

# CT MR $^{18}\text{F}$ -FDG PET 가<sup>1</sup>

. . . <sup>2</sup> . .

: CT MR  $^{18}\text{F}$ -FDG PET

(n=21) : CT MR  $^{18}\text{F}$ -FDG PET CT 20 21

, MR 2 2 . PET  $^{18}\text{F}$ -FDG

17 , 3 .

Standard uptake value (SUV) , SUV

t - test .

:PET 8 가 2

21 38%

41% .

:  $^{18}\text{F}$ -FDG PET , 가

가

9%

(1), , 93% 90%

(Ultrasound: US), (Computed Tomo -

graphy: CT), (Magnetic Resonance: MR)

가 ,

(2).

(2 - 3). ,

, US, CT, MR

(2 - 4).

F - 18 2 - fluoro - 2 - deoxy - D - glucose ( $^{18}\text{F}$  - FDG,

FDG) (PET)

(5). FDG

2003 6 2006 12

CT MR ,

2007 6 7

2007 8 27

FDG - PET

: CT MR <sup>18</sup>F-FDG PET 가

20 58.5 (37 - 1 (transmission) 3

77 ) 가 6 , 가 14 (emission) . PET

17 ( 7 , 3 , 3 , OSEM (ordered subsets expectation maximization)

2 , 1 , 1 ) , 3 algorithm (4 iteration. 8 subsets)

21 가

CT 2 MR CT MR , 1

가 PET , PET FDG

6 , 6

가

CT MR 가

(4, 7). 2 (region of

CT MR FDG - PET 45.7 interest: ROI)

. PET Allegro (Phillips, Cleveland, OH, U.S.A.) (standard uptake value ( SUV)) SUV

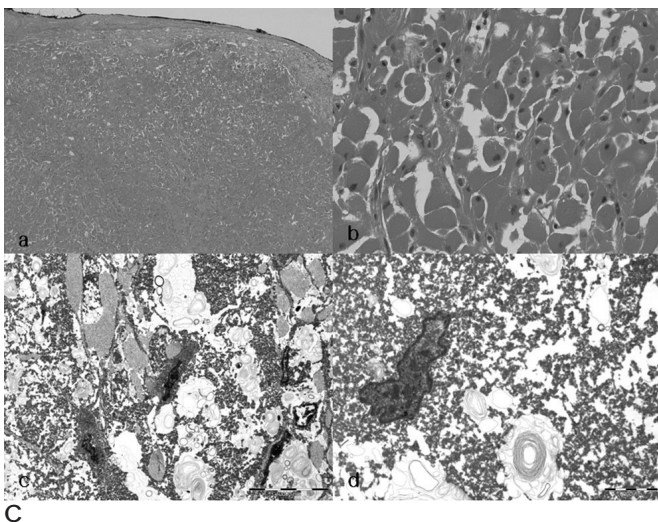
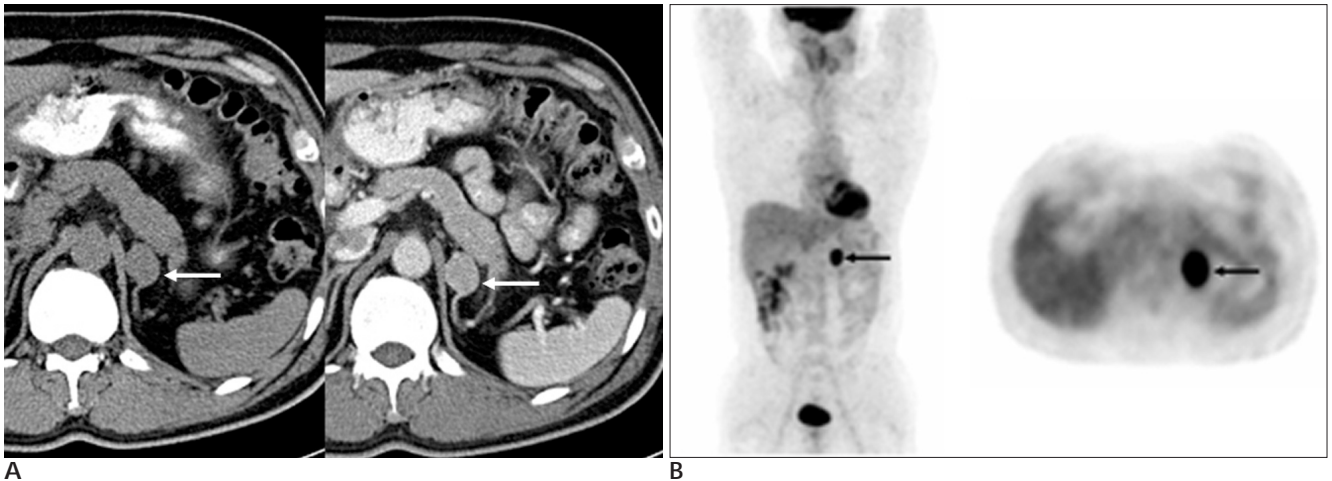
FDG - PET FDG .

