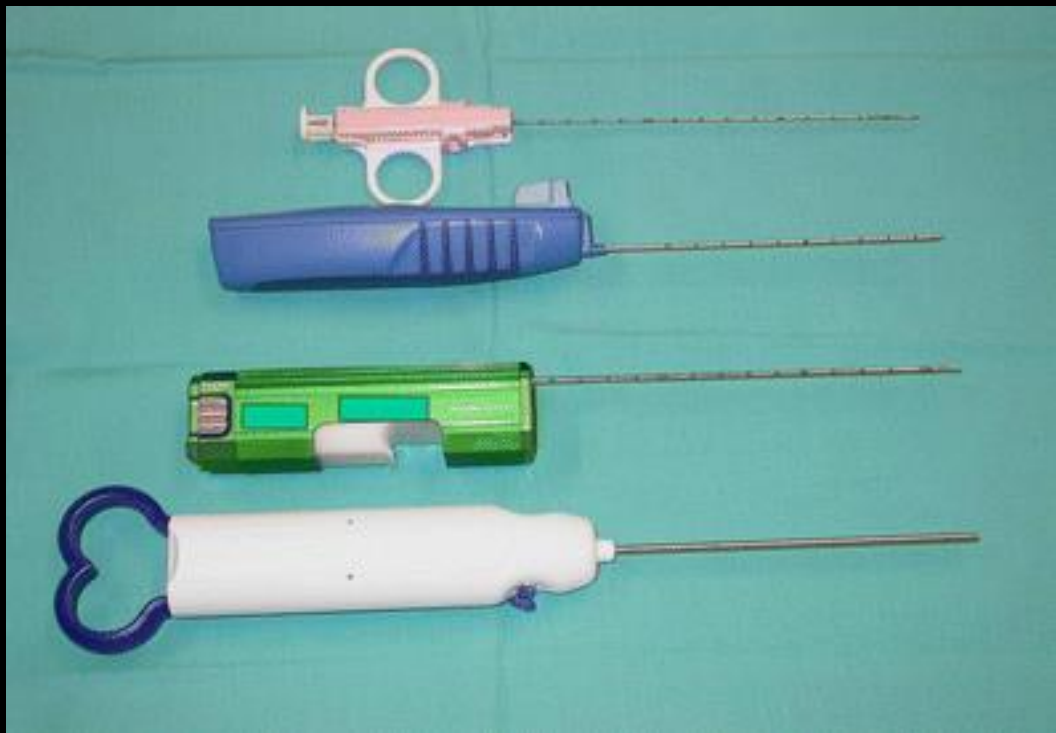
Melanoma cells FNA



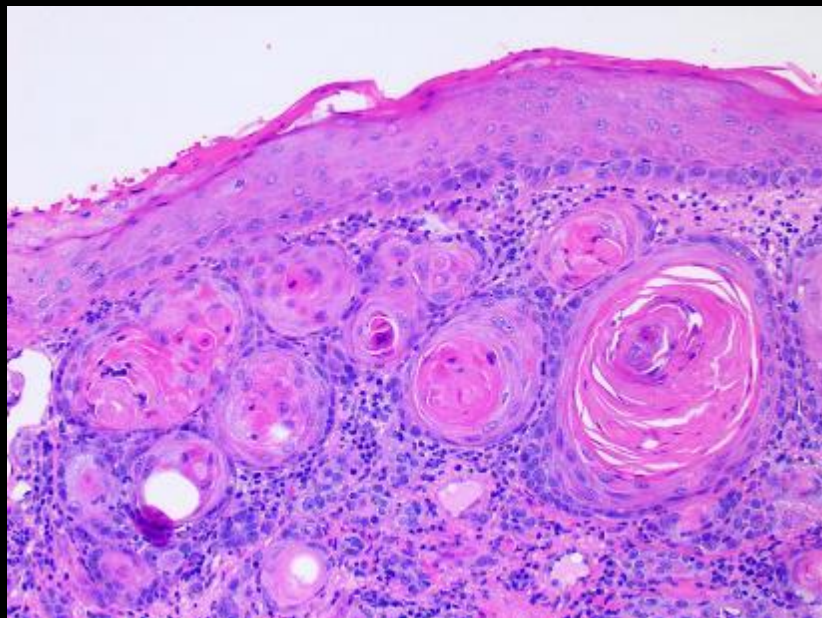
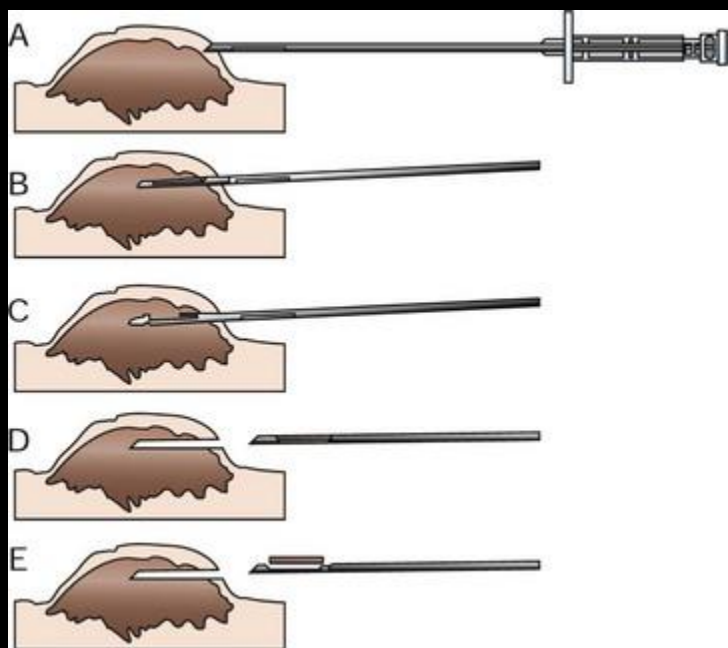
Squamous cell carcinoma cells FNA

Core Needle Biopsy (core)

- Tissue sampling using a large hollow needle
- Large tissue sample maintains the original architecture of the lesion
- Pathologist finely slices the sample, places on slides, and stains
- Views slides under microscope to make diagnosis



Melanoma CORE



Squamous cell carcinoma CORE

FNA or Core biopsy?

FNA

- Smaller lesions
- Lesion in critical locations
 - Near blood vessels, nerves, organs
- Patients with high bleeding risk
- Only small amount of tissue needed

Core biopsy

- Larger lesions
- Prior non-diagnostic FNA
- Need for lots of tissue for ancillary testing
 - Genetic testing
 - Immunostaining
 - Flow cytometry

Culture (microbial culture)

- Method of multiplying microbial organisms under controlled lab conditions
- FNA and Core samples can be cultured
- Material sent to the laboratory (not pathology department)
- Any case where infection may be part of the disease

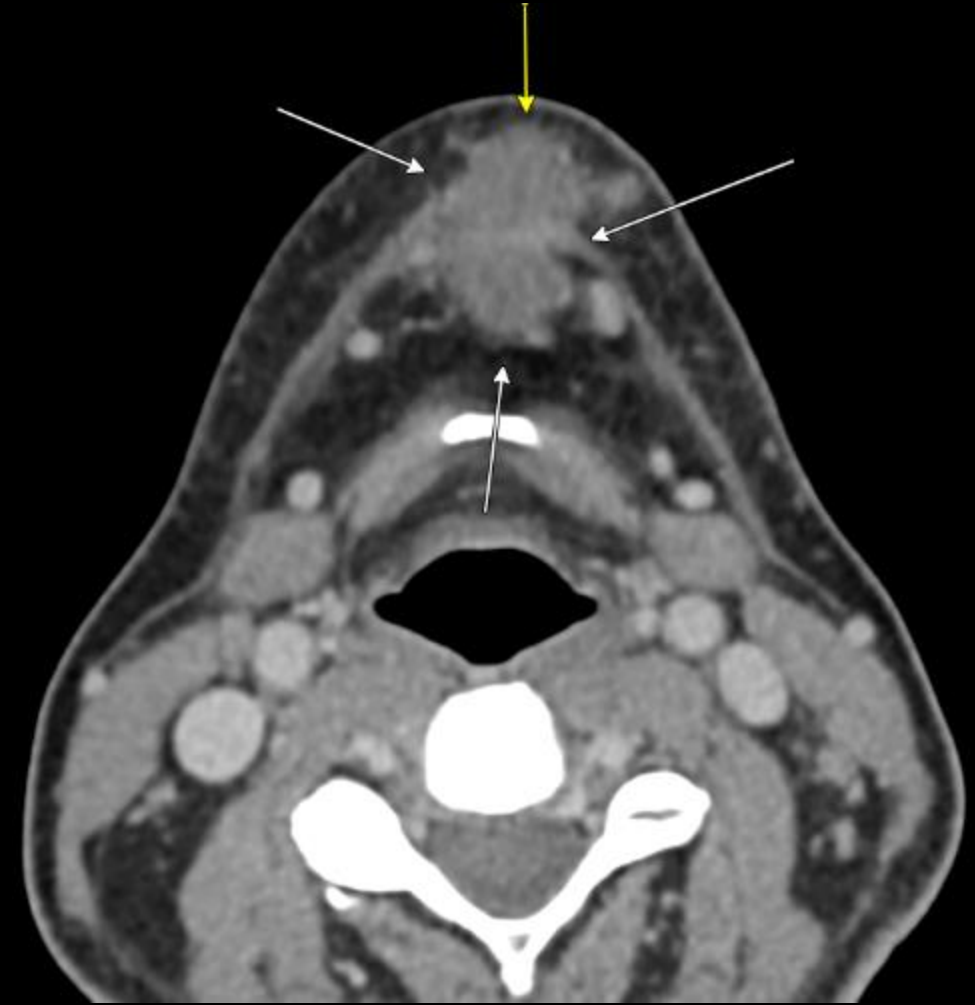
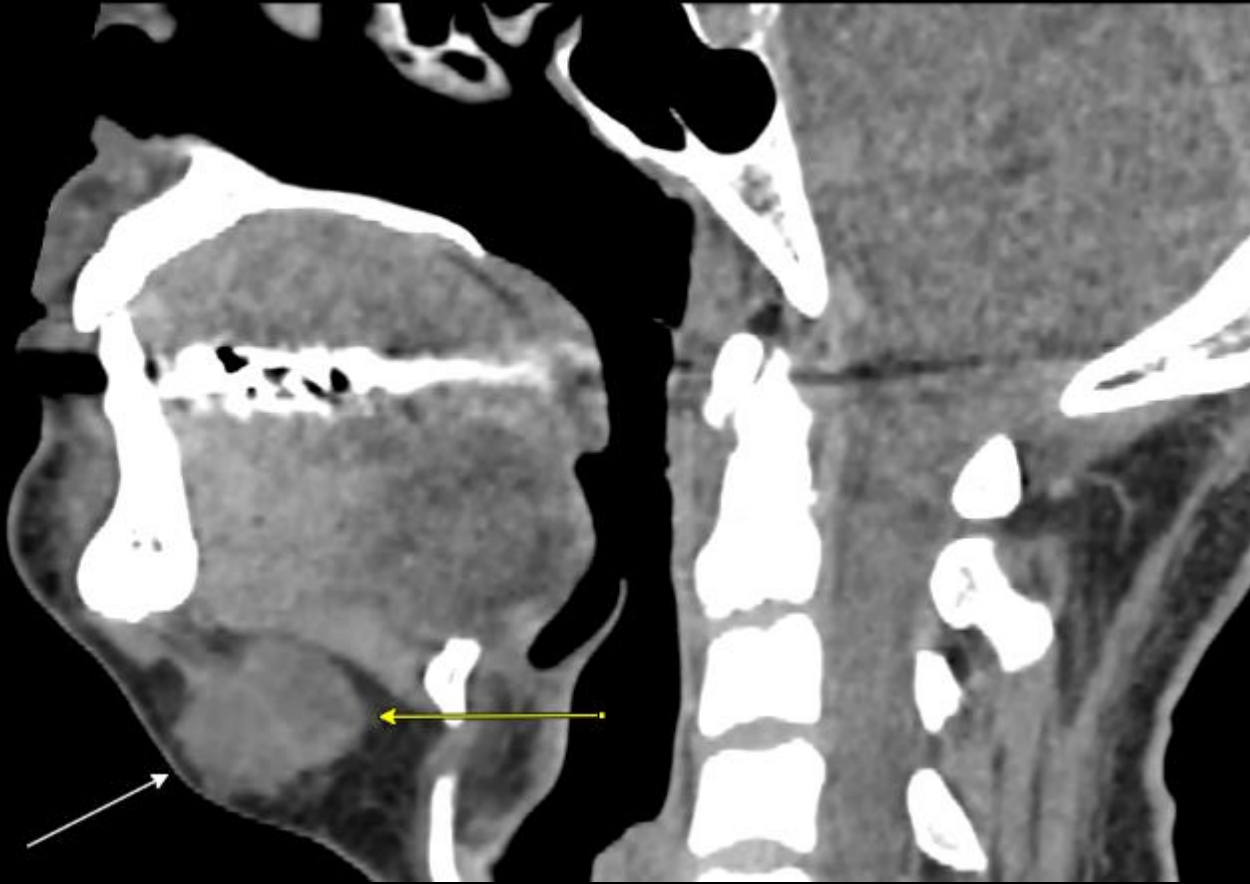
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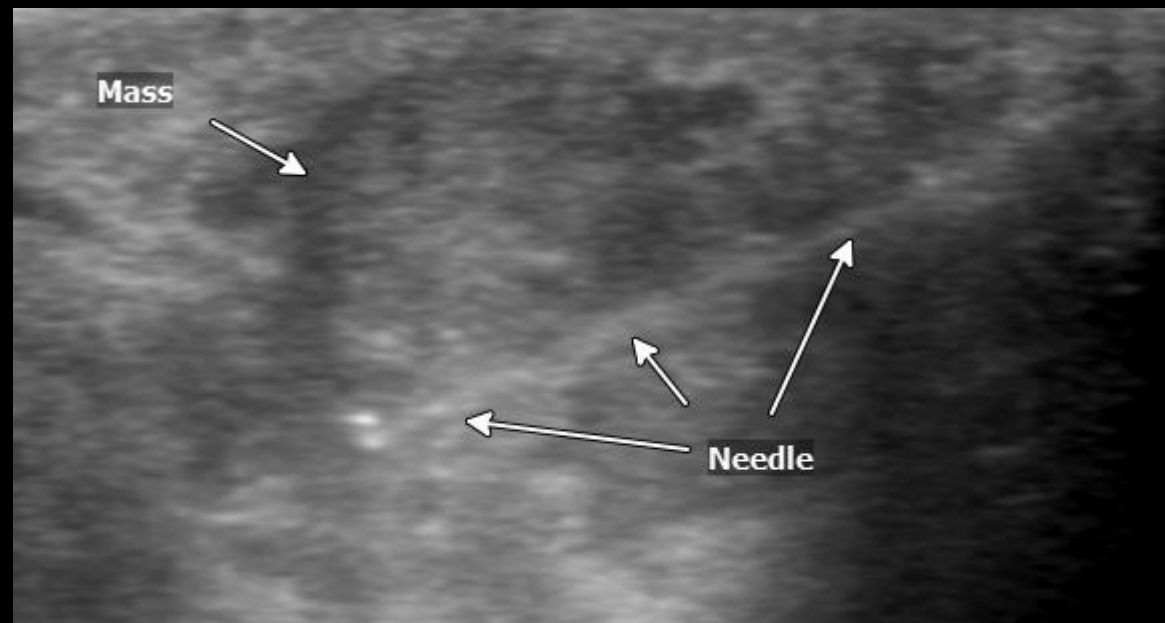
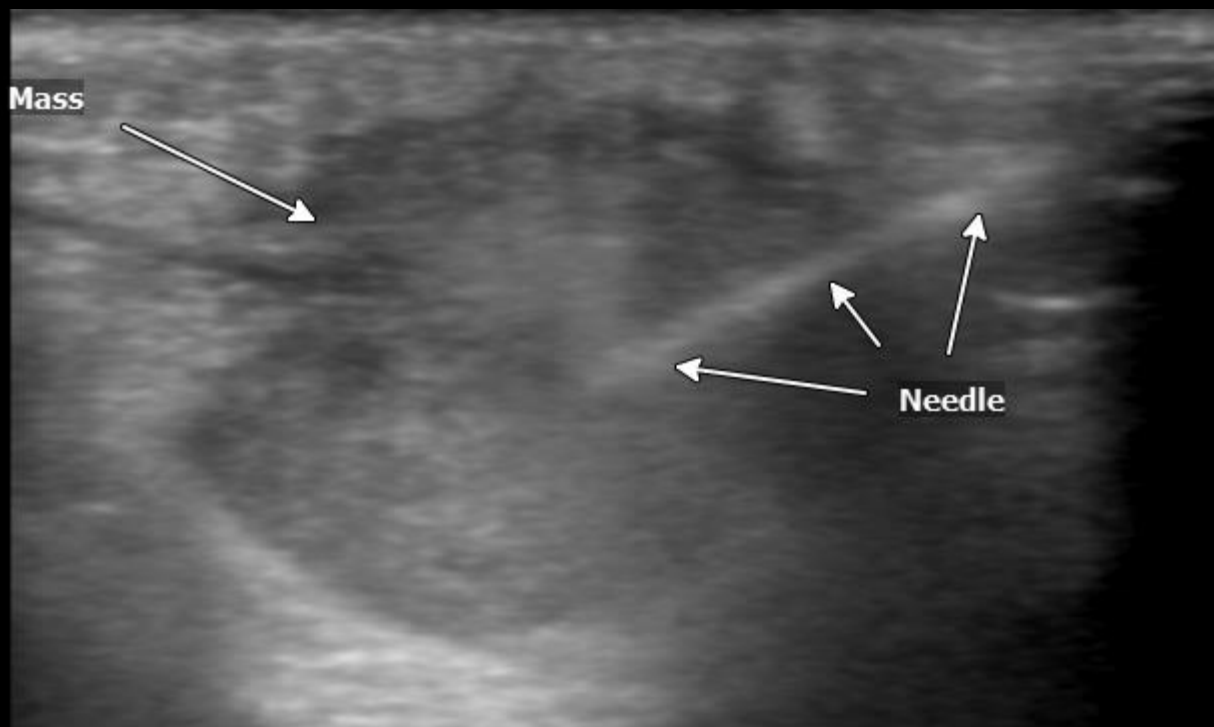
#1: Ultrasound guided core biopsy – neck mass

