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# Appearance of ipsilateral and contralateral thalamic diaschisis together with Crossed Cerebellar Diaschisis viewed from brain perfusion images in a case with acute ischemic stroke

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**Abstract**
Crossed Cerebellar Diaschisis (CCD) and Ipsilateral Thalamic Diaschisis (ITD) are the hypoperfusion/hypometabolism of contralateral cerebellum and ipsilateral thalamus due to the distant cortical or subcortical lesions. In this case, we utilized the Single Photon Emission Computed Tomography (SPECT) to identify the two aforementioned diseases. From the SPECT images, the cerebral blood flow (rCBF) in the right hemisphere of cerebrum was more than the left one and the rCBF of left (ipsilateral) thalamus decreased as well. However, the hypoperfusion of right-sided (contralateral) thalamus exists in the images simultaneously. To the best of our knowledge, it is the first case that shows CCD with ipsilateral and contralateral diaschisis observed from SPECT in a stroke case. In addition, there are more evidence manifesting the difference between ipsilateral and contralateral thalamic diaschisis.

**Keywords:** cerebellar diaschisis; ipsilateral thalamic diaschisis; contralateral thalamic diaschisis; single photon emission computed tomography

## Introduction

Diaschisis is a phenomenon that a focal lesion in cortical or subcortical area influenced the hypoperfusion and hypometabolism of the remote area [1]. It is common when suffering from problems in central nervous system, particularly in a stroke case [2]. Based on the research in these few years, there are many different types of diaschisis. Clinically, there are two issues provoking a strong sense of resonance called Crossed Cerebellar Diaschisis (CCD) and Ipsilateral Thalamic Diaschisis (ITD).

CCD is a common type of diaschisis and due to the interruption of cortico-ponto-cerebellar tracts [3, 4]. Nowadays, it was consistently discovered in many diseases, including stroke [5, 6], diffuse large B cell lymphoma [7], epilepticus [8] and Alzheimer's disease [9]. Moreover, it can only be diagnosed by Single Photon Emission Computed Tomography (SPECT).

ITD was another type of diaschisis, which is the hypoperfusion of thalamus due to distant lesions in brain but seems not to be related to thalamic infarction [10]. In addition, the most common case of ITD was in the patients suffering from stroke. Nonetheless, there was little study showing the coexistence of ipsilateral and contralateral thalamic diaschisis. There were only two articles indicating hypoperfusion in the bilateral thalami, one for Japanese encephalitis [11] and the other for epilepsy [12]. We herein introduce a case with appearance of CCD and ITD after stroke episode.

**Case Presentation**

A 62-year-old lady without any history or drug use was afflicted by severe headache, which gradually converted into dysarthria, and finally experienced the right-sided limbs weakness at home. At this scene, her family members called ambulance to sent her to Emergency Department (ED) of Kaohsiung Veterans General Hospital on January 14 night, 2022. At ED, she still had clear consciousness, GCS score is E4V5M6. The muscle power of right upper limb was 1/5, and right lower limb was 2/5. The muscle power of left-sided limbs was 5/5. Acute stroke was highly suspected, and ED doctors arranged the computed tomography (CT) scan immediately. Brain CT showed possible infarction at left periventricular white matter and the high density lesion at M2 segment of left middle cerebral artery (MCA). Moreover, there are several small infarctions scattering into left frontotemporal area and right caudate nucleus. During that time at ED, she was given with the anti-coagulants and adequate fluid supplement, therewith was admitted to the neurological ward for further observation.

After hospitalization, the MRI of brain showed acute ischemic infarctions at left periventricular white matter and several small acute ischemic infarctions scattered at left frontotemporal area, with high signal intensity on T2WI, FLAIR, and DWI, and lower apparent diffusion coefficient. Moreover, there were also several tiny hyperintensities in the periventricular white matter regions on T2WI and FLAIR, which may be gliosis, demyelination or tiny old ischemia or tiny previous brain insult. Furthermore, the tiny and old ischemic infarction or previous brain insult involved in right caudate nucleus, and the bilateral lateral ventricles showed symmetrical without dilatation and there was an occlusion of one branch of left M2 in complex.

