Artefacts and Pitfalls in PET/CT Imaging of Gastrointestinal Cancers

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Gastrointestinal (GI) Cancers

- In the past two decades, PET/CT has become an essential modality in oncology increasingly used in the management of gastrointestinal (GI) cancers, being used for diagnosis, staging, evaluation of treatment response, and assessment of prognosis.

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- Most PET/CT tracers used in clinical practice show some degree of GI uptake.
- One must also be aware of technical artifacts causing difficulties in interpretations.
- It is imperative to know the common variants and benign diseases that can mimic malignant pathologies.

Outline

- Technical Artifacts in Imaging
- Variants and Pitfalls of PET/CT in GI Cancers

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- Technical Artifacts in Imaging
  - Misalignment
  - Partial volume effect
  - Truncation Artefacts
  - Errors in CT-Derived Attenuation Coefficients
    - ✓ Contrast Medium
    - ✓ Metallic Implant

Misregistration

- Misregistration is an incorrect superimposition of PET and CT data on a fused image, potentially resulting in an abnormality being ascribed to the wrong structure.

- It may be due to Involuntary Motion (breathing, bowel motility, distension of the bladder) or Voluntary Motion (patient motion) and can result in both false-positive or false-negative PET findings if not identified and corrected appropriately.

Misregistration

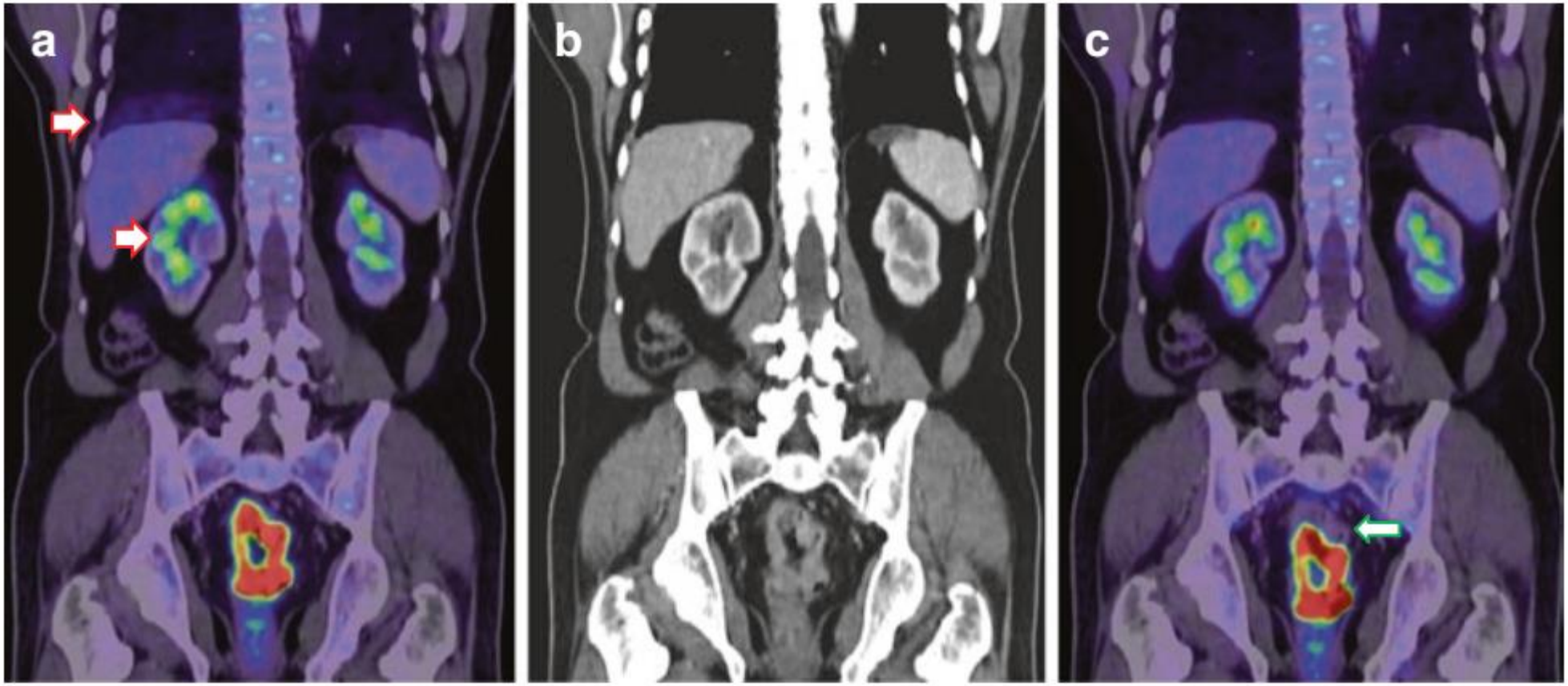


Figure. Misregistration of liver and renal FDG uptake (**a - coronal fused PET/CT, b – corornal contrast enhanced CT**) due to respiratory movement (*red arrows*). (**c**) Images after manual correction for misregistration of liver and renal activity, but it induces misregistration at the site of pathological FDG uptake in the lesion in the rectum (***green arrow***). Care should be taken while interpreting images with misregistration