6 122 mg/dL FDG - PET

. 370 mBq FDG SUV

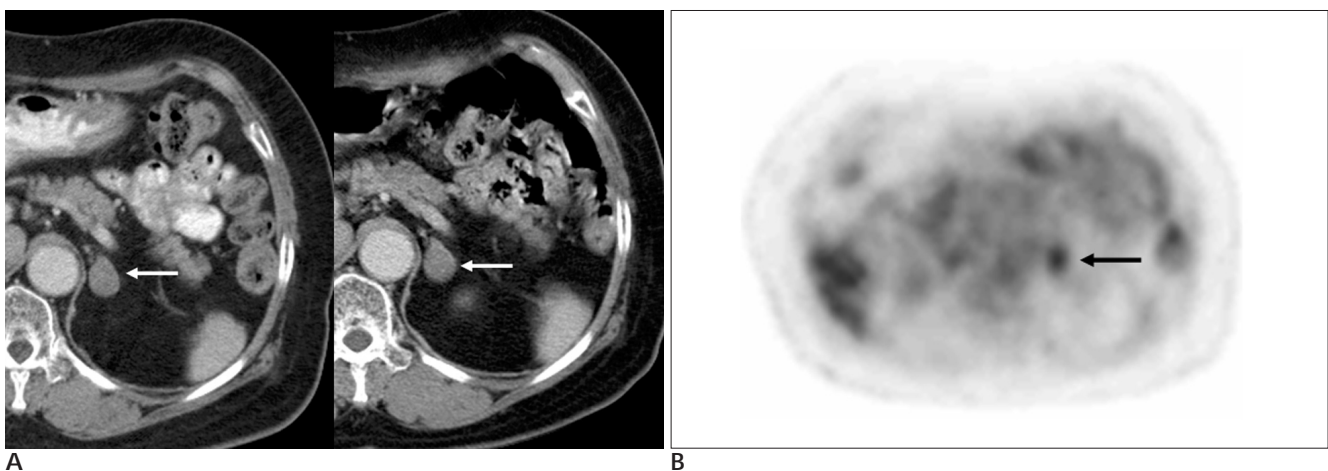
40 - 60 t - test ,

multiple bed position . p - value가 0.05 .

