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Case report

A rare incidence of acute ischaemic stroke with reversible middle cerebral artery occlusion in a methamphetamine addict: Case report

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ABSTRACT

Background: Methamphetamine is an illegal drug that poses serious public health concerns worldwide. Previous studies have demonstrated a strong association between methamphetamine abuse and non-lethal haemorrhagic stroke. Ischaemic stroke after methamphetamine intake is less common than haemorrhagic stroke. The present study investigated the clinical features and potential pathogenesis in a young methylamphetamine addict that presented with acute ischaemic stroke and reversible middle cerebral artery (MCA) occlusion.

Methods: A retrospective data analysis was performed for the young methylamphetamine addict admitted to a hospital for acute ischaemic stroke followed by a literature review to explore the possible pathogenesis.

Results: The patient had been receiving methamphetamine for past 2 years. His recurrent headache occurred half an hour after each consumption and was relieved within a few hours. The patient was admitted for acute ischaemic stroke. Urine toxicology screening was positive for methamphetamine. Magnetic resonance angiography revealed occlusion of the right MCA. After discontinuing medication and routine treatment, digital subtraction angiography revealed normal blood flow in the right MCA, indicating reversible MCA occlusion.

Conclusion: For young patients with a stroke, a thorough investigation of the history of illicit drug use and toxicological screening of urine and serum samples should be performed. Young methamphetamine users need to be aware of the elevated risk of stroke as well as early signs and symptoms. Transient headaches in young methamphetamine users may be caused by cerebral vasospasms, suggesting the possibility of future catastrophic stroke events.

1. Introduction

Methamphetamine, a widely used illegal drug, has become a significant public health concern worldwide [1]. The biological and behavioral effects of methamphetamine range from wakefulness, vigour, and euphoria to adverse outcomes such as myocardial infarction, arrhythmia, haemorrhagic stroke, and psychosis [2,3]. A strong association has been found between methamphetamine abuse and non-lethal haemorrhagic stroke by previous studies [4]. However, methamphetamine associated ischaemic stroke is less common than hemorrhagic stroke [5]. Herein, we report the case of a young methylamphetamine addict with acute ischaemic stroke

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accompanied by reversible occlusion of the middle cerebral artery (MCA) and analyse the associated clinical features and prognosis.

2. Case presentation

A 24-year-old male methamphetamine addict presented with speech disorder and left hemiplegia for one day. He had been receiving methamphetamine for two years and suffered from headache half an hour after each consumption, that relieved after a few hours. Previously, he had no medical history. His vital signs on admission were normal, except for elevated blood pressure (160/70 mmHg). Physical examination of the circulatory system, respiratory system, and abdomen revealed normal physiology. Neurological examination revealed unclear speech, mild central facial paralysis, glosoparesis on the left side, left-sided hemiparesis, and a positive Babinski sign on the left side. The National Institutes of Health Stroke Scale (NIHSS) score was 6. The results of haematological analysis, including routine blood tests and analyses of hepatic function, blood lipids, serum homocysteine, protein C, protein S, antithrombin III, renal function, electrolytes, thyroid function, antinuclear antibody, anti-neutrophil antibody, HBsAg, HCV-Ab, HIV-Ab, and TP-Ab, was within reference values. Urine toxicology screening was positive for methamphetamine. Microembolic signals were not detected during microembolic monitoring. The transthoracic echocardiography and contrast-enhanced transcranial Doppler were negative. No abnormality was found in the holter electrocardiogram monitored for 72 hours. As brain magnetic resonance imaging (MRI) images shown in Fig. 1a-d, acute cerebral infarction was found in the right basal ganglia. Cerebral blood flow velocity was monitored using transcranial Doppler ultrasound (TCD) before treatment, and the results indicated that the RMCA blood flow rate increased (Fig. 2a) , while others were normal, as shown in Fig. 2b-d. Magnetic resonance angiography (MRA) suggested occlusion of the right MCA (Fig. 3a). After one week of treatment with anti-platelet aggregating medication (aspirin 100 mg/d combined with clopidogrel 75 mg/d), human urinary kallidinogenase (HUK, 0.15 PNA/d, IVGTT) was added to promote the establishment of collateral circulation and fluid replacement support. The NIHSS and mRS scores were 2 and 2, respectively. No adverse events occurred during treatment. Digital subtraction angiography (DSA) images of the cerebral blood vessels are shown in Fig. 3b and c.

