

PET/CT for Hardware and Line Infections

SWC SNMMI 2024 Annual Meeting | April 12th 2024

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Objectives

Individuals attending this session will be able to:

- Identify appropriate uses of FDG PET/CT in evaluation of hardware/line infections
- Optimize patient preparation and protocol selection in evaluation of hardware/line infections.
- Recognize typical appearances of hardware/line infections and common "false positives."

Background

- Increasing use of FDG PET/CT in the evaluation of infection
 - Improved availability
 - Effective 1/1/2021, CMS has removed “non-coverage” language for FDG PET in infection and inflammation
 - Efforts by SNMMI and other lobbying bodies have shed light on the evidence-base for FDG PET in infection and inflammation
- Appropriate patient selection and preparation as well as understanding of the clinical scenario are critical for accurate interpretation

First Code

1960

National Coverage Determination (NCD)

FDG PET for Infection and Inflammation

220.6.16

Indications and Limitations of Coverage

220.6.16 FDG PET for Inflammation and Infection

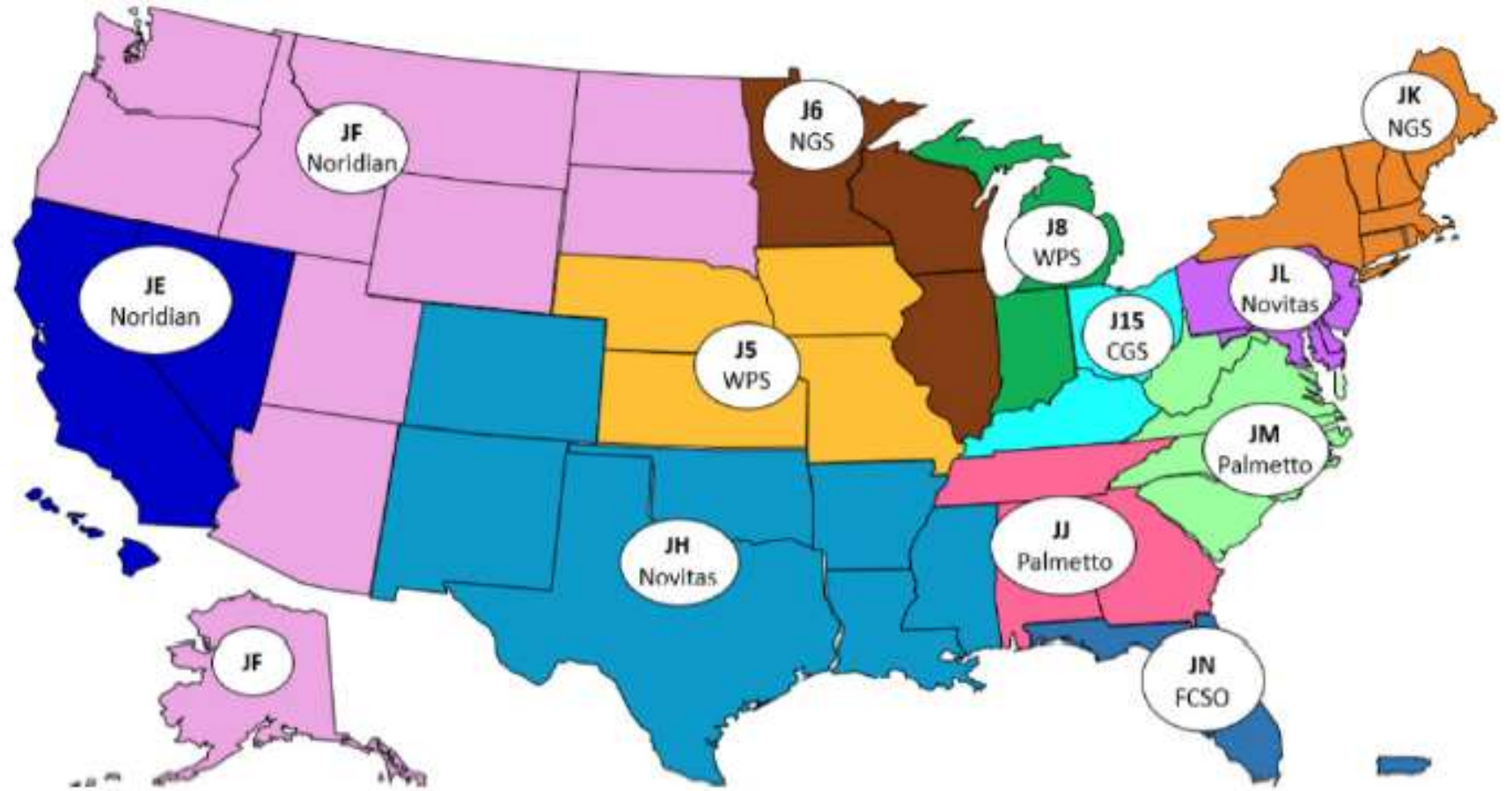
*(Rev.10838, Issued, 06-08-21, **Effective: 01-01-2021**, Implementation 06-22-21)*

*Effective January 1, 2021, the Centers for Medicare & Medicaid Services determined that **no national coverage determination (NCD) is appropriate** at this time for FDG PET for Inflammation and Infection. In the absence of an NCD, coverage determinations will be made by the Medicare Administrative Contractors under section 1862(a)(1)(A) of the Social Security Act.*

CMS removed non-coverage of FDG PET for inflammation and infection

<https://www.cms.gov/medicare-coverage-database/view/ncd.aspx?NCDId=323&NCDver=2>

Medicare Administrative Contractors (MACs) Coverage areas



JH Novitas

- MAC chat to discuss coverage decisions after the fact
 - Must provide NPI, PTAN, and Pt name, DOB and DOS
 - Register in advance for Medicare Part A or Part B session
- Phone contact for general questions

The screenshot shows the Medicare JH website interface. At the top, the Novitas Solutions logo is on the left, and navigation links for 'Contact Us', 'Join E-Mail List', 'Policy Search', 'Novitasphere', and 'Share Link' are on the right. A search bar is also present. Below the header, the page title is 'Medicare JH' with a sub-header 'Providers in AR, CO, LA, MS, NM, OK, TX, Indian Health & Veteran Affairs'. A left-hand navigation menu lists various services, with 'Contact Us' highlighted by a red box. The main content area features a red alert banner about 'Incorrect denials for medical necessity'. Below this is a message from Harvey Dikter, CEO and President, regarding COVID-19. A yellow arrow points from this message to a 'MAC Chat' banner, which encourages users to register for a 15-minute session. To the right of the MAC Chat banner is a 'Novitasphere' login/sign-up section with a list of topics like 'Change provider location or address' and 'Deductibles / Coinsurance / Therapy thresholds'.

<https://www.novitas-solutions.com/webcenter/portal/MedicareJH>

FAQs

- Q: Is there a limit of 1 scan per year or per patient lifetime?
- A: No. For infection and inflammation, there are currently no limits to the MACs

- Q: Do I append the PI or PS modifier for infection and inflammation scans?
- A: No. These are only for oncologic PET studies to identify initial and subsequent indications.

- Q: What do I do if my claim is denied?
- A: Appeal, and if you are denied, appeal again and be sure you are discussing with the medical policy staff or physicians to explain the value of the study for the patient. Along with guidelines and medical literature. If you need assistance, contact SNMMI.

- Q: Where can I find the most up to date information on CMS coverage determination?
- A: The Medicare National Coverage Determination Manual can be accessed online https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/Downloads/ncd103c1_Part4.pdf

Table 1 Overview of Common Practical Or Technical Pitfalls And Potential Solutions

Challenges in FDG-PET/CT	Consequence	(Potential) solution
Imaging of moving structures such as the heart and lungs.	Reduced diagnostic accuracy of diseases such as endocarditis or pulmonary septic emboli.	Perform ECG-gated or respiratory-gated PET/CT.
High physiologic FDG uptake of the myocardium.	Reduced ability to diagnose cardiac infections, especially endocarditis	Follow adequate dietary precautions. Administer single dose of heparin before FDG-PET/CT.
Inability to distinguish malignant disease from infection or inflammation	Additional testing such as biopsy is necessary for diagnosis.	Dual time point or dynamic PET/CT imaging may be performed.
Diabetic patients with hyperglycemia.	A serum glucose level above 11 mmol/L may result in low lesion-to-background ratios.	Dietary precautions should be followed and rapid-acting insulin may be given up to 4 hours before FDG-PET/CT.
Extensive brown fat activation.	Extensive FDG avidity in the head and neck region that may mimic active lymph nodes	Keep (young) patients warm before FDG-PET/CT.

EANM/SNMMI Guideline for ^{18}F -FDG Use in Inflammation and Infection

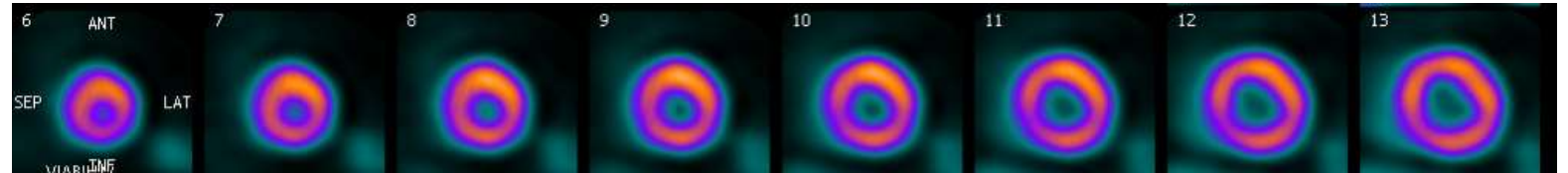
Patient Preparation:

- Standard preparation for FDG PET (NPO 4-6 h, no insulin for 4-6 h prior to scan)
- For any suspected cardiac disease or cardiac device infection, low carbohydrate, high fat diet for 1-2 days prior to scan is necessary to suppress myocardial glucose metabolism

FDG PET &
Myocardial
Metabolic
plasticity

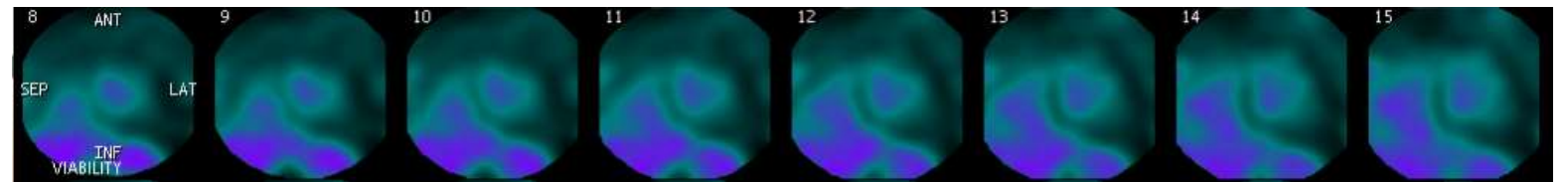
Non-fasting

^{18}F -FDG



High Fat & Protein - No/low Carb diet

^{18}F -FDG



Cardiac Inflammation ~~Cardiac Sarcoid~~ Protocol

Entire day before PET

Patient may ingest ONLY:

- Meat and fish (Non-breaded beef, steak, pork, bacon, chicken, fish of any kind, lamb)
- Eggs
- Nuts
- Green vegetables (less than 1 cup)
- Water, plain coffee, or tea

