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CASE REPORT

Singular case of the driving instructor: Temporal and topographical disorientation

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Abstract

Lesions of the medio-parietal lobes are linked with topographical and temporal disorientation, and are of interest to understanding mental time. We examined a 39-year-old man who worked as a driving instructor before cerebral hemorrhage, and followed his case for 8 years including neuropsychological testing and brain imaging. The patient had mild anterograde episodic amnesia, but no semantic amnesia. He felt that time passed too quickly, and developed a compulsive routine to compensate, although he was able to count time at a normal speed. Furthermore, he was unable to accurately sketch the layout of his house and to make a cross-reference type timetable for the future. Brain magnetic resonance imaging showed lesions of the left anterior–posterior cingulate gyrus, and N-isopropyl-[^{123}I] p-iodoamphetamine single-photon emission computed tomography showed decreased blood flow mainly of the left medio-parietal lobe.

Introduction

Temporal and topographical orientation is important to the evaluation of consciousness and cognitive function. Pure topographical disorientation is linked with the right retrosplenial cortex in the medial parietal lobe.[1] Disorientation in time and place have been linked with posterior cingulate gyrus in Alzheimer's disease.[2] The present patients had impaired temporal and topographical orientation at the same time.

Case report

A-39-year-old, right-handed man who worked as a driving instructor felt that time passed too quickly, and lived according to a "clock watching" routine (Fig. S1) for 8 years after a cerebral hemorrhage. Because of his difficulties, he returned to work as a clerk with the same company. His family had to accompany him both to the office and the hospital for 2 years, because he had difficulty in recalling routes. He even lost his way around the house.

We examined the patient using the following: Mini-Mental State Examination,[3] Frontal Assessment Battery,[4] Wechsler Adult Intelligence Scale,[5] Wechsler Memory Scale-Revised,[6] Rey–Osterrieth Complex Figure Test[7] and Behavioral Assessment of Dysexecutive Syndrome[8] (Table 1). Screening tests revealed the patient was alert with no frontal lobe dysfunction. He had mild anterograde amnesia and a mild attention decrease, but no visuospatial memory problems. Autobiographical memory tests revealed anterograde amnesia for episodic memory, but no semantic or retrograde amnesia.[9] We also interviewed the patient after his brain hemorrhage for symptoms connected with mental time and videotaped his comments (Video S1). He was accurately able to count time at a normal speed, but estimated time to be shorter than it was (Video S2). Furthermore, he was able to narrate the layout of his house, but unable to sketch it accurately (Video S3 and Fig. S2) and make a cross-reference type timetable for the future (Fig. S3).

Magnetic resonance imaging was carried out using a 1.5T Magnetom Avanto (Siemens, Erlangen, Germany) equipped with a 12-channel head coil. T2-weighted axial, T2 short-term inversion recovery axial and T2 coronal slicing was carried out of 5-mm thickness. Single-photon emission computed tomography imaging was carried out with a triple-headed gamma camera (GCA-9300R; Toshiba Medical Systems Corporation, Tokyo, Japan), using fan beam collimators (N2). Magnetic resonance imaging showed lesions of the left hemisphere involving anterior–posterior cingulate gyrus as a result of brain infarct, and hemorrhage of the anterior cerebral artery (Fig. 1a,b). N-isopropyl-[^{123}I] p-iodoamphetamine brain blood flow single-photon emission computed tomography showed decreased flow mainly in the left medio-parietal lobe (Fig. 1c).

Table 1 Neuropsychological findings

MMSE (max: 30)	29
FAB (max: 18)	18
WAIS-III	
VIQ	117
PIQ	97
FIQ	109
WMS-R	
Verbal memory	95
Visual memory	99
General memory	96
Attention	78
Delayed recall	74
ROCFT (max: 36)	
Copying	35
Immediate recall	17
Delayