Understanding your scans and PRRT: How imaging guides Treatment.

Heather Cole
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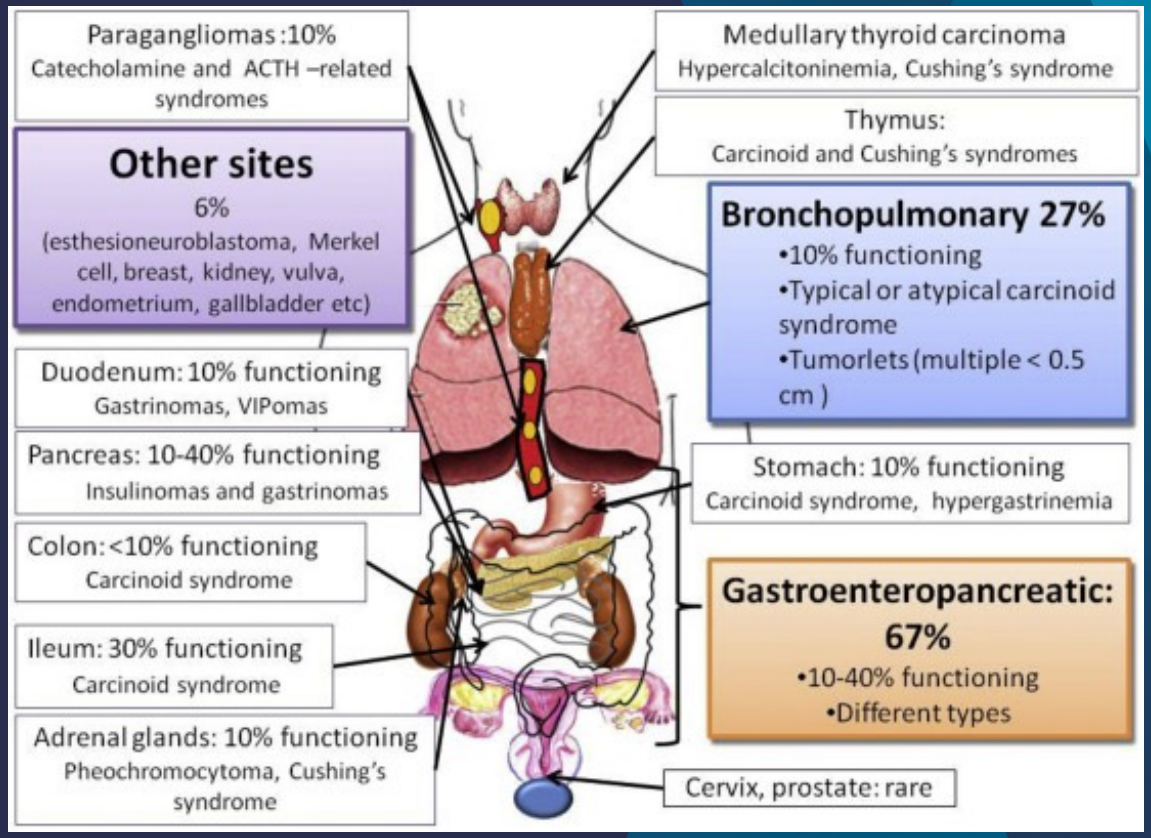
VANDERBILT HEALTH

Disclosure Statement

No relevant financial or conflict of interest to disclosure

What are Neuroendocrine Neoplasms

- Neuroendocrine Neoplasms come from nerve cells and hormone-producing cells.
- Common primary sites include digestive tract, pancreas, and lung.



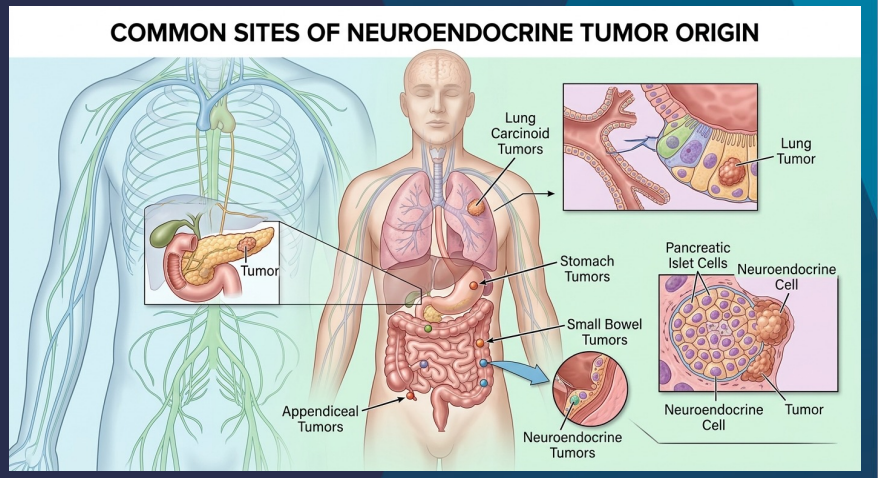
What are Neuroendocrine Neoplasms

Behave very differently from one another.

Some grow **very slowly over many years**, while others can grow more quickly.

Because of this, **one scan does not fit everyone**.

That's why imaging is so important—it helps us understand **your tumor's behavior**, not just where it is.



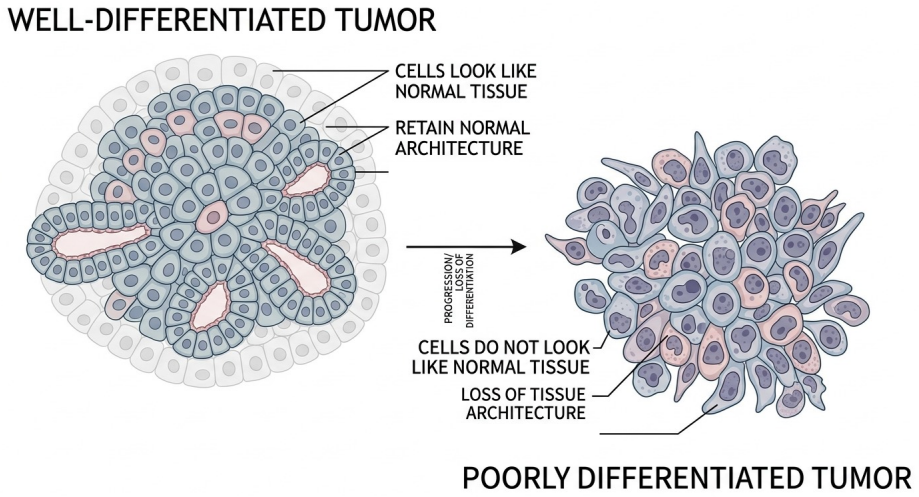
Spectrum of Neuroendocrine Neoplasms (NEN)

Neuroendocrine Tumors (NET) – Well-Differentiated

- Subdivided into three grades based on how quickly cells divide/replicate
  - G1 = Low grade (<2%)
  - G2 = Intermediate Grade (3-20%)
  - G3 = High Grade (>20%)

