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"Επώδυνη μετεγχειρητική άρθρωση νεώτερες υβριδικές τεχνικές PET/CT & PET/MRI"

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Nothing to Disclose

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Evaluation of Joint Replacements & Postoperative Complications

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PET/CT & PET/MRI

Evaluation of joint replacement complications and posttherapy evaluations are the new role of PET/CT and PET/MRI because of the limitations of MRI and CT in these settings (e.g., susceptibility artifacts in MRI and beamhardening artifacts in CT) and low sensitivity of ultrasound and radiographs.

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^{18}F-FDG

Μόριο ^{18}F-Fluorodeox

Most widely used PET tracer
for Oncologic purposes

Highly Sensitive ≠ NON sPECIFIC

Taken up by sites of Inflammation and Infection

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^{18}F-FDG PET vs single-photon emitters

^{18}F-FDG PET offers multiple advantages

- ❑ Time savings (compared with dual-tracer techniques, which need dual-image acquisition).
- ❑ Higher spatial resolution
- ❑ Improved safety profile when compared with the complexity and risks of labeled WBC use, including direct handling of blood products.

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^{18}F-FDG PET vs single-photon emitters

- Prospective study → patients with painful hip or knee arthroplasty.
- A total of 134 hip and 87 knee prostheses, suspected of being either infected or noninfectious loosening, were evaluated.
- All 221 prostheses underwent FDG PET, whereas both WBC/BM imaging and FDG PET were performed in 88 prostheses.
- Final diagnosis was based on microbiological examinations of the surgical specimens in 125 prostheses and joint aspirations combined with the clinical follow-up of 6 months.

Basu et al., Clin Nucl Med 2017

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Results

^{18}F-FDG PET vs single-photon emitters

^{18}F-FDG PET in hip prostheses
Sensitivity: 81.8%
Specificity:93.1%
PPV: 79.4%
NPV: 94.0%

^{18}F-FDG PET in knee prostheses
Sensitivity: 94.7%
Specificity:88.2%
PPV: 69.2%
NPV: 98.4%

WBC/BM imaging in hip prostheses
Sensitivity:38.5%
Specificity:95.7%
PPV: 71.4%
NPV: 84.6%

WBC/BM imaging in knee prostheses
Sensitivity:33.3%
Specificity:88.5%
PPV: 25.0%
NPV: 92.0%

Basu et al., Clin Nucl Med 2017

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^{18}F-FDG PET

- 74 prostheses in 62 patients in whom infection was suspected after artificial hip or knee placement
- A final diagnosis was made by surgical exploration or clinical follow-up for 1 y.

^{18}F-FDG PET in knee prostheses
Sensitivity: 95.9%
Specificity:82.0%
Accuracy: 77.8%

^{18}F-FDG PET in hip prostheses
Sensitivity: 90,1%
Specificity:89.3%
Accuracy: 89.5%

Overall Sensitivity & specificity for lower limb infections
90.5% & 84.1%

Zhuang et al., JNM 2010

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^{18}F-FDG PET/CT is a promising imaging modality that can aid in the work up of patients with suspected implant-related infections and may be used as a supportive measure in clinical decision making.