Misregistration

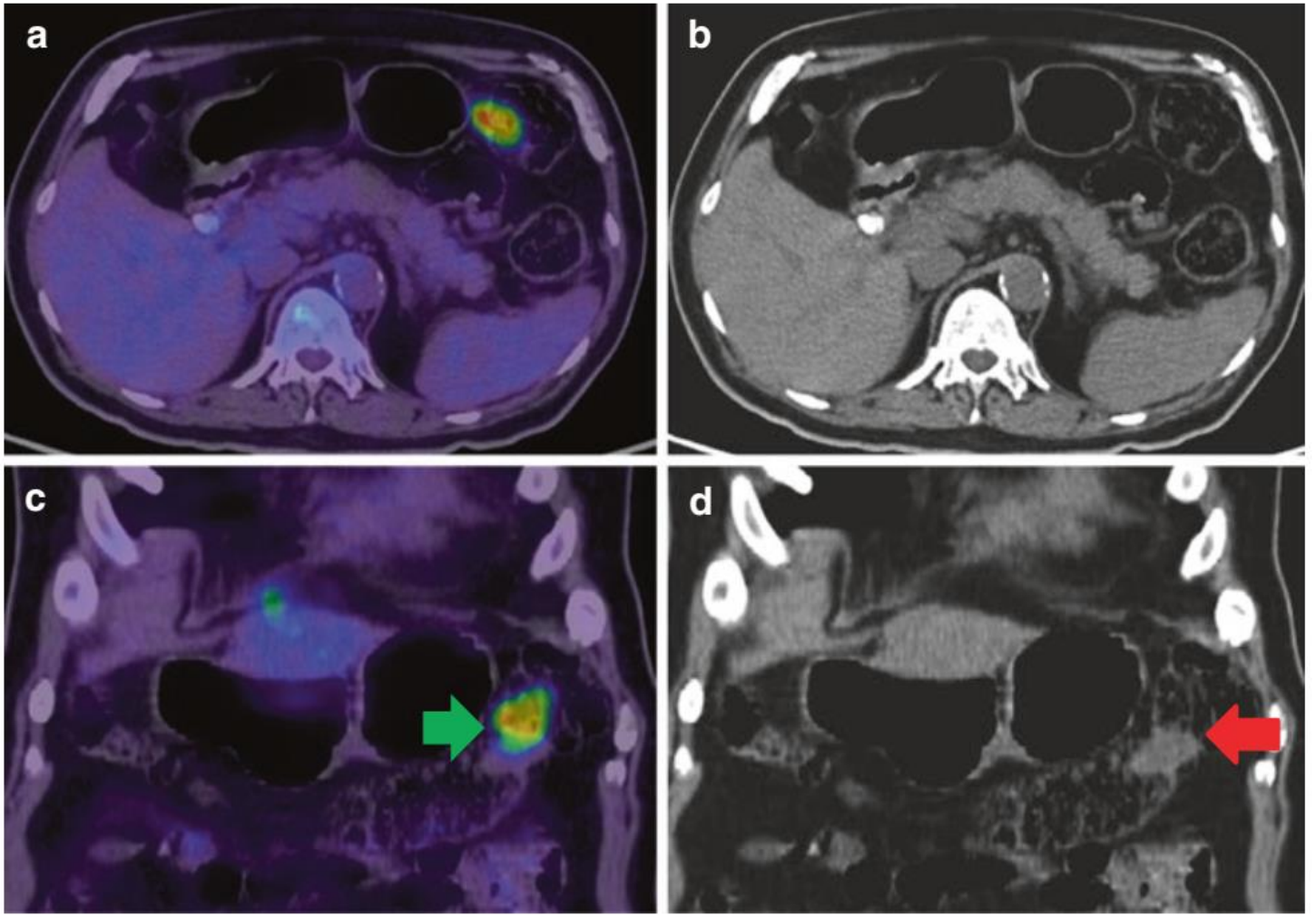
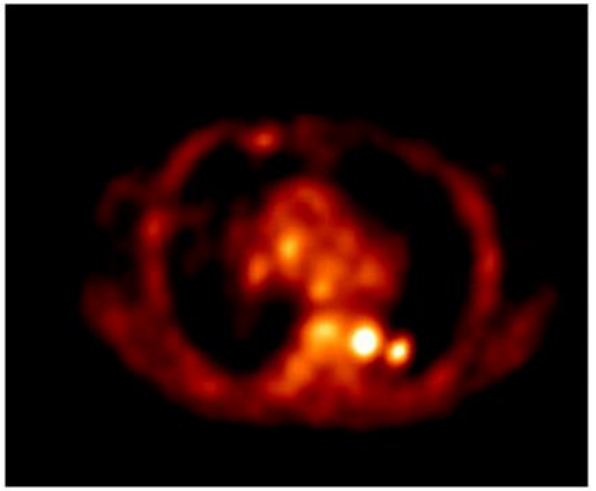


Figure. Misregistration due to bowel movement. Intensely FDG concentration in the left third of the transverse colon (a) with no corresponding lesion seen in CT (b). Careful review of coronal images (c - coronal fused PET/CT and d - coronal CT images) reveals the misregistration (**green arrow**—FDG uptake and **red arrow**, lesion in CT)

Partial Volume Effect

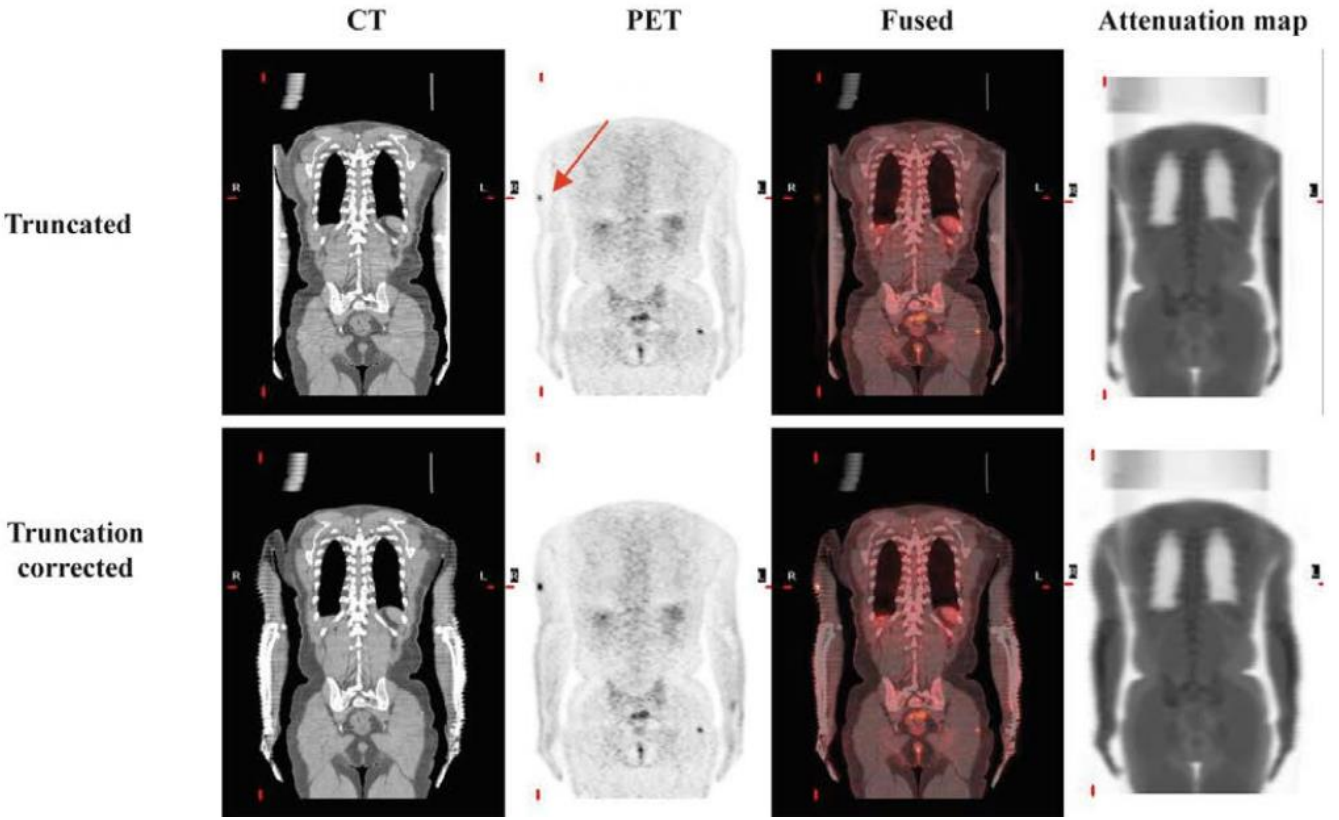
- Partial volume effects (PVEs) represent a major source of degradation in PET imaging, introducing large biases especially for small structures.

- Main contributing factors include the finite spatial resolution of PET systems and the discrete sampling of reconstructed images.



