Acta Med. Okayama, 2023
Vol. 77, No. 3, pp. 319–321

Acta Medica Okayama
http://escholarship.lib.okayama-u.ac.jp/amo/

Case Report

Cerebral Hypoperfusion Detected by Arterial Spine-Labelled MR Imaging in a Patient Presenting with Migraine and Panic Attacks

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I report a case of arterial spine-labelled MR imaging (ASL)-detected cerebral hypoperfusion during migraine and panic attacks. A 20-year-old woman with a history of headache for 6 years and independent panic attacks for 3 years was transferred to Okayama Kyokuto Hospital for panic attacks. On that day, she had had severe headache that was improved by taking non-steroidal anti-inflammatory drug, but panic attacks initiated. On arrival, she also complained of a mild headache. ASL revealed cerebral hypoperfusion in the right temporo-occipital region. The threshold to induce panic attacks in migraine patients could be lowered by the physiopathology underlying migraine attacks.

Key words: migraine, panic attack, arterial spine-labelled magnetic resonance imaging, aura, cortical spreading depression

Arterial spine-labeled MR imaging (ASL) can be used to visualize cerebral perfusion. Migraine attacks have been postulated to cause trigeminal hypersensitivity induced secondarily to cortical spreading depression (CSD), or a wave of cortical neuronal excitation followed by inhibition. Several authors have reported changes in cerebral perfusion during migraine attacks detected by ASL [1-4]. Serial imaging studies [1] have revealed that focal cerebral hypoperfusion can be detected after a migraine aura is first felt, sometimes accompanied by arterial thinning of the corresponding region. Such hypoperfusion may turn into hyperperfusion 5.5 to 24 h after the onset of neurologic symptoms [1, 3, 4]. Here, we report the longitudinal ASL findings of a patient who presented with migraine and panic attacks.

Case Report

A 20-year-old woman was transferred to the Okayama Kyokuto Hospital because of panic attacks. She had a history of migraine attacks, often with scintillating scotoma, almost twice a year for the last 6 years. She had also presented with panic attacks once a year over the last 3 years. Her panic attacks occurred when she had trouble with her interpersonal relationships. One month prior to admission, repeated attacks of transient one-sided numbness in the hand and/or foot, with or without headache, were noted. On the day of admission, she had a severe headache at around 9 AM that resolved within 3 h after a non-steroidal anti-inflammatory drug was administered. However, at that time, around noon of the same day, she developed panic attacks accompanied by hyperventilation without any interpersonal trouble and was transferred to Okayama Kyokuto Hospital. She also complained of a mild headache in the right forebrain, pain in the right

Received September 20, 2022; accepted December 7, 2022.
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Conflict of Interest Disclosures; Kenichi Kashihara has received honoraria from Kyowa Kirin, Otsuka Pharm, Ono Pharm, and Takeda Pharm.

eye, bilateral numbness in the hands and feet, and nausea. Visual aura was not a complaint at this time.

Intramuscular injection of hydroxyzine hydrochloride controlled the panic attack. She was thus admitted to the hospital for symptom follow-up. MR was performed at approximately 4:00 PM, which revealed a normal brain and intracranial arteries (Fig. 1). ASL showed temporo-occipital hypoperfusion in the right hemisphere of the brain, not confined to a single vascular territory (Fig. 2A). This region converted to hyperperfusion within 24 h, when no migraine symptoms remained (Fig. 2B).

The combined attacks of headache and panic were also noted in at least the following two migraine attacks which occurred 7 and 10 months later.

Ethical conduct statement. This study was conducted in accordance with the Declaration of Helsinki. The study design was approved by the appropriate ethics review board of Okayama Kyokuto Hospital, and the patient provided informed consent for publication of this report.

Discussion

The present patient had a history of migraines with visual aura. Repeated attacks of transient one-sided numbness in the hand and/or foot may have been part of the migraine aura. Bilateral numbness in the hands and feet, which was a complaint on the day of the MR study, may have been caused by hyperventilation due to panic attacks. Thus, the diagnosis of the present patient should be migraine with aura.

Migraine attacks are associated with CSD [5]; changes in brain function are known to occur from the premonitory phase, accompanied by shoulder stiffness, fatigue, depression, *etc.* [6]. Brain hypoperfusion detected by ASL in the present study may also represent CSD, and the subsequent hyperperfusion may represent vascular dilatation.