S Shemesh et al., Injury 2017

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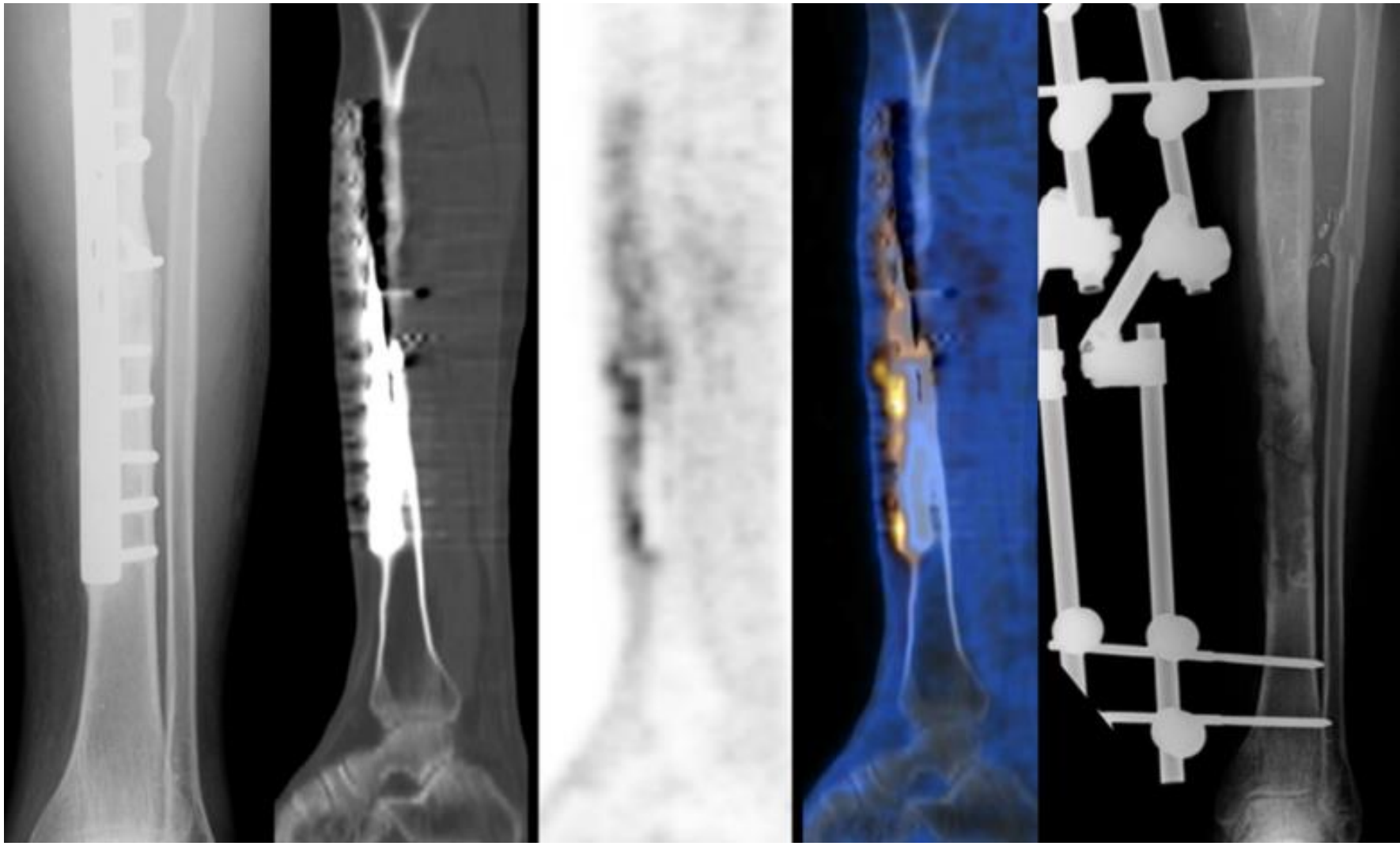
^{18}F-FDG PET/CT

- A 47-year old who presented with fever, pain and swelling of his left shin went years after plating of the tibia.
- The patient had no superficial fistulation and conventional radiographs did notdemonstrate radiolucency around the implant.
- PET/CT demonstrated highly increased FDG uptake in the tibial shaft involving the implant-bone interface supporting the diagnosis of osteomyelitis.
- Decision was made to remove the hardware and perform partial ostectomy of the involved bone and stabilize the leg with an external fixator.