Truncation Artefacts

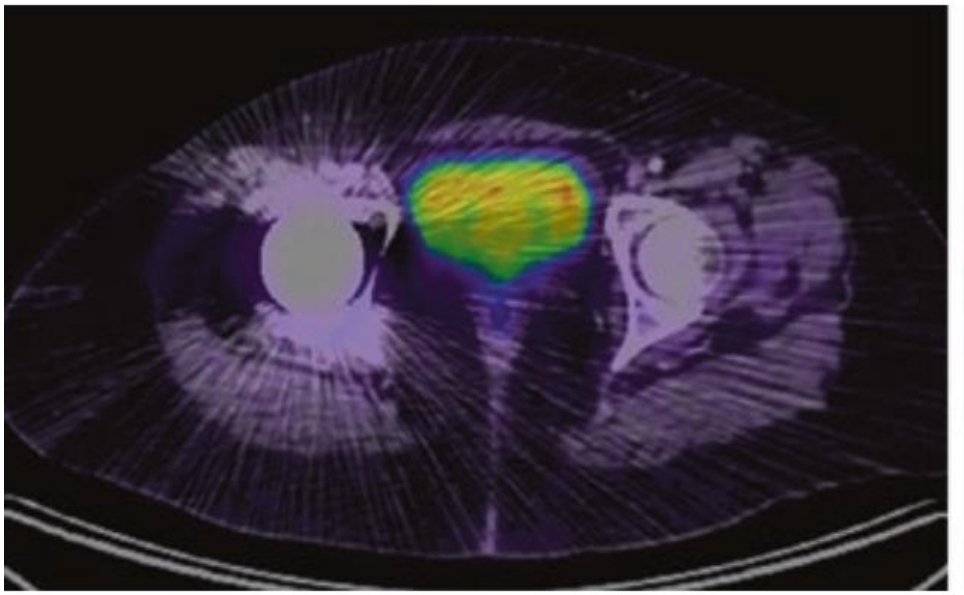
- Truncation artefacts in PET/CT are essentially due to the **difference in size of the axial field of view** between the **CT (50 cm)** and the **PET (70 cm)** tomographs.

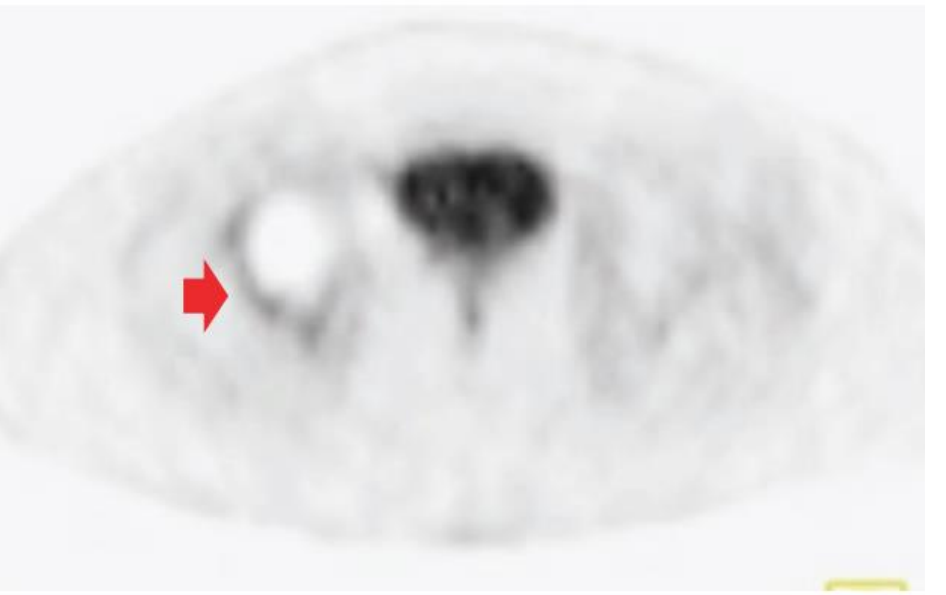


Attenuation Correction Artefacts

Attenuation correction artefacts are seen in the presence of highly attenuating objects like

- Metallic Implant (metallic prostheses/ stents)





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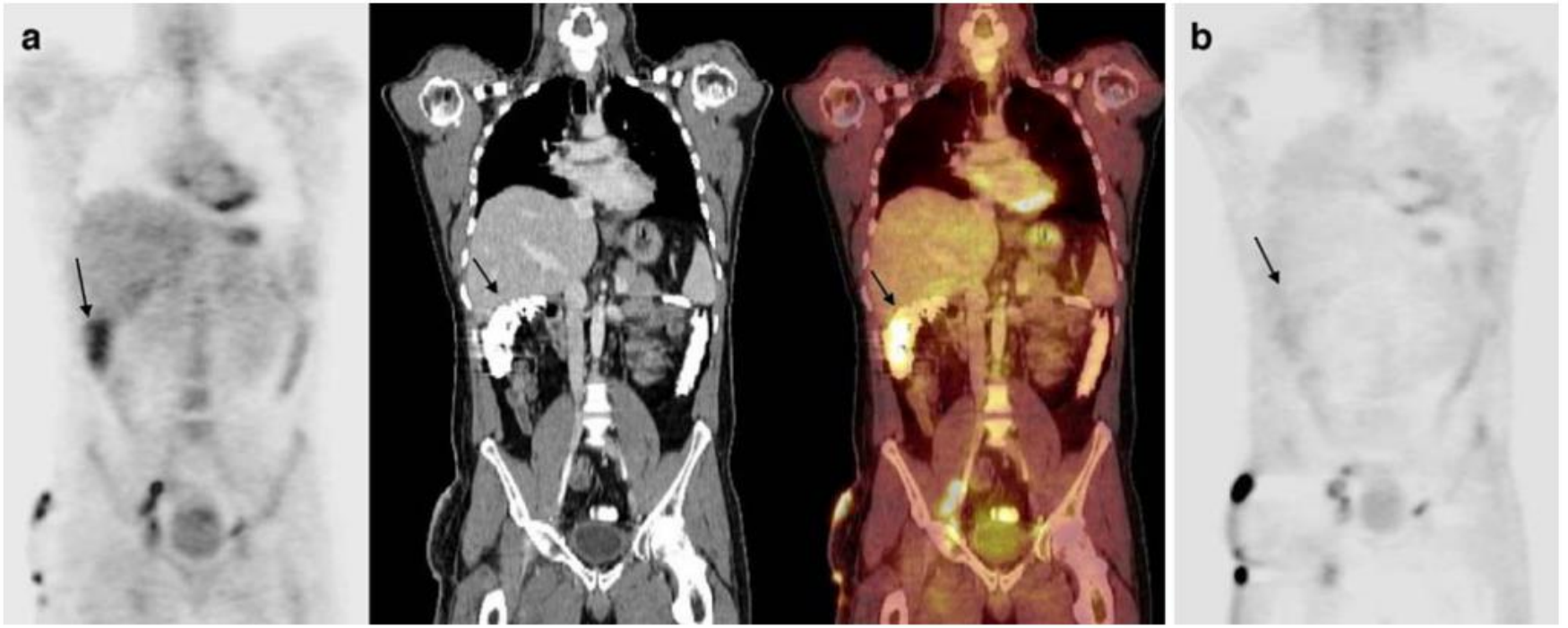
- Metallic Implant (metallic prostheses/ stents)
- Contrast Medium (dense intravenous contrast in the path of the CT beam)

