# Image Analysis of Intractable Epilepsy:18F-FDG PET Scan of the Cortical Dysplasia

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# IV. 2. Image Analysis of Intractable Epilepsy: $^{18}$F-FDG PET Scan of the Cortical Dysplasia

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## INTRODUCTION

Cortical dysplasia was studied by various imaging method, but only a few reports compared FDG-PET, SPECT, and EEG in the same case[1]. In this study, we assessed the FDG-PET findings in 9 patients with cortical dysplasia. The results were compared with those of MRI, interictal SPECT, and EEG in order to study the pathophysiology of cortical dysplasia.

## MATERIALS AND METHODS

*Patients*

This study was performed, included nine patients (two males, seven females, age range one year to 26 years) with cortical dysplasia, diagnosed by MRI findings (Table 1) after informed consent for the patients or their guardians. Two was diagnosed band heterotopia, two was hemimegalencephaly, four cortical dysplasia, and one pachygyria. No cases were operated on.

*SPECT procedure*

$^{99m}$Tc-ethyl cysteinate dimer (ECD) was intravenously injected while the patients were awake. The SPECT images were acquired 30 minutes after injection using a Multispect 3 (Siemens, Gerfahldt, Germany) with a low-energy, high-resolution, fan-beam collimater. The patients were sedated with trichloryl hydrochloride or diazepam during scan. None of the patients showed clinical evidence of seizures during SPECT scan.

*FDG-PET procedure*

Out of the nine patients, six patients were studied with SET-2400W (Shimadzu Co., Japan), and three patients were studied with a model PT-931 scanner (CTI Inc., USA). Emission scan was performed 30 to 45 minutes after the 7.4-74 MBq FDG injection.

We analyzed MRI findings, EEG patterns, regional blood flow by SPECT, and regional glucose utilization by FDG-PET. SPECT and FDG-PET scans were assessed

visually by independent physicians on two separate occasions.

## RESULTS

The following results were obtained (Table 2): (1) in all cases EEG showed spike focus in the dysplastic region, (2) the hyperperfusion was found in three patients, the isoperfusion in two, and the hypoperfusion in four patients in dysplasitic region, (3) the hypermetabolic pattern was found in five patients, the isometabolic pattern in three, and the hypometabolic pattern in one patient in dysplasitic region, (4) In one of bandheterotopia, area of inner heterotopia showed hypoperfusion by SPECT and isometabolism by PET. But other patients showed isoperfusion by SPECT and hypermetabolism by PET (Figure A, B, C). (5) FDG-PET and interictal SPECT was not concordant in 4 patients.

## DISCUSSION

In the past literatures, SPECT show abnormal area as hyperperfusion in ictal state, hypoperfusion in interictal state, and FDG-PET show abnormal area as hypometabolism, reflecting neuronal activity in the epileptic foci of partial epilepsy[2,3]. In cortical dysplasia, however, both hyperperfusion and hypoperfusion by SPECT were reported, there is little agreement about that[4].

In our report, one case of hemimegalencephaly showed hyperperfusion by interictal SPECT and hypometabolism by FDG-PET (Figure D, E, F). We can not exclude the possibility that alteration with age of hemimegalencephalic hemisphere might cause this discrepancy, because FDG-PET was examined two years after SPECT. Although Tagawa et al.[5] reported serial IMP-SPECT of hemimegalencephaly, which was pathological hemispheric findings changed from hyperperfusion pattern to hypoperfusion pattern during 3 to 7 months. However, this may be unlikely to apply our case aged over 20 years. Dyscrepancy between perfusion and metabolism such as hyperperfusion of SPECT and hypometabolism of FDG-PET, was reported in subacute stage of ischemic brain disease[6]. It needs further consideration what discrepancy and metabolic characteristics of hemimegalencephaly.

Miura et al.[7] reported a case with isometabolism of band heterotopia. Although De Volder et al.[8] reported two cases with isometabolism or hypermetabolism by FDG-PET of band heterotopia. The comparative study of FDG-PET and SPECT were not published to the best of our knowledge. Pinard et al.[9] reported a case which showed an activation of both subcortical band heterotopia and the true cortex by functional MRI. Our two cases suggest the heterogeneity in band heterotopia.

## CONCLUSION

FDG-PET does not necessarily showed the same pattern as SPECT in cortical

dysplasia. There can be characterisitic pathophysiolosy of cortical dysplasia, other than partial epilepsy.

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Table 1. Clinical data of the patients. Abbreviations: MRI, magnetic resonance imaging; MR, mental detardation; rt, right; lt, left; FCD, focal cortical dysplasia; ND, not done.

| | MRI | Age | Sex | Symptoms |
|---|---|---|---|---|
| 1 | band heterotopia | 25 | F | mild MR, several seizure |
| 2 | band heterotopia | 17 | F | mild MR several seizure |
| 3 | rt. hemimegalencephaly | 2 | M | hemiplesia partial seizure |
| 4 | lt. hemimegalencephaly | 26 | F | hemiplesia, mild MR partial seizure |
| 5 | bilateral perisylvian syndrome | 9 | F | disarthria several seizure |
| 6 | rt. FCD | 1 | F | several seizure |
| 7 | rt. hemispheric FCD | 9 | M | hemiplesia, mild MR |
| 8 | rt. hemispheric FCD | 7 | F | hemiplesia, MR, seizure |
| 9 | pachygria | 8 | F | severe MR, frequent seizure |