S Shemesh et al., Injury 2017

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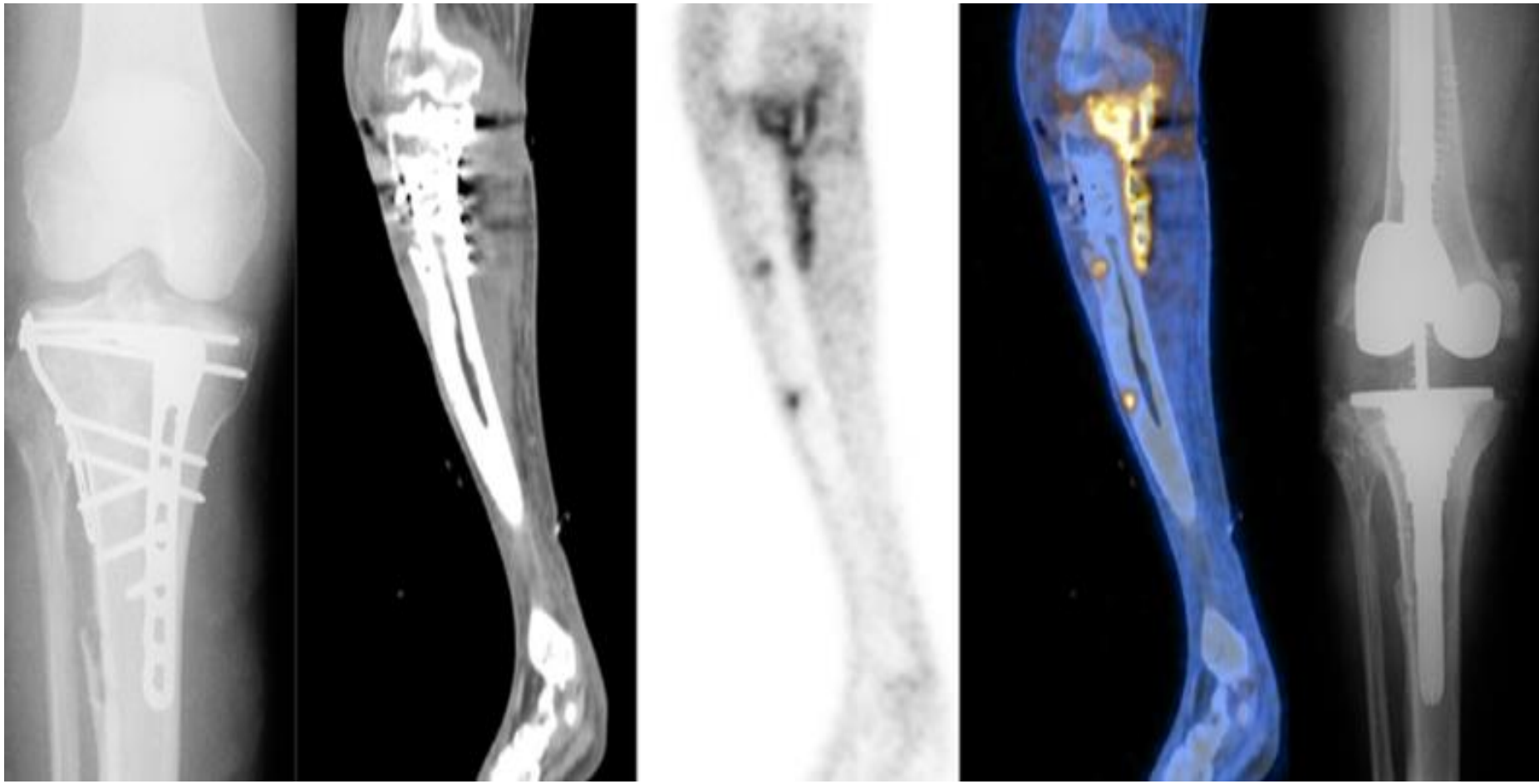
^{18}F-FDG PET/CT

- A53-year old man who presented with signs of infection four months following open reduction and internal fixation for a tibial plateau fracture.
- Reconstructed CT PET and coregistered PET/CT demonstrated highly increased FDG uptake in the proximal tibia involving both the implant-bone interface and the joint space, suggesting osteomyelitis.
- On the following surgery, the hardware was completely removed and the patient underwent total knee arthroplasty(E).



S Shemesh et al., Injury 2017

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^{18}F-FDG PET/CT

Differentiation between septic or aseptic loosening of endoprostheses.

- ^{18}F-FDG-PET examinations and multiphase bone scan were performed on hip and knee endoprostheses in 27 patients prior to revision surgical procedures planned for prosthetic loosening.
- Intact prostheses were found at the opposite site in some patients so that additional 9 joints could be examined with the field of view of ^{18}F-FDG PET.
- Verification and valuation of the PET and scintigraphic image findings were conducted by comparing them with information combined from intraoperative findings, histopathology, and microbiological investigations.

Delank et al., BMC Musculoskeletal Disorders 2016

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Results

^{18}F-FDG PET/CT

Differentiation between septic or aseptic loosening of endoprostheses.

