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Central European Journal of Experimental Biology, 2021, 9 (4): 01-05
(http://scholarsresearchlibrary.com/archive.html)

ISSN:2278-7364

Coexistence of Ipsi-and Contralateral Cerebellar Diaschisis in Adult Intraparenchymal Hemorrhage: Manifestation of Brain Perfusion Image

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ABSTRACT

It is common to find brain profusion changes after head injury or other cerebrum events. Among them, Crossed Cerebellar Diaschisis (CCD) might affect patients' long-term prognosis. Ipsilateral Cerebellar Diaschisis (ICD) revealed lower incidence with unknown effects for recovery. Both can be detected by brain perfusion scintigraphy. In this article, we present the case of a 50-year-old male with headache attack months ago. Intraparenchymal hemorrhage of brain was diagnosed with a right ruptured aneurysm. Poor improvement of left side hemiplegia after operation, we arranged brain perfusion scan for further evaluation. Images disclosed hypoperfusion in right frontal lobe and bilateral cerebellum area. There were no studies about CCD and ICD occurred at the same time. We speculated that ICD as well as CCD can affect the patient long-term motor outcomes compared with those without phenomenon of ICD.

Keywords: Crossed cerebellar diaschisis, Ipsilateral cerebellar diaschisis, Intraparenchymal hemorrhage, Coexistence, Intracerebral hemorrhage, Single-photon emission computed tomography.

INTRODUCTION

Diaschisis is a form of focal cerebral damage with 'reduction of excitability' or 'functional standstill' of distant brain areas, which had no relation to the lesion [1]. Both Crossed Cerebellar Diaschisis (CCD) and Ipsilateral Cerebellar Diaschisis (ICD) have manifested themselves as changes of blood flow around cerebellar area, occurring in patients who underwent stroke, tumor or encephalitis [2,3]. The real lesion in cerebellum is not fulfilled the definition of cerebellar diaschisis, such as infarction or hemorrhage, although it also will result in dysfunction of cerebellar blood flow [4-7]. There are few case reports and no statistics of ICD after brain injury. Its long-term influence is unclear. We present herein a case of hemorrhagic stroke, in which the brain perfusion Single Photon Emission Computed Tomography (SPECT) disclosed CCD and ICD at the same time one month after the accident.

CASE REPORT

A 50-year-old male, without any known congenital anomaly of brain, had a personal history of hypertension and chronic obstructive pulmonary disease. He presented with initial headache and cold sweating starting on the afternoon of January 3, 2021; he was admitted to our Emergency Department (ED) that evening.

His vital sign was E1V1M1. Preventive Intubation was executed due to his falling into a coma state. Computed Tomography (CT) scan of brain disclosed a high-density intraparenchymal hemorrhage in right frontal lobe, about 6.5 × 4 × 4 (cm) (52 cc), with rupture into right lateral ventricle, and mass effect causing midline shift to left side, confirming as Intracerebral Hemorrhage (ICH). Simultaneously, high-density images were observed in the basal cistern, prepontine cistern, ambient cistern, and anterior interhemispheric fissure, and Subarachnoid Hemorrhage (SAH) was confirmed, which was caused by rupture of the aneurysm at M1 segment of right middle cerebral artery after brain Computed Tomography Angiography (CTA). He underwent right fronto-temporo-parietal craniectomy for clipping of the aneurysm. The patient was successfully weaned of ventilator a few days ago, and was discharged under stable condition on February 9, 2021(Figure 1).

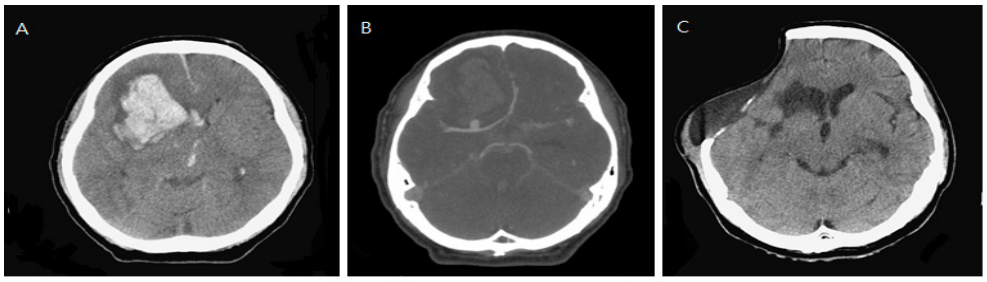

Figure 1. Images of brain of the patient before and after the operation

He visited our rehabilitation clinics on February 17, 2021 for his left-sided limb hemiplegia. After admission, muscle strength was found to be 2 in the left hand and 3 in the foot, and about 4 to 5 in the right hand and foot. He showed severe dependence on care in his daily activities due to poor recovery of motor function. Technetium-99m ethyl cysteinate dimer (Tc-99m-ECD) SPECT was arranged and showed decreased perfusion in residual right frontal lobe, basal ganglion, thalamus, left prefrontal cortex, as well as the left-sided and right-sided cerebella (Figure 2). To date, rehabilitation therapy is still ongoing.