- 47-year-old patient
- Liver transplant
- Hospitalized with liver transplant rejection
- Awaiting new liver transplant

- Developed neck mass under chin

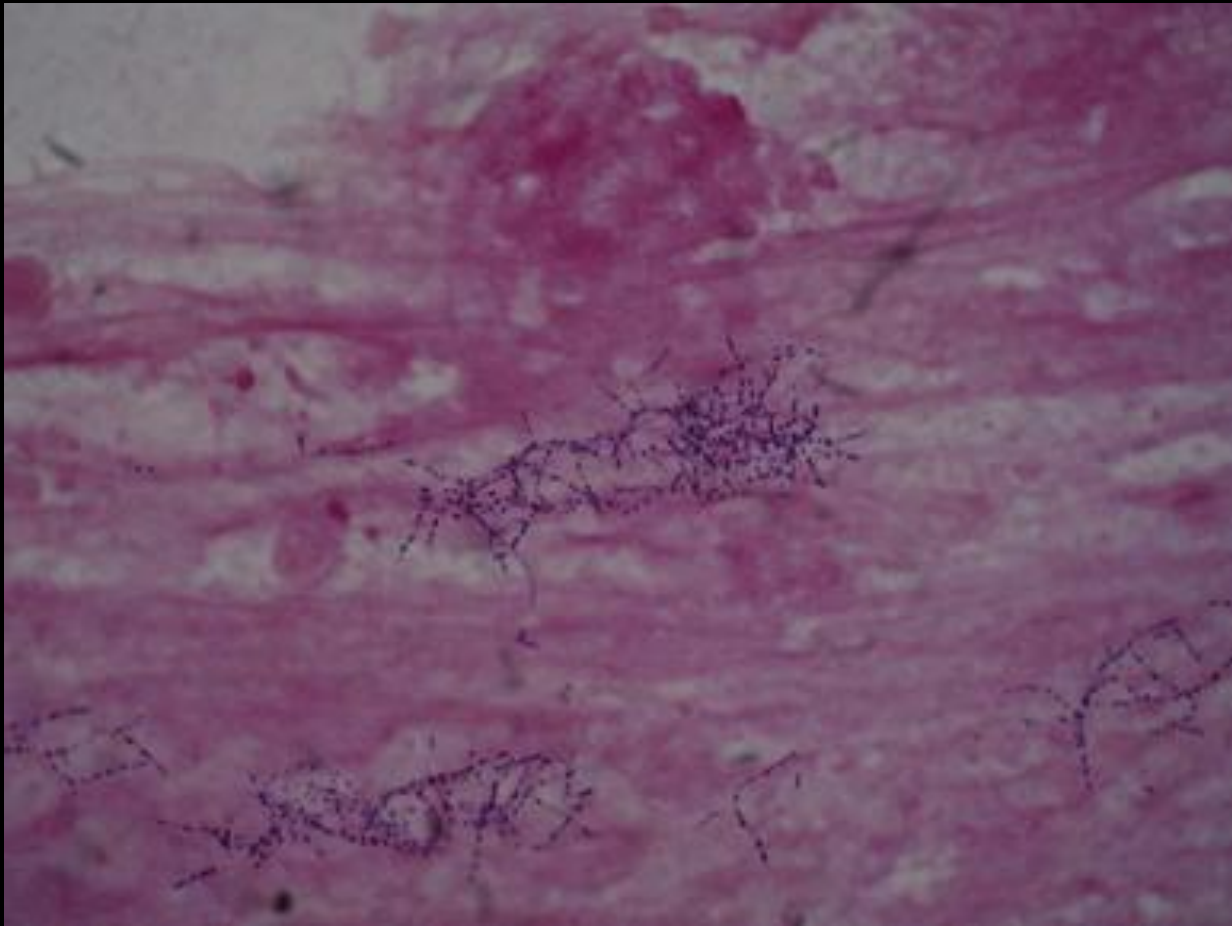


- Upper neck mass under the chin
- Concern for cancer, which would prevent new liver transplant



- Ultrasound guided core biopsy of upper neck mass

Diagnosis



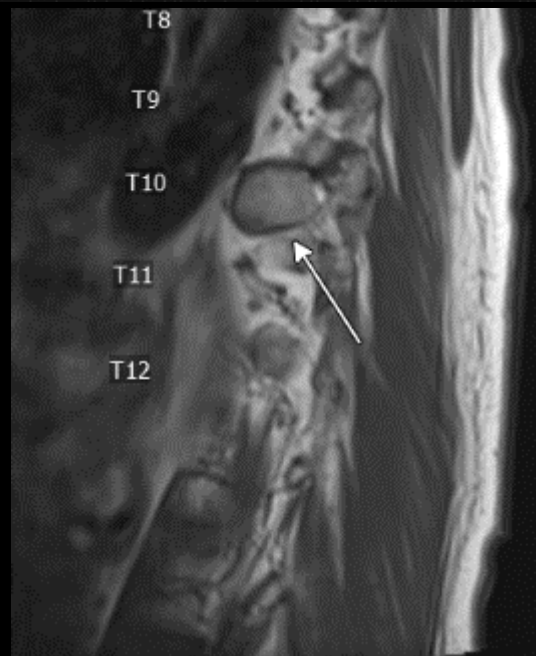
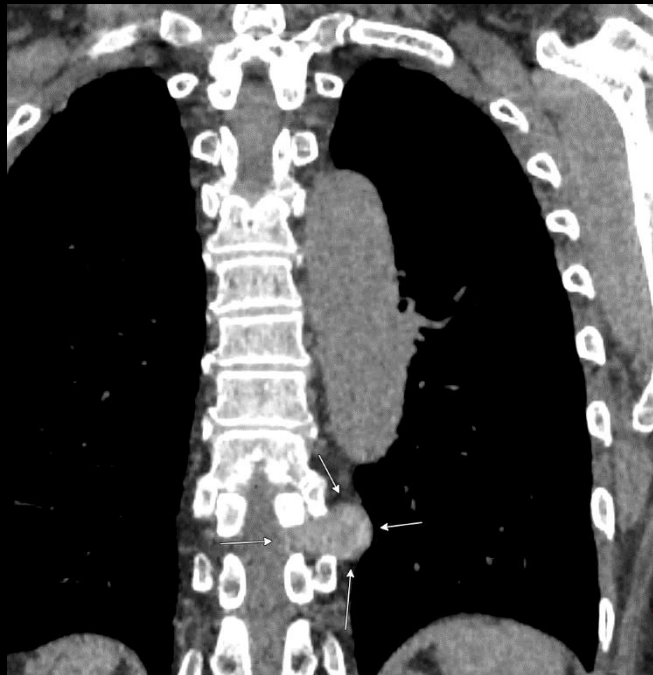
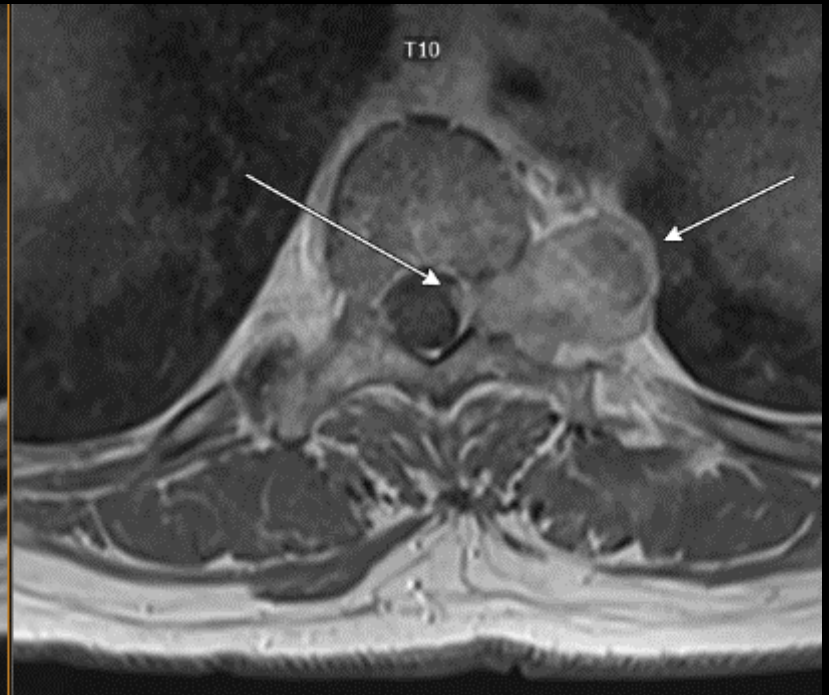
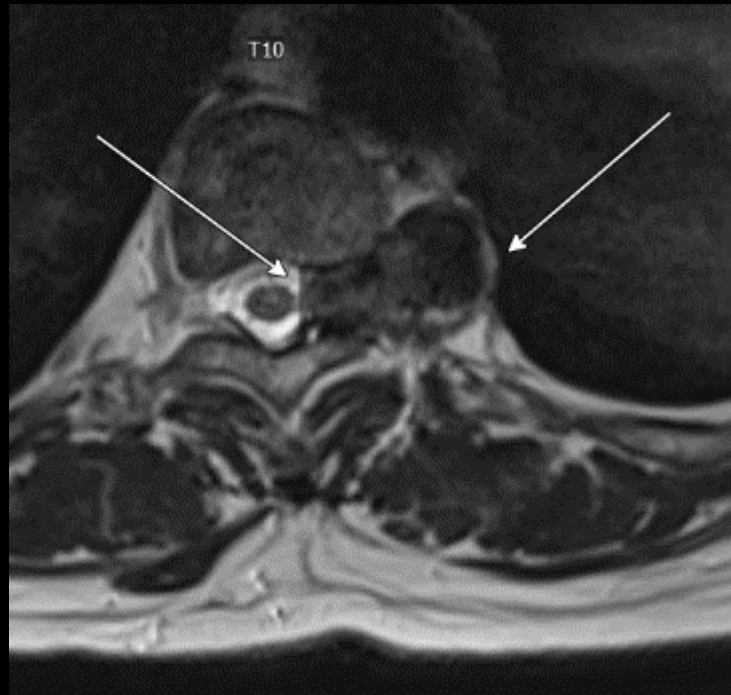
- No malignancy
- Inflammatory cells
- Ancillary testing
 - *Nocardia niwae*

