

# **İnfektif Endokardit: 2023'te Neler Deđiřti?**

## **Nükleer Tıp Yöntemlerinden Elde Edilen Bulgular**

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# İnfektif Endokardit

- Doğal ve protez kalp kapakları
- Kardiyak cihazlar
- Vasküler grafter
- Tanısı güç
- Mortalite ve morbidite yüksek



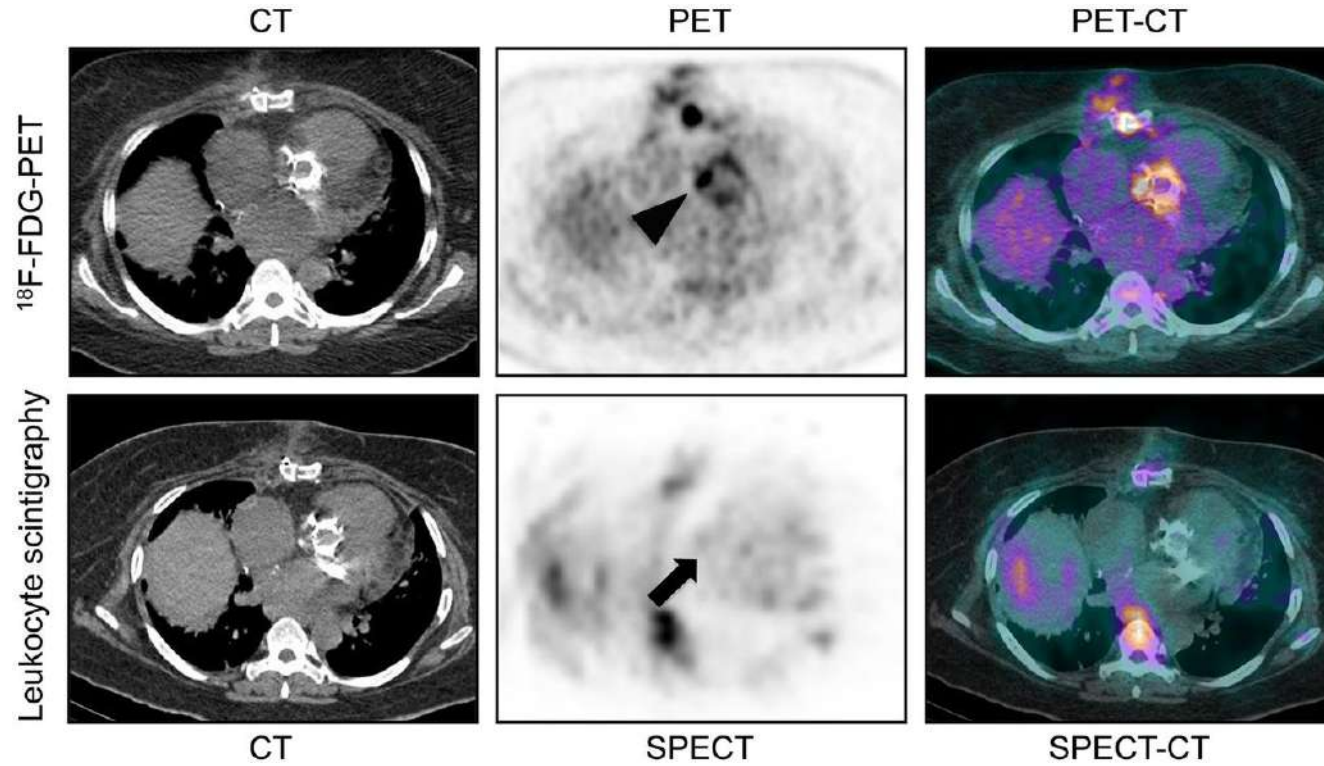
İnfektif Endokardit ekibi  
Komplike vakalar → Referans merkezler  
Tüm tanı yöntemleri  
Tecrübeli cerrahi ekip

# Tanısal Yöntemler

- Ekokardiyografi
- Kardiyak BT ve MR görüntüleme
- Radyonüklid yöntemler
- Kan kültürü, PCR
- Histopatoloji

# İnfektif Endokardit Tanısında Radyonüklid Yöntemler

- İşaretli Lökosit Sintigrafisi
- F<sup>18</sup>- FDG PET Görüntüleme



# Gelişmekte Olan Radyofarmasötik Ajanlar

**TABLE 3: Selected Investigational Infection Imaging Radiopharmaceuticals [83–90]**

Agent	Mechanism of Localization
Radiolabeled IL-1, IL-1ra, IL-2, IL-6, IL-8, IL-10, IL-12 p40, G-CSF, IFN- $\gamma$ , and EGF	Cytokine, direct involvement in the inflammation related to infection
Fluorodeoxysorbitol	Metabolic substrate for bacteria
$^{68}\text{Ga}$ -citrate, $^{68}\text{Ga}$ -chloride, and $^{68}\text{Ga}$ -apotransferrin	Iron metabolism within bacteria; WBCs; inflamed tissues (transferrin receptors, ferritin, lactoferrin)
$^{68}\text{Ga}$ -DOTA-depsidomycin and $^{68}\text{Ga}$ -NOTA-UBI-29-41	Bacterial cell wall
$^{68}\text{Ga}$ -DOTAVAP-P1	Vascular adhesion protein-1
$^{68}\text{Ga}$ -TAFC and $^{68}\text{Ga}$ -FOX E	Siderophores; iron transporters in bacteria and fungi
$^{124}\text{I}$ -fialuridine	Bacterial pathogens expressing endogenous TK enzyme
$^{111}\text{In}$ -biotin	Bacterial growth factor
Polyclonal IgG	Antibody and infectious agent localization
Radiolabeled antibiotics (especially ciprofloxacin)	Depends on mechanism of antibiotic; for ciprofloxacin, bacterial DNA gyrase
Antimicrobial peptides	Blood-derived proteins that are part of innate immune system that target important microbial structures

Note—IL = interleukin, G-CSF = granulocyte colony-stimulating factor, IFN = interferon, EGF = epidermal growth factor, DOTA = tetraazacyclododecanetetraacetic acid, NOTA-UBI-29-41 = 1,4,7-triazacyclononane-1,4,7-triacetic acid (a bifunctional chelating agent conjugated to the 29–41 amino acid fragment of ubiquicidin), DOTAVAP-P1 = 1,4,7,10-tetraazacyclododecane-N''N''',N''''-tetraacetic acid-peptide targeted to VAP-1, TAFC = triacetylfusarinine, FOX E = ferrioxamine E, TK = thymidine kinase.

# The 2023 Duke-International Society for Cardiovascular Infectious Diseases Criteria for Infective Endocarditis: Updating the Modified Duke Criteria

Vance G. Fowler Jr,<sup>1,2</sup> David T. Durack,<sup>1</sup> Christine Selton-Suty,<sup>3</sup> Eugene Athan,<sup>4</sup> Arnold S. Bayer,<sup>5,6</sup> Anna Lisa Chamis,<sup>1</sup> Anders Dahl,<sup>7</sup> Louis DiBernardo,<sup>1</sup> Emanuele Durante-Mangoni,<sup>8</sup> Xavier Duval,<sup>9</sup> Claudio Querido Fortes,<sup>10</sup> Emil Fosbøl,<sup>11</sup> Margaret M. Hannan,<sup>12</sup> Barbara Hasse,<sup>13</sup> Bruno Hoen,<sup>14</sup> Adolf W. Karchmer,<sup>15</sup> Carlos A. Mestres,<sup>16</sup> Cathy A. Petti,<sup>1,17</sup> Maria Nazarena Pizzi,<sup>18</sup> Stephen D. Preston,<sup>19</sup> Albert Roque,<sup>20</sup> Francois Vandenesch,<sup>21,22</sup> Jan T. M. van der Meer,<sup>23</sup> Thomas W. van der Vaart,<sup>23</sup> and Jose M. Miro<sup>24,25</sup>

## B. Imaging Major Criteria

(1) Echocardiography and **cardiac computed tomography (CT)** imaging

i. Echocardiography and/or **cardiac CT** showing vegetation,<sup>e</sup> valvular/leaflet perforation,<sup>f</sup> valvular/leaflet aneurysm,<sup>g</sup> abscess,<sup>h</sup> pseudoaneurysm,<sup>i</sup> or intracardiac fistula<sup>j</sup>

*or*

ii. Significant new valvular regurgitation on echocardiography as compared with previous imaging. Worsening or changing of preexisting regurgitation is not sufficient.

*or*

iii. New partial dehiscence of prosthetic valve as compared with previous imaging [52]

**(2) Positron emission computed tomography with 18F-fluorodeoxyglucose ([18F]FDG PET/CT imaging)**

**Abnormal metabolic activity<sup>k</sup> involving a native or prosthetic valve, ascending aortic graft (with concomitant evidence of valve involvement), intracardiac device leads or other prosthetic material<sup>l,m</sup>**



## **FDG PET Görüntüleme**

Native veya protez kapakta, asendan aort greftinde (beraberinde eşlik eden kapak tutulumu ile), intrakardiyak cihaz elektrotlarında ve diğer protez materyallerinde anormal metabolik aktivite izlenmesi

## II. MINOR CRITERIA

- A. Predisposition
- **Previous history of IE**
  - Prosthetic valve<sup>o</sup>
  - Previous valve repair<sup>o</sup>
  - Congenital heart disease<sup>p</sup>
  - More than mild regurgitation or stenosis of any etiology
  - **Endovascular intracardiac implantable electronic device (CIED)**
  - Hypertrophic obstructive cardiomyopathy
  - Injection drug use
- B. Fever Documented temperature greater than 38.0 °C (100.4 °F)
- C. Vascular Phenomena Clinical or radiological evidence of arterial emboli, septic pulmonary infarcts, **cerebral or splenic abscess**, mycotic aneurysm, intracranial hemorrhage, conjunctival hemorrhages, Janeway lesions, purulent purpura
- D. Immunologic Phenomena Positive rheumatoid factor, Osler nodes, Roth spots, or immune complex-mediated glomerulonephritis<sup>q</sup>
- E. Microbiologic Evidence, Falling Short of a Major Criterion
- 1) Positive blood cultures for a microorganism consistent with IE but not meeting the requirements for Major Criterion<sup>r</sup>
- or
- 2) **Positive culture, PCR, or other nucleic acid based test (amplicon or shotgun sequencing, *in situ* hybridization) for an organism consistent with IE<sup>r</sup> from a sterile body site other than cardiac tissue, cardiac prosthesis, or arterial embolus; or a single finding of a skin bacterium by PCR on a valve or wire without additional clinical or microbiological supporting evidence [51]**
- F. Imaging Criteria
- Abnormal metabolic activity as detected by [18F]FDG PET/CT within 3 mo of implantation of prosthetic valve, ascending aortic graft (with concomitant evidence of valve involvement), intracardiac device leads or other prosthetic material**
- G. Physical Examination Criteria<sup>s</sup>
- New valvular regurgitation identified on auscultation if echocardiography is not available. Worsening or changing of preexisting murmur not sufficient



### **FDG PET Görüntüleme**

Protez kapak cerrahisi sonrası **3 ay içerisinde** protez kapakta, asendan aort greftinde (beraberinde eşlik eden kapak tutulumu ile), intrakardiyak cihaz leadlerinde ve diğer protez materyallerinde anormal metabolik aktivite izlenmesi



# IE- F<sup>18</sup>-FDG PET/BT

- ✓ Major kriter olarak kabul etmek için cerrahi sonrası en az **3 ay** geçmiş olmalı
- ✓ Bazı protez kapaklar intrinsik olarak patolojik olmayan FDG tutulumu gösterebilir
- ✓ Pil jeneratör cebinde izole FDG pozitifliği intrakardiyak enfeksiyon yoksa Major Kriter olarak kabul edilmez.
- ✓ PET/BT ekstrakardiyak odaklar açısından dikkatle değerlendirilmelidir



ESC

European Society  
of Cardiology

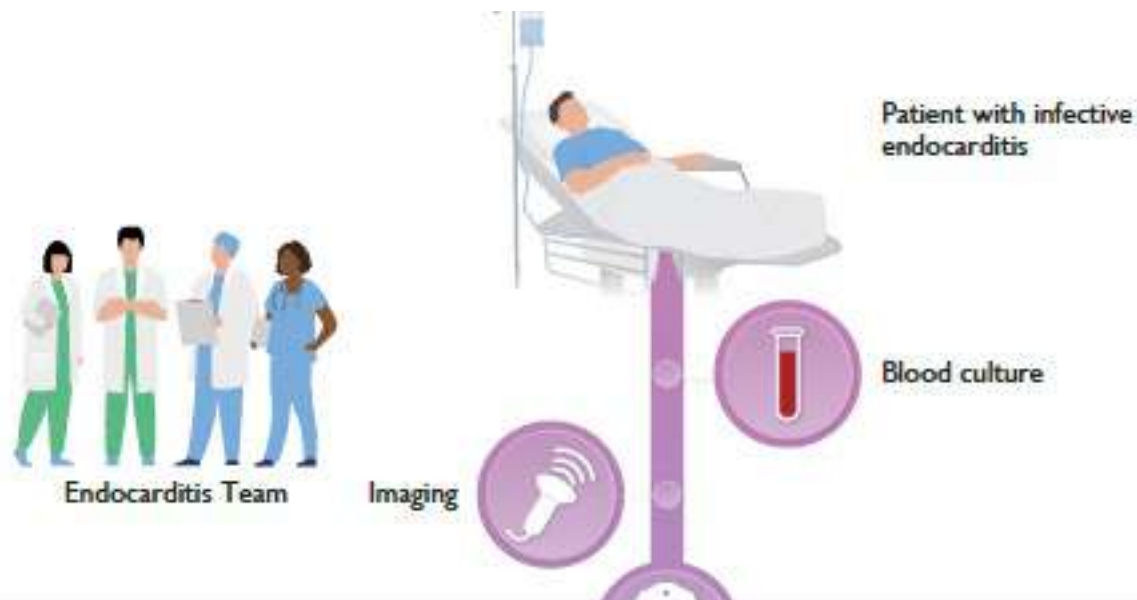
European Heart Journal (2023) 00, 1–95  
<https://doi.org/10.1093/eurheartj/ehad193>

ESC GUIDELINES

# 2023 ESC Guidelines for the management of endocarditis

Developed by the task force on the management of endocarditis of the European Society of Cardiology (ESC)

Endorsed by the European Association for Cardio-Thoracic Surgery (EACTS) and the European Association of Nuclear Medicine (EANM)



**Table 10** Definitions of the 2023 European Society of Cardiology modified diagnostic criteria of infective endocarditis

**Major criteria**

**(i) Blood cultures positive for IE**

- (a) Typical microorganisms consistent with IE from two separate blood cultures:  
Oral streptococci, *Streptococcus gallolyticus* (formerly *S. bovis*), HACEK group, *S. aureus*, *E. faecalis*
- (b) Microorganisms consistent with IE from continuously positive blood cultures:
- $\geq 2$  positive blood cultures of blood samples drawn  $> 12$  h apart.
  - All of 3 or a majority of  $\geq 4$  separate cultures of blood (with first and last samples drawn  $\geq 1$  h apart).
- (c) Single positive blood culture for *C. burnetii* or phase I IgG antibody titre  $> 1:800$ .

**(ii) Imaging positive for IE:**

Valvular, perivalvular/periprosthetic and foreign material anatomic and metabolic lesions characteristic of IE detected by any of the following imaging techniques:

- Echocardiography (TTE and TOE).
- Cardiac CT.
- [18F]-FDG-PET/CT(A).
- WBC SPECT/CT.



Protez kapaklı hastalarda protezde veya periprostetik alanda fokal FDG tutulumu cerrahi zamanından bağımsız olarak pozitif Major kriter

**Section 5. Recommendation Table 6 — Recommendations for the role of computed tomography, nuclear imaging, and magnetic resonance in infective endocarditis**

Cardiac CTA is recommended in patients with possible NVE to detect valvular lesions and confirm the diagnosis of IE.	<b>I</b>	<b>B</b>
[18F]FDG-PET/CT(A) and cardiac CTA are recommended in possible PVE to detect valvular lesions and confirm the diagnosis of IE.	<b>I</b>	<b>B</b>
[18F]FDG-PET/CT(A) may be considered in possible CIED-related IE to confirm the diagnosis of IE.	<b>IIa</b>	<b>B</b>
Cardiac CTA is recommended in NVE and PVE to diagnose paravalvular or periprosthetic complications if echocardiography is inconclusive.	<b>I</b>	<b>B</b>
Brain and whole-body imaging (CT, [18F]FDG-PET/CT, and/or MRI) are recommended in symptomatic patients with NVE and PVE to detect peripheral lesions or add minor diagnostic criteria.	<b>I</b>	<b>B</b>
WBC SPECT/CT should be considered in patients with high clinical suspicion of PVE when echocardiography is negative or inconclusive and when PET/CT is unavailable.	<b>IIa</b>	<b>C</b>
Brain and whole-body imaging (CT, [18F]FDG-PET/CT, and MRI) in NVE and PVE may be considered for screening of peripheral lesions in asymptomatic patients.	<b>IIb</b>	<b>B</b>

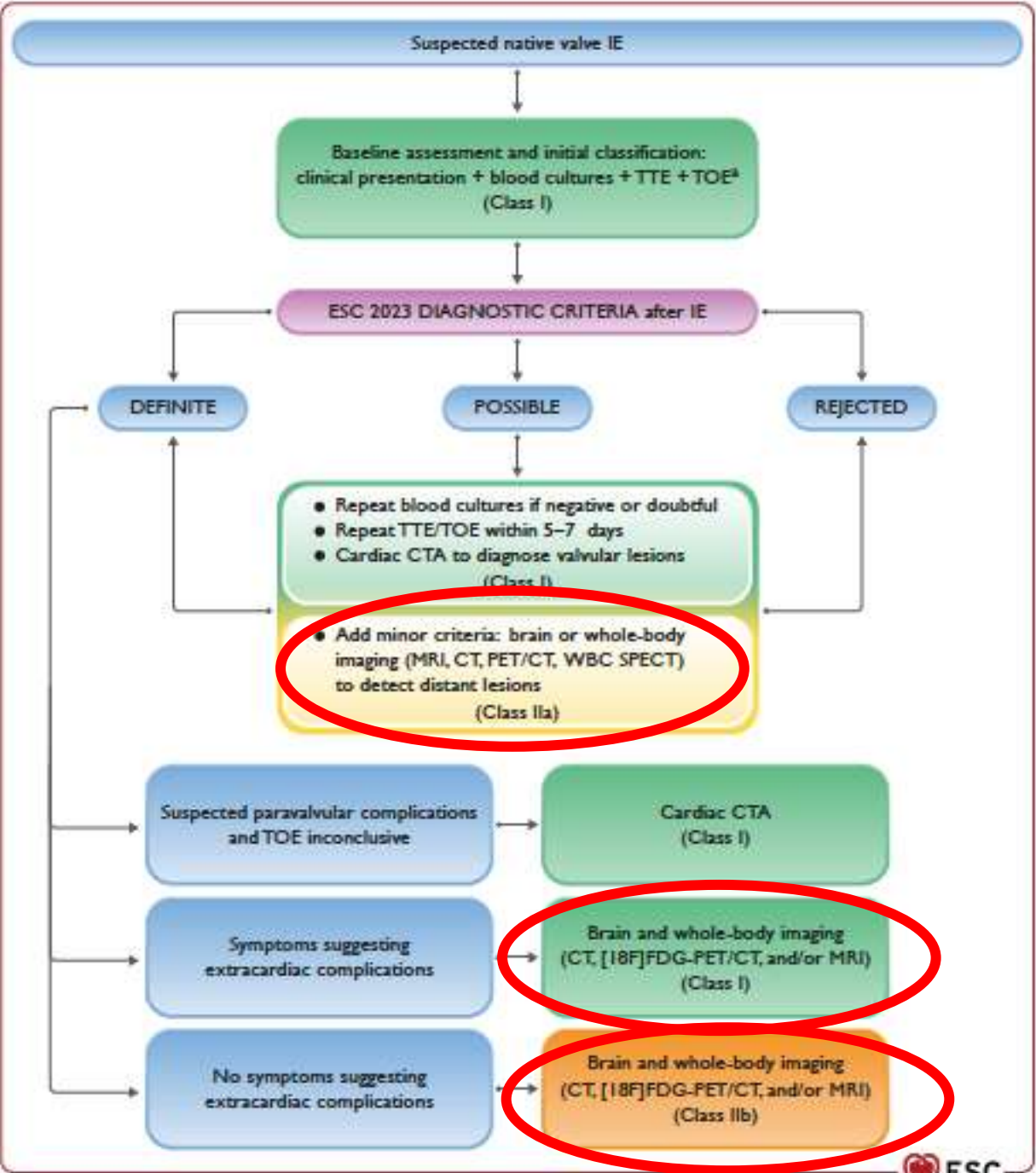
FDG PET/BT ve BTA olası protez kapak enfeksiyonlarında valvuler lezyonların tespiti ve IE tanısında önerilmekte **Class I**

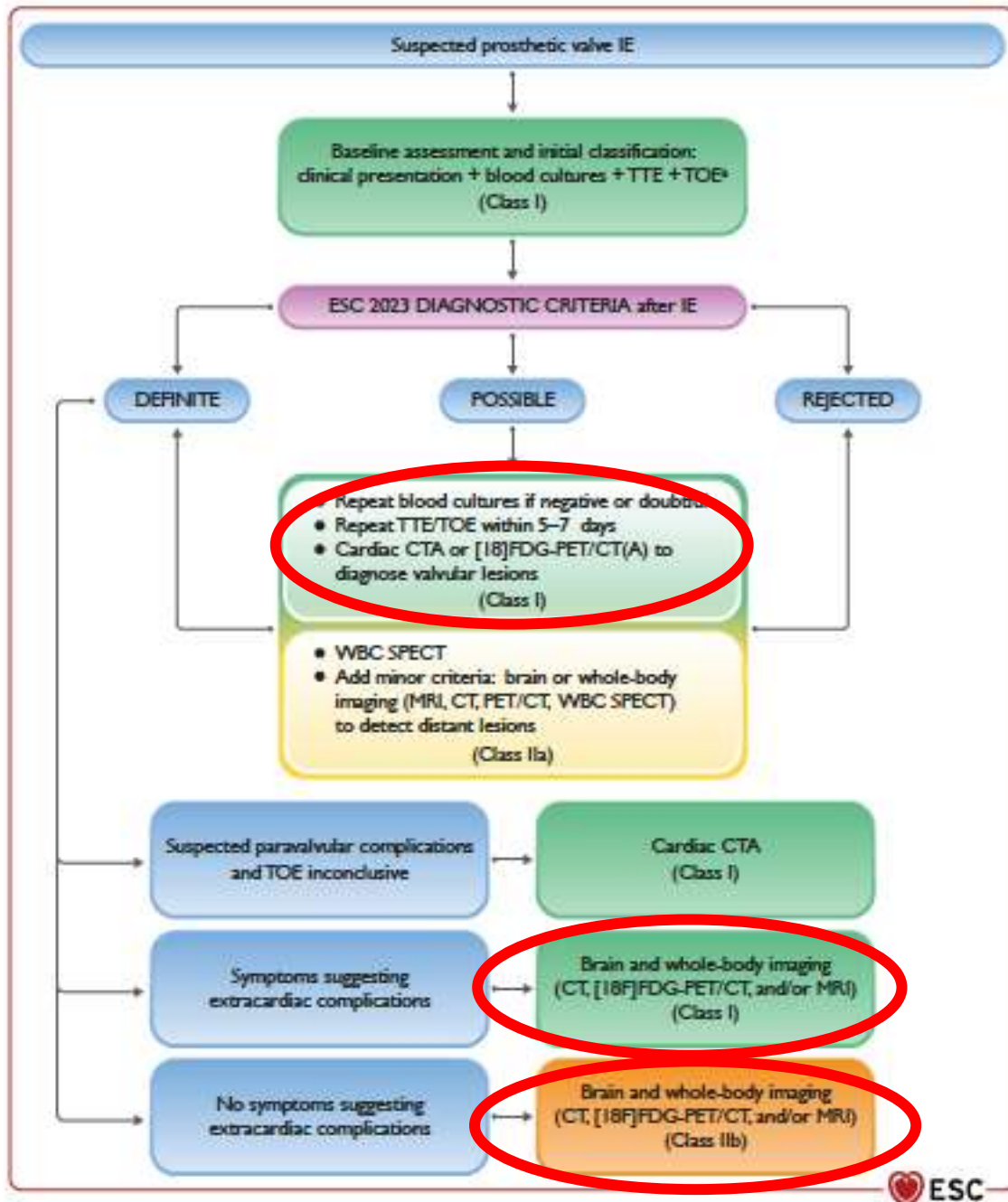
FDG PET/BT olası kardiyak cihaz ilişkili IE'de tanıyı konfirme etme amaçlı önerilmekte **Class IIa**

