



Cancer is Not the Answer

Getting Upset by PET False Positives in the Head, Neck and Skull Base

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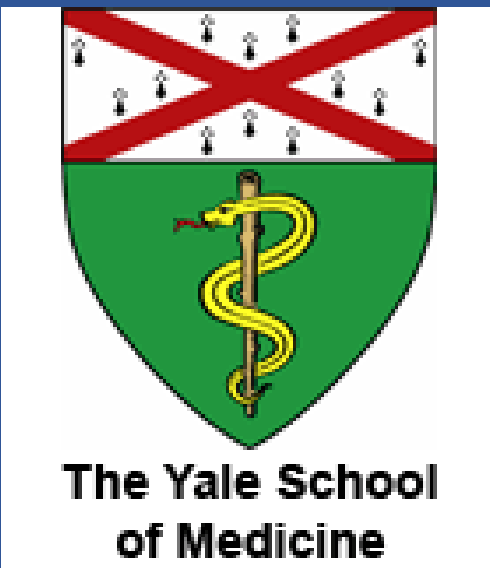


Figure 1- Skull Base Anatomy & Cranial Nerves

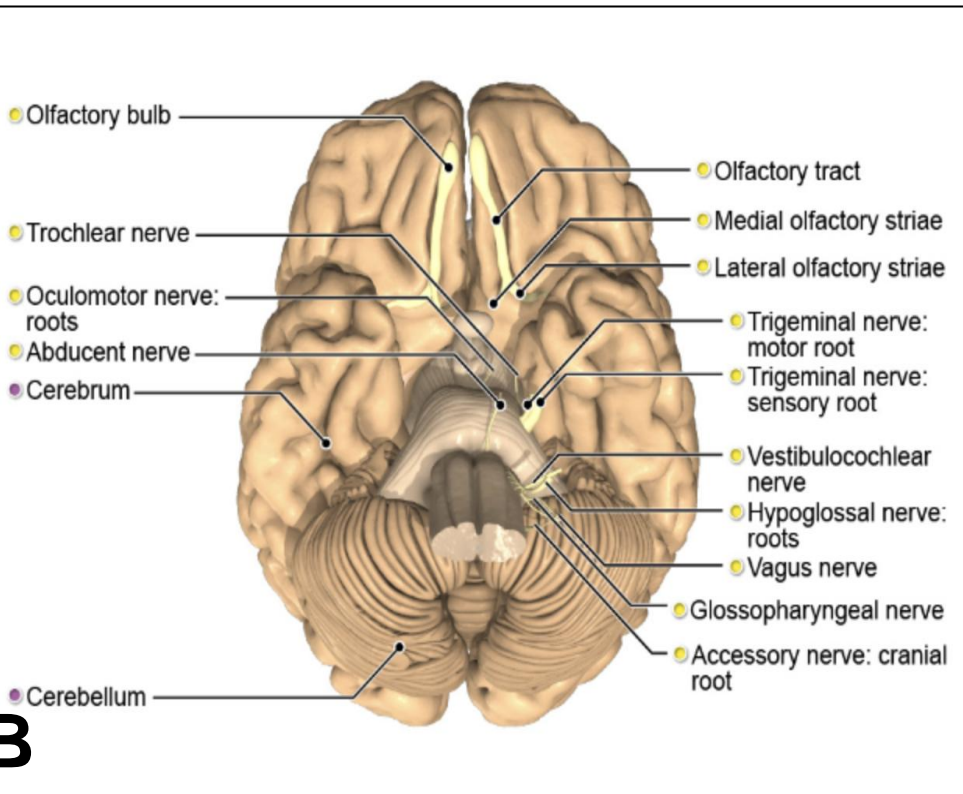
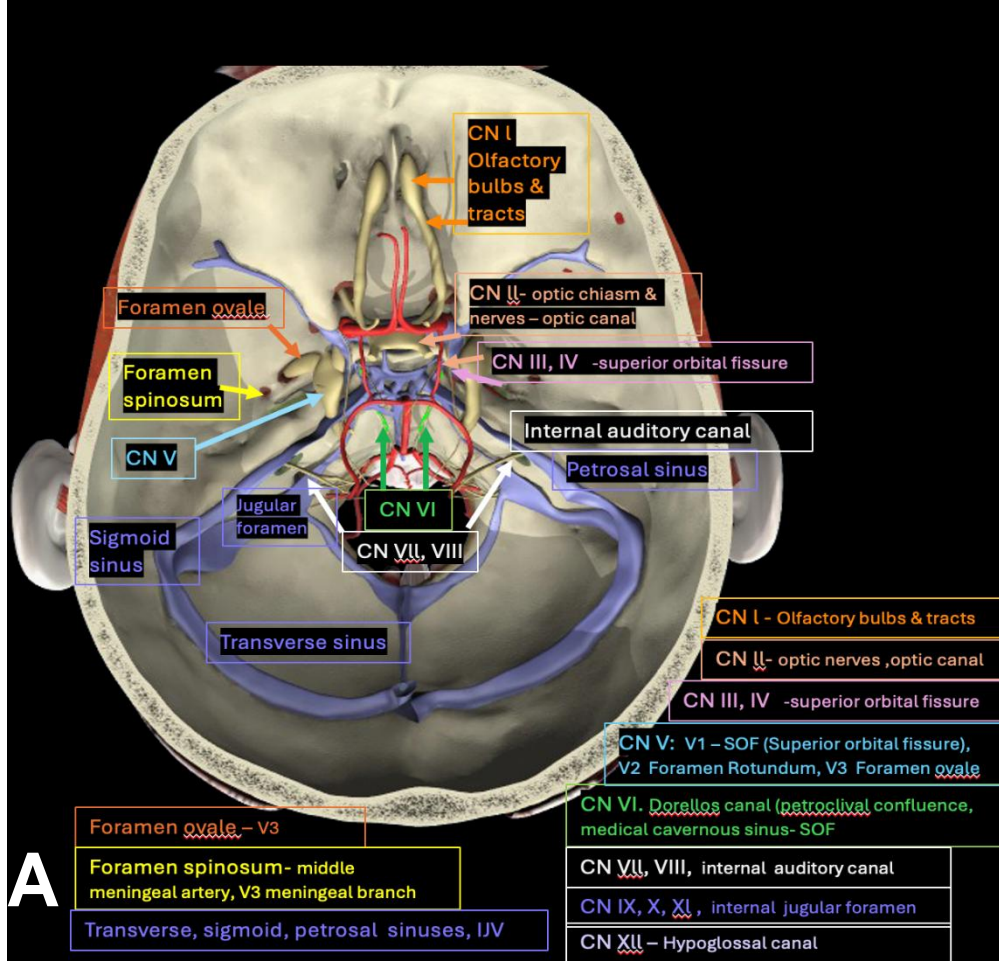