#1: Ultrasound guided core biopsy – neck mass

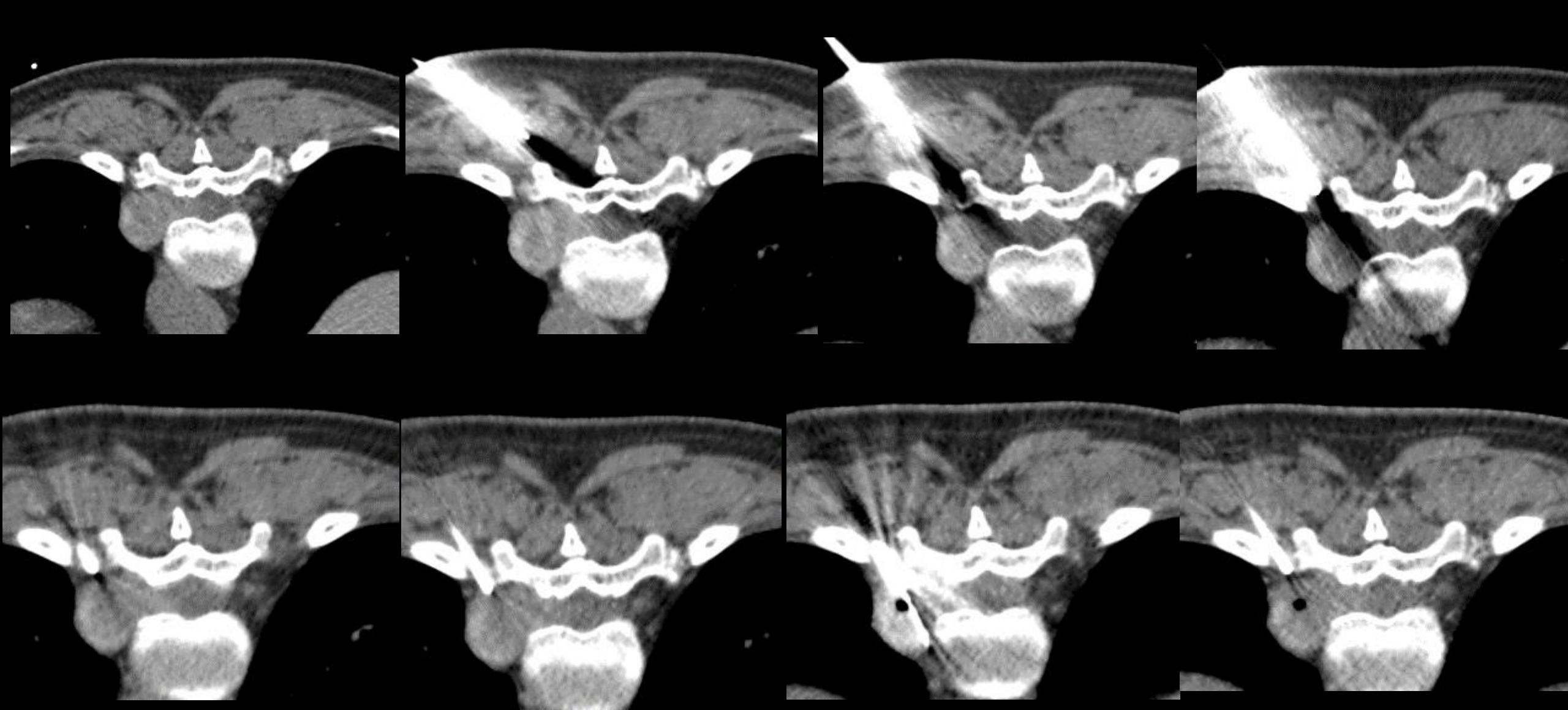
- *Nocardia niwae* lymphadenitis
- Very rare infection
- Organism found in soil
- Immune system suppression from transplant placed patient at risk

#2: CT guided core biopsy – spine

- 72-year-old patient
- CT of lungs to screen for lung cancer because of smoking history
- Incidentally discovered spine mass

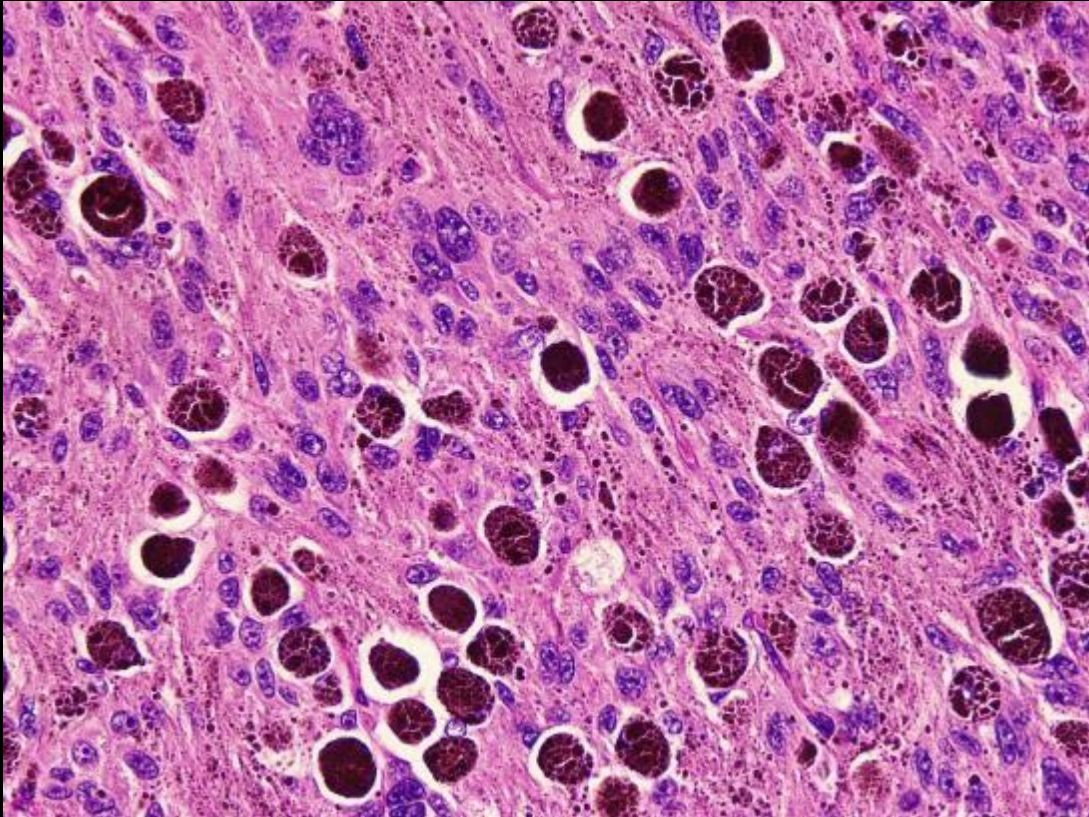


- Mass on left side of thoracic spine
- Most likely diagnosis is schwannoma
- Other tumors possible, but uncommon



- CT guided core biopsy of the mass
- Biopsy needle slowly advanced into the mass
- Repeat scanning after every needle manipulation

Diagnosis



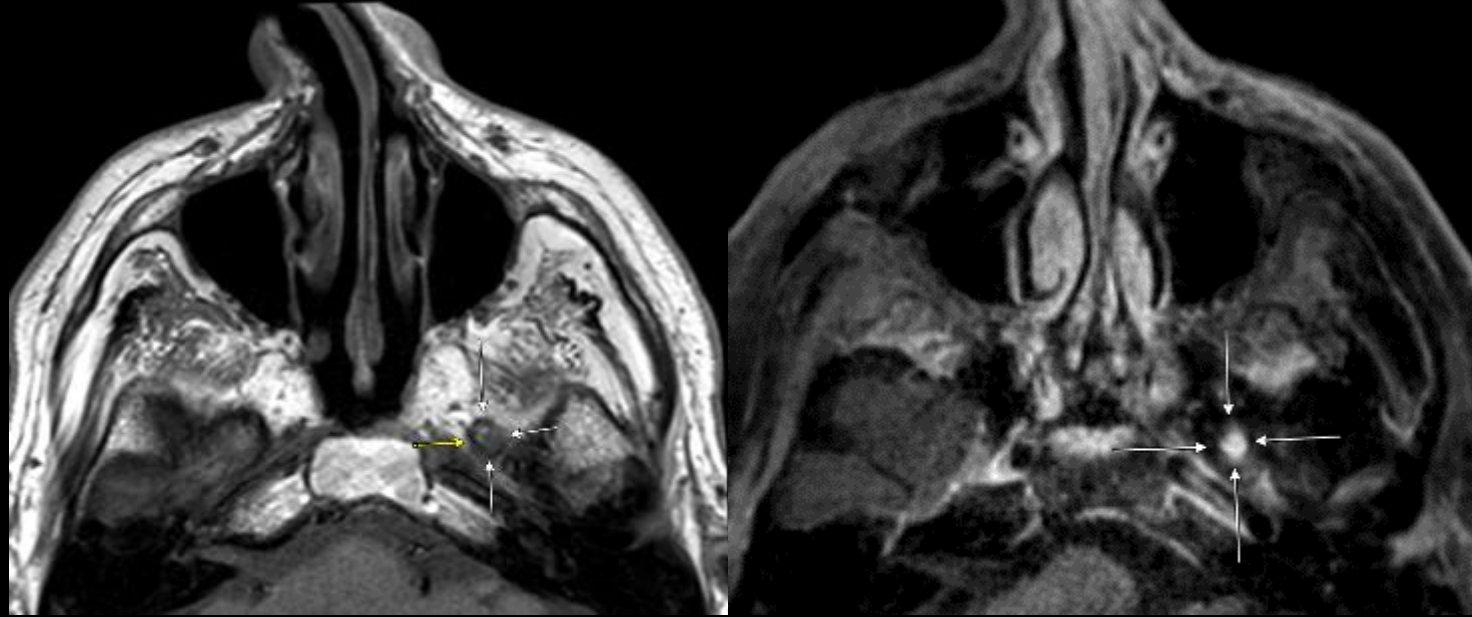
- Malignant melanotic nerve sheath tumor
- Aka melanotic schwannoma
- NOT benign schwannoma

#2: CT guided core biopsy – spine

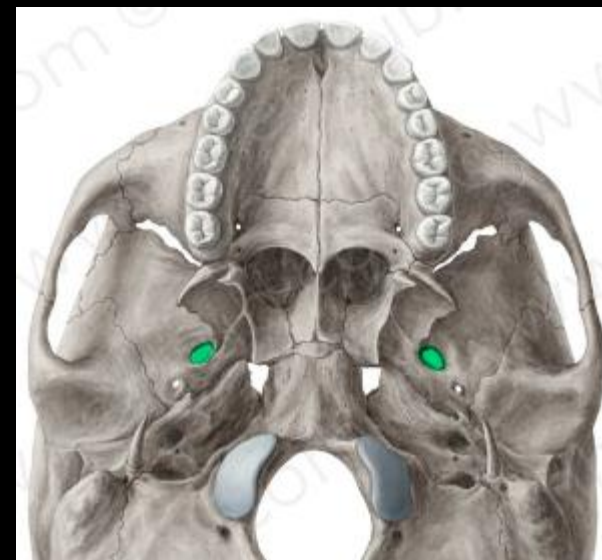
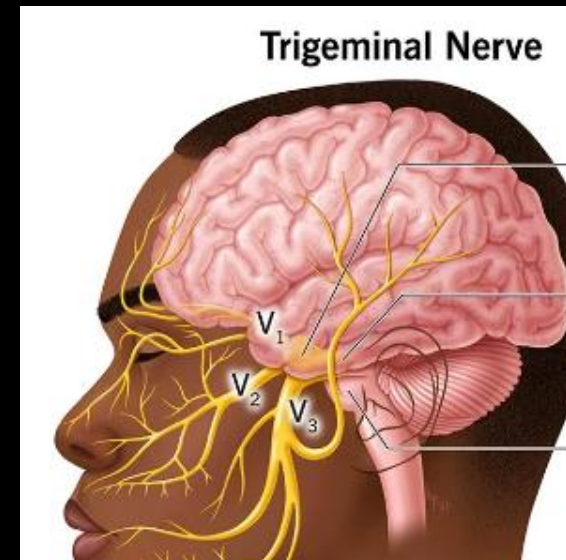
- Malignant melanotic nerve sheath tumor
- Rare tumor
- Less than 200 cases reported in medical literature
- Looks like benign schwannoma on imaging, but acts like malignant melanoma

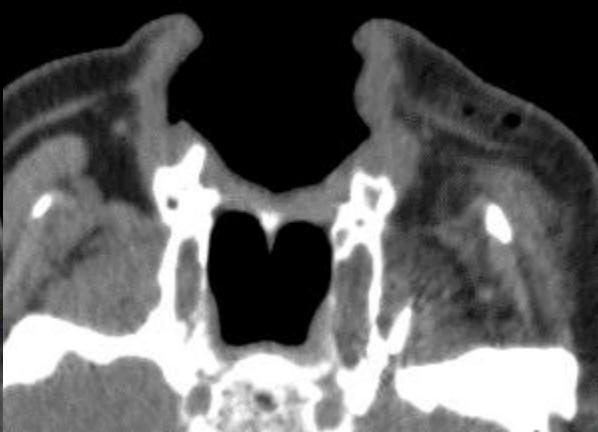
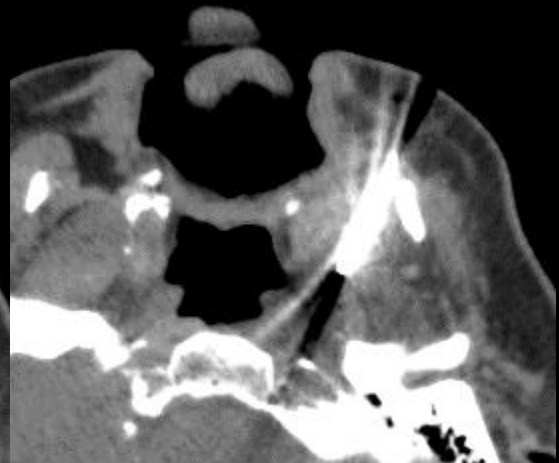
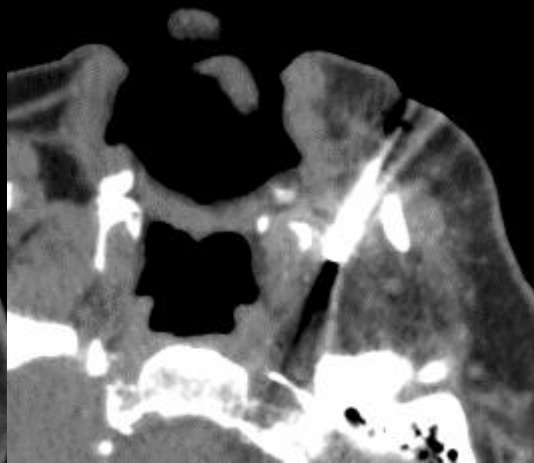
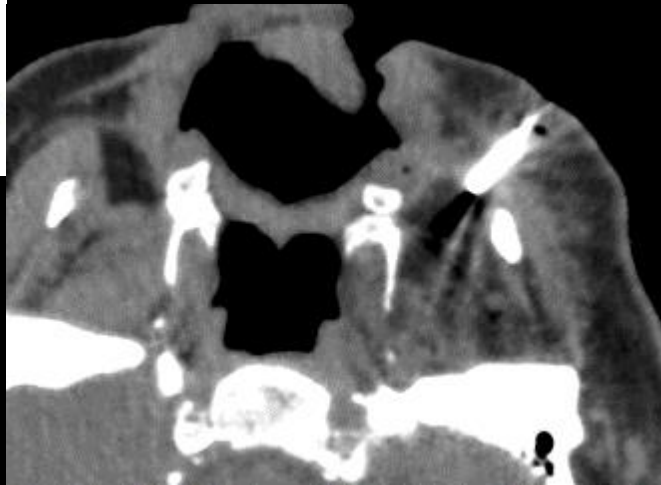
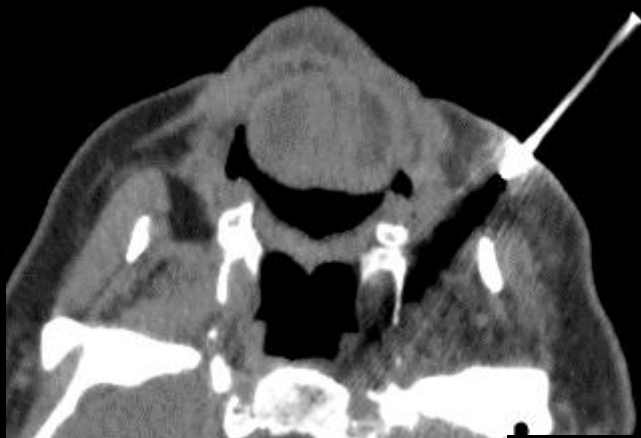
#3: CT guided FNA – nerve at skull base