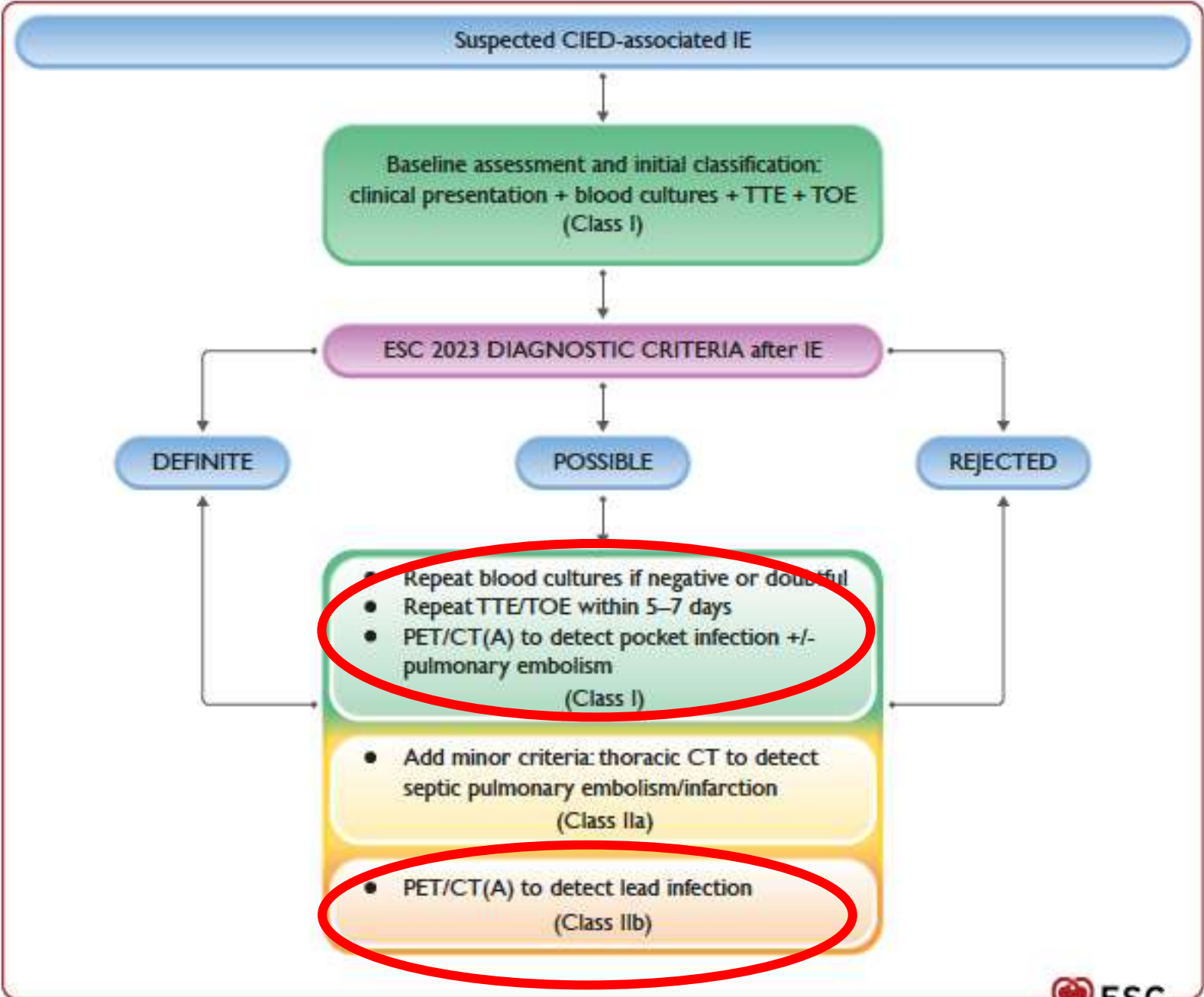
Semptomatik nativ ve protez kapak IE hastalarında periferik lezyon tespitinde Beyin ve tüm vücut görüntüleme (FDG PET veya BT) önerilmekte **Class I**

Lökosit sintigrafisi FDG PET/BT mevcut değilse eko'nun negatif olduğu, klinik şüphe yüksek olan protez kapak enfeksiyonlarında endike **Class IIa**

Aseptomatik nativ ve protez kapak IE hastalarında periferik lezyon tespitinde Beyin ve tüm vücut görüntüleme (FDG PET veya BT) önerilmekte **Class IIb**







UYGULAMA KILAVUZU

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Nucl Med Semin 2020;6:220-228

# **Enfektif Endokardit Tanısında Nükleer Tıp Uygulamaları**

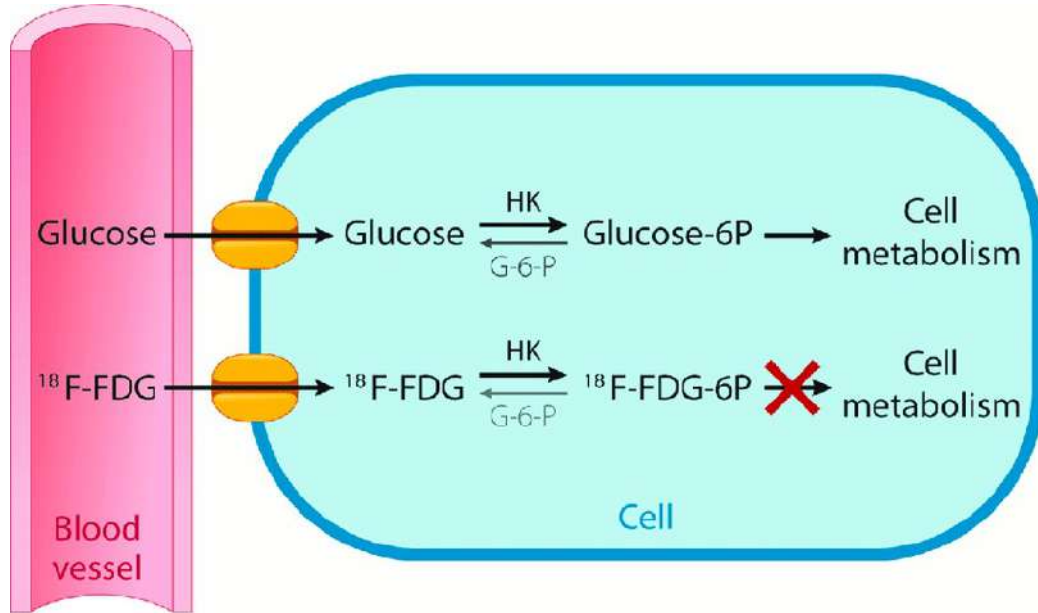
Nuclear Medicine Procedures in Diagnosis of Infective  
Endocarditis

© Hakan Demir<sup>1</sup>, © Fevziye Canbaz Tosun<sup>2</sup>, © Gülay Durmuş Altun<sup>3</sup>, © Elif Özdemir<sup>4</sup>, © Semra Özdemir<sup>5</sup>, © Feyza Şen<sup>6</sup>



# F<sup>18</sup>-FDG PET/BT

- F18 Floro-deoksi-glukoz → glikolitik aktivite



Enfeksiyon ve inflamasyonda salınan sitokinler ile aktive olan lökosit, monosit, makrofaj, T lenfositlerde GLUT ekspresyonu artar → artmış FDG tutulum izlenir

# F<sup>18</sup>-FDG PET/BT Görüntüleme

- En az 6 saat açlık, AKŞ <200 mg/dL (160)
- Böbrek fonksiyon bozukluğunda uygulanabilir, protokol değişikliği gerekmez
- Myokarda yoğun fizyolojik tutulum
- **Myokard tutulumunu suprese etmek için düşük karbonhidratlı (<1g), yağdan zengin diyet önerilir**
- F18-FDG iv uygulama
- Enjeksiyondan 60 dk sonra görüntüleme
- IE'de geç görüntüleme (2-3. saat) katkı sağlayabilir

# F<sup>18</sup>-FDG PET/BT Myokard Supresyonu

Tablo 1. Düşük karbonhidratlı örnek diyet listesi	
Sabah	Çay-kahve
	2 tane yumurta
	2 dilim yağlı peynir
	Zeytin (sınırsız)
Öğle-akşam	Et-tavuk-balık (unsuz)
	Hindi-köfte (ekmeksiz)
	Marul-maydonoz-roka salatası (zeytinyağlı)
Yasaklar	Tüm meyve ve sebzeler (örnek listedekiler hariç)
	Unlu gıdalar (ekmek, pasta, pilav, makarna, galeta)
	Kuru baklagiller
	Süt ve sütlü gıdalar (yoğurt, ayran, dondurma vb.)
	Tüm kuruyemişler
	Tüm çorbalar

## Heparin Enjeksiyonu

Lipoprotein ve lipaz aktivasyonu ile plazma yağ asit oranını arttırabilir

50 IU/kg, ultra-fraksiyone heparin F-18 FDG enjeksiyonundan 15 dk önce iv bolus

# FDG PET Hata Kaynakları

## Yanlış Pozitiflik

- Yapay kapak ve kardiyak cihazlar atenüasyon düzeltim hataları ile yanlış pozitifliğe neden olabilir. Atenüasyon düzeltimi yapılmamış görüntüler değerlendirilmeli
- Non-spesifik bir ajan, yanlış pozitifliklere dikkat edilmeli (tümör, enfeksiyon, inflamasyon, non-infektif trombüs, doku yapıştırıcıları...)
- Cerrahi girişim sonrası erken dönemde inflamasyona sekonder yanlış pozitiflik (3 ay?)

# FDG PET Hata Kaynakları:

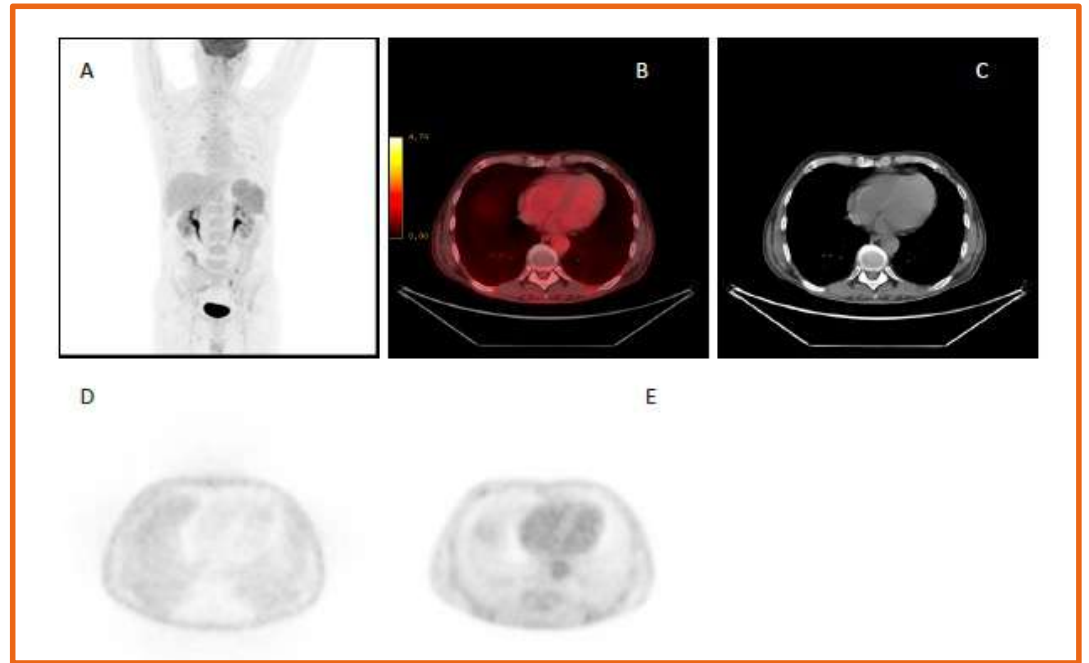
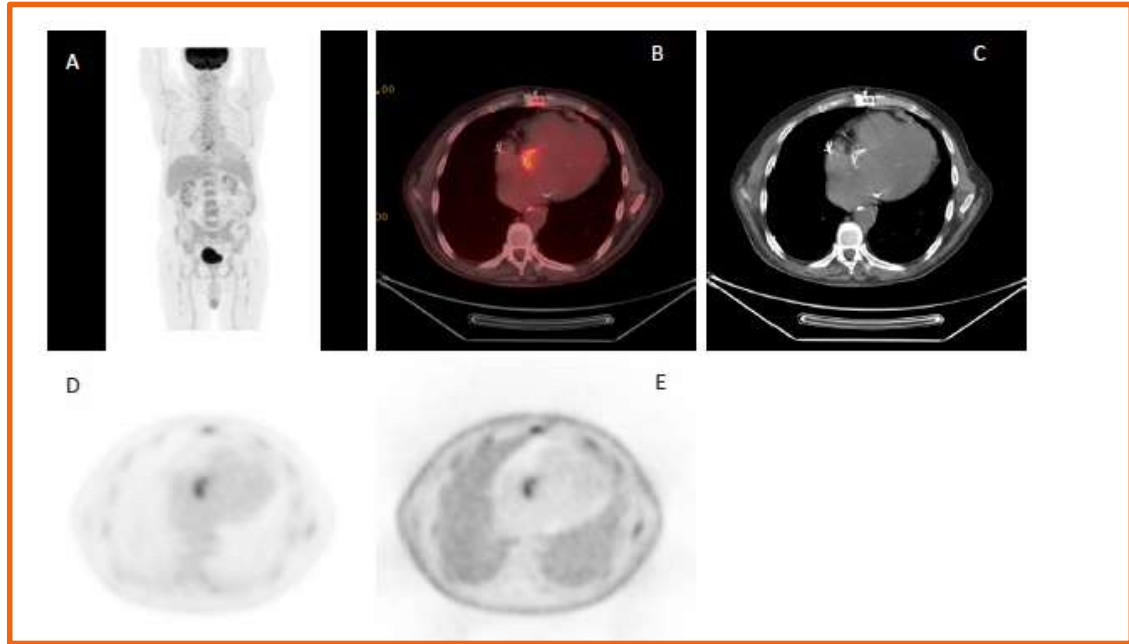
## Yanlış Negatiflik

- Diabetik hastalarda AKŞ yüksekliği
- Yetersiz diyet
- Rezolüsyon sınırının altında kalan küçük vejetasyonlar
- Beyin embolisi
- Antibiyotik kullanımı?? (kesilmesi önerilmez)

# FDG PET Deęerlendirme ve Raporlama-1

## Görsel Deęerlendirme

- Metal artefaktlar varsa atenüasyon düzeltimi yapılmış ve yapılmamış görüntüler birlikte deęerlendirilmeli
- **Doęal kapak, protez kapak, kardiyak cihaz santral ve periferik kesimlerinde damar graftleri çevresinde yoğun heterojen yer yer fokal tutulumlar IE'i destekler**
- Cerrahi girişim sonrası tutulumlar genellikle homojen/diffüz paternde, ılımlı düzeyde
- Primer enfeksiyon odaęı dışında septik emboli ve metastatik enfeksiyonlar açısından detaylı tüm vücut deęerlendirme yapılmalı
- Ayırıcı tanıda veya predispozan faktörler arasında yer alan malignite açısından deęerlendirme



# FDG PET Deęerlendirme ve Raporlama-2

- Kantitatif ve semikantitatif deęerlendirme
  - Eşik SUVmaks deęeri net deęil
  - SUV deęerleri takipte yardımcı olabilir



**Table 1** Qualitative and Semi-quantitative 18-F FDG PET/CT Interpretation Methods Used in Evaluation of Infective Endocarditis and CIED Infection

Study	Population	Visual Analysis Methods and Results	Semi-quantitative Analysis Methods And Results
Granados 2016 <sup>41</sup>	N = 80 NVE, PVE, CIED-IE Myocardial suppression: 12 hour fast, heparin bolus	Increased FDG activity on AC and NAC images  Sensitivity 82%, specificity 96% NVE excluded – sensitivity 96%, specificity 94%, NPV 97%	SUV <sub>max</sub> at target area SUV <sub>ratio</sub> = target SUV <sub>max</sub> / SUV <sub>mean</sub> at MBP, liver SUV <sub>max</sub> ≥ 3.5: Sensitivity 91%, specificity 94%
Jimenez-Ballve 2016 <sup>79</sup>	N = 41 PVE, CIED-IE Myocardial suppression: 12 hour fast, heparin bolus, high fat/low carbohydrate diet for 48 hours	Increased FDG activity on AC and NAC images  Sensitivity 100%, specificity 73%	SUVmax at target area SUVmax compared to MBP, liver (grading system) SUVmax ≥ 5.5 Sensitivity 50%, specificity 80%
Pizzi 2015 <sup>24</sup>	N = 92 PVE, CIED-IE Myocardial suppression: 12 hour fast, heparin bolus	Increased FDG uptake on AC and NAC images  Sensitivity 90%, specificity 90%	SUV <sub>max</sub> at target area SUV <sub>ratio</sub> = target SUV <sub>max</sub> / MBP SUV <sub>max</sub> SUVmax ≥ 3.7: Sensitivity 91%, specificity 79% SUVratio ≥ 1.69: Sensitivity 91%, specificity 76%
Ricciardi 2014 <sup>80</sup>	N = 27 NVE, PVE Myocardial suppression: 6 hour fast, high fat/low carbohydrate diet for 1 meal	Increased FDG uptake on AC and NAC images Sensitivity 55%, specificity 100% PVE only - Sensitivity 85%, specificity 100%	Not performed
Rouzet 2014 <sup>47</sup>	N = 39 PVE Myocardial suppression: 12 hour fast, high fat/low carbohydrate diet for 1 meal	Increased FDG uptake on AC and NAC images  Sensitivity 93%, specificity 71%	SUVmean at target area SUVratio = target SUVmean / MBP SUV mean SUVmean ≥ 6.2: Specificity 100% SUVratio ≥ 4.4: Specificity 100%
Saby 2013 <sup>23</sup>	N = 72 PVE Myocardial suppression: 12 hour fast, high fat/low carbohydrate diet for 1 meal	Increased FDG uptake on AC and NAC images  Sensitivity 73%, specificity 80%	SUVmax SUVratio = Target SUVmax / MBP SUVmax SUV max higher in definite PVE (P = 0.02) SUVratio not significantly different (P = 0.16) <i>Values not provided in text</i>

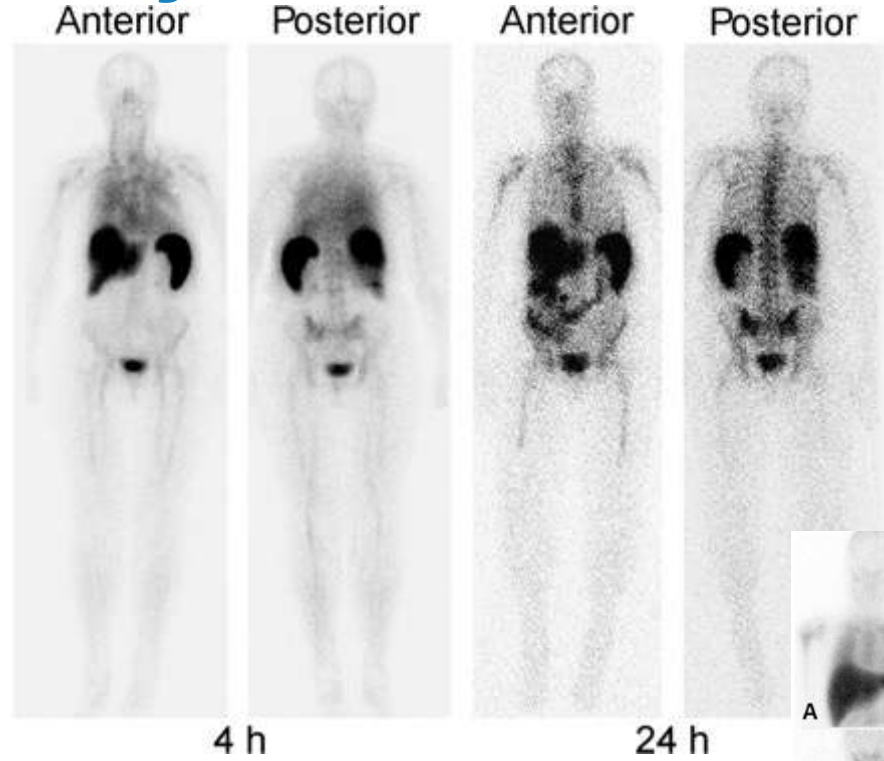
# Tc99m HMPAO İşaretli Lökosit Sintigrafisi

- Otolog lökositler invitro olarak Tc99m HMPAO ile işaretlenerek iv yolla hastaya verilir
- Enfeksiyon tanısında özgüllüğü yüksek
- Böbrek fonksiyon bozukluğunda yapılabilir, protokol değişikliği gerekmez

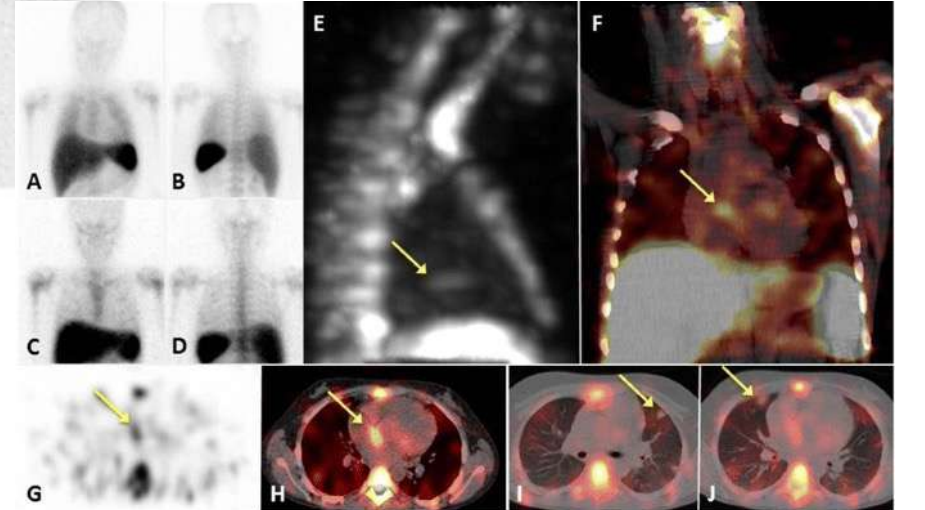
# Tc99m HMPAO İşaretli Lökosit Sintigrafisi

- Aseptik koşullarda radyoaktif işaretleme prosedürü uzun
- Ekipman (Class A laminar hava akımlı kabin) ve tecrübeli personel gerektirmekte (Radyoaktif ve mikrobiyolojik bulaş riski)
- Görüntüleme süresi uzun (4 ve 24. saatlerde görüntüleme)
- Rezolüsyon PET görüntülemeden düşük
- Mutlaka SPECT/BT görüntüleme yapılmalı ve atenüasyon düzeltimi yapılmamış görüntüler değerlendirilmeli

# Tc99m HMPAO İşaretli Lökosit Sintigrafisi



Tüm vücut tarama, planar ve SPECT/BT Görüntüleme



# Tc99m HMPAO İşaretli Lökosit Sintigrafisi

## Değerlendirme

IE düşünülen bölgede (kapak, kardiyak cihaz, lead vb)

- Erken görüntüde tutulum izlenmiyor → Sintigrafi negatif
- Erken görüntüde tutulum var geç görüntüde aynı veya artıyorsa → Sintigrafi pozitif
- Erken görüntüde tutulum var geç görüntüde tutulum yoğunluğu ve boyutu azalıyor → şüpheli bulgu

Beyin, akciğer, yumuşak doku embolilerinde artmış tutulum

Dalaktaki fizyolojik artmış tutulum nedeniyle dalak embolilerinde duyarlılık düşük

# Tc99m HMPAO İşaretli Lökosit Sintigrafisi

## Yanlış Negatiflik

Antibiyotik kullanımı duyarlılığı azaltabilir ???

