

Positive Radionuclide Imaging & Pathology Overlap

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Where YOU come first



Introduction

- The overlap between positive radionuclide imaging and pathology refers to the intersection of molecular imaging signals (PET/SPECT) and tissue-level findings (microscopy/biomarkers).
- Providing a definitive framework for clinical diagnosis, staging and personalized therapy.
- While tissue biopsy remains the definitive gold standard, correlating with imaging ensures greater accuracy, revealing areas where functional activity matches cellular disease markers.
- When a scan displays high tracer uptake and tissue analysis confirms the corresponding disease state, the findings are considered concordant.

The Diagnostic Continuum: Function Meets Morphology

- **Nuclear Medicine:** Captures cellular metabolism and molecular pathways using radiotracers.
- **Histopathology:** Analyzes physical biopsy tissue under microscopy to provide a definitive diagnosis.
- **The overlap:** Radionuclide imaging highlights where the disease is active; pathology confirms what the disease is at a cellular level.
- **Radiographer role:** Ensuring high-quality image acquisition to prevent/minimize false positives and accurately guide tissue biopsies.

Why the overlap Matters

- **Enhanced Sensitivity:** Radionuclide imaging (FDG-PET) highlights metabolic changes, sometimes identifying active disease before structural or physical abnormalities become visible in routine pathology samples.
- **Minimizing Sampling Error:** Because biopsies only sample a tiny fraction of tissue, they can occasionally miss a larger malignancy. Radionuclide scans guide the radiologist/pathologist by pointing exactly to the most metabolically active or aggressive regions.
- **Targeted Biomarker Mapping:** Radiotracers bind to specific molecular targets in the body. The macroscopic binding patterns observed on scans often directly overlap with immunohistochemical (IHC) and molecular findings analysed by anatomic pathologists in the lab.

Common Clinical Applications

- **Oncology:** A positive radionuclide scan (PSMA-PET for prostate cancer) confirms whether a suspicious mass –subsequently biopsied and examined under a microscope is indeed malignant.
- **Neurology:** In neurodegenerative diseases like Alzheimer's, specialized radiotracers can map the topographic spreading of tau proteins and amyloid plaques in the brain. This functional map closely overlaps with post-mortem neuropathological examinations.
- **Cardiology:** In cardiac amyloidosis, certain radiotracers bind heavily to protein buildups, verifying tissue pathology non-invasively.

Clinical Discrepancies and Challenges

- **False Positives:** Occasionally, benign conditions such as severe inflammation, recent fractures or liver cirrhosis can trigger a positive radionuclide scan. These scan results look visually identical to malignancies, making strict radiologic-pathologic correlation mandatory to prevent misdiagnosis.
- **Spatial Resolution Gaps:** Radionuclide imaging yields lower spatial resolution, meaning subtle or low-density microscopic pathology can sometimes evade scan detection while remaining visible under a microscope.
- **Diagnostic Harmony:** The cancer MDTs should review both imaging data and tissue pathology to resolve discrepancies and minimize diagnostic errors.