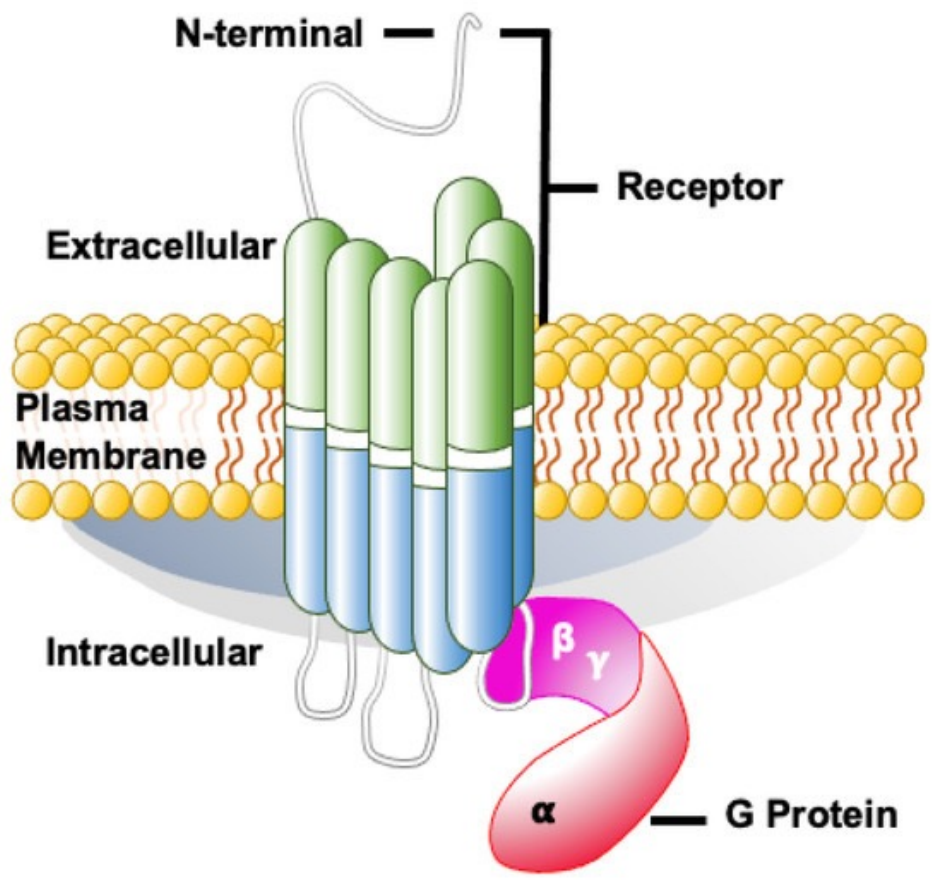
Neuroendocrine Carcinoma (NEC) – Poorly Differentiated

- High rates of cellular replication
  - Small cell
  - Large cell



Somatostatin Receptor expression

- Well differentiated NET
- 5 receptor subtypes
  - SSTR 2 is most commonly overexpressed in NET



IMAGING GOALS

Detect & Stage Disease

Identify the primary tumor (often small or occult) and define extent with locoregional nodes and metastases (liver, bone, lung).

Guide Treatment Choice

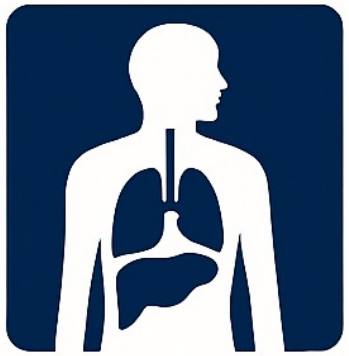
Imaging determines resectability and suitability for liver-directed therapy, systemic therapy, and PRRT.

Baseline, Response & Surveillance

Establish consistent baseline and follow-up imaging to measure response and detect progression, recurrence, or complications; tailor intervals to grade and burden.

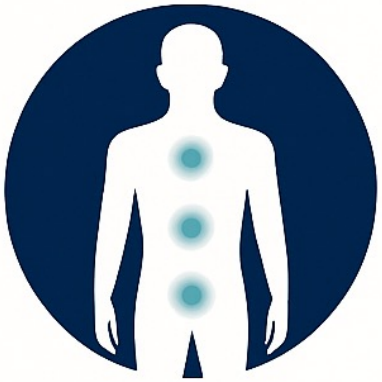
Two Categories of Scans

Anatomic Imaging



These scans show the structure

Molecular Imaging



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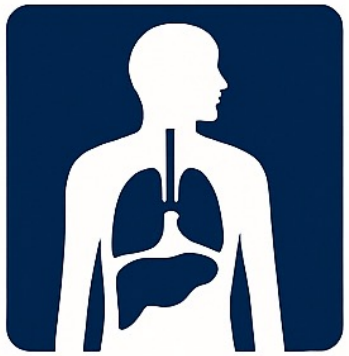

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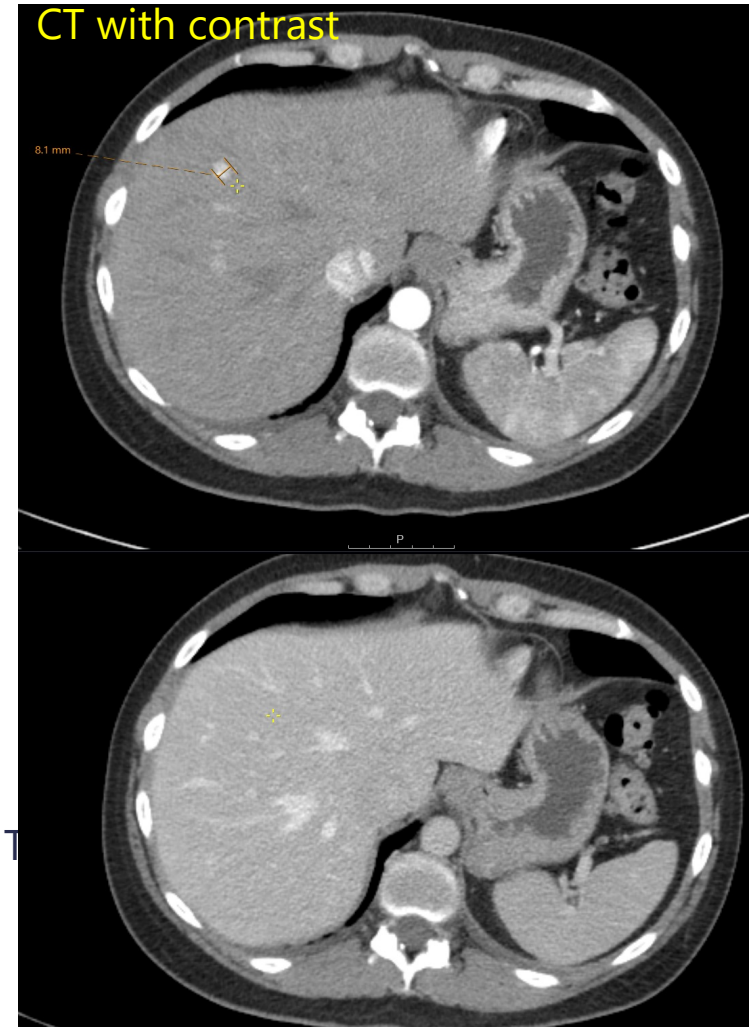