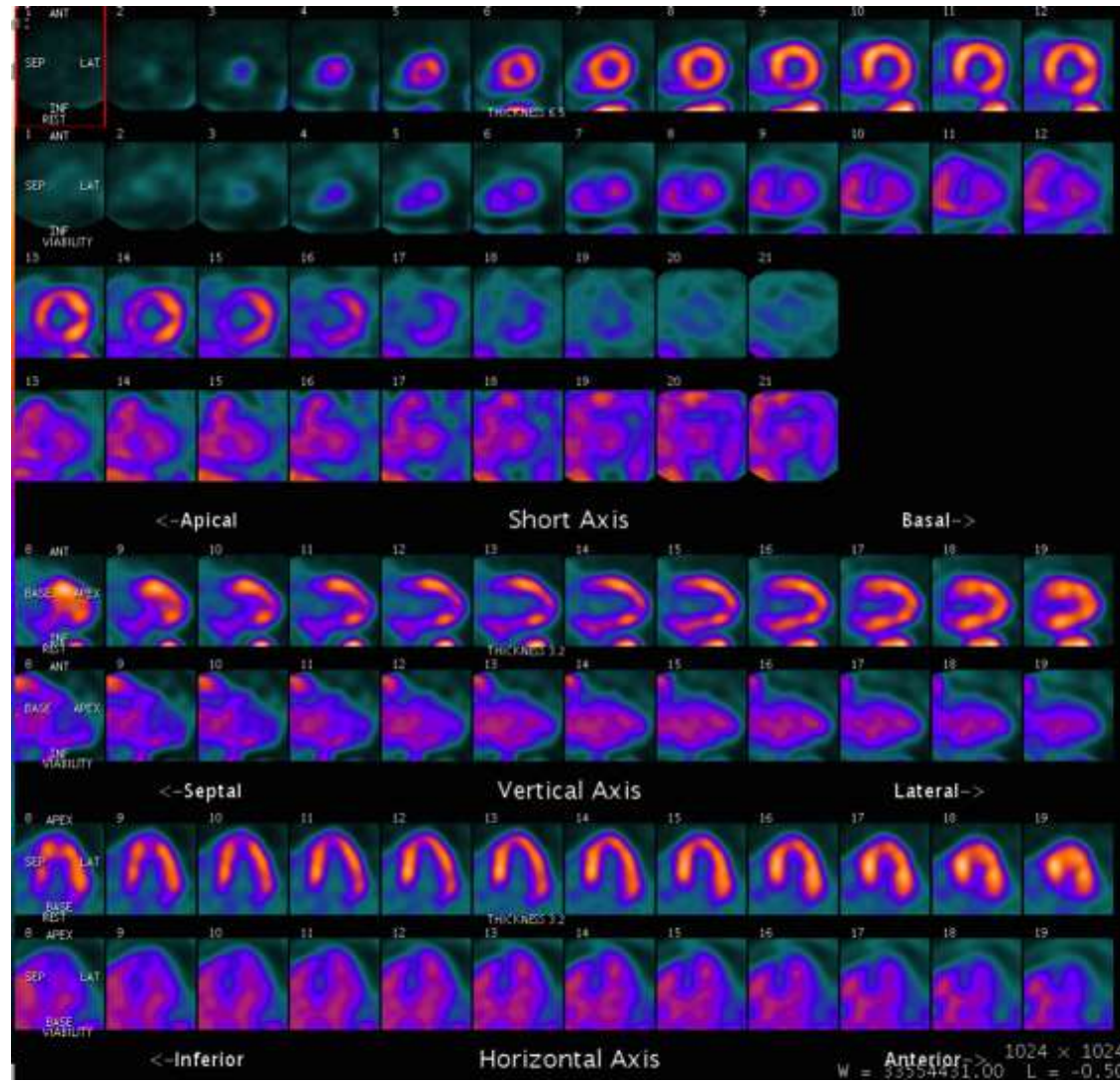
No tortillas, rice, or beans

MAY NOT HAVE: any foods that contain carbohydrates (sugar, starch, corn syrup fruit, fruit juice, alcohol, milk) the entire day prior to the scan. Patient should avoid processed foods (sausage, deli meats, spam). Patient should use plain salt, pepper, or herbs, but avoid seasonings that may have sugar added (all season, jerk, etc), as well as avoid seasoned nuts (spiced or honey glazed).

12 hours before PET

- Patient may not eat anything
- Patient may drink water or plain coffee or tea (no milk, cream, sugar, or anything else added)
- Patient may take all medications as usual with water.
- Diabetic patients should not take insulin or anti-diabetic medications the morning of the study.

Same Pt with
Appropriate
DIET and FAST



Second Code

1923

EANM/SNMMI Guideline for ^{18}F -FDG Use in Inflammation and Infection

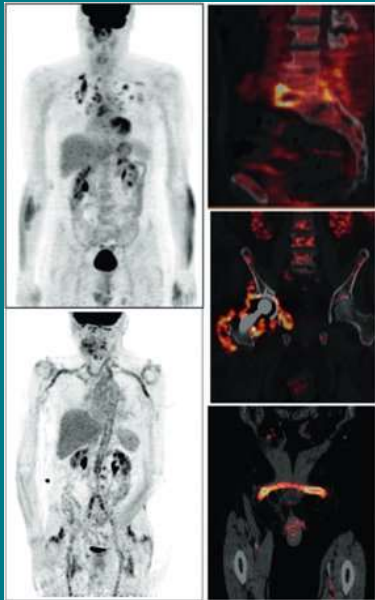
Additional useful info:

- Recent trauma or surgery/procedure
- Presence or absence of fever, labs (WBC, ESR, CRP, etc.)
- Any known infectious/inflammatory condition
- Immunosuppressive status
- Medications (esp. antibiotics and steroids)
- Pathophysiologic disturbances and symptoms, such as diarrhea and localized pain, especially in the extremities (e.g., knee, for appropriate choice of field of view).
- Presence of benign disease with high tissue proliferation.
- Pregnancy or suspected pregnancy, breastfeeding, and date of the last menses.

FDG-PET/CT for suspected infective endocarditis.

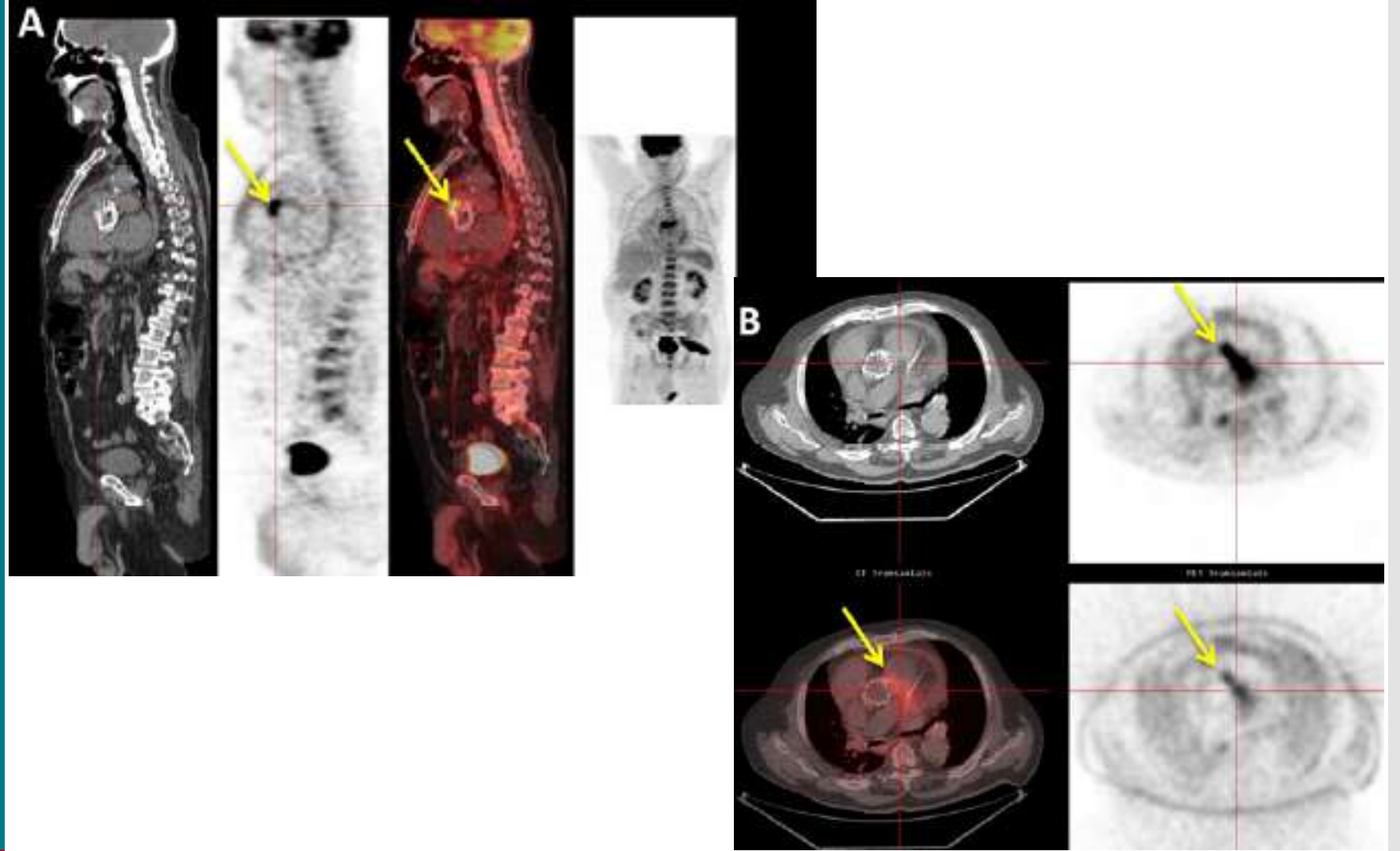
Native valve endocarditis	Prosthetic valve endocarditis	Cardiac device related endocarditis	
		Pocket infections	Lead infections
<p>Indications FDG-PET/CT Evaluation disseminated disease</p> <p>Intracardiac lesion detection Sensitivity 36% Specificity 98%</p> <p>Key points Cardiac preparation (intracardiac lesions as potential additional findings)</p>	<p>Indications FDG-PET/CT Evaluation disseminated disease Evaluation intracardiac lesions</p> <p>Intracardiac lesion detection Sensitivity 86% Specificity 84%</p> <p>Key points Cardiac preparation Surgery reports: Bioglue, Medtronic Mosaic prosthetic valve (false positives) Confirm findings on NAC images</p>	<p>Indications FDG-PET/CT Evaluation disseminated disease Evaluation device pocket</p> <p>pocket lesion detection Sensitivity 93% Specificity 98%</p> <p>Key points Cardiac preparation Confirm findings on NAC images</p>	<p>Indications FDG-PET/CT Evaluation disseminated disease Evaluation intracardiac lesions</p> <p>Intracardiac lesion detection Sensitivity 65% Specificity 88%</p> <p>Key points Cardiac preparation Confirm findings on NAC images Possible benefit delayed acquisition (180 minutes)</p>