Enterokok ve Candidaya bağlı IE olgularında yanlış negatiflik bildirilmiş

Küçük vejetasyonlar

## Yanlış Pozitiflik

Sekonder iyileşme ile granülasyon gösteren yaralar

Damar yolları

Diyaliz kateterleri

Ponksiyon bölgeleri

# Neden FDG PET Öne Çıkıyor?

- **2023 Duke-ISCVID IE Kriterlerine Major kriter olarak eklendi**
- ✓ Ekokardiyografinin protez materyallerindeki tanısal limitasyonlarını aşıyor
- ✓ FDG PET ile tekrar sınıflandırıldığında önemli sayıda olası IE olgusu, kesin tanıya dönmekte
- ✓ Çalışma grubu PET'in **pozitif belirleyici değerine** odaklanmış
- ✓ PET'in tanısal performansı zamanla artış gösterdiği bilinmekte

**ORIGINAL ARTICLE**

# Diagnosis of Infective Endocarditis by Subtype Using <sup>18</sup>F-Fluorodeoxyglucose Positron Emission Tomography/Computed Tomography

## A Contemporary Meta-Analysis

• 26 çalışma, 1358 hasta

**Table 2.** Pooled Analyses of <sup>18</sup>F-FDG PET/CT for Diagnosis of Infective Endocarditis and Its Subtypes

IE group	All IE	NVIE	PVIE	CIEDIE
Number of IE cases/total scanned	509/1358	88/297	333/634	89/208
Number of studies	26	4	15	9
Sensitivity	0.74 (0.70–0.77)	0.31 (0.21–0.41)	0.86 (0.81–0.89)	0.72 (0.61–0.81)
Specificity	0.88 (0.86–0.91)	0.98 (0.95–0.99)	0.84 (0.79–0.88)	0.83 (0.75–0.89)
Positive likelihood ratio	4.40 (2.60–7.44)	14.0 (5.56–35.4)	3.23 (1.75–5.95)	5.25 (1.42–19.4)
Negative likelihood ratio	0.36 (0.29–0.46)	0.71 (0.60–0.84)	0.21 (0.14–0.32)	0.36 (0.19–0.69)
Odds ratio	16.9 (10.4–27.5)	23.0 (8.06–65.6)	22.0 (10.0–48.2)	18.0 (4.72–68.9)



**ORIGINAL ARTICLE**

**Diagnosis of Infective Endocarditis by Subtype Using  $^{18}\text{F}$ -Fluorodeoxyglucose Positron Emission Tomography/Computed Tomography**  
A Contemporary Meta-Analysis

PET'in tanısal performansı zamanla artış gösterdi

2014 öncesi 9 çalışmaya göre, 2015 sonrası 17 çalışmada PET'in duyarlılık ve özgüllüğünde artış

Görüntüleme teknolojisindeki gelişmeler, değerlendirici tecrübesinde artış



## Impact of Systematic Whole-body 18F-Fluorodeoxyglucose PET/CT on the Management of Patients Suspected of Infective Endocarditis: The Prospective Multicenter TEPvENDO Study

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3 tersiyer merkezden, 140 hasta  
70 PV, 70 NV

- ✓ ESC2015 kriterleri
- ✓ modDuke kriterleri
- ✓ Hasta Yönetiminde değişiklik

FDG PET ile ve PET olmaksızın 2 uzman değerlendirmesi

PET ile hem PV hem de NV olan hastalarda tanısal sınıflama ve hasta yönetiminde anlamlı değişim

**Table 2:** Diagnostic value of the Duke-Li criteria at inclusion and after <sup>18</sup>F-FDG-PET/CT according to the final Duke-Li IE classification in the 140 patients

	Total N=140	Prosthetic valve patients N=70				Native valve patients N=70				P value**
		Final IE classification (gold standard)				Final IE classification (gold standard)				
		Definite N=47	Possible N=17	Excluded N=6	Total N=70	Definite N=48	Possible N=9	Excluded N=13	Total N=70	
<b>Duke-Li classification at inclusion*</b>										
Definite	80 (57.1)	32 (68.1)	2 (11.8)	0 (0)	34 (48.6)	42 (87.5)	0 (0)	4 (30.8)	46 (65.7)	0.095
Possible	56 (40.0)	15 (31.9)	13 (76.5)	5 (83.3)	33	6 (12.5)	9 (100)	8 (61.5)	23 (32.6)	
Excluded †	4 (2.6)	0 (0)	2 (11.8)	1 (16.7)	3 (4.3)	0 (0)	0 (0)	1 (7.7)	1 (1.4)	
<b><sup>18</sup>F-FDG-PET/CT results</b>										
<b>Perivalvular uptake</b>										
Abnormal uptake ‡	64 (45.7)	38 (80.4)	7 (41.2)	2 (33.3)	47 (67.1)	16 (33.3)	1 (11.1)	0 (0)	17 (24.3)	< 0.001
Non-interpretable	5 (3.6)	2 (4.3)	2 (11.8)	0 (0)	4 (5.1)	1 (2.2)	0 (0)	0 (0)	1 (1.4)	0.282
<b>Extracardiac uptake</b>										
Peripheral IE complication §	69 (49.3)	24 (51.1)	7 (41.2)	1 (16.7)	32 (45.7)	27 (56.3)	3 (33.3)	7 (53.9)	37 (52.9)	0.381
Portal of entry										
All	33 (23.6)	11 (23.4)	4 (23.5)	0 (0)	15 (21.4)	14 (29.2)	1 (11.1)	3 (23.1)	18 (25.7)	0.302
Revealed	12 (8.0)	6 (12.8)	2 (11.8)	0 (0)	8 (11.4)	3 (6.3)	0 (0)	1 (7.7)	4 (5.7)	0.366
Confirmed	21 (15.0)	5 (10.6)	2 (11.8)	0 (0)	7 (10.0)	11 (22.9)	1 (11.1)	2 (15.4)	14 (20.0)	0.154
<b>Modification of Duke-Li criteria   </b>										
Modification of any Duke criterion	43 (30.7)	22 (46.8)	3 (17.7)	1 (16.7)	26 (37.1)	14 (29.2)	1 (11.1)	2 (15.4)	17 (24.3)	0.142
Modification of a Minor Duke criterion	21 (15.0)	6 (27.3)	0 (0)	1 (100)	7 (10.0)	11 (22.9)	1(100)	2 (100)	14 (20.0)	< 0.001
Modification of a Major Duke criterion	23 (16.4)	17 (77.3)	3 (100)	0 (0)	20 (28.6)	3 (6.3)	0 (0)	0 (0)	3 (4.3)	< 0.001
<b>Modification of Duke-Li classification   </b>										
Any modification	21 (15.0)	13 (27.7)	3 (17.7)	1 (16.7)	17 (24.3)	3 (6.3)	0 (0)	1 (7.7)	4 (5.7)	0.003
Modification due to a minor Duke	6 (4.3)	3 (4.6)	0 (0)	1 (16.7)	4 (5.7)	1 (2.1)	0 (0)	1 (100)	2 (2.9)	0.544
Modification due to a major Duke	16 (11.4)	11 (84.6)	3 (100)	0 (0)	14 (20.0)	2 (4.2)	0 (0)	0 (0)	2 (2.9)	0.228
<b>m-ESC2015 <sup>18</sup>F-FDG-PET/CT classification</b>										
Definite	95 (67.9)	45 (95.7)	1 (5.9)	0 (0)	46 (65.7)	45 (93.8)	0 (0)	4 (30.8)	49 (70.0)	0.889
Possible	41 (29.3)	2 (4.3)	16 (94.1)	4 (66.7)	22 (31.4)	3 (6.3)	9 (100)	7 (53.9)	19 (27.1)	
Excluded	4 (2.9)	0 (0)	0 (0)	2 (33.3)	2 (2.9)	0 (0)	0 (0)	2 (15.4)	2 (2.9)	

PET ile hem PV hem de NV olan hastalarda tanısal sınıflama ve hasta yönetiminde anlamlı deęişim

Perivalvüler tutulum PV: %67,2 NV: %24,3

Ekstrakardiyak tutulum: PV: %44,3 NV:%24,3

Sınıf deęişikliği: PV %24,4 NV: %5,7

Hastalık yönetiminde deęişiklik PV%21,4 NV%31,4

# Kapak Cerrahi Sonrası FDG PET/ Ne zaman?

Normal imaging findings after aortic valve implantation on  $^{18}\text{F}$ -Fluorodeoxyglucose positron emission tomography with computed tomography

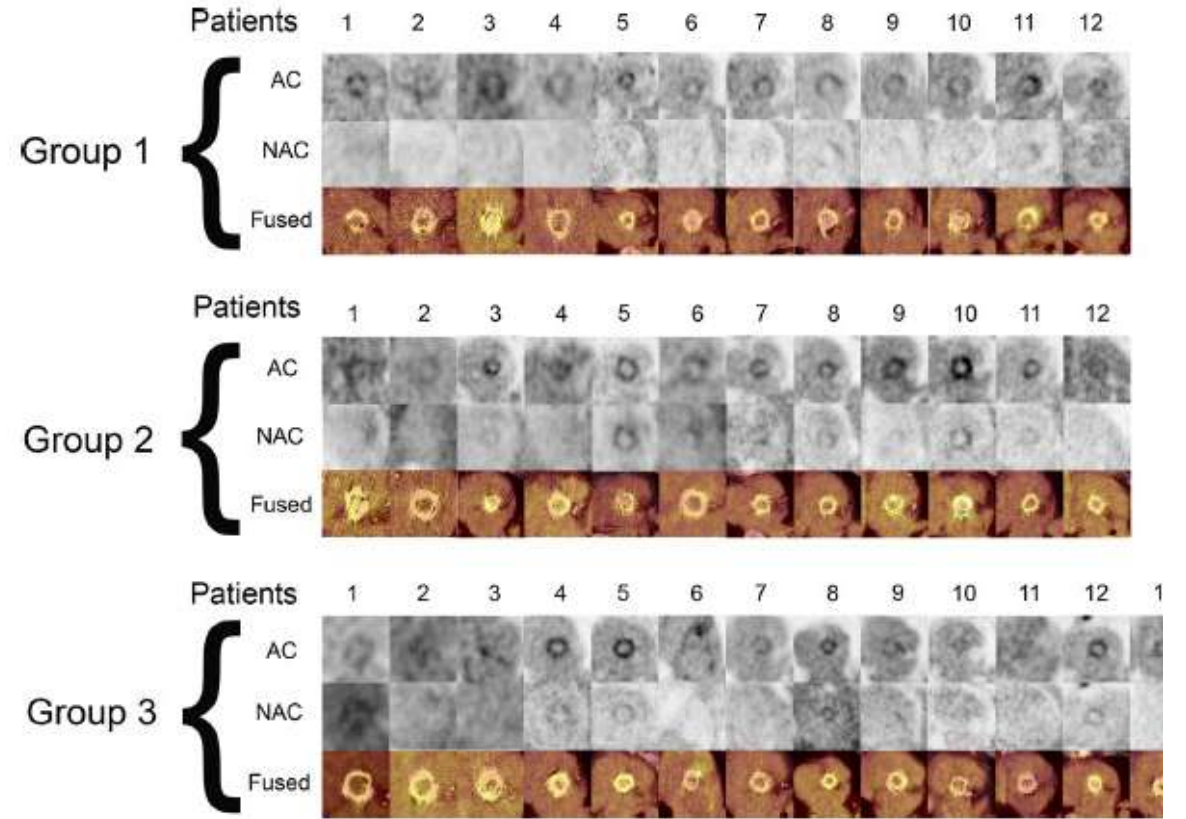
Aort kapak cerrahisi sonrası Komplike olmayan hastalar

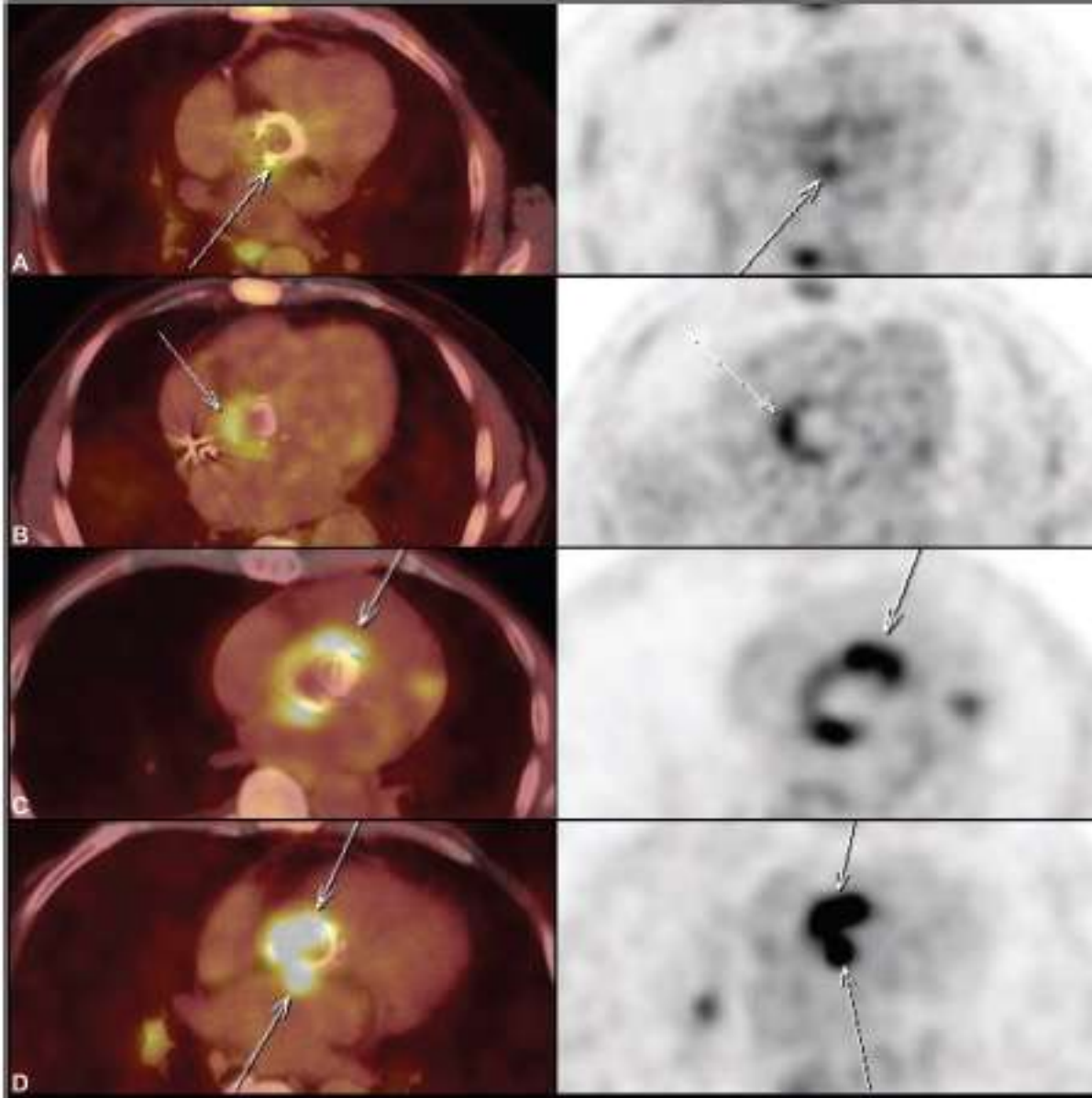
Grup 1: 5 hf

Grup 2: 12 hf

Grup 3: 52 hf

Düşük/orta düzeyde homojen tutulum





Enfeksiyon paternini tanımak önemli

1 ay gibi erken dönemde bile PET katkı sağlayabilir

# Vaka-1 Biyoprotez kapak enfeksiyonu

- 80 y/E
- Bir yıl önce AVR öyküsü mevcut
- Genel durum bozukluğu şikayeti ile acile başvuruyor.
- Yapılan tetkiklerde

HGB:8,0

Ekokardiyografi Aort kapak biyoprotez üzerinde 23x15 mm boyutlu vejetasyon +

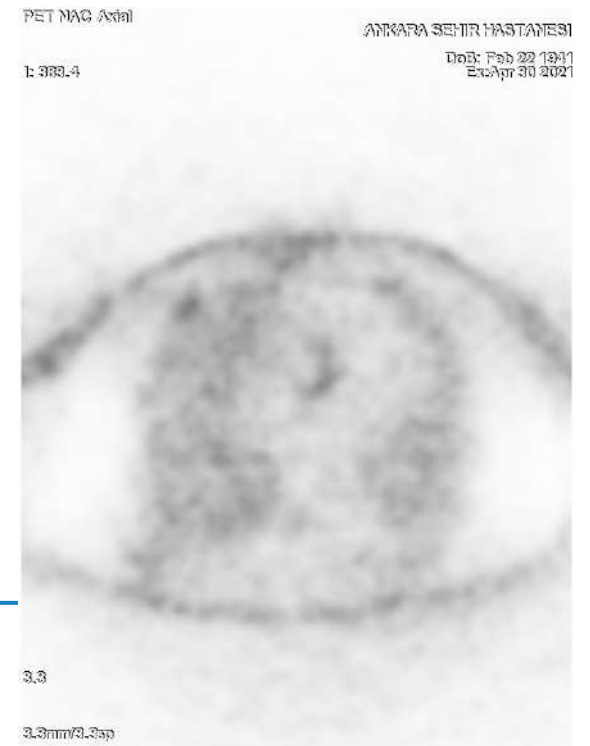
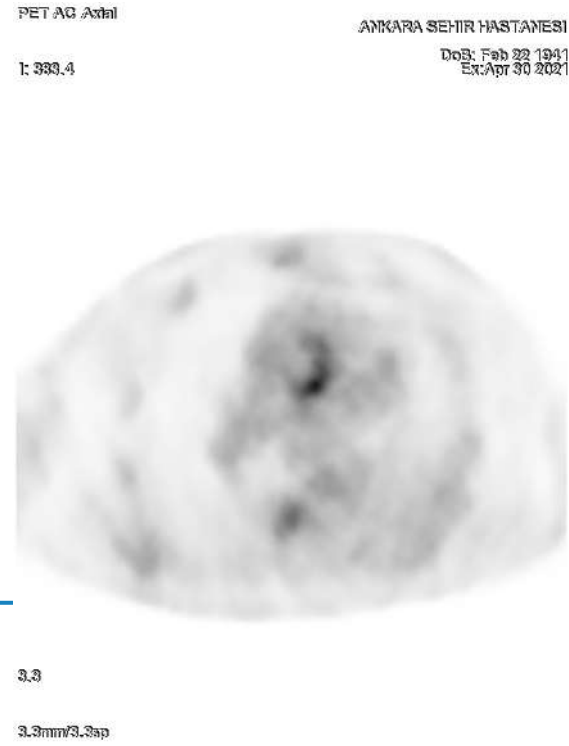
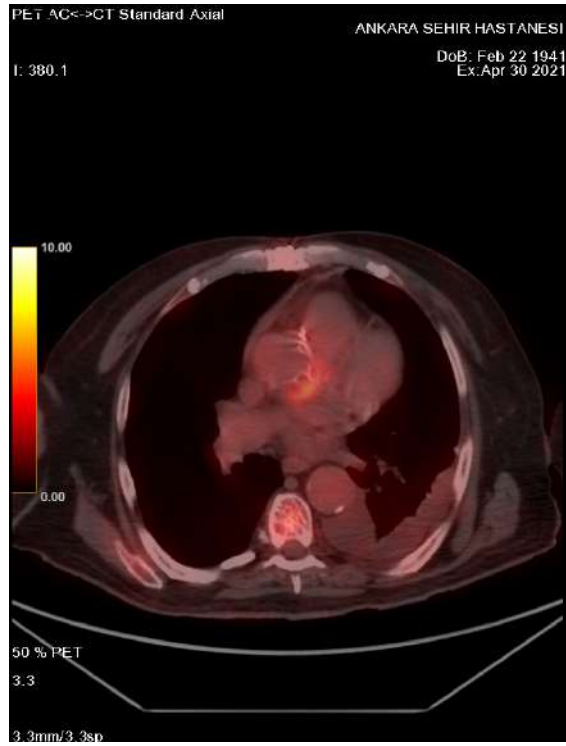
WBC: 9,73 (Nötrofil: 8,29)

Kan kültürü : Ampsilin duyarlı enterococcus faecalis +

PLT: 76. 000

Prokalsitonin:0,22

CRP:129



IE ile uyumlu PET bulguları



# Vaka 2 Doğal kapak enf.

- 45 y /E
- İskemik inme+ ateş etyolojisi araştırılan hasta

Hgb:12,0

WBC:12,03 (Neu:8,92)

