

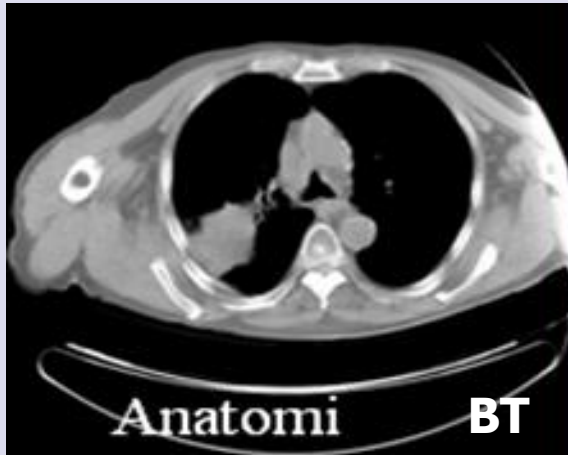
MALİGN-BENİĞN AYIRIMINDA POZİTRON EMİSYON TOMOGRAFİSİ (PET)

Prof. Dr. Kerim Sönmezoğlu



İ.Ü. Cerrahpaşa Tıp Fakültesi
Nükleer Tıp Anabilim Dalı

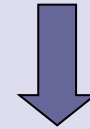
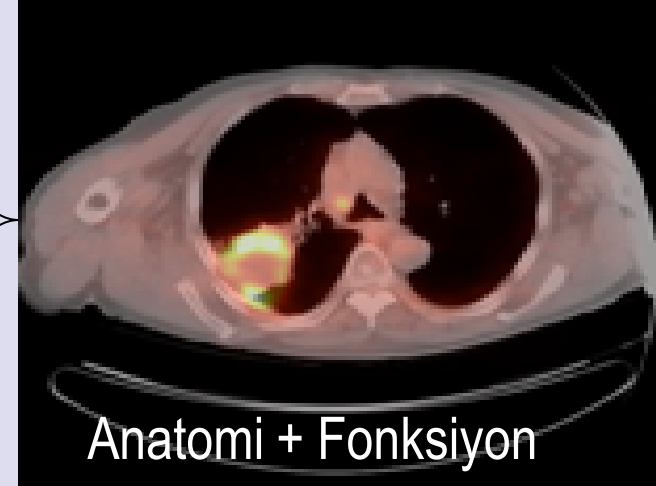
PET TRANSFORMASYONU



Metabolik aktivite
Proliferatif aktivite
Reseptör içeriđi
Perfüzyon

- ✓ Boyut
- ✓ Kenar düzeni
- ✓ Dansite
- ✓ Yağ içeriđi
- ✓ Kalsifikasyon
- ✓ Kanlanma

PET/BT



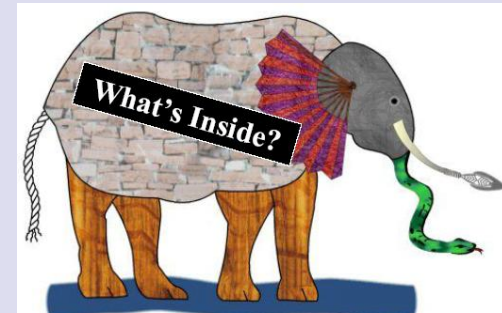
**Maksimum kitle
karakterizasyonu**

Neoplazide PET görüntüleme temeli

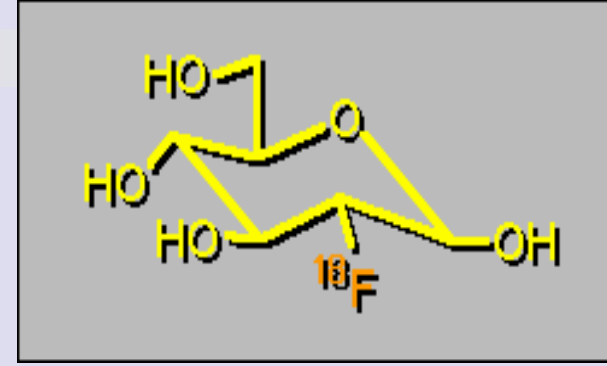
Kanser hücresi

↑ Glikoliz	F-18 fluorodeoksiglukoz (FDG)
↑ DNA sentezi	C-11 timidin, F-18 fluorotimidin
↑ A.asit transportu	C-11 metionin, C-11 tirozin
↑ Protein sentezi	F-18 fluorometil tirozin
↑ Oksidatif metabolizma	C-11 asetat
↑ Lipid sentezi	C-11 kolin, F-18 fluorokolin
↑ Reseptör durumu	F-ES, F-HDT
↓ Oksijenasyon	F-MISO, Cu-ATSM

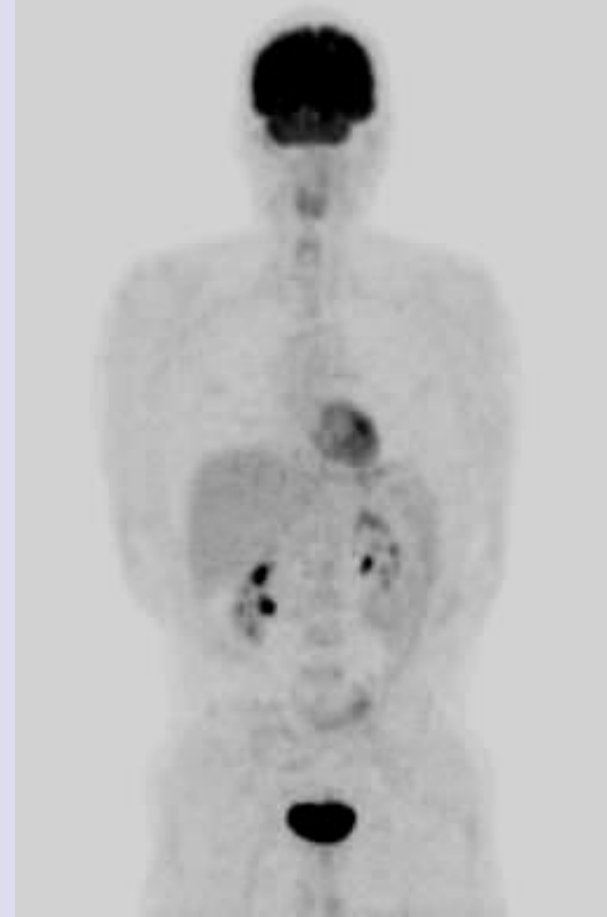
PET ⇒ kansere biyolojik bakış



¹⁸F-Fluorodeoksiglukoz (FDG)



- 👍 En yaygın PET radyofarmasötiği (> %90)
- 👍 Glikoliz hızını (invivo) yansıtır
- 👍 Çoğu kanserde yüksek uptake
- 👍 Taşınabilir (T1/2=110 dk)
- 👍 Üretimi kolay-otomatize
- 👎 Bazı tümörlerde uptake yetersiz
- 👎 Birçok selim tümörlerde de tutulur
- 👎 İnflamasyon-infeksiyon ve granülomatöz hast. da tutulabilir
- 👎 Fizyolojik dağılımında değişkenlikler



Malign tümörlerde FDG afinitesi

YÜKSEK

- Akciğer — Bronkoalveoler ca, karsinoid
- Baş-boyun — Adenokistik ca, tiroid ca
- Özefagus
- Mide — Taşlı yüzük hücreli, musinöz
- Kolorektal — Düşük grade'li NHL, MALT, Burkitt
- Lenfoma
- Melanom — Tubuler, lobuler
- Meme — Berrak hücreli
- Over
- Pankreas
- Safra yolları
- Serviks
- Endometrium
- Germ hücreli
- İskelet-kas
- Nöroblastom

DÜŞÜK

- Prostat
- GEP tümörleri

Az differansiye
Agressif formlar

DEĞİŞKEN

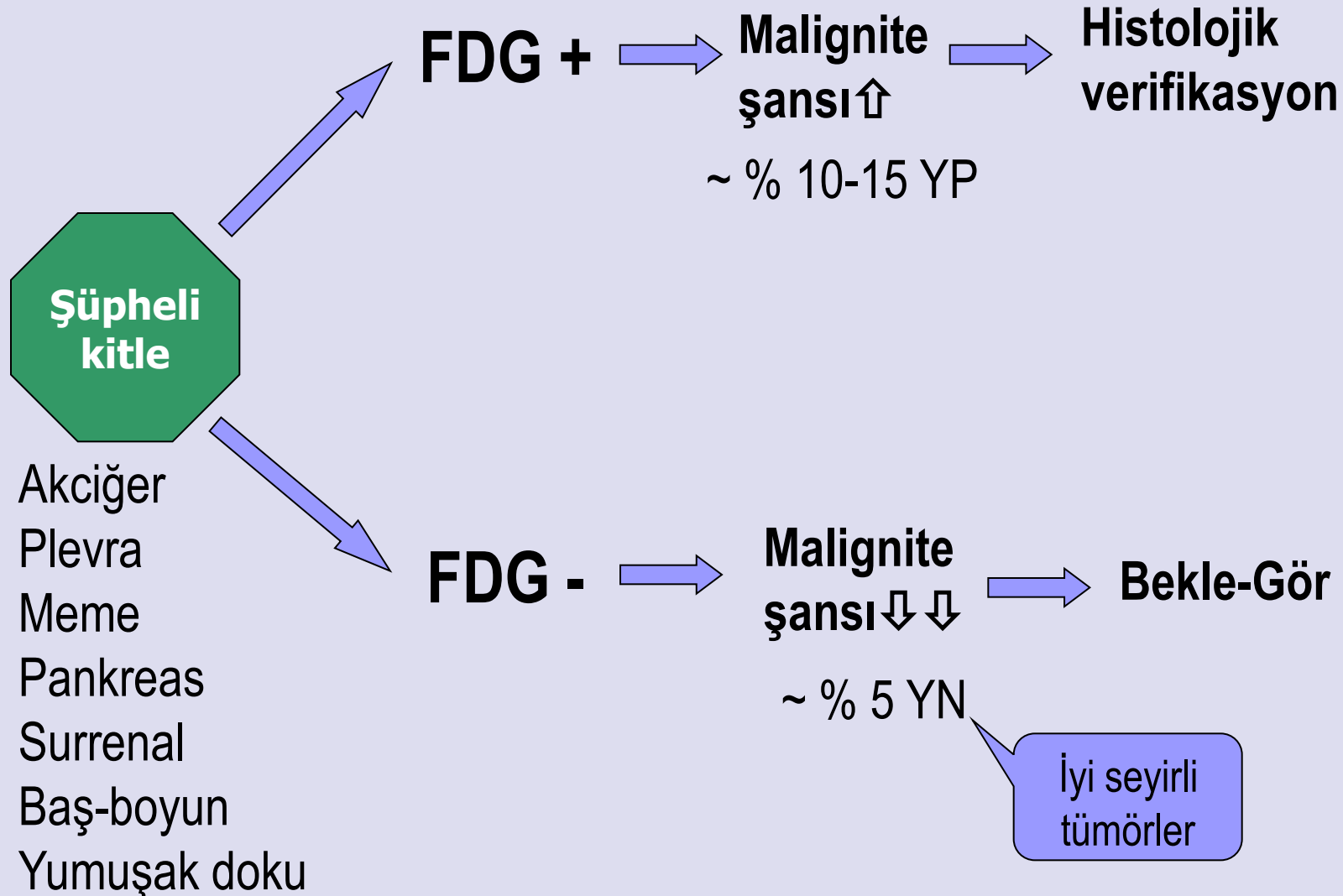
- Hepatosellüler
- Renal cell ca
- İyi diff. tiroid ca
- Tiroid meduller ca
- Feokromositoma