Figure 1A, Normal skull base anatomy & cranial nerve openings, color coded 1B, Cranial nerves as they emerge from the brain

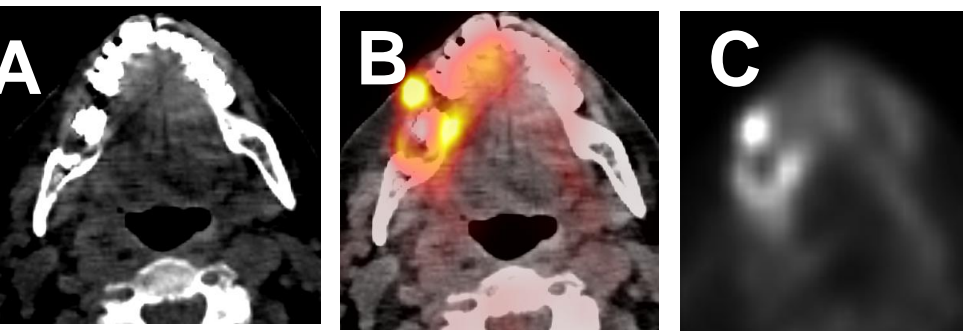


Figure 2A, axial CT, B, C, Axial PET-CT false positive from infected right first mandibular molar tooth