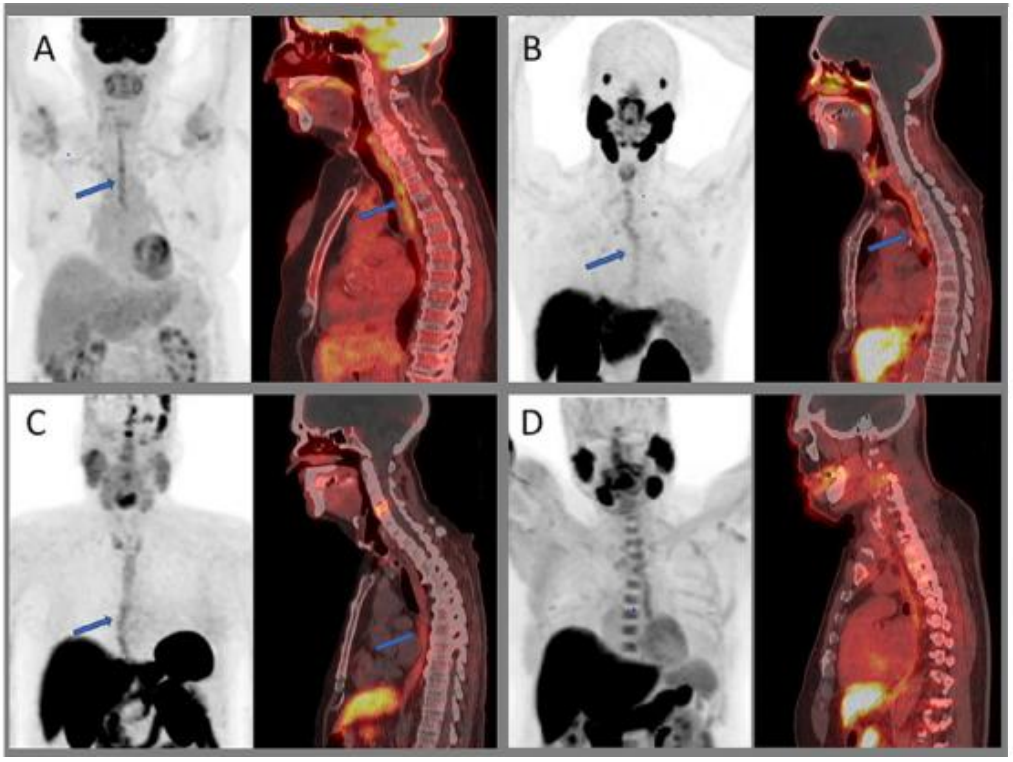


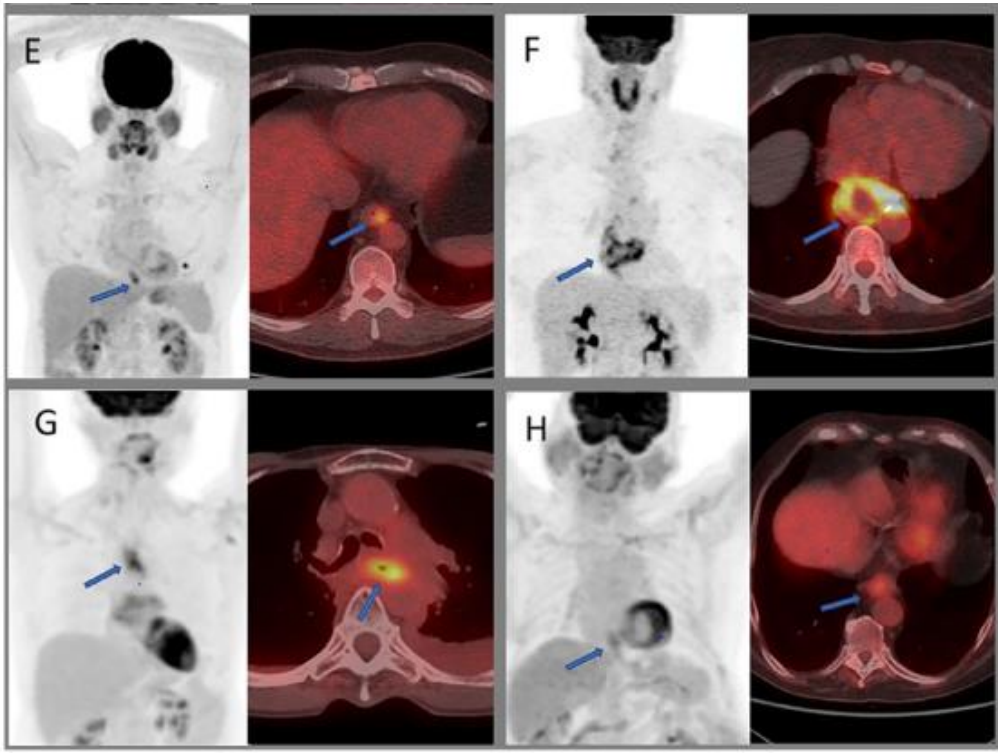
Outline

- Technical Artifacts in Imaging
- Variants and Pitfalls of PET/CT in GI Cancers

Variants and Pitfalls of PET/CT in GI Cancers

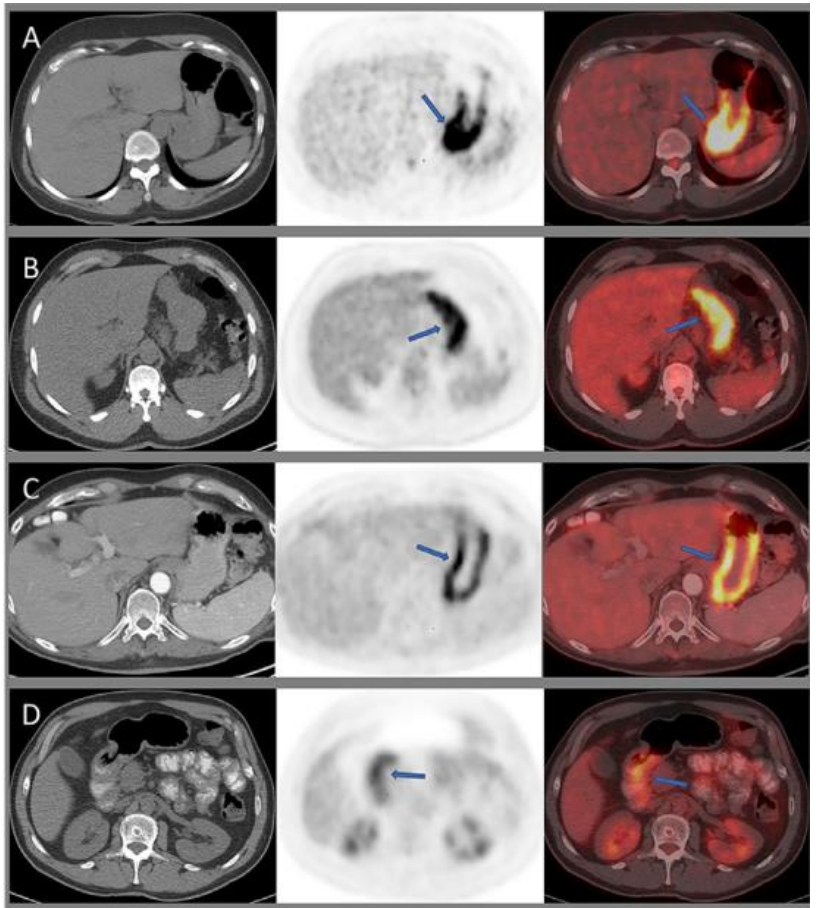
Site	Tracer Used	Benign Conditions That Can Mimic Malignancy	Malignant Conditions With Unreliable or Low-Grade Uptake
Esophagus	FDG	Esophagitis, leiomyoma	T-staging is unreliable Early-stage adenocarcinoma can be low-grade with low PPV for Stage 1 disease Radiation induced fibrosis or inflammation versus residual disease can have similar appearance