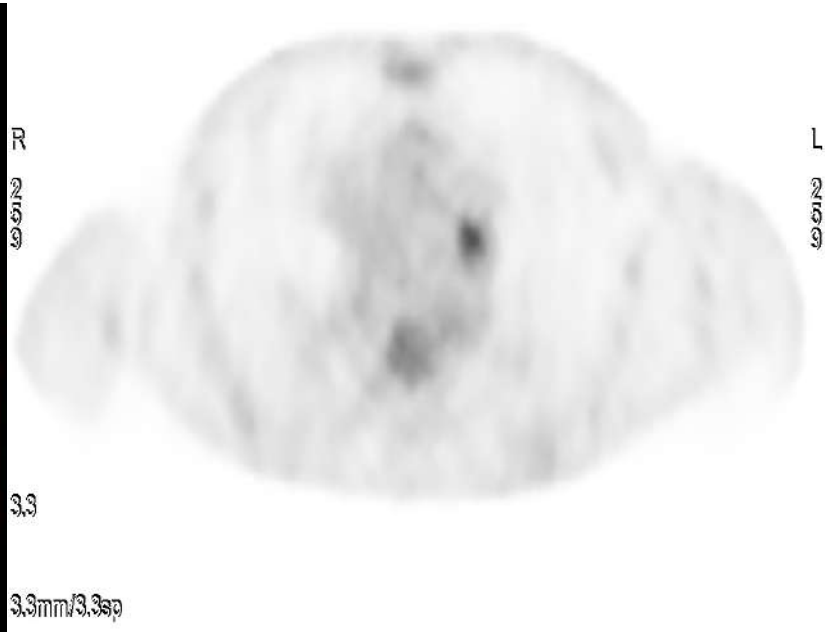
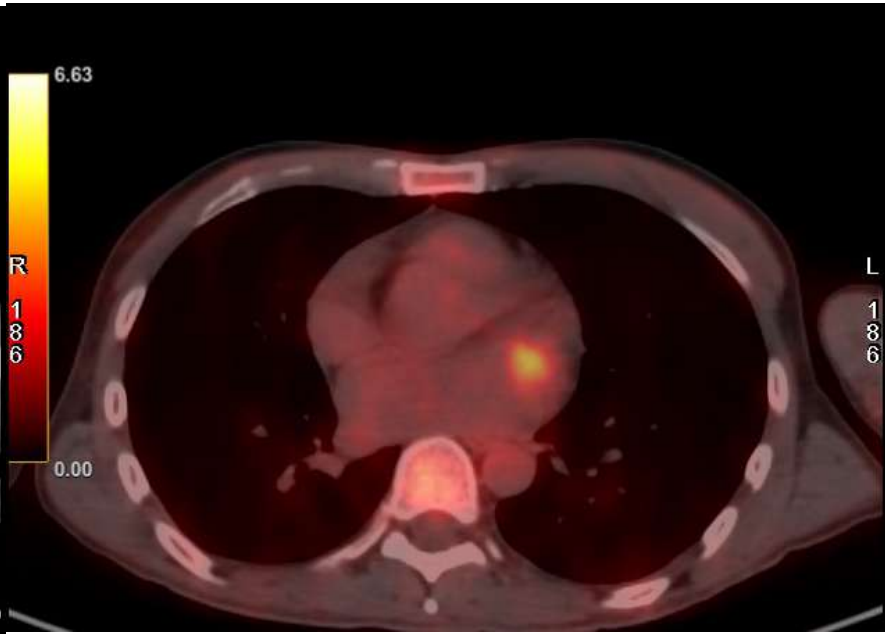
PLT:380.000

CRP:0,1

Beyin MR: Küçük bir alan iskemi +

**TEE: AMVL karnabahar şeklinde 5 mm amorf çıkıntılar oluşturan yüksek olasılık vejetasyon düşündüren yapı**

**Kan kx: Streptococcus oralis/miralis +**



# Vaka 3. AVR+Ascendan aort grefti- IE?

- 73Y/E
- 5 yıl önce AVR + Ascendan aort greft+
- Ateş etyolojisi araştırılıyor
- Yapılan tetkiklerde:

HGB:11,8

WBC:9,72 (%80 nötrofil)

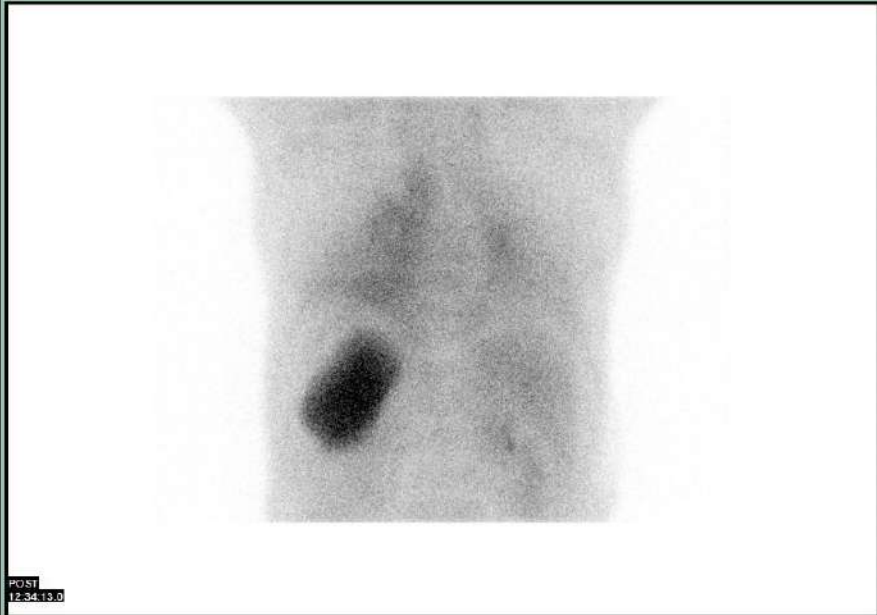
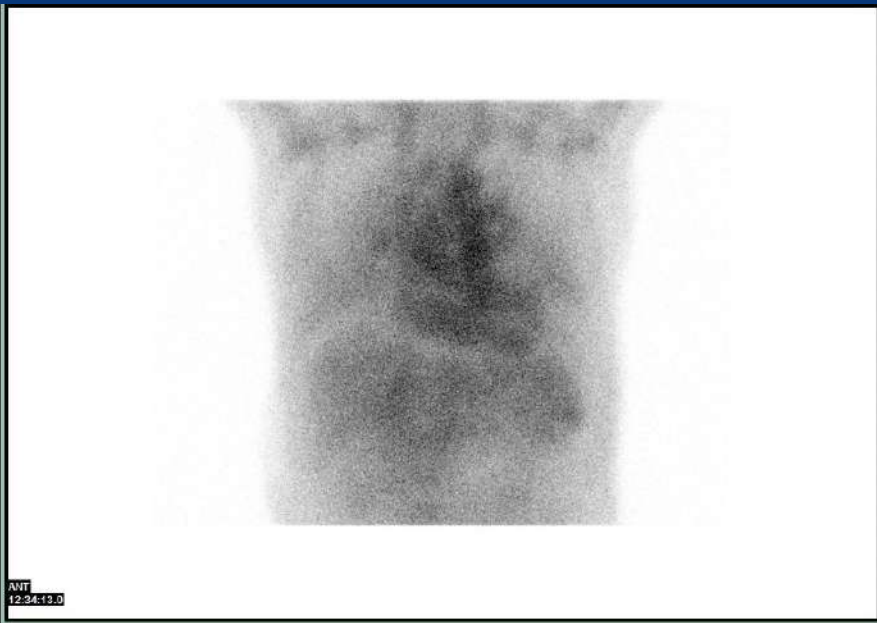
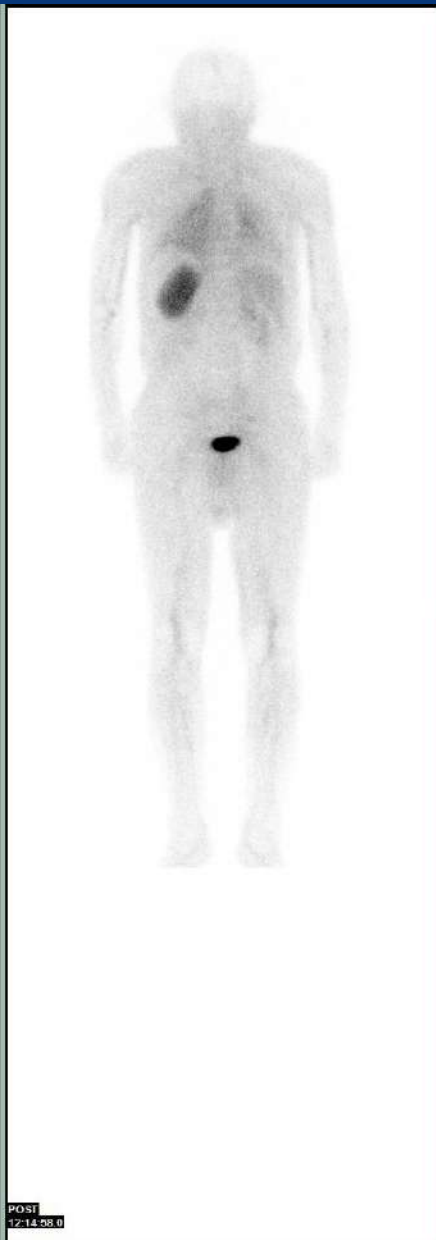
PLT:103.000

ESR:28

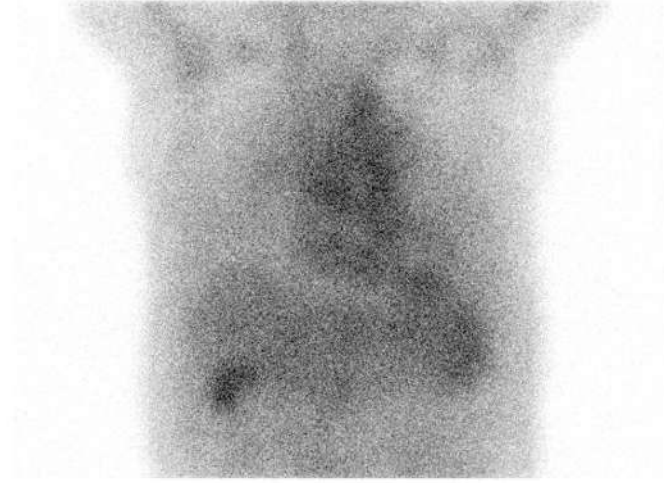
CRP:294

TEE: Biyolojik AVR çevresi ödemli enfeksiyon? F-18 FDG PET/BT değerlendirilmesi önerilir

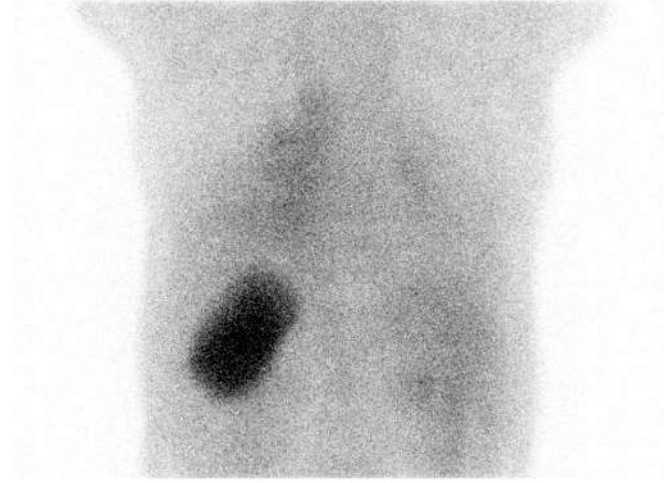
Kan kx: Enterococcus faecalis +



Tc99m HMPAO ILS

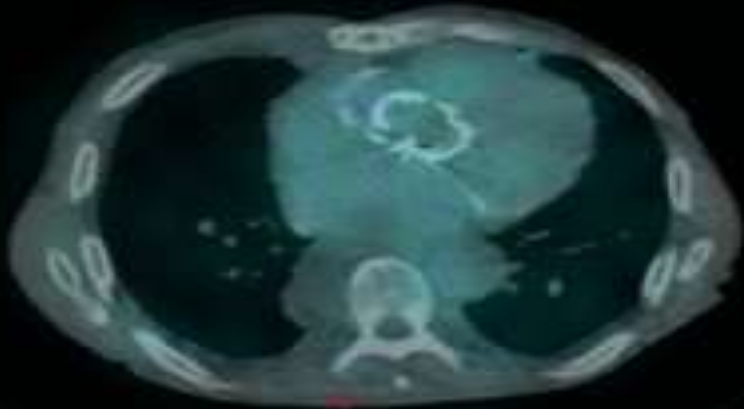


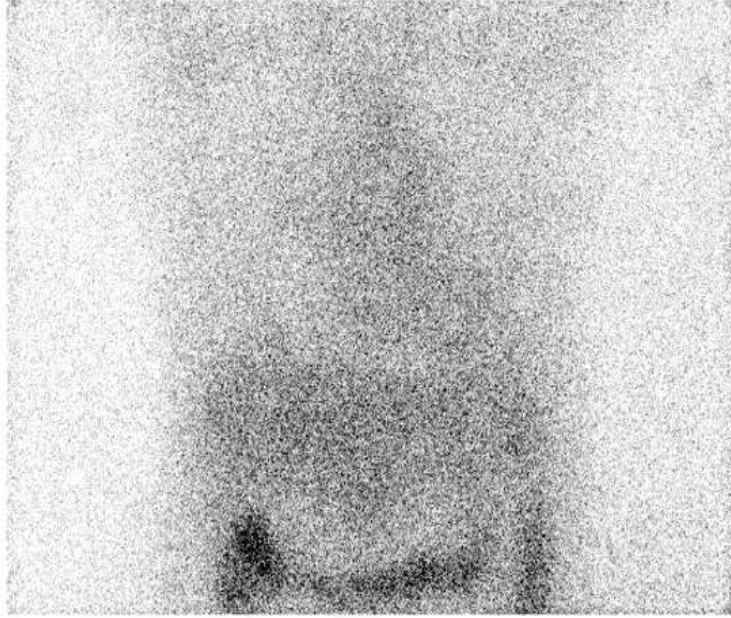
ANT  
19:24:42.0



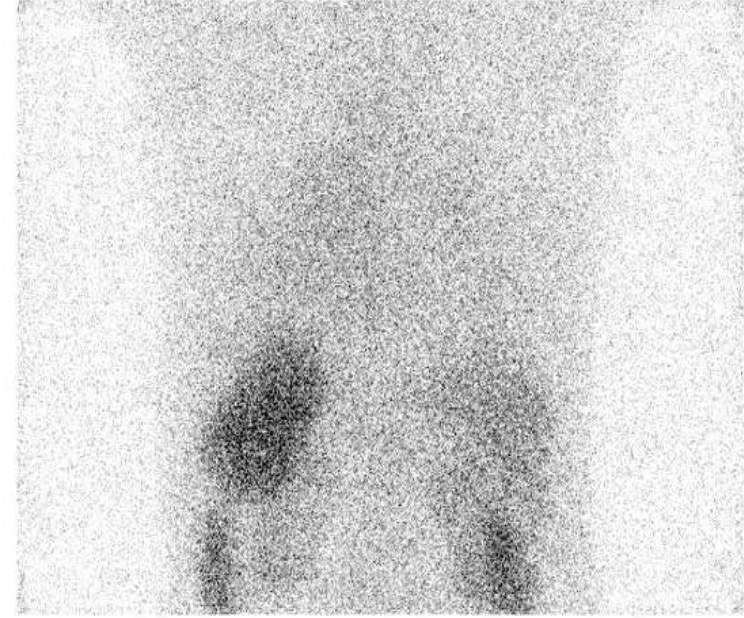
POST  
19:24:42.0

4. saat görüntüleri





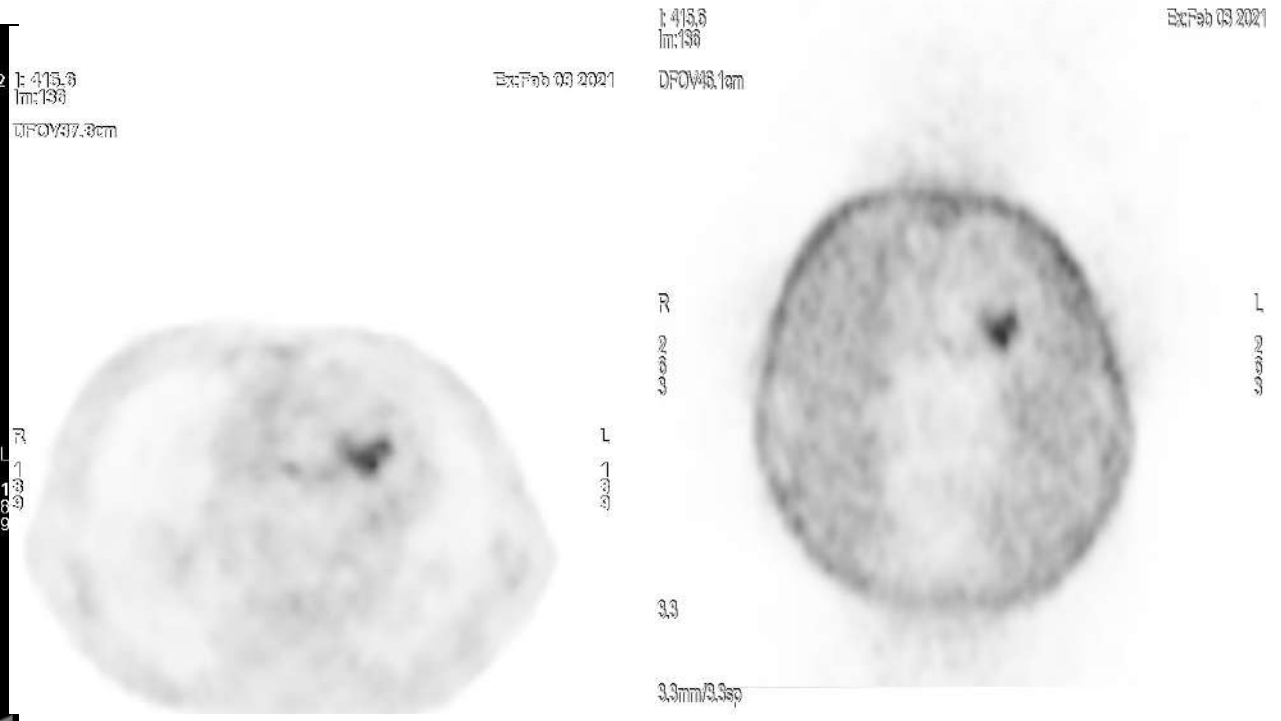
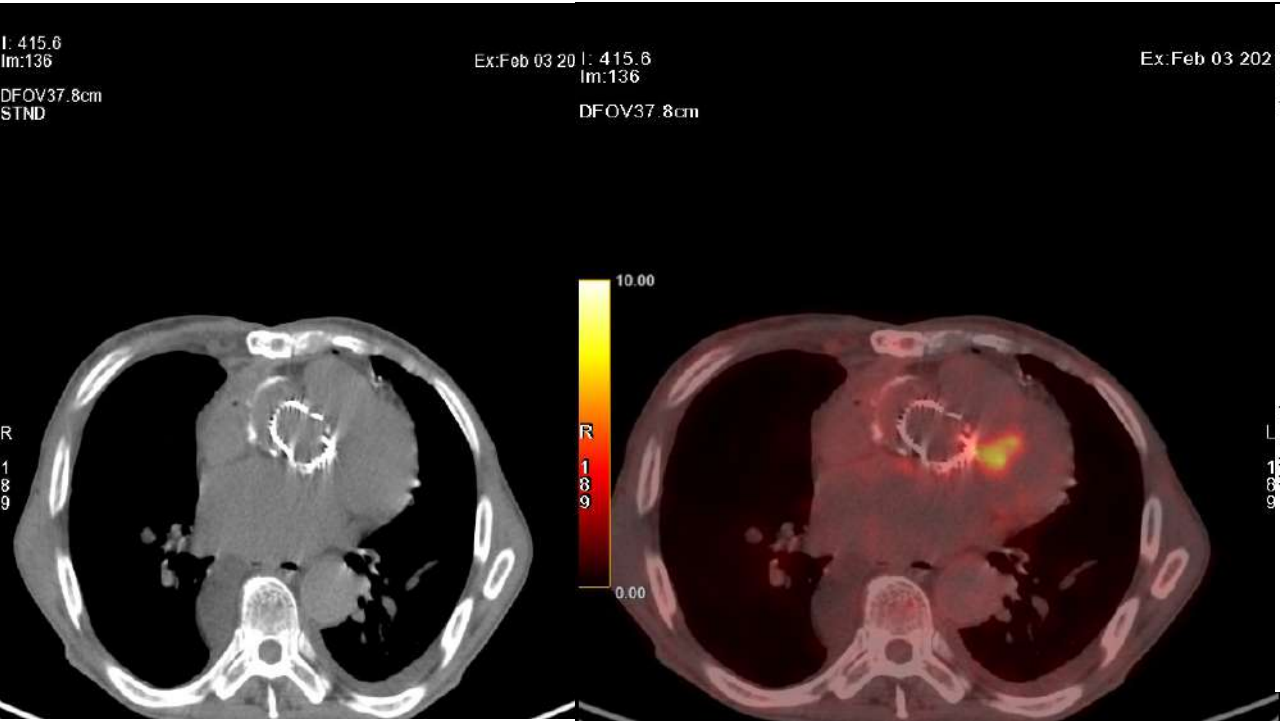
ANT  
11:32:42.0



POST  
11:32:42.0

24. Saat görüntüleri

# Vaka-3



-FDG görüntüleri enfektif endokardit olarak değerlendiriliyor.

