Abdomen and Pelvic Hybrid Imaging: Anatomy, Variants, Urgent Findings

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You are reading a PET-CT for lung cancer and see this...
Or this…
Is it abnormal?

And what is it?
First review:

Slice by Slice
Correlative Anatomy
Latissimus dorsi

Serratus anterior

Latissimus dorsi
colon: splenic flexure

7 = posterior, right
(right hepatic vein)
8 = anterior, right
(middle hepatic vein)
4a = medial, left
(left hepatic vein)
2 = lateral, left
Aorta
Spleen
Splenic vessels
Spleen
Fissure for ligamentum venosum

Caudate lobe
6 = posterior, right (approximate)
5 = anterior, right (gallbladder)
4b = medial, left (falciform fissure)
3 = lateral, left
Fissure for ligamentum teres

Adrenals
Hepatic Segments
Portal vein  IVC  Aorta
Splenic artery and vein
Superior kidneys
Crura of diaphragm
Left renal vein crossing over aorta, not duodenum
Colon

Psoas muscles
Small bowel loops (jejunum)
Inferior kidneys
3rd portion of duodenum
Rectus abdominis

Transverse abdominus

Internal oblique

External oblique
Psoas muscles
Small bowel loops
Aortic bifurcation
IVC bifurcation
Psoas muscles
Ileocecal valve
Psoas muscles
Small bowel loops

Colon
Iliacus muscle
Psoas muscles
Iliacus muscle
Internal iliac vessels

External iliac vessels
Gluteus maximus
Gluteus medius
Gluteus minimus
Focal ureteral activity
Iliopsoas muscle
Small bowel loops
Sigmoid colon
Small bowel loops
Ureters inserting into trigones
Seminal vesicles
Ischium
Obturator internus
Ischial tuberosity
Anus
Penile crura
Testicles
Abdominal Misregistration

Colon projected into liver
Normal Uptake and Variants - GI Tract

- Widely variable
  - Must distinguish from pathology
  - Usually contiguous but may also be focal
    - can also be polyp, cancer
  - IBD can also cause false positive uptake

- PET-CT invaluable

- GE junction common
  - Probably related to LES
GI Tract

• Stomach
  – Usually mild, diffuse
  – More common and intense at fundus
  – Can be focal, especially if contracted
  – Hiatal hernia
  – Intense and focal or distal evaluate
  – CT abnormality evaluate
GI Tract

- **Small Bowel and Large Bowel**
  - Usually lower intensity and contiguous
  - Can be focal
    - Especially right colon
      - Smooth muscle
      - Active mucosa
      - Lymphoid tissue
      - Secretions and microbe flora
Colon and Small Bowel

• Focal or segmental
  – More intense than liver
    • Worry about tumor
      – Most will be benign
    • CT correlation can be helpful

• IBD/diverticulitis/inflammation

• Colitis
  – Post-chemotherapy

Prabhakar et al. Radiographics 2007;27:145
Normal Uptake and Variants - Esophageal

EG junction
Normal Uptake and Variants - Esophageal
Normal Uptake and Variants - Stomach
Normal Uptake and Variants – Small Bowel

Small bowel uptake

Small bowel uptake but no colon
Normal Uptake and Variants - Colon
Colon Polyp
Liver

- Normal heterogeneity
- Respiratory artifact
Normal Uptake and Variants – GB

- Physiologic accumulation infrequent normal variant

- But uptake in wall
  - Cholecystitis
  - Possibly tumor, especially focal
Adrenal

- No uptake or less than liver is good
  - Watch out for necrosis
  - Combine appearance on PET with CT

- Intense uptake malignant
Adrenal

- Bilateral adrenal masses
- Right: low density adenoma
- Left adrenal cancer
Mild uptake left adrenal low density nodule or hyperplasia with SUV of 1.7 and HU of 1.4, stable on f/u CT 6 months later.
MIBG SPECT/CT: Pheochromocytoma

Solid right adrenal mass seen well on CT and intense on MIBG
Normal Uptake and Variants – Renal