3. Discussion

As a potent sympathomimetic, methamphetamine can cause the release of norepinephrine and dopamine from sympathetic nerves, making it a risk factor for stroke in young adults [6–8]. In an observational study of methamphetamine abuse-associated cerebrovascular complications in 30 patients by Emily L et al., 10 patients experienced ischaemic stroke, with an average age of 43 years. All patients had one or more risk factors for ischaemic stroke, such as previous stroke, hypertension, hyperlipidaemia, diabetes mellitus, tobacco and alcohol [9]. Herein, we report a case of a young methylamphetamine addict who experienced an acute ischaemic stroke in the absence of other common risk factors, distinguishing him from previously reported patients. Additionally, his occluded RMCA returned to normal after routine antithrombotic therapy, which can be referred to as “reversible MCA occlusion”.

The mechanism of methamphetamine-associated stroke is still controversial [10]. Previous literature has suggested that methamphetamine may cause aseptic vasculitis. However, a postmortem examination revealed occlusion of the right internal carotid artery and MCA, as well as extensive medial necrosis of the vessel walls. Surprisingly, few inflammatory cells were seen [11]. Research suggests that intravenous use of illicit drugs increases the risk of ischaemic stroke through thromboembolic mechanisms [12]. However, the patient’s microembolic monitoring did not detect embolic signals, which did not support thromboembolic mechanisms. Moreover, the reversible MCA occlusion did not support vasculitis or atherosclerosis. It may be assumed that the pathogenesis of the

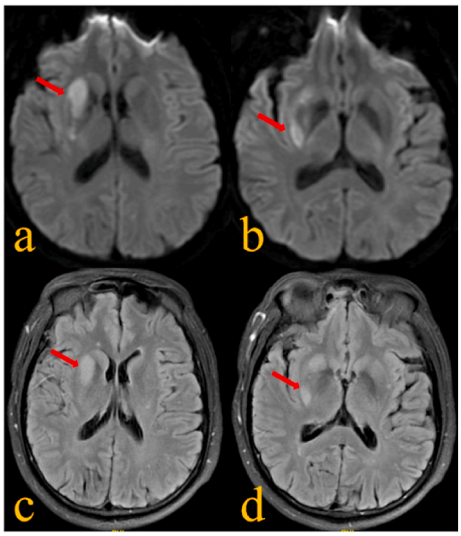

Fig. 1. DWI (1a and 1b) and FLAIR (1c and 1d) showed acute cerebral infarction in the right basal ganglia.

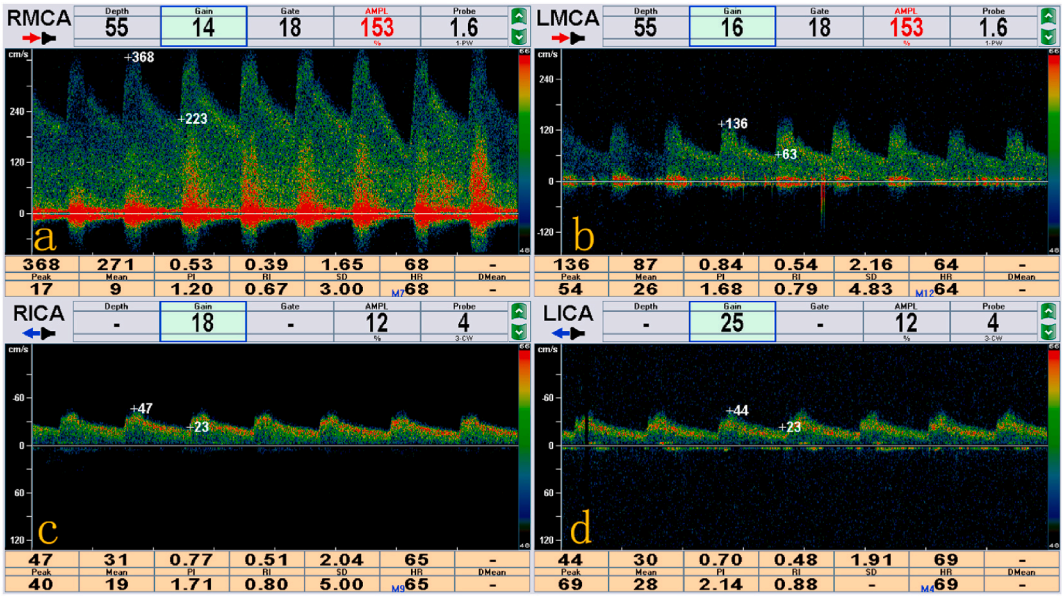

Fig. 2. The mean flow velocity (MFV) of the RMCA M1 segment (2a) was 271 cm/s, and the MFV of the RICA extracranial segment (2c) was 31 cm/s, with a Lindegaard ratio of 8.7; The MFV of the LMCA M1 segment (2b) was 87 cm/s, and the MFV of the LICA extracranial segment (2d) was 30 cm/s, with a Lindegaard ratio of 2.9.