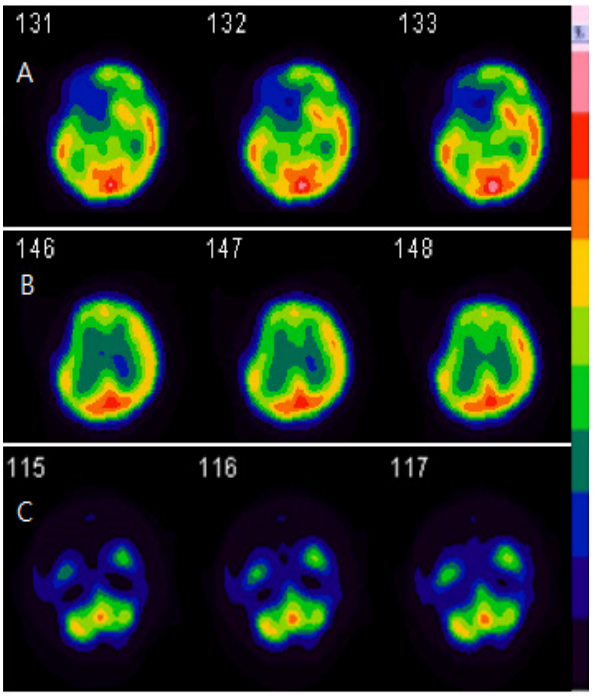

Figure 2. Brain perfusion 99mTc-ECD SPECT images obtained.

DISCUSSION

The brain SPECT of our case with SAH and ICH shows obvious decreased uptake on the left-sided and right-sided cerebella. Therefore, CCD and ICD seemed co-exist in such a situation. To our knowledge, this is the first case to demonstrate hypoperfusion of cerebellum in the ipsilateral and contralateral sides on SPECT images after an episode of ICH.

The phenomenon of CCD was first described by Baron et al. in 1980 [8,9]. It is widely believed that CCD is associated with change in blood flow and metabolism in the unharmed cerebellum area contralateral to a local injured supratentorial brain cortex,

usually an infarct, but it can also be attributed to uncontrolled seizures, radiation necrosis, tumor, carbon monoxide intoxication, and midbrain hemiatrophy [10-17].

With respect to the symptom associated with CCD, it revealed almost asymptomatic without specific cerebellar symptoms in the acute stage; namely, neurological deficit or motor dysfunction should first be considered to be caused by initial supratentorial lesions [18,19], except sleep disturbance [20]. In the subacute or chronic stage, CCD has been demonstrated as behavior deficits and decreased motor function restoration, for instance, parakinesia brachialis oscitans [21], shoulder subluxation [14], postural imbalance [22], and complex regional pain syndrome [23]. Sin et al. [3] studies seventy-four patients with ICH with measuring by the Fugl-Meyer Assessment, and found that, ended up with CCD, nearly half of those patients had poorer improvement of motor function than those without CCD [3].

As mention the mechanism of CCD, interruption of cortico-ponto-cerebellar pathway is regarded as decreased excitatory input to cerebellum [24]. In another way, outputs away from cerebellum, either spinocerebellar [25] or dentato-rubro-thalamo-cortical tract [10] are also associated with CCD.

In contrast to CCD, ICD is a relatively rare phenomenon, and the correlation between ICD and age is unclear. In infant and children, Hamano, et al., the first report of ICD, found that ICD can be found in those before 6 years' old who had brain injury such as acute SDH in the perinatal period or infancy, or acute hemiplegia in childhood [2]. Based on the fact of the developing time of vestibulo, spino, olivo, and reticulo-cerebellar fibers was from eighth fetal month to third postnatal month [26], ICD was theorized to be associated with the dysfunction of fibers in cerebellar peduncles [2]. In teenagers and adults, although CCD is more common than ICD, ICD still can be observed in hospitalized patients with severe head injury, such as SAH and cerebral focal or diffuse lesion like intraparenchymal hemorrhage [27], infarct brain [28], and in disease of mitochondrial encephalomyopathy with lactic acidosis and stroke like episodes (MELAS) [29]. On the other hand, the infarcts of medulla and pons can also lead to ICD [30]. As stated above, the cortico-ponto-cerebellar tract is highly relevant to CCD, if the pontine nuclei are damaged, it may cause CCD [31,32]. Moreover, the lesions of other fibers like caudal or lateral tissue that comprise middle cerebellar peduncle will cause ICD [30]. There was less definite clinical appearance of ICD till now, except scoliosis [33]. Because the tract of ICD is close to CCD, we cannot exclude the possibility that, like CCD, it would affect motor outcomes and long-term recover of our patient.

Brain SPECT/PET had been applied in clinical for diagnosis of CCD. This phenomenon can be disclosed by Positron Emission Tomography (PET) within 3 hours of stroke, which can play a role in clinical evaluation of reperfusion therapies and outcomes follow-up [34-36]. In contrast, there are fewer reports for ICD diagnosed by SPECT due to low incidence of ICD, except disease of MELAS [29] and the study of Hamano, et al. [2]. So far, there is no enough information indicating the exact time interval appeared from onset of brain lesion to the development of ICD. In summary, there is no denying that SPECT is still a relevant technique to assess ICD in the clinical practice. More interesting fact is occurrence of CCD and ICD together by brain SPECT in our case.

There are some limitations of this case report. The first is that SPECT was not done after the hemorrhage in the early time; it was conducted one month later. We are unable to compare the images with initial perfusion condition. Hence, we are unable to confirm coexistence of CCD and ICD initially or one of them came up first. Second, because of less evidence, it is still unclear for symptoms of subacute or chronic ICD.

In conclusion, the phenomena of CCD and ICD coexisted in our case with ICH in subacute stage, manifesting from brain perfusion image. The hypothesis of CCD/ICD needs more studies and follow-up. The brain perfusion SPECT plays a crucial role in assessing disease outcome in the field of scintigraphic rehabilitation.

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