FDG PET/CT in Infectious and Inflammatory Diseases



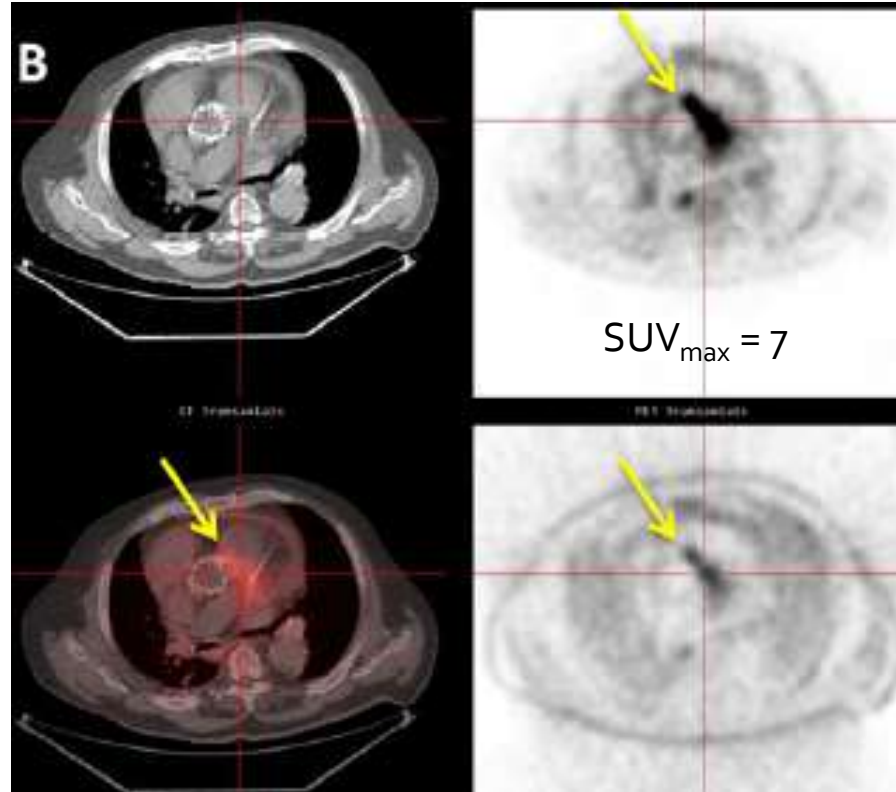
Indication	Pooled Sensitivity	Pooled Specificity
FUO	84-98%	52-86%
Large vessel vasculitis	70-90%	77-98%
Infective endocarditis	61-81%	78-88%
CIED infections	85-87%	90-94%
Vascular graft infections	95-97%	80-89%
Cardiac Sarcoidosis	75-89%	78-83%
Osteomyelitis	92%	92%
Osteomyelitis related to diabetic foot	74-89%	91-92%
Prosthetic joint infection	70-86%	84-93%
Spondylodiscitis	95-97%	88-90%
Inflammatory bowel disease	84-85%	86-87%
Rheumatic diseases	No meta-analyses	No meta-analyses