Subsequently, she was transferred to Rehabilitation (REH) Ward on January 23. In REH, A brain imaging study using Technetium-99m ethyl cysteinate dimer single photon emission computed tomography (SPECT) was performed to evaluate regional perfusion and showed a recent ischemic insult with penumbra in left frontal, parietal, and temporal regions, together with hypoperfusion in the right-sided cerebellum than the left one (Figure 1). Interestingly, there was relatively decrease hypoper fusion in left basal ganglion and bilateral thalami (Figure 2).

Her physical situation made a slight progress. She was then discharged and planed to conduct home care in domestic nursing home. A timeline table of our case was shown in Figure 3.

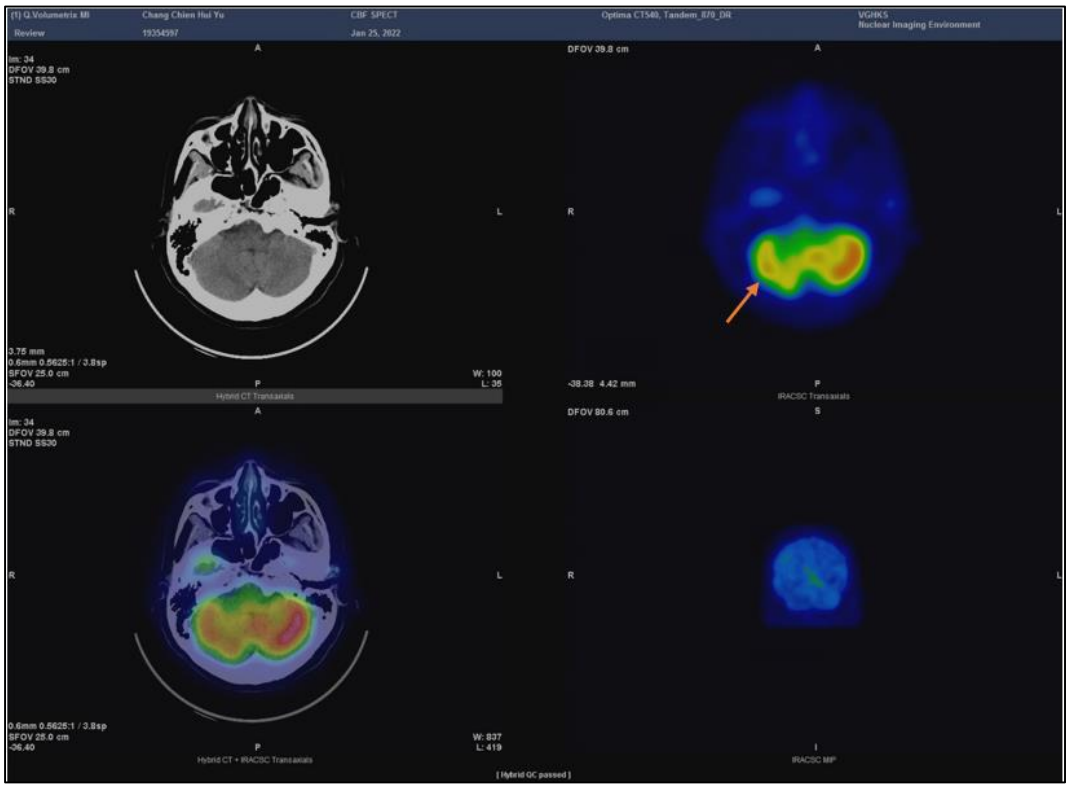

**Fig 1:** Axial view of Tc-99m ethyl cysteinate dimer (ECD) brain perfusion SPECT study. A decreased uptake of the tracer can be seen in the right cerebellum (arrow). Left upper panel: CT image. Right upper panel: SPECT image. Left lower panel: hybrid image of SPECT and CT.