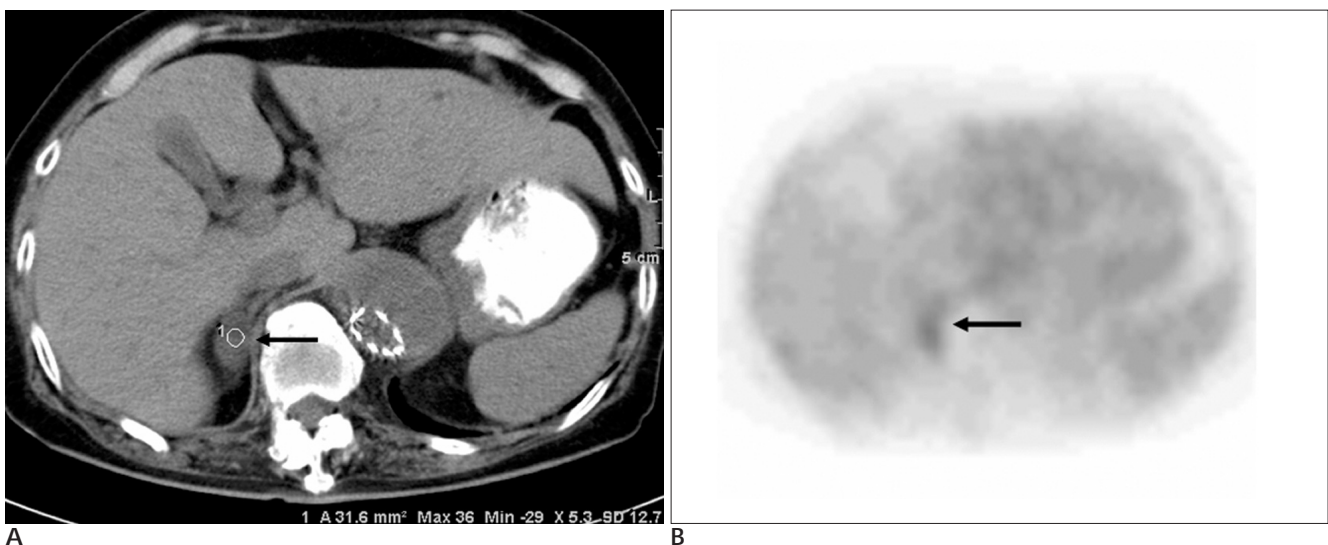


**Fig. 1.** Left adrenocortical oncocytoma in a 43-year-old man.  
**A.** Axial non-enhanced CT scan (**A**) shows a  $2.3 \times 2.0$  cm size mass with isointense attenuation to the spleen in left adrenal gland and contrast-enhanced CT scan (**B**) shows homogeneous contrast enhancement.  
**B.** Coronal and axial  $^{18}\text{F}$ -FDG PET scan shows intense FDG up-take on left adrenal mass (SUV 17.3).  
**C.** Low power microscopic findings (**A**, **B**) show relatively well defined homogenous lesion composed of abundant eosinophilic cells (**A**: H & E,  $\times 40$ , **B**: H & E,  $\times 400$ ). Ultrastructural findings (**C**, **D**) by electronic microscope show multiple compact and degenerated mitochondria with lamellated membranous bodies(**c**:  $\times 4000$ , **d**:  $\times 10000$ ).

16 , 3 , 1  
 1.9 cm ( $\pm$  0.7 cm) . FDG - PET  
 8 2  
 (adrenocortical  
 3 6  
 (Fig. 1), 가 (Fig.  
 oncocytoma) 가  
 2). , 3 2 CT  
 (Fig. 3) 1 MR  
 (Table 1, 2).  
 cm)  
 0.8 cm)  
 2 cm ( $\pm$  0.4  
 1.8 cm ( $\pm$   
 ( $p > 0.05$ ).  
 SUV 5.2 ( $\pm$  5.1)  
 SUV 1.7 ( $\pm$  0.4)  
 가 ( $p < 0.05$ ).  
 SUV 3.3 ( $\pm$  2.2)  
 SUV 1.4 ( $\pm$  0.2)  
 가 ( $p <$   
 0.05).  
 21 8  
 38% , 41%



**Fig. 2.** Left adrenal mass in a 70-year-old female with a history of breast cancer.  
**A.** Axial contrast-enhanced CT scan shows a  $2.0 \times 1.5$  cm size mass on left adrenal gland (a).  
 One year later, follow-up axial contrast-enhanced CT scan shows no interval change of mass on left adrenal gland (b).  
**B.** Axial  $^{18}\text{F}$ -FDG PET scan shows increased FDG uptake on left adrenal mass (SUV 2.4).



**Fig. 3.** Right adrenal mass in a 70-year-old female with a history of colon cancer. This patient was not followed up.  
**A.** Axial non-enhanced CT scan shows a  $2.3 \times 1.3$  cm size mass on right adrenal gland. This mass had an attenuation value of 5.3 H.U.  
**B.** Axial  $^{18}\text{F}$ -FDG PET scan shows increased FDG uptake on right adrenal mass (SUV 3.3).

: CT MR <sup>18</sup>F-FDG PET 가

, T1 (chemical shift) MR (in - , SUV 3.1 28% 가 , phase) (out - of - phase) 가 , 96% (10). CT MR FDG - PET가 , 100 - 94% 100 - 90% (5).

. CT 가 , 가 (6). , 100 - 94% 100 - 90% (5).

. CT 가 , 가 (7). 73% (wash - out) (8). , CT 가 가 (9), 가 MR CT 가 MR 가

(Hounsfield Unit [HU]) 10

HU 96% 가 (7).

CT

CT (capillary blush) (wash - out)

(8). , CT 가 가 (9), 가

MR CT 가 MR 가

**Table 2.** Summary of <sup>18</sup>F-FDG PET Findings

	Positive* (n = 8)	Negative† (n = 13)
Malignant‡ (n = 17)		
Surgery	1	
CT follow-up	3	7
Others	3	4
Benign§ (n = 3)		
Surgery	1	
Others		2

\* <sup>18</sup>F-FDG uptake of the adrenal mass was greater than or equal to that of the liver

† <sup>18</sup>F-FDG uptake of the adrenal mass was lesser than that of the liver

‡ Patient with proven primary malignancy.