Prosthetic Valve Endocarditis

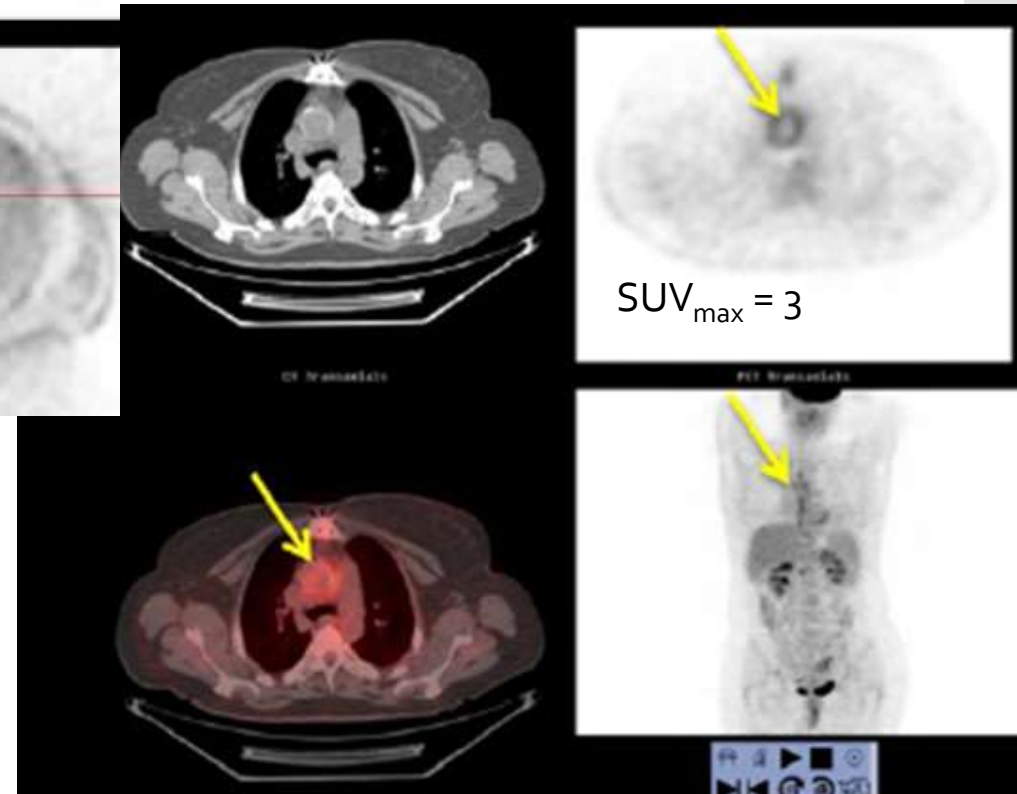


Prosthetic Valve Endocarditis

Positive

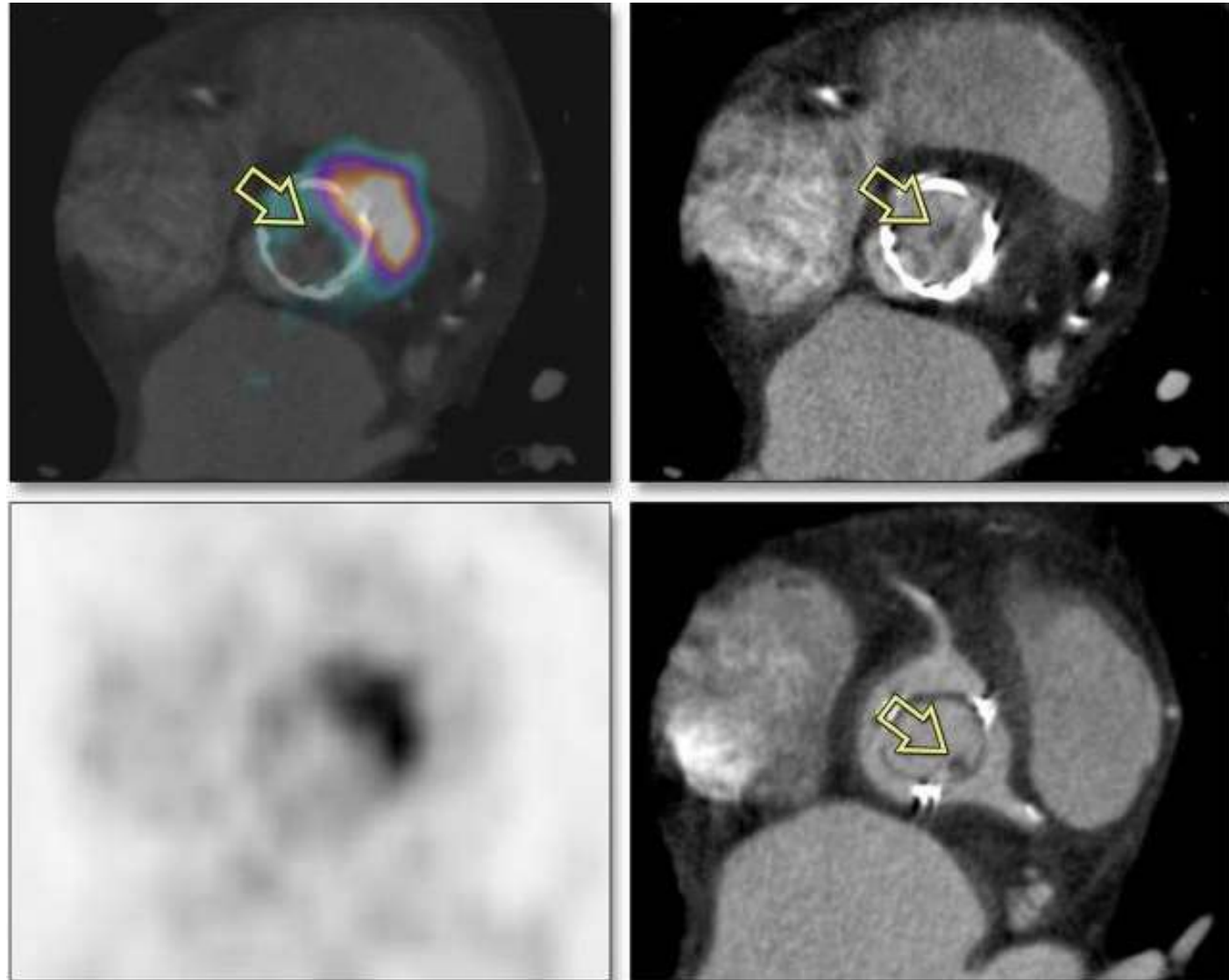


False Positive



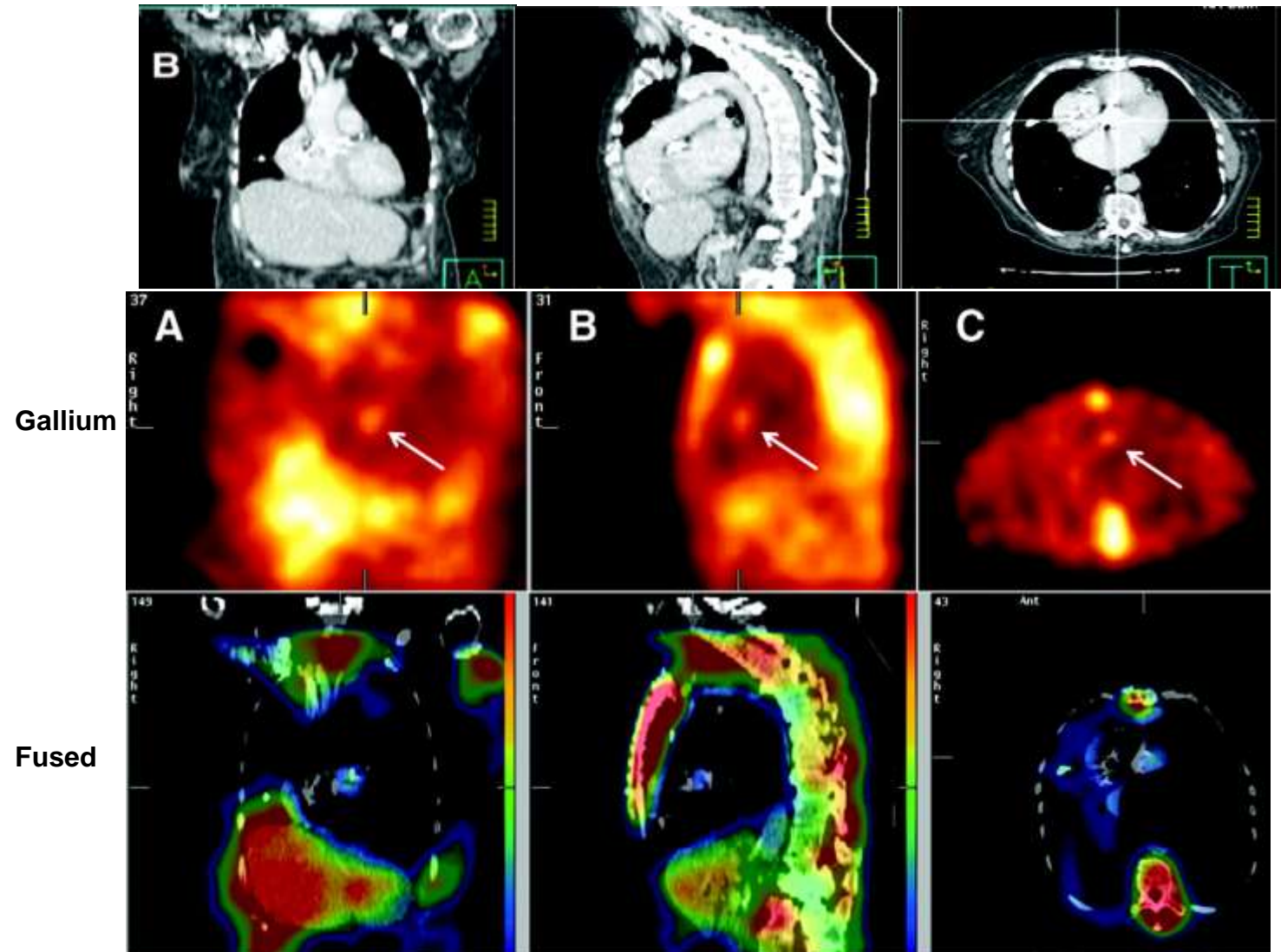
Prosthetic Valve Endocarditis

(FDG PET & CTA Chest)

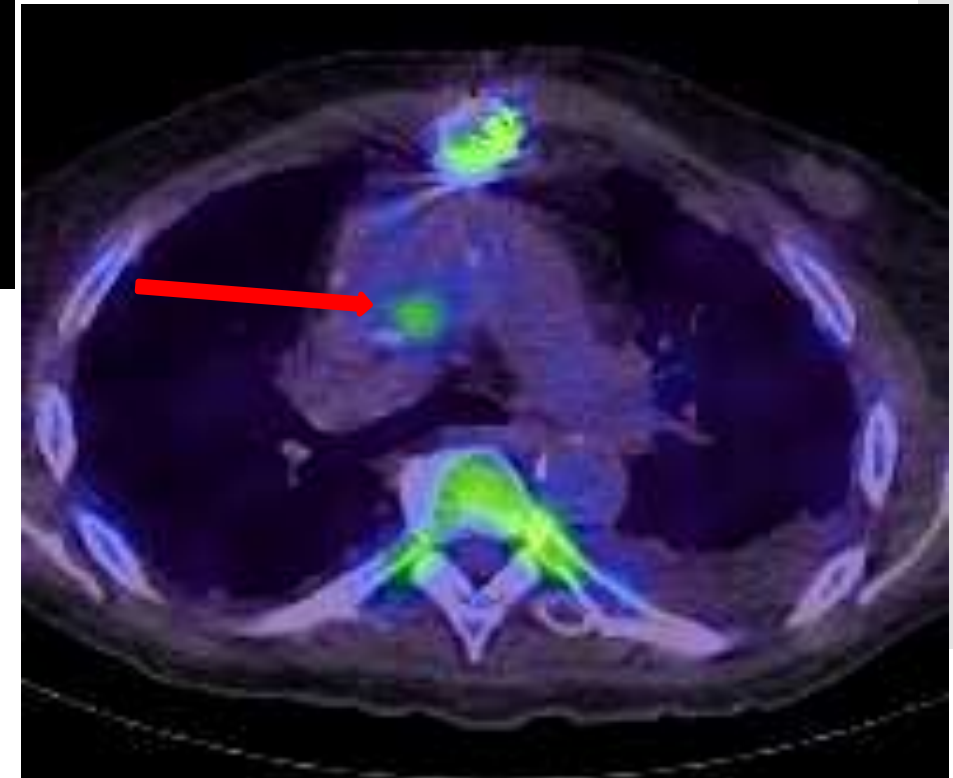
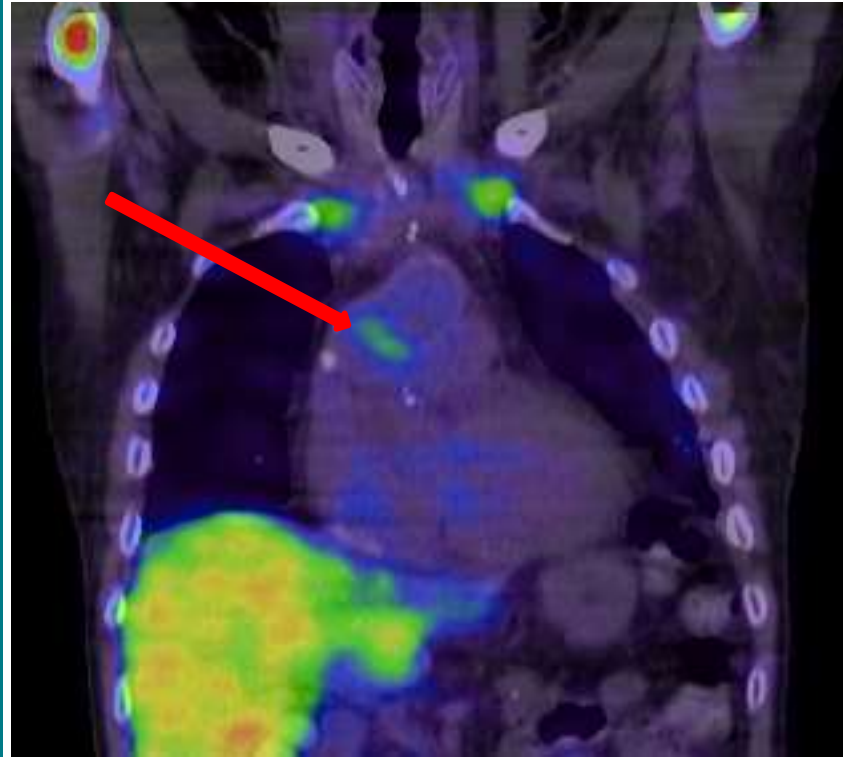


^{67}Ga SPECT/CT & Endocarditis

^{67}Ga SPECT/CT & Endocarditis

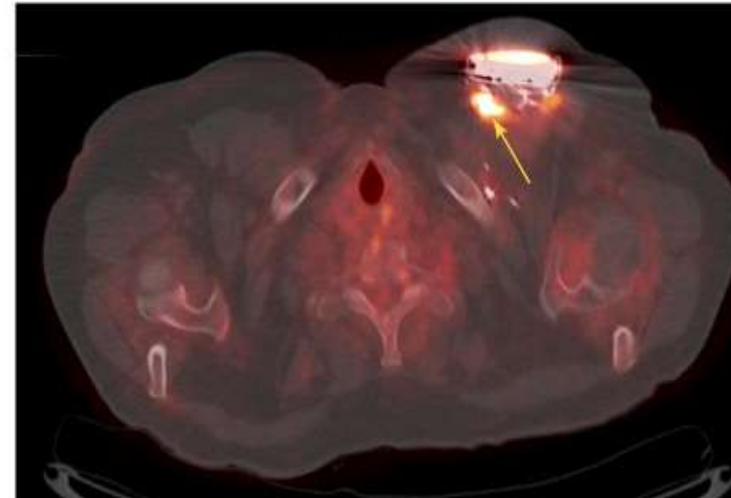
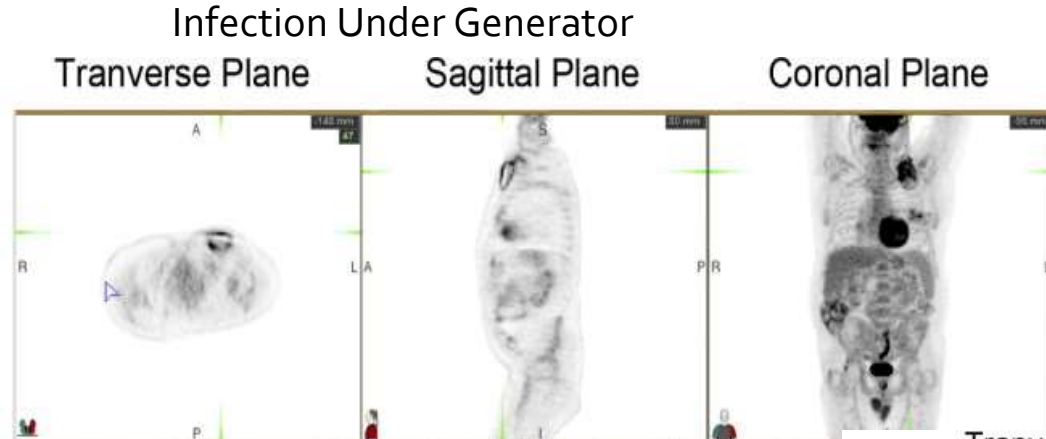


^{99m}Tc -
HMPAO-
WBC &
Infected
Aortic Graft
Anastamosis

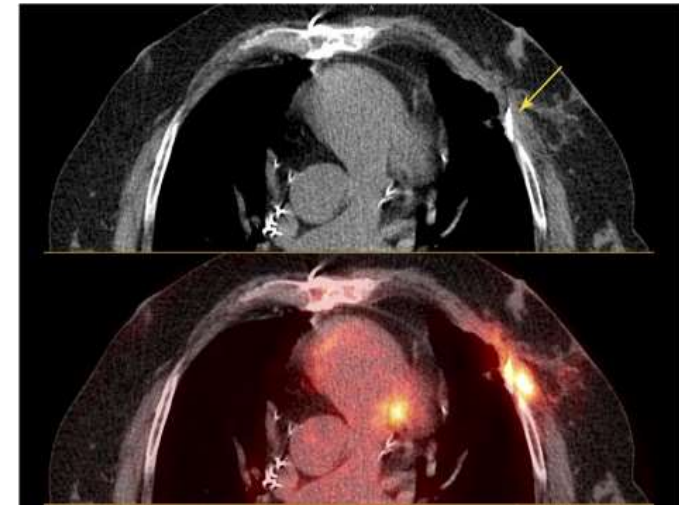
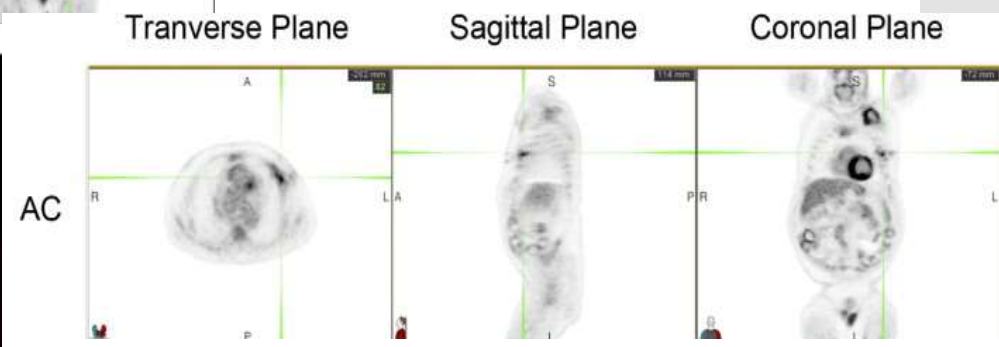