Resolving Technical Artifacts vs True Pathology

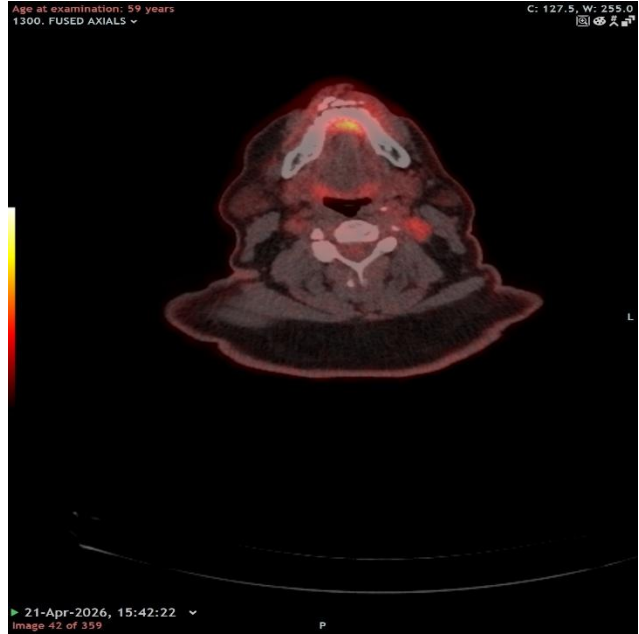
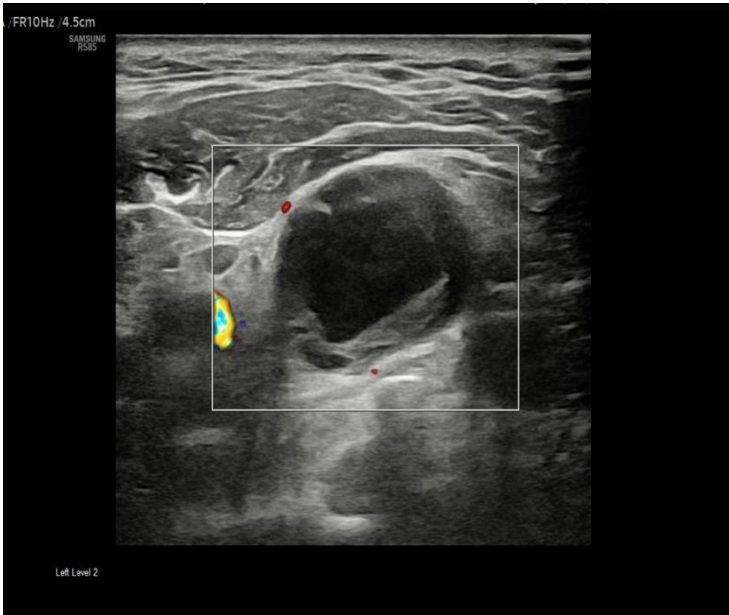
- **Misregistration:** Patient movement between CT and PET/SPECT acquisition can create false localization of tissue uptake. Minimal patient movement can help reduce misregistration.
- **Attenuation Correction:** Metal implants (pacemakers, hip replacements) can cause dense artifacts that falsely elevate calculated SUV values.
- **Excretion Artifacts:** Free pertechnetate or urinary tracer pooling can easily mask pelvic or abdominal pathology.
- **Prevention:** Vigilant patient positioning, breathing instructions and checking raw uncorrected images.

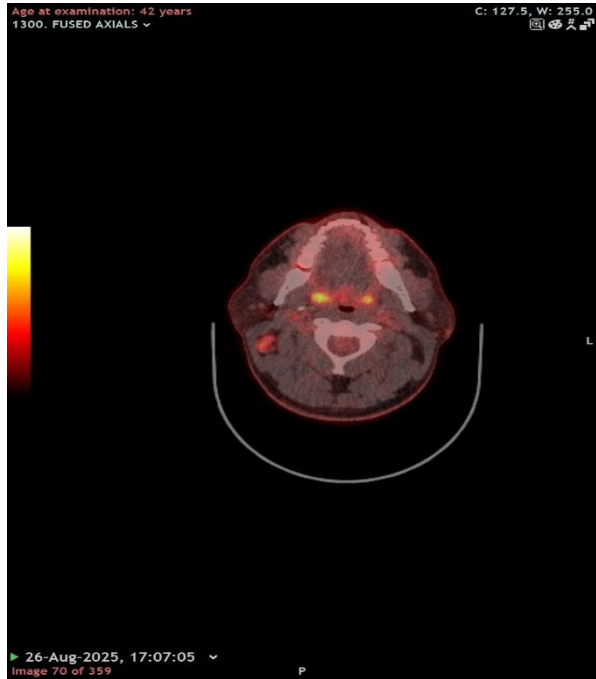
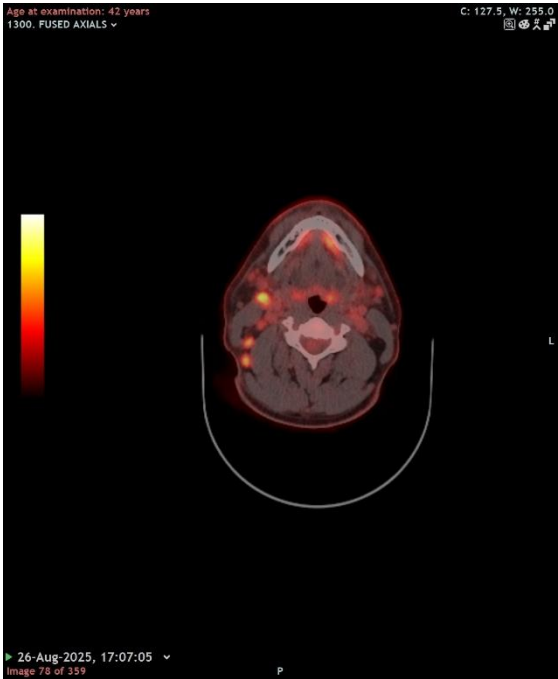
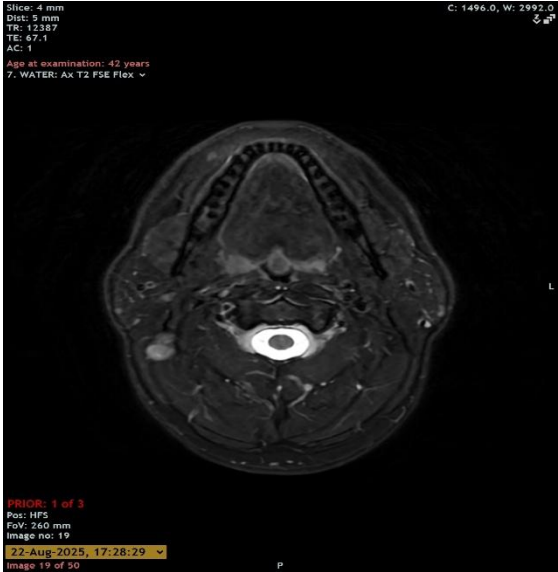
Summary and Key Takeaways