§ Patient with incidentaloma.

**Table 1.** Summary of Patients

No	Sex	Age	Medical History	Site	Size	PET	Confirm
1	F	70	Breast Cancer	Left	2.0 × 1.5 cm	Positive *	No change†
2	F	50	Breast Cancer	Left	2.1 × 1.4 cm	Negative†	No change
3	F	37	Breast Cancer	Left	1.2 × 0.8 cm	Positive	No change
4	F	56	Breast Cancer	Left	0.7 × 0.7 cm	Negative	No change
5	F	59	Breast Cancer	Left	1.8 × 1.3 cm	Negative	Loss §
6	F	52	Breast Cancer	Right	0.9 × 0.9 cm	Negative	No change
7	F	47	Breast Cancer	Left	2.1 × 1.5 cm	Negative	No change
8	M	77	Colon Cancer	Left	2.0 × 0.8 cm	Positive	Loss
9	M	77	Colon Cancer	Left	1.6 × 1.6 cm	Negative	No change
10	F	70	Colon Cancer	Right	2.3 × 1.3 cm	Positive	Loss
11	F	72	Lung Cancer	Right	1.6 × 1.2 cm	Negative	Loss
				Left	1.7 × 0.9 cm	Negative	
12	F	65	Lung Cancer	Left	1.4 × 1.1 cm	Negative	No change
13	F	76	Lung Cancer	Left	0.7 × 0.6 cm	Negative	Loss
14	M	42	Malignant thymoma	Left	2.3 × 2.2 cm	Positive	No change
15	M	45	Malignant thymoma	Left	2.7 × 1.3 cm	Negative	No change
16	F	69	Hepatocellular carcinoma	Left	1.8 × 1.3 cm	Positive	Adrenocortical oncocytoma
17	F	39	Thyroid Cancer	Left	1.9 × 1.3 cm	Positive	Loss
18	M	43	Incidentaloma	Left	2.3 × 2.0 cm	Positive	Adrenocortical oncocytoma
19	M	49	Incidentaloma	Left	2.2 × 1.5 cm	Negative	Loss
20	F	76	Cushing syndrome	Right	3.6 × 3.0 cm	Negative	Loss

\* <sup>18</sup>F-FDG uptake of the adrenal mass was greater than or equal to that of the liver

† <sup>18</sup>F-FDG uptake of the adrenal mass was lesser than that of the liver.

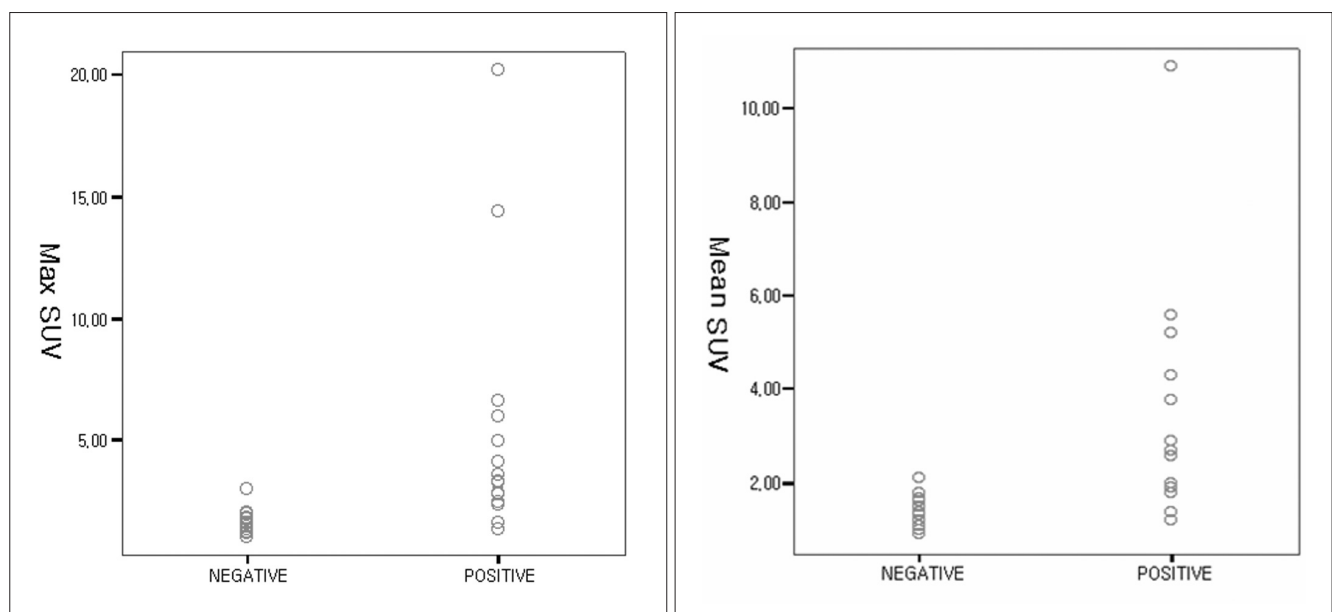
‡ No change of lesion size was noted on follow-up imaging study.

