Downbeat nystagmus due to a paramedian medullary lesion

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1. Introduction

Vertical nystagmus due to small lesions in the lower brainstem often manifests as upbeat nystagmus. Downbeat nystagmus, however, is often caused by cerebellar floccular lesions. Groups of cells in the paramedian tract (PMT) occur in and around the medial longitudinal fasciculus in the paramedian region of the lower brainstem. These PMT cells project to the cerebellar flocculus and are involved in ocular movement. Although PMT cells have long been suggested to have an important role in eye movement control, the mechanism and clinical relevance are poorly understood. Only limited evidence is available from animal experiments and clinical studies on downbeat nystagmus associated with impaired PMT cells.

We present a patient with downbeat nystagmus due to a damaged subgroup of PMT cells caused by a localized lesion in the paramedian region of the medullary tegmentum.

2. Case report

We present a 50-year-old female who, at 42 years of age, manifested right-sided lateral medullary syndrome caused by occlusion of the right posterior inferior cerebellar artery. Her brain MRI showed a small, new ischemic lesion in the lateral portion of the medulla oblongata. However, she led a normal life afterwards without symptoms of nystagmus. At 47 years of age she manifested dizziness and oscillopsia and visited our clinic with persistent oscillopsia on lateral gaze 3 months after the onset of symptoms. Her neurological examinations revealed downbeat nystagmus during fixation, and mild, crossed sensory deficits in the right part of the face, left extremities, and trunk, but she had no ataxia or paralysis. Previous right-sided lateral medullary syndrome was suspected to be responsible for the crossed sensory disturbances. Her downbeat nystagmus lasted more than 3 years from the onset of symptoms. An ischemic lesion in the right dorsal paramedian portion of the medulla oblongata was believed to be responsible for nystagmus.

Fig. 1. (A) Midsagittal brain T1-weighted MRI showing low-intensity lesions in the medulla oblongata (arrow); and (B) axial brain T2-weighted MRI showing punctate, high-intensity lesions in the tegmentum and the right paramedian region of the dorsal medulla oblongata (arrow). These lesions, which are probably small infarctions, are believed to be responsible for nystagmus.
of the medulla oblongata was shown in thin-slice brainstem MRI (Fig. 1).

The patient’s eye movements were also recorded with electro-
nystagmography (First, Tokyo, Japan), using a direct current (DC) recording technique. Downbeat nystagmus was observed in the light and in the dark, and in the absence of fixation (rapid phase: velocity, 61.7°/s; amplitude, 4.7°; and slow phase: velocity, 14.9°/s; amplitude, 4.4°; frequency, 2.1/s) (Fig. 2). Downbeat nystagmus was accentuated in the lateral eye position and was not influenced by the upward and downward eye positions of the eyes in the orbit, or the position of the head.

3. Discussion

The MRI revealed an ischemic lesion in the paramedian tegmen-
tal region of the medulla oblongata after nystagmus, the lesion was in the paramedian region in which cell groups of PMT are located;

Fig. 2. Electronystagmography recording (direct current) of eye movement in the absence of fixation (eyes open in the dark): upper – vertical eye position; lower – corresponding eye movement velocity. Downbeat nystagmus lowering in the fast-phase and rising in the slow-phase was noted.

Fig. 3. Schematic of the pathogenesis of downbeat nystagmus showing how vertical eye movement might be generated by events starting with cell groups of paramedian tract (PMT) neurons impaired by lesions in the lower brainstem, attenuating the activity of floccular Purkinje cells. Upward eye movements are induced that constitute the slow phase of nystagmus, which is then followed by the compensatory fast-phase beating in a downward direction, resulting in downbeat nystagmus. G = cerebellar granule cells, P = Purkinje cells.
hence, the lesion was suspected to be responsible for the observed downbeat nystagmus.

PMT cell groups are important in gaze holding and in the maintenance of vestibular balance. Impaired PMT cells have been shown to induce downbeat nystagmus in an animal model. In the present patient, the medullary lesion was much lower than the location of PMT cells that control eye movement. In the animal model, as also suggested by a previously reported human lesion, the PMT cells are supposed to be at the medullary–pons interface. However, the PMT cell groups spread from the pons to the lower medulla oblongata and project to the cerebellar flocculus. Furthermore, the eye movement disorders seen in our patient resembled those observed in the floccular lesions. According to previous reports, the cerebellar flocculus and paraflocculus are important in maintaining gaze holding and vestibular balance, and the impairment of these regions induces downbeat nystagmus.1,7 In the present patient, the impairment of PMT cells might have induced a disorder similar to those resulting from floccular lesions. This finding suggests that feedback from the brainstem might influence the control of ocular movement in the cerebellum.

Fig. 3 presents a summary of the pathogenesis of downbeat nystagmus caused by lesions in PMT cell groups. Lesions in PMT cells attenuate the activity of floccular Purkinje cells, which, in turn, reduce the inhibition of secondary vestibular nucleus neurons that receive input from the anterior semicircular canals. However, the neuronal activity of the posterior canal-related secondary vestibular nucleus neurons remains unaffected because the neurons do not receive inhibitory regulation from the flocculus. As a result, only the anterior canal-related secondary vestibular nucleus neurons are activated, which induces upward eye movement that constitutes the slow phase of nystagmus. This is then followed by compensatory fast-phase downward beating, resulting in downbeat nystagmus. It is suspected that lesions in PMT cells might be responsible for central vestibular imbalance in the vertical direction, suggesting that a PMT–flocculus–vestibular nucleus pathway might be important in maintaining vestibular balance.

This patient is unusual in that downbeat nystagmus was caused by vestibular imbalance as a result of damage caused to PMT cells by small brainstem infarctions.

Disclosure
The authors report no conflicts of interest.

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Abnormalities of neuromuscular transmission in patients with Miller–Fisher syndrome

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The mechanism of motor weakness in patients with Miller–Fisher syndrome (MFS) remains to be fully elucidated. We performed stimulated single fibre electromyography (sSFEMG) in a clinically weak frontalis muscle in a patient with MFS. Stimulate single fibre EMG revealed increased jitter in over 50% of the apparent single fibre action potentials from the frontalis muscle in addition to increased mean jitter. The findings in the present study suggest dysfunction of neuromuscular transmission in patients with MFS.

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1. Introduction

MFS is clinically characterised as a syndrome of ataxia, areflexia, and ophthalmoplegia but the phenotype may be varied and include facial and bulbar weakness. MFS is typically associated with an antecedent infection, particularly with Campylobacter jejuni, and