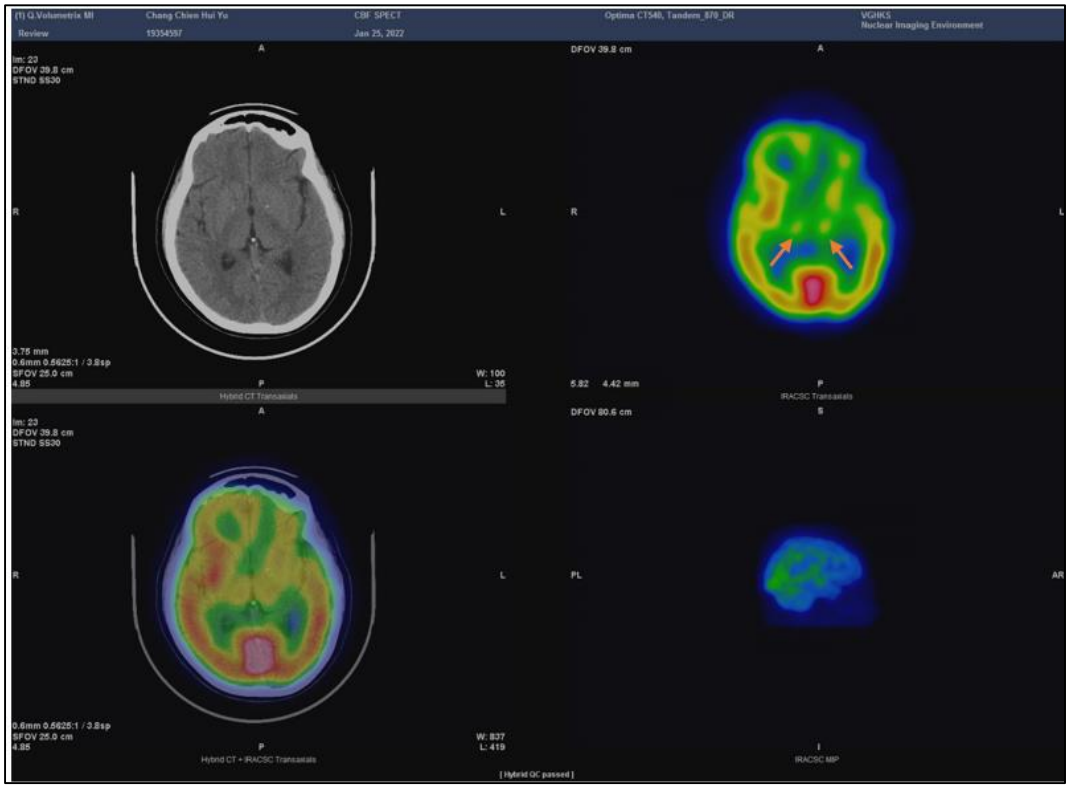

**Fig 2:** Axial view of Tc-99m ethyl cysteinate dimer (ECD) brain perfusion SPECT study. A decreased uptake of the tracer can be seen in the bilateral thalami (arrows). Left upper panel: CT image. Right upper panel: SPECT image. Left lower panel: hybrid image of SPECT and CT.