Hücreden fakir formlar
(nekrotik, müsinöz, kistik)

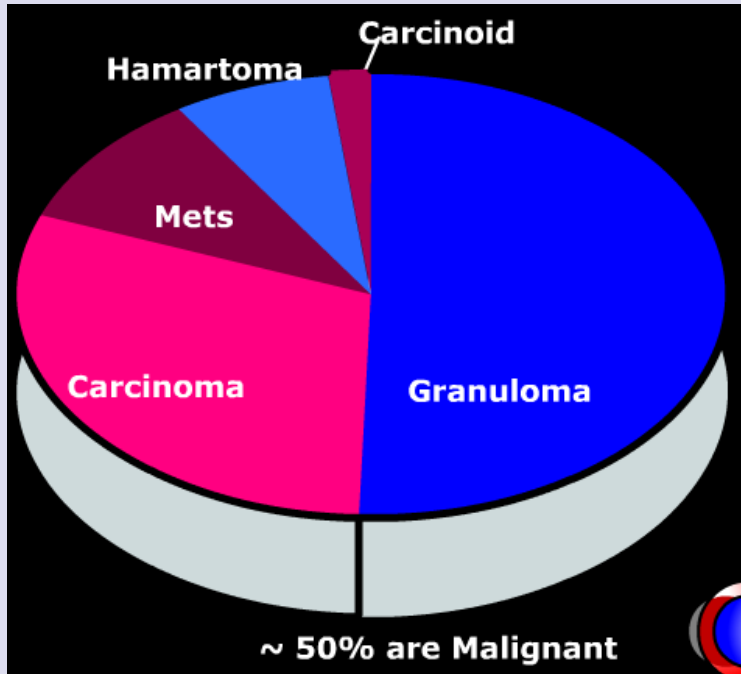
FDG afiniteli selim processler

- ✓ Tükrük bezi tümörü
- ✓ Fibroidler
- ✓ Barsak polipleri
- ✓ Foliküler adenom
- ✓ Paratiroid adenomu
- ✓ Fibröz displazi
- ✓ Granülomatöz hastalıklar
- ✓ Enfeksiyonlar
- ✓ İnflamasyonlar
- ✓ Radyoterapi sonrası doku reaksiyonları
- ✓ Cerrahi insizyonlar
- ✓ Kemik fraktürleri
- ✓ İnflamasyon ve enfeksiyonlarda özellikle aktive makrofajlar ve fibroblastlar FDG tutulumundan sorumludur *Chakrabarti, et al. 1994 Journal of Immunology ; Gamelli, et al. 1996 Journal of Leukocyte Biology; Sorbara, et al. 1996 Journal of Virology*
- ✓ Ayrıca sitokinler ve growth faktörlerin glukoz taşıyıcı proteinleri tetiklediği bilinmektedir. *Lang, et al, 1992 Am J Physiol; Ottlakan, et al 1998 Eur Surg J*

FDG-PET ile metabolik karakterizasyon



Soliter Pulmoner Nodül Değerlendirme



- ✓ PET ile %15 hasta gereksiz torakotomiden korunur

JAMA, The Journal of the American Medic...

Feb 21, 2001 v285 i7 p914

Page 1

Accuracy of Positron Emission Tomography for Diagnosis of Pulmonary Nodules and Mass Lesions: A Meta-analysis.

by Michael K. Gould, Courtney C. Maclean, Ware G. Kuschner, Chara E. Rydzak and Douglas K. Owens

40/727 çalışma
(MEDLINE ve CANCERLIT)

Fokal akciğer lezyonu

n

1474

Duyarlılık
(ortalama)

% 83-100
(% 96)

Özgüllük
(ortalama)

% 50-100
(% 73.5)

Soliter akciğer nodülü

450

(% 93.9)

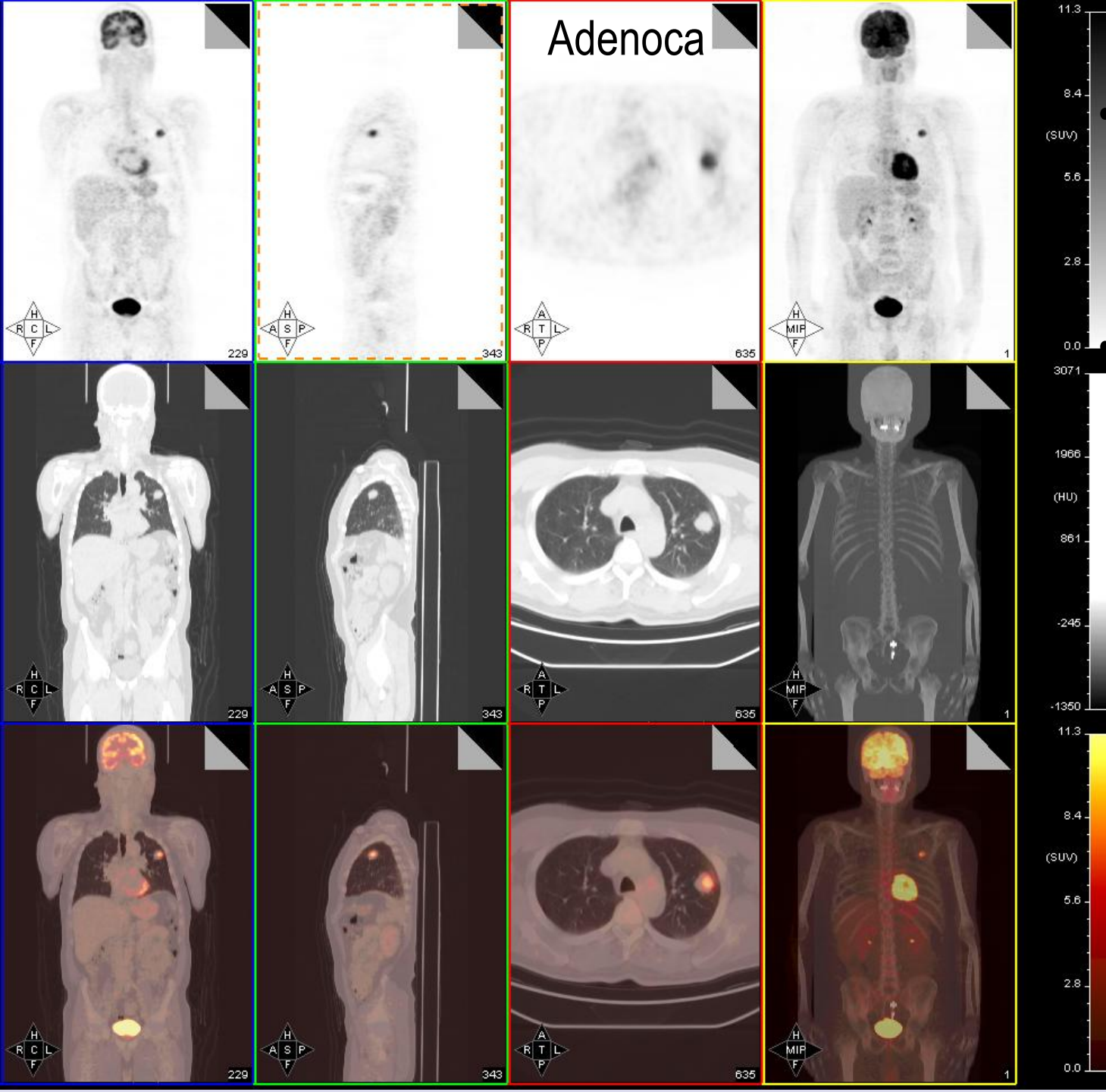
(% 85.8)

Adenoca

**Her kanser
hipermetabolik
değildir**

YN = % 5

- BAC
- Karsinoid



Citak, Sevgi
F
Jul 17, 2006

Citak, Sevgi
F
Jul 17, 2006

Citak, Sevgi.
F
Jul 17, 2006

Tüberkölom

7.9

YP=%10-20

- Tüberküloz
- Sarkoidoz
- Wegener
- Abse
- Silikoz
- Fungal infeksiyon
- Pnömoni