^{18}F -FDG PET & Infected Electronic Devices

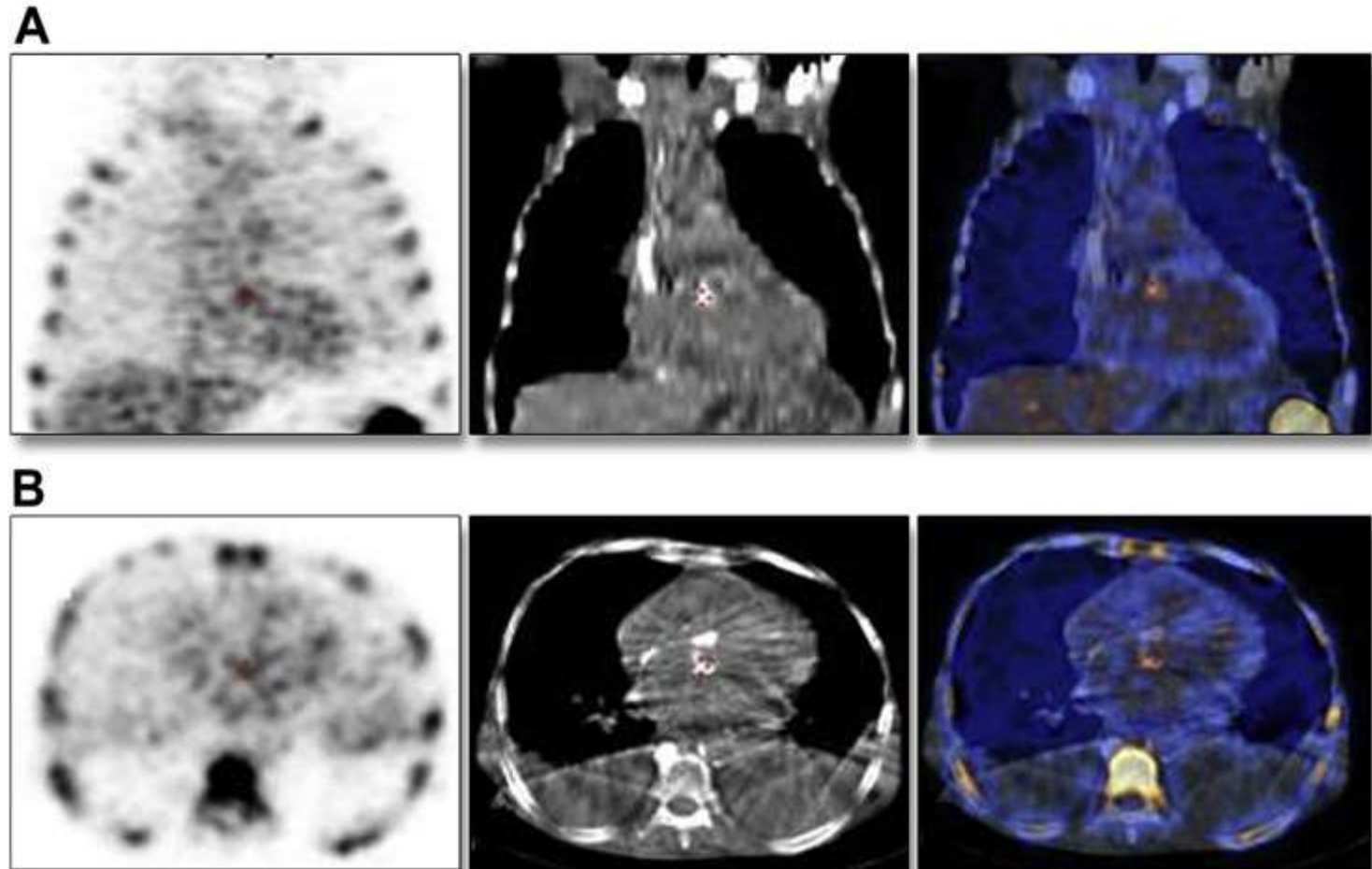
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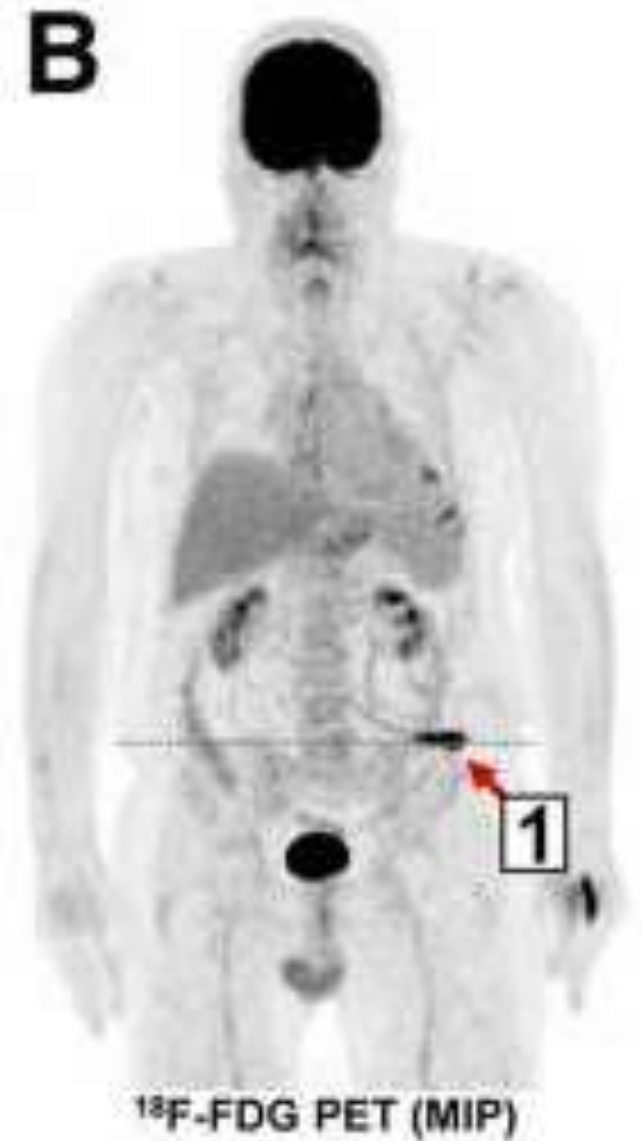
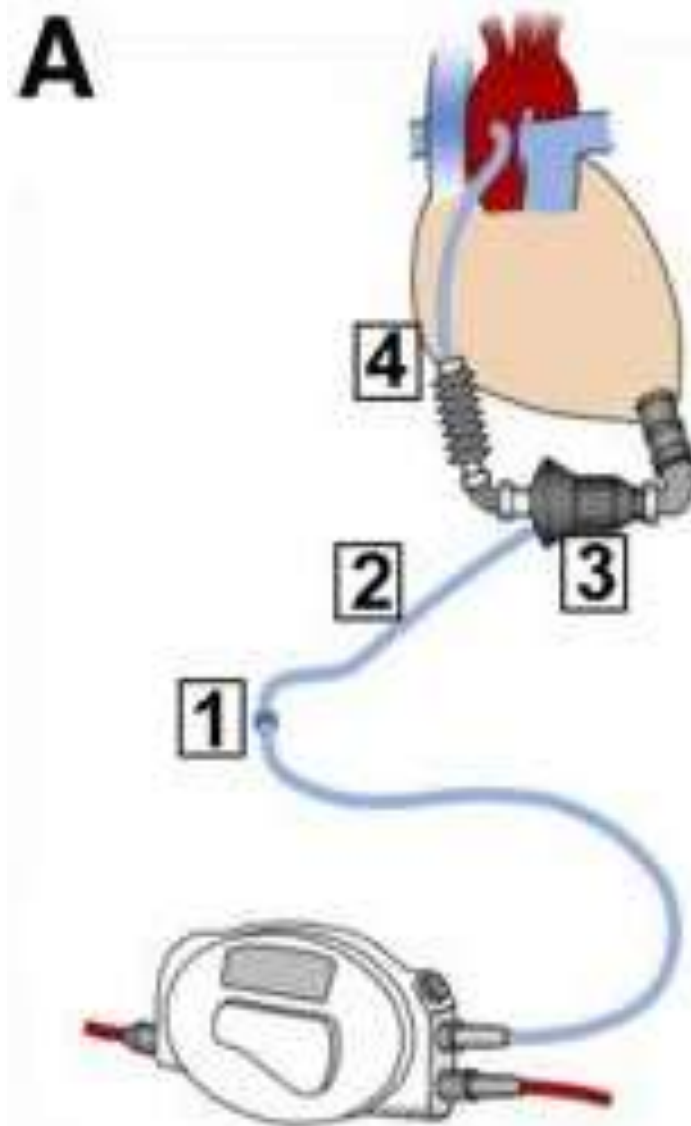
Infection Along Lead