Variants and Pitfalls of PET/CT in GI Cancers

Site	Tracer Used	Benign Conditions That Can Mimic Malignancy	Malignant Conditions With Unreliable or Low-Grade Uptake
Stomach	FDG	Physiologic uptake, particularly within the fundus, gastritis, schwannoma, leiomyoma	Distal gastric tumors ca be low-grade compared to proximal tumors Decreased sensitivity for LNs Decreased sensitivity for diffuse-type cancers such as Signet ring cell cancers Decreased sensitivity for some indolent NHL such as gastric MALT Response assessment not possible for non-avid or minimally avid tumors Higher sensitivity for determining treatment failure than to predict response for GIST Role is unclear in routine follow up Can have false positive results



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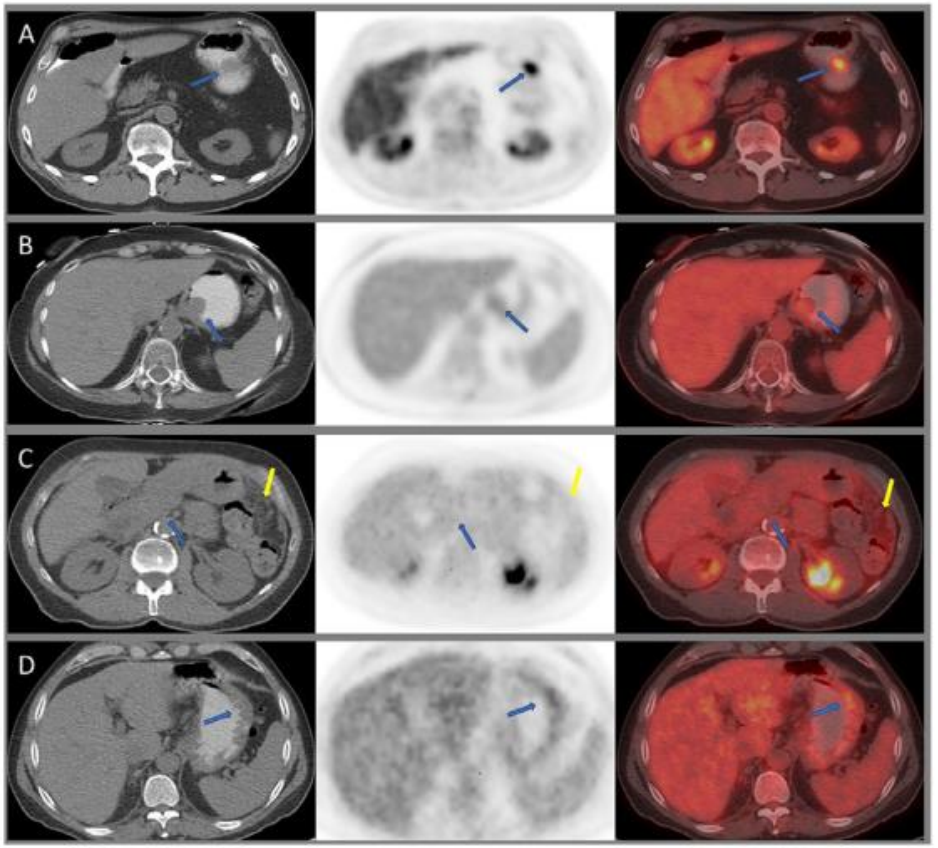

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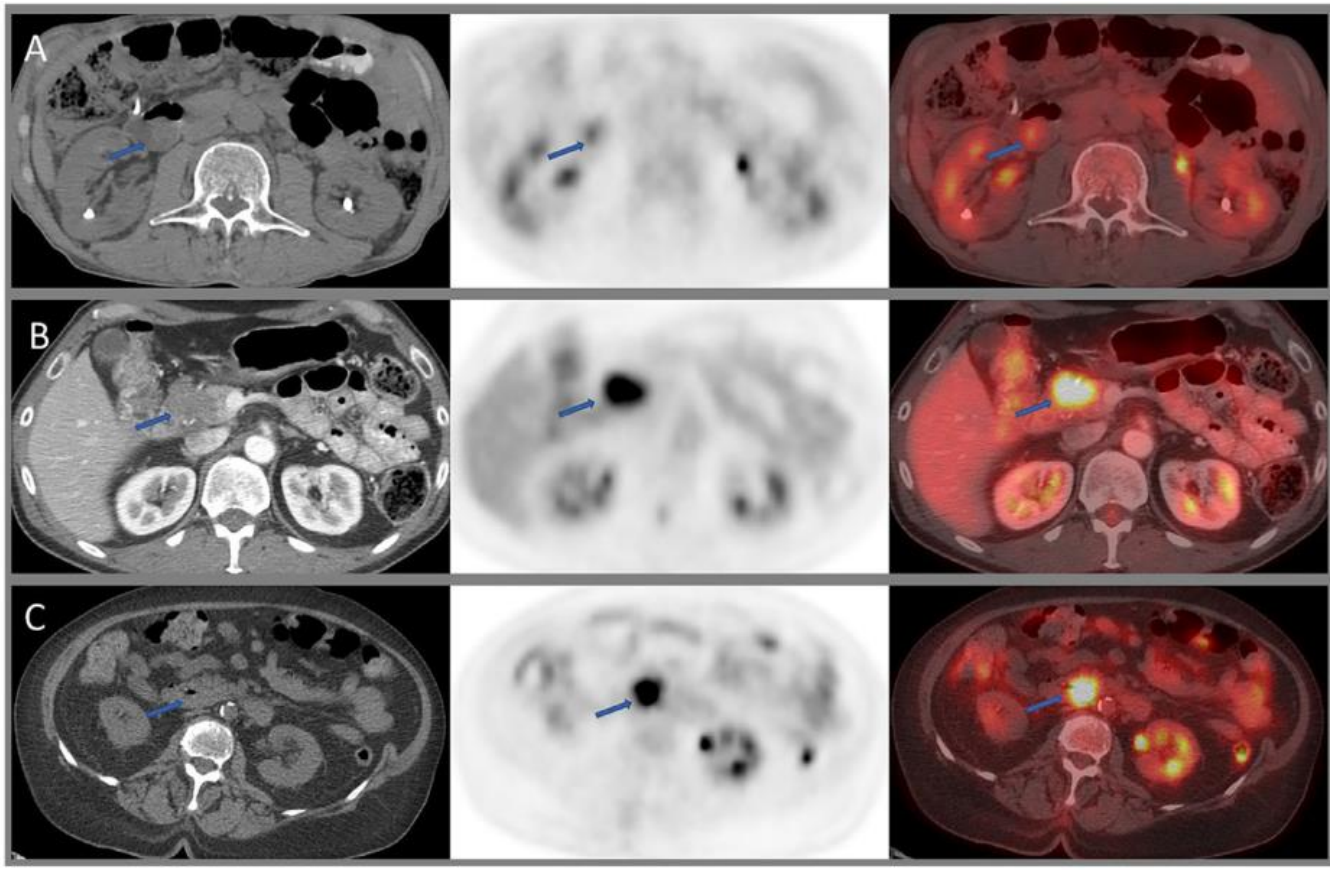
Site	Tracer Used	Benign Conditions That Can Mimic Malignancy	Malignant Conditions With Unreliable or Low-Grade Uptake
Small Bowel	FDG Ga-DOTATATE	Physiologic uptake, IBD, enteritis,	Can be low-grade for MALT lymphoma and neuroendocrine tumors (NET) High proliferation index and poorly differentiated NETs and neuroendocrine carcinomas