# Vaka -4

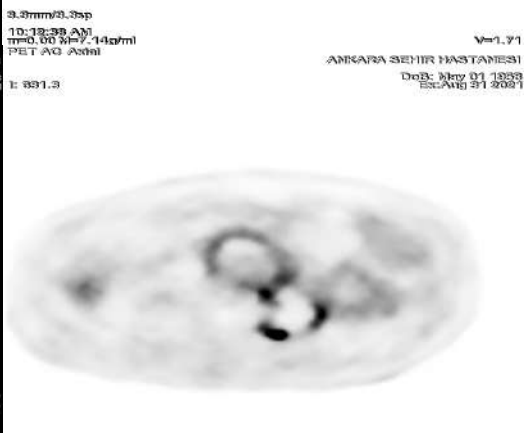
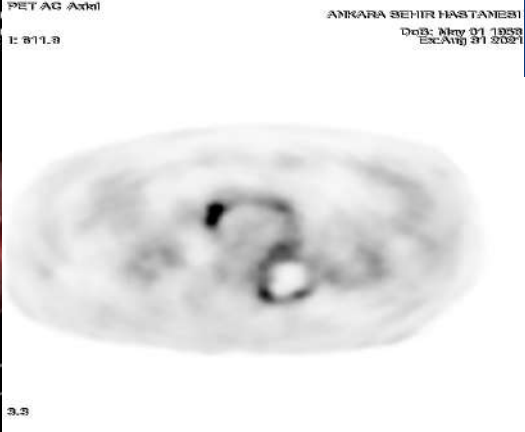
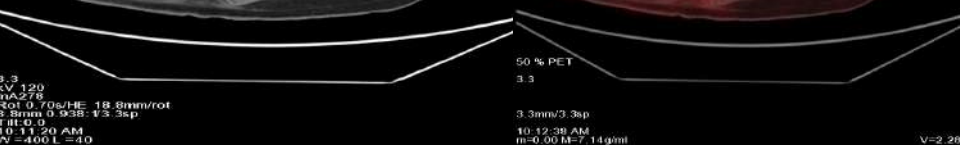
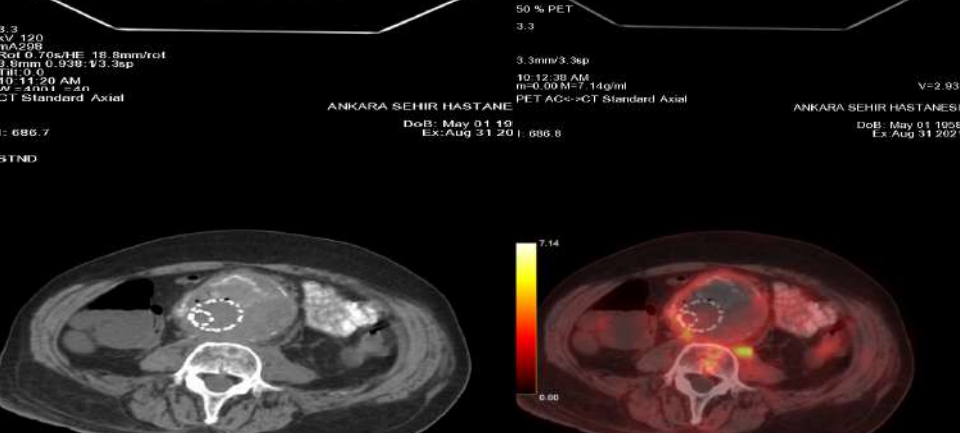
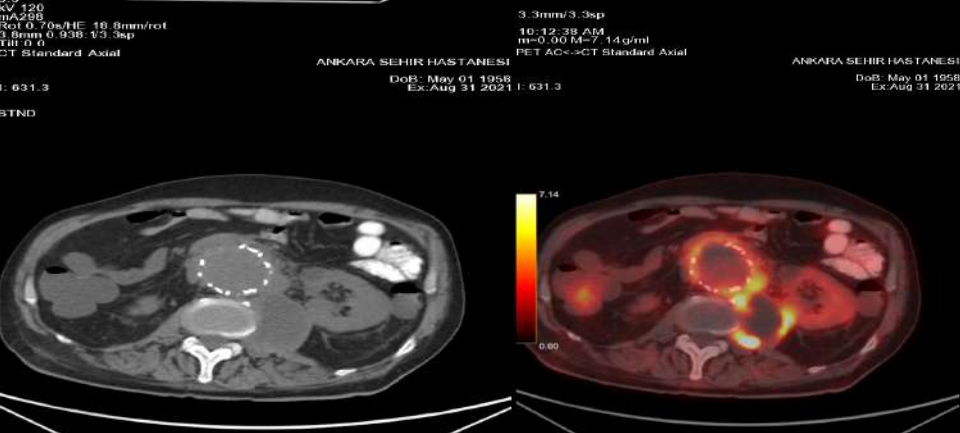
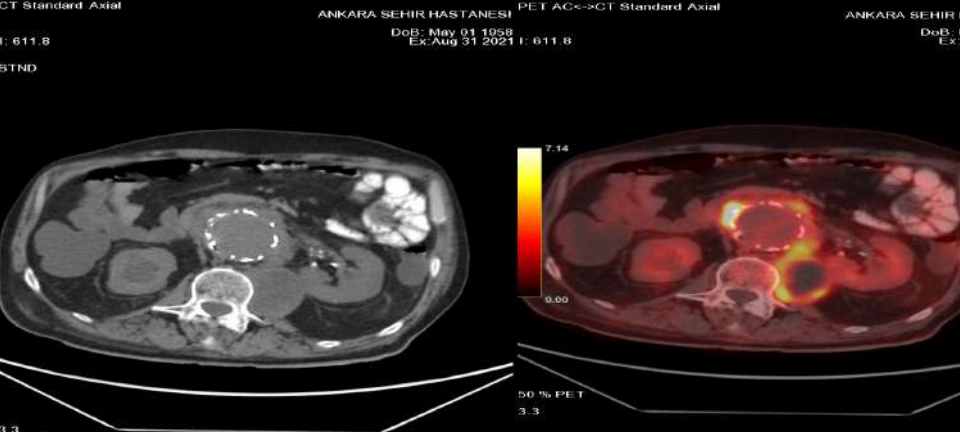
- 63Y/E
- 3 yıl önce EVAR öyküsü olan hasta karın ağrısı, ateş, halsizlik şikayetleri ile başvuruyor

HGB:13,5  
WBC:6,35  
PLT:258000  
CRP:23

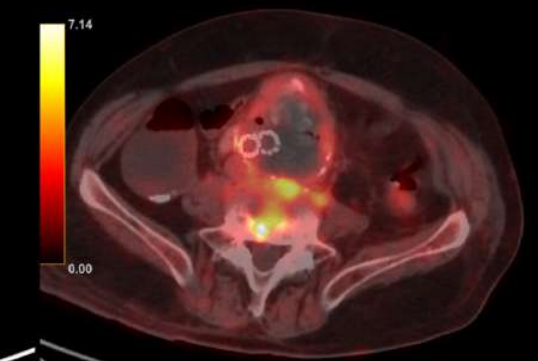
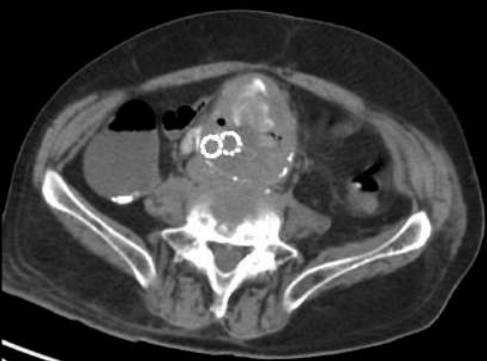
Abdomen BT: Abdominal aortada anevrizma ve bu düzeyde mural trombusu bulunan patent konumda endovasküler yolla yerleştirilmiş stent-greft  
Anevrizmada stent-greft komşuluğunda hava değerleri (enfeksiyon, şüpheli aortoenterik fistül?). Sol psoasta abse

Greft enfeksiyonu? ön tanısı ile F-18 FDG PET/BT görüntüleme



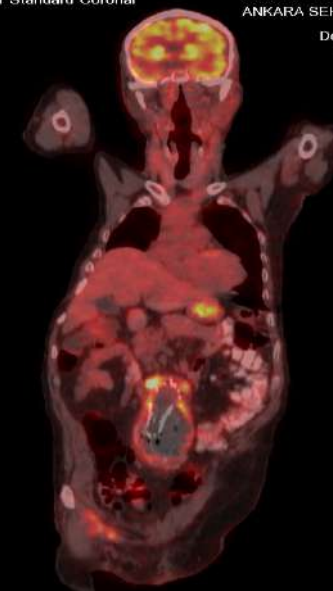


-Abdominal aorta greft çevresi patolojik FDG tutulumu  
-Sol psoas absesi periferik FDG tutulumu



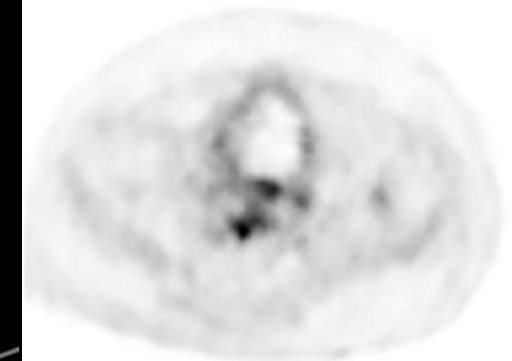
3.3  
kV 120  
mA266  
Rot 0.70s/HE 18.8mm/rot  
3.8mm 0.938:1/3.3sp  
Tilt:0.0  
10:11:20 AM  
W=400 L=40

50 % PET  
3.3  
3.3mm/3.3sp  
10:12:38 AM  
m=0.00 M=7.14g/ml  
V=1.54



1.15  
kV 120  
mA160  
Rot 0.70s/HE 18.8mm/rot  
3.8mm 0.938:1/3.3sp  
Tilt:0.0  
10:11:20 AM  
W=400 L=40

50 % PET  
3.6  
3.3mm/3.3sp  
10:12:38 AM  
m=0.00 M=7.14g/ml  
V=0.28



3.3  
3.3mm/3.3sp  
10:12:38 AM  
m=0.00 M=7.14g/ml  
V=1.54



3.3  
3.3mm/3.3sp  
10:12:38 AM  
m=0.00 M=7.14g/ml  
V=0.27

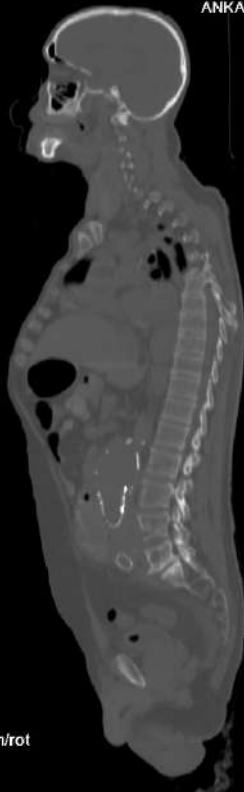


- Graft enfeksiyonu
- Psoas Absesi
- L5 S1 vertebralarda osteomyelit

CT Standard Sagittal

R: 15.6

STND



ANKARA SEHIR HASTANESI

DoB: May 01 1958  
Ex: Aug 31 2021 R: 16.4



50 % PET  
3.6

3.3mm/3.3sp  
10:12:38 AM  
m=0.00 M=7.14g/ml

1.15  
kV 120  
mA Mod.  
Rot 0.70s/HE 18.8mm/rot  
3.8mm 0.938: 1/3.3sp  
Tilt: 0.0  
10:11:20 AM  
W=2000 L=350  
CT Standard Axial

ANKARA SEHIR HASTANESI

DoB: May 01 1958  
Ex: Aug 31 2021 I: 712.8

I: 712.8

STND



50 % PET  
3.3

3.3mm/3.3sp  
10:12:38 AM  
m=0.00 M=7.14g/ml

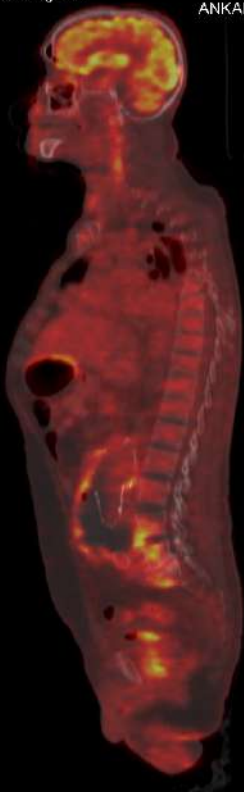
3.3  
kV 120  
mA288  
Rot 0.70s/HE 18.8mm/rot  
3.8mm 0.938: 1/3.3sp  
Tilt: 0.0  
10:11:20 AM  
W=400 L=40

ANKARA SEHIR HASTANESI

DoB: May 01 1958  
Ex: Aug 31 2021 I: 712.8

ANKARA SEHIR HASTANESI

DoB: May 01 1958  
Ex: Aug 31 2021 R: 18.4



ANKARA SEHIR HASTANESI

DoB: May 01 1958  
Ex: Aug 31 2021 I: 712.8

V=3.46

V=1.54

PET AC Sagittal

R: 18.4

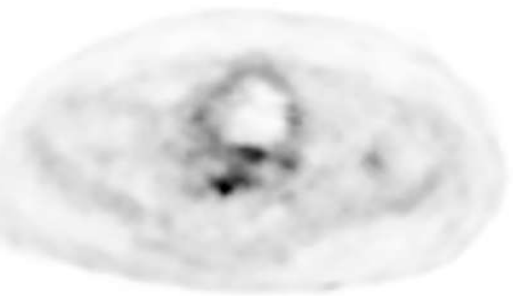
3.8

3.3mm/3.3sp  
10:12:38 AM  
m=0.00 M=7.14g/ml  
PET AC Axial

ANKARA SEHIR HASTANESI

DoB: May 01 1958  
Ex: Aug 31 2021 I: 712.8

I: 712.8



3.8

3.3mm/3.3sp  
10:12:38 AM  
m=0.00 M=7.14g/ml

ANKARA SEHIR HASTANESI

DoB: May 01 1958  
Ex: Aug 31 2021 I: 712.8

ANKARA SEHIR HASTANESI

DoB: May 01 1958  
Ex: Aug 31 2021 R: 18.4



ANKARA SEHIR HASTANESI

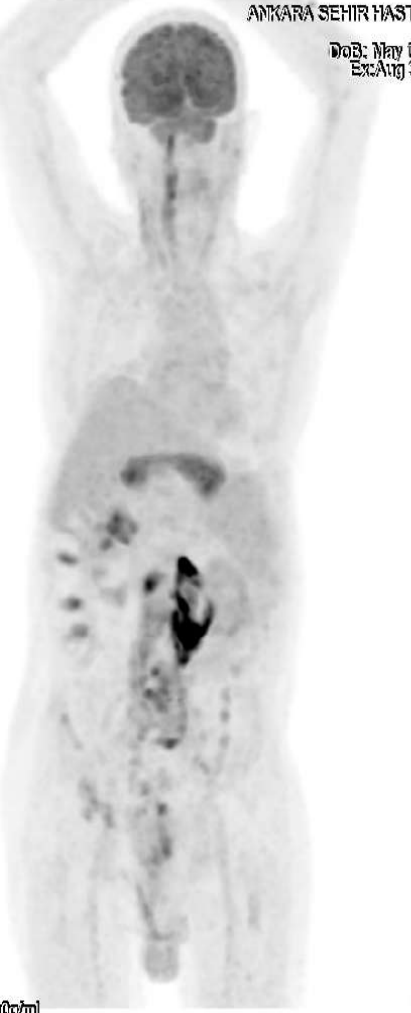
DoB: May 01 1958  
Ex: Aug 31 2021 I: 712.8

V=3.46

V=1.54

PET AC 3D

HD NIP No cut



ANKARA SEHIR HASTANESI

DoB: May 01 1958  
Ex: Aug 31 2021 R: 18.4

V=1.71

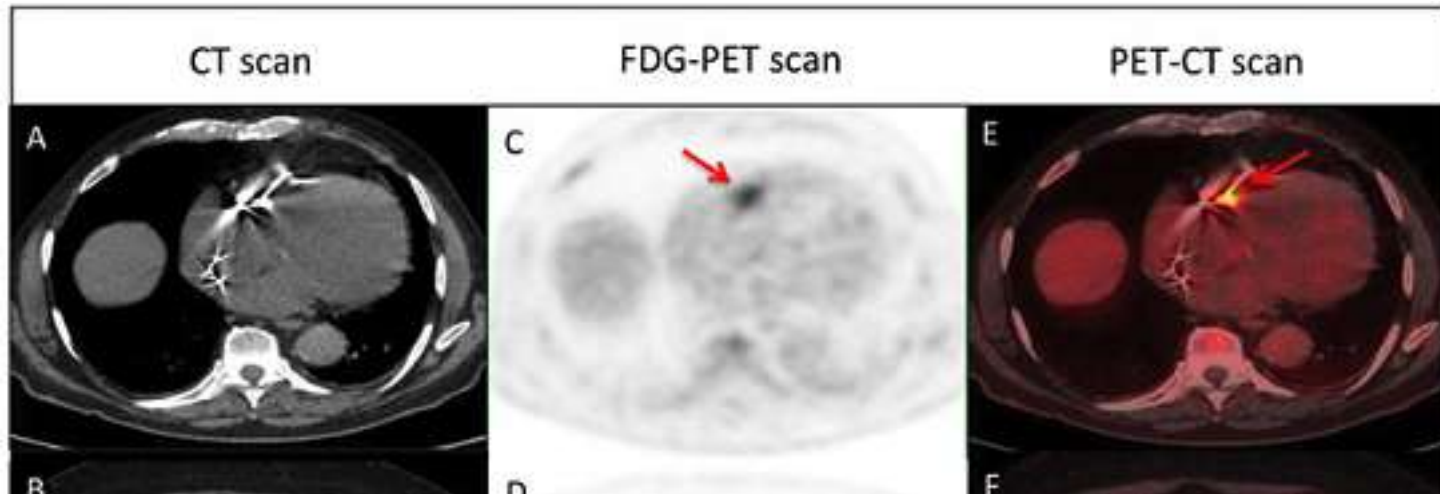
No VCI

3.3mm/3.3sp

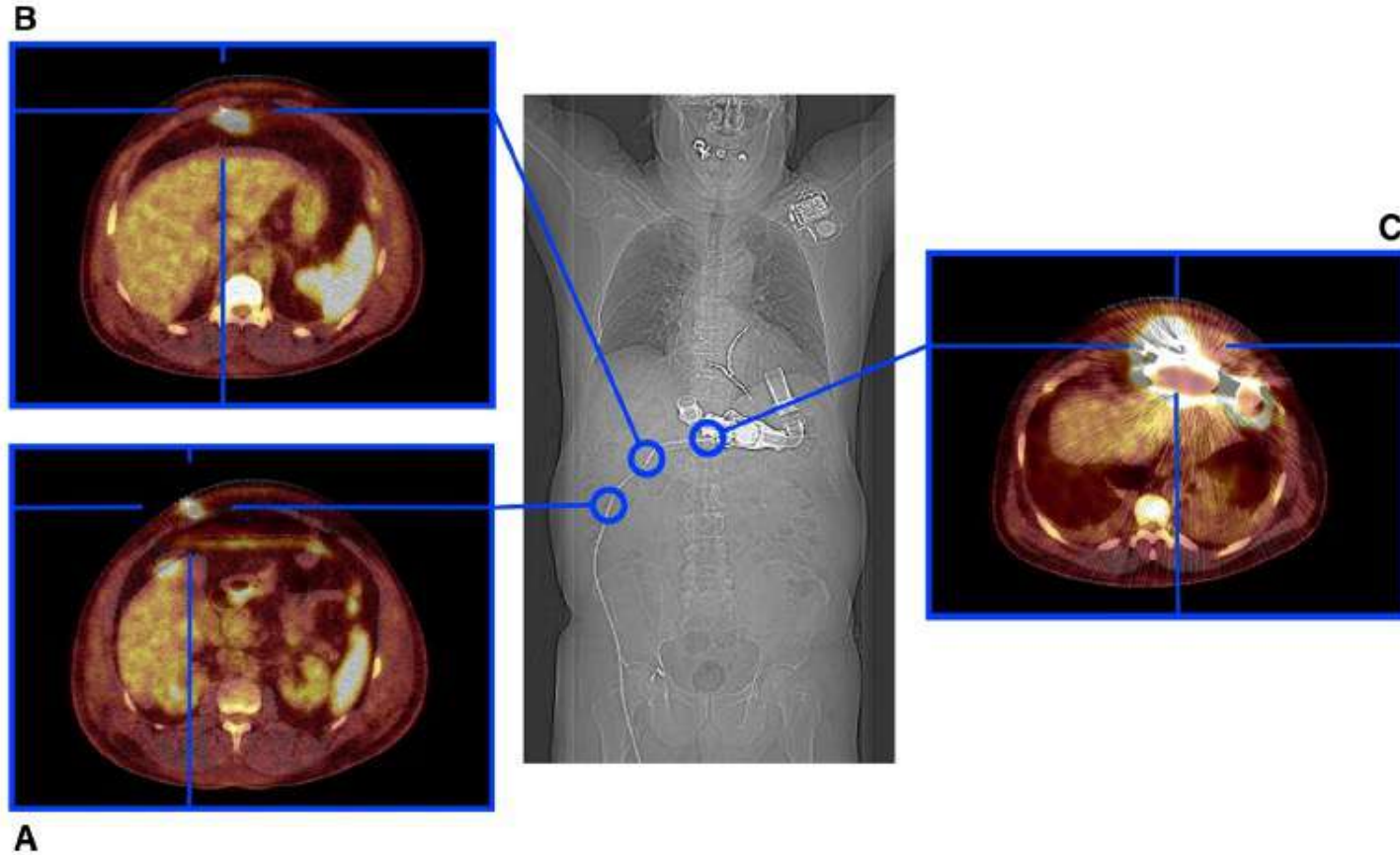
10:12:38 AM  
m=0.00 M=7.14g/ml

-Graft enfeksiyonu +  
-L5 S1 vertebralarda  
osteomyelit+

# Kardiyak Cihaz Enfeksiyonu



# LVAD Enfeksiyonu



**Figure 3.** Exemplary case of a 48-year-old male patient with a suprafascial driveline infection. Note: positioning of only three volumes of interest due to implementation of a HeartMate II device. (A) Driveline exit site. (B) Suprafascial driveline. (C) subfascial driveline.

76 y, K

Opere bentalli hasta, lead enfeksiyonu nedeni ile girişim planlanıyor

2007 de aort diseksiyon öyküsü

2008 de avr


Pace maker +

2008 de aort diseksiyon operasyondan 1 ay ve 3 yıl sonra intrakranial kanama öyküsü

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PET AC 3D Ex:10456 S 273 DINC FATMA ANKARA SEHIR HASTANESI F 76 30695127430 DoB: Aug 20 1945 Ex:Feb 11 2022

Se:12 HD MIP No cut DFOV169.3cm



R 3 4 6 L 3 4 6

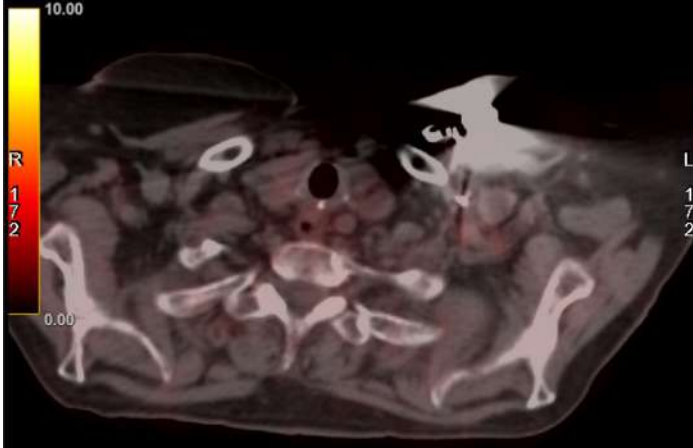
No VOI

3.3mm/3.3sp

09:49:41 AM m=0.00 M=10.00g/ml 12092 V=1.33

PET AC->CT Standard Axial A 241 DINC FATMA ANKARA SEHIR HASTANESI F 76 30695127430 DoB: Aug 20 1945 Ex:Feb 11 2022

Se:12 / 3 I: 317.9 Im:92 DFOV34.4cm



35% PET

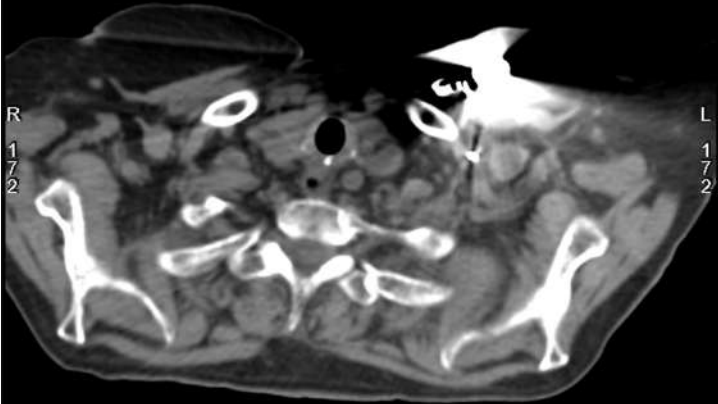
3.3

3.3mm/3.3sp

09:49:41 AM m=0.00 M=10.00g/ml P 241 V=1.11

CT Standard Axial A 241 DINC FATMA ANKARA SEHIR HASTANESI F 76 30695127430 DoB: Aug 20 1945 Ex:Feb 11 2022