- 73-year-old patient
- 1 year history of facial weakness, worsening over time
- New onset facial pain



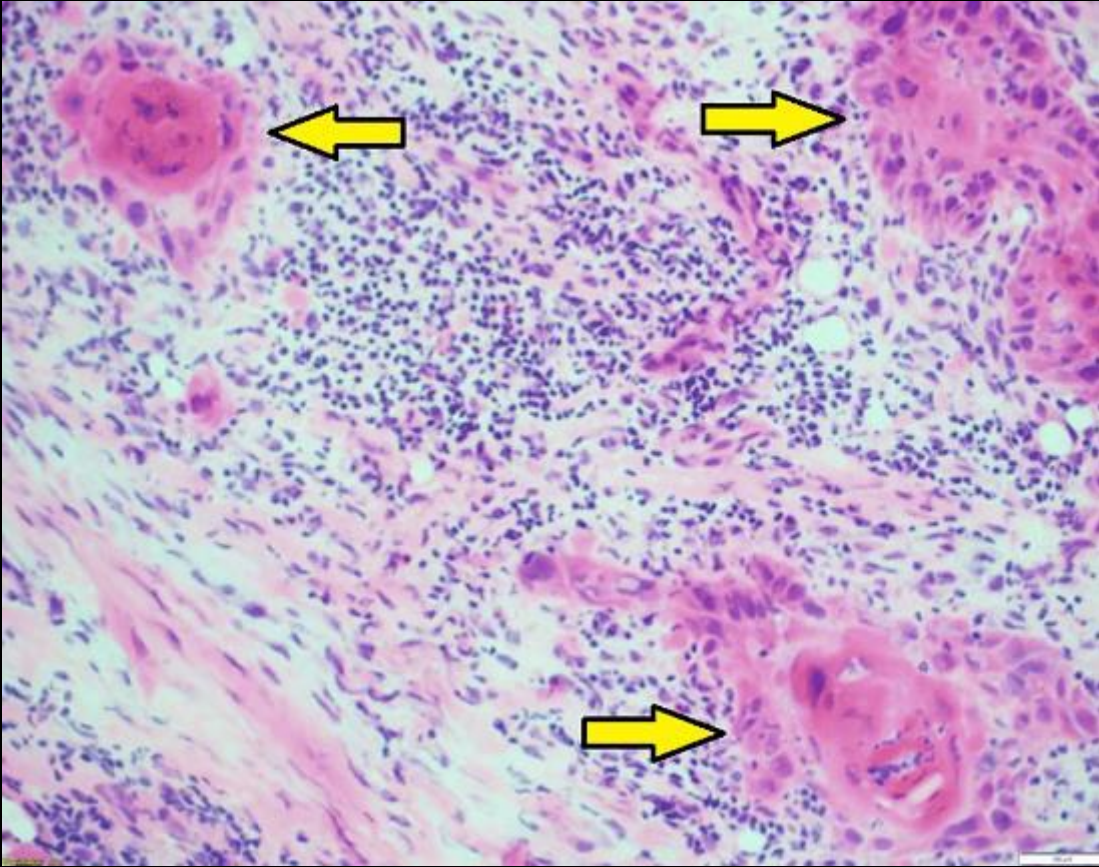
- Abnormal left trigeminal nerve at skull base
- Possibilities:
 - Viral infection (common)
 - Rare infections
 - Rare inflammatory disease (Covid)
 - Cancer





- CT guided FNA of left trigeminal nerve

Diagnosis



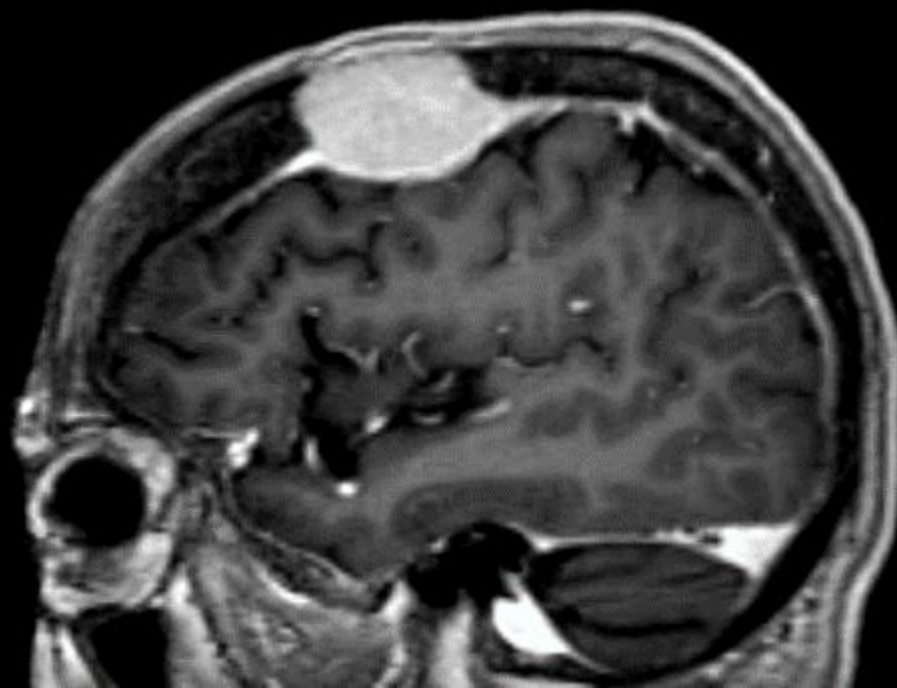
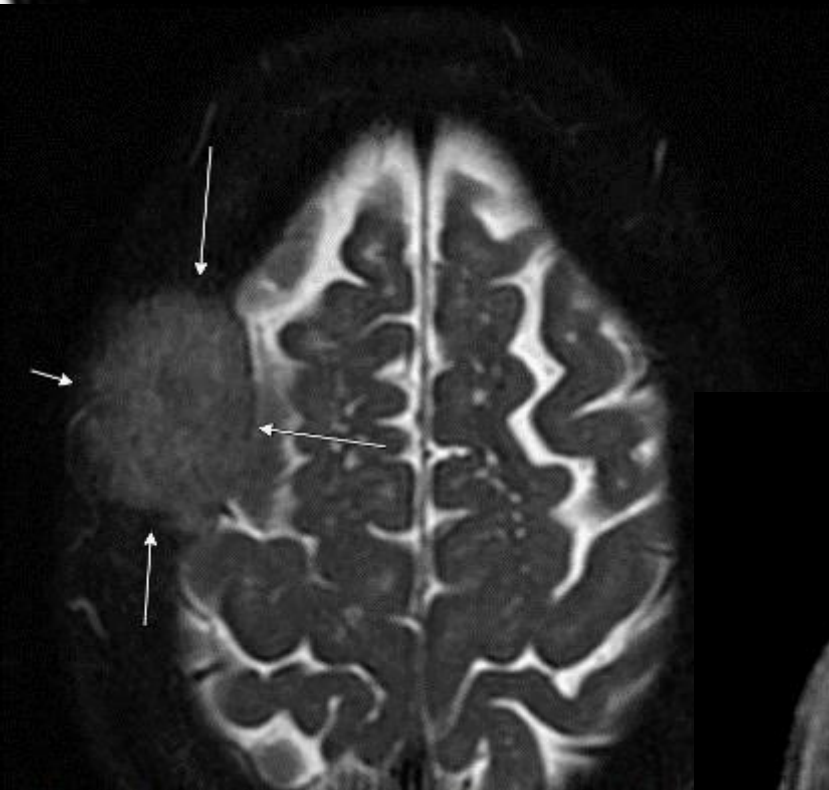
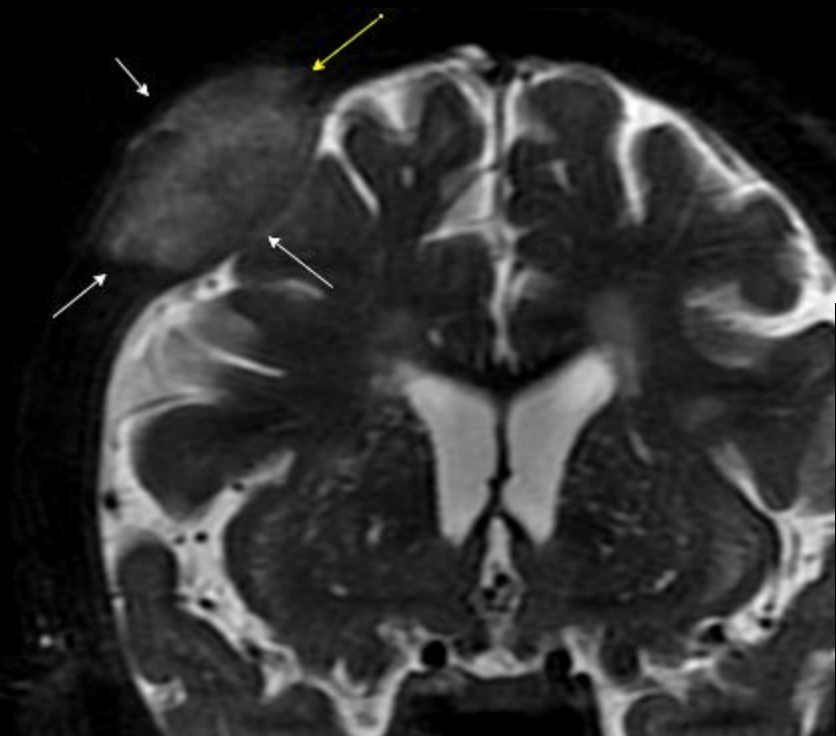
- Perineural invasion by squamous cell carcinoma

#3: CT guided FNA – nerve at skull base

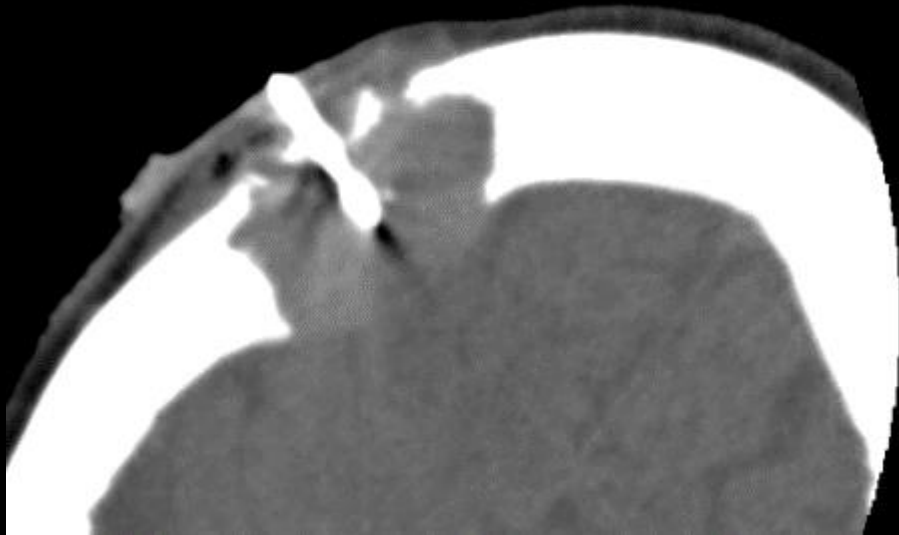
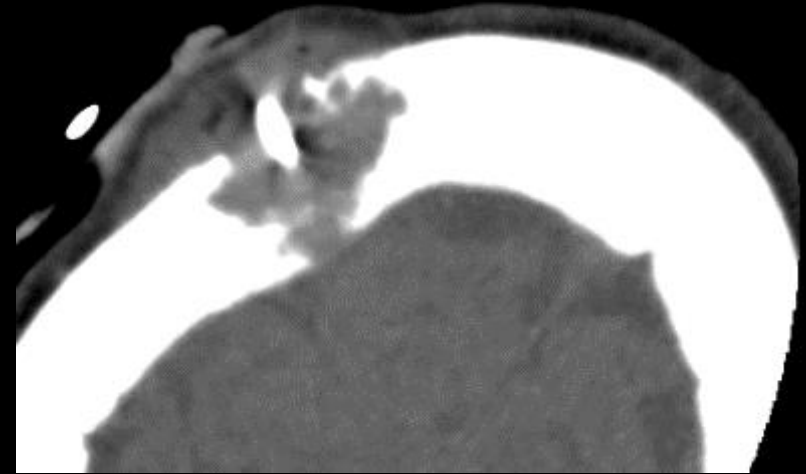
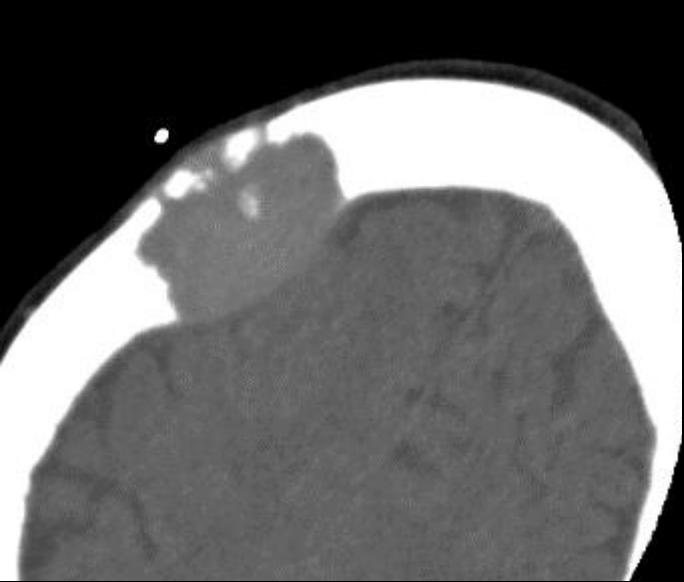
- Patient had a very remote history of skin cancer on left face
- This represented slow growing recurrent skin cancer on the nerves
- Squamous cell cancer of skin frequently grows along the nerves in skin