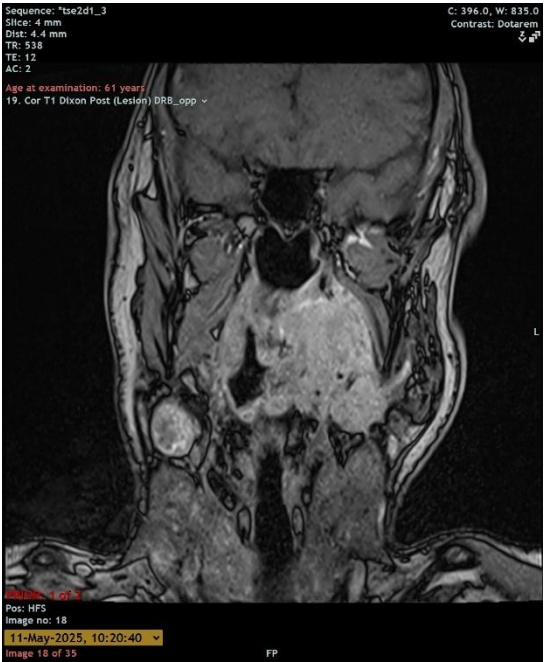
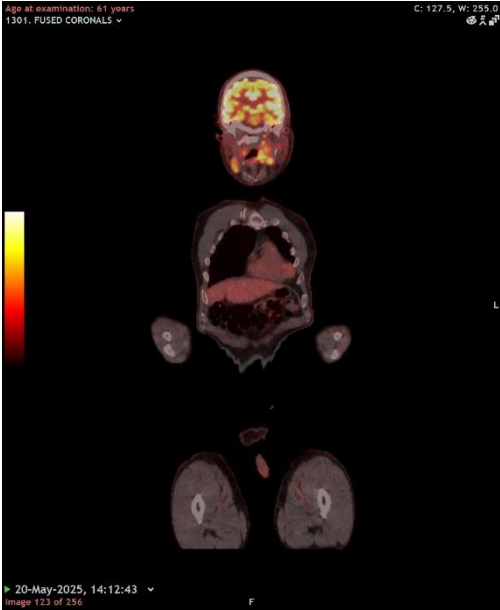
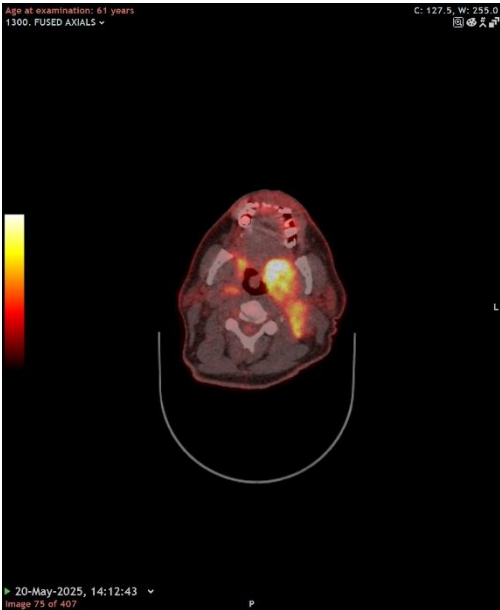
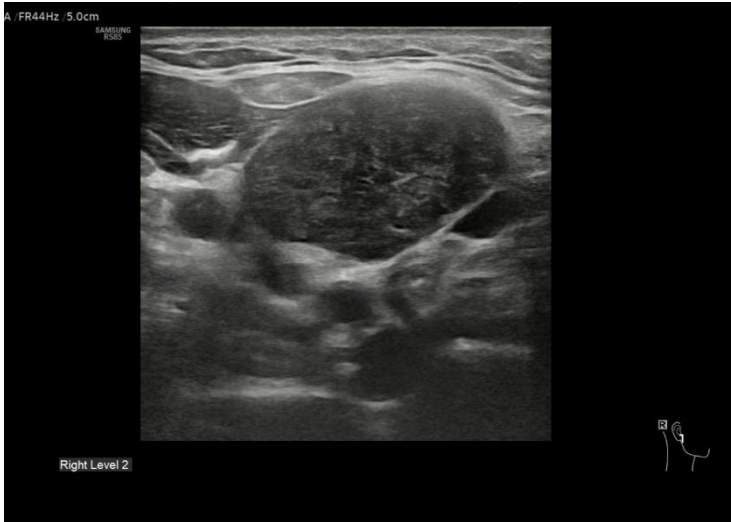
- **Molecular Mapping:** Radionuclide scans map cellular function; pathology delivers the final cellular diagnosis.
- **Technical Excellence:** Image quality, patient preparation and artifact mitigation directly impact diagnostic accuracy.
- **Theranostics:** Precision nuclear medicine relies on radiographers to ensure accurate imaging and on the radiologist to ensure accurate reporting for targeted tissue therapies.
- **Teamwork:** Everyone in the nuclear imaging department are essential to the provision of high-quality imaging and reporting; that ultimately bridges imaging and pathology.

