

# Increased Contralateral Cerebellar Uptake of $^{99m}\text{Tc}$ -HMPAO on Ictal Brain SPECT

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= 국문 초록 =

## $^{99m}\text{Tc}$ -HMPAO를 이용한 발작시 뇌 SPECT상 반대편 소뇌의 섭취증가에 관한 연구

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뇌졸중환자의 뇌 SPECT 소견상 나타나는 소뇌교차해리현상(crossed cerebellar diaschisis)은 잘 알려진 현상이다. 한편 간질 환자의 발작시 뇌 SPECT에서 반대편 소뇌에 혈류증가를 보이는 역교차해리현상(reverse type of crossed cerebellar diaschisis)은 드물게 보고되었었다. 따라서 본 저자들은 발작시 뇌 SPECT에서 역교차해리현상의 빈도 및 간질병소를 찾는 데 있어서의 유용성에 대해 알아보려고 하였다.

복합부분발작환자 중 임상적, 뇌파검사상 및 SPECT 소견등에서 간질병소가 일치하는 12명의 환자를 대상으로 하였다. 환자 모두에서 시행한 발작시 스캔은 발작중 혹은 환자가 aura를 호소할때  $^{99m}\text{Tc}$ -HMPAO 15-20mCi를 정맥주입 후 시행하였으며 발작간 스캔은 11명의 환자에서 발작시 스캔 후 적어도 3일 간격을 두고 시행하였다.

간질병소는 우측측두엽이 6예, 좌측측두엽이 4예, 우측후두엽이 1예, 좌측전두엽이 1예 등이었다. 발작시 스캔상 간질병소 및 반대편 소뇌에 혈류가 증가하는 역해리현상은 모두 8명(75%)의 환자에서 나타났으며 특히 2명의 환자에서는 간질병소보다 반대편 소뇌의 동위원소 섭취가 더욱 뚜렷했다. 역해리현상을 보였던 환자의 발작간 스캔소견에서는 발작시 증가되었었던 소뇌의 동위원소 섭취가 7예에서 정상화되었고 나머지 1예에서는 감소되었었다.

따라서 소뇌의 역교차해리현상은 발작시 뇌 SPECT의 자주 볼 수 있는 현상으로 간질병소의 편측화에 도움을 줄 수 있을 것으로 생각된다.

**Key Words:** Epilepsy,  $^{99m}\text{Tc}$ -HMPAO brain SPECT, Diaschisis

## INTRODUCTION

Seizure disorder is classified into partial and generalized forms. The partial seizures begin in a

part of one hemisphere. On the other hand, generalized seizures are bilateral from the start. Partial seizures are considered to be simple when consciousness is not impaired, and complex when consciousness is impaired<sup>1)</sup>.

Medically intractable complex partial seizure is a good indication for surgical treatment, therefore identification of epileptic focus in complex partial seizures is essential for surgical treatment<sup>2)</sup>.

For the lateralization of epileptic foci, EEG, electrocorticography (ECoG) and magnetic resonance imaging(MRI) have been used. SPECT and PET were also proved to be important diagnostic tools. Recently, SPECT study is widely available in conjunction with EEG data which show high corresponding diagnostic rate in the localization of epileptic foci<sup>3,4,11)</sup>. In general, hyperperfusion or hypermetabolism is detected ictally and hypoperfusion or hypometabolism is detected interictally in seizure patients<sup>3,9)</sup>.

Cross cerebellar diaschisis(CCD) which is the phenomenon of reduction of blood flow in the contralateral cerebellum due to supratentorial lesion in stroke patients was first described by Baron et al in 1980 using PET<sup>5)</sup>. Same as the CCD in the mechanism of cerebral and cerebellar metabolic connection, reverse type of CCD (RCCD, increased uptake in both supratentorial and contralateral cerebellar area) was sporadically reported in the seizure patients during the ictal phase<sup>6,7)</sup>.

The aim of our study was to evaluate the characteristic findings of RCCD and to assess the usefulness of RCCD for localization of epileptic foci on the ictal scan.