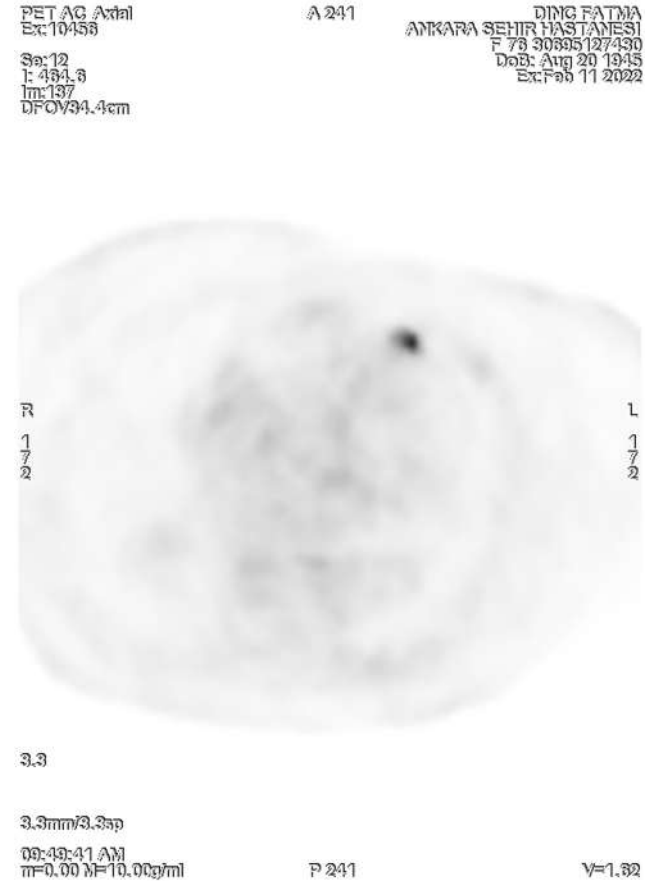
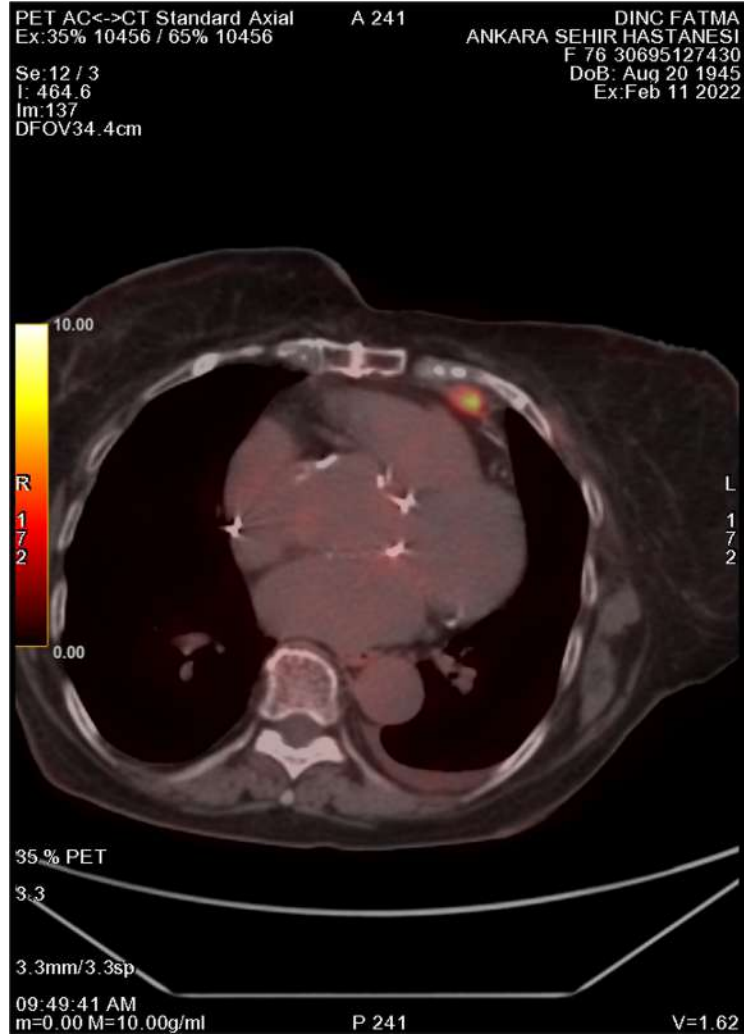
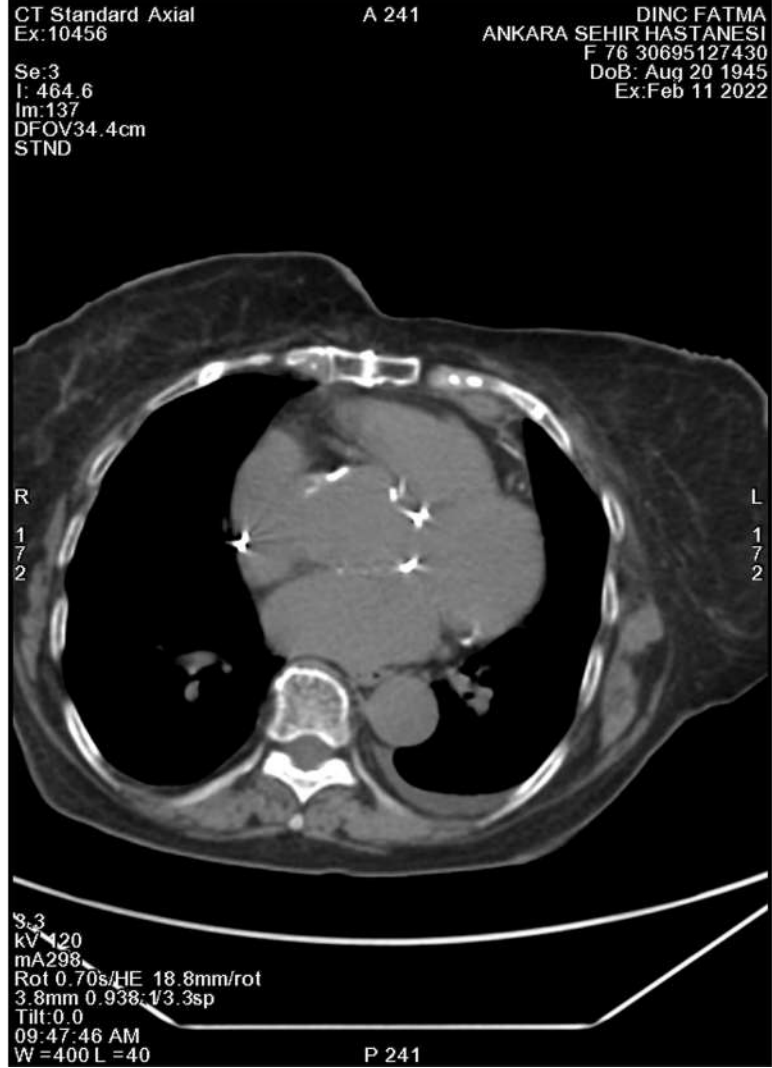
Se:3 I: 317.9 Im:92 DFOV34.4cm STND



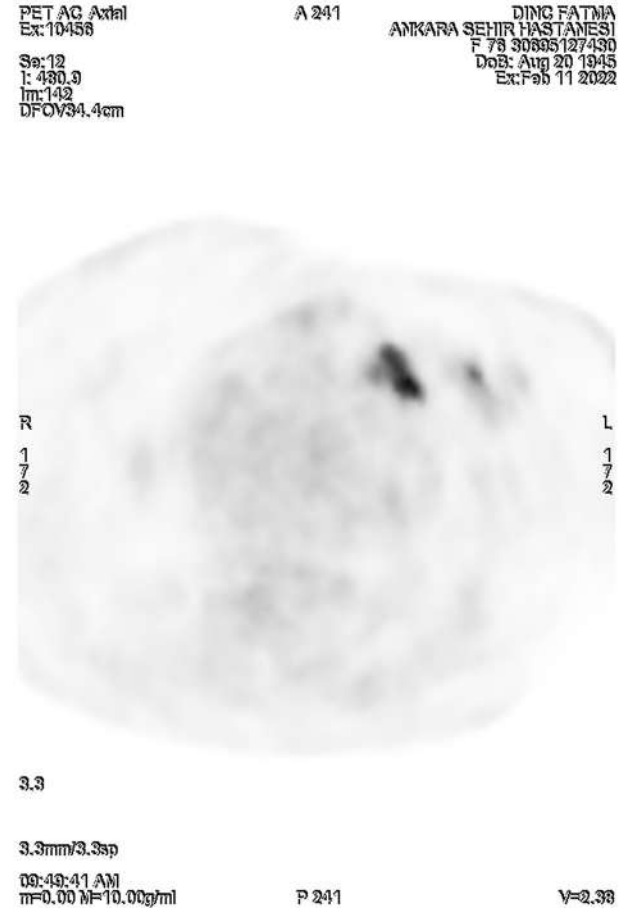
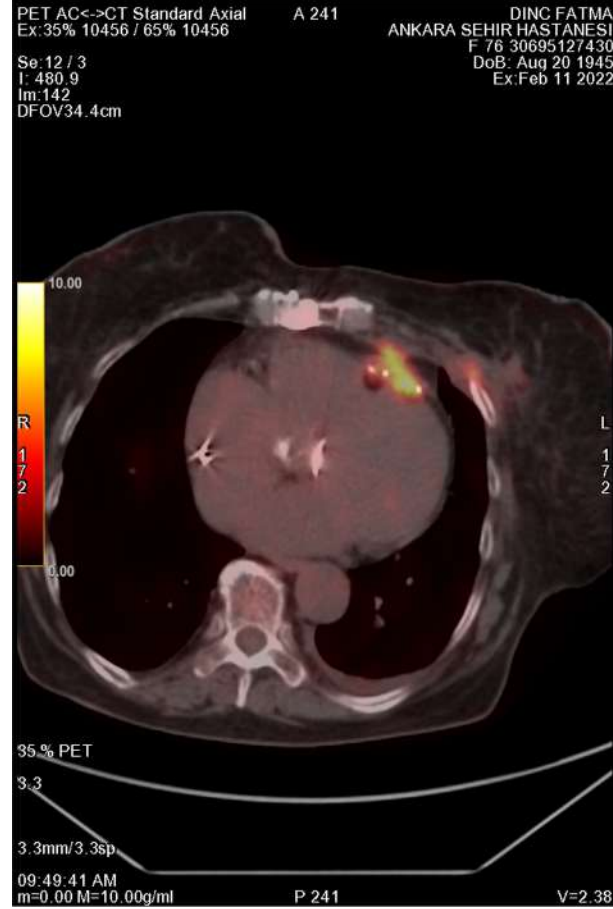
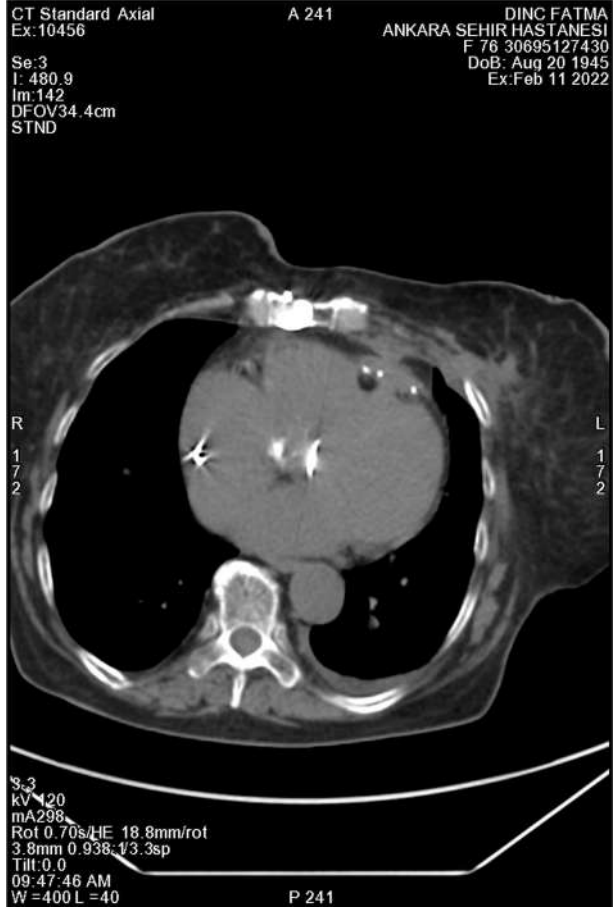
3.3

kV 120 mA298 Rot 0.70s/HE 18.8mm/rot 3.8mm 0.938 1/3.3sp Tilt:0.0

09:47:46 AM W=400 L=40 P 241





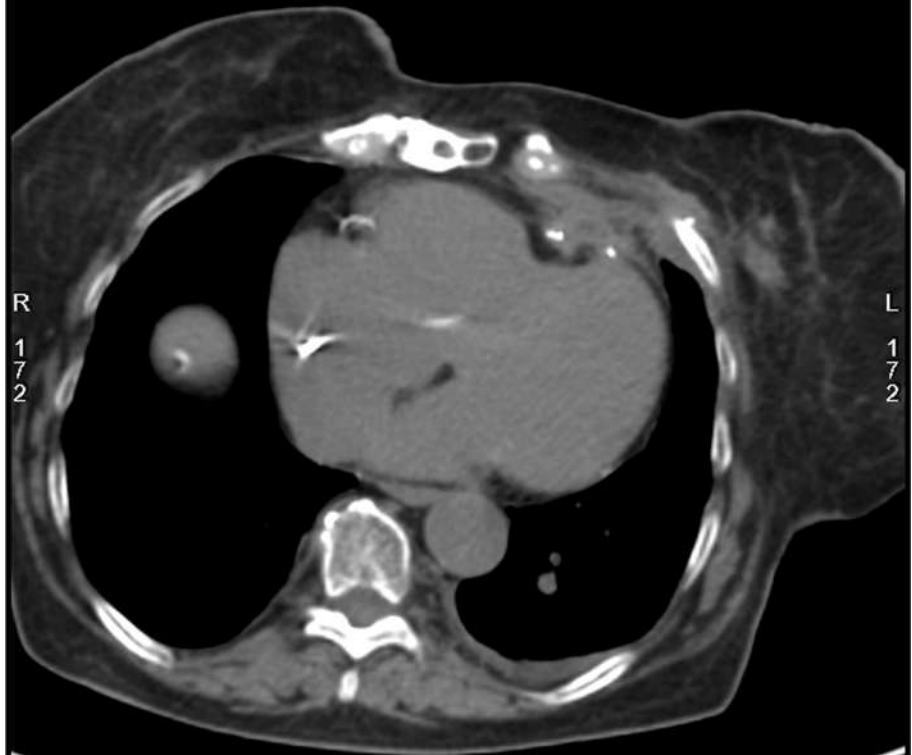


CT Standard Axial  
Ex:10456

A 241

DINC FATMA  
ANKARA SEHIR HASTANESI  
F 76 30695127430  
DoB: Aug 20 1945  
Ex:Feb 11 2022

Se:3  
I: 487.4  
Im:144  
DFOV34.4cm  
STND



R  
1  
7  
2

L  
1  
7  
2

3.3  
kV 120  
mA298  
Rot 0.70s/HE 18.8mm/rot  
3.8mm 0.938; 1/3.3sp  
Tilt:0.0  
09:47:46 AM  
W =400 L =40

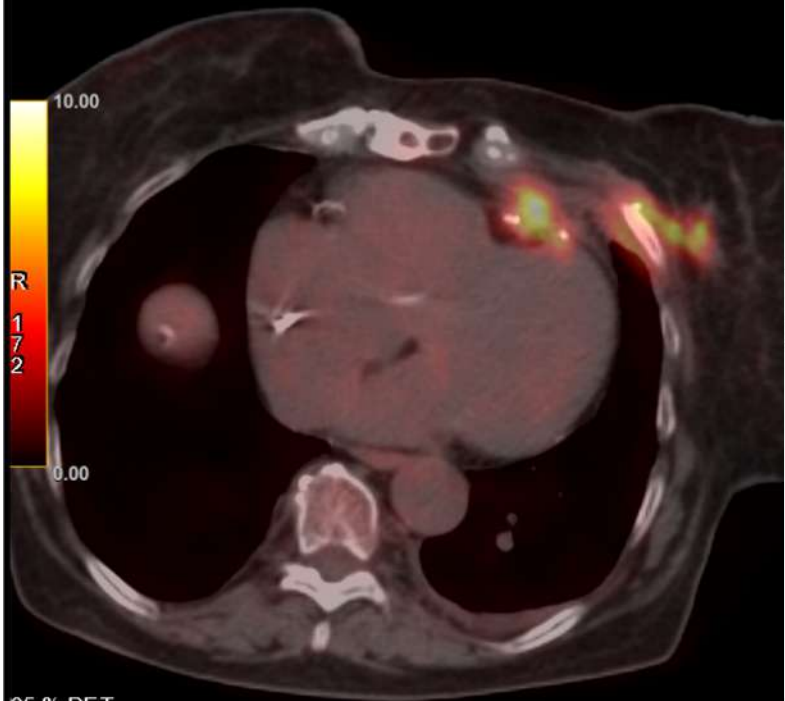
P 241

PET AC->CT Standard Axial  
Ex:35% 10456 / 65% 10456

A 241

DINC FATMA  
ANKARA SEHIR HASTANESI  
F 76 30695127430  
DoB: Aug 20 1945  
Ex:Feb 11 2022

Se:12 / 3  
I: 487.4  
Im:144  
DFOV34.4cm



10.00  
0.00  
R  
1  
7  
2

R  
1  
7  
2

35 % PET  
3.3  
3.3mm/3.3sp  
09:49:41 AM  
m=0.00 M=10.00g/ml

P 241

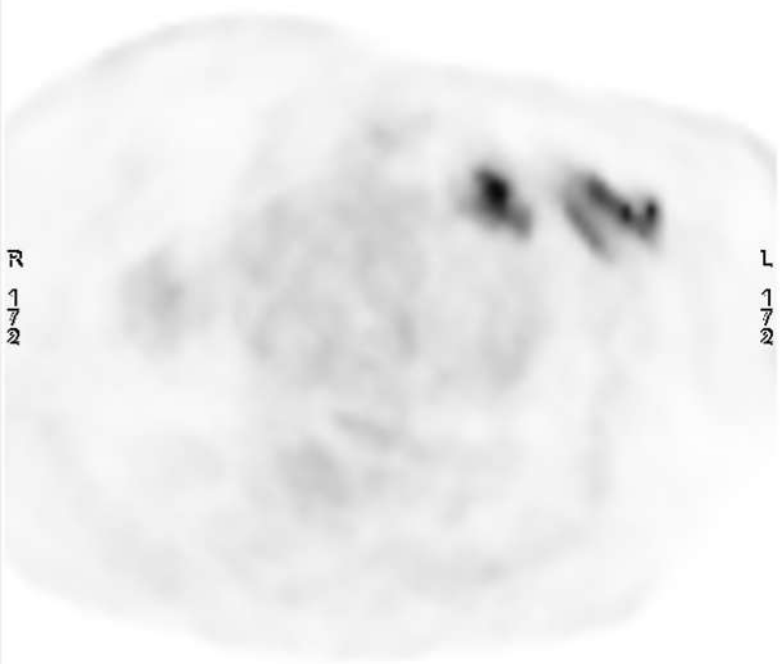
V=1.63

PET AC Axial  
Ex:10458

A 241

DINC FATMA  
ANKARA SEHIR HASTANESI  
F 76 30695127430  
DoB: Aug 20 1945  
Ex:Feb 11 2022

Se:12  
I: 487.4  
Im:144  
DFOV34.4cm



L  
1  
7  
2

3.3  
3.3mm/3.3sp  
09:49:41 AM  
m=0.00 M=10.00g/ml

P 241

V=1.63

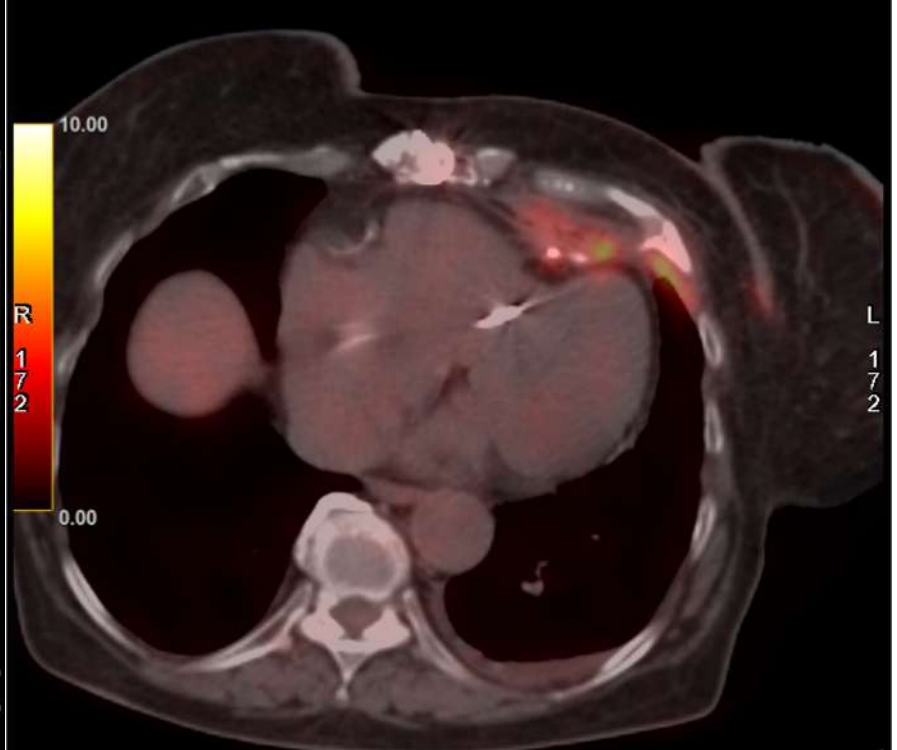
CT Standard Axial  
Ex:10456  
A 241  
DINC FATMA  
ANKARA SEHIR HASTANESI  
F 76 30695127430  
DoB: Aug 20 1945  
Ex:Feb 11 2022  
Se:3  
I: 497.2  
Im:147  
DFOV34.4cm  
STND



3.3  
kV 120  
mA298  
Rot 0.70s/HE 18.8mm/rot  
3.8mm 0.938:1/3.3sp  
Tilt:0.0  
09:47:46 AM  
W=400 L=40

P 241

PET AC->CT Standard Axial  
Ex:35% 10456 / 65% 10456  
A 241  
DINC FATMA  
ANKARA SEHIR HASTANESI  
F 76 30695127430  
DoB: Aug 20 1945  
Ex:Feb 11 2022  
Se:12 / 3  
I: 497.2  
Im:147  
DFOV34.4cm