Citak, Sevgi
F
Jul 17, 2006

Citak, Sevgi
F
Jul 17, 2006

Citak, Sevgi
F
Jul 17, 2006

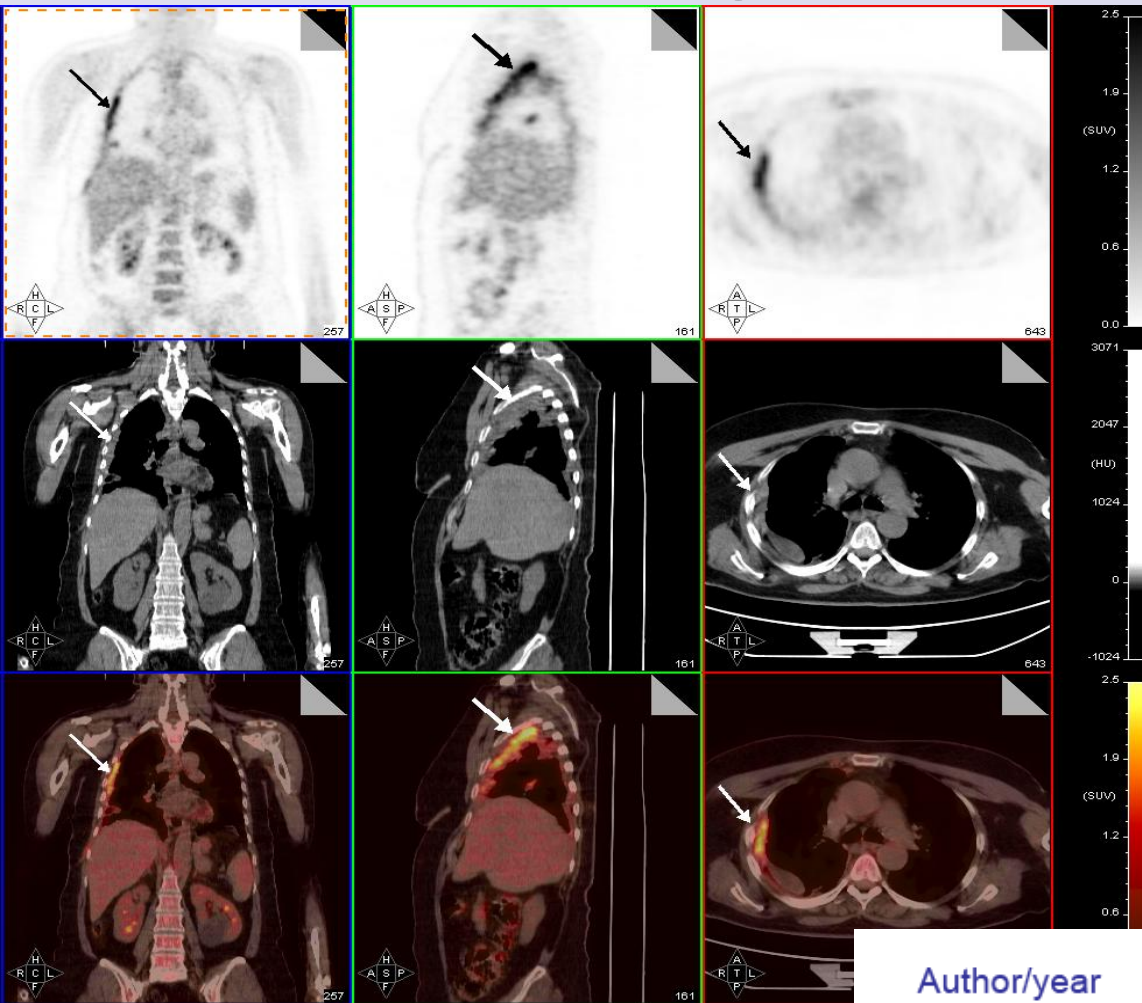
Citak, Sevgi
F
Jul 17, 2006

Citak, Sevgi
F
Jul 17, 2006

Citak, Sevgi
F
Jul 17, 2006

Her hipermetabolik kitle kanser değildir

Plevral malignitelerde PET



Malign plevral efüzyon ve plevral maligniteleri tanımda etkin

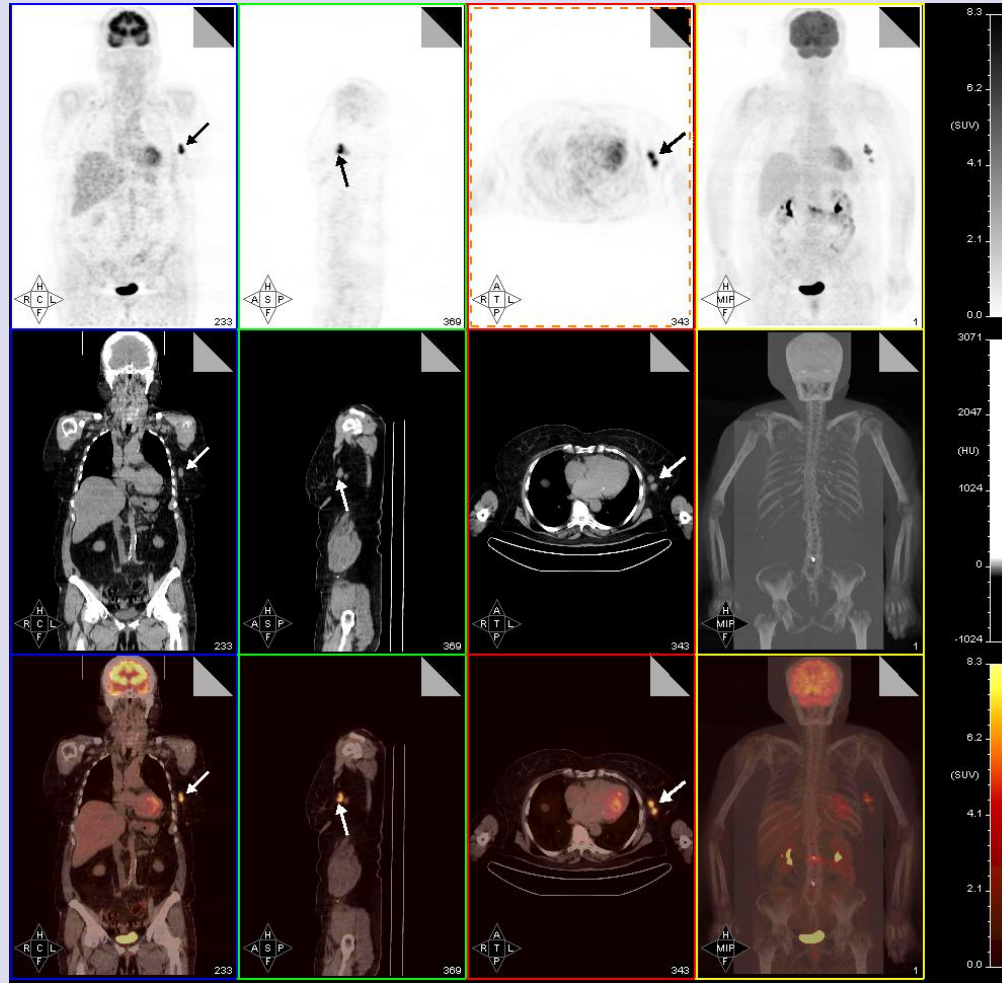
İnflamasyonda YP

Talk plörodezde YP

Author/year	# patients	Sensitivity	Specificity	PPV
Bernard 1998	24	91	100	
Carretta 2000	14	92		
Kramer 2004	32	95	92	95
		> 90%	> 90%	

Meme kitlelerinde PET

- ✓ Meme kitlelerinin değerlendirilmesinde primer yöntem değil
- ✓ pT1 tümörlerde duyarlılık az
 - >1cm 91%
 - <1cm 57%
- ✓ İyi diff tubular, ductal insitu, lobular ca duyarlılık azalır
- ✓ Benign lezyonlarda (fibroadenom, ductal adenom) yalancı pozitiflik (~%10)



	Duyarlılık	Özgüllük
FDG-PET	64-96 (88)	75-100 (79)
Mammography	75-90	90-95

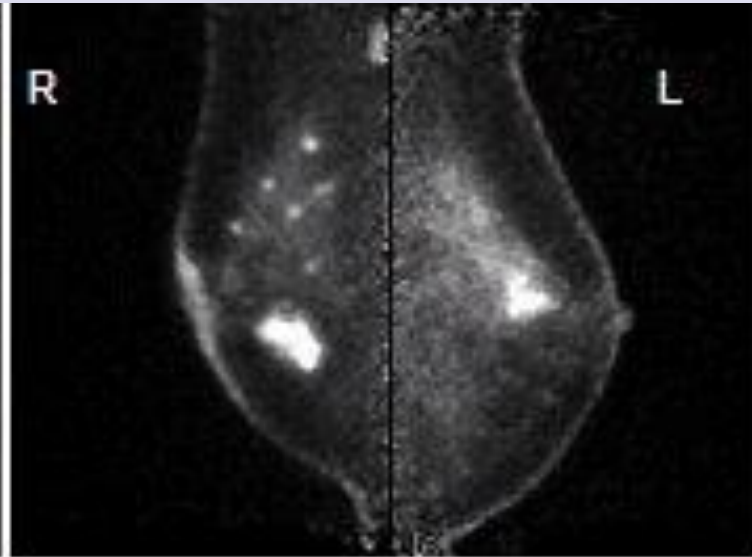
POZİTRON EMİSYON MAMOGRAFİ(PEM)

- ✓ Konvansiyonel mamografiye entegre edilen iki planar dedektör
- ✓ DCIS deteksiyonunda yüksek duyarlılık (91%) (XRM 55%, US 47%, MRI 17%, WBPET 25%) Berg 2006 Breast J.