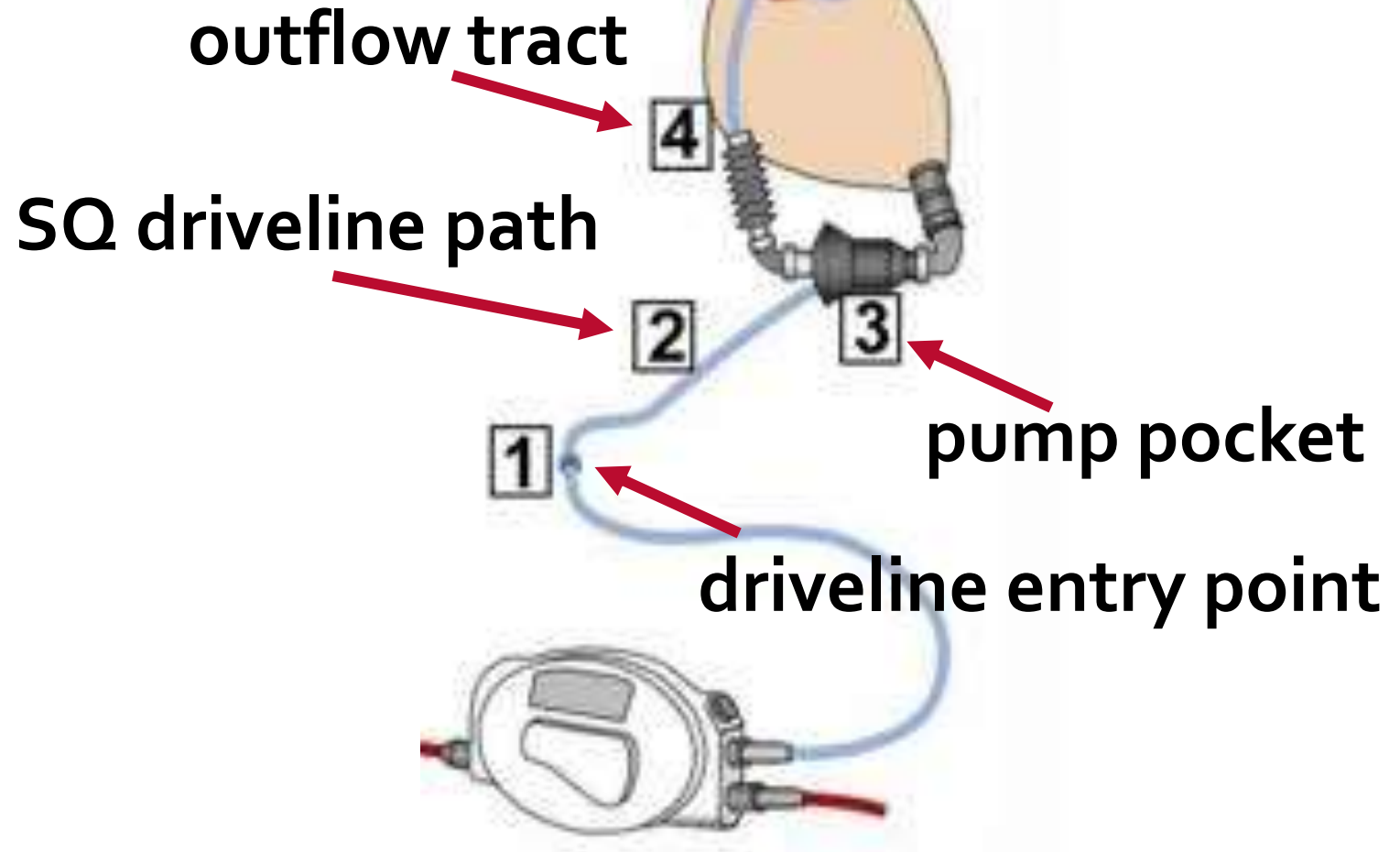
^{99m}Tc -
HMPAO-
WBC &
Infected Lead



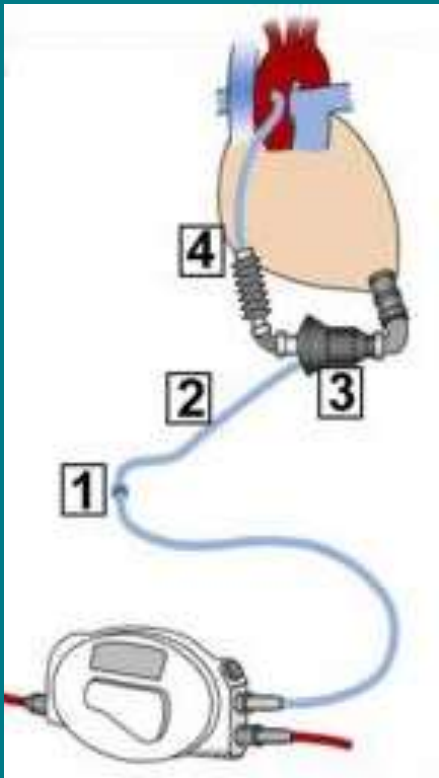
FDG PET/CT in LVAD Infection



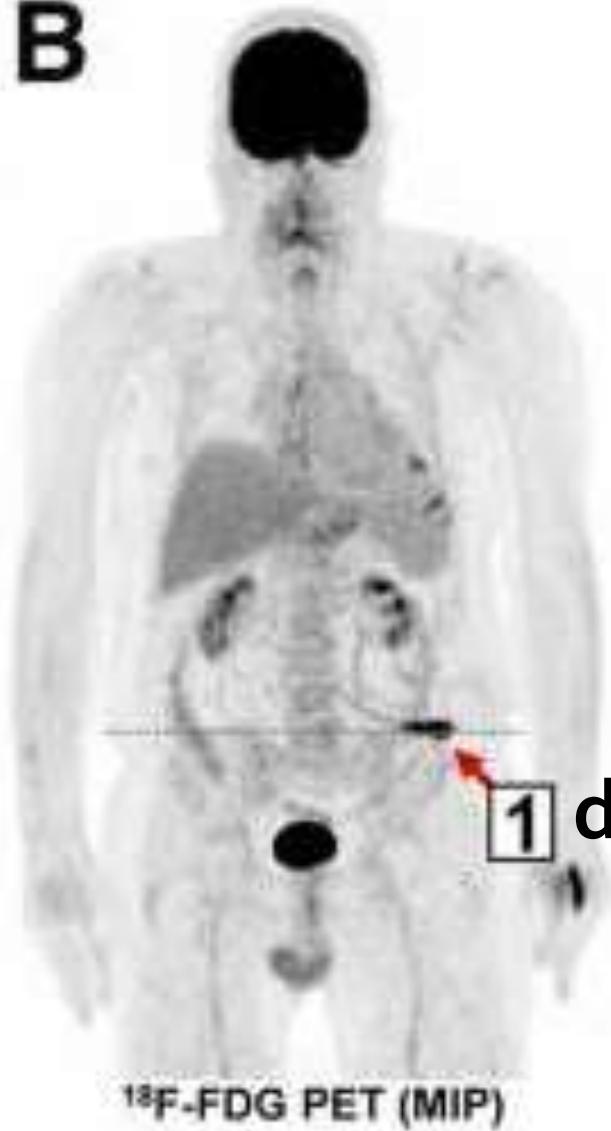
FDG PET/CT in LVAD Infection



LVAD Infection

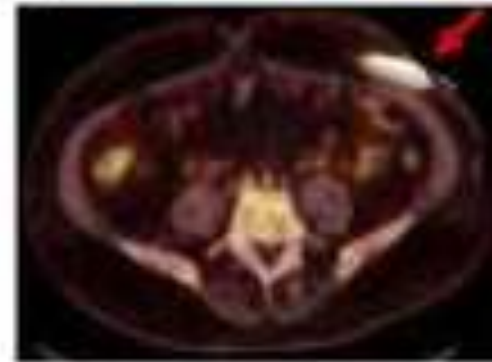
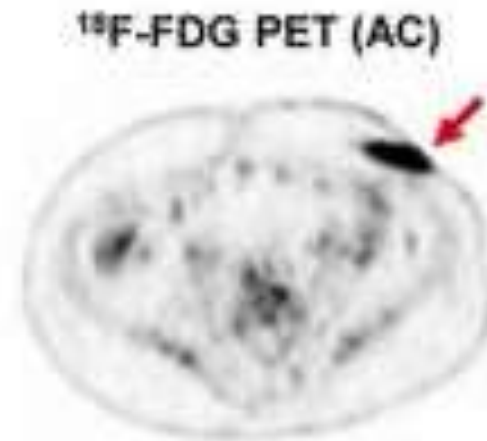
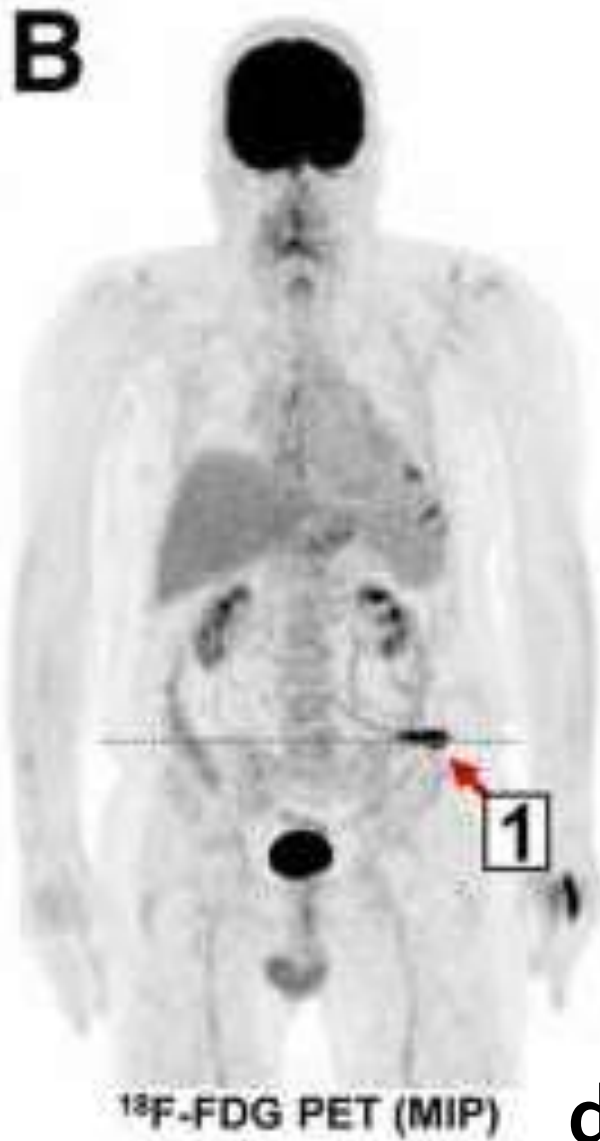
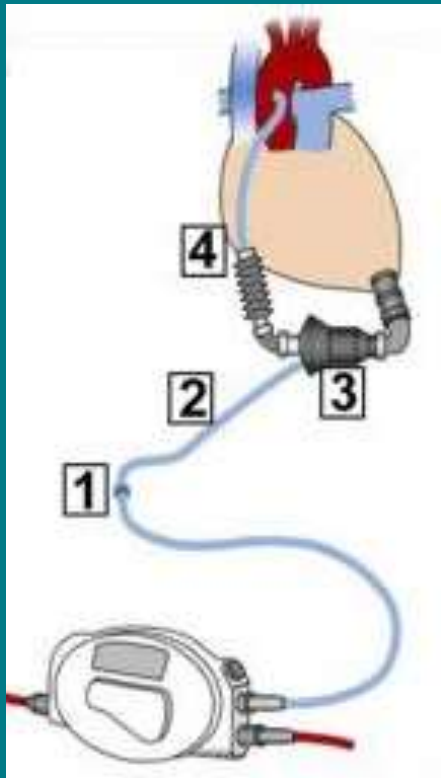