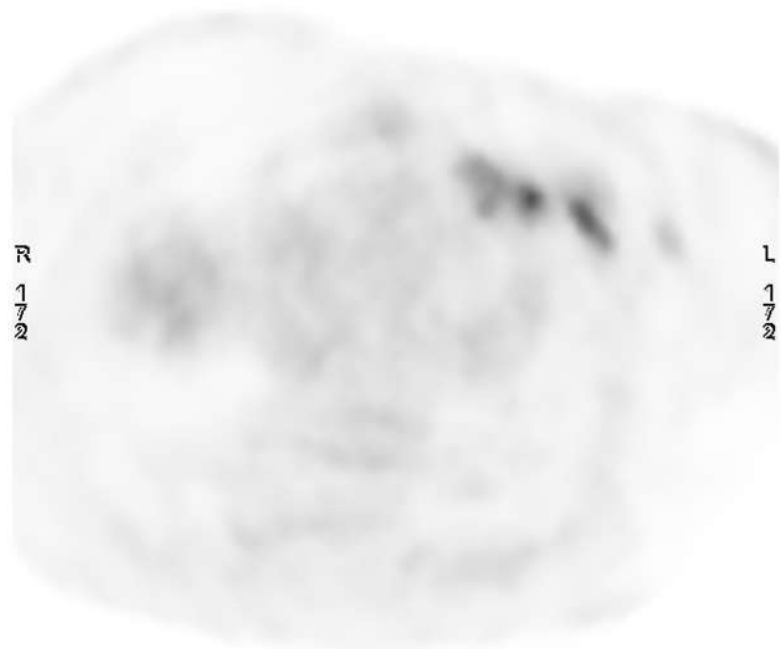


35% PET  
3.3  
3.3mm/3.3sp  
09:49:41 AM  
m=0.00 M=10.00g/ml

P 241

V=1.61

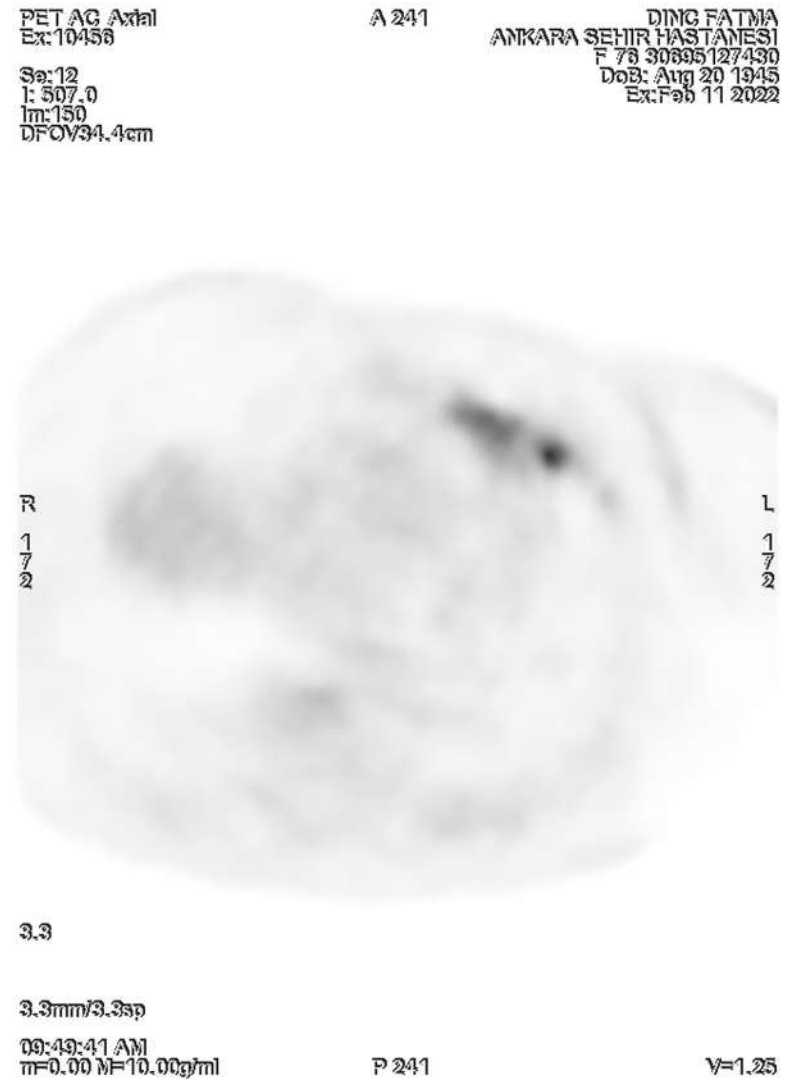
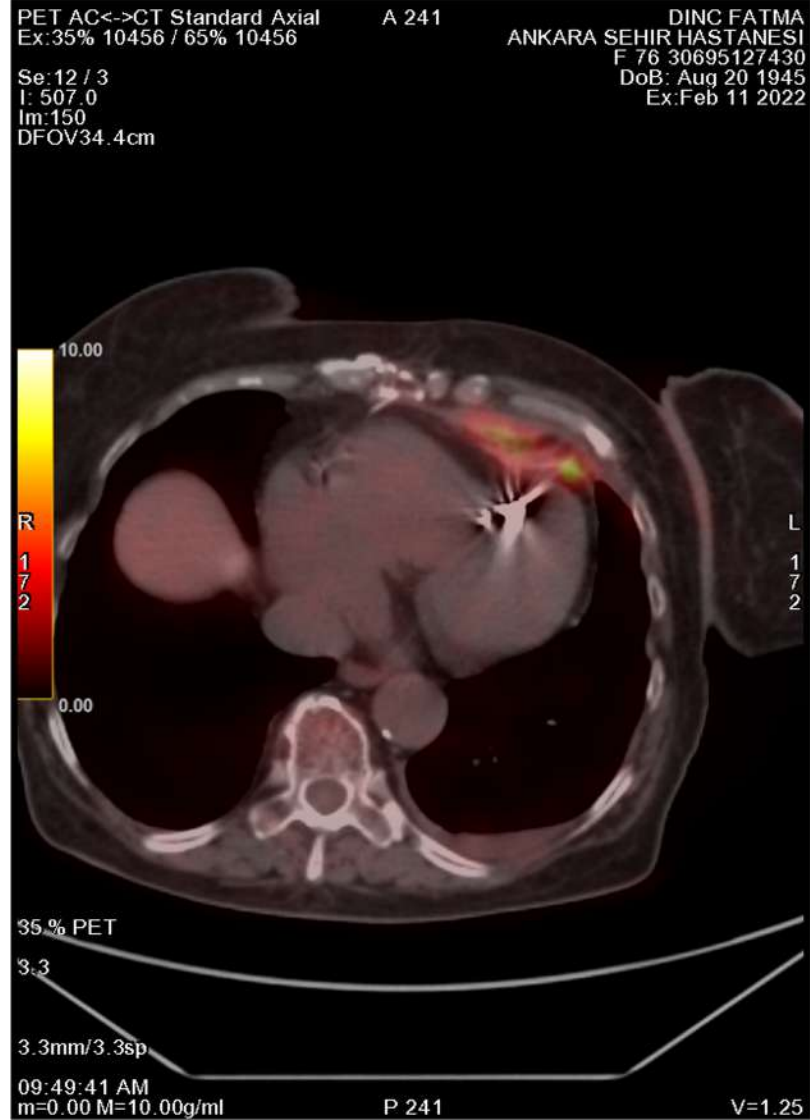
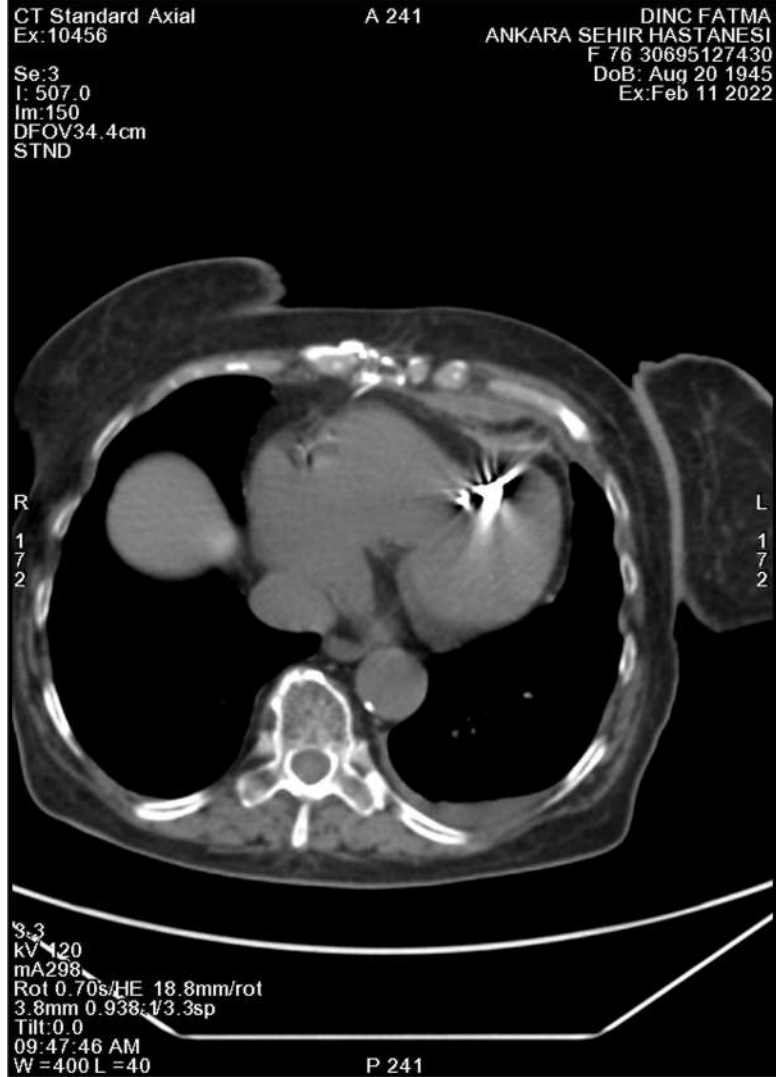
PET AC Axial  
Ex:10456  
A 241  
DINC FATMA  
ANKARA SEHIR HASTANESI  
F 76 30695127430  
DoB: Aug 20 1945  
Ex:Feb 11 2022  
Se:12  
I: 497.2  
Im:147  
DFOV34.4cm



3.3  
3.3mm/3.3sp  
09:49:41 AM  
m=0.00 M=10.00g/ml

P 241

V=1.61



CT Standard Axial  
Ex:10456  
Se:3  
I: 513.5  
Im:152  
DFOV34.4cm  
STND

A 241  
DINC FATMA  
ANKARA SEHIR HASTANESI  
F 76 30695127430  
DoB: Aug 20 1945  
Ex:Feb 11 2022

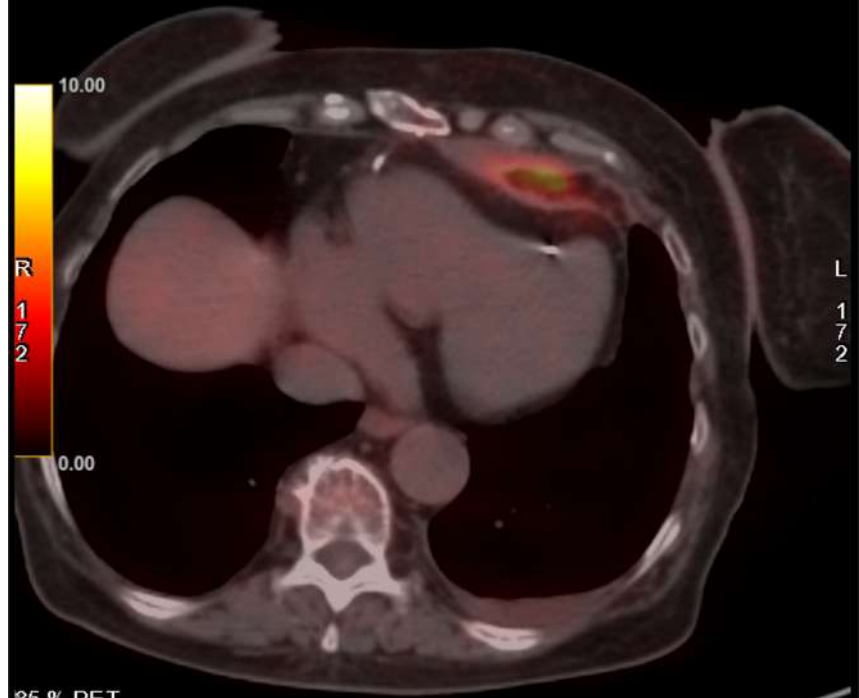


Se:3  
kv 120  
mA298  
Rot 0.70s/HE 18.8mm/rot  
3.8mm 0.938:1/3.3sp  
Tilt:0.0  
09:47:46 AM  
W=400 L=40

P 241

PET AC<->CT Standard Axial A 241  
Ex:35% 10456 / 65% 10456  
Se:12 / 3  
I: 513.5  
Im:152  
DFOV34.4cm

DINC FATMA  
ANKARA SEHIR HASTANESI  
F 76 30695127430  
DoB: Aug 20 1945  
Ex:Feb 11 2022



35 % PET  
3.3  
3.3mm/3.3sp  
09:49:41 AM  
m=0.00 M=10.00g/ml

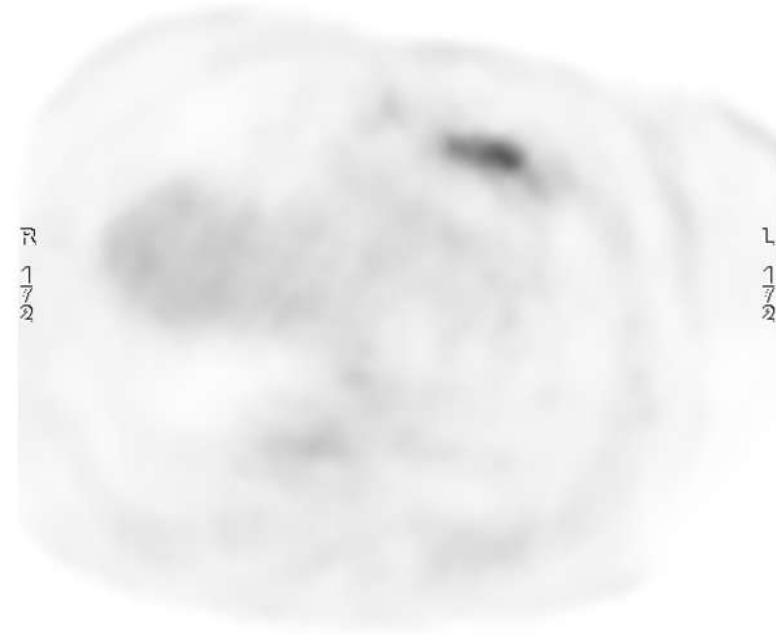
P 241

V=1.09

PET AC Axial  
Ex:10456  
Se:12  
I: 513.5  
Im:152  
DFOV34.4cm

A 241

DINC FATMA  
ANKARA SEHIR HASTANESI  
F 76 30695127430  
DoB: Aug 20 1945  
Ex:Feb 11 2022

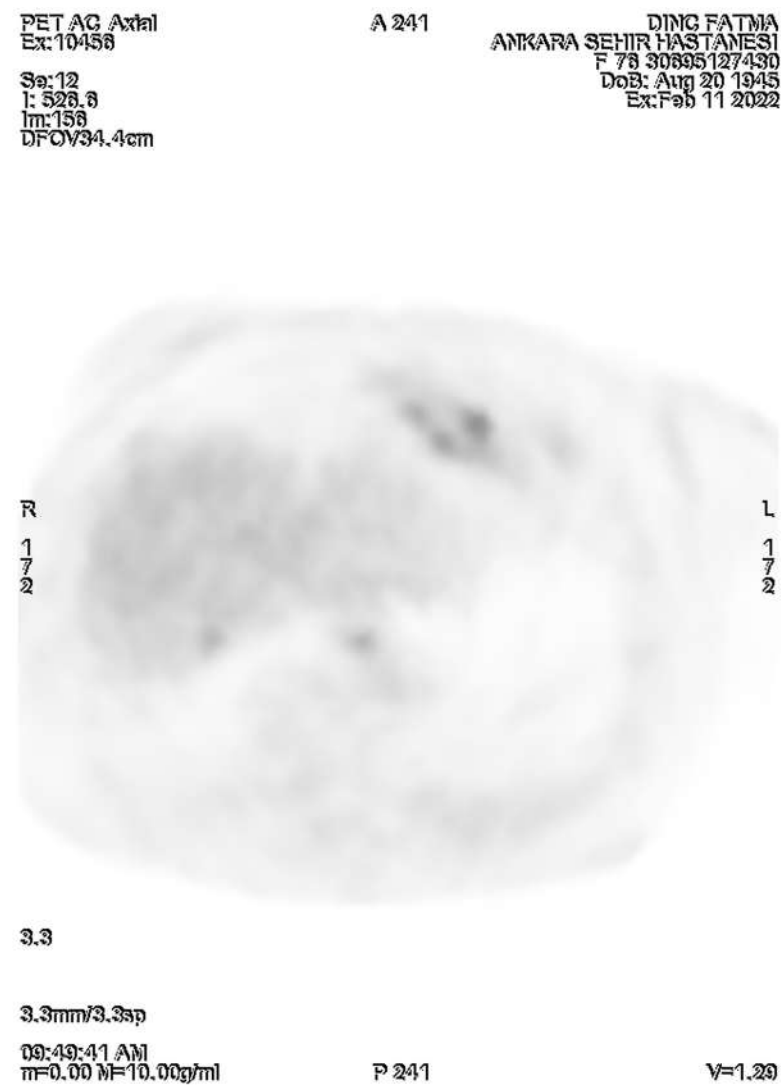
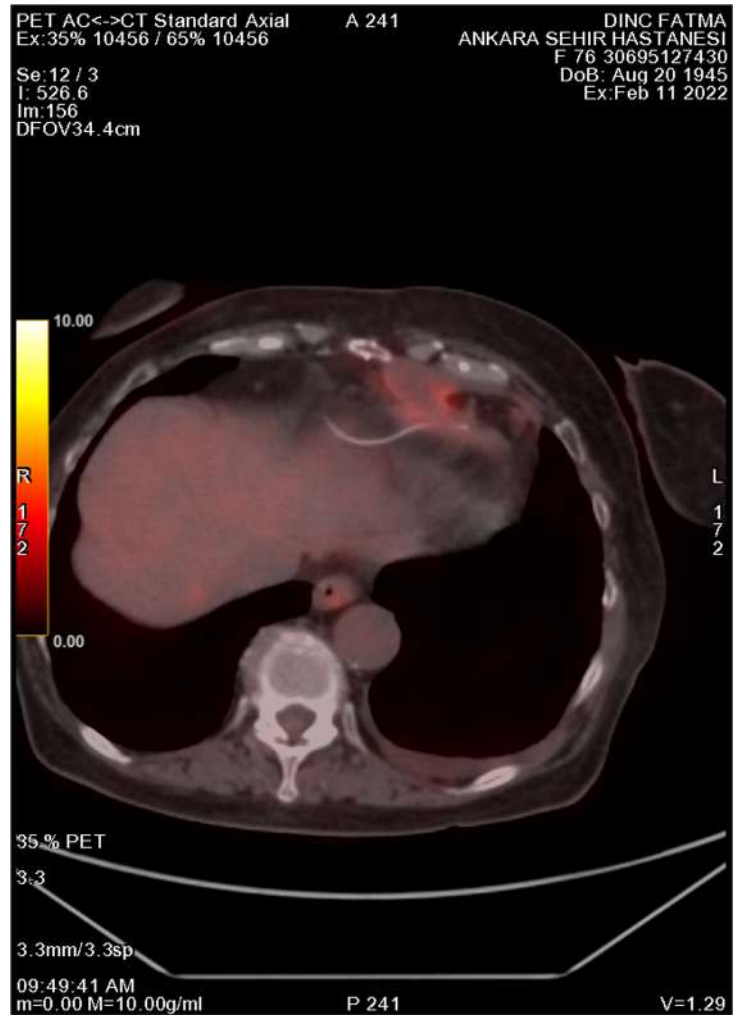
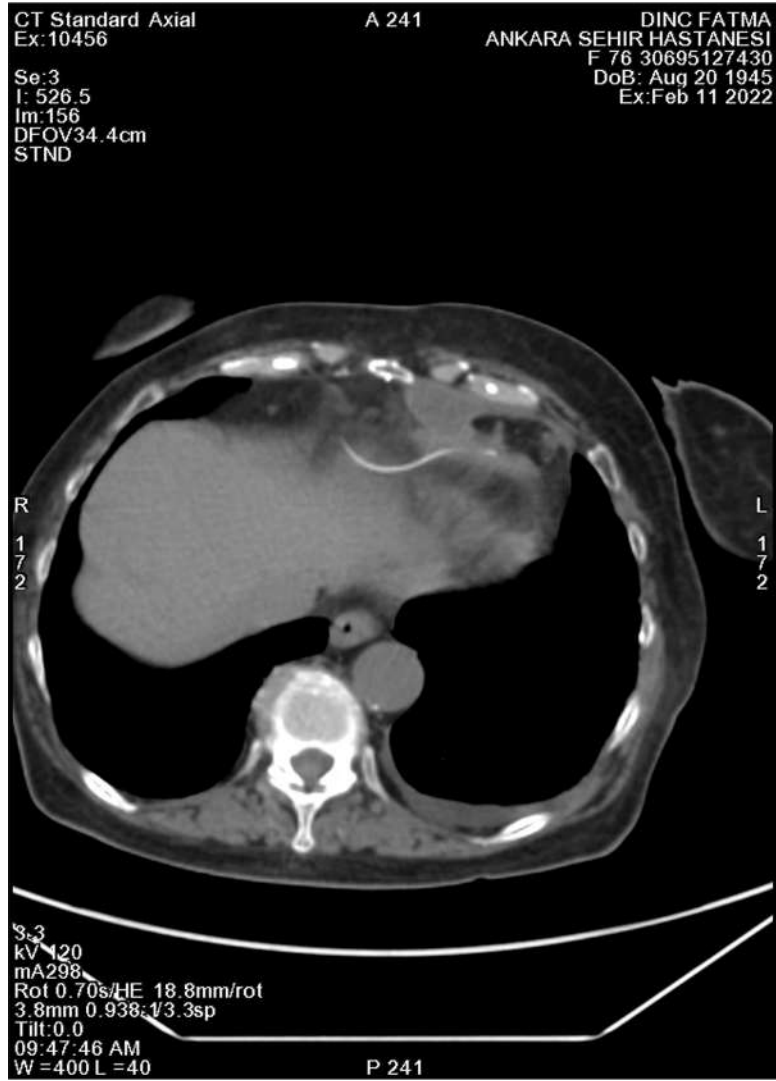


