

Clinical effect of canal plugging on paroxysmal positional vertigo

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Abstract

A 63-year-old woman had disabling positional vertigo for four months. She showed intense direction-changing apogeotropic nystagmus. Conservative treatment failed to resolve her vertigo. From the findings of the nystagmus, cupulolithiasis of the right lateral canal was suspected. Plugging of this canal successfully eliminated the nystagmus and positional vertigo. Positional vertigo can sometimes be disabling and unresponsive to conservative therapy. Careful analysis of the nystagmus may allow selection of the most appropriate treatment.

Key words: Vertigo; Labyrinth, Surgery

Introduction

Benign paroxysmal positional vertigo (BPPV) is one of the most common vestibular disorders. Its clinical course is generally benign and vertiginous symptoms resolve in several weeks. The aetiology is still controversial, but canalolithiasis of the posterior semicircular canal (PSC) is one of the possibilities. However, there are other types of positional nystagmus that present horizontal direction-changing nystagmus with the head in a side down position. These types had been reported as BPPV variant or BPPV of the lateral canal type. The authors experienced a case with severe vertigo with direction-changing apogeotropic nystagmus. From the patterns of the nystagmus, lateral canal cupulolithiasis was suspected. Surgical plugging of the lateral canal successfully alleviated the positional vertigo and nystagmus.

Case report

A 63-year-old woman consulted the department of Otolaryngology, Tokyo Medical University on 10 November 1998. She had experienced positional vertigo since December 1997. Vertigo appeared when she changed the head position to right or left side down and lasted for about 30 seconds. The degree of vertigo on the right head side down position was so severe that she could not sleep in this position. There were no other symptoms, such as hearing disorder, tinnitus, headache, motor disturbance nor numbness of the extremities.

Clinical data

She was a well-orientated, average-built woman. The otolaryngological inspection was negative. The audiogram was normal. Temporal bone radiography, blood count and serological test results were all normal.

Equilibrium test results

Mann's test, stepping test and body sway test² were within the normal range. Cranial nerve examination was normal.

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Accepted for publication: 4 July 2000.

Gaze nystagmus was absent. Positional and positioning nystagmus tests were performed through an infra-red charge coupled device (CCD) camera. The positional nystagmus test is to observe nystagmus on static head side down position. The positioning nystagmus test is to observe the nystagmus induced by quickly changing the head position from sitting to head down. On the first day, counter-clockwise torsional nystagmus was observed in the supine position. Its direction changed to clockwise on the sitting position. Optokinetic nystagmus pattern and smooth pursuit were normal.

Time course of the nystagmus

A week later, the positional nystagmus changed into direction-changing geotropic nystagmus. Canalolithiasis of the right lateral semicircular canal (LSC) was suspected. Physical therapy for LSC canalolithiasis designed by the authors was performed.³ On 20 November, the positional nystagmus changed into direction-changing apogeotropic positional nystagmus. On 30 November, the nystagmus became more pronounced (Figure 1) and persisted thereafter. In the sitting position there was no nystagmus. When she started to lean backward, horizontal nystagmus toward the left appeared, and increased its magnitude and frequency. In the supine position, the same brisk nystagmus continued. On the right side down position, the nystagmus became even more frequent. On the left side down position, the nystagmus instantly ceased and started to beat toward the right side. The frequency of the nystagmus reached up to 6 Hz. In either position, the nystagmus lasted more than one minute. Whenever the nystagmus was present, the patient experienced a severe rotating sensation and nausea.