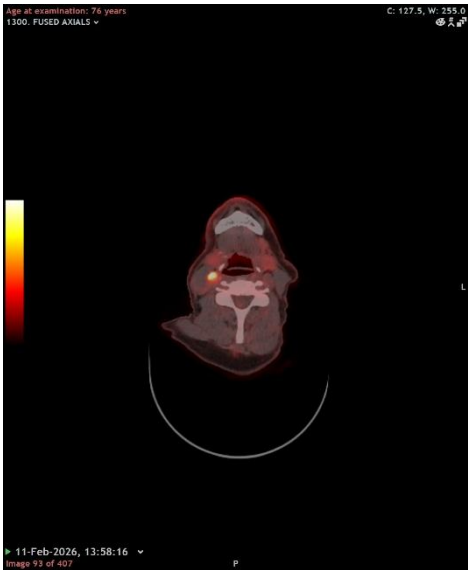
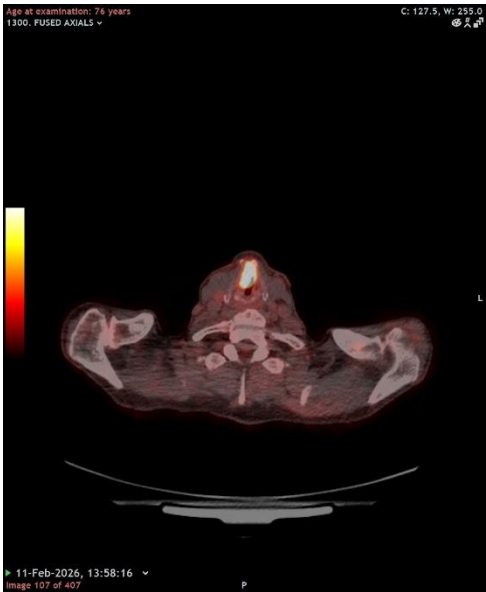
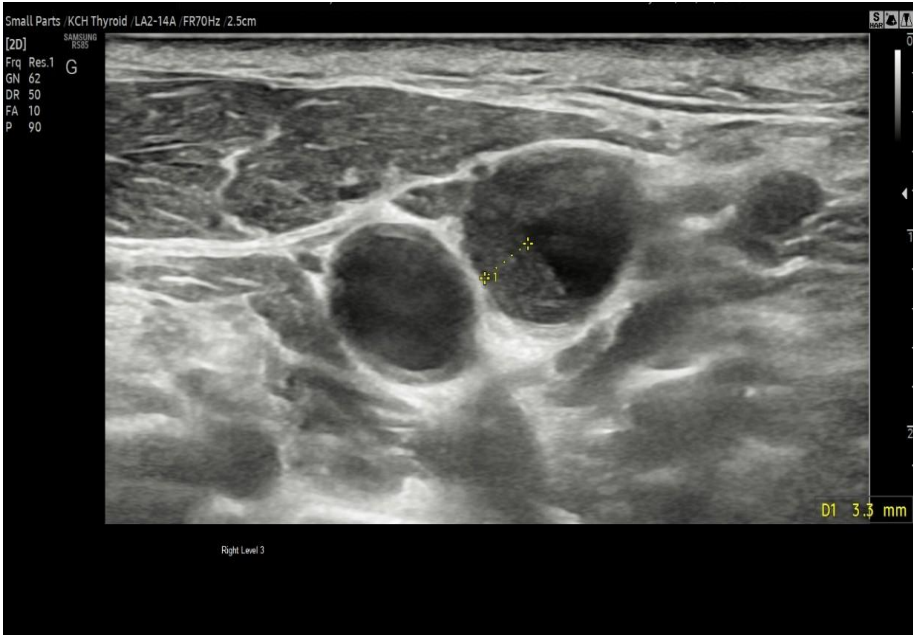
Interesting Cases