B



1 driveline entry point infection

LVAD Infection

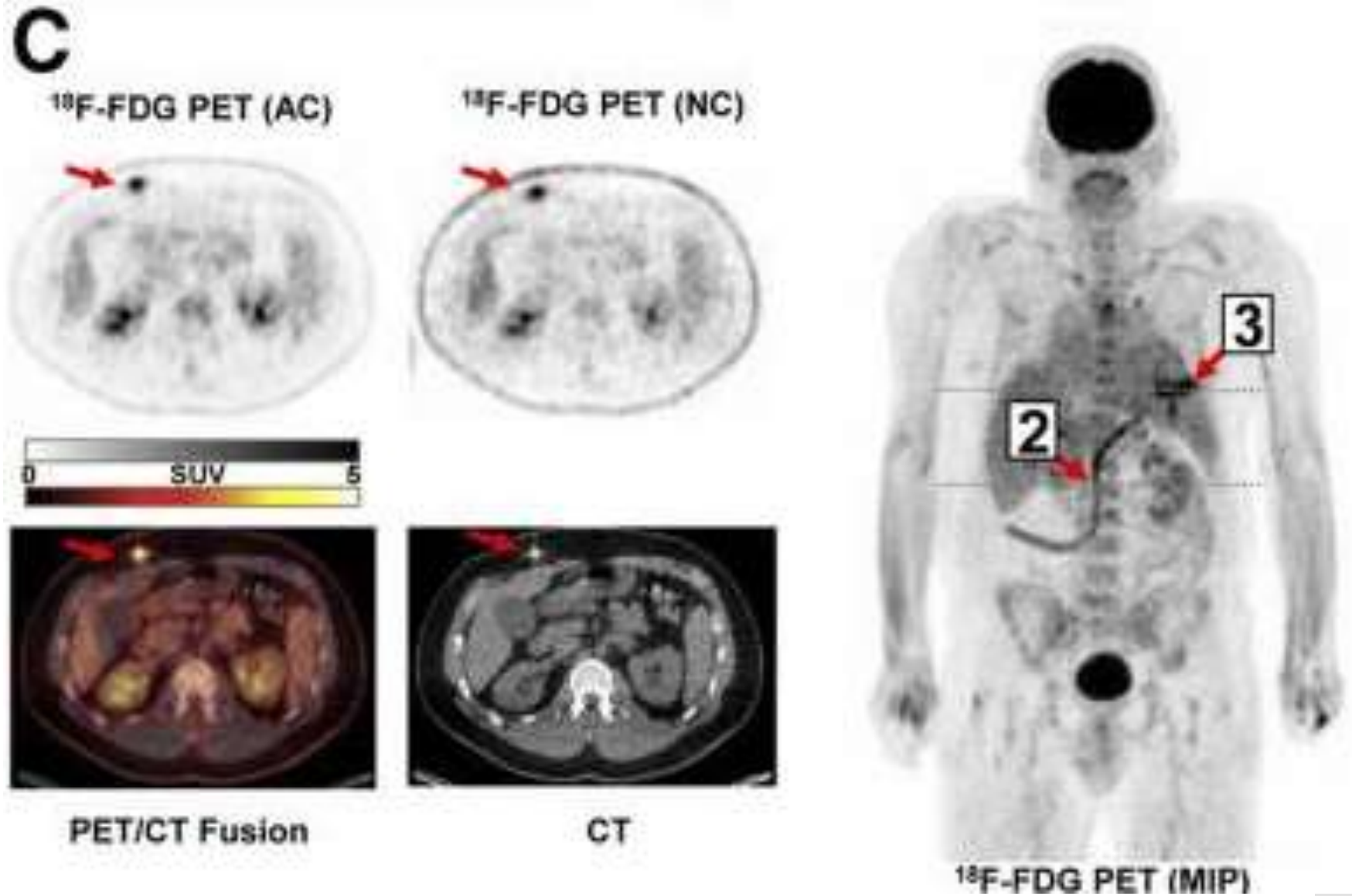
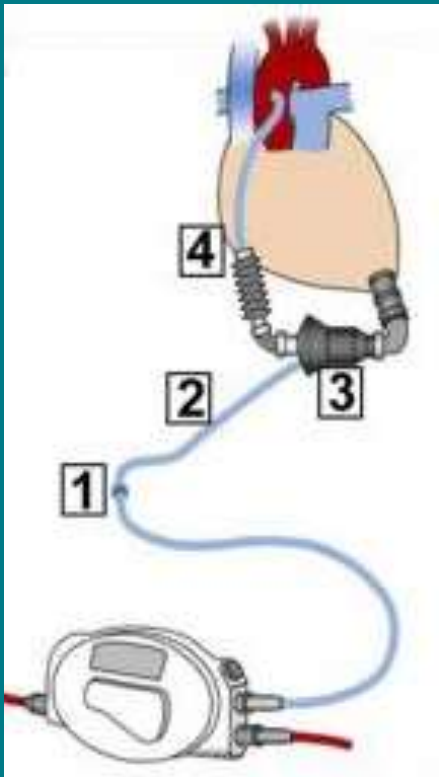


PET/CT Fusion

CT

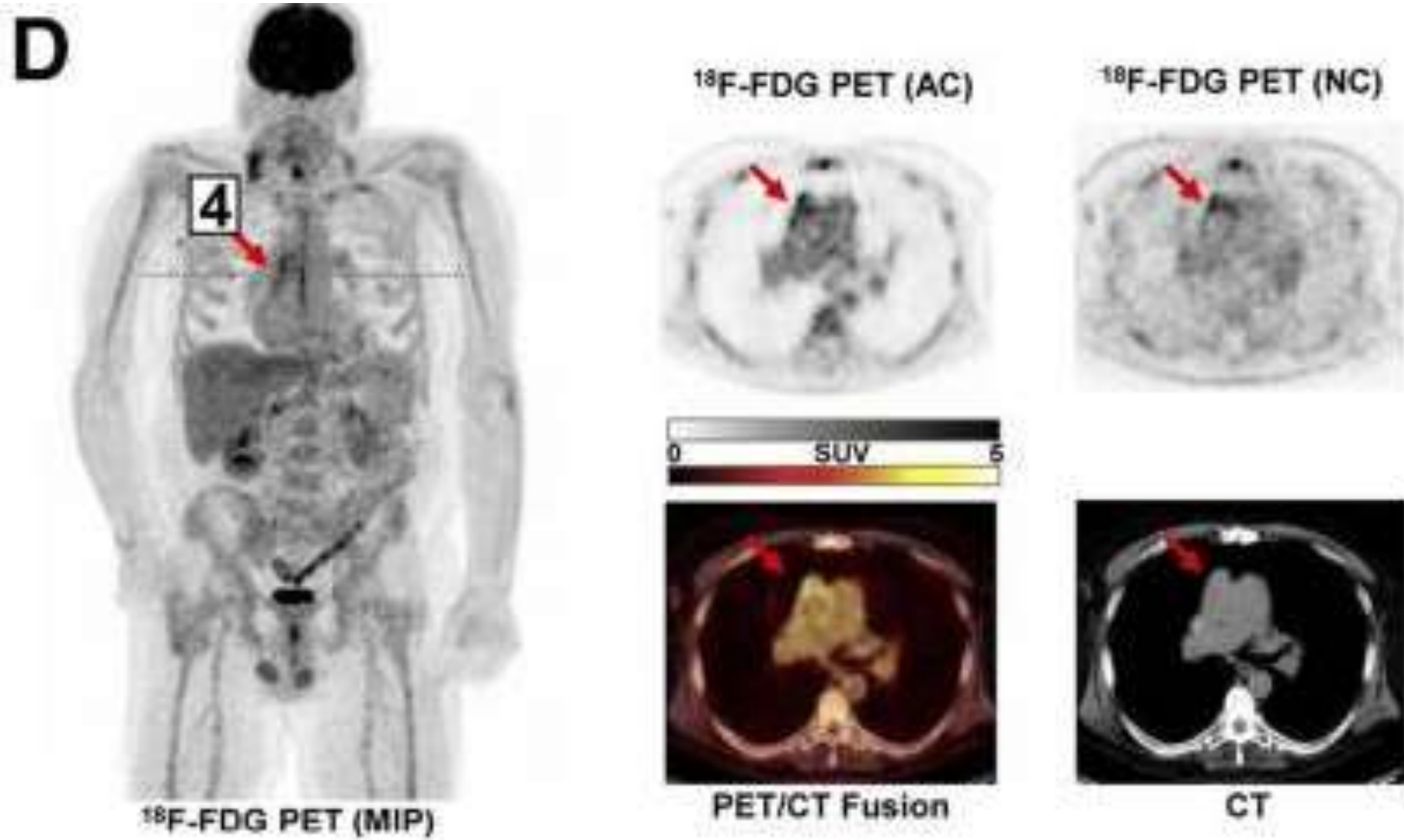
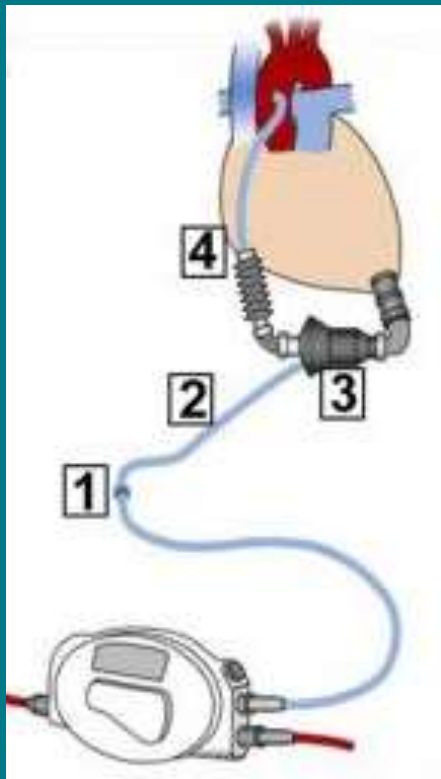
driveline entry point infection