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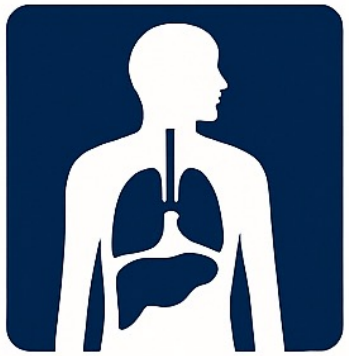

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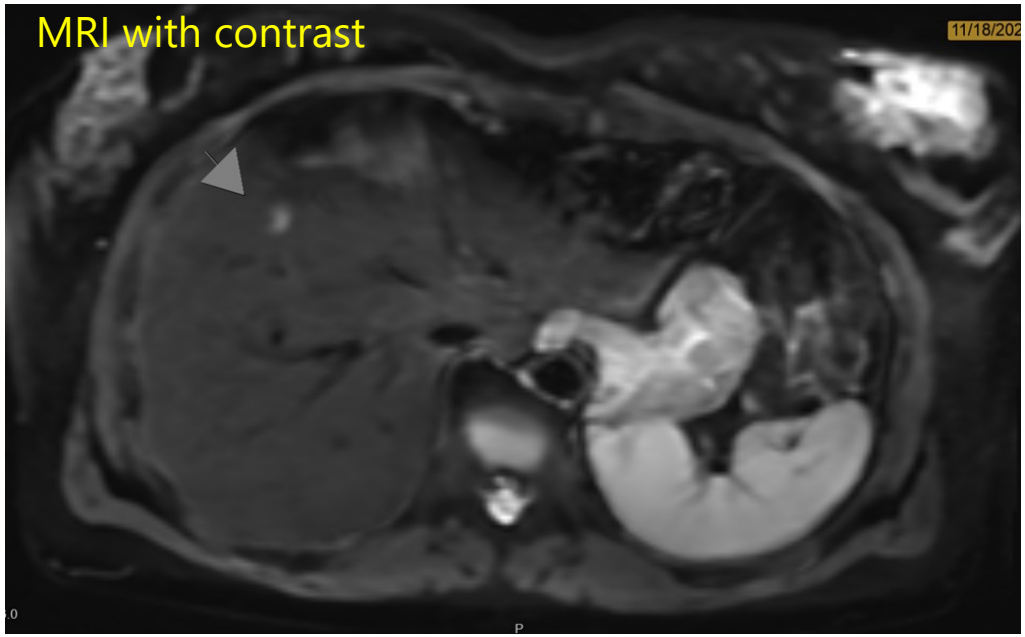

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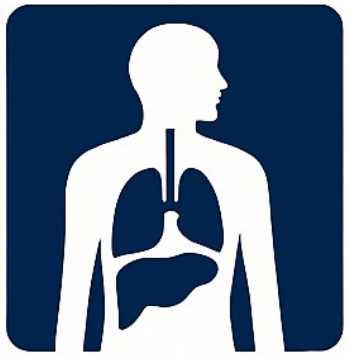

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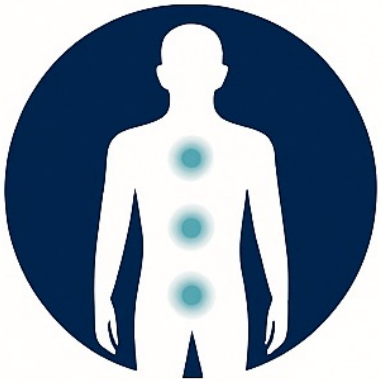

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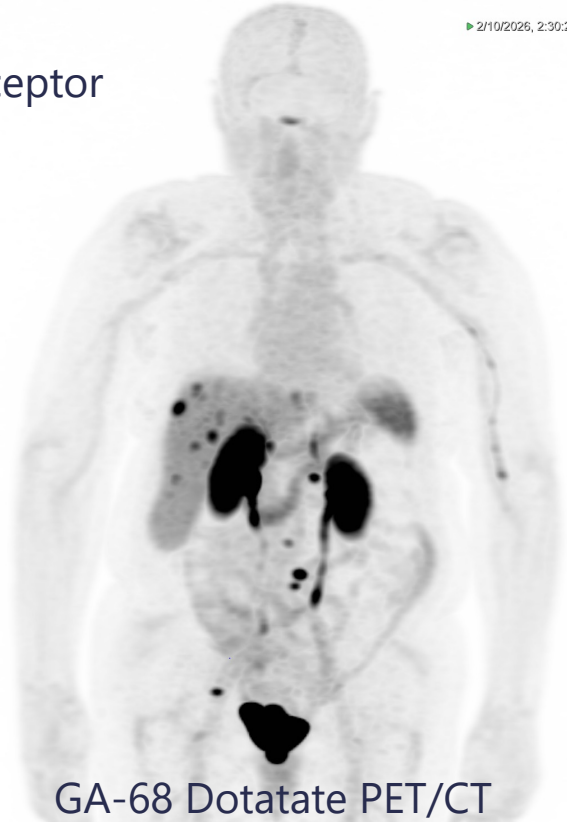
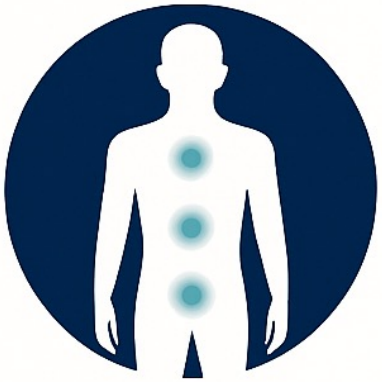
Two Categories of Scans

Somatostatin Receptor Imaging



GA-68 Dotatate PET/CT

Molecular Imaging



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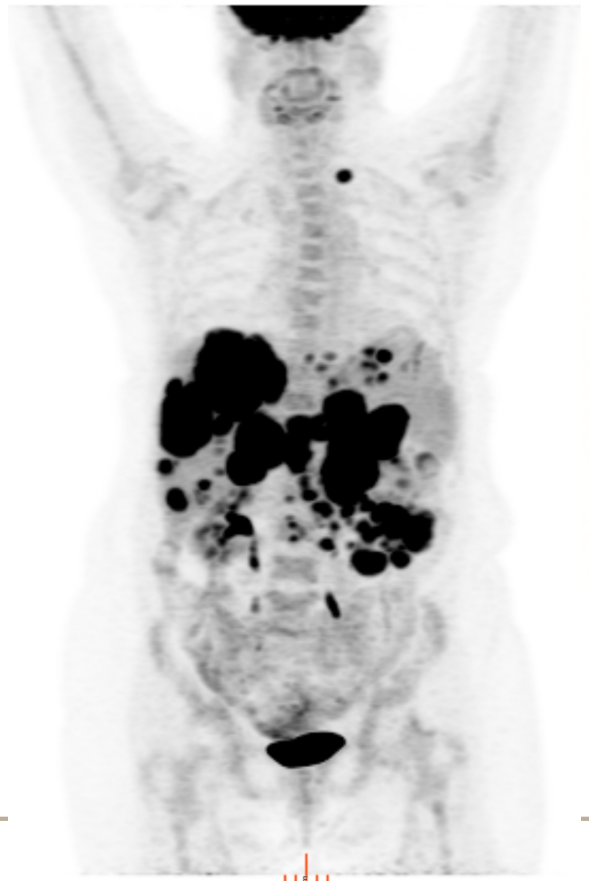
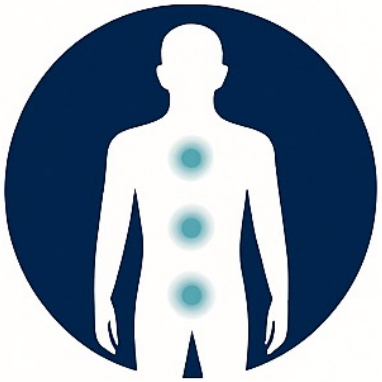
Two Categories of Scans