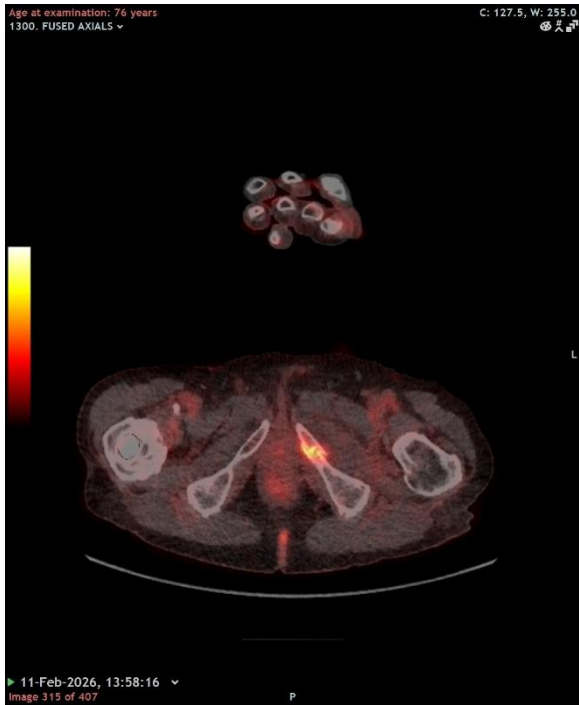
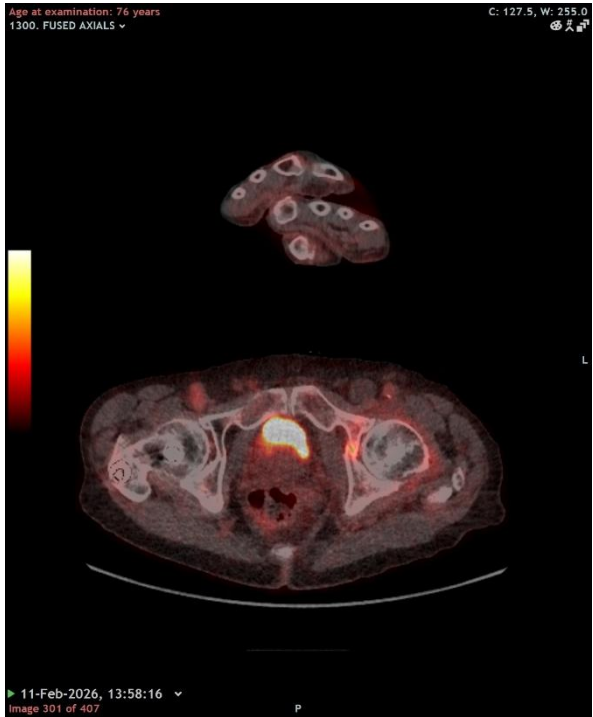
- Case # 1
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- Case # 5