Table 2. EEG, SPECT and PET Findings with Cortical Dysplasia. Abbereviations: MRI, magnetic resonance imaging; SPECT, single photon emission computed tomography; PET positron emission tomography; bil., bilataral; rt, right; lt, left; FCD, focal cortical dysplasia; O, occipital; F, frontal; P, parietal; mT, midtemporal; ND, not done; [SPECT] hypo, hypoperfusion; iso, isoperfusion; hyper, hyperperfusion; [PET] hypo, hypometabolism; iso, isometabolism; hyper, hypermetabolism.

| | MRI | Age | Sex | EEG Foci | SPECT | PET |
|---|---|---|---|---|---|---|
| 1 | band heterotopia | 25 | F | bil. O | hypo | iso |
| 2 | band heterotopia | 17 | F | bil. O | iso | hyper |
| 3 | rt. hemimegalencephaly | 2 | M | rt. F | hyper | iso |
| 4 | lt. hemimegalencephaly | 26 | F | lt. F | hyper | hypo |
| 5 | bilateral perisylvian synedome | 9 | F | lt. P rt. mT | hyper | iso |
| 6 | rt. FCD | 1 | F | rt. O | hypo | iso |
| 7 | rt. hemispheric FCD | 9 | M | rt. F-C | hypo | hyper |
| 8 | rt. hemispheric FCD | 7 | F | rt. C | hypo | hypo |
| 9 | pachygria | 8 | F | bil. F | iso | hypo |

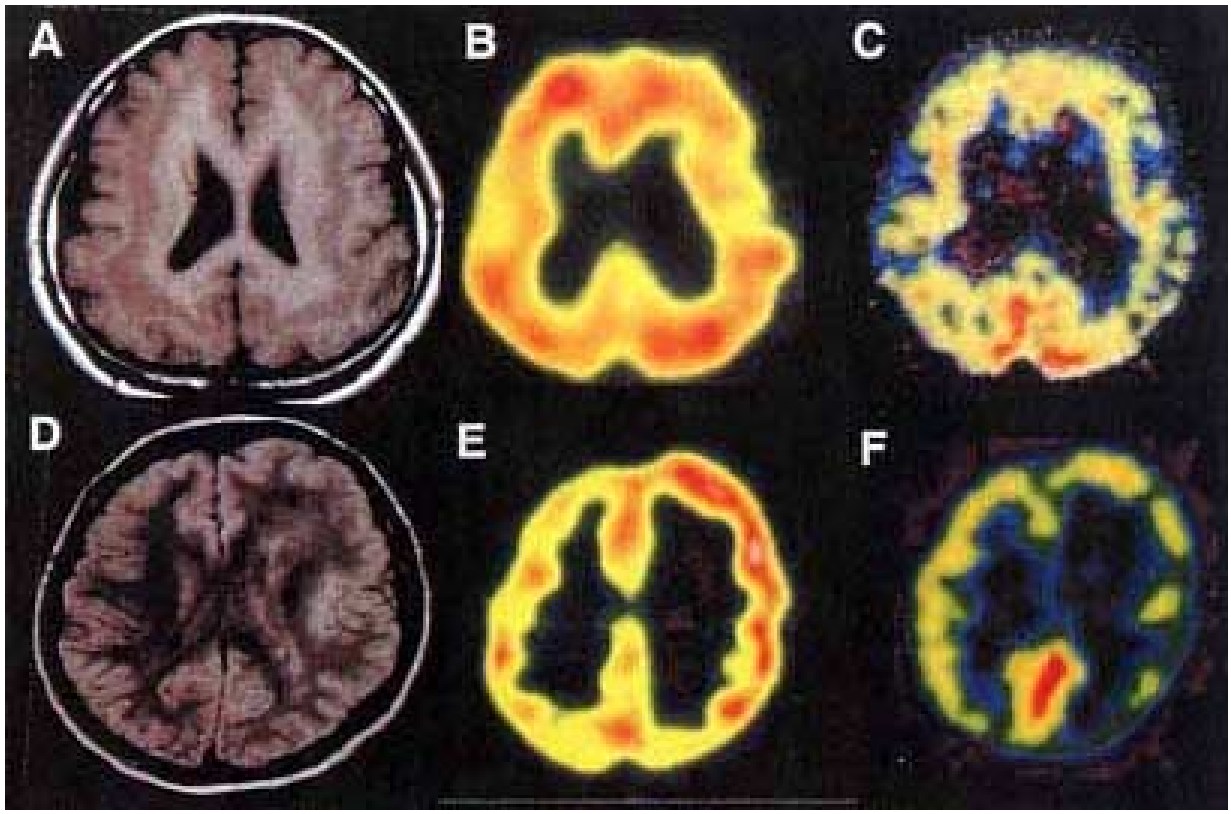


Figure 1.
Case 2: MRI(A), interictal SPECT (B), and FDG-PET (C) of bandheterotopia
FDG-PET showed hypermetabolism in subcortical heterotopic zone.
Case 4: MRI (D) , interictal SPECT (E), and FDG-PET (F) of left hemimegalencephaly. SPECT showed hyperperfusion in left hemisphere, but FDG accumulation was low.