F-18 FDG PET/CT



Molecular Imaging



These scans show tumor behavior

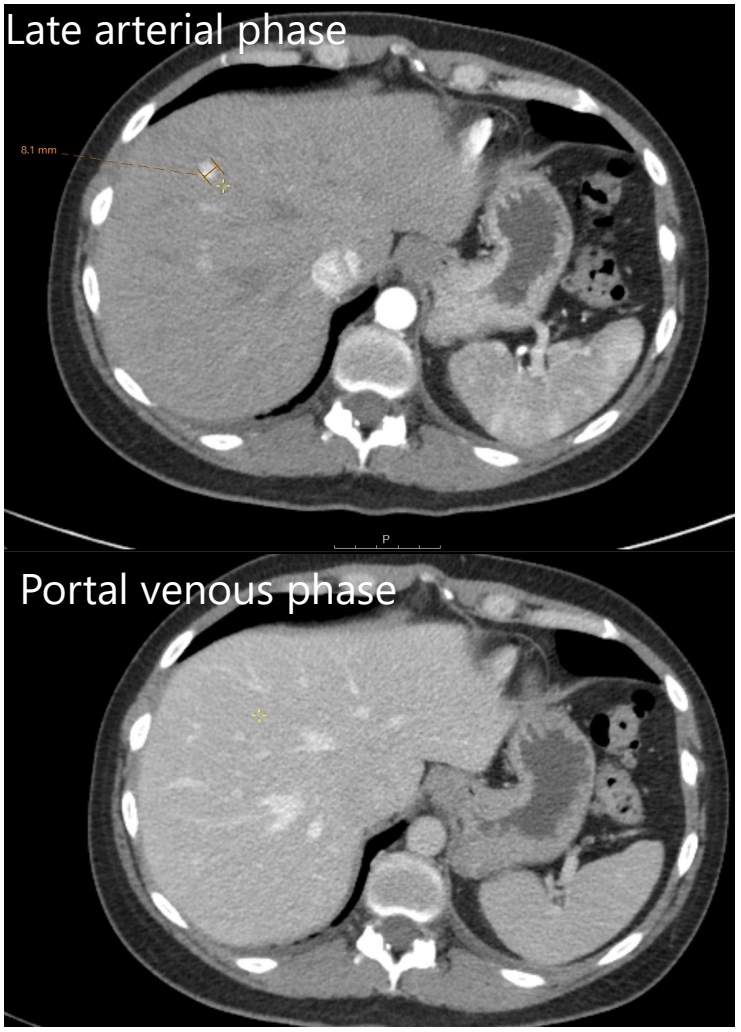
CT Scan with Contrast: A Workhorse Tool

When to use:

- Initial imaging
- Staging
- Surgical planning or intervention

Limitations :

- Small primary tumors
- Liver, pancreatic and bone lesions



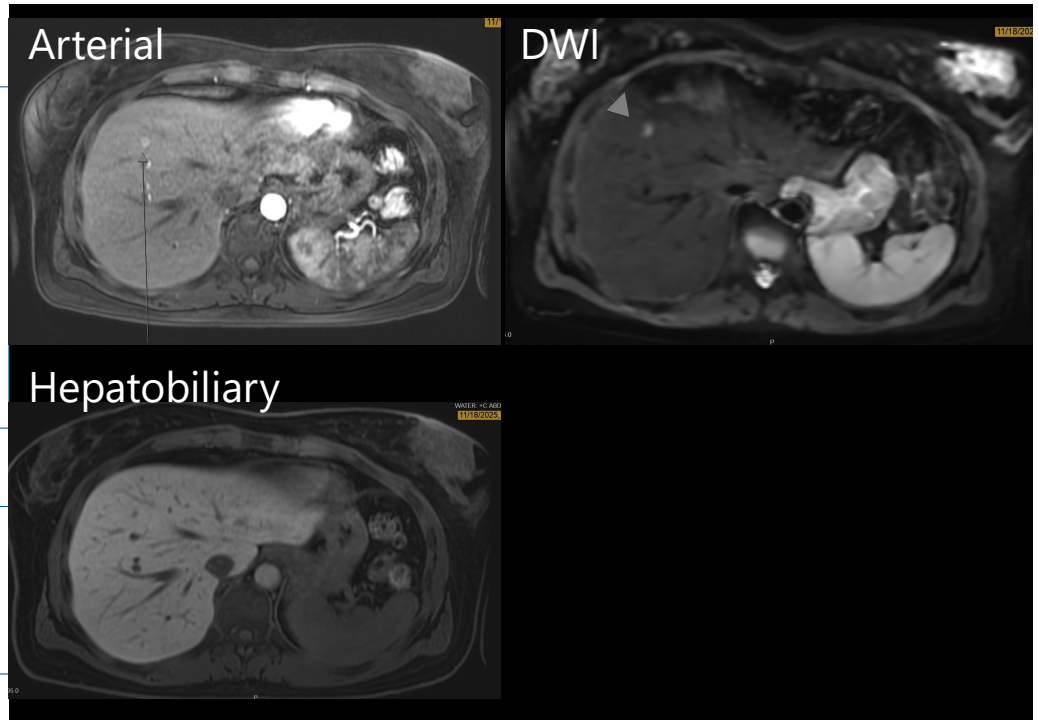
MRI: Especially helpful for Liver and Pancreas lesions

When to use:

- Pancreatic NET primary lesions
- Liver and skeletal metastasis
- Limited radiation exposure (pediatrics, MEN)

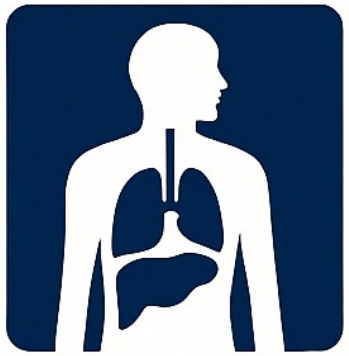
Limitations :

- Used to augment CT imaging



Two Categories of Scans

Anatomic Imaging



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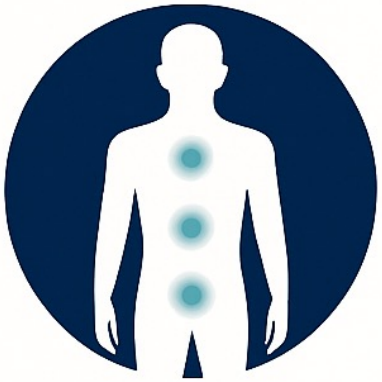
What does it look like?

Molecular Imaging



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How does the tumor act?