Mamografi



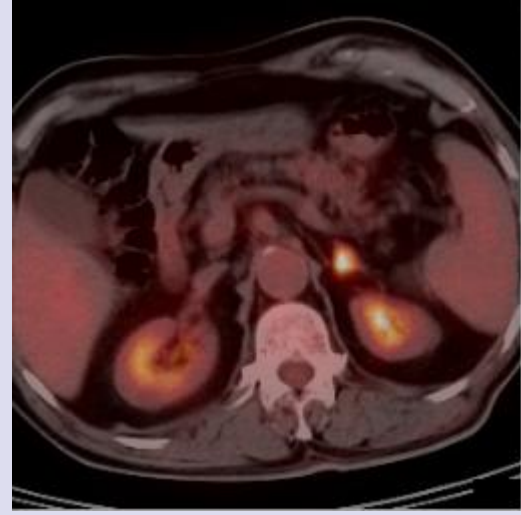
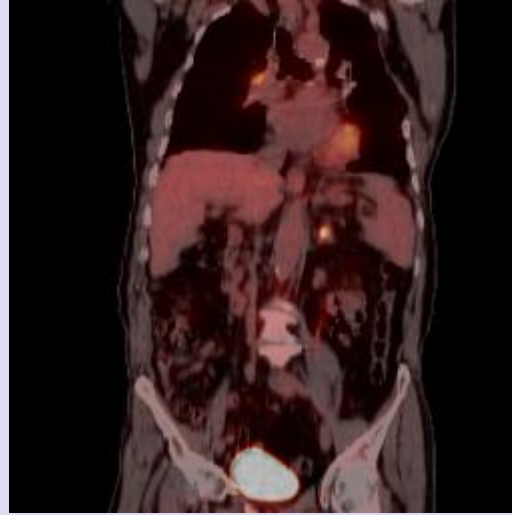
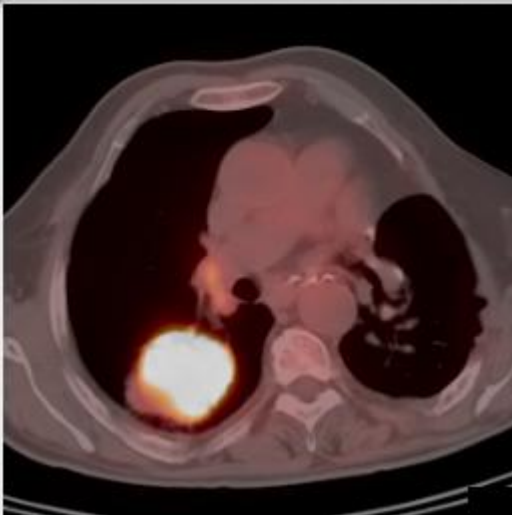
PEM



^{18}F -FDG PET in Characterizing Adrenal Lesions Detected on CT or MRI

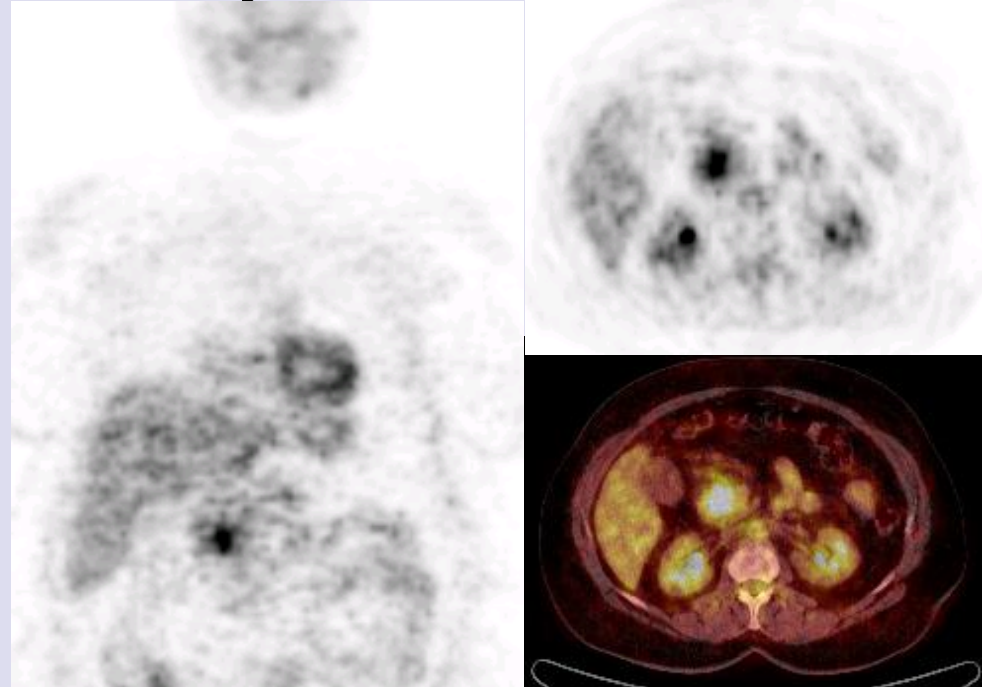
Mijin Yun J Nucl Med 2001; 42:1795–1799

- ✓ 18/18 malign lezyonda PET pozitif (%100 duyarlılık)
- ✓ 30/32 benign lezyonda FDG negatif (%94 özgüllük)
- ✓ 3/13 lezyon MR'da YP iken PET ile GN
- ✓ Mükemmele yakın sonuç;bazı selim adenomlarda YP (Histolojik verifikasyon)



Pankreas kitle karakterizasyonu

- ✓ Duyarlılık %85-96; Özgüllük %78-100
- ✓ Pankreatitlerde yalancı pozitif sonuçlar
- ✓ Küçük tümörlerde ve hiperglisemi (serum glukoz düzeyi >130 mg/dl) durumunda ve diabetik hastalarda yanlış negatif sonuçlar