Interpretation of the nystagmus

From the these findings, cupulolithiasis of the right LSC was suspected. The key to determine the right side as the site of the primary lesion is as follows (Figure 2). 1) The nystagmus to the left already appeared when the head was

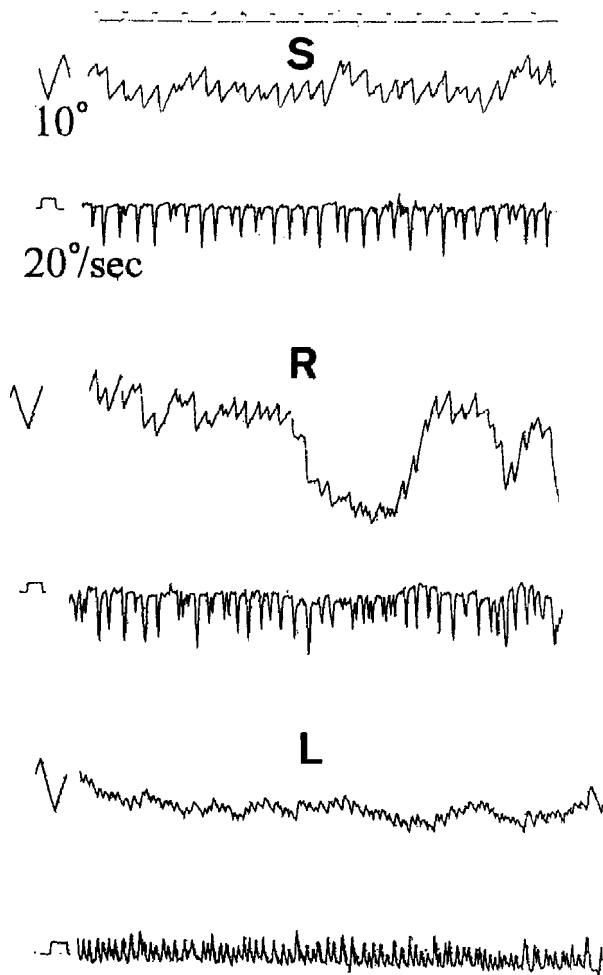


FIG. 1

ENG recordings of the positional nystagmus. Upper trace (S) = supine position with the head straight; centre trace (R) = right head side down position; lower trace (L) = left head side down position. Brisk left-beating nystagmus is seen at both straight and right-side-down positions. Right-beating nystagmus appeared on left-side-down position.

leaning backward. This indicates the cupula of the right LSC received gravity loading in the ampullofugal direction. 2) The nystagmus increased its intensity in the right head down position. This indicates increase of the gravity loading in this position. 3) The direction of the nystagmus changed to the right in the left side down position. This indicates gravity loading to the other direction (ampullopetal direction). 4) The duration of the nystagmus was more than one minute which is far longer than the typical BPPV nystagmus. This indicates sustained loading to the cupula such as cupulolithiasis.

Treatment for the direction-changing apogeotropic nystagmus

The patient had been on antivertiginous agents, vasodilators and intravenous injection of sodium bicarbonate. However, the symptoms did not resolve at all. She refused to undergo any physical therapy, since her vertigo was so severe. In the meantime, brain CT scan and MRI were performed, yielding normal images.

As there was no sign of resolution, surgery was indicated. On 20 April 1999, plugging of the right LSC was performed. Conventional mastoidectomy was performed to expose the surgical dome of LSC. A part of the