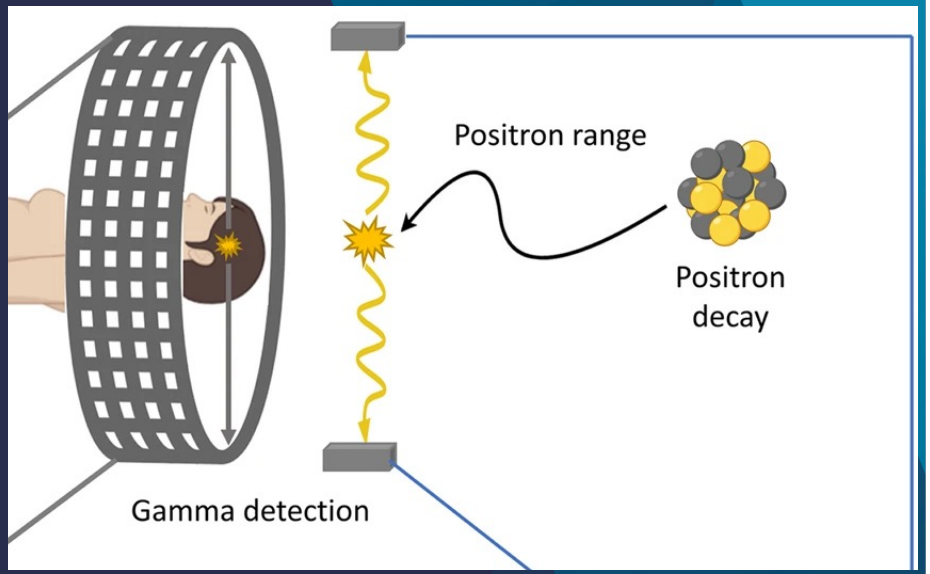
Molecular Imaging with PET/CT

First –

Let's discuss a few definitions

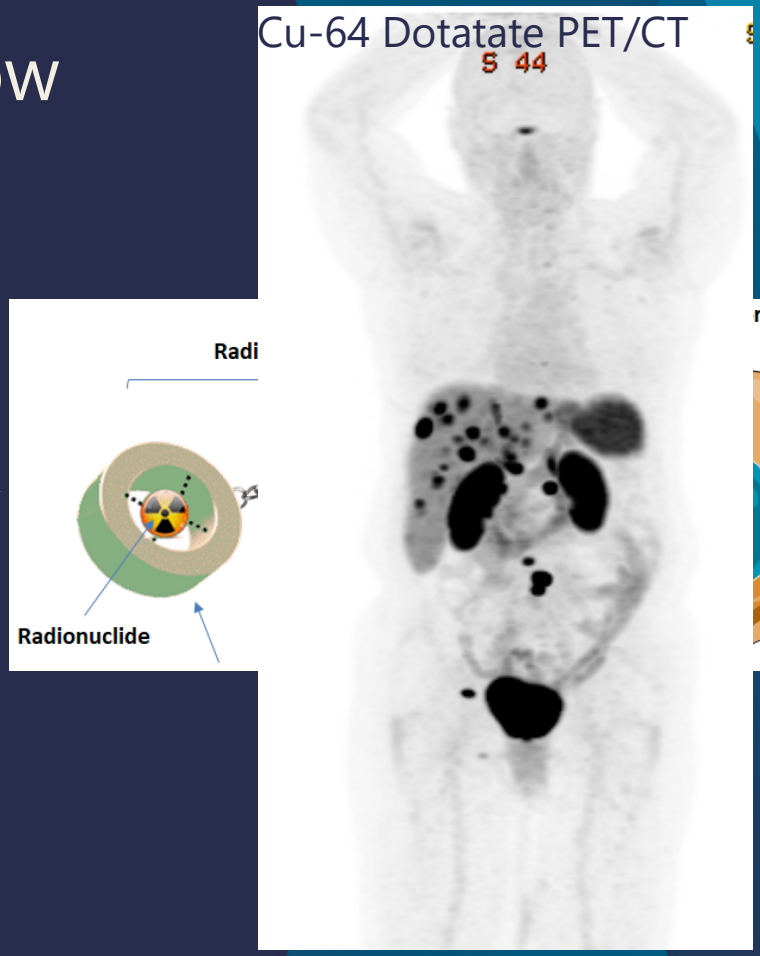
How do we see PET images?

1. Radionuclide = tiny atom that gives off energy
2. Energy can be seen by a PET Scanner
3. It is safe in small amounts and doesn't stay long in the body



How does the radionuclide know where to go?

1. Radionuclide + something the body uses = Radiopharmaceutical
2. Think of it like a glowing tag attached to the lock and key
3. The tracer travels in the body and the scanner sees where it goes



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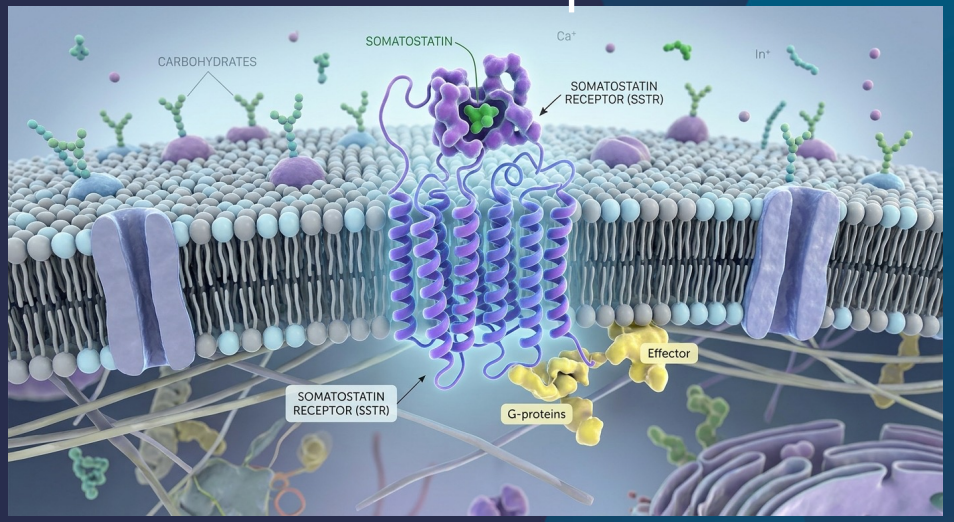
What is Somatostatin Receptor Imaging in PET