- Evidence of loosening was correctly determined in 76.4% of cases using ^{18}F-FDG-PET, and in 55% of cases using bone scan.
- The detection of periprosthetic inflammation using ^{18}F-FDG-PET had a sensitivity of 100% for septic cases and of 45.5% in cases of increased abrasion.
- Reliable differentiation between abrasion-induced and bacterial-caused inflammation was not possible using ^{18}F-FDG-PET.

Delank et al., BMC Musculoskeletal Disorders 2016

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- ^{18}F-Fluoro-deoxyglucose positron emission tomography (^{18}F-FDG-PET) allows reliable prediction of peri-prosthetic septical inflammatory tissue reactions.
- Because of the high sensitivity of this method, a negative PET result in the setting of a diagnostically unclear situation eliminates the need for revision surgery.
- In contrast, a positive PET result gives no clear differentiation regarding the cause of inflammation.

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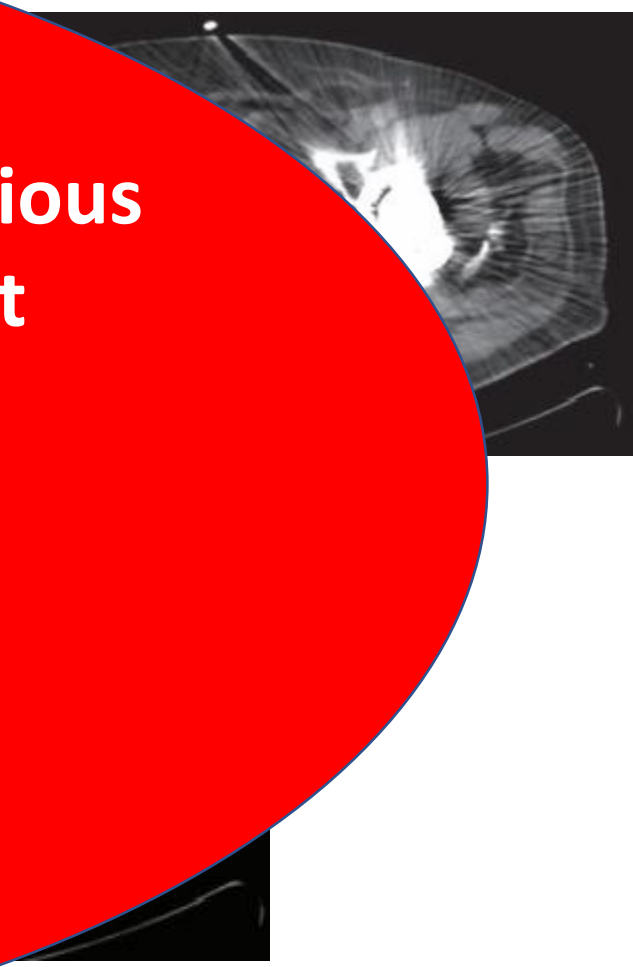
  arthritis.
- Hip aspirate culture was negative
  abrasion-induced inflammation.



- **Confident differentiation between infectious and abrasion-induced inflammation is not possible using FDG PET.**
- **However, a negative scan can reliably exclude underlying infection.**

Gholamrezanezhad et al., AJR 2018

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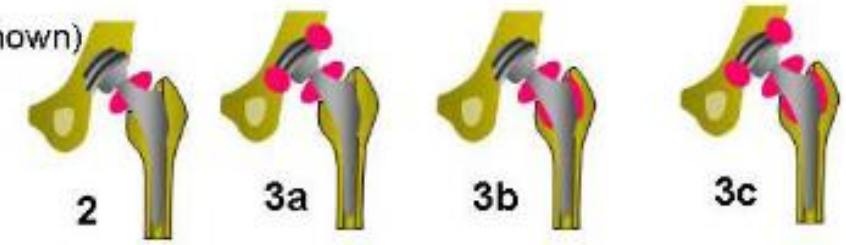
^{18}F-FDG PET/CT