Bilier tümörlerde FDG-PET



SAFRA KESESİ TM

6 çalışma ortalaması

- ✓ Duyarlılık % 91
- ✓ Özgüllük % 73

KOLANJİOKARSİNOM

12 çalışma ortalaması

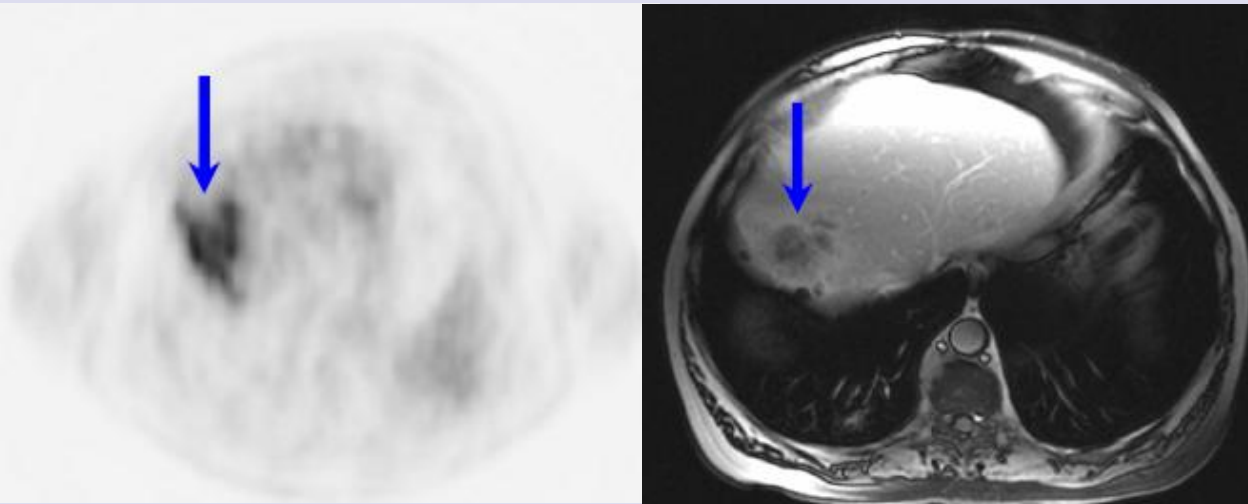
- ✓ Duyarlılık % 78
- ✓ Özgüllük % 84

İntrahepatik

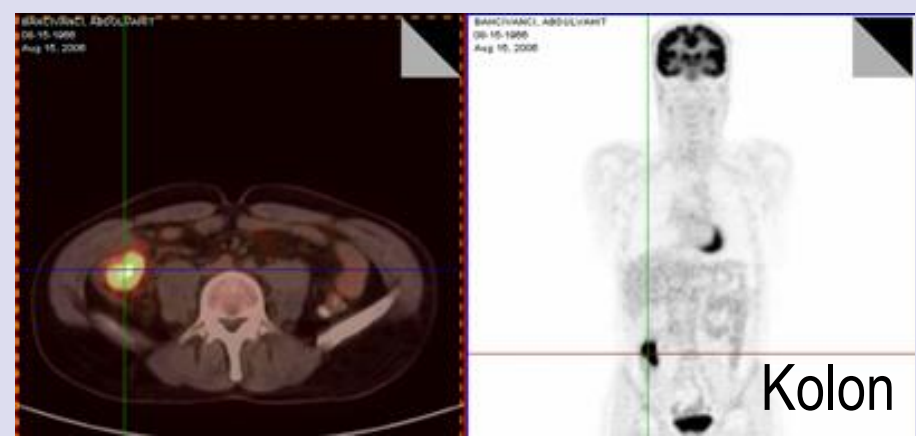
- ✓ Duyarlılık % 94
- ✓ Özgüllük % 80

Ekstrahepatik

- ✓ Duyarlılık % 70
- ✓ Özgüllük % 76

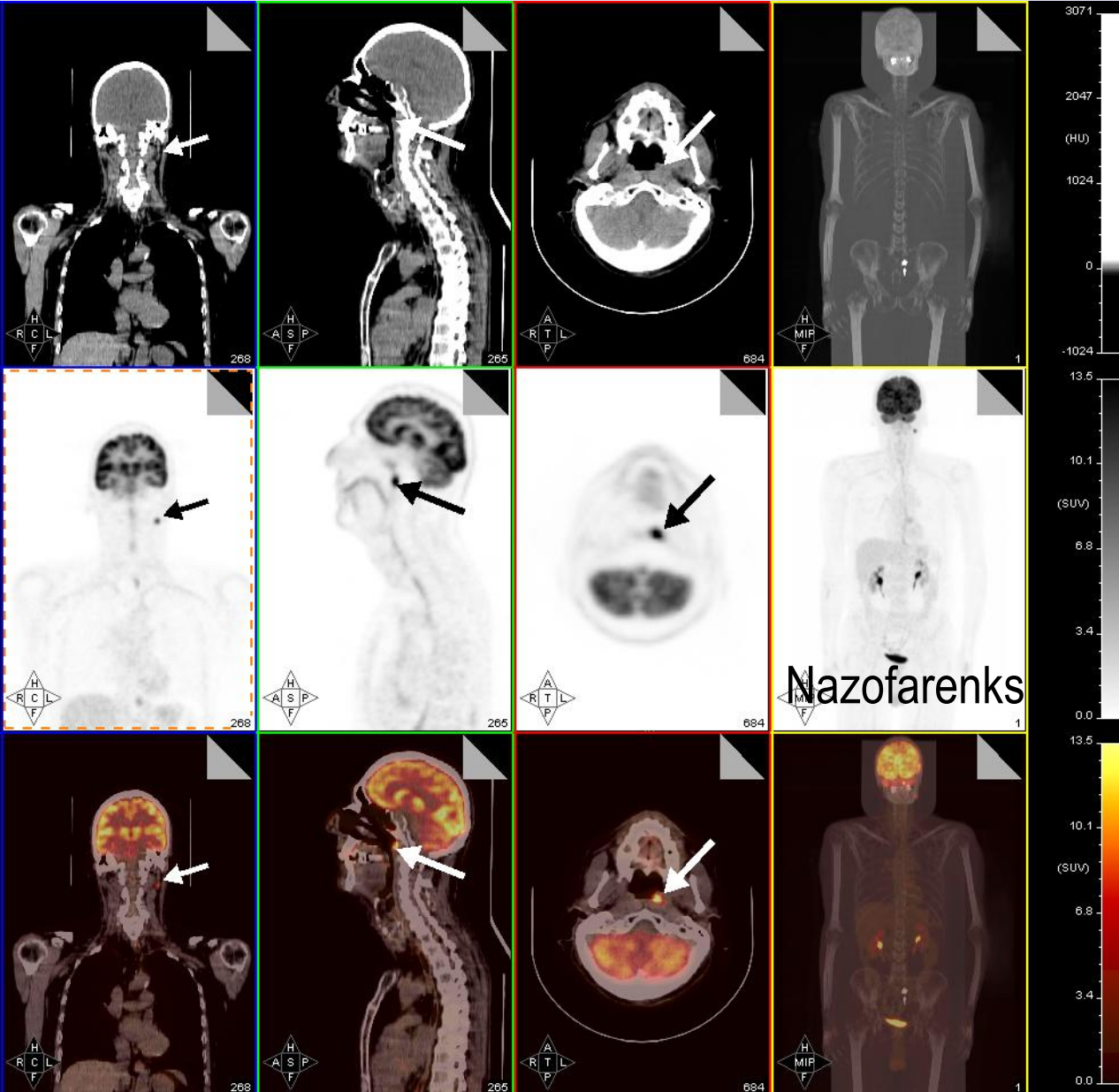


Gastrointestinal Kanal Tümörleri



- ✓ Kolon tümörlerinde duyarlı, ancak özgüllüğü düşük
 - Adenomlarda ve büyük poliplerde YP oranı yüksek

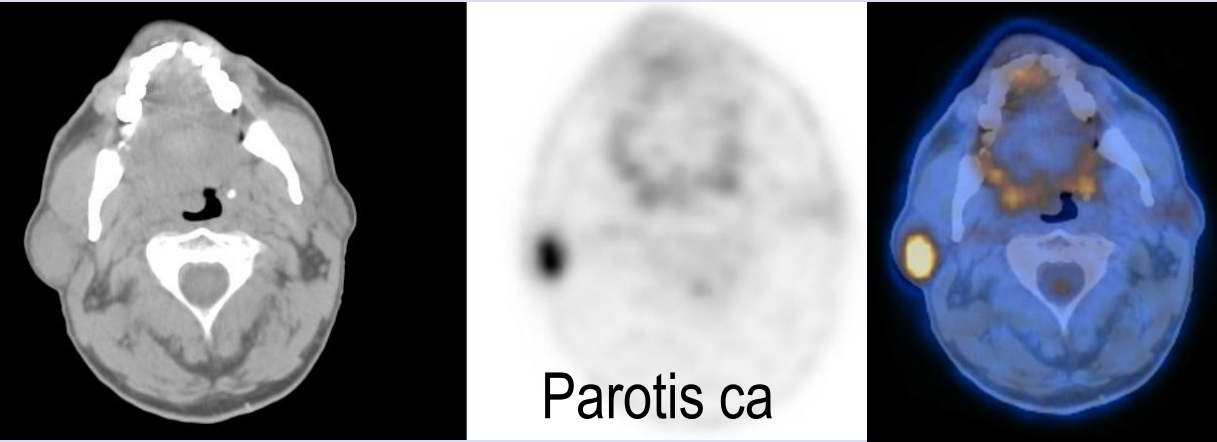
Baş-Boyun Tümörlerinde FDG-PET



- ✓ Skuamöz ca'da yüksek duyarlılık
- ✓ Primer odak bulmada ~ % 50 başarı

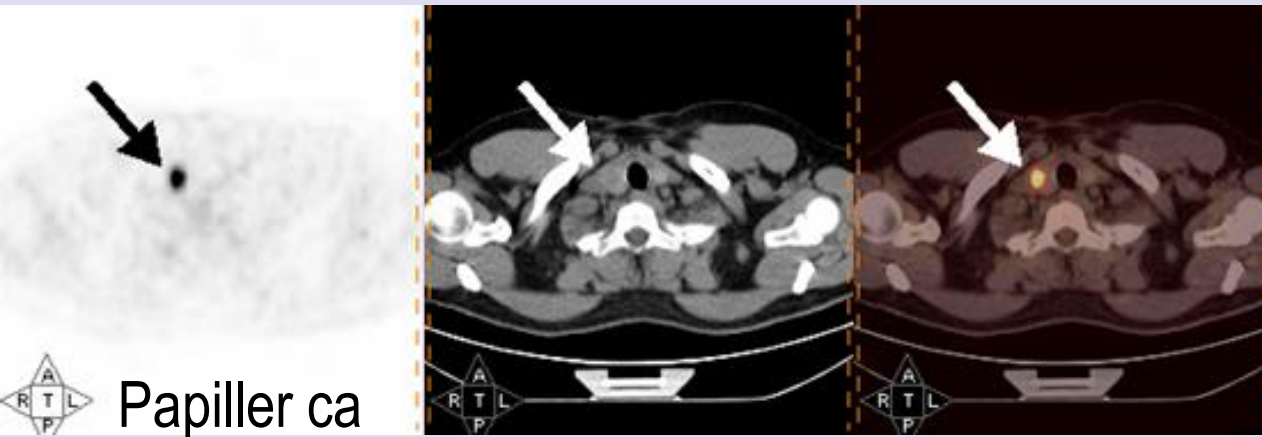
Nazofarenks

Tükrük bezi ve tiroid tümörleri



TÜKRÜK BEZİ

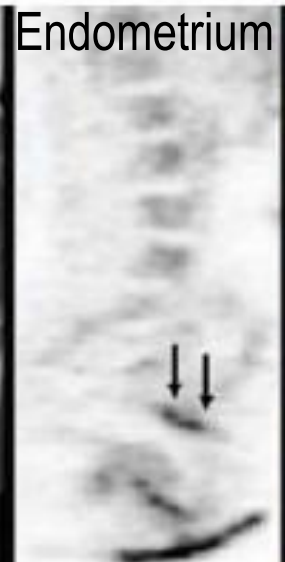
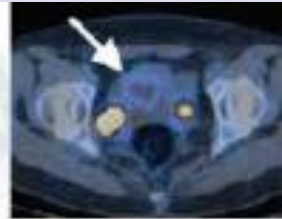
- ✓ Selim tümörlerde FDG +
 - Warthin
 - Pleomorfik adenom



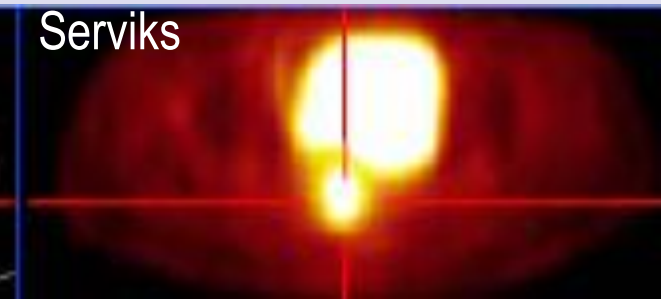
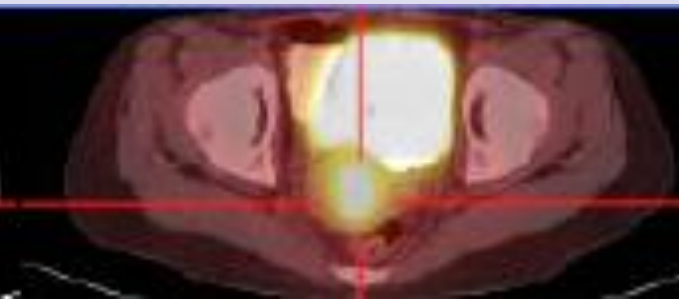
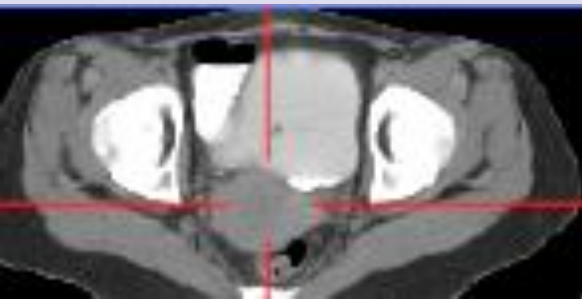
TİROİD

