# **CASE REPORT**



# Isolated oculomotor nerve palsy due to mesencephalic infarction diagnosed by ZOOM DWI

Shangpei Wang<sup>1,2</sup>, Yajie Cai<sup>1,2</sup>, Xiaosan Wu<sup>3</sup>, Sunhong Yan<sup>3\*</sup> and Longsheng Wang<sup>1,2\*</sup>

# Abstract

**Background** Oculomotor nerve palsy is a common neurological presentation in daily practice.

**Case presentation** A 55-year-old man presented with a 3-h history of diplopia and drooping of his bilateral especially left eyelids. Examination revealed an isolated oculomotor nerve palsy consisting of left medial rectus, inferior oblique, superior rectus, inferior rectus with intact pupillary reflexes and bilateral especially left superior palpebral levator. Conventional diffusion weighted imaging (DWI) of the brain showed a suspicious restriction in the left midbrain periaqueductal region. If the clinical symptomatology indicates a lesion in the midbrain, of which a high signal intensity was encountered from neurologically healthy older adults, the limited spatial resolution of conventional axial DWI is an enormous disadvantage. Zonally magnified oblique multislice (ZOOM) DWI correlated with apparent diffusion coefficient map providing higher accuracy for accurate diagnosis can identify signal alterations of mesencephalic interpeduncle area.

**Conclusions** This is a rare presentation of isolated oculomotor nerve palsy due to pure mesencephalic infarction especially verified by ZOOM DWI.

Keyword Oculomotor nerve palsy, Mesencephalic infarction, ZOOM DWI

# Introduction

Oculomotor paresis is a common neurological presentation in daily practice. There are various causes to oculomotor nerve palsy, with major causes being diabetes, cerebral aneurysms and mononeuritis [1]. Typical mesencephalic infarction mimicking the oculomotor

\*Correspondence: Sunhong Yan yan-smiling@163.com Longsheng Wang

wanglongsheng@ahmu.edu.cn

<sup>1</sup> Department of Radiology, the Second Affiliated Hospital of Anhui

Medical University, Furong Road NO.678, Hefei 230601, China

<sup>2</sup> Medical Imaging Research Center, Anhui Medical University,

Hefei 230601, China

mononeuropathy has been reported only rarely and easy to be ignored by clinicians [2]. Here, we presented a case of pure mesencephalic infarction triggering isolated oculomotor paresis diagnosed by using zonally magnified oblique multislice (ZOOM) diffusion weighted imaging (DWI).

# **Case presentation**

A 55-year-old man, smoker, with hypertension and diabetes presented with a 3-h history of diplopia and drooping of his bilateral especially left eyelids without ocular discomfort or blurred vision. On neurological examination, there was an isolated oculomotor paresis consisting of left medial rectus, inferior oblique, superior rectus, inferior rectus with intact pupillary reflexes and bilateral especially left superior palpebral levator (Fig. 1A). Otherwise, the rest of the examinations including fatigability were



© The Author(s) 2025. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by/4.0/.

<sup>&</sup>lt;sup>3</sup> Department of Neurology, the Second Affiliated Hospital of Anhui Medical University, Furong Road NO.678, Hefei 230601, China



Fig. 1 The pupillary sphincter is selectively spared in recorded eye movements (A); CT angiography of the brain vessels suggest the left vertebral artery originated directly from aortic arch (B). Abbreviations: L, left

unremarkable. Computed tomography (CT) angiography of the brain vessels showed left vertebral artery originated directly from the aortic arch, rather than the subclavian artery (Fig. 1B). Meanwhile, there were no other positive findings on CT images before and after injection of contrast agent. Conventional DWI with an in-plane resolution of  $1.3 \times 1.3$  mm<sup>2</sup> showed a suspicious restriction in the left midbrain periaqueductal region (Fig. 2) and verified by a specific technique, termed ZOOM DWI correlated with apparent diffusion coefficient map (Ingenia CX 3.0T, Philips). ZOOM DWI parameters were as follows: repetition time = 2500 ms, echo time = 85 ms, field of view= $97 \times 39$  mm<sup>2</sup>, matrix= $80 \times 32$ , single shot echo plane imaging, slice thickness = 3 mm, b value = 1000 s/ mm<sup>2</sup>, and 24 slices, providing with an in-plane resolution of  $0.6 \times 0.6 \text{ mm}^2$  that can clearly distinguish the boundary between the target and the surrounding tissue [3, 4]. Thus, the patient was diagnosed with pure mesencephalic infarction. The recommended therapy was antiplatelet aggregation. The patient, therefore, received oral aspirin 100 mg/d, clopidogrel 75 mg/d and atorvastatin 20 mg/d. Gradual recovery of his palsy occurred within 3 months, and preventing cerebral infarction treatments were needed.