Figure 3 False Positive PET Necrotizing Otitis Externa & Petrous Apicitis

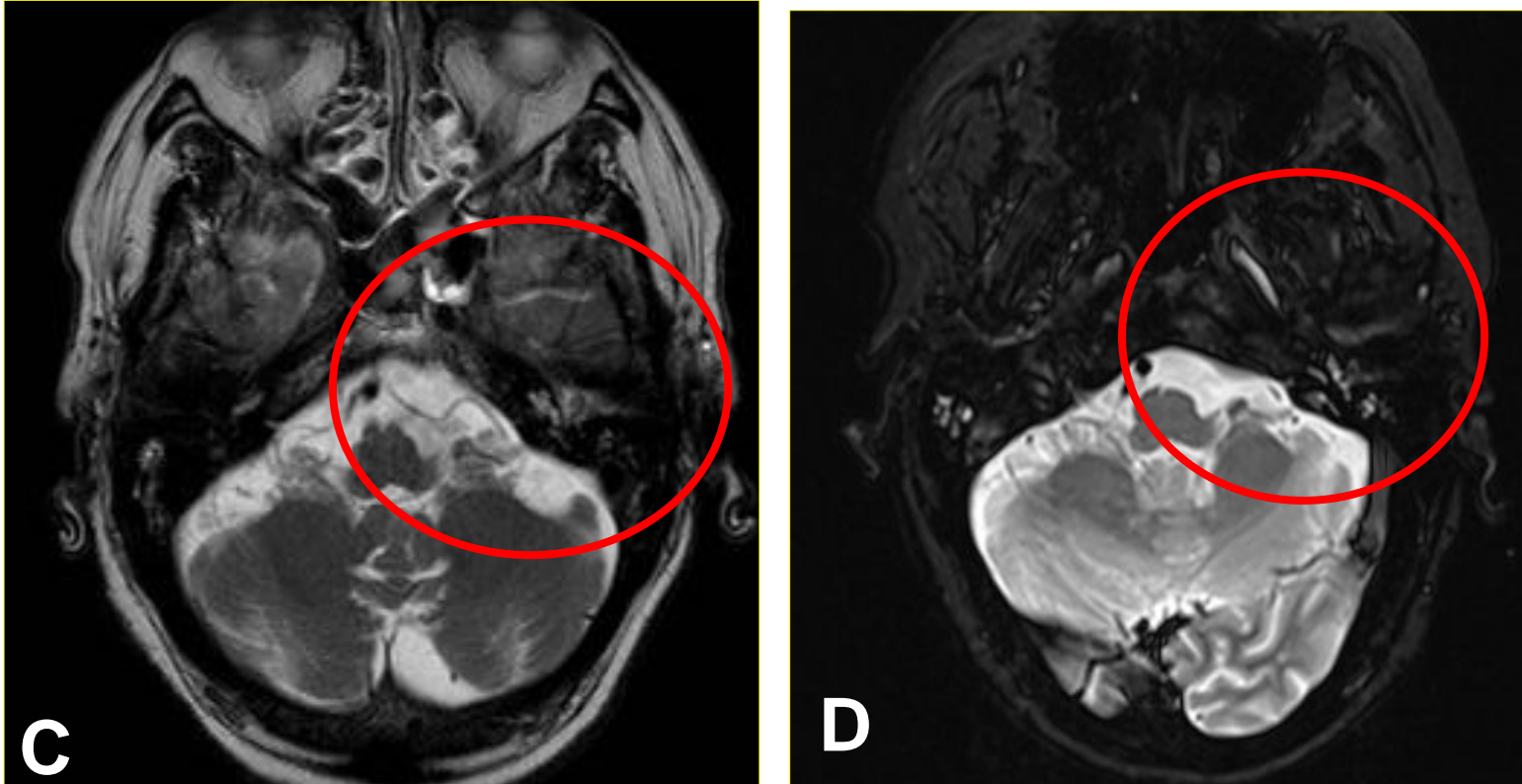
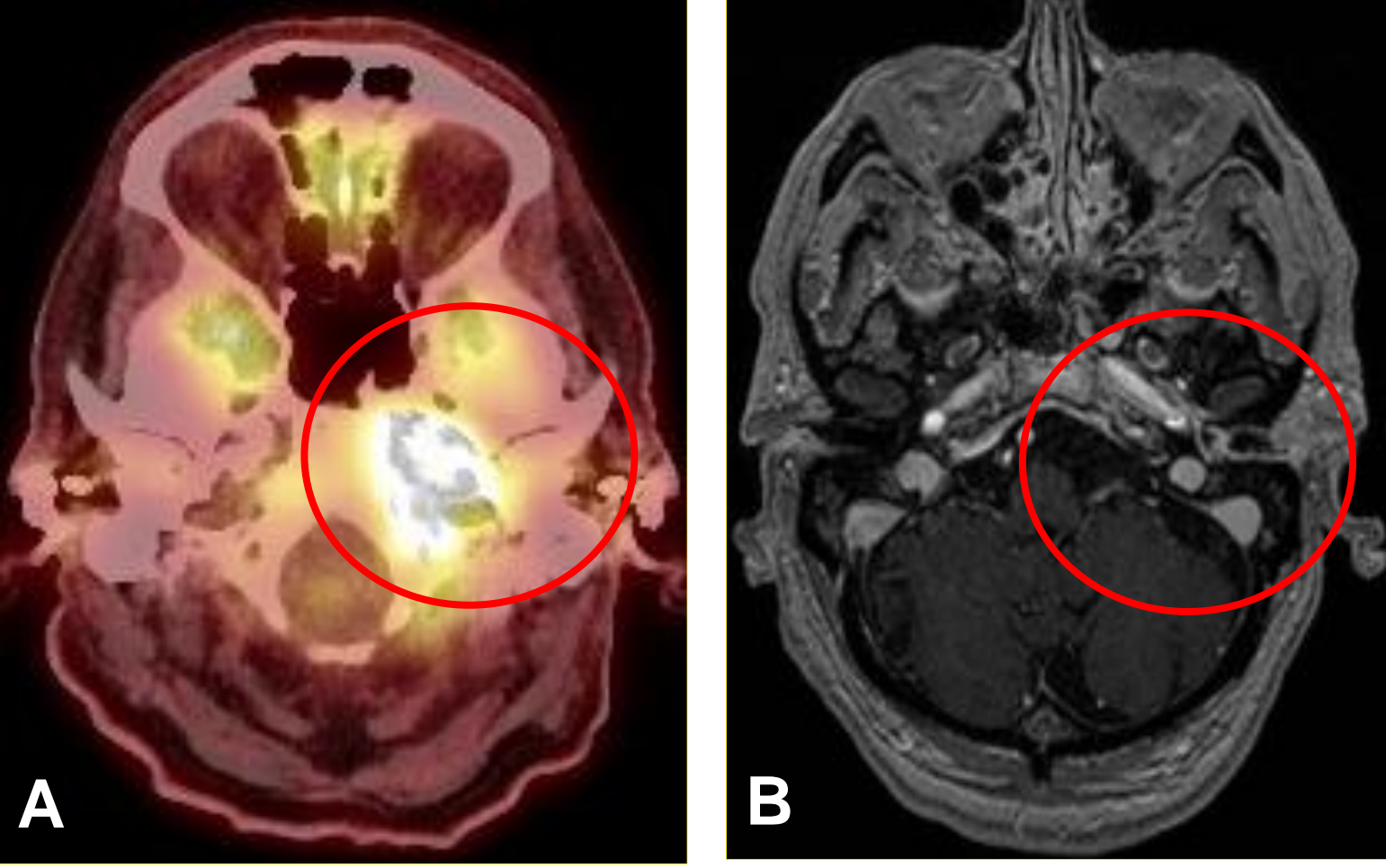