1. Somatostatin receptors are very specific cell surface proteins found on Neuroendocrine neoplasms

Somatostatin Receptor



What is Somatostatin Receptor Imaging in PET

1. Somatostatin receptors are very specific cell surface proteins found on Well differentiated neuroendocrine tumors

2. Imaging with GA-68 or CU-64 localizes receptors = tumor/disease

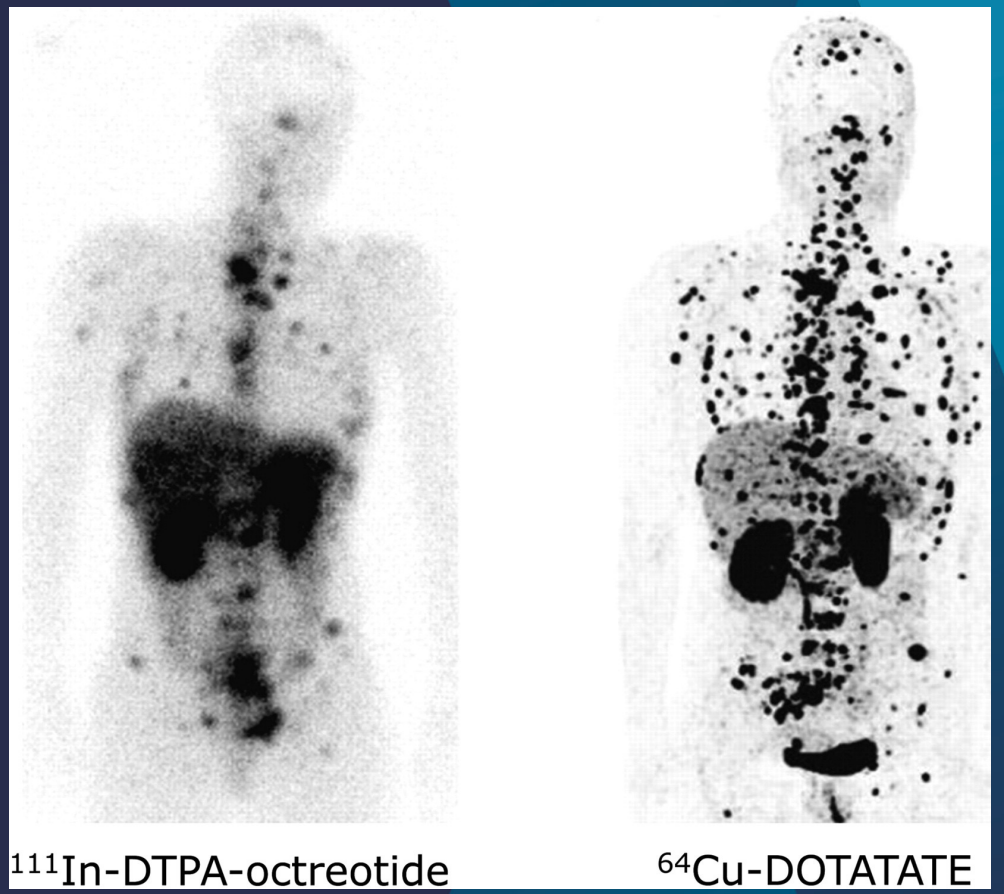
Somatostatin Receptor Imaging

Octreotide SPECT/CT (Legacy)

- Low resolution.
- Not commonly used

DOTATATE v DOTATOC

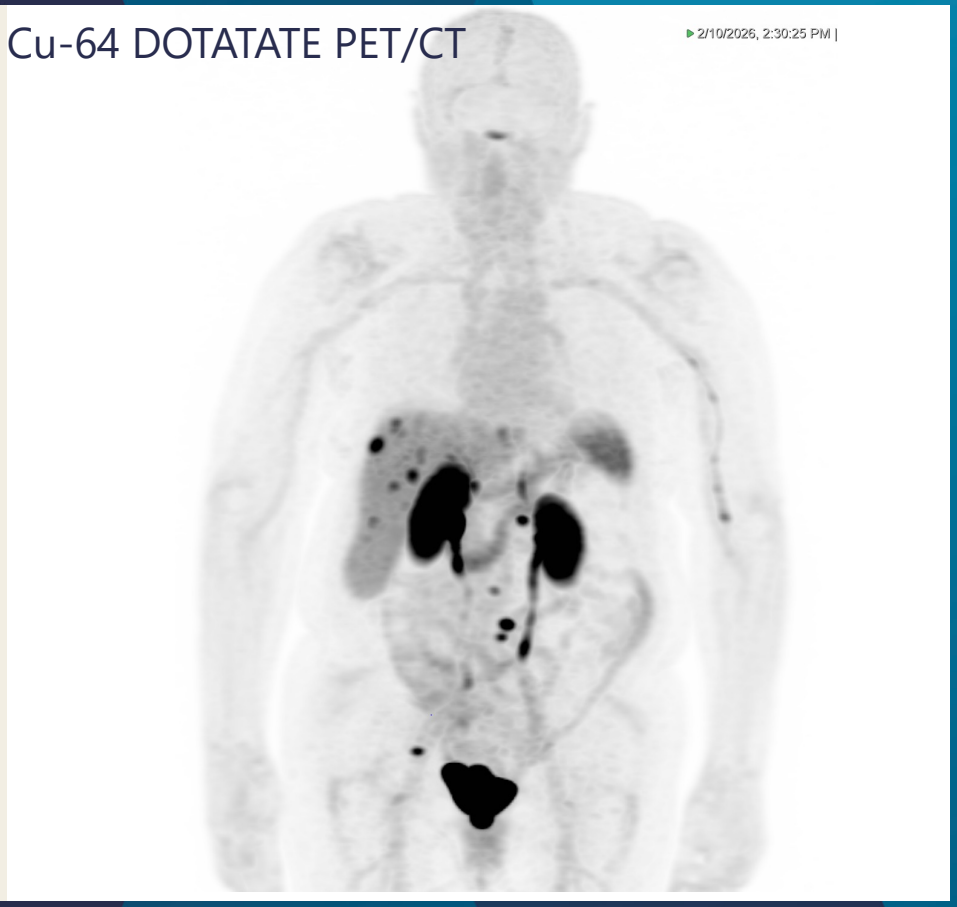
Gallium 68 v Copper 64



Clinical PET of Neuroendocrine Tumors Using 64Cu-DOTATATE: First-in-Humans Study Andreas Pfeifer et al Journal of Nuclear Medicine Aug 2012, 53 (8) 1207-1215; DOI: 10.2967/jnumed.111.101469

Somatostatin Receptor Imaging

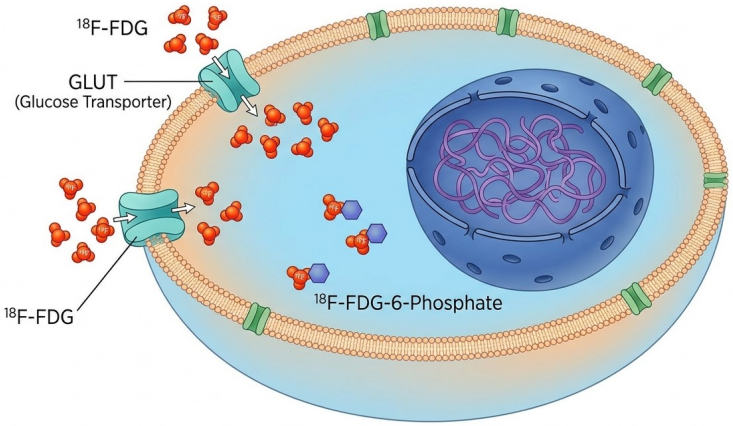
- High sensitivity for Grade 1 and 2 NETs
- Detects small metastases / unknown primaries
- Guides eligibility for PRRT / Lutetium Lu-177 DOTATATE



F18-FDG PET : A Different Kind of Information

1. FDG = type of sugar (glucose)
2. Cancer cells use lots of sugar
3. Shows = FAST growing, active cells

F-18 FDG PET



^{18}F-FDG (Fluorodeoxyglucose) Uptake in a Generalized Cell.