## MATERIALS AND METHODS

Twelve patients with medically intractable complex partial seizure having congruent clinical, EEG and brain SPECT findings were included.

The patients' group consisted 9 males and 3 females, ranging from two to fifty-two years of ages(mean age ; 20 years). Seven patients underwent surgical therapy ; temporal lobectomy

in five, occipital cortisectomy in one and callosotomy in the other one. MRI was performed in 6 patients. Mesial temporal sclerosis was found in two but normal in four patients. Remaining 6 patients underwent brain CT which did not show any structural abnormality.

All patients underwent surface scalp EEG and electrocorticography was obtained in two patients.

For ictal brain SPECT, the patients were monitored by video and EEG monitoring.

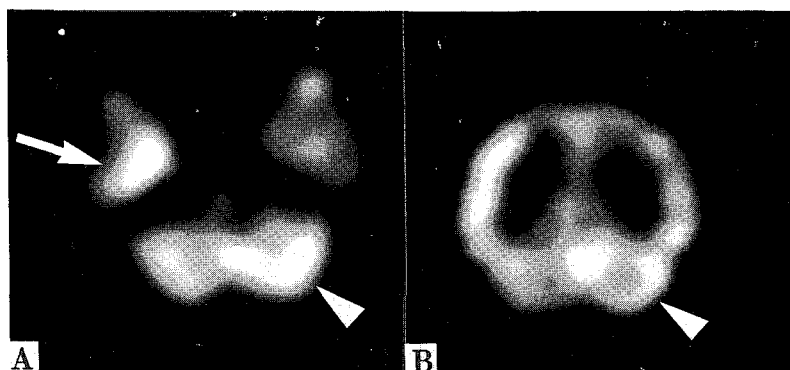
When seizure or aura were developed, 15-20mCi of <sup>99m</sup>Tc-HMPAO (0.25mCi/kg) was injected intravenously, and then the patient was transported to the nuclear medicine unit for scanning within 1 hour of injection. The scanning procedure was performed by using a single(Siemens, Orbiter 7500, Illinois, USA) or a dual-headed gamma camera (ADAC, Milpitas, CA) equipped with high-resolution, low-energy parallel-hole collimators. Sixty-four projections with an acquisition time of 40 sec/view were acquired in 64 × 64 matrices with a 5.6-degree of angular increment. Transaxial images were obtained by filtered back projection method using a Butterworth filter (Nyquist frequency 0.38cycle/cm at an order no. 5) and coronal and sagittal images were reconstructed. The slice thicknesses was 5.8mm.

Interictal scans were followed at least 3 day after the ictal scan in 11 patients.

The SPECT findings were visually interpreted

**Table 1. Location of Epileptic Foci and Incidence of RCCD**

	Epileptic focus	RCCD
Rt.temporal	6	4
Lt.temporal	4	2
Rt.occipital	1	1
Lt.frontal	1	1
Total	12	8



**Fig. 1.** Rt.temporal epilepsy in a 17-year-old female patient. Ictal brain SPECT images demonstrate typical RCCD. Transaxial(A) and coronal(B) images show increased uptakes in Rt.temporal(arrow) and contralateral cerebellum (arrowhead).

**Table 2.** <sup>99m</sup>Tc-HMPAO Activity on Interictal SPECT

	ictal foci	contralateral cerebellum
Normalize	4	7
Decreased	4	1
Total	8	8

tated blind to EEG findings by two experienced nuclear medicine specialists.

## RESULTS

Epileptic foci were found as an area of hot activity in Rt. temporal (n=6), Lt. temporal (n=4), Rt. occipital (n=1), and Lt. frontal (n=1) areas. Increased contralateral cerebellar uptake (RCCD) on ictal scan was observed in 8(75%) of the 12 pts ; Rt. temporal in four, Lt.temporal in two, Rt. occipital in one and Lt. frontal in one patient(Fig. 1).

In remaining 4 patients, there was no increased uptake in cerebellum(Table 1).