- ✓ FDG + nodüllerin
~%50'si malign

Jinekolojik tümörler

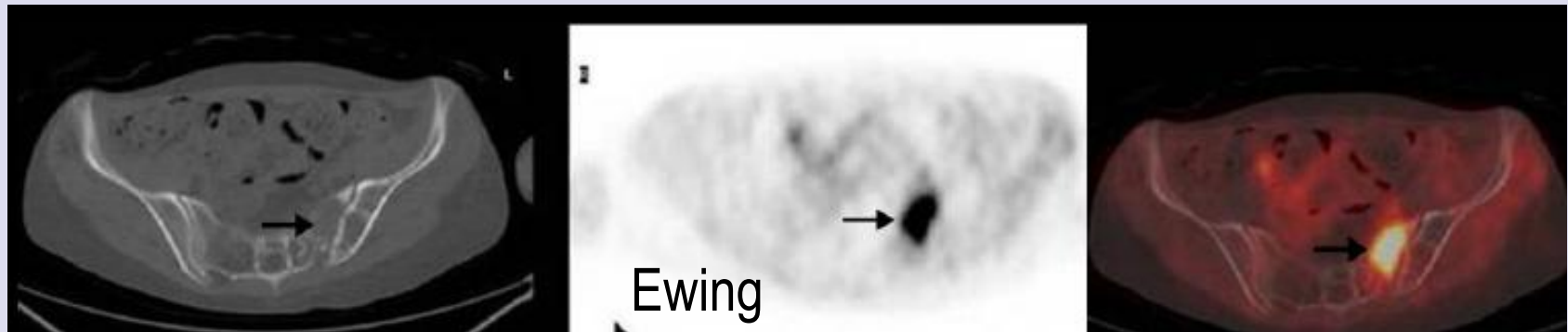
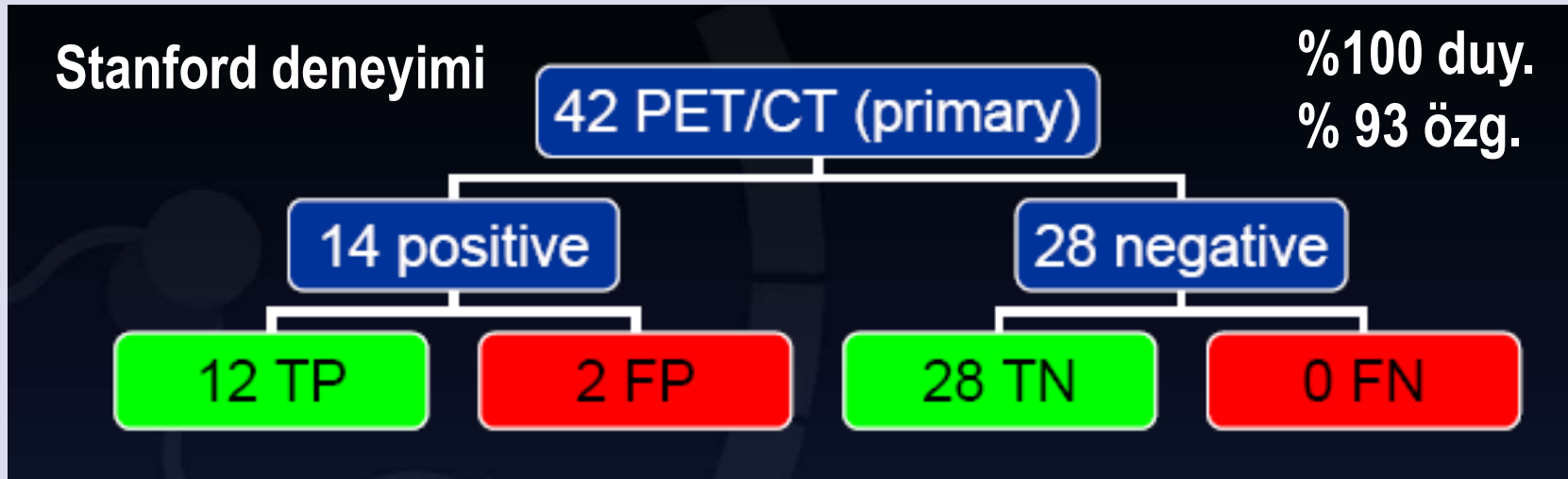


Endometrium

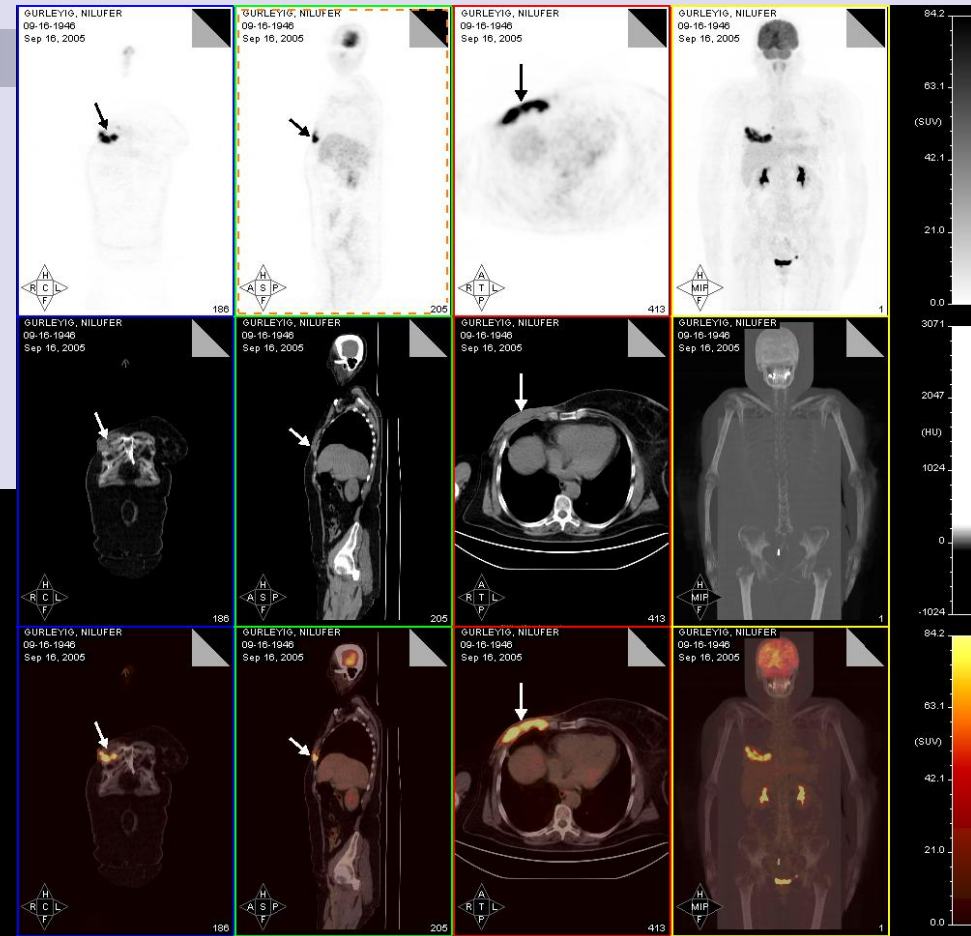
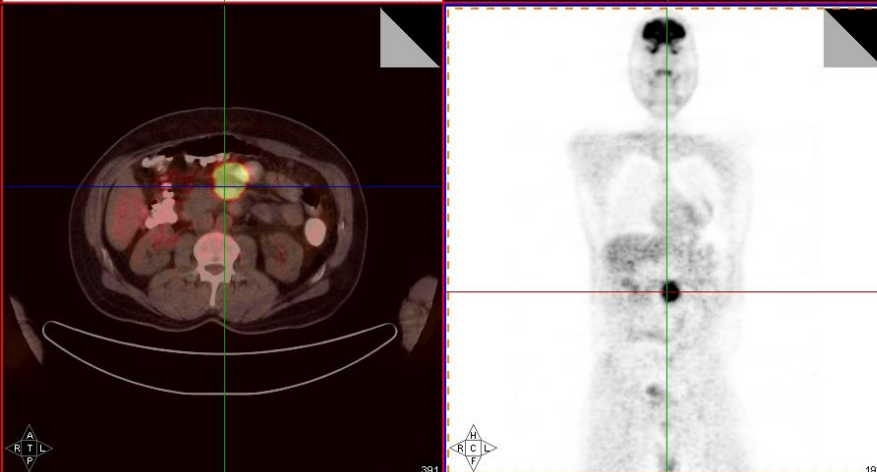
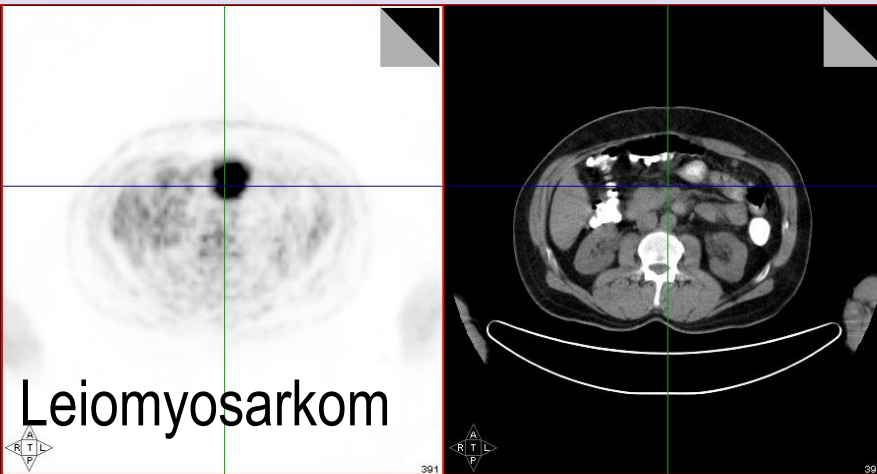