F18-FDG PET

1. FDG = type of sugar (glucose)
2. Cancer cells use lots of sugar
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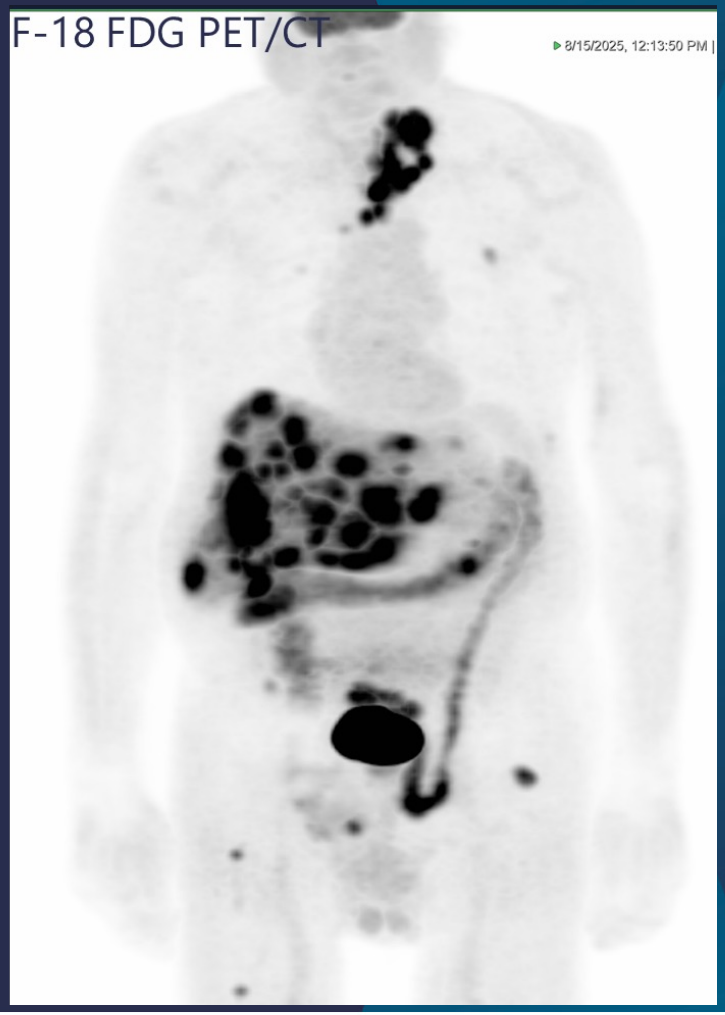
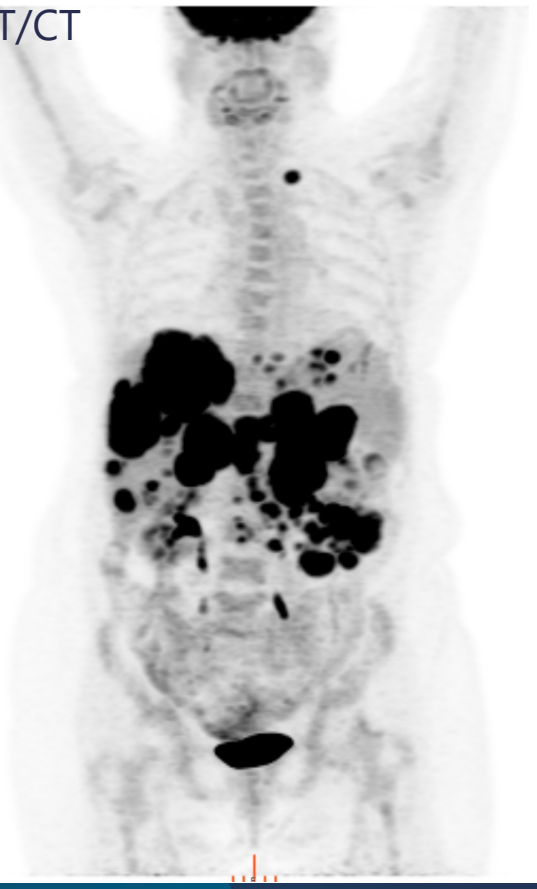


FDG Imaging

- Measures glucose metabolism
- Used for poorly differentiated tumors
  - Grade 3 NET/Neuroendocrine Carcinoma

F-18 FDG PET/CT

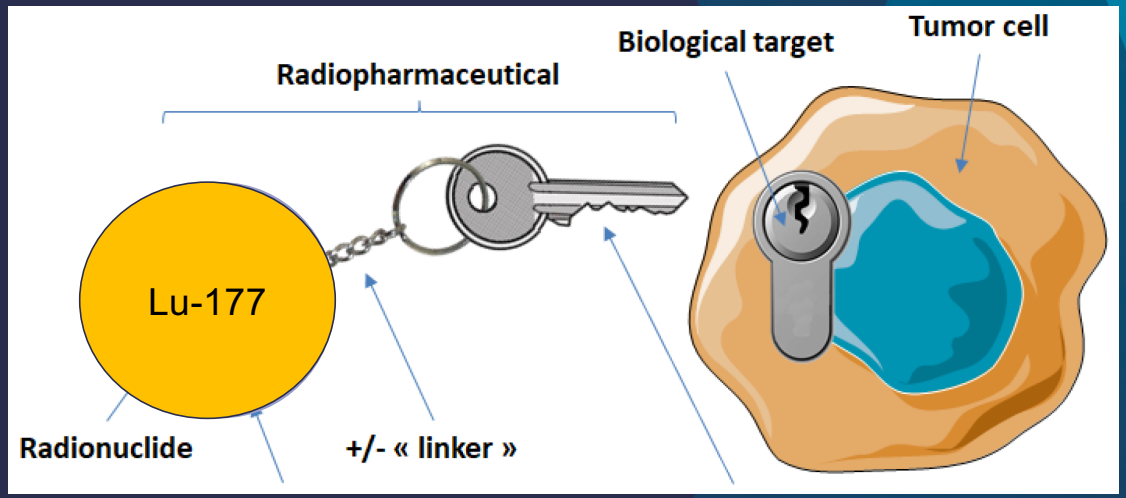


Tumor biology dictates imaging

1. Grade 1 NET -> SSTR
2. Grade 2 NET -> SSTR +/-FDG
3. Grade 3 NET -> SSTR / FDG
4. Neuroendocrine Carcinoma -> FDG

Peptide Receptor Radionuclide Therapy : Why imaging is so important

1. SSTR imaging with GA-68 or CU-64
2. Lutetium 177 replaces imaging radionuclide and delivers targeted radiation
3. MUST confirm tumor has somatostatin receptors



GA-68 Dotatate PET

Patient 1

- Numerous avid lesions
- PRRT Reasonable

Patient 2

- Minimal avid disease
- Alternative therapy

Summary

1. Multiphase contrast CT / MRI for anatomic imaging
2. PET / Molecular imaging for whole body disease staging, occult primaries, therapy guidance, new symptoms
3. Well-differentiated NET → Somatostatin receptor imaging
   High-grade NET/NEC → FDG PET