Differentiation between infectious inflammation and aseptic loosening

Qualitative visual analysis of tracer distribution according to the classification system of Reinartz et al

no loosening

1: no increased periprosthetic uptake (not shown)
2: neck of the prosthesis
3a: neck of the prosthesis + parts of the cup
3b: neck of the prosthesis + proximal shaft
3c: pattern 3a + 3b



loosening

4a: neck of the prosthesis + total cup
4b: neck of the prosthesis + wide parts of the shaft
4c: pattern 4a + 4b

infection

5: periprosthetic soft tissue

Delank et al., BMC Musculoskeletal Disorders 2016

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^{18}F-FDG PET/CT

Pitfalls

- Orthopedic surgical interventions often cause increased focal uptake for an extended period at FDG PET.
- The distinction of benign reactive and postoperative hypermetabolism from pathologic uptake is important to minimize false-positive interpretations.
- This mainly relies on a detailed review of the patient's medical and surgical history and careful correlation of the location and pattern of hypermetabolism with the anatomic information on the co-registered CT or MR images.

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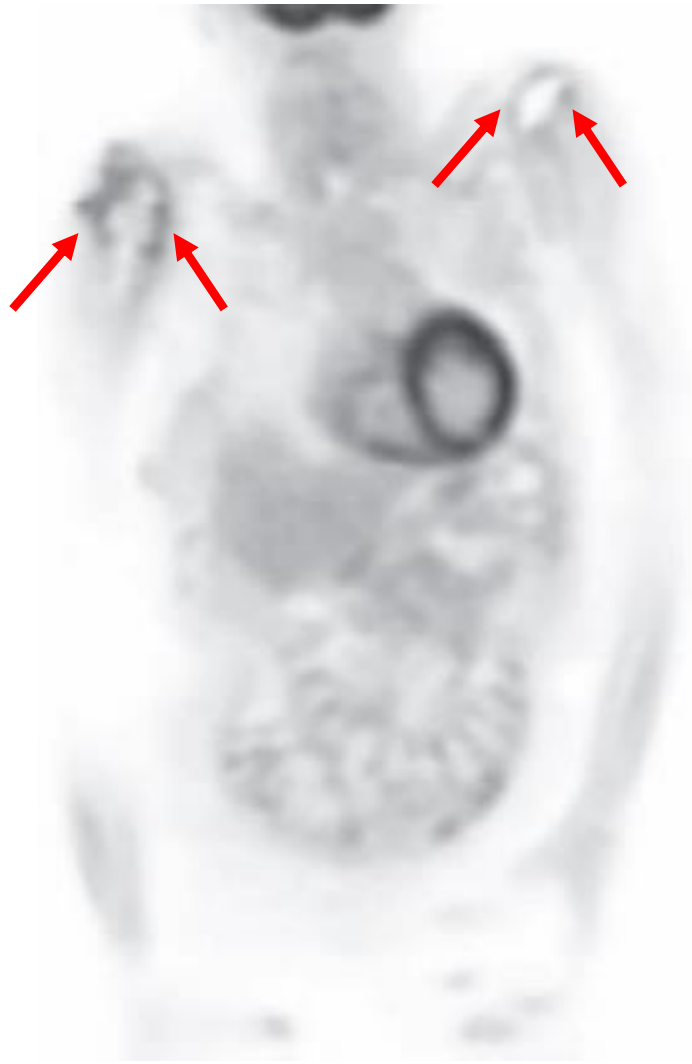
^{18}F-FDG PET/CT

Pitfalls

- 72-year-old woman who underwent right and left shoulder hemiarthroplasty.
- Left shoulder hemiarthroplasty and distal clavicle open reduction with internal fixation performed 10 months before PET/CT.
- Right reverse shoulder arthroplasty that was placed during interim between date of PET/CT and left shoulder hemiarthroplasty.
- No hypermetabolism associated with remote left shoulder hemiarthroplasty.
- Mild hypermetabolism is identified surrounding more recent right reverse shoulder arthroplasty, indicative of postoperative inflammatory changes



Gholamrezanezhad et al., AJR 2018

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Conclusions

- ^{18}F-FDG-PET/CT allows reliable detection of peri-prosthetic septical inflammation
- A negative ^{18}F-FDG-PET/CT scan eliminates the need for revision surgery.
- Cannot differentiate between septic or aseptic joint loosening.
- Novel PET-tracers –> Sterile inflammation

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Thank you