Serviks

Kemik-yumuşak doku sarkomlarında FDG-PET



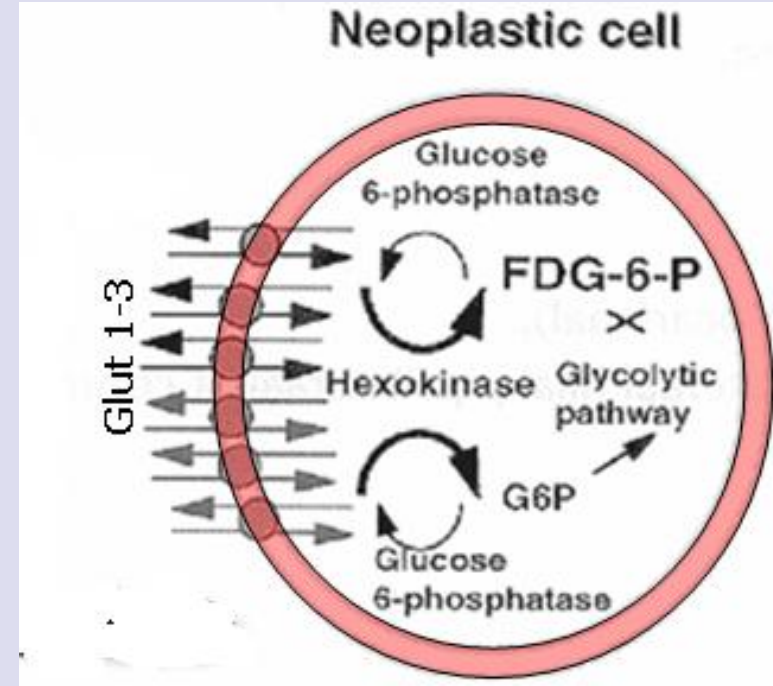
Duyarlılık % 80-90, Özgüllük % 70-80



RT'ye sekonder anjiosarkom

Çift zamanlı PET

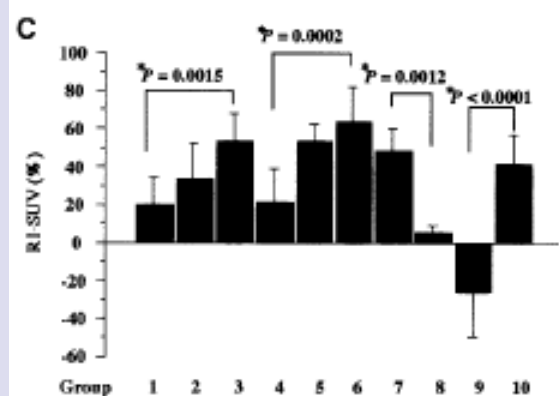
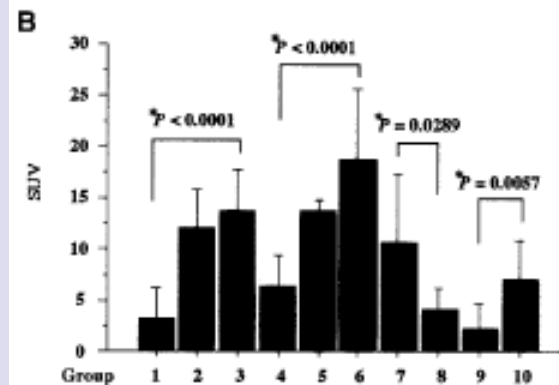
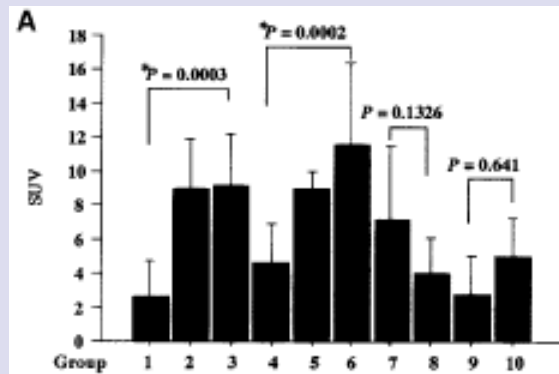
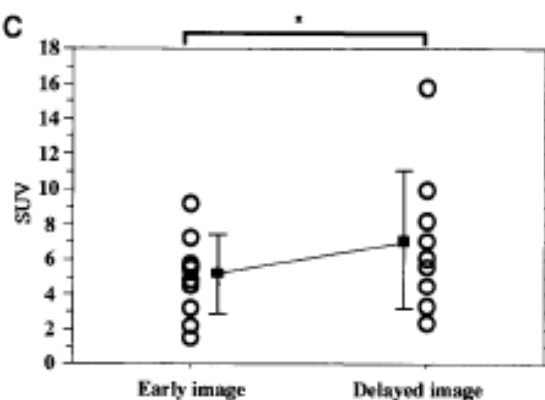
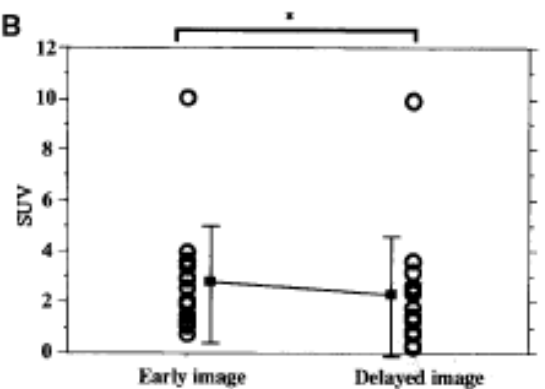
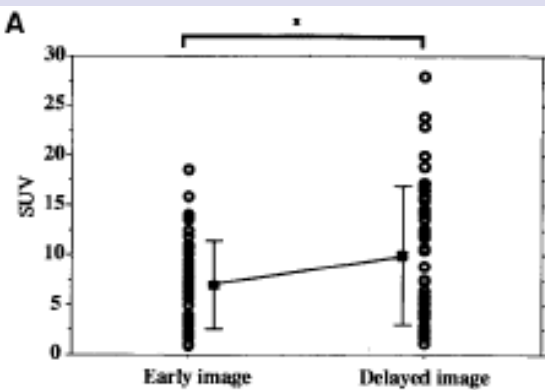
- ✓ Çoğu tümörde 3-4. saatlerde maksimum FDG birikimi
- ✓ Geç (2-3. saat) görüntü alarak FDG birikimindeki % değişimin hesaplanması
- ✓ Akciğer, meme, pankreas, safra kesesi tümörlerinde duyarlılık ↑
- ✓ Yumuşak doku sarkomlarında katkısı gösterilememiş
- ✓ Granülomatöz hastalıklarda da artış gözükabiliyor



$$\text{Retansiyon indeksi} = \frac{\text{GeçSUD} - \text{ErkenSUD}}{\text{ErkenSUD}} \times 100$$

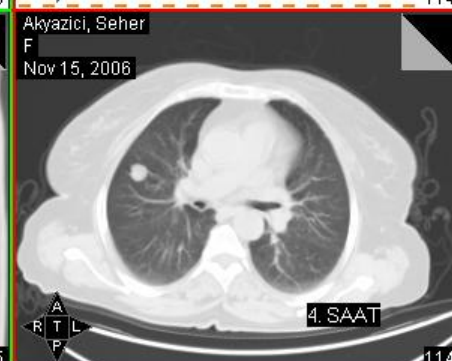
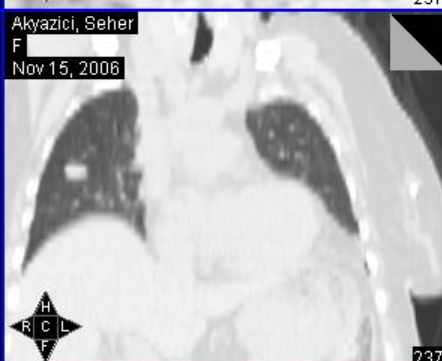
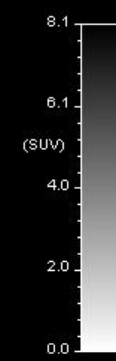
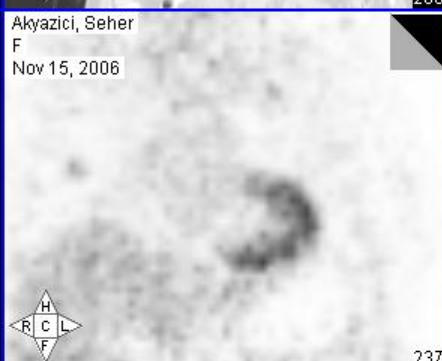
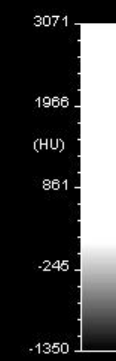
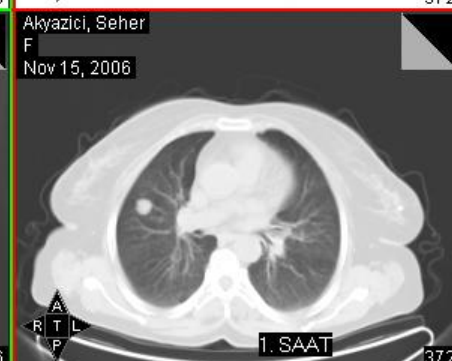
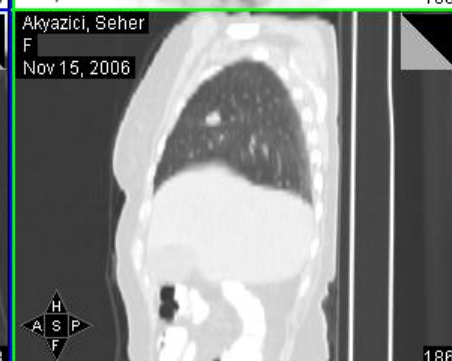
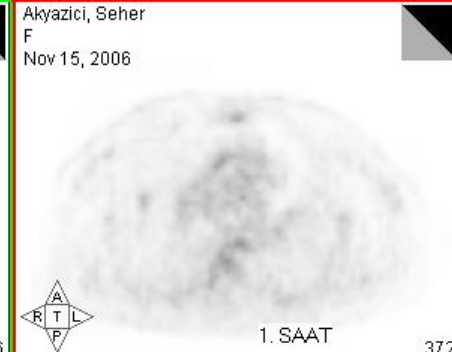
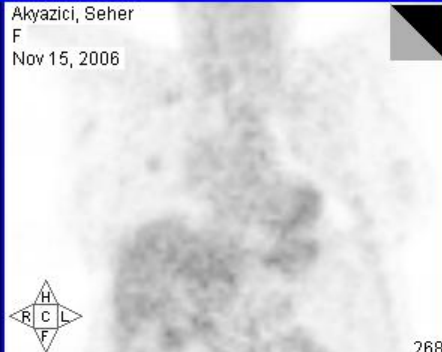
^{18}F -FDG Accumulation with PET for Differentiation Between Benign and Malignant Lesions in the Thorax