Figure 3 A, Axial PET-CT, B, Axial 3T MRI T1, C Axial 3T MRI T2 post gadolinium, D Axial 3T MRI STIR patient with Diabetes Mellitus & Necrotizing Otitis with false positive PET-CT with increased uptake in left mastoid, left petrous apex and left skull base. Axial T1 MRI with gadolinium enhancement, T2 with soft tissue swelling external auditory canal, fluid filled Eustachian tube, opacified left mastoid, middle ear with sinus opacification.

Figure 4 & 5 Foreign Body Material Such as Teflon leads to inflammation, granuloma formation and False Positive PET-CT

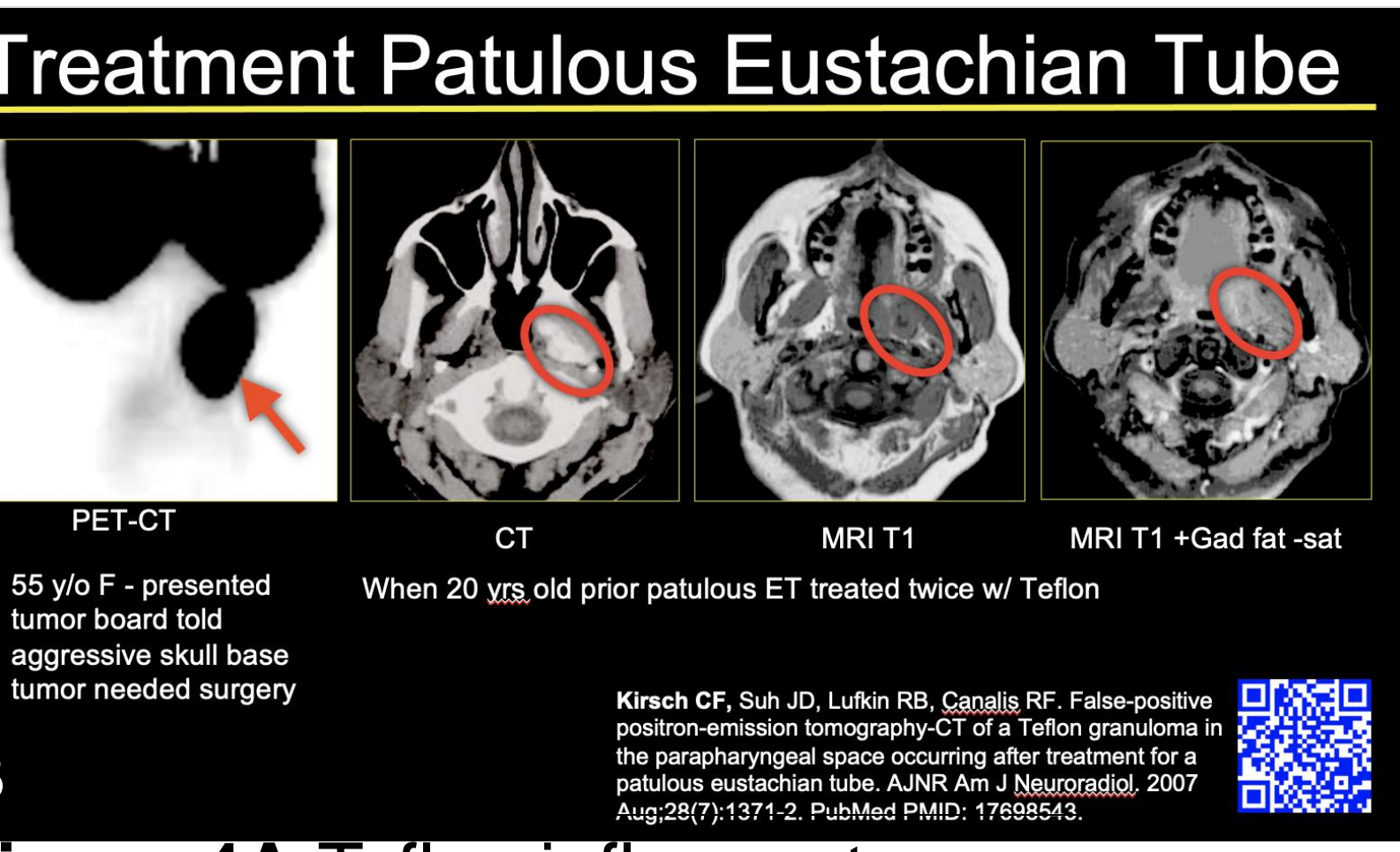
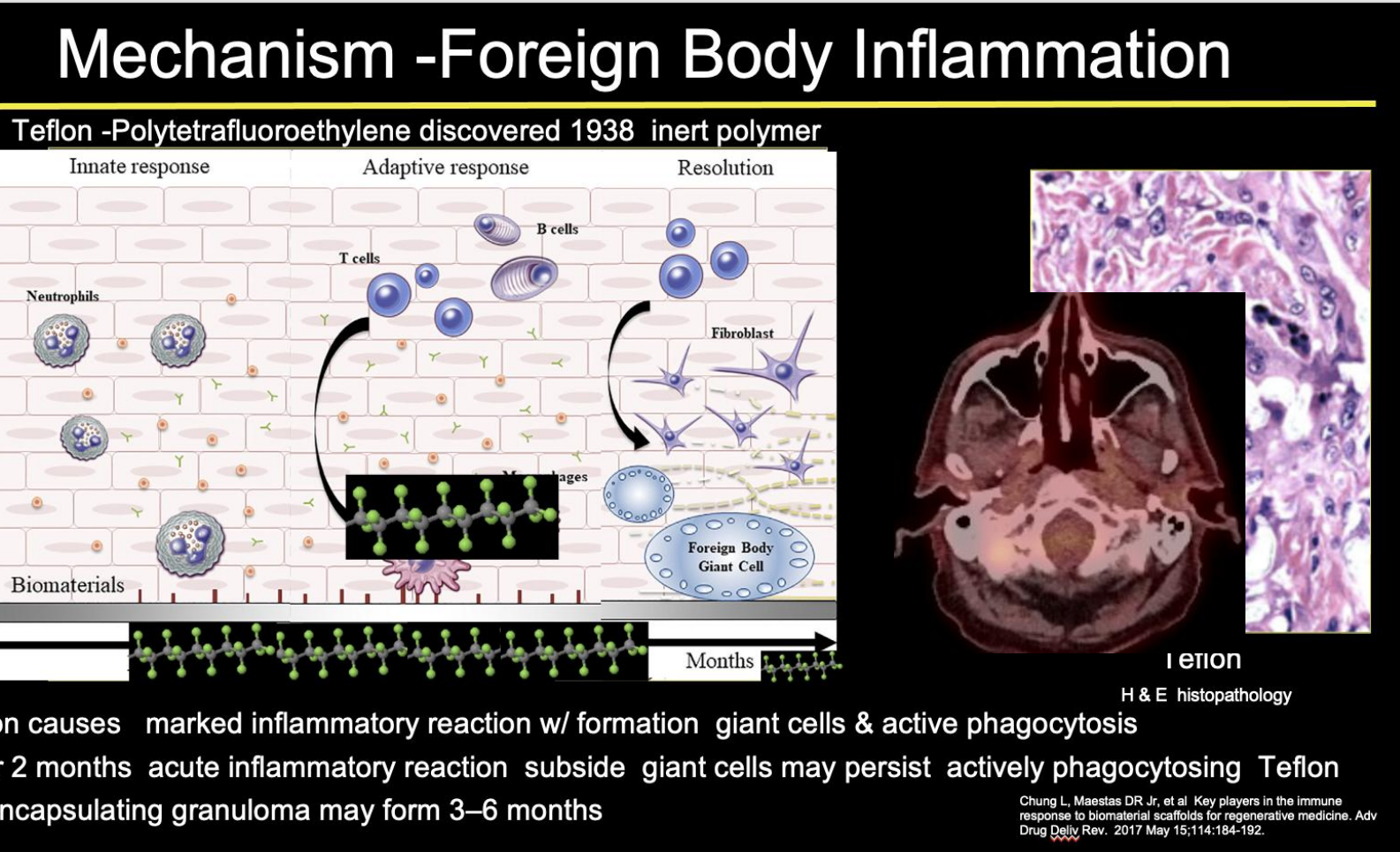