Thank you

Heather Cole MD
Heather.cole.1@vumc.org

Department of Radiology
Department of Nuclear Medicine

vanderbilthealth.com

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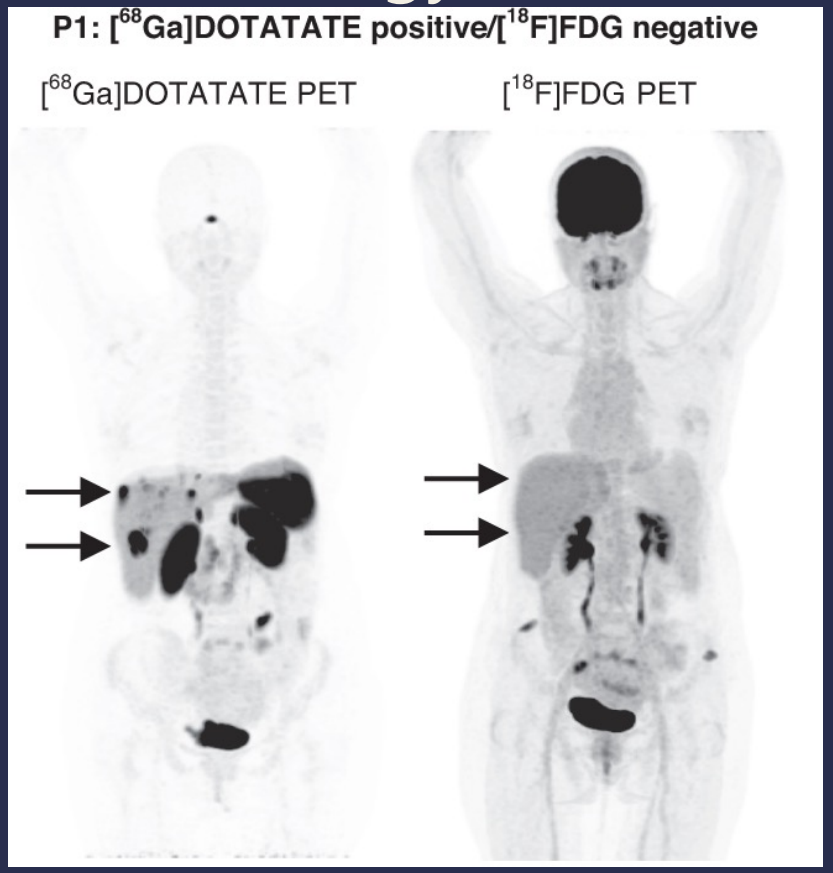
Imaging based on tumor biology

Grade 1 Neuroendocrine Tumor



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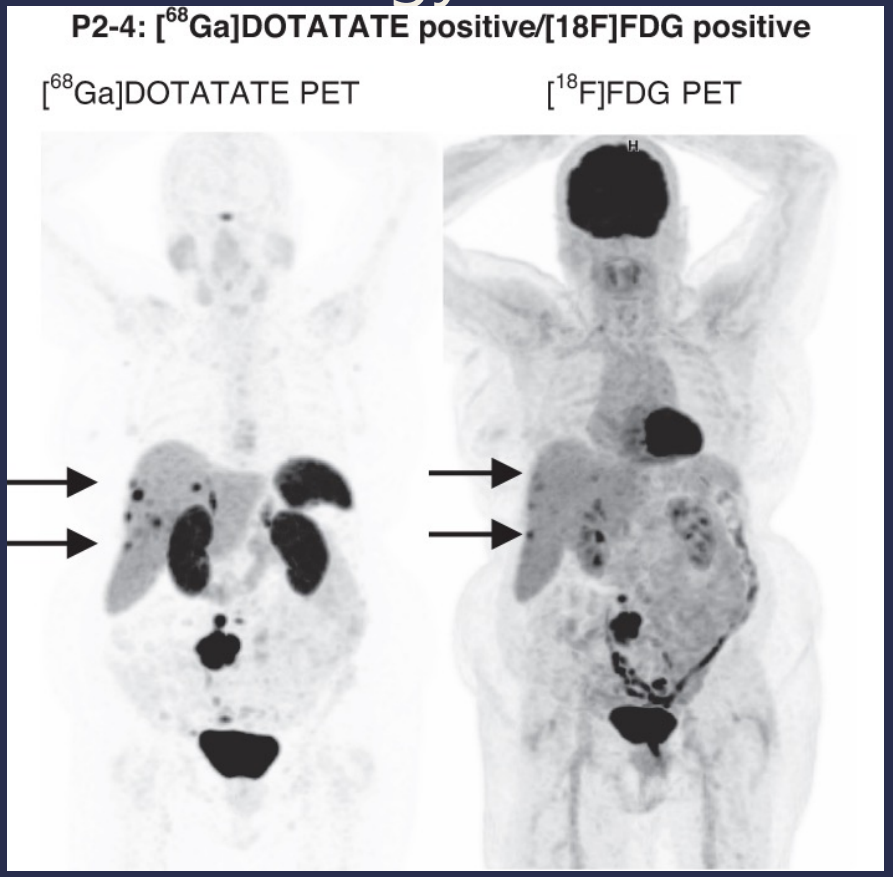
Imaging based on tumor biology

Grade 2 Neuroendocrine Tumor



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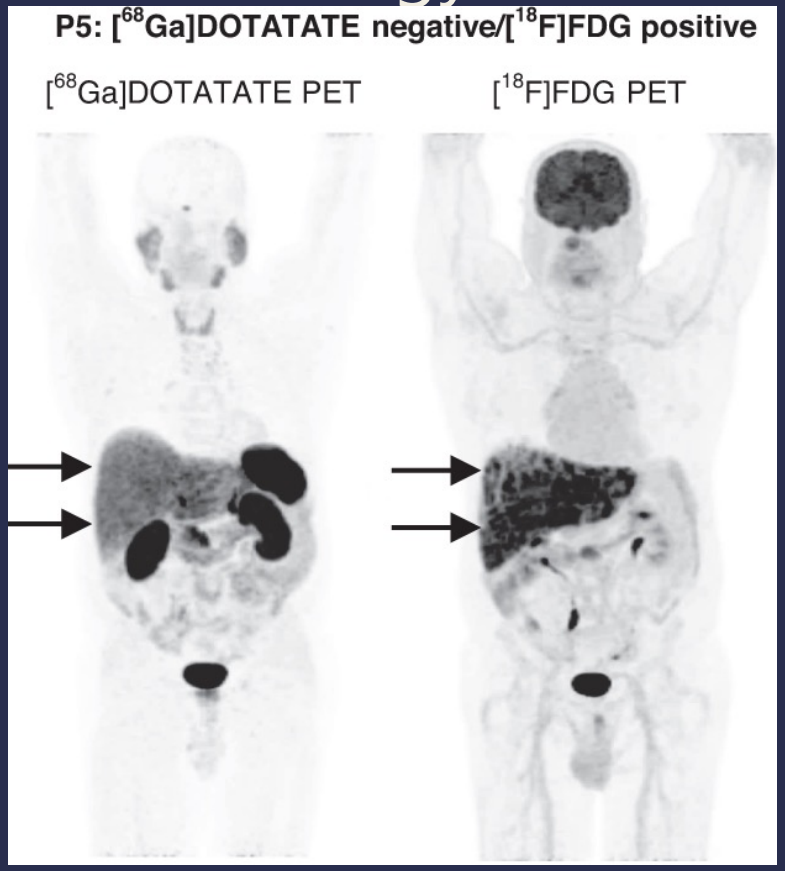
Imaging based on tumor biology

Grade 3 Neuroendocrine Tumor / Neuroendocrine Carcinoma



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