#4: CT-guided core biopsy - skull

- 74-year-old patient
- Bump on head
- History of pancreatic cancer that has been treated

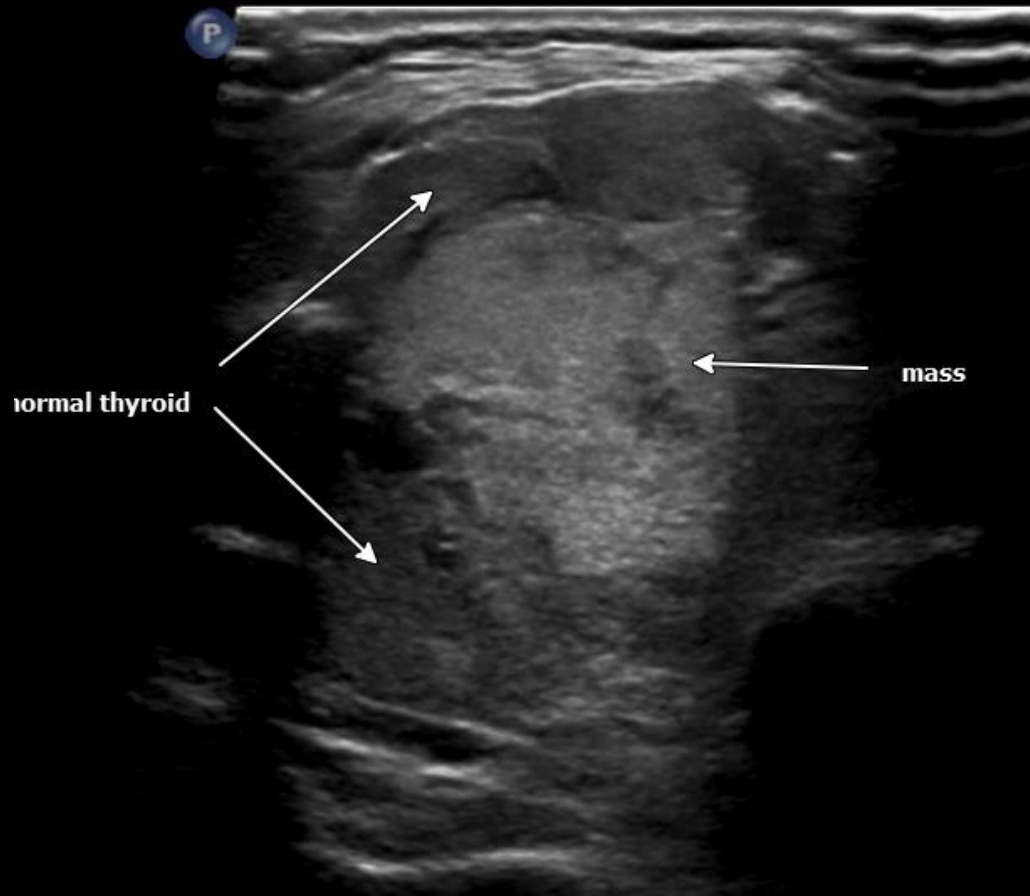


- Mass in the right skull
- Compressing the brain



- CT guided core biopsy of right skull

Diagnosis



- Metastatic carcinoma, consistent with follicular thyroid
- Metastasis from thyroid cancer

- Ultrasound images of thyroid gland

#4: CT-guided core biopsy - skull

- Patient had unknown thyroid cancer
- Underwent thyroidectomy, which confirmed thyroid cancer
- Currently receiving thyroid cancer therapy...very different than therapy for metastatic pancreatic cancer!

#5: Ultrasound guided FNA – parotid gland mass

- 76-year-old patient
- Lump on left face



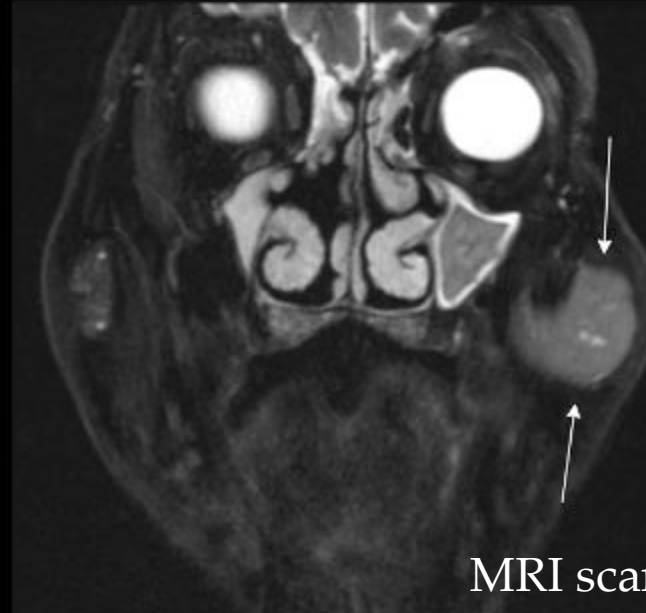
CT scan



CT scan

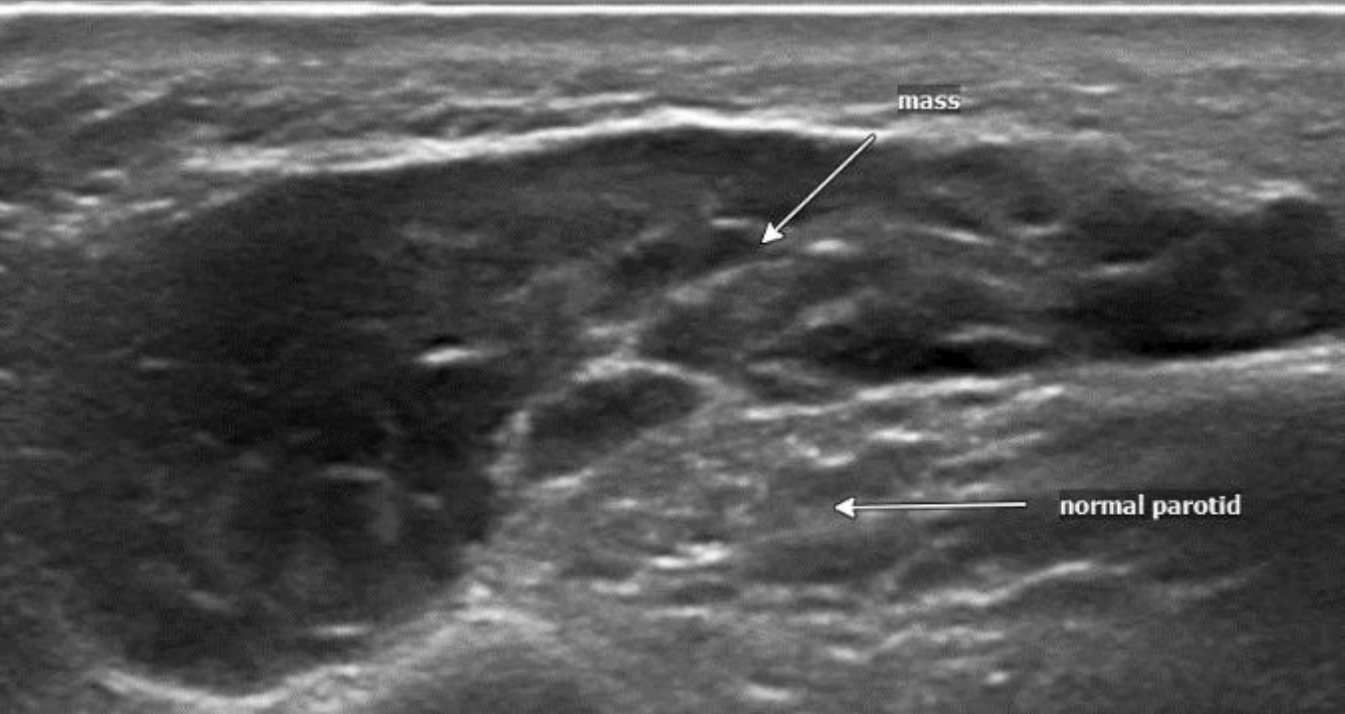


MRI scan



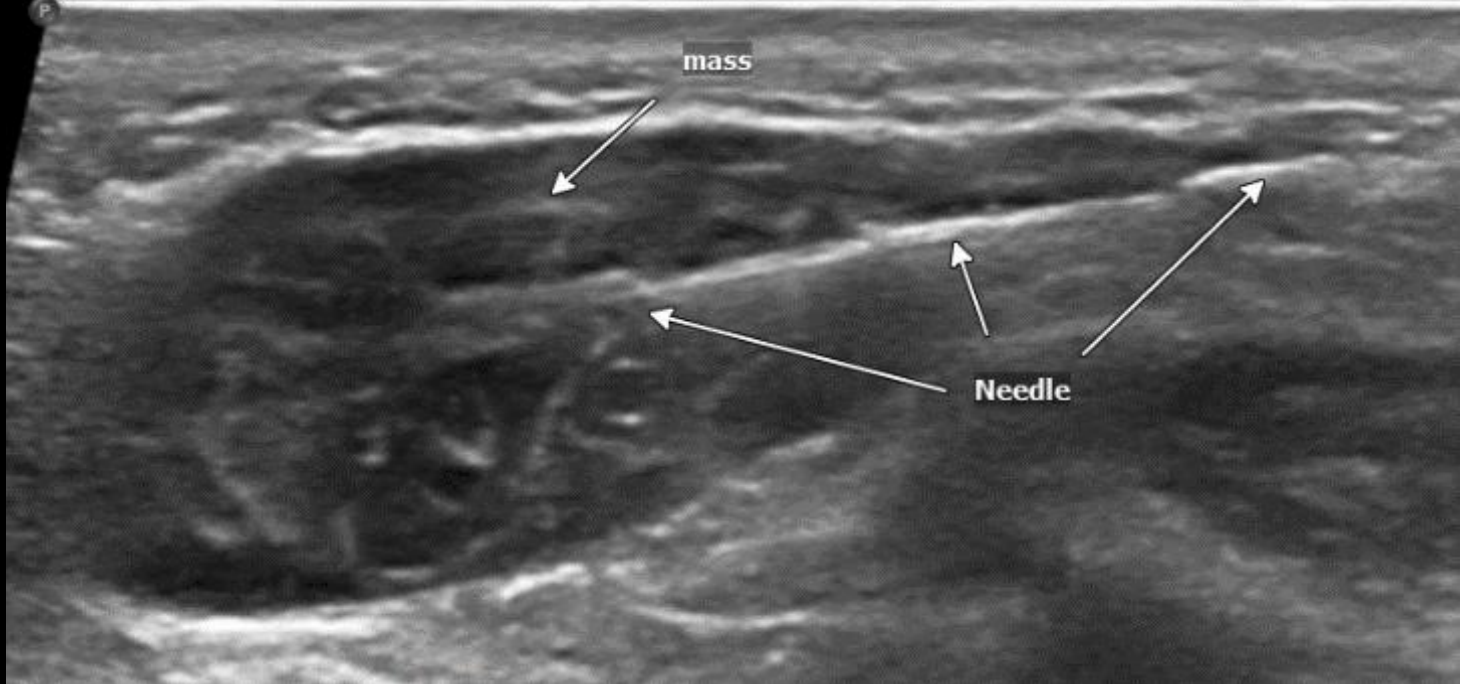
MRI scan

- Mass in the left parotid gland
- Most likely an epithelial tumor, but other rare tumors are possible