In 2 of 8 patients with RCCD, contralateral cerebellar uptake was more obviously increased than that in the epileptic foci(Fig. 2).

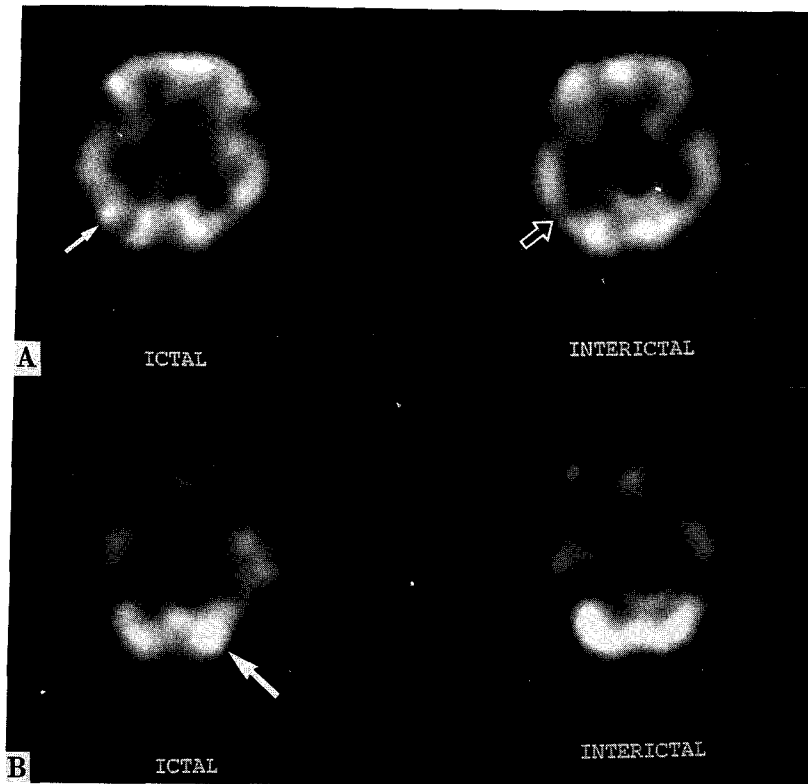
In 5 of 11 patients, interictal SPECT revealed diminished uptakes in epileptic foci. Normaliza-

tion of cerebellar activity was seen in 7 of 8 RCCD on interictal scan(Fig. 3) while diminished cerebellar perfusion was seen in remaining one (Fig. 4, Table 2).

## DISCUSSION

Crossed cerebellar diaschisis (CCD) which is a well-established SPECT findings in stroke patients, is generally considered to be a functional depression of a cerebellar hemisphere correlated with a contralateral cerebral lesion. This phenomenon is resulted from a crossing of cortico-ponto-cerebellar pathways and a functional connection between the contralateral cerebellar hemisphere and the cerebral cortex<sup>5,8,10</sup>.

On the other hand, reverse condition such as hyperperfusion or hypermetabolic state of a cerebellum can be occurred contralateral to the cerebral hemisphere which has hyperperfusion or hypermetabolism by same mechanism. Indeed, Duncan et al reported a case of focal epilepsy who had increased blood flow at the area of the epileptic focus accompanied by increased flow in the contralateral cerebellar hemisphere. They also observed on the interictal scan of that pa-