Figure 4A, Teflon inflammatory response B, Coronal PET avid skull base mass, Axial CT high density Teflon material in the parapharyngeal space, axial T1 MRI axial T1 post-gadolinium MRI, with Teflon, surrounding enhancement. Patient had Teflon placed for treat patulous eustachian tube, 20 years prior. Teflon inflammation is a cause of false positive PET, knowing history of foreign materials is critical to avoid misinterpretation and false positives!

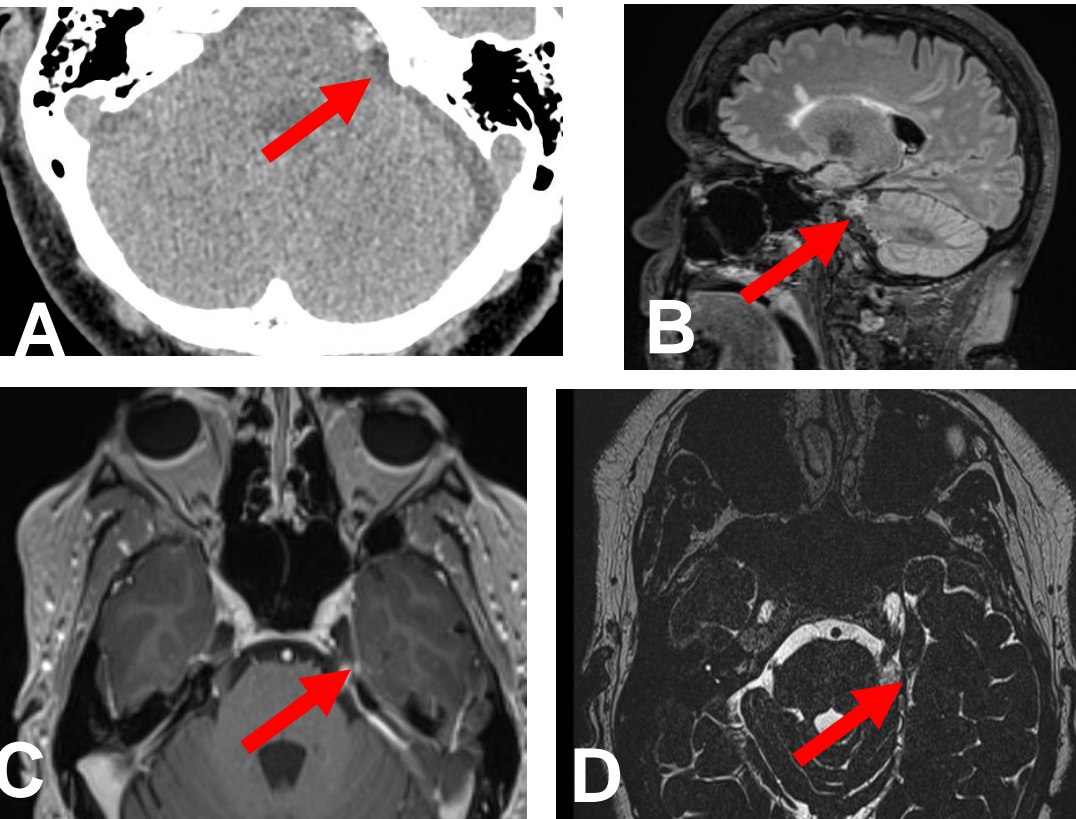


Figure 5 A-D, A axial CT, B Sag FLAIR, C axial post gadolinium T1, D axial thin section T2, red arrow Teflon placed for trigeminal neuralgia formed a "Teflon granuloma" cisternal left trigeminal nerve. Teflon granulomas are hot on PET-CT