Yoshiki Demura, J Nucl Med 2003; 44:540

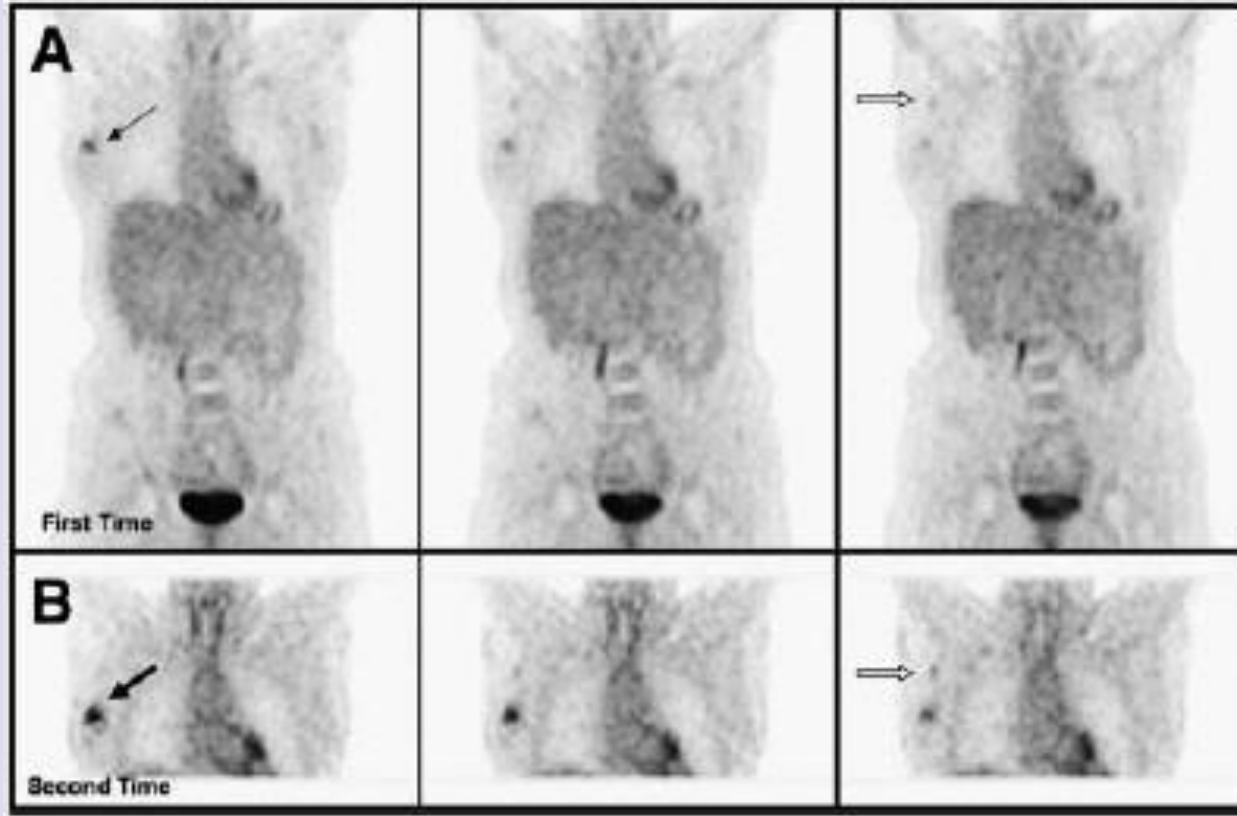


	Duy	Özg	Doğ
Erken	74	50	65
Geç	76	57	69
Ret. ind	98	67	86

- 1 Well-diff. Adenoca (7 BAC)
- 2 Moderately diff. adenoca.
- 3 Poorly diff. adenoca.
- 4 Well-diff. SCC
- 5 Moderately diff. SCC
- 6 Poorly diff. SCC
- 7 Undiff. carcinoma
- 8 Low-grade malignancy
- 9 Benign disease
- 10 Granulomatous disease



Meme kanserinde çift zamanlı PET (Mavi JNM 2006)



- ✓ İnvaziv ca'da duyarlılık
 - >10 mm %90
 - 4-10 mm %83
- ✓ Noninvaziv ca'da duyarlılık % 77

Erken SUVmax 2.2; geç SUVmax 2.6 (%18.2 artış)
Bx: 2.5 cm invaziv ductal carcinoma ve aksiller metastaz

Dual-Time-Point ^{18}F -FDG PET for the Evaluation of Gallbladder Carcinoma

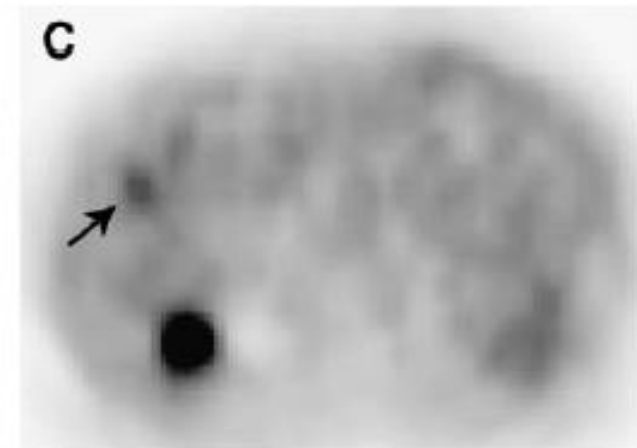
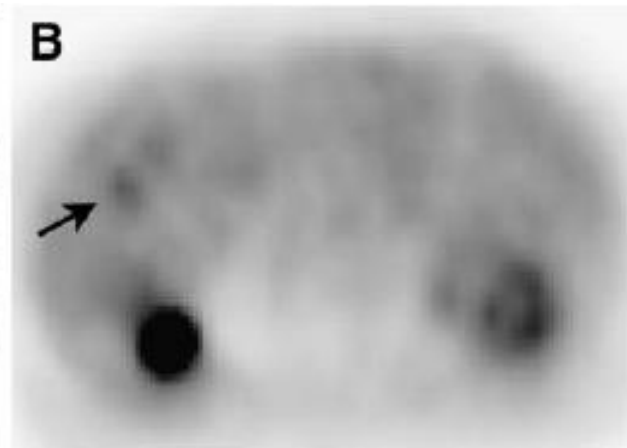
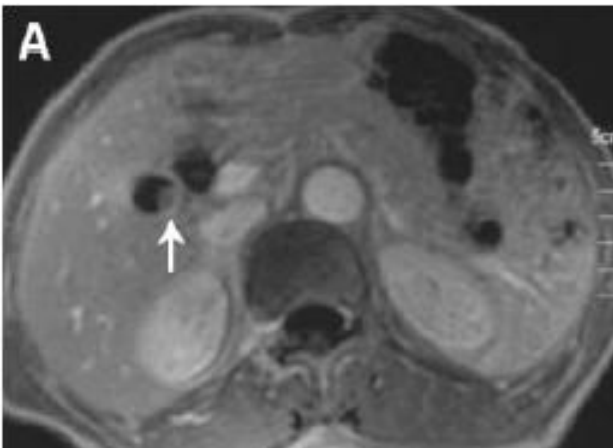
Nishiyama, J Nucl Med 2006; 47:633–638

Diagnostic Value of ^{18}F -FDG PET Using Visual and Semiquantitative Analysis in 32 Patients Suspected of Having Gallbladder Carcinoma

Parameter	Visual analysis		Semiquantitative analysis		
	Early image	Delayed image	SUV _{early}	SUV _{delayed}	RI
Sensitivity	82.6% (19/23)	91.3% (21/23)	82.6% (19/23)	95.7% (22/23)	100% (23/23)
Specificity	44.4% (4/9)	44.4% (4/9)	55.6% (5/9)	44.4% (4/9)	44.4% (4/9)
PPV	79.2% (19/24)	80.8% (21/26)	82.6% (19/23)	81.5% (22/27)	82.1% (23/28)
NPV	50.0% (4/8)	66.7% (4/6)	55.6% (5/9)	80.0% (4/5)	100% (4/4)
Accuracy	71.9% (23/32)	78.1% (25/32)	75.0% (24/32)	81.3% (26/32)	84.4% (27/32)

PPV = positive predictive value; NPV = negative predictive value.

Numbers in parentheses indicate numbers of patients. SUV_{early} cutoff value was 4.50; SUV_{delayed} cutoff value was 2.90; RI cutoff value was -8 .



- ✓ YP'leri minimize etmek için inflamasyon markerleri pozitif olan hastalar ekarte edilmelidir

SONUÇ

- ✓ Benign-malign ayırımı tanısal görüntülemelerde halen zor
- ✓ PET çalışmaları önemli oranda katkı yapsa da kesin ayırım mümkün değil
- ✓ Maligniteye daha spesifik radyofarmasötikler gelecekte PET'in rolünü artıracaktır

Müjde ! Tüm eksizyonel biyopsileriniz negatif geldi



dinlediğiniz için teşekkürler