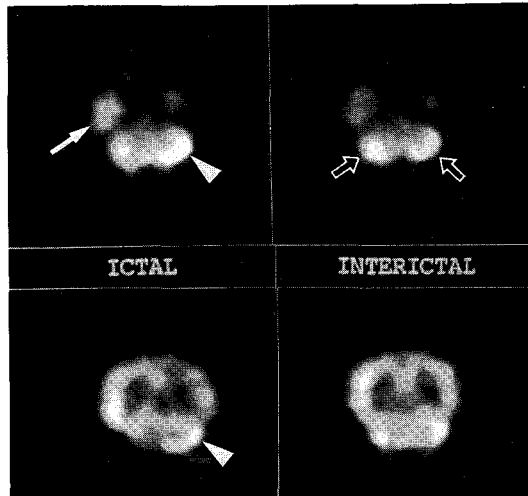


**Fig. 2.** Rt.occipital lobe epilepsy in a 17-year-old male patient.

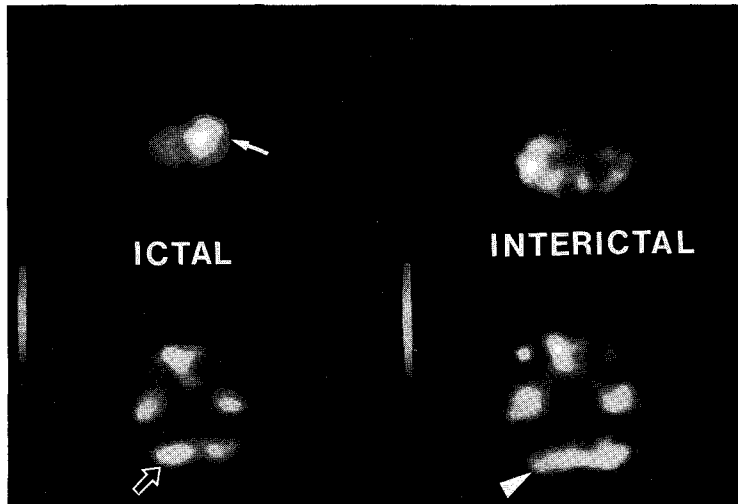
- (A) In ictal SPECT, there is subtle increased radiotracer uptake at Rt.occipital lobe (arrow). Interictal SPECT shows a focal area of decreased perfusion at the same site of occipital lobe(open arrow)
- (B) Increased uptake of contralateral cerebellum(arrow-head) is more obvious than that of the occipital epileptic focus. This case was confirmed by CEoG with grid insertion. Interictal scan shows normalization of cerebellar activity.

tient that the hyperperfused ictal focus became slightly hypoperfused and cerebellar flow was symmetrically normalized<sup>7)</sup>. Park et al. also reported a case of RCCD in partial complex seizure related to the herpes simplex encephalitis<sup>(6)</sup>. However, the frequency or clinical usefulness of RCCD was not fully established, yet. In this study, the frequency of RCCD was 75% on ictal scan. Therefore, RCCD might be described as a common finding on ictal brain SPECT in seizure patient. In two patients, the ictal scan showed

almost normal uptake within the cerebral hemisphere but a focal hot activity or diffusely increased uptake was seen within the contralateral cerebellum(Fig. 2). Surface EEG was not diagnostic. Follow up interictal SPECT showed a focal area of decreased uptake at right occipital in one and right temporal in the other one, contralateral to abnormal cerebellar uptake on ictal scan. In former case, operative ECoG with grid insertion demonstrated abnormal focal wave at Rt. occipital area, concordant with the area seen



**Fig. 3.** Rt. temporal lobe epilepsy in a 16-year-old male patient. Ictal SPECT shows increased uptake in Rt. temporal lobe (arrow) and Lt. cerebellar hemisphere (arrowhead) in left panel. Interictal SPECT shows normal activity within the cerebellum (open arrows) in right panel.



**Fig. 4.** Lt. frontal lobe epilepsy in a 4-year-old male patient. Transaxial ictal SPECT shows increased uptake in Lt. vertex (arrow) and Rt. cerebellum (open arrow). Interictal SPECT demonstrates diminished uptake in epileptic focus and Rt. cerebellum (arrowhead).

as diminished activity on interictal SPECT. Therefore RCCD aided in the lateralization of seizure foci despite lack of typical uptake pattern on ictal SPECT or surface EEG.

## CONCLUSIONS

In our study, the frequency of RCCD(in-

creased uptake in both supratentorial and contralateral cerebellar area) was 75% on ictal brain SPECT. In two patients of RCCD group, contralateral cerebellar uptake was more obvious than that in epileptic focus. RCCD is a frequent finding of ictal brain SPECT in seizure patients and it may aid in the lateralization of epileptic foci.

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