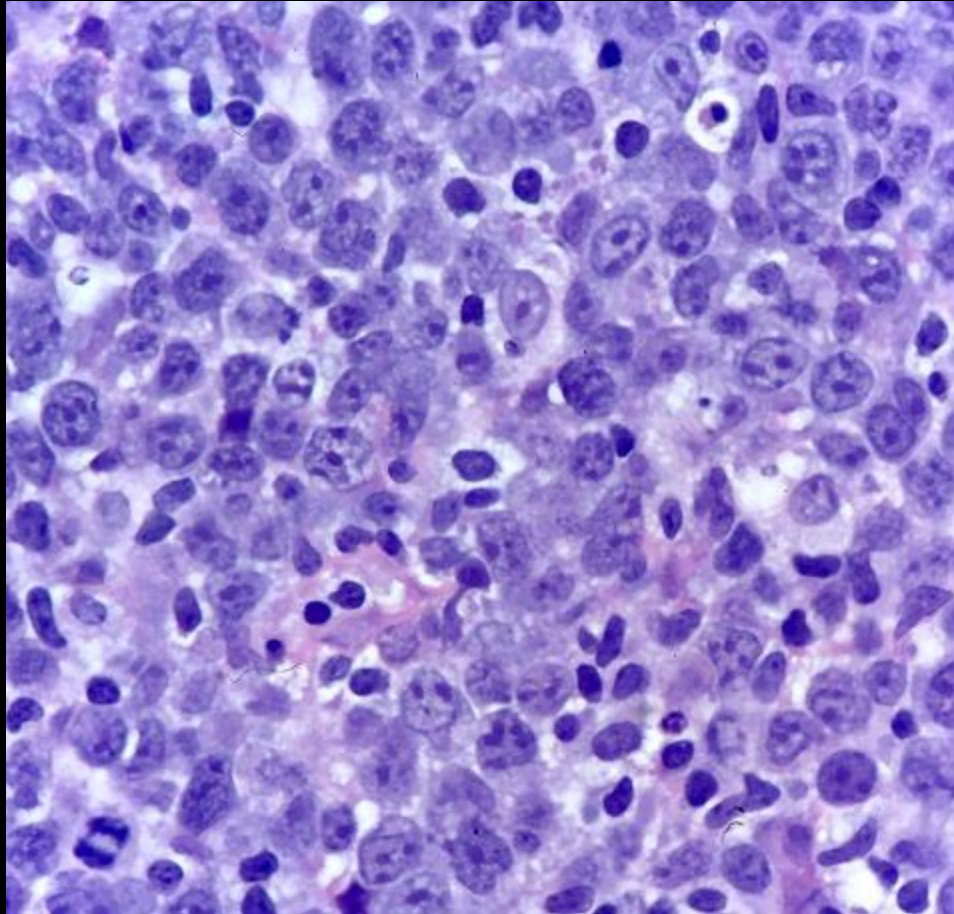


- Biopsy of the left parotid gland mass

- Ultrasound of the left parotid gland mass



Diagnosis



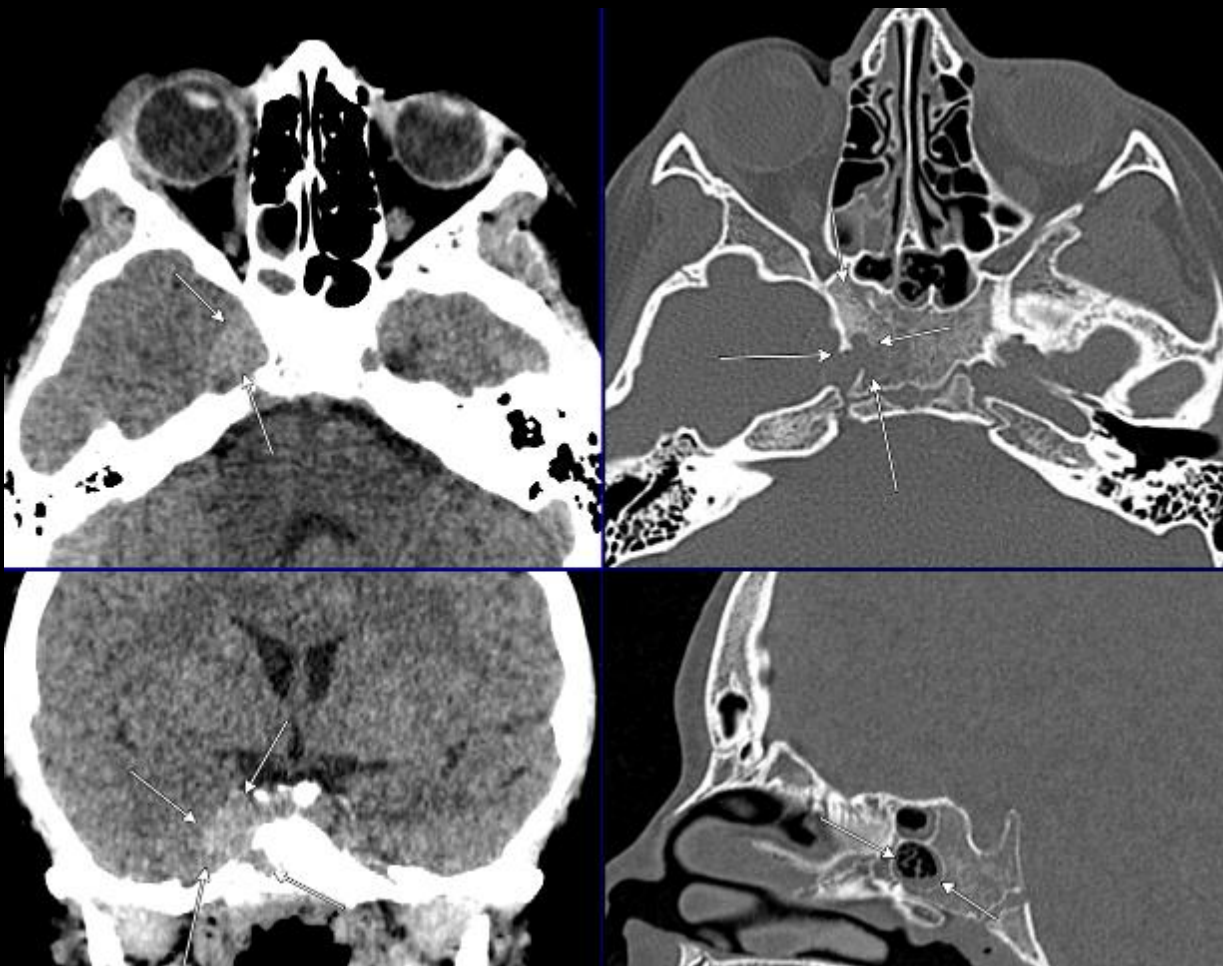
- Low grade B Cell lymphoma

#5: Ultrasound guided FNA – parotid gland mass

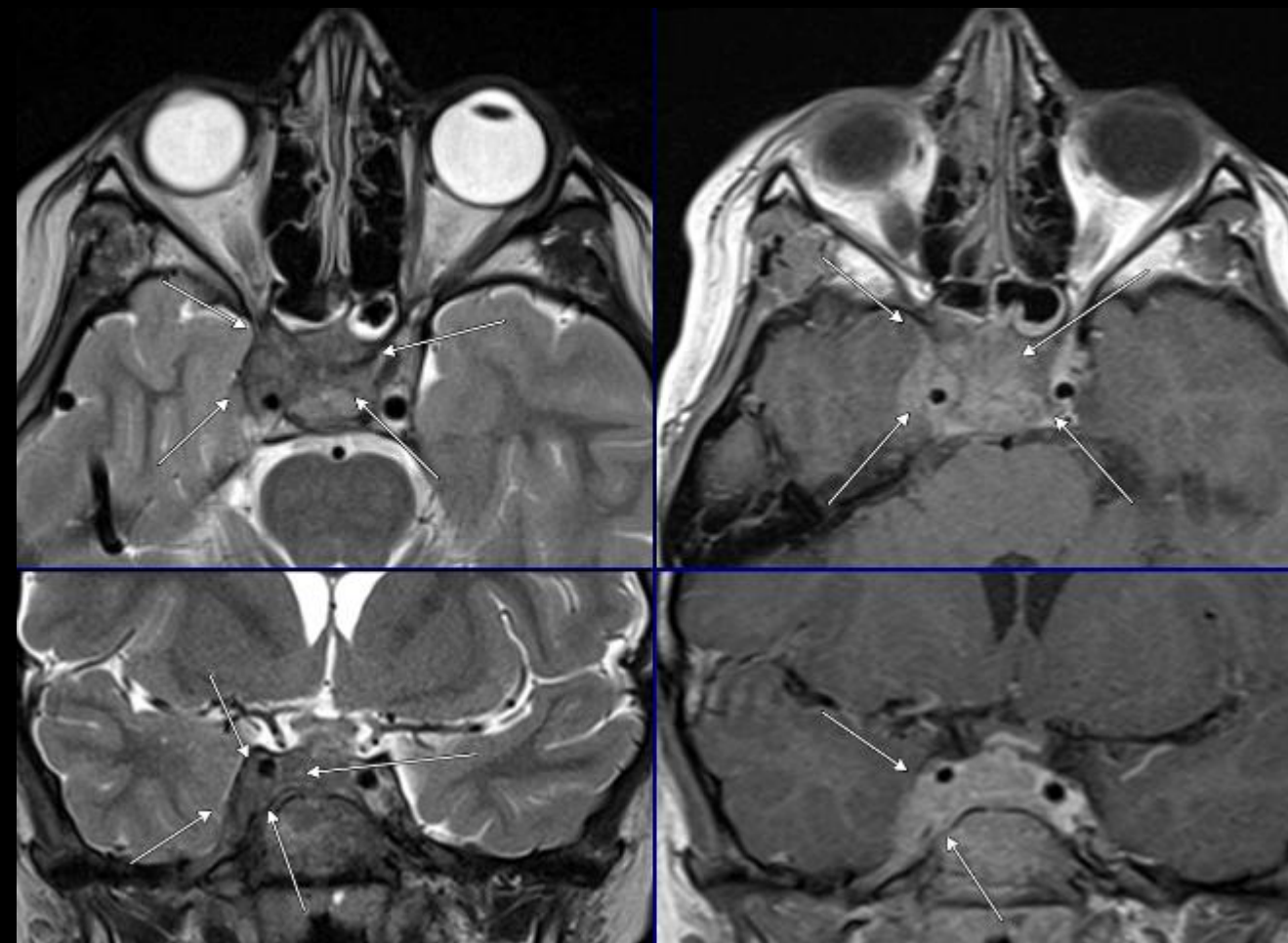
- Low grade B cell lymphoma
- Treatment is chemotherapy and/or radiation...NOT surgery
- If it had been epithelial tumor (pleomorphic adenoma), then surgery would have been primary treatment

#6: CT-guided core biopsy – skull base

- 11-year-old patient
- Several months of double vision and headache
- No significant medical history

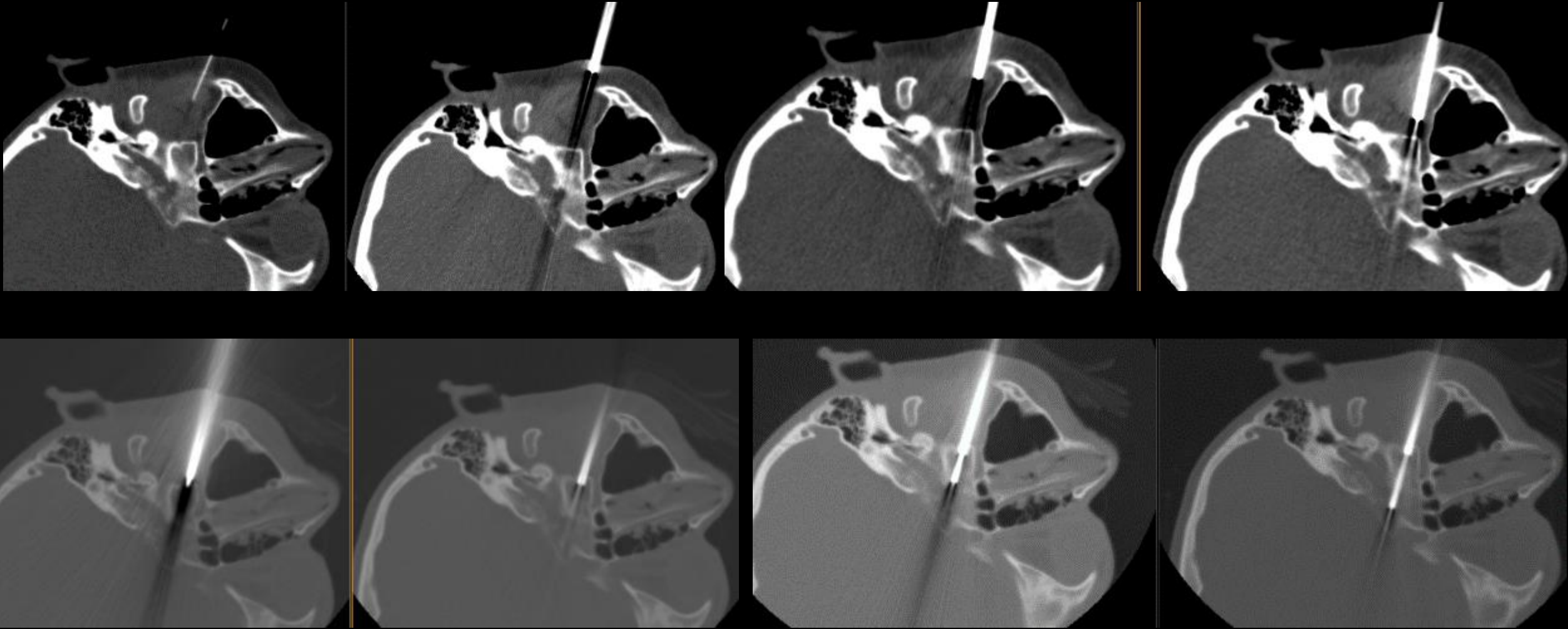


CT scan



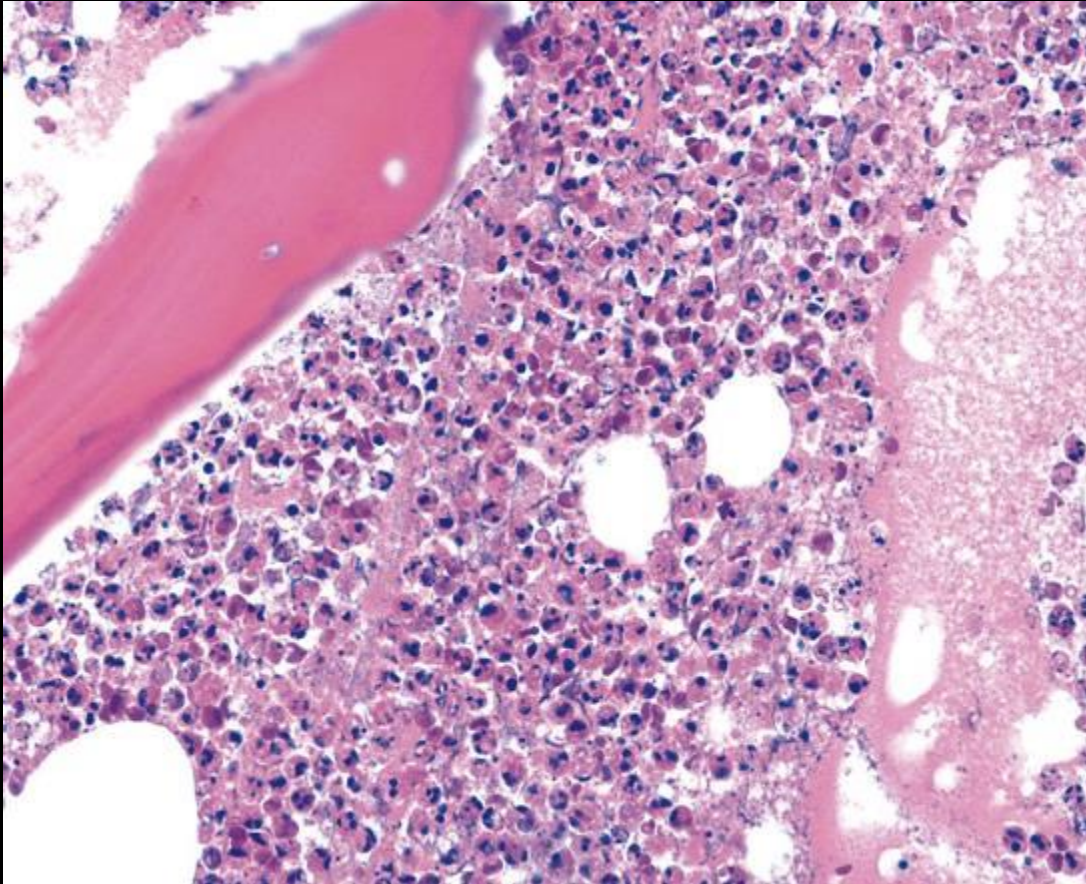
MRI scan

- Mass in the skull base on the right side near the paranasal sinuses
- Involving cavernous sinus...location of oculomotor nerves
- Involves the bone of the central skull base
- Appearance most concerning for malignant tumor: lymphoma or sarcoma