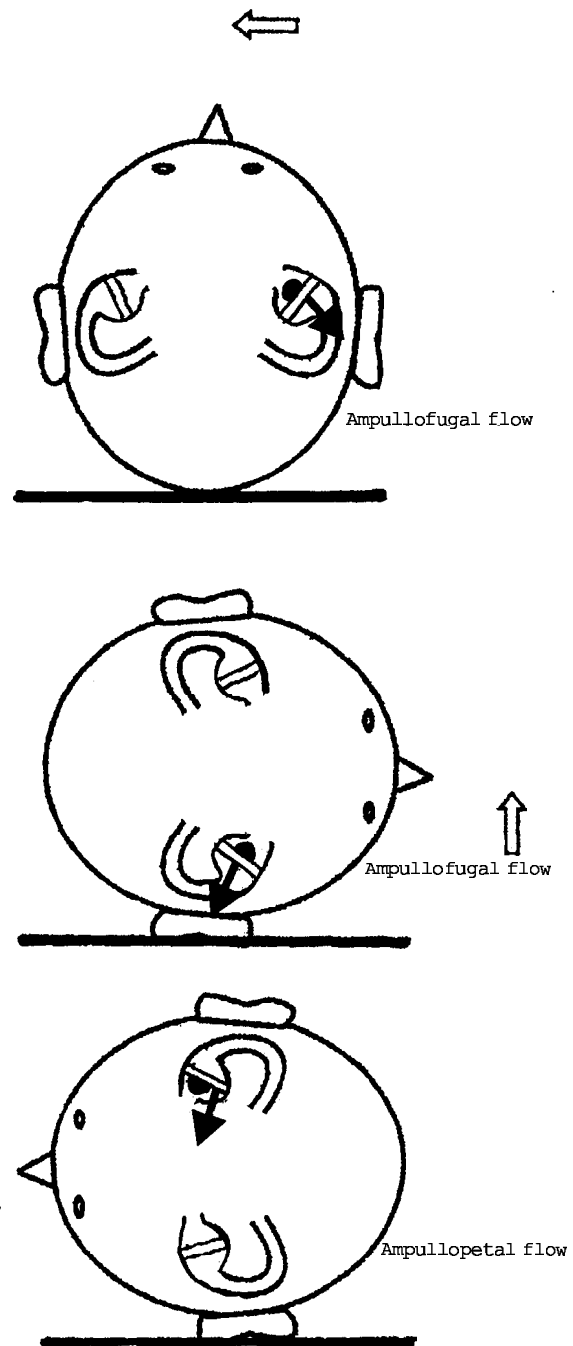


FIG. 2

Schemas showing a possible mechanism of the nystagmus. Schematic view of the head and lateral canals seen in the horizontal axis. Closed dots = otoconial mass attached on the cupula; closed arrows = direction of the cupula movement; open arrows = direction of nystagmus. In the supine position with the head straight (top), nystagmus to the left appeared, as the cupula of the right LSC was subjected to gravity loading to ampullofugal direction. The nystagmus to the same direction appears on the right-side-down position (centre), as the cupula moves to the same direction. The direction of the nystagmus changed to the right on the left-side-down position (bottom), as the cupula move to ampullopetal direction.

bony wall of the LSC was removed and the canal lumen was obstructed using a piece of muscle and bone.

Post-operatively, she was dizzy with distinct left-beating horizontal nystagmus in all gaze directions. However, the dizziness started to decrease from 24 April and only weak

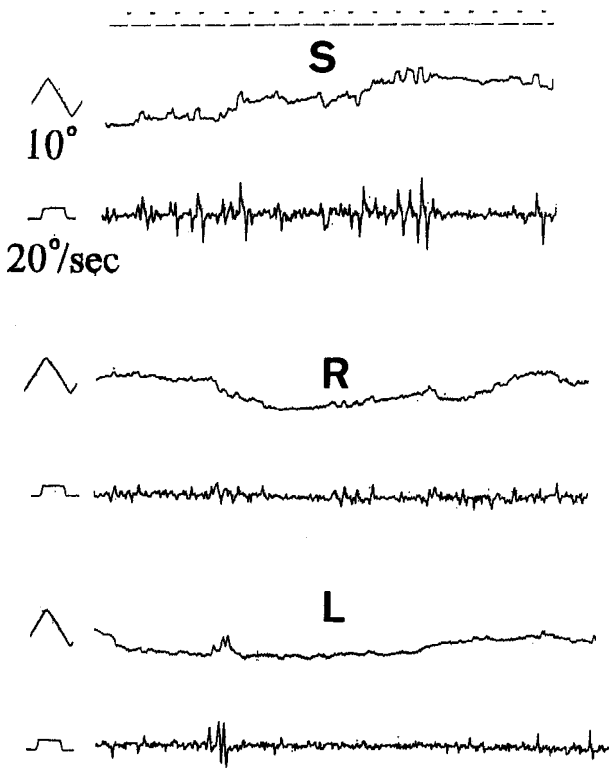


FIG. 3

ENG recordings after the canal plugging. No obvious nystagmus is seen in any position of the head.

positional nystagmus to the left was seen. At present, the positional nystagmus has further decreased (Figure 3). At the moment, the patient feels slightly unsteady when moving the head quickly, but could lie down and sleep in any head position. The hearing temporarily dropped across all frequencies to 57 dB on average, but it recovered to 20 dB on average on 25 May 1999.