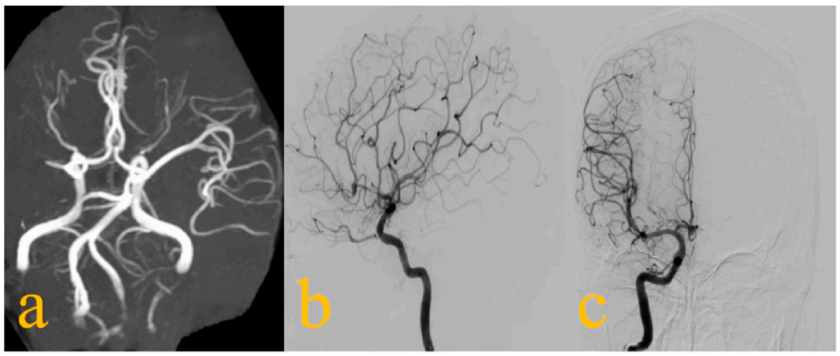

Fig. 3. MRA on admission (3a) suggested the occlusion of the RMCA. DSA after routine treatment (3b and 3c) showed the recanalized RMCA.

patient's headache after methamphetamine inhalation originated from cerebral vasospasm, also supported by elevated blood pressure. Therefore, anti-platelet aggregation therapy and HUK was administered to promote collateral circulation and fluid support. In clinical trials and animal studies, HUK has been found to enhance microcirculation and cerebral blood flow, promote angiogenesis and neurogenesis, and inhibit inflammation and apoptosis [13,14]. There is no evidence that HUK reopens the blocked blood vessels. Therefore, it may be hypothesised that the use of the drug does not interfere with our speculation. The sympathomimetic effect of amphetamines can directly stimulate α- and β-adrenerge receptors, and inhibit monoamine oxidase, resulting in intense vasoconstriction and ischaemic events [15]. Methylphenidate and amphetamine may have similar effects on cerebral vessels because of their structural and functional similarities [16].

Headache, nausea, vomiting, and confusion typically occur within minutes to hours after drug administration. Like other strokes of any cause, motor and sensory signs may also be observed in patients with methamphetamine-related stroke, depending on the lesion [3]. This patient experienced headache half an hour after each consumption of methamphetamine, which was relieved within a few hours. After 2 years of methamphetamine treatment, neurological deficits, such as speech disorder and left hemiplegia, appeared.

Although the above evidence suggests that the mechanism of ischaemic stroke in methamphetamine addicts may involve cerebral vasospasm and TCD before treatment indicated that the RMCA blood flow rate increased significantly supports cerebral vasospasm, TCD imaging to assess cerebral blood flow during and after each headache following methamphetamine administration is currently lacking. Moreover, MRA was singularly used to evaluate the intracranial vascular condition upon admission, which was not comparable to DSA after treatment. MRA with three dimensional time of flight method can only observe vascular occlusion. It cannot evaluate changes in blood flow velocity and the dynamic evolution of vasospasm in real time. DSA at the time of onset can be used to

demonstrate the reversibility of vasoconstriction after intraarterial administration of vasodilators, proving the reversibility of arterial vasoconstriction.

In future, similar patients will be evaluated using above basis, the investigation will be improved and additional supporting evidence will be sought. The present case suggests that when a patient presents with stroke and toxicant or drug exposure histories, the patient should be screened in addition to routine stroke risk factor screening. In the present case, the blood flow velocity of narrow blood vessels was measured dynamically using the TCD. If available, high-resolution MRI should be used to identify high-risk plaque characteristics.

4. Conclusion

For young patients with a stroke, a thorough investigation of the history of illicit drug use and toxicological screening of urine and serum samples should be performed. Young methamphetamine users need to be aware of the elevated risk of stroke as well as early signs and symptoms. Transient headaches in young methamphetamine users may be caused by cerebral vasospasms, suggesting the possibility of future catastrophic stroke events.

Ethics approval and consent to participate

All methods were performed in accordance with the relevant guidelines and regulations. Written informed consent was obtained from the patient.

Data availability statement

Data associated with the study has never been deposited into any publicly available repository.

Consent for publication

This article does not contain any data that would reveal the participant's identity. The patient provided informed consent for publication of the case.

CRediT authorship contribution statement

Meng Xue: Writing – review & editing. **Fang Li:** Writing – original draft. **Shaobin Feng:** Investigation. **Shifu Liu:** Supervision. **Lina Gao:** Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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