

# Crossed cerebellar diaschisis

Crossed [cerebellar diaschisis](#) reflects left-to-right asymmetry of metabolism in the cerebral hemispheres.

In patients with steno-occlusive disease, recent findings suggest that hemodynamic alterations may also be associated with crossed cerebellar diaschisis (CCD) rather than a functional disruption alone.

Purpose: To use a quantitative multiparametric hemodynamic MRI to gain a better understanding of hemodynamic changes related to CCD in patients with unilateral anterior circulation stroke.

Study type: Prospective cohort study.

Population: Twenty-four patients (25 datasets) with symptomatic unilateral anterior circulation stroke.

Field strength/sequence: 3T/two sequences: single-shot (echo-planar imaging) EPI sequence and T2 \* gradient echo perfusion-weighted imaging study.

Assessment: The presence of CCD was inferred from the cerebellar asymmetry index (CAI) of the blood oxygenation-level dependent cerebrovascular reactivity (BOLD-CVR) exam, which was calculated from the mean BOLD-CVR and standard deviation of the CAI of the healthy control group. For all perfusion-weighted (PW)-MRI parameters, the cerebellar and middle cerebral artery (MCA) territory asymmetry indices were calculated.

Statistical tests: Independent Student's t-test to compare the variables from the CCD positive(+) and CCD negative(-) groups and analysis of covariance (ANCOVA) to statistically control the effect of covariates (infarct volume and time since ischemia onset).

Results: CCD was present in 33% of patients. In the MCA territory of the affected hemisphere, BOLD-CVR was significantly more impaired in the CCD(+) group as compared to the CCD(-) group (mean BOLD-CVR  $\pm$  SD [%BOLD signal/ $\Delta$ mmHgCO<sub>2</sub>]:  $-0.03 \pm 0.12$  vs.  $0.11 \pm 0.13$ ,  $P < 0.05$ ). Moreover, the mean transit time (MTT) (asymmetry index (%)) CCD(+) vs. CCD(-):  $28 \pm 23$  vs.  $4 \pm 11$ ,  $P < 0.05$ ) and time to peak (TTP) ( $10 \pm 10$  vs.  $2 \pm 5$ ,  $P < 0.05$ ) in the MCA territory of the affected hemisphere were significantly prolonged, while cerebral blood volume was, on average, increased in the CCD(+) group ( $25 \pm 15$  vs.  $4 \pm 19$ ,  $P < 0.05$ ).

Data conclusion: Our findings show that, in patients with symptomatic unilateral anterior circulation stroke, CCD is associated with hemodynamic impairment in the ipsilateral MCA territory, which further supports the concept of a vascular component of CCD.

Level of evidence: 3 TECHNICAL EFFICACY STAGE: 3 <sup>1)</sup>.

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Yoshida et al., present a case of a 67-year-old woman who developed [transient aphasia](#) 3 days after the onset of a mild [acute subdural hematoma](#). [Computed tomography](#) scan and [magnetic resonance imaging](#) during aphasia did not show enlargement of the [hematoma](#) or any new [lesions](#). [Electroencephalography](#) did not show any abnormalities. Early images of [123I-Iomazenil SPECT](#) 3 days after the onset of [aphasia](#) revealed a decrease in [radioactivity](#) in the right [cerebellar hemisphere](#) relative to that in the left cerebellar hemisphere. Late images of the same <sup>123</sup>I-IMZ SPECT displayed a decrease in radioactivity in the left cerebral hemisphere relative to that in the right cerebral

hemisphere. Twenty-four days later, the aphasia disappeared and the left-to-right asymmetries of radioactivity in the cerebellar and cerebral hemispheres on the early and late <sup>123</sup>I-*Iomazenil* SPECT images also resolved <sup>2)</sup>.