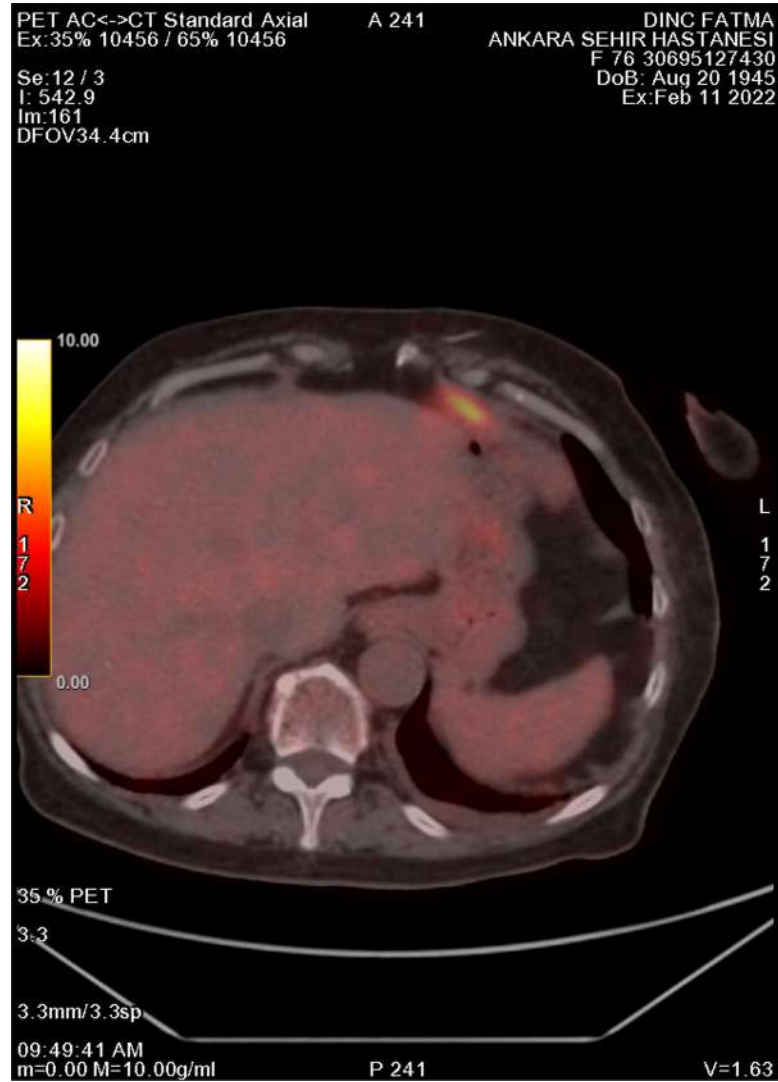
3.3

3.3mm/3.3sp  
09:49:41 AM  
m=0.00 M=10.00g/ml

P 241

V=1.09

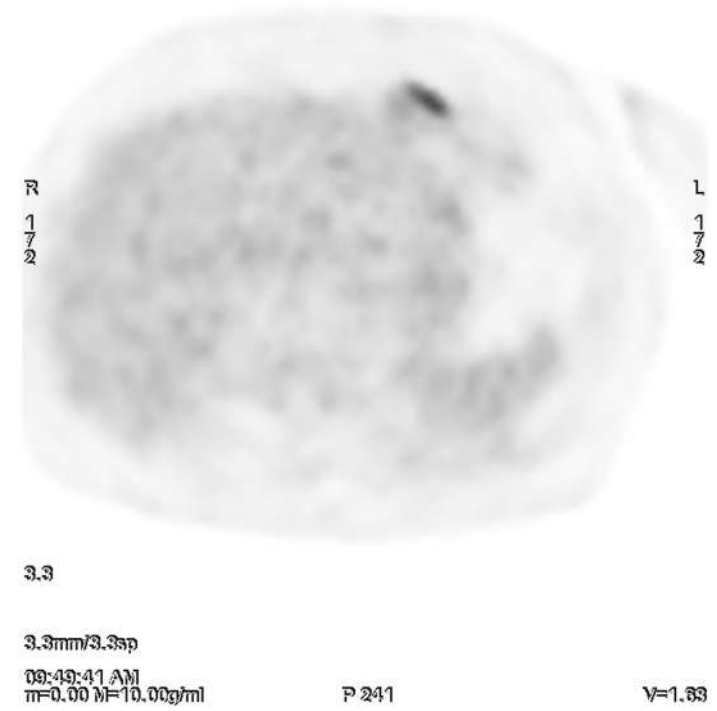


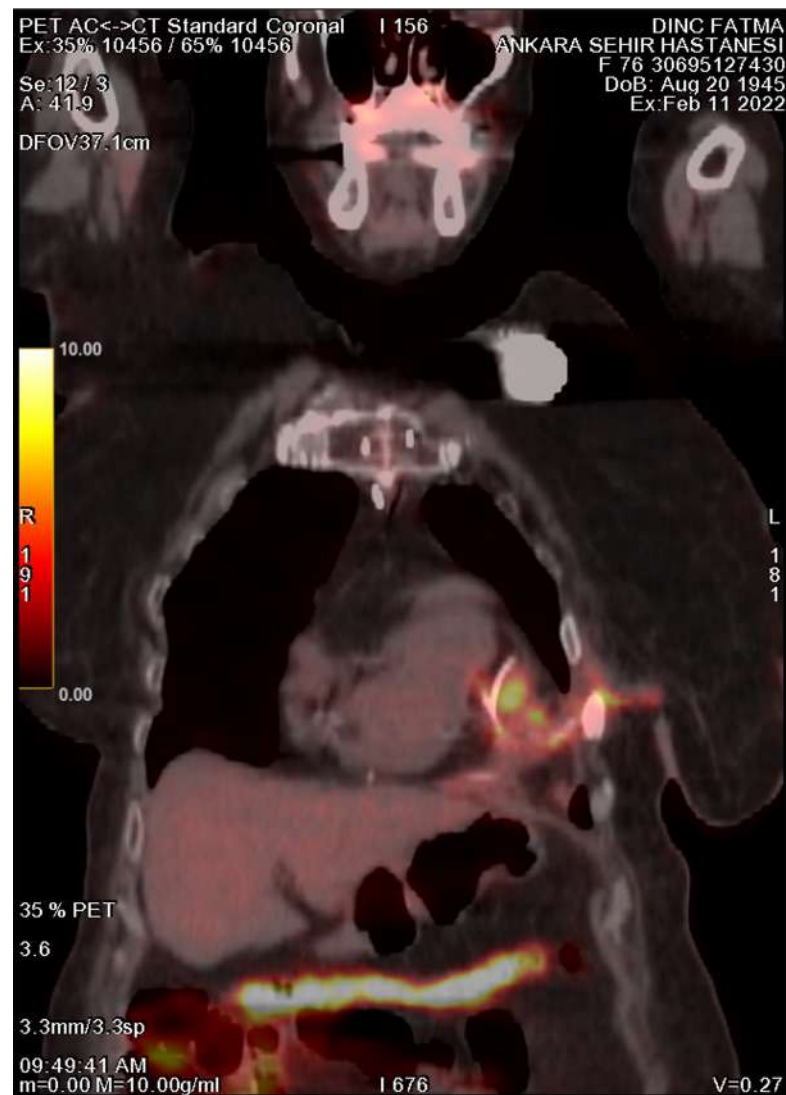


PET AC Axial  
 Ex: 10456  
 Se: 12  
 I: 542.9  
 Im: 161  
 DFOV34.4cm

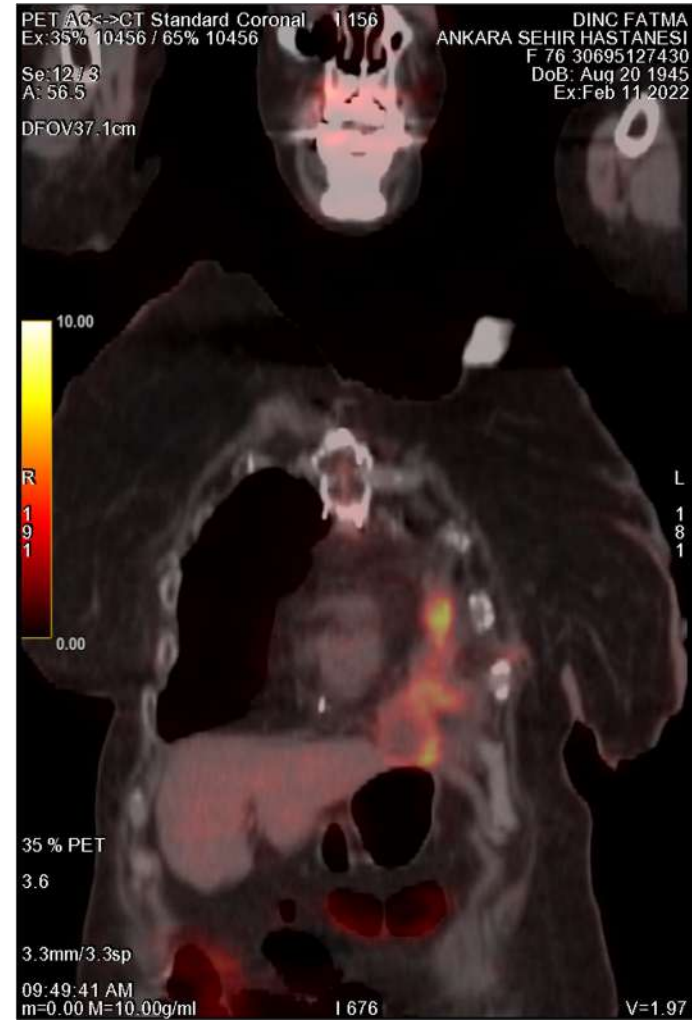
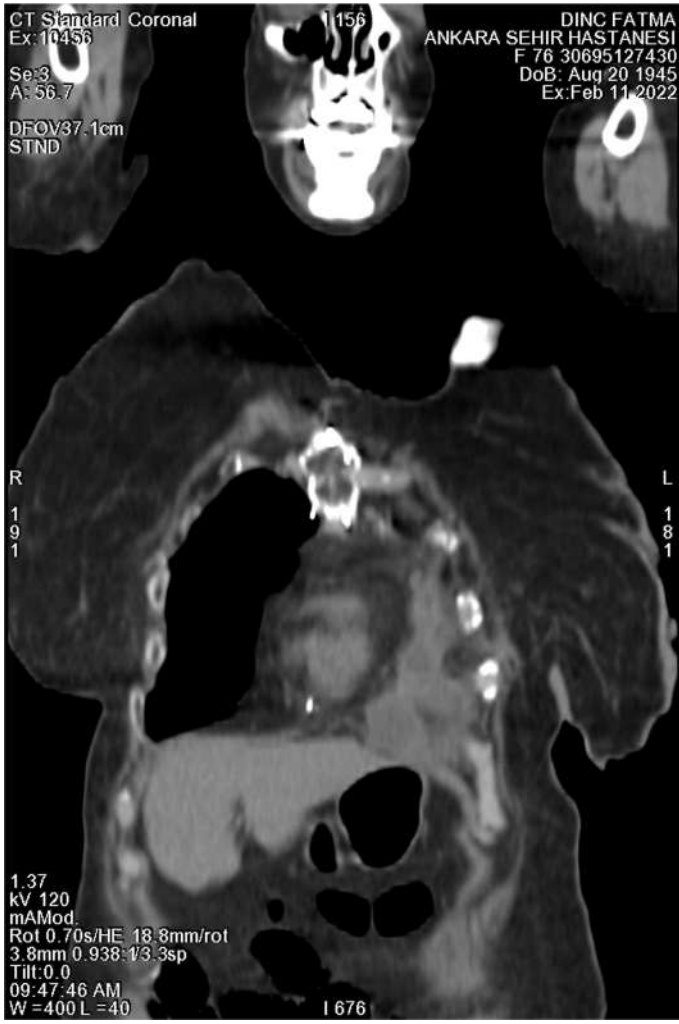
A 241

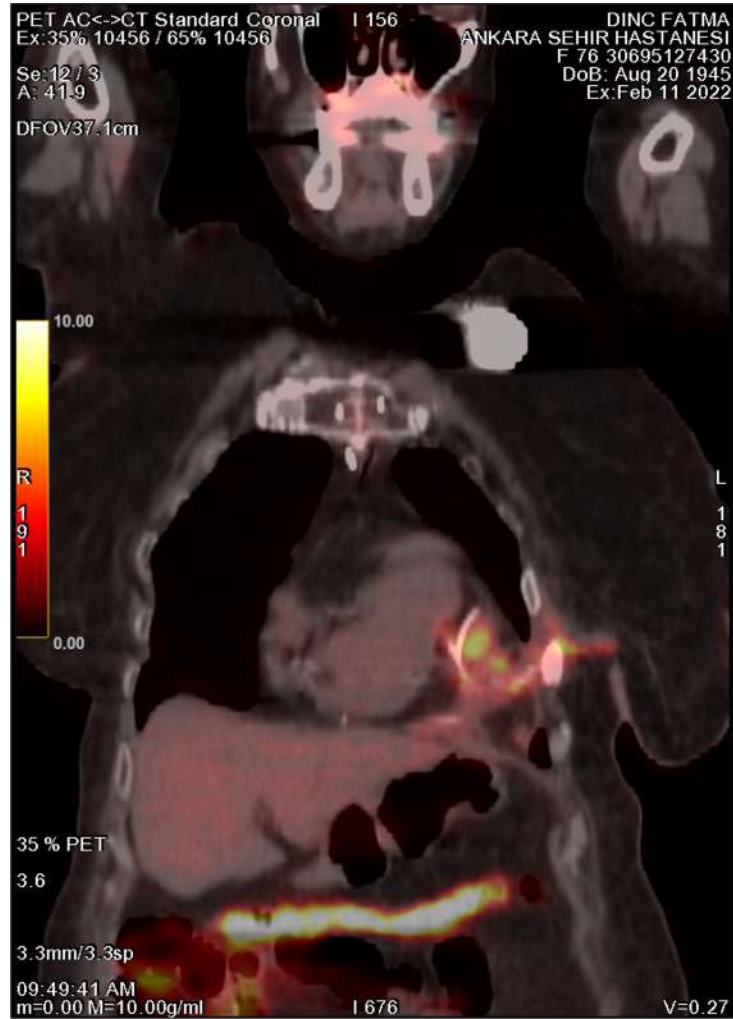
DINC FATMA  
 ANKARA SEHIR HASTANESI  
 F 76 30695127430  
 DoB: Aug 20 1945  
 Ex: Feb 11 2022











# The Role of <sup>18</sup>F-Fluorodeoxyglucose Positron Emission Tomography/Computed Tomography in the Diagnosis of Left-sided Endocarditis: Native vs Prosthetic Valves Endocarditis

Raphael Abegão de Camargo,<sup>1</sup> Marcio Sommer Bitencourt,<sup>2,3</sup> José Claudio Meneghetti,<sup>4</sup> Jose Soares Jr,<sup>4</sup> Luis Fernando Tonello Gonçalves,<sup>4</sup> Carlos Alberto Buchpiguel,<sup>1</sup> Milena Ribeiro Paixão,<sup>5</sup> Marília Francesconi Felício,<sup>6</sup> Alexandre de Matos Soeiro,<sup>7</sup> Tania Mara Varejão Strabelli,<sup>6</sup> Alfredo Jose Mansur,<sup>8</sup> Flavio Tarasoutchi,<sup>5</sup> Mucio Tavares de Oliveira Jr,<sup>7</sup> Jussara Bianchi Castelli,<sup>9</sup> Danielle Menosi Gualandro,<sup>10</sup> Lucas Zoboli Pocebon,<sup>6</sup> Ron Blankstein,<sup>11</sup> Abass Alavi,<sup>12</sup> John Edmund Moore,<sup>13</sup> Beverley Cherie Millar,<sup>13</sup> and Rinaldo Focaccia Siciliano<sup>6</sup>

LOWYER

303 hasta.

188 prostetik aort kapağı ve aortik tüp

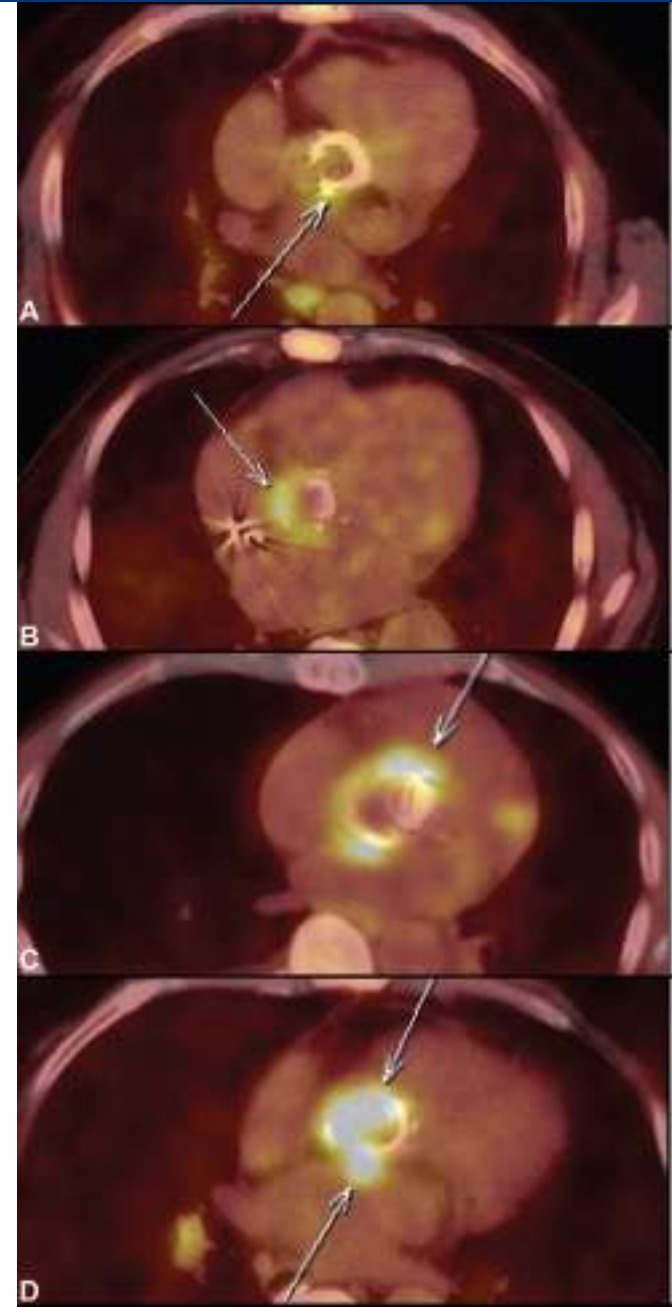
115 native kapak

Fokal tutulumlar (+)

Diffüz tutulum veya tutulum olmaması (-)

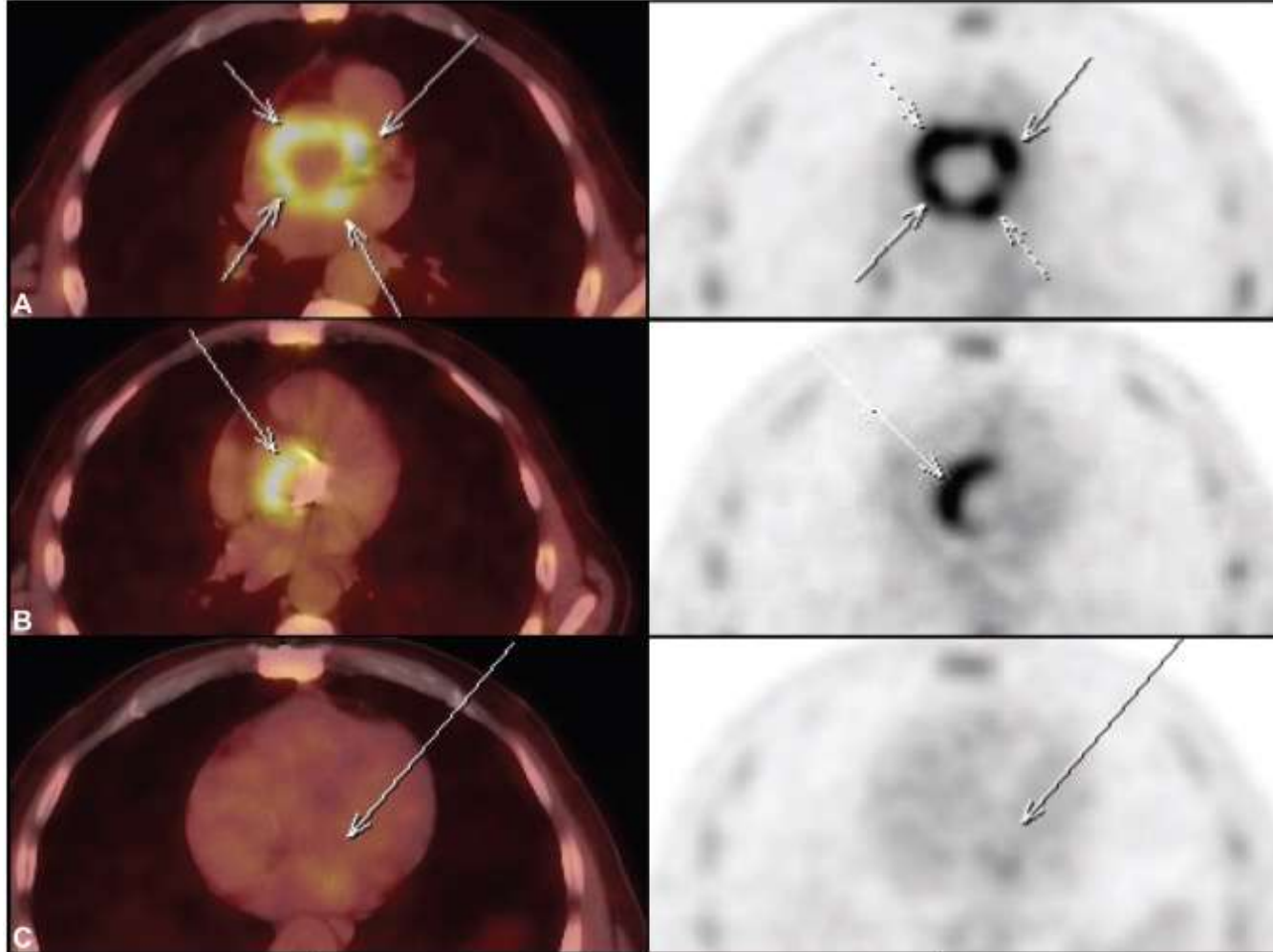
69 hasta histopatolojik inceleme

	n	SE	SP	PPV	NPV	AC
<b>PROTEZ K.</b>						
EKO	151	60	95	91	75	79.5
PET	151	<b>91</b>	<b>94</b>	<b>92</b>	<b>93</b>	<b>92.7</b>
mDK	151	42	88	74	65	67.5
mDK+PET	151	<b>91</b>	<b>88</b>	<b>86</b>	<b>93</b>	<b>89.4</b>
<b>PROTEZ K. ve Aortik tüp</b>						
EKO	188	59	96	93	73	78.7
PET	188	<b>93</b>	<b>90</b>	<b>89</b>	<b>94</b>	<b>91.5</b>
mDK	188	41	90	78	63	67
mDK+PET	188	<b>93</b>	<b>90</b>	<b>89</b>	<b>94</b>	<b>91.5</b>



<b>Doğal Kapak</b>						
EKO	115	70	93	86	82	83.5
PET	115	22	91	100	66	68.7
mDK	115	54	91	81	75	76.5
mDK+PET	115	65	91	83	80	80.9
<b>mDK+PET'de emboli</b>	115	78	91	86	86	86

# Prostetik ve Native Kapak IE



68 y, E

Ascendan aort ve aort kapak protez cerrahisi

Histopatolojik olarak konfirme edilmiş bivalvular IE  
(Strep. Viridans)

Ascendan aort ve aort kapağı FDG +  
Native mitral kapak FDG (-)

FDG-PET/CT for suspected infective endocarditis.

Cardiac device related endocarditis

Native

Current Cardiology Reports (2021) 23: 130  
<https://doi.org/10.1007/s11886-021-01542-y>

CARDIAC PET, CT, AND MRI (P CREMER, SECTION EDITOR)



## <sup>18</sup>F-FDG PET/CT in Infective Endocarditis: Indications and Approaches for Standardization

D. ten Hove<sup>1,2</sup> · R.H.J.A. Slart<sup>1,3</sup> · B. Sinha<sup>2</sup> · A.W.J.M. Glaudemans<sup>1</sup> · R.P.J. Budde<sup>4</sup>

Accepted: 18 March 2021 / Published online: 7 August 2021  
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Intracar

Ca

(intracardiac lesions as potential additional findings)

Surgery reports:  
Bioglue, Medtronic Mosaic prosthetic valve (false positives)  
Confirm findings on NAC images

Confirm findings on NAC images

Confirm findings on NAC images  
Possible benefit delayed acquisition (180 minutes)

# Sonuç

- Radyonüklid görüntüleme protez kapak ve kardiyak cihaz ilişkili endokarditte yüksek duyarlılığa ve özgüllüğe sahiptir.
- Native kapak endokarditinde duyarlılık düşük olmakla birlikte özgüllük yüksektir. Ayrıca ekstrakardiyak odaklar yüksek duyarlılıkla saptanır.
- FDG PET yüksek duyarlılığı ile ilk tercih edilecek yöntem olmalıdır.
- Cerrahi sonrası erken dönemde FDG PET bulguları yanıltıcı olabilir, inflamatuvar patern ve patolojik patern ayırımında değerlendirici tecrübesi önemlidir
- Ekokardiyografi ve radyolojik görüntüleme bulguları ile korelasyon ve multidisipliner değerlendirme tanısal doğruluğu arttıracaktır.