PHOTO ESSAY

Diffusion-Weighted Magnetic Resonance Imaging in Acute Retinal Pathology

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ABSTRACT

The authors describe diffusion-weighted magnetic resonance imaging (DWI) as an accessible way to screen for acute retinal pathology in emergency setting. They describe three proof-of-principle patients who had abrupt onset of vision loss from acute retinal pathology where DWI was diagnostic. The deficits included central retinal artery occlusion and acute retinitis with retinal necrosis. DWI can be non-specific for aetiology, but it can rapidly localise the retinal pathology and initiate early therapeutic interventions in the emergency room.

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Introduction

Acute retinal pathology presenting with an abrupt onset of monocular vision loss can pose a clinical conundrum. The brain magnetic resonance imaging (MRI) is frequently performed in the emergency room, as ischaemic stroke is seen in about a quarter of patients presenting with acute visual loss.¹ Diffusion-weighted imaging (DWI) sequence of MRI, not typically utilised for identification of acute retinal pathology, can be useful for detecting acute retinal pathologies. In three examples of acute onset of monocular vision loss, we demonstrate clinical utility of DWI to establish the diagnostic outline and promptly initiate treatment in the acute setting.

Materials and methods

We studied three patients with acute monocular vision loss who presented to the emergency room at the University Hospitals Cleveland Medical Center between July 2015 and January 2016. Due to their vision loss, these patients were suspected of having central aetiology and had DWI scans (Siemens MRI technology, 1.5 tesla, 4 mm thickness) to rule out stroke in the emergency department. All patients had abnormal retinal signal on DWI B1000. The imaging abnormality consistently correlated

with the laterality of the clinical deficit. The brain MRI, asymptomatic eye, and the optic nerve were normal. Table 1 depicts the details of clinical examination.

Results

Patient 1

A 57-year-old woman with history of hypertension presented with acute painless vision loss from the left eye. She reported intermittent symptoms of flashing lights and blurred vision in her left eye for 2 days prior to presentation. Subsequently, her vision acutely turned grey and then black, when she presented to the emergency room. Examination revealed light perception in the left eye, and arteriolar narrowing with boxcarring and a pale fundus. Table 1 depicts the details of pertinent ophthalmological examination. Remaining neurological examination was unremarkable. The findings were consistent with central retinal artery occlusion. DWI sequence revealed multiple areas of diffusion restriction in the left retina (Figure 1A) suggestive of multiple punctate infarcts. There were no significant vascular stenoses, as confirmed in intracranial and neck magnetic resonance angiograms (MRAs). Echocardiogram revealed a mobile mass measuring 1.28 × 0.88 cm on the

Table 1. Clinical features.

Parameter	Patient 1		Patient 2		Patient 3	
	OD	OS	OD	OS	OD	OS
Visual acuity	20/25	LP	20/30	NLP	HM	20/20
Pressure (mmHg)	20	20	19	9	20	20
Visual field	Full	Unable	Full	NLP	Inferior field decreased	Full
Lid	Normal	Normal	Normal	Normal	Normal	Normal
Pupil	Normal	APD	Normal	APD	APD	Normal
Muscle balance/Motility	Ortho/full	Ortho/full	Ortho/full	Ortho/full	Ortho/full	Ortho/full
Cup to disc	0.3	0.4	0.4	0.7	Unable	0.5
Optic disc	Pink sharp	Pink sharp	Pink sharp	Pale, haem	Grade 5 oedema	Pink sharp
Vitreous	Clear	Clear	Clear	Clear	Clear	Clear
Macula	Exudates	Cherry red spots	Normal reflex	Normal reflex	Subretinal fluid, pallor	Normal
Vessels	Normal	Arteriolar boxcarring, pale	Normal	CRAO	Attenuated	Normal

OD = right eye; OS = left eye; Ortho = orthophoric; APD = afferent pupillary defect; haem = haemorrhage; CRAO = central retinal artery occlusion.

Figure 1. Three examples of diffusion restriction in DWI retinal images in patients who presented with abrupt vision loss. The arrows depict diffusion restriction in affected retina. Patients 1 (A) and 2 (B) had ischaemic retinal injury, whereas patient 3 (C) had retinal necrosis due to HSV-1 infection.

posterior mitral annulus. The mass was removed surgically, and pathology showed fibrin and calcification consistent with vegetation. Microorganisms were not found, as the patient was on empiric broad-spectrum intravenous antibiotics.

Patient 2

A 72-year-old man with a history of glaucoma and cataract in the left eye had acute onset of left

monocular vision loss. The examination revealed no light perception of the left eye, with left ptosis and an afferent pupillary reflex. Ophthalmoscopic examination revealed pale optic disc with haemorrhage. Table 1 depicts the details of ophthalmological examination. The findings were consistent with central retinal artery occlusion. The DWI revealed diffusion restriction in the left retina suggestive of multiple punctate infarcts. Brain MRI was unremarkable for acute pathologies. MRA and computed tomography (CT) angiogram showed dissection and occlusion of the left internal carotid artery.

Patient 3

A 60-year-old man had acute onset of right monocular vision loss. The deficit started with blurred central vision but preserved peripheral vision; the symptoms fluctuated. One week later, the patient had acute onset of vision loss in the right eye. The examination revealed that visual acuity diminished to 20/500; there was an afferent pupillary defect. Ophthalmoscopy revealed grade 4+ optic nerve head oedema and serious detachment of the macula, inferior, and temporal retina, areas of retinal whitening, and scattered intraretinal haemorrhages. Table 1 presents details of ophthalmological examination. Neurological examination was otherwise normal. DWI revealed diffusion restriction in the right retina with concentric granular appearance of the retina and retinal thickening. The brain MRI was unremarkable. The diagnosis was acute retinal necrosis confirmed with an aqueous tap polymerase chain reaction (PCR) that was

strongly positive for herpes simplex virus 1 (HSV-1).

Discussion

The direct visualisation of ocular fundus and retina using indirect ophthalmoscopy, ocular coherence tomography, and ophthalmic ultrasound is frequently used to diagnose retinal pathologies leading to acute vision loss. These modalities are direct and specific, since they offer direct visualisation of the retina; however, they mandate the availability of technological infrastructure and the presence of an eye specialist for immediate consultation, which may not be the standard for many emergency departments in the community. MRI scanners, on the contrary, are readily available for diagnostics in the emergency room. MRI is frequently used for the diagnosis of retro-orbital optic neuritis.^{2,3} Optic nerve diffusion-positive MRI was reported once in a single patient who had central retinal artery occlusion,⁴ DWI revealed subretinal abscess in two patients,⁵ and DWI abnormality on imaging of the optic nerve head is a known feature of fulminant idiopathic intracranial hypertension.^{6,7}

Here we show that diffusion-weighted MRI can detect acute retinal pathologies leading to acute vision loss, namely, central retinal artery occlusion and infectious retinitis. Such modalities are conveniently utilised by non-ophthalmologist providers for prompt identification of acute retinal pathologies. We also emphasise that DWI, which is otherwise non-specific, can only identify acute retinal pathology, but it does not replace detailed ophthalmological examination by an expert. The goal of this case series is to point out that acute retinal pathologies can be seen in MRI that is traditionally done to rule out brain ischaemia in the emergency room.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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