# Discussion

In clinical practice, we have often encountered a high signal intensity of the interpeduncle region of midbrain from neurologically healthy older adults on conventional axial DWI [5]. This need to be mentioned and evaluated, for identifying areas of abnormal diffusion optimally would be much more useful. As a small-field imaging technique reducing field of view, ZOOM DWI can identify restricted diffusion region without producing curl. Compared with conventional DWI images, ZOOM DWI has lower magnetic susceptibility artifact and higher image quality, and its advantages have been applied to the diagnosis of cervical spondylotic myelopathy [6]. Considering the caudal central subdivision of oculomotor nerve nuclei, located in the ventral periaqueductal region of midbrain, which is a single midline nucleus that supplies the superior palpebral levator on both sides, isolated nuclear oculomotor nerve palsy will produce bilateral ptosis [7]. The intra-axial oculomotor fascicular fibers are arranged from the lateral to medial side in the following order: the pupillary sphincter, inferior rectus, superior palpebral levator, medial rectus, superior rectus, and inferior oblique fibers. Due to the fascicular of left lateral side involved and medial most side spared, this case presented as ipsilateral dominant superior palpebral levator paralysis without pupil sphincter. The intra-axial oculomotor fascicular fibers are supplied by the inner and outer penetrating arteries of the superior medial mesencephalic branch (SMMB) of the posterior cerebral artery originated from the vertebrobasilar arteries, which are located medially and laterally respectively. The lateral occlusion of inner SMMB may speculate as the etiology, which blood flow supplies inferior oblique, superior rectus, medial rectus, superior palpebral levator, inferior rectus and pupillary sphincter from lateral to medial successively [8].



Fig. 2 The mesencephalic periaqueductal slice T2WI (**A**), a suspicious restriction in conventional DWI (**B**), correlated apparent diffusion coefficient map (**C**), a corresponding T2WI of the ZOOM DWI (**D**), a verified restriction in the ZOOM DWI (**E**) and correlated apparent diffusion coefficient map (**F**). Abbreviations: L, left

The left vertebral artery originated directly from the aortic arch but posterior cerebral artery lesions were not found in CT angiography. It is difficult to say whether it was the responsible factor for stroke or not, as one study has found association of posterior circulation stroke with vertebrobasilar system abnormalities [9]. Moreover, the patient had a history of diabetes, which usually presented as bilateral, incomplete oculomotor palsy [10] and less involved the superior palpebral levator. In addition, the mesencephalic infarction on ZOOM DWI could explain the symptoms and signs of the patient, so diabetic oculomotor palsy was not considered.

## Conclusion

The limited spatial resolution of conventional DWI is an enormous disadvantage if the clinical symptomatology indicates a lesion in the midbrain. For accurate diagnosis and evaluation of cerebral infarction, it is critical to identify signal alterations of mesencephalic interpeduncle area. ZOOM DWI technology provides higher accuracy for a small field of view than conventional does and should be recommended in selected patients presenting with specific midbrain syndromes. This is a rare presentation of partial oculomotor nerve palsy due to pure mesencephalic infarction especially verified by ZOOM DWI.

### Abbreviations

CT	Computed tomography
DWI	Diffusion weighted imaging
SMMB	Superior medial mesencephalic brancl
ZOOM	Zonally magnified oblique multislice

### Acknowledgements

We thank Professor Xianwen Chen at the first affiliated hospital of Anhui medical university for the professional guidance of neurology, and Doctor Huan Li at the second affiliated hospital of Anhui medical university for the technological guidance of ZOOM DWI.