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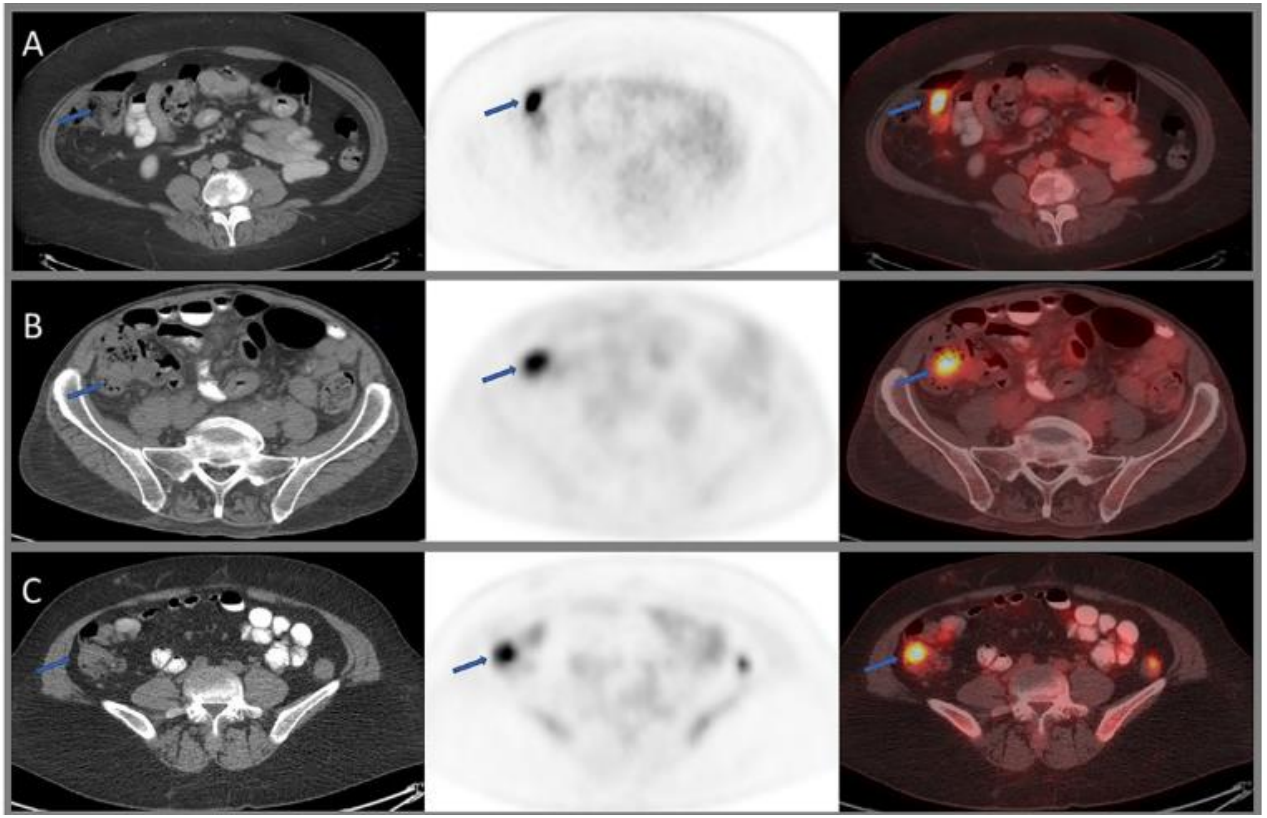

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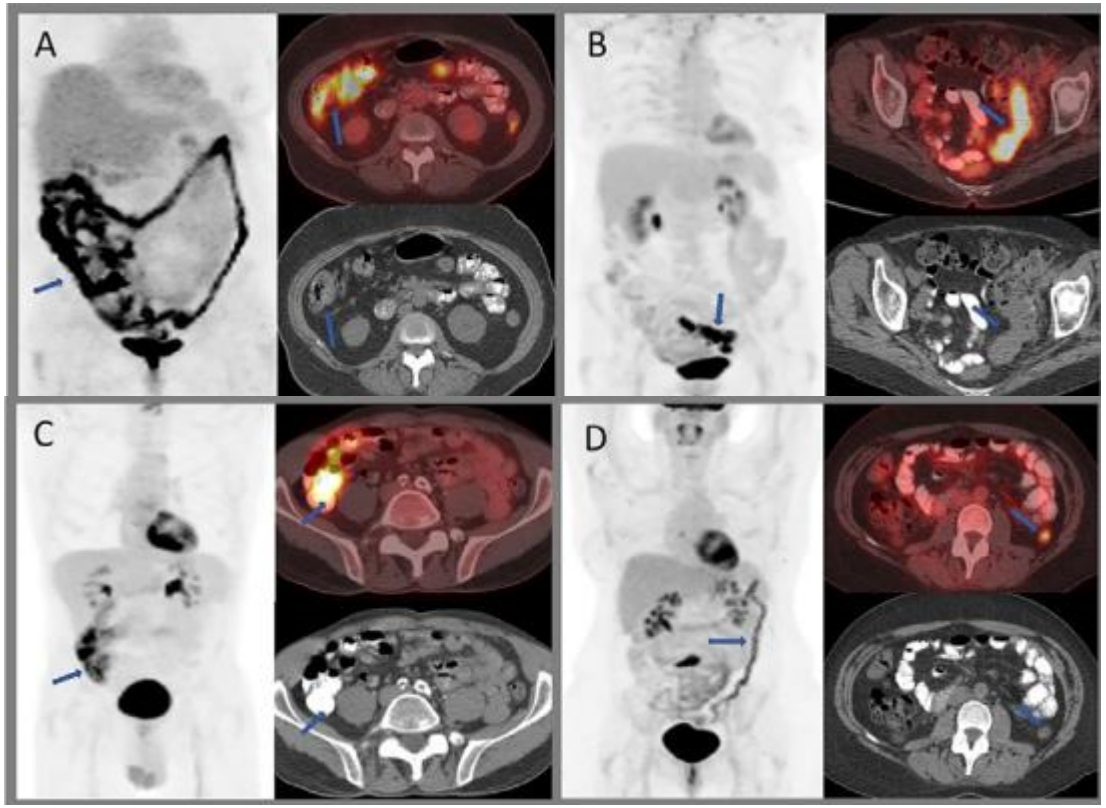
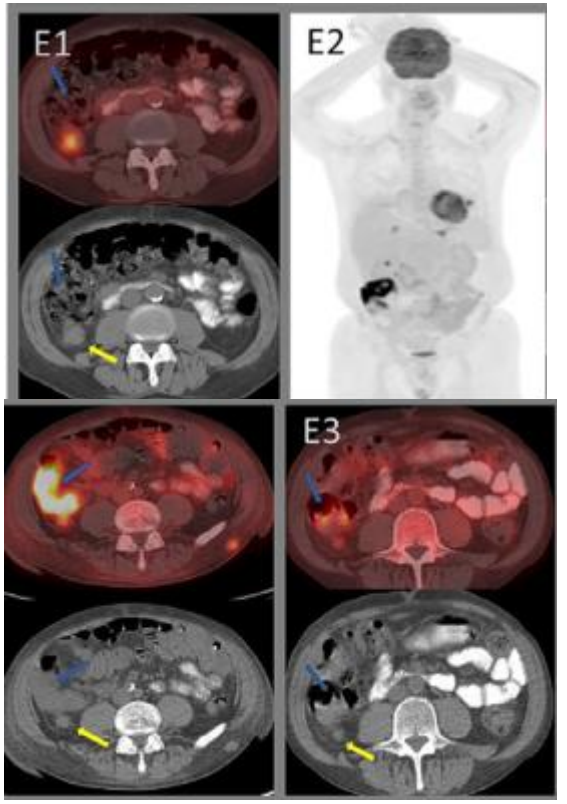
Colon and Rectum	FDG	Physiologic uptake, metformin bowel, colonic or ileostomy stoma, polyps, diverticulitis, IBDs, colitis, Inflammatory pseudotumor, sarcoidosis, normal appendix Anastomotic uptake – physiological and inflammation Post-operative changes and complications such as fistula Radiation induced inflammation	May not be helpful in staging of localized disease without metastases Mucinous tumors can be low-grade Can have false positive results for response assessment in neoadjuvant setting