§ Loss of follow-up, but characteristic benign lesion in CT or MRI.

Kumar (5) FDG - PET  
 10% 가 , , , (13 - 15).  
 41%  
 (Table 3).  
 FDG - PET , FDG - PET  
 가 ,  
 가 2 (16).  
 FDG  
 . Yun (17)  
 FDG  
 . Metser (18)  
 SUV 3.1  
 98.5% 92%  
 SUV 3.1  
 28% (Fig. 4).  
 가  
 CT MR  
 , 가 FDG - PET  
 PET CT MR  
 2 , FDG - PET  
 가 .  
 (11, 12). (oncocyte)  
 가 (11, 12).  
 (13 - 15).

**Table 3.** False Positive Rate of Published  $^{18}\text{F}$ -FDG PET Studies on Patients with Primary Malignancy and Adrenal Lesions

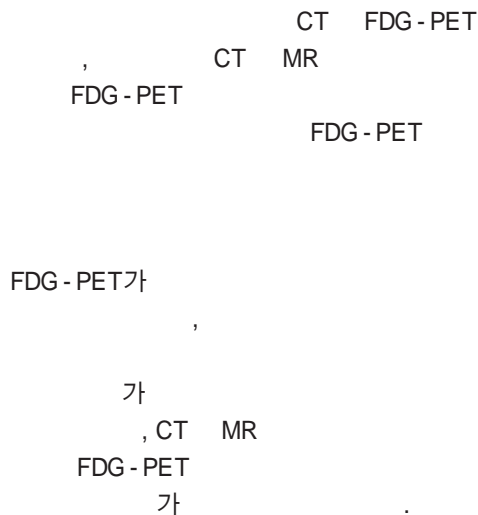
Study	Number of Patients	False Positive Rate
Yun et al.(17)	41	6 %
Gupta et al.(19)	30	8 %
Kumal et al.(5)	94	10 %



**Fig. 4. A.** Scatter plot of maximal SUVs of all adrenal masses.

**B.** Scatter plot of mean SUVs of all adrenal masses.

Positive defined as  $^{18}\text{F}$ -FDG uptake of the adrenal mass was greater than or equal to that of the liver. Negative defined as  $^{18}\text{F}$ -FDG uptake of the adrenal mass was lesser than that of the liver.



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## Reassessment of the Usefulness of $^{18}\text{F}$ -FDG PET in the Evaluation of Adrenal Masses Detected on CT or MR<sup>1</sup>

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**Purpose:** To reassess the usefulness of  $^{18}\text{F}$ -FDG PET in the differential diagnosis of benign and malignant tumors from adrenal masses detected on CT or MR.

**Materials and Methods:** A retrospective analysis was performed on 20 patients ( $n = 21$ ), on whom PET scans were obtained with characteristically benign CT ( $n = 21$ ) and MR ( $n = 2$ ) findings. Seventeen patients had a proven primary malignancy and three patients had adrenal incidentalomas. PET findings were interpreted as positive if the  $^{18}\text{F}$ -FDG uptake of the adrenal mass was greater than or equal to that of the liver. Each adrenal mass was characterized by its size and standardized uptake value (SUV). For statistical analysis, the t-test was used to analyze results for size and SUV.

**Results:** PET findings were positive for eight adrenal masses; two masses were pathologically proven as adrenocortical oncocytomas. The false positive rate was 38% in all patients and 41% in patients with a malignancy.

**Conclusion:**  $^{18}\text{F}$ -FDG PET was useful in evaluating the primary lesions as well as metastases, but a high false positive rate in patients with a primary malignancy should be considered in the diagnosis of metastasis to the adrenal gland.

**Index words :** Positron-emission tomography  
Tomography, X-ray computed  
Adrenal gland neoplasms  
Adrenocortical adenoma  
Adenoma, oxyphilic  
Fluorodeoxyglucose F18

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