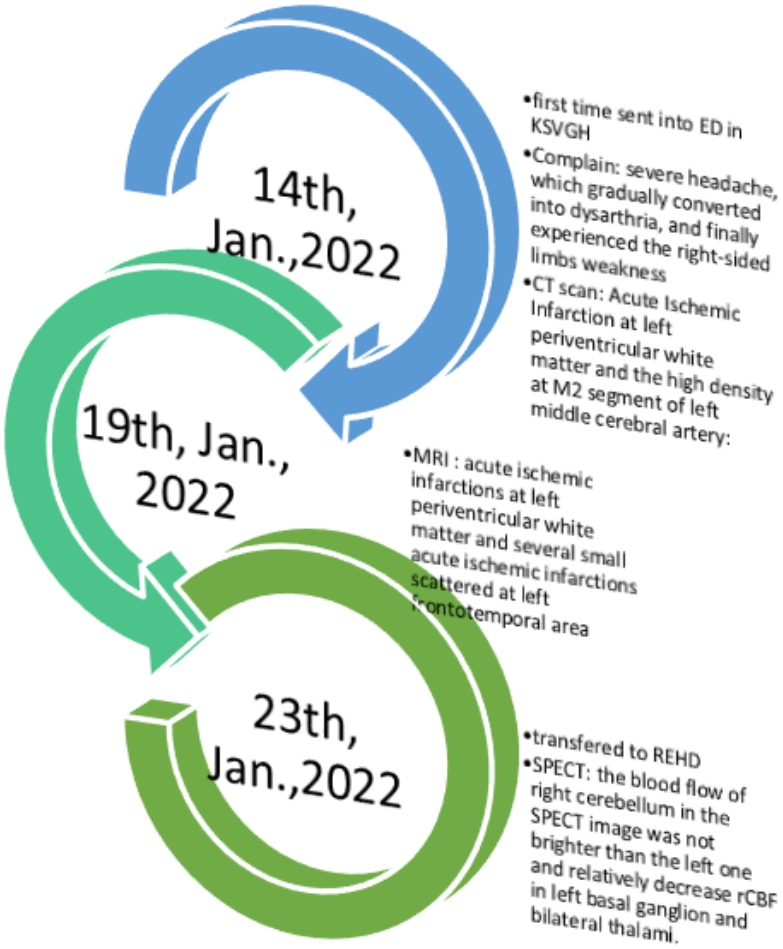


**Fig 3:** Timeline table of our case.

## Discussion

CCD is a perfusional lesion with lack of blood flow in one-sided cerebellum after lesion occurred in contralateral cerebrum [13], which could be confirmed from the images of cerebellum manifesting less vivid in the right one than the left (Figure 3). Simultaneously, relatively hypoper fusional areas were observed in left basal ganglion and the bilateral thalami (Figure 2). The thalamic hypoper fusion was rare reported in bilateral sides. In fact, there are several articles discussing CCD associated with unilateral (ipsilateral) thalamic lesion in SPECT images. However, there was little article linking CCD with hypoper fusion in bilateral thalamus. To our knowledge, there was combination of CCD with ipsilateral and contralateral thalamic diaschisis found in SPECT images of our case.

In fact, CCD is a negative predictor for motor and postural outcomes, for instance, in situations of shoulder subluxation [14] and postural asymmetry [15]. SPECT is an effective tool to find the abnormality in the brain. Nowadays, SPECT was utilized in assessing the outcome in many diseases.

With respect to the appearance of hypoperfusion in bilateral thalami in the SPECT images, it occurred due to the infarction of MCA, seemed to not correlate with CCD, and its phenomenon has been mentioned by several articles [16]. In fact, the phenomenon has been called as ipsilateral thalamic diaschisis (ITD), which is thalamic hypoperfusion due to distal cerebral lesion(s) [17], and is highly correlated with ischemia in basal ganglia and thalamus in the acute phase of stroke. [10, 16]. Our case had similar situation, as Figure 2.

Researchers have confirmed the neurological outcomes of the patients with ITD were worse than those without ITD, based on the evidence of less perfusion in the caudate nucleus, internal capsule, and lentiform nucleus [10]. Nonetheless, it was also irrelevant with the outcome of stroke [10]. ITD was reported to be associated with olfactory disturbance in a case of ischemic stroke, and plays a role in the olfactory sensation [18]. Our case might have smelling disturbance, but it was difficult in to verify due to poor communication after aphasia. In order to tell the outcome if thalamic hypoperfusion occur in ipsilateral side or bilateral sides, more evidence was needed to provide.

## Conclusion

To the best of our knowledge, it was the first case to illustrate ipsilateral and contralateral thalamic hypoperfusion together with right CCD viewed from the brain SPECT. The brain SPECT might be a useful tool to see the brain circulation in the field of scintigraphic rehabilitation.

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