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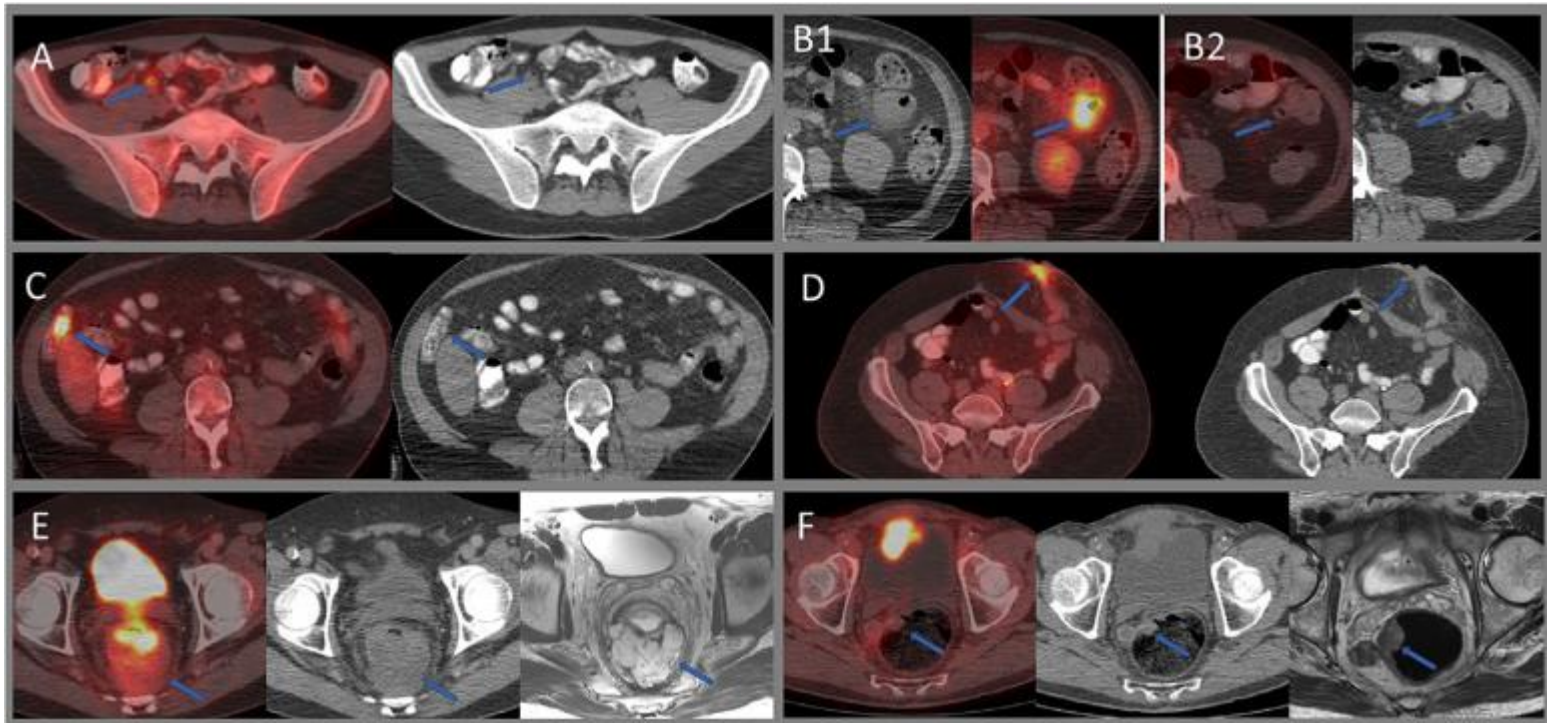

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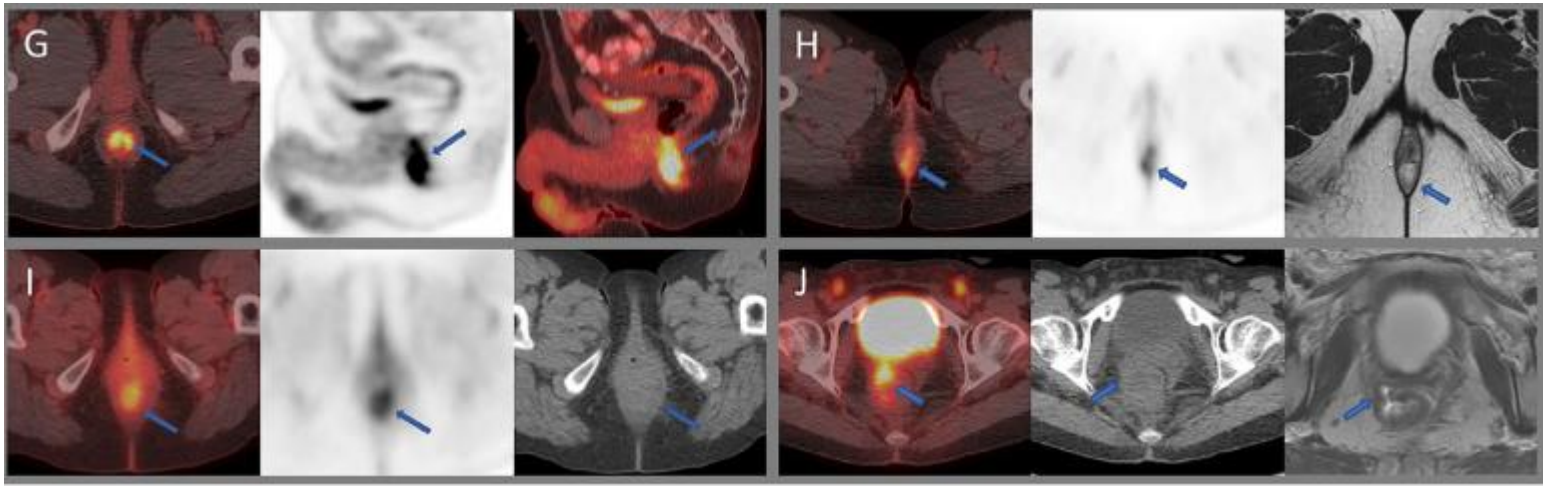
Anal Canal	FDG	Physiological, hemorrhoids, anal fistulas Radiation induced inflammation	Not recommended for routine follow up; can have false positive results Not for local staging of primary tumor Can be false positive if performed soon after chemoradiotherapy Role in follow up unclear – uptake within the anal canal on follow up does not necessarily indicate recurrence