LVAD Infection

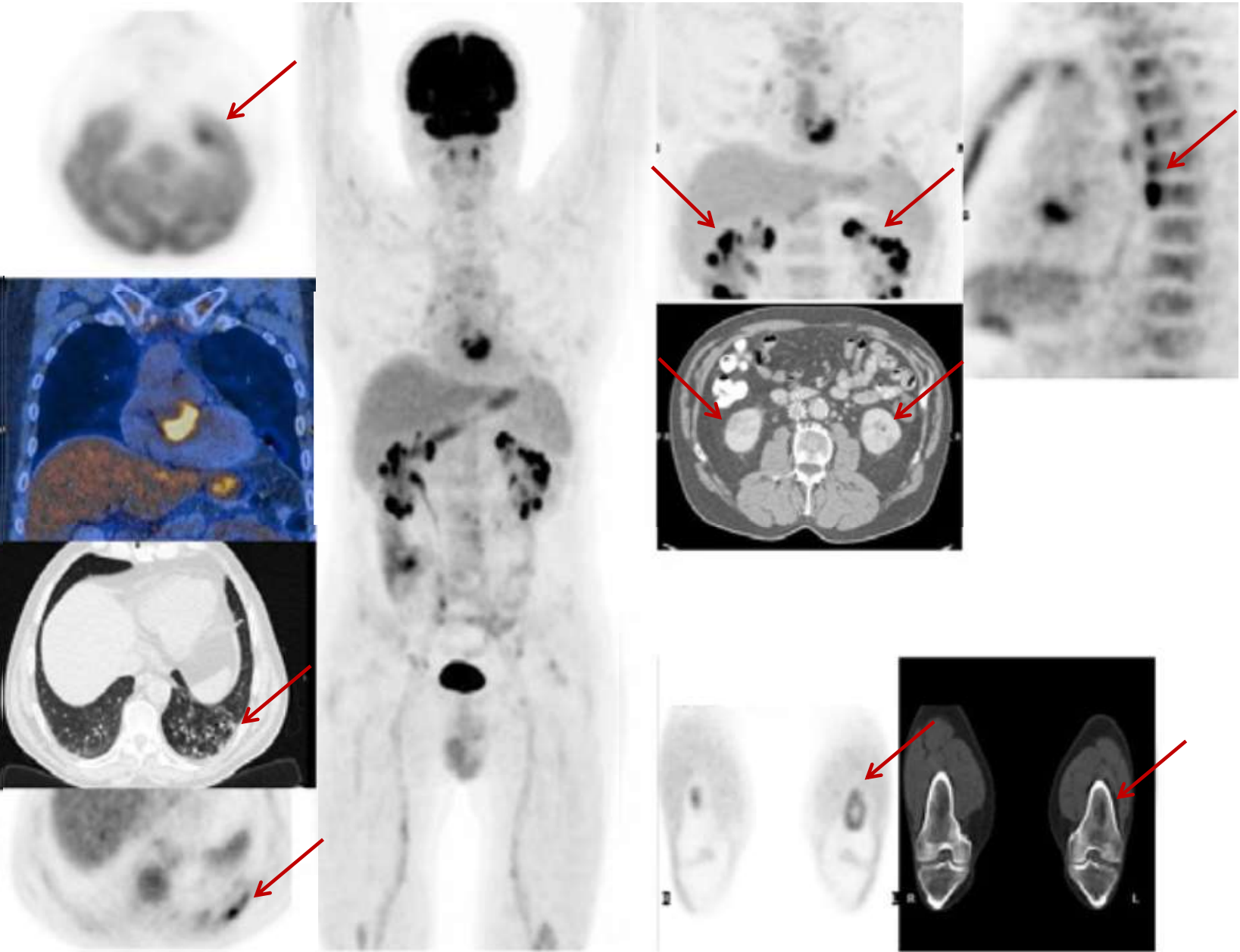


SQ driveline path & pump pocket infection

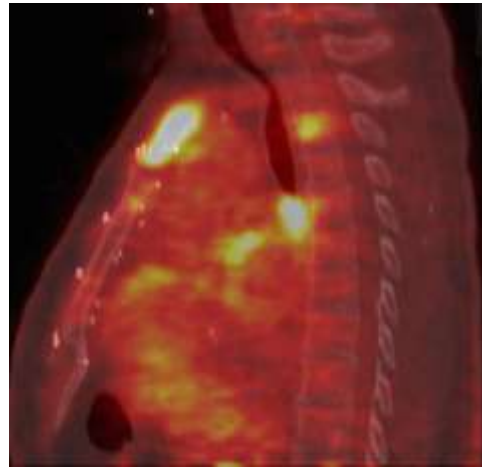
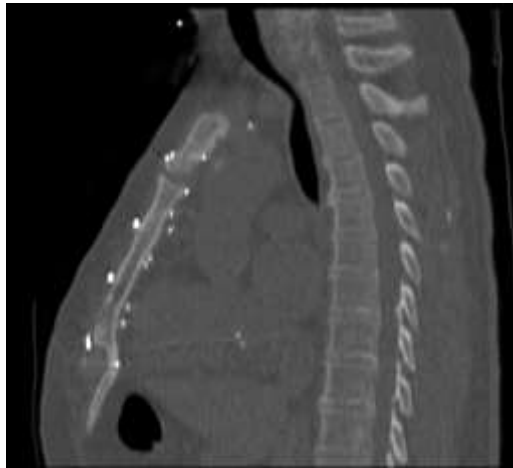
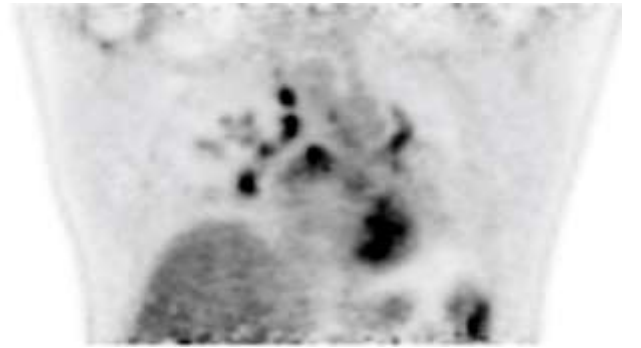
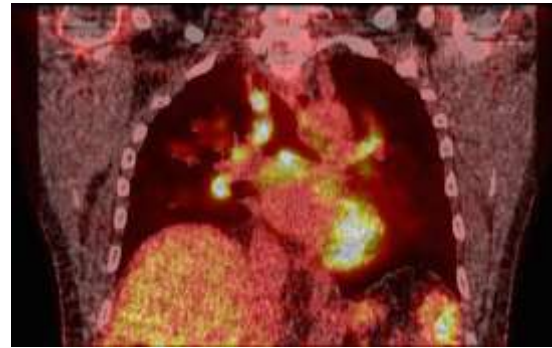
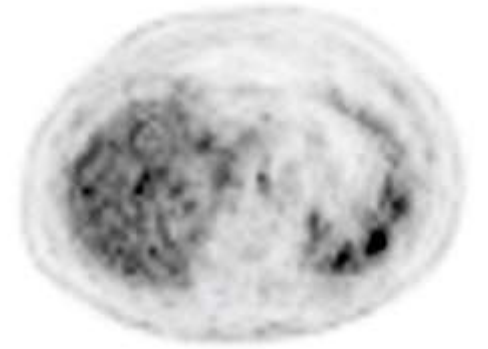
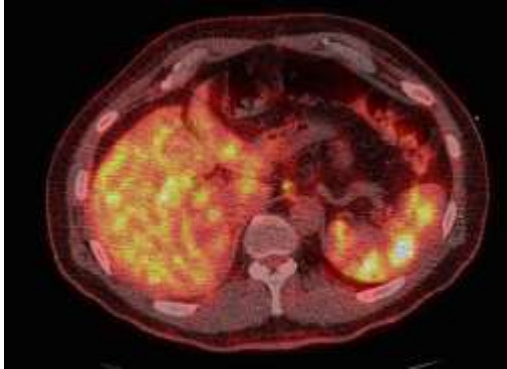
LVAD Infection



outflow tract infection



Sarcoidosis



Giant cell arteritis in patient with FUO

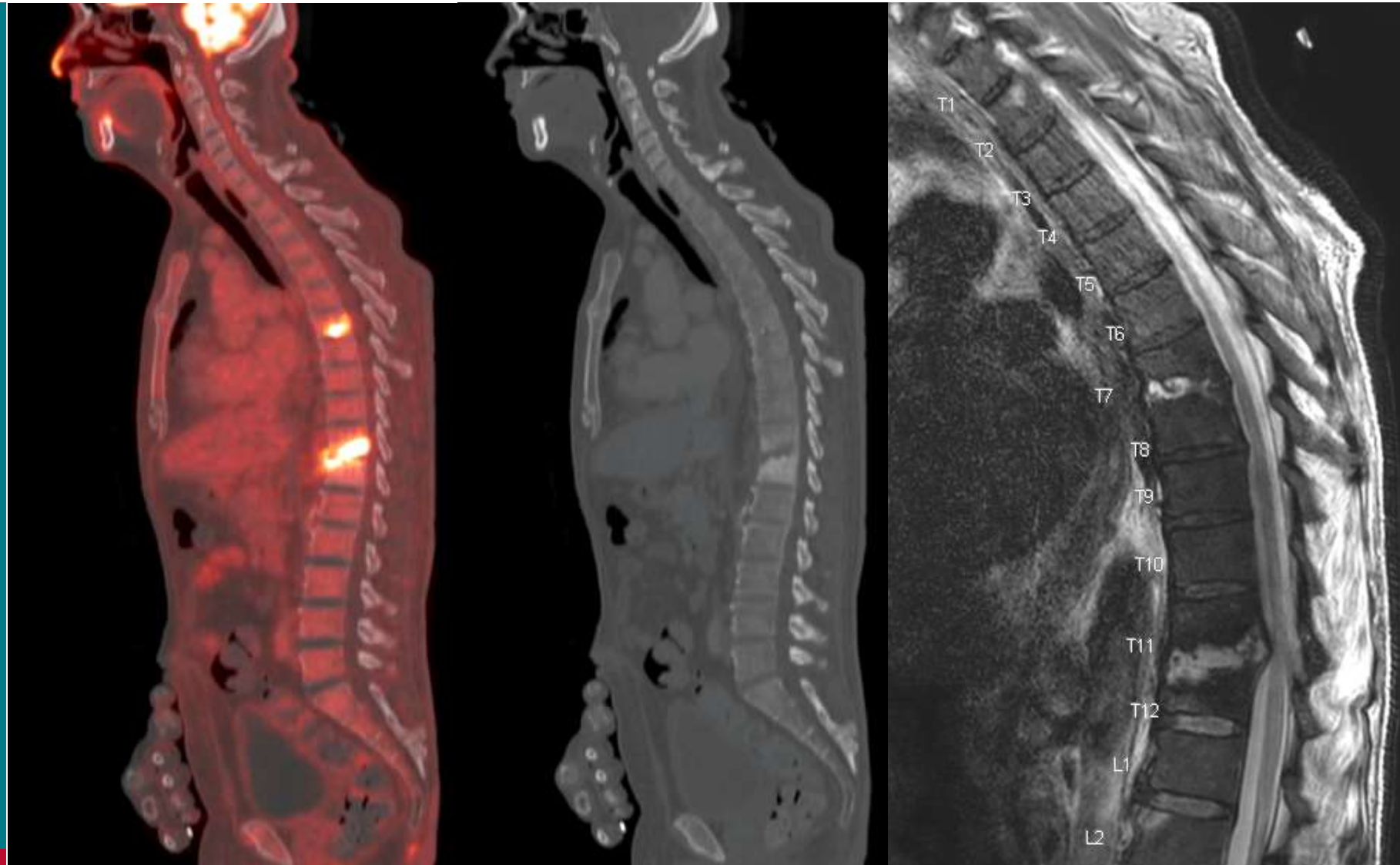


Infected right hip joint in patient with F.U.O

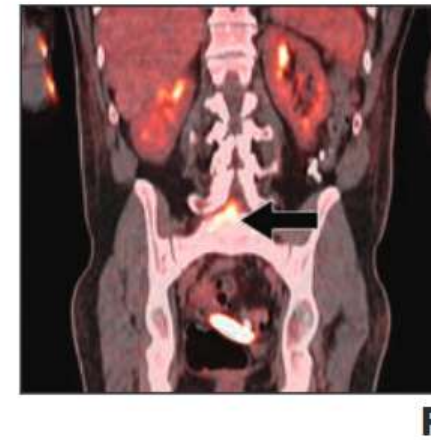
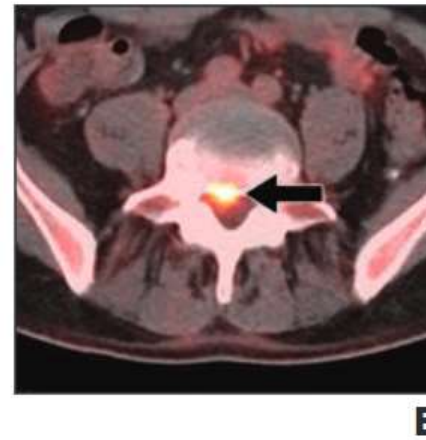
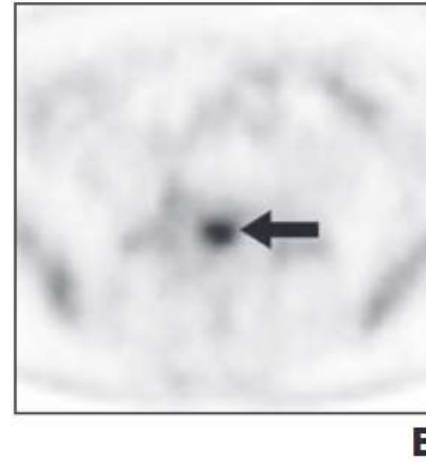
Biopsy and blood cultures performed after F-18 FDG PET/CT confirmed infective coxitis caused by *Staphylococcus aureus*



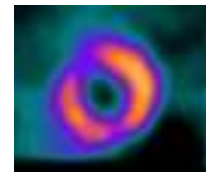
Spondylodiskitis



Epidural abscess at PET after negative MRI



E.H. Dibble, et al. *AJR* 2019, 1358-1365



Take Home Points

- FDG PET/CT is an important problem-solving tool in patients with IUO who have cardiac devices in place.
- Appropriate patient preparation and clinical history is helpful in improving sensitivity and specificity.
- Even if a single site is suspected, WB imaging can identify additional sites of involvement with systemic inflammatory and infectious etiologies

Questions?

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