• Renal excretion of FDG.
  – Unlike glucose, FDG not well reabsorbed by tubular cells of the kidney
  – Well hydration to wash out renal excretion
  – Some advocate lasix
  – Patient supine so radiotracer pools in upper collecting system
  – Also look for diverticula, communicating cysts, redundant and duplicated ureters
Renal Cyst

Simple cysts should be photopenic
Normal Uptake and Variants – Urinary

- Ureter usually linear, easily identifiable
- Focal ureter activity may look like lymph node but CT fusion helps
- Bladder usually intense but doesn’t obscure with iterative reconstruction
  - Look for diverticula, nodules, TURP
  - Some advocate foley

Duplicated Right Ureter

Bifid ureter, not adjacent lymph node
Normal Uptake and Variants – Renal

Use other imaging planes...
Normal Uptake and Variants – Renal

Duplex system on the right
Normal Uptake and Variants – Renal

Focal ureter crossing over iliac vessels, no lymph node
Normal Uptake and Variants – Bladder

Even with iterative reconstruction, may still cause some artifact
Normal Uptake and Variants
Bladder Diverticulum
Brown fat may be around diaphragm and even peri-renal
Normal Uptake and Variants – Uterine

- Low level uptake is common, but can increase with menses.


  CONCLUSION: In premenopausal patients, normal endometrial uptake of (18)F-FDG changes cyclically, increasing during the ovulatory and menstrual phases. Increased uptake in the endometrium adjacent to a cervical tumor does not necessarily reflect endometrial tumor invasion. Increased ovarian uptake in postmenopausal patients is associated with malignancy, whereas increased ovarian uptake may be functional in premenopausal patients.
Normal Uptake and Variants – Uterine

Uterus with slightly hotter stripe at endometrium

Mild ovarian uptake
Normal Uptake and Variants – Uterine

Young female with benign mediastinal mass

Uptake in vagina is not cancer but tampon.
Premenopausal uptake in fibroid may be intense
Normal Uptake and Variants – Ovarian

- Increased unilateral uptake with ovulation (may be bilateral)
- Also look at morphology of ovaries. May need followup.
  - PET positive with 7/12 malignant tumors
  - Uptake, even intense, with benign disease at times
    - Corpus luteum cysts
    - Other benign tumors and inflammation

Normal mild uptake in ovaries
Gastric Cancer

Krukenberg tumors: Bilateral uptake, post-menopausal, complex appearing ovaries
Normal Uptake and Variants – Testes

• Normal and decreases with aging

• If see unilateral or very intense, investigate further
Normal Uptake and Variants – Testes
Remember: CT Adds Other Information

  - 59 cases
  - In 10 patients, CT provided important information which impacted interpretation
  - Also found 15 incidental findings such as renal and gallstones, etc.
and you see this...

6cm AAA and horseshoe kidney

Pick up the phone...
Ruptured AAA

Normal
Aortic Dissection
Pneumoperitoneum

Free air anterior to liver

Small foci of air outside bowel lumen
Pneumoperitoneum
Use Lung Windows to Help
Pneumoperitoneum: Use Other Planes
Pneumatosis and Pneumobilia
Small Bowel Obstruction Due to Ventral Hernia
Persistent Abdominal Pain in Post-Colon Cancer Despite Treatment for Recent “UTI”

Appendicitis on Surgery
Crohn Disease
(DDX infection, inflammation, ischemia)

Normal
Diverticulitis
Cholecystitis
Ruptured Diaphragm: GB Points Up
Emphysematous Cholecystitis

Normal
Emphysematous Cystitis
Pancreatitis

Pancreatitis

Normal
Ascites
Ascites on Liver/Spleen Scan
But Remember This Appearance: Omental Caking
New Mild Hydronephrosis
New Mild Hydronephrosis

Stone in ureter
Right ureterovesical junction stone

Left ureteral stone
Don’t Confuse Pelvic Kidney with Tumor
Knowing CT is Important: Not All Cancer is Hot

Mucinous Adenocarcinoma Recurrence
The End….  
Stay tuned for MSK…