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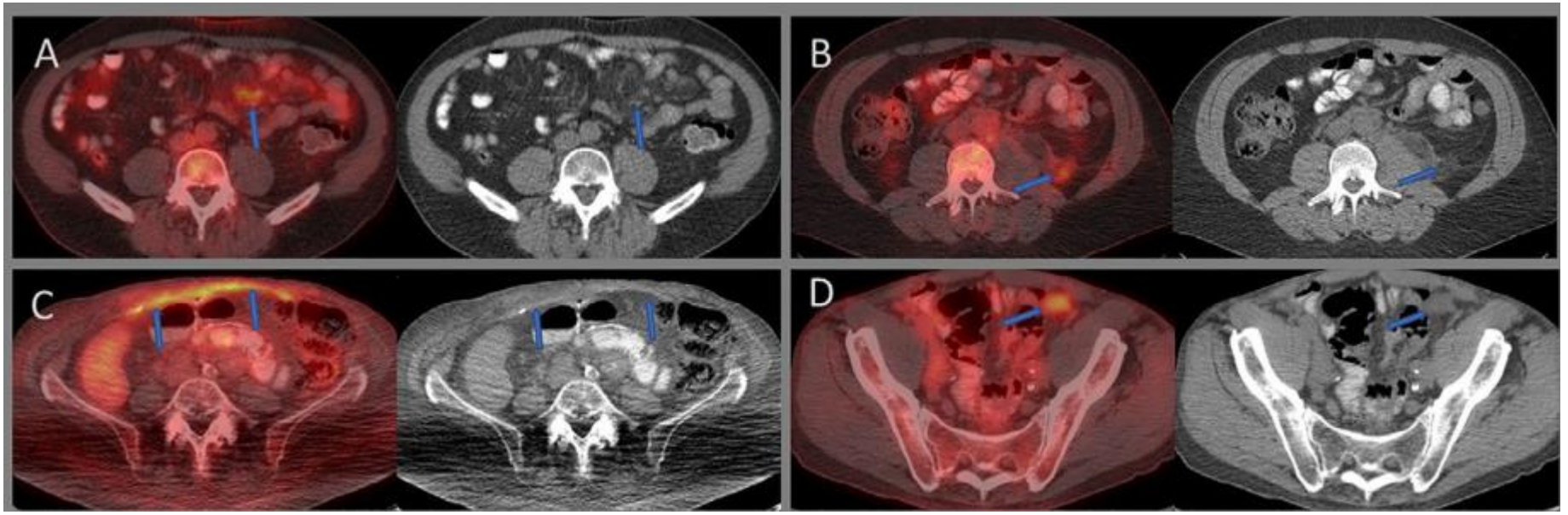
Peritoneum	FDG	Benign conditions as such mesenteric panniculitis, post-operative changes, TB peritonitis Splenules, transposed ovaries, sarcoidosis, portal vein thrombosis, mesh prosthesis, hernia repair plug, Post hyperthermic intraperitoneal chemotherapy (HIPEC) or operative changes	Decreased sensitivity for small-volume disease, predominantly cystic disease, ascites, multicystic peritoneal mesothelioma, pseudomyxoma peritonei Response assessment and recurrence – PET/CT may underestimate disease



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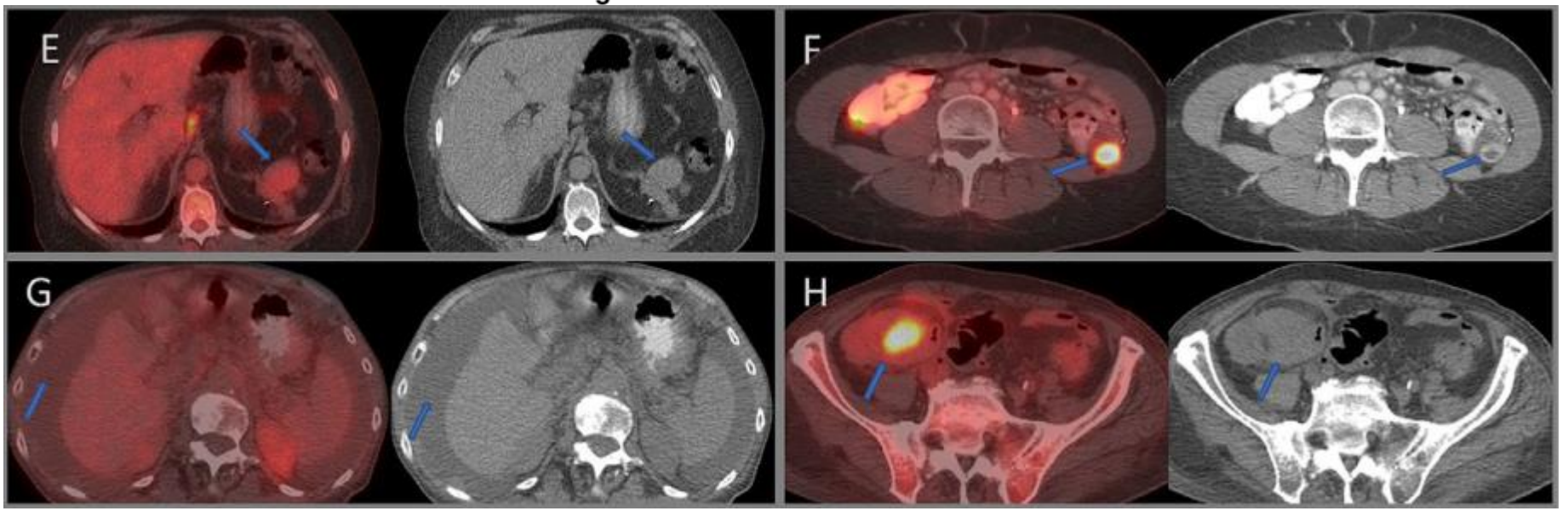

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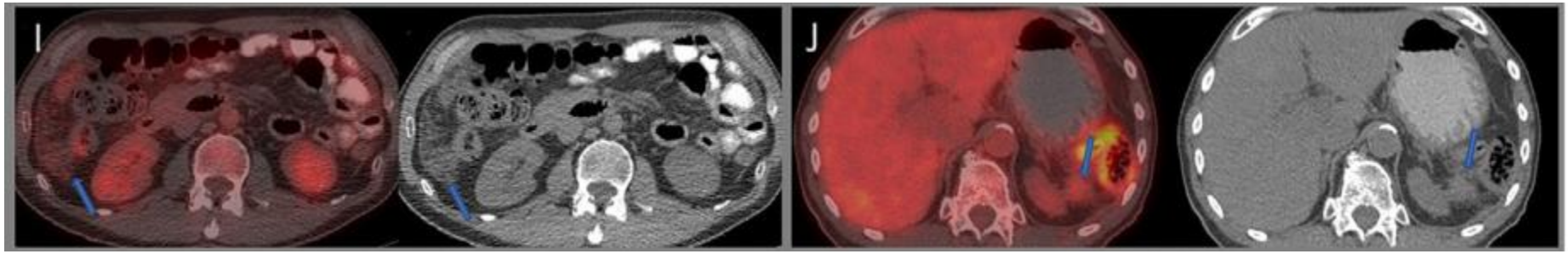


Thanks for your kind attention!