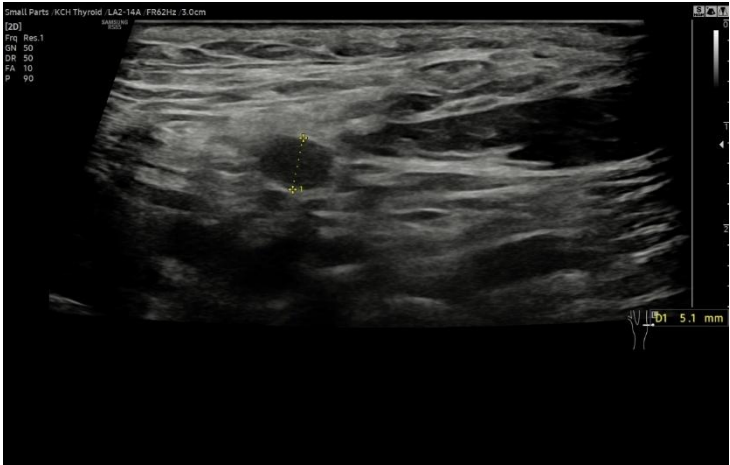
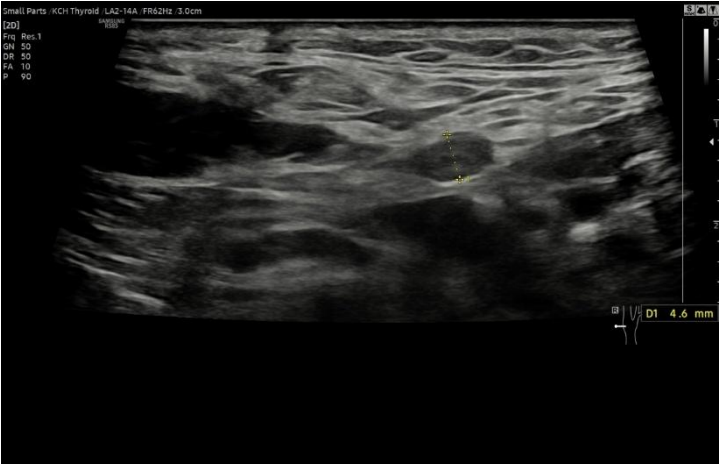
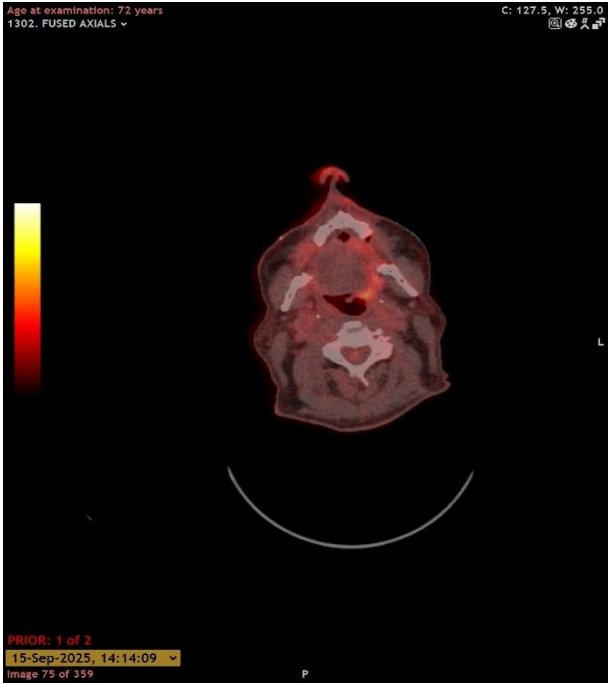
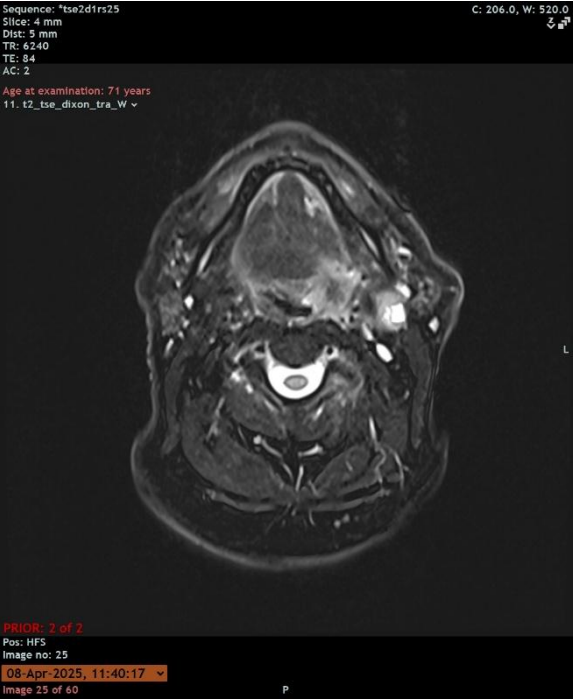












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Thank you for your attention.