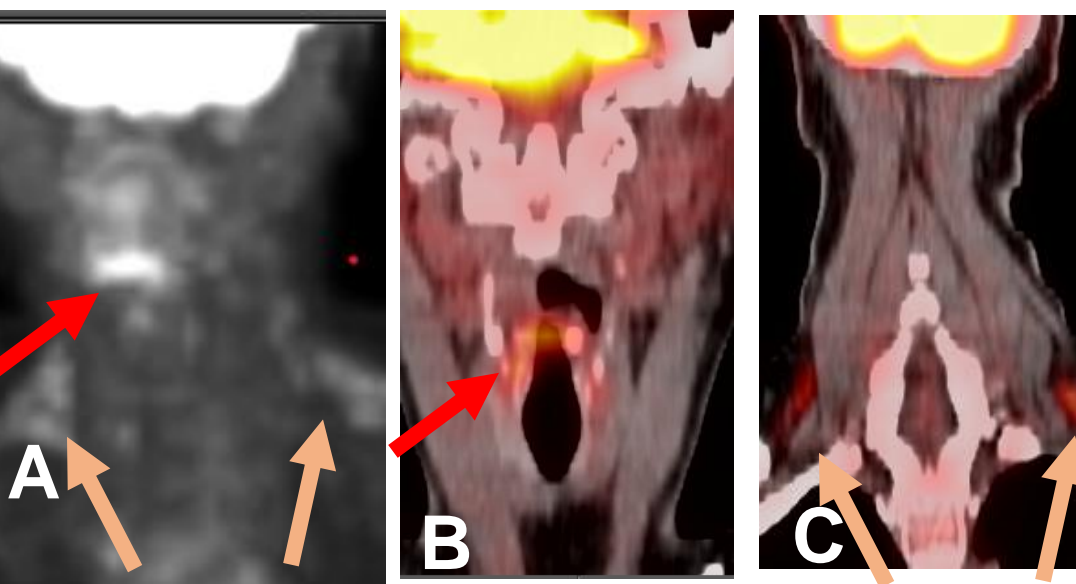


Figure 6A-C, Coronal PET CT, in patient with left vocal cord palsy who was talking during the PET-CT scan with active right vocal cord movement, false positive hot on PET (red arrow), false positive brown fat also hot on PET-CT (light brown arrows!)

Introduction

Positron emission tomography (PET) and computed tomography (CT), is a dual modality radiographic technique that typically utilizes the radiopharmaceutical F-18 flourodeoxyglucose (FDG), although additional tracers such as Ga-68 DOTATATE may be utilized for neuroendocrine tumors. Because tumor cells rapidly proliferate and have a need for increased glucose utilization from upregulated hexokinase activity, the FDG radiopharmaceutical glucose analog is taken up by tumor cells, with a rate of uptake in proportion to the tumor activity. FDG is phosphorylated to FDG-6-phosphate, within metabolically active tumor cells and releases photons. These are produced by positrons or positively charged electrons that annihilate with electrons milliseconds after its emission, releasing two 511keV photons going in opposite directions. These annihilation photons are detected by the PET scanner scintillation crystals combined to photomultiplier tubes (PMTs), and in many cases an increased number of photons seen on a scan often implies malignancy. Although, PET is a useful tool to find tumors, there are pitfalls causing false positives as detailed in examples above

Methods and Materials

Although tumors are PET avid and demonstrate increased uptake to FDG additional etiologies including, foreign body material, infection and inflammation can also have increased glucose metabolism in the head and neck and skull base and mimic skull base neoplasms.

Results

In skull base imaging interpretation, awareness of skull base anatomy, foramina and cranial nerves is essential as outlined **Figure 1,B**. In cases such as **Figure 2A-C**, infected first right mandibular tooth is obvious, it is important to remember infection is hot on a PET-CT scan. This can be trickier in cases such as necrotizing otitis externa (NOE) leading to a petrous apicitis, affecting CNs V, VI, as shown in **Figure 3A-D**, NOE is often seen in diabetic patients and caused by pseudomonas infection and can lead to petrous apicitis. Unlike a skull base tumors, although the tissue is inflamed, enhancing and enlarged the overall tissue planes and structures are preserved with STIR bright fluid trapped in the left eustachian tube, red circle **Figure 3D**. Placement of Teflon, often used to treat skull base disorders including a patulous eustachian tube, trigeminal neuralgia or vocal cord palsy, or any foreign body material, including those used for cosmetic injections in plastic surgery can lead to an inflammatory response and false positive PET CTs as shown in **Figures 4 and 5**.

Discussion

This educational exhibit highlights the key foramina and nerves in skull base anatomy and PET-CT positive pitfalls of infection such as skull base involvement from NOE, or inflammation from foreign body material such as Teflon for patulous eustachian tubes, or trigeminal neuralgia, or vocal cord palsy, with a review of the key pearls and pitfalls involved in PET-CT imaging.

Conclusions

Positive PET CTs are not always neoplasms. Infections such as necrotizing otitis externa and petrous apicitis, foreign body material if placed such as Teflon for patulous eustachian tube, trigeminal neuralgia vocal cord palsy, or cosmetic injections, can cause inflammatory responses, and be hot on PET-CT, as can muscle activity and brown fat. This exhibit highlights key examples with a focus on anatomic pearls and pitfalls involved in PET-CT imaging.

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