- CT guided core biopsy of the central skull face
- Trajectory is through the right cheek

Diagnosis



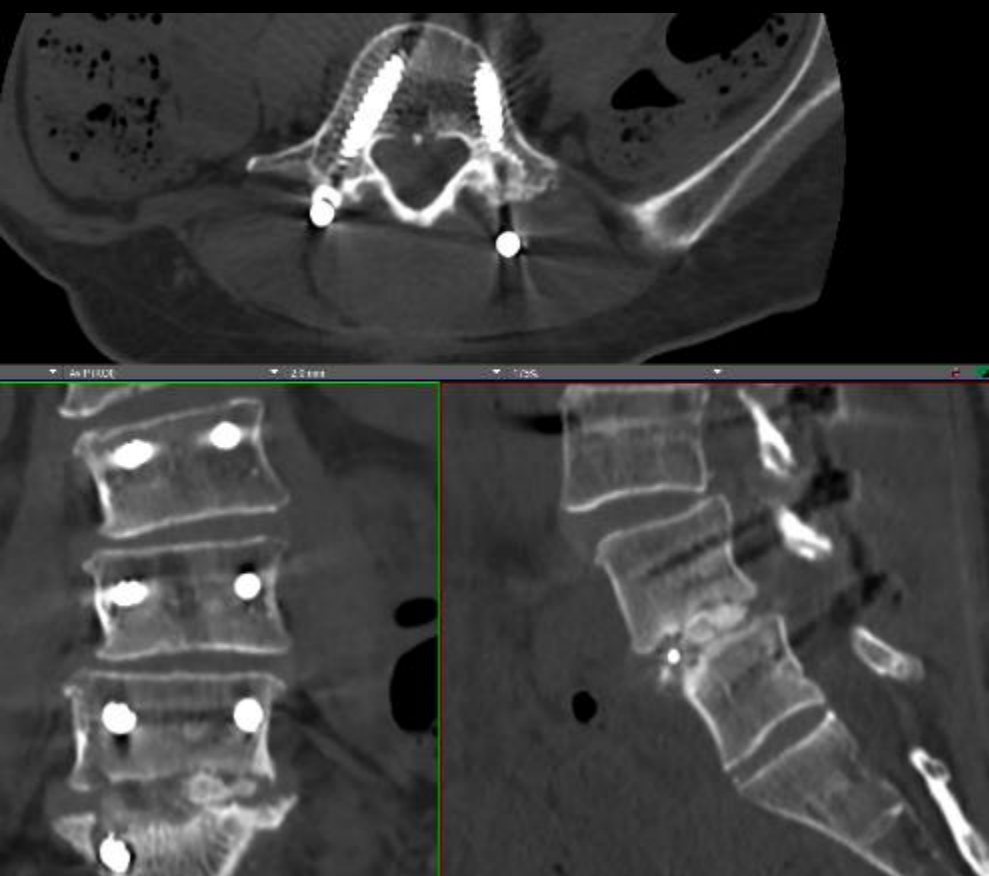
- Bone marrow with inflammation and infection
 - Osteomyelitis
- No evidence of malignancy
- Culture:
 - Multiple organisms
 - *Rothia mucilaginosa*
 - *Viridans streptococcus*
 - *Staphylococcus sp*
 - *Cutibacterium acnes*

#6: CT-guided core biopsy – skull base

- Biopsy excluded cancer and confirmed infection
- Treated with long term antibiotics
- No need for surgery, chemotherapy, or radiation

#7: CT-guided core biopsy – spine

- 73-year-old patient
- History of back pain and spinal stenosis
- Recent lumbar spine fusion surgery
- Patient presented with worsening back pain 10 weeks after surgery

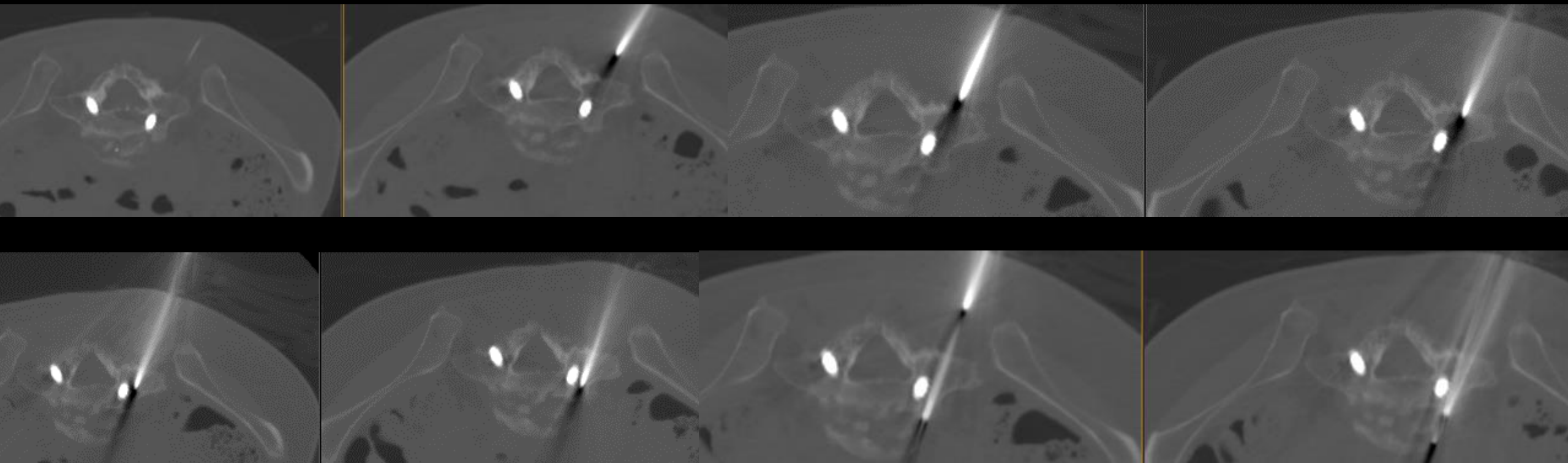


CT scan



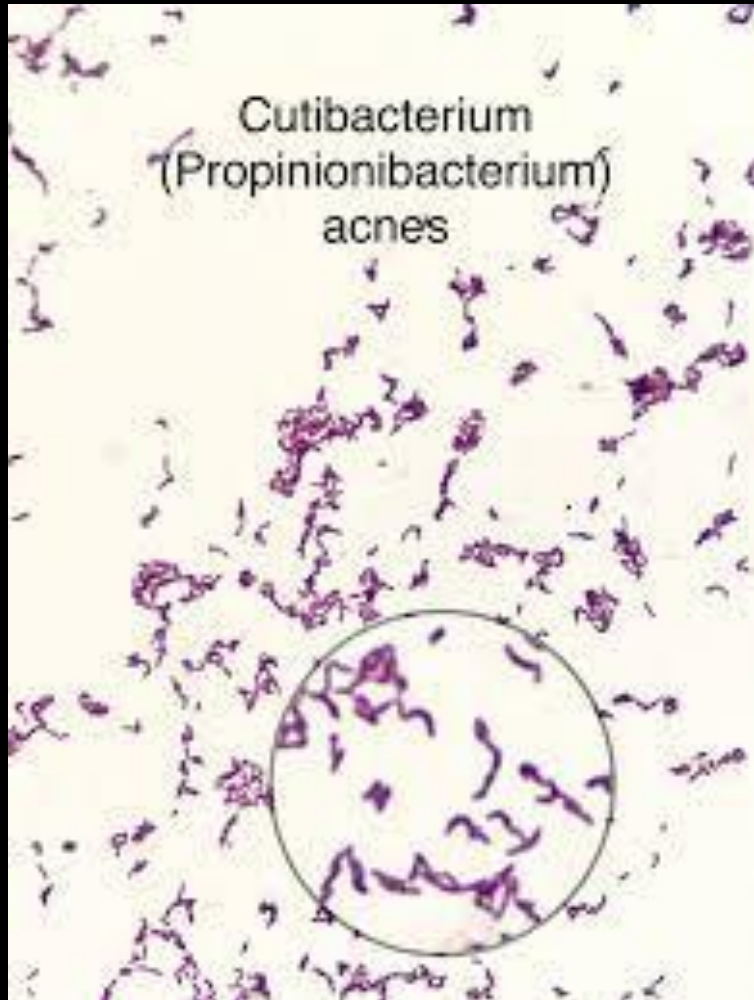
MRI scan

- MRI shows swelling in the bones and soft tissues
- Could be related to surgery, but surgery was 10 weeks ago
- Concern for hardware infection



- CT guided core biopsy of the L5-S1 disc space
- Sample obtained for culture to identify possible organism

Diagnosis



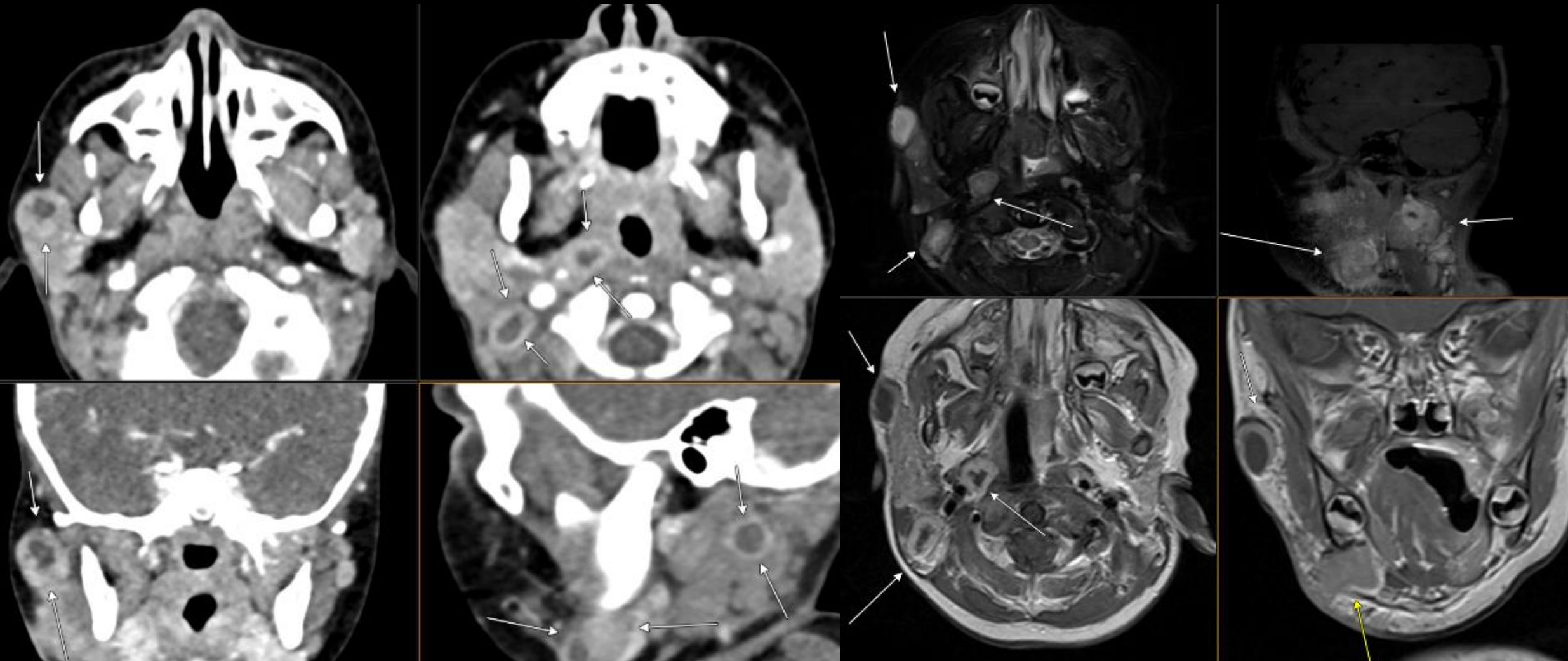
- Positive culture:
 - *Cutibacterium acnes*

#7: CT-guided core biopsy – spine

- Biopsy confirmed infection of the operated level
- Patient treated with long term antibiotics
- Fusion hardware left in place

#8: Ultrasound guided core biopsy – neck mass

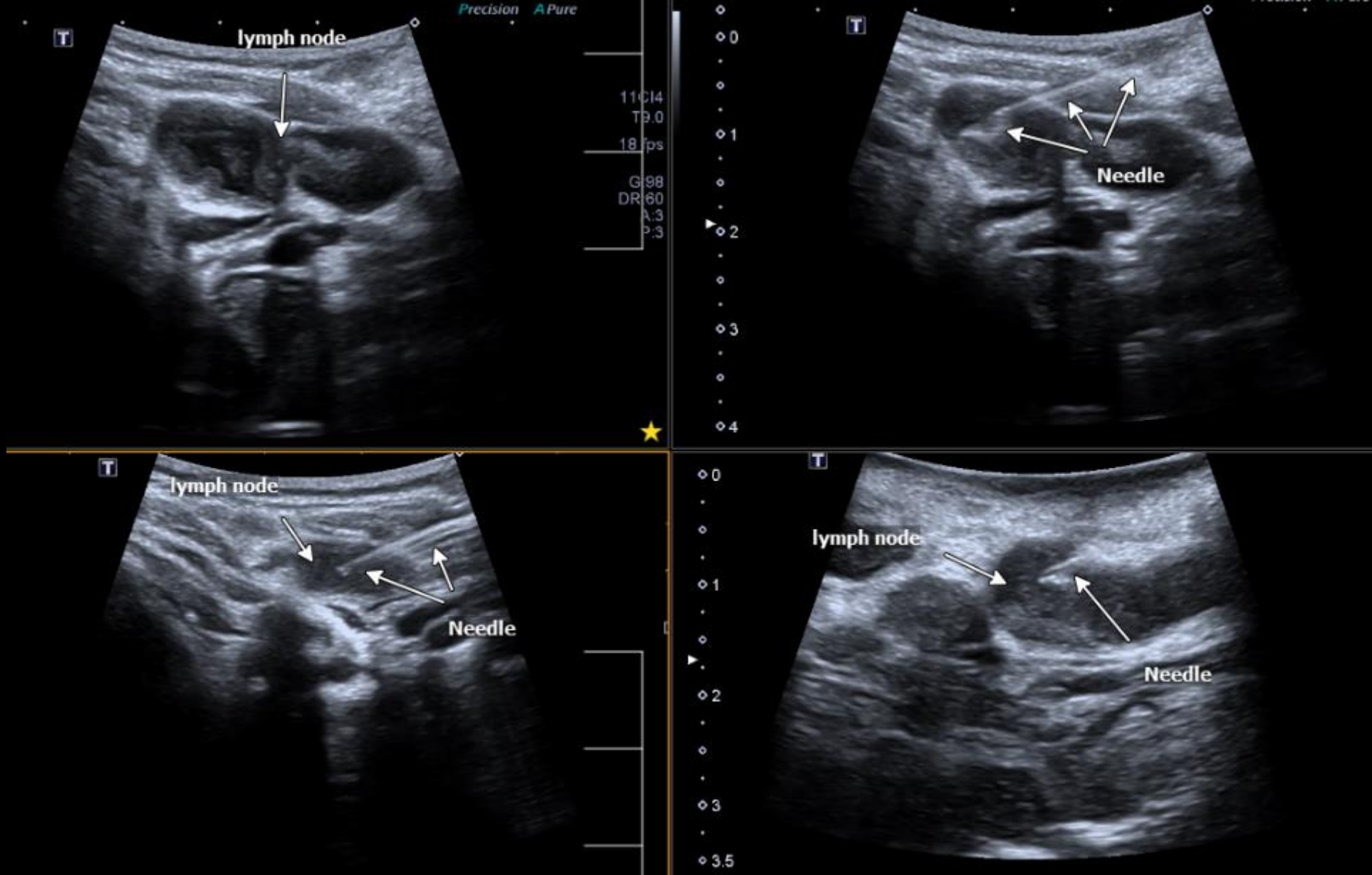
- 22-month-old patient
- Enlarging right neck masses
- Right neck wound
- No significant medical history