No apparent neurologic symptom such as visual aura or hemiplegia was noted in association with hypoperfusion in the right brain on the day of the present MR study. Pain in the right eye, as well as headache, may have been initiated by trigeminal sensitization induced by physiological chemical mediators such as the calcitonin gene-related peptide released by CSD [7].

Panic attacks frequently occur in migraine patients [8,9]. Blau [10] reported four patients who presented panic attacks during the headache phase of migraine. Terlevic *et al.* [11] suggested that these migraine-related panic attacks were associated with dysfunction of the hypothalamus. Stankewitz *et al.* [12] reported the predominant role of the hypothalamus in generating migraine attacks. They suggested the loss of hypothalamic control over limbic structures during the headache phase [12]. Results of the present study indicate that CSD may be associated with both headaches and panic attacks. Dysfunction of the hypothalamus of the present patient could have been induced by CSD associated with migraine attacks, which in turn lowered the threshold for provoking panic attacks. Thus, a panic

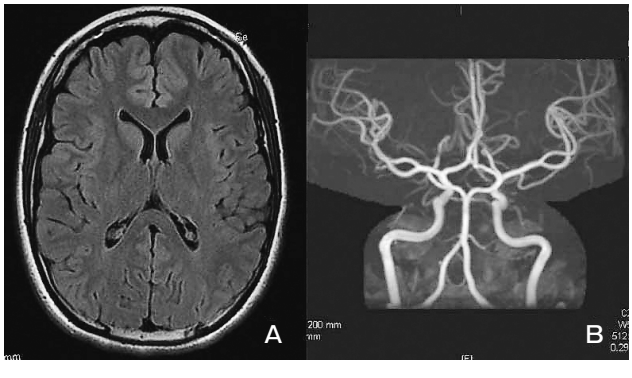

Fig. 1 MR imaging of the brain (A) and cerebral arteries (B). No abnormalities are detectable.

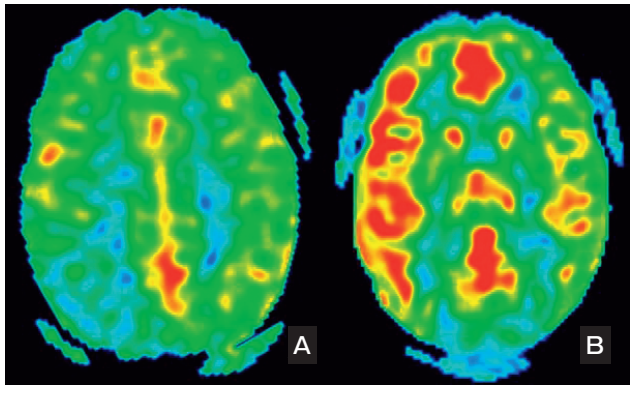

Fig. 2 Arterial spine-labelled MR imaging (ASL) in a patient with migraine presenting with panic attack. A, ASL performed 7 h after the initial sign of headache and 4 h after panic attacks began. The perfusion map shows marked right temporo-occipital hypoperfusion; B, ASL performed 24 h after the first MRI. The perfusion map shows hyperperfusion in the right hemisphere of the brain.

attack could be considered part of the migraine aura or CSD-related symptom in the present patient.

Migraine aura has been described to occur after the prodromal phase and just before the headache phase, sequentially [13]. Results of the present study suggest that the CSD or aura phase may exist during or even after the headache phase as well as before it. Such results support the idea of Peng and May [14], who do not consider aura a separate phase of the migraine phenomenon.

Another point of interest in the present study was the hyperperfusion region detected by the second ASL (Fig. 2B), when no headache remained. The first ASL (Fig. 2A), performed during headache and soon after hydroxyzine control of panic attacks, showed hypoperfusion. Moskowitz *et al*. [15] presented the trigeminovascular theory to explain migraine headaches, by which trigeminal nerves innervating the cephalic blood vessels were postulated to mediate vasodilatation and pain. ASL findings of the present patient, however, indicated that cerebral hyperperfusion or vessel dilatation may not necessarily be associated with migraine headache.

Conclusion

Panic attacks in patients with migraine can be induced as a consequence of migraine-related changes in brain function. Future studies of cerebral blood flow during migraine-related panic attacks will provide further insight into this issue

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