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A case of hydrocephalus in which a crossed cerebellar diaschisis with single photon emission CT (SPECT) using <sup>123</sup>I-iodoamphetamine (<sup>123</sup>I-IMP) disappeared by a ventriculo-peritoneal shunting operation, was reported. A 54-year-old female had a clipping surgery for an aneurysm of the left middle cerebral artery on April 9, 1987. Post-operatively, she had a transient mild aphasia. Cerebral blood flow (CBF) study with <sup>123</sup>I-IMP-SPECT had showed low perfusion in the left frontal and temporal lobe. But after a month, clinical symptom and CBF findings had improved. She had been doing well after the discharge until October, 1987, when she developed disorientation. CT on re-admission showed the ventricular dilatation with periventricular low density (left greater than right). <sup>123</sup>I-IMP-SPECT study showed the crossed cerebellar diaschisis which was a low perfusion in the left frontal, temporal, parietal, thalamus, basal ganglionic area and in the opposite cerebellum. A ventriculo-peritoneal shunting operation was performed which brought the disappearance of the crossed cerebellar diaschisis and the clinical improvement. The phenomenon of crossed cerebellar diaschisis has been reported in a lot of literatures. However, those diseases were located in unilateral supratentorium. It has been speculated that crossed cerebellar diaschisis is the transneuronal metabolic change through the cortico-ponto-cerebellar pathway by supratentorial lesion. Crossed cerebellar diaschisis in hydrocephalus has not been reported so far <sup>3)</sup>.

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The lipophilic brain SPECT agent [<sup>99m</sup>Tc]hexamethyl propylene amine oxime (HM-PAO) was used in three cases before and during unilateral anesthesia of one hemisphere for lateralization of speech dominance (Wada test). This procedure led to a decrease of regional cerebral blood flow (rCBF) in each of the hemispheres to 55 and 90%, respectively. Diminution of rCBF was significantly more pronounced in the dominant hemisphere. A second phenomenon observed during the Wada test was crossed cerebellar diaschisis. These findings support the assumption that HM-PAO allows monitoring of brain perfusion, as rapid changes of rCBF due to decreased neuronal activity cause respective alterations of cerebral and cerebellar uptake of this new brain agent <sup>4)</sup>.

<sup>1)</sup>

Sebök M, van Niftrik CHB, Piccirelli M, Muscas G, Pangalu A, Wegener S, Stippich C, Regli L, Fierstra J. Crossed Cerebellar Diaschisis in Patients With Symptomatic Unilateral Anterior Circulation Stroke Is Associated With Hemodynamic Impairment in the Ipsilateral MCA Territory. *J Magn Reson Imaging*. 2020 Oct 28. doi: 10.1002/jmri.27410. Epub ahead of print. PMID: 33118301.

<sup>2)</sup>

Yoshida J, Komoribayashi N, Oikawa K, Ohmama S, Kojima D, Shimada Y, Ogasawara K. [<sup>123</sup>I-*Iomazenil* Single-Photon Emission Computed Tomography Imaging in a Patient with Mild Traumatic Subdural Hematoma Accompanied by Delayed Transient Aphasia]. *No Shinkei Geka*. 2018 Dec;46(12):1081-1086. doi: 10.11477/mf.1436203872. Japanese. PubMed PMID: 30572305.

<sup>3)</sup>

Abe M, Kanaoka N, Nonomura K, Kawase T, Sano H, Kanno T, Toyama H. [Crossed cerebellar diaschisis in hydrocephalus—a case report]. *No To Shinkei*. 1989 Nov;41(11):1085-90. Japanese. PubMed PMID: 2620009.

<sup>4)</sup>

Biersack HJ, Linke D, Brassel F, Reichmann K, Kurthen M, Durwen HF, Reuter BM, Wappenschmidt J, Stefan H. Technetium-<sup>99m</sup> HM-PAO brain SPECT in epileptic patients before and during unilateral hemispheric anesthesia (Wada test): report of three cases. *J Nucl Med*. 1987 Nov;28(11):1763-7.

PubMed PMID: 3499495.

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Last update: **2024/06/07 02:57**