CT scan

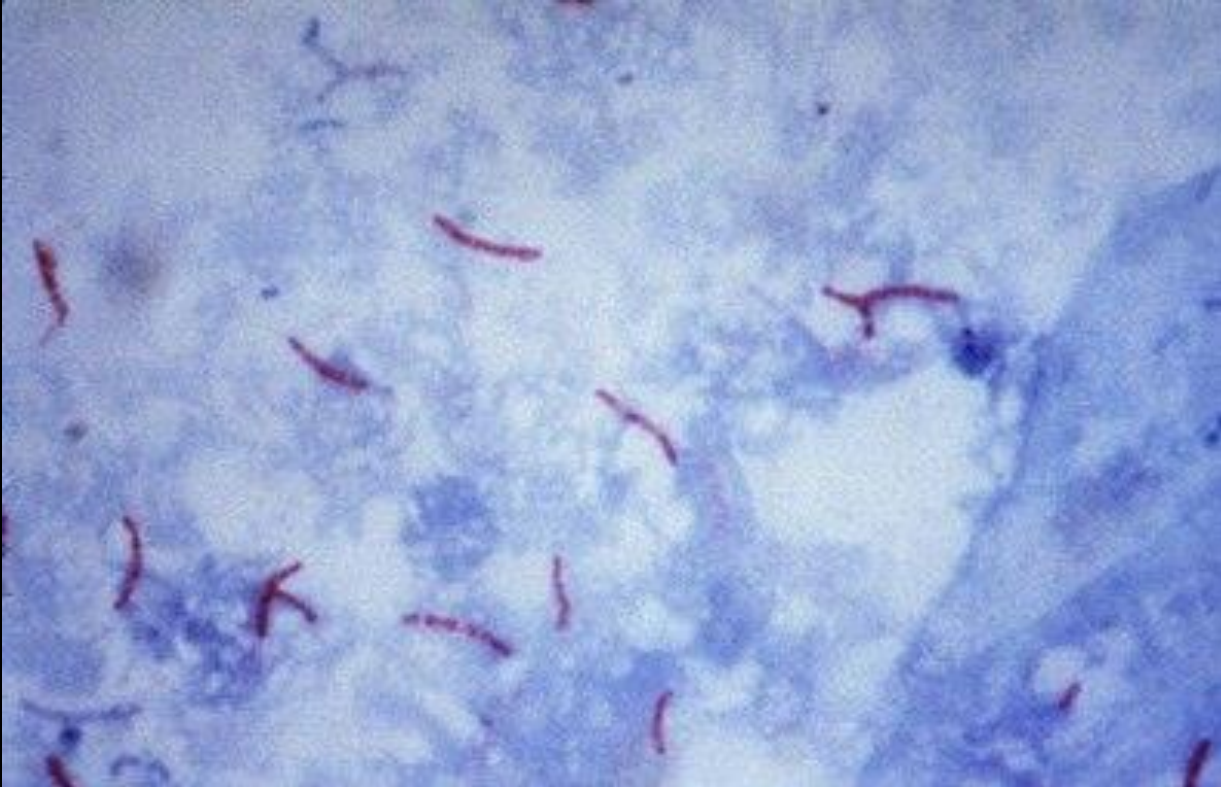
MRI scan

- CT and MRI shows multiple neck masses having the appearance of multiple enlarged lymph nodes
- Primary concern is malignant tumor of the neck with lymph node metastases



- Ultrasound guided core biopsy of one of the right neck lymph nodes

Diagnosis



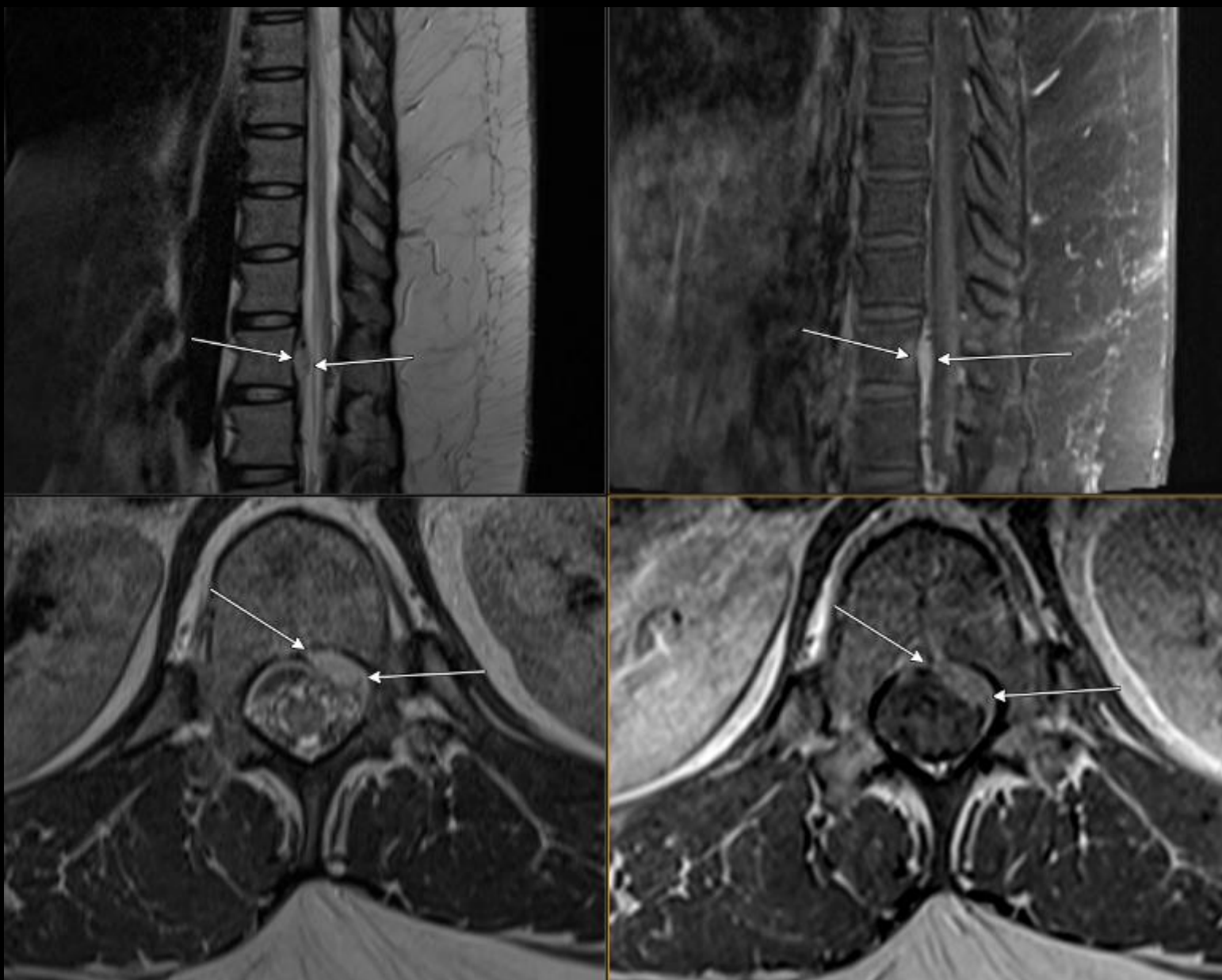
- No malignancy
- Inflammation of lymph node
 - lymphadenitis
- Positive culture:
 - *Mycobacterium avium complex*

#8: Ultrasound guided core biopsy – neck mass

- Biopsy excluded cancer and confirmed infection
- *Mycobacterium avium complex*
 - Common in the environment...water, household dust, soil
 - Related to *Mycobacterium tuberculosis* (responsible for tuberculosis)
 - Can infect lymph nodes anywhere in the body...lymphadenitis
- Nontuberculous mycobacterial cervical lymphadenitis
 - Hard to treat
 - Long term antibiotics
 - If antibiotics fail may need surgery to remove all of the lymph nodes

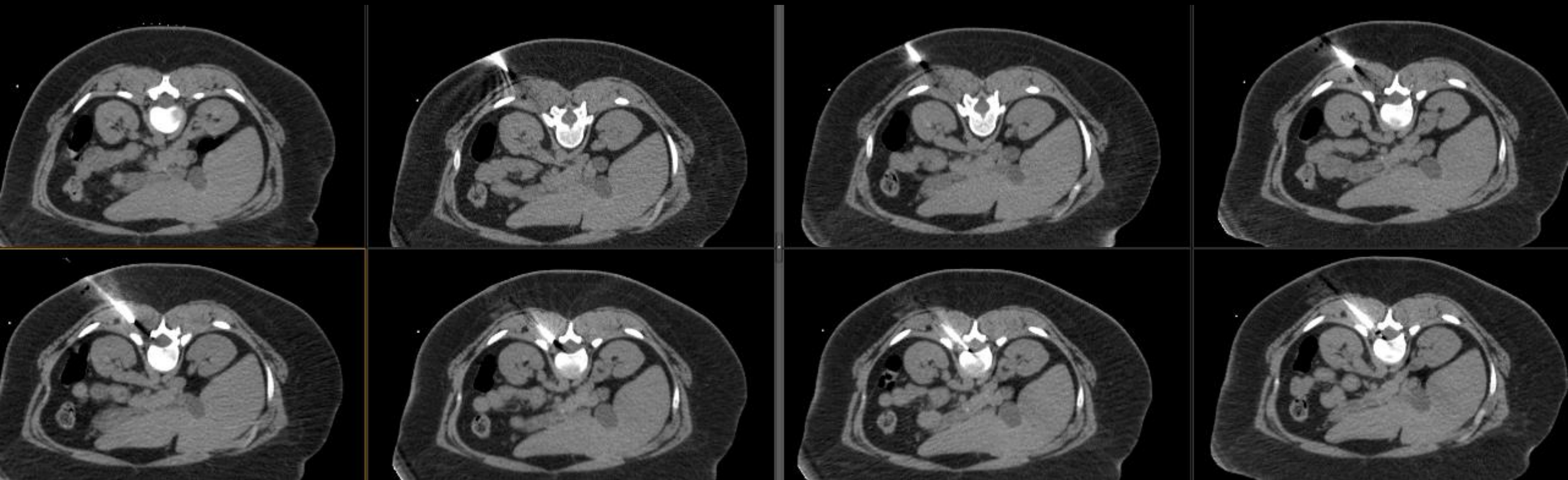
#9: CT-guided core biopsy – spine

- 16-year-old patient
- History of treated neuroblastoma
- Screening MRI of the spine revealed a very small lesion



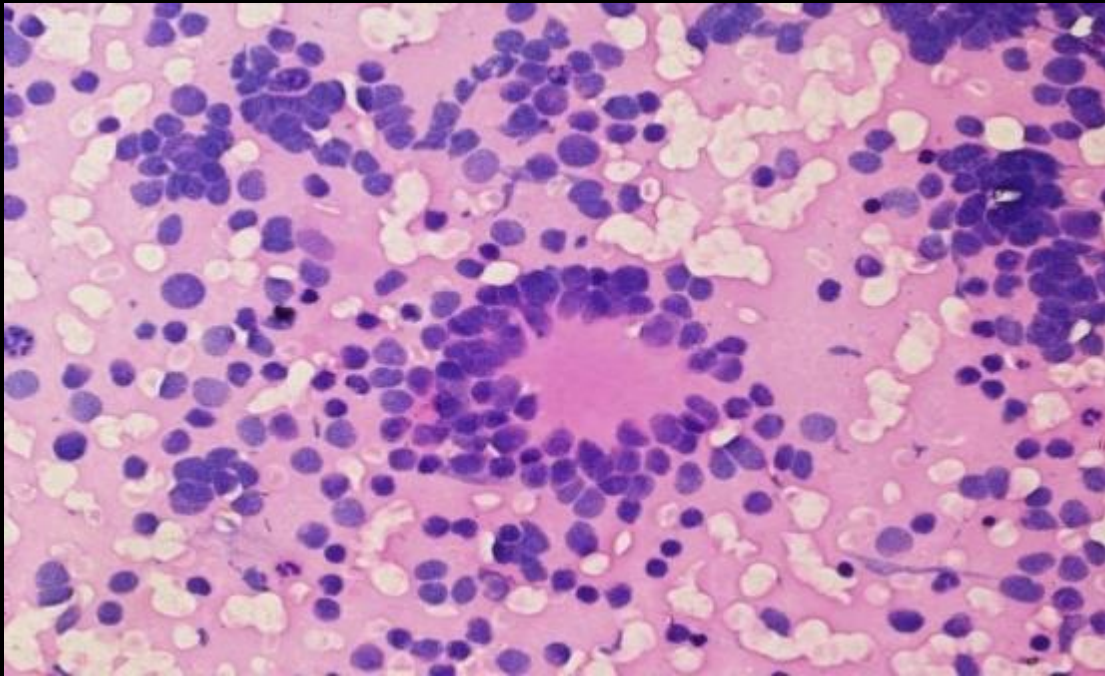
MRI scan

- MRI shows a small mass in the lower thoracic spine very suspicious for recurrent neuroblastoma
- Difficult location to biopsy, but tissue diagnosis confirming recurrence important for treatment



- CT guided core biopsy of the mass
- Biopsy needle slowly advanced into the spinal canal
- Repeat scanning after every needle manipulation

Diagnosis



- Abnormal small round blue cells
- Suspicious for recurrent neuroblastoma

#9: CT-guided core biopsy – spine

- Biopsy confirmed presence of recurrent disease
- New treatment initiated

Thank you!

- Questions?