Discussion

The aetiology of BPPV is still controversial, but canalolithiasis of the PSC is the most probable from histological findings of the temporal bone,⁴ microscopic findings of PSC at surgery,^{5,6} efficacy of physical therapy,^{7,8} PSC plugging^{9,10} and singular neurectomy.¹¹ The symptom of BPPV resolves in several weeks or months in most cases. However, in some cases they can be persistent and disabling, eventually requiring surgical treatment.

Direction-changing positional nystagmus had been regarded as a variant of BPPV by some authors.¹ There are two types in this category of nystagmus, geotropic and apogeotropic nystagmus. Direction-changing geotropic nystagmus is more frequently seen in clinical practice than the other. Both central and peripheral lesions are possible in both types. As a peripheral lesion, geotropic type suggests canalolithiasis in the LSC. Physical therapy

TABLE I
TYPES OF NYSTAGMUS AND POSSIBLE LESIONS

	Cupulolithiasis	Canalolithiasis
PSC	direction-changing	torsional
LSC	direction-changing apogeotropic	direction-changing geotropic

PSC = posterior semicircular canal; LSC = lateral semicircular canal.

was designed for this type and generally yields favourable results.^{3,12} Most of the apogeotropic type is due to central lesions, such as cerebellar and brain stem disorders and a peripheral lesion is less common. The present case was considered to be a peripheral lesion, since the optokinetic nystagmus, smooth pursuit, CT and MRI were all negative and no neurological sign was present. Severe and recurrent vertigo accompanied by the intensive nystagmus also suggests a peripheral lesion.

The types and direction of nystagmus is essential for differentiating possible lesions of positional vertigo. The table summarizes types of nystagmus in cupulolithiasis and canalolithiasis that affects PSC and LSC. The nystagmus of the PSC lesion is always torsion-dominant and is evoked by changing position in the vertical plane. The nystagmus of LSC lesion is a direction-changing type with head side-down positions.

As mentioned before, direction-changing apogeotropic nystagmus suggests a lesion of the right LSC. Duration of the nystagmus was longer than typical PSC type BPPV. This indicates a gravity loading to the right LSC, namely cupulolithiasis. The authors showed cupulolithiasis presents a longer time constant of ampullary nerve discharge using a frog semicircular canal model.¹³ The finding that the nystagmus was always horizontal indicates the lesion is in the LSC from the vestibulo-ocular reflex theory.¹⁴

The surgical result of the present case was satisfactory, suggesting the right LSC was affected. The authors showed the canal plugging is extremely effective for cupulolithiasis using frog semicircular canal models.¹⁵ Plugging creates a closed space in the canal between the plugged site and the cupula, thus effectively inhibiting deflection of the cupula. In the present case, the plugging resulted in satisfactory locking of the LSC cupula and did not allow the minimum cupula deflection.

Clinicians must be aware that positional vertigo can be very disabling and even requires surgical intervention. Careful observation and analysis of the positional nystagmus contributes well to determination of the lesion and selection of the appropriate treatment.

Summary

We experienced a case of positional vertigo which showed intense direction-changing apogeotropic nystagmus. Conservative treatments failed to resolve the vertigo. From the findings of the nystagmus, cupulolithiasis of the right lateral semicircular canal was suspected. Plugging of this canal successfully eliminated the nystagmus and positional vertigo.

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Dr M Suzuki takes responsibility for the integrity of the content of the paper.
Competing interests: None declared