### Disclosure

The authors report no disclosures relevant to the manuscript.

### Authors' contributions

Shangpei Wang: Data curation, Project administration, Writing – original draft, Writing – review & editing. Yajie Cai: Data curation, Writing – original draft. Xiaosan Wu: Resources, Supervision. Sunhong Yan: Investigation, Writing – review & editing. Longsheng Wang: Project administration, Supervision, Writing – review & editing, Funding acquisition. All authors contributed to the article and approved the submitted version.

### Funding

This work was supported by grants from Anhui Provincial Natural Science Research Project for Universities (2023AH040377).

### Data availability

No datasets were generated or analysed during the current study.

### Declarations

### Ethics approval and consent to participate

Informed written consent was signed by the patient.

### **Consent for publication**

Informed consent for publication was signed by the patient.

### **Competing interests**

The authors declare no competing interests.

Received: 11 September 2024 Accepted: 3 January 2025 Published online: 07 February 2025

### References

- Phuljhele S, Dhiman R, Sharma M, Kusiyait SK, Saxena R, Mahalingam K, Sharma P. Acquired ocular motor palsy: current demographic and etiological profile. Asia Pac J Ophthalmol (Phila). 2020;9(1):25–8. https:// doi.org/10.1097/01.APO.0000617940.70112.be.
- Cheong CY, Aung TH, Pang WY, Ng CJ, Yap P. Isolated complete unilateral ptosis with intact extraocular eye movements. Age Ageing. 2019;48(4):596–7. https://doi.org/10.1093/ageing/afz041.
- Wilm BJ, Svensson J, Henning A, Pruessmann KP, Boesiger P, Kollias SS. Reduced field-of-view MRI using outer volume suppression for spinal cord diffusion imaging. Magn Reson Med. 2007;57(3):625–30. https://doi. org/10.1002/mrm.21167.
- Sartoretti T, Sartoretti E, Binkert C, Gutzeit A, Reischauer C, Czell D, Wyss M, Brüllmann E, Sartoretti-Schefer S. Diffusion-weighted zonal oblique multislice-EPI enhances the detection of small lesions with diffusion restriction in the brain stem and hippocampus: a clinical report of selected cases. AJNR Am J Neuroradiol. 2018;39(7):1255–9. https://doi. org/10.3174/ajnr.A5635.
- Ma D, Liu C, Kong Q, Xie Y, Chen X. Apparent diffusion coefficient and diffusion-weighted signal intensity of the interpeduncle region of the midbrain in adults: initial evaluation. Clin Imaging. 2013;37(4):645–8. https://doi.org/10.1016/j.clinimag.2013.02.007.
- Li J, Tian XN, Zhao BG, Wang N, Zhang YJ, Zhang L. Diagnostic value of cervical spine ZOOM-DWI in cervical spondylotic myelopathy. Eur Spine J. 2024;33(3):1223–9. https://doi.org/10.1007/s00586-023-08110-8.
- Fritzsch B. Evolution and development of extraocular motor neurons, nerves and muscles in vertebrates. Ann Anat. 2024;253:152225. https:// doi.org/10.1016/j.aanat.2024.152225.
- Ogawa K, Suzuki Y, Takahashi K, Kamei S, Ishikawa H. Clinical study of eleven patients with midbrain infarction-induced oculomotor nerve palsy. J Stroke Cerebrovasc Dis. 2016;25(7):1631–8. https://doi.org/10. 1016/j.jstrokecerebrovasdis.2016.03.020.
- Gilberti N, Gamba M, Costa A, Vergani V, Spezi R, Pezzini A, Volonghi I, Mardighian D, Gasparotti R, Padovani A, Magoni M. Pure midbrain ischemia and hypoplastic vertebrobasilar circulation. Neurol Sci. 2014;35(2):259–63. https://doi.org/10.1007/s10072-013-1502-x.
- Chen H, Wang X, Yao S, Raza HK, Jing J, Cui G, Hua F. The aetiologies of unilateral oculomotor nerve palsy: a clinical analysis on 121 patients. Somatosens Mot Res. 2019;36(2):102–8. https://doi.org/10.1080/08990 220.2019.1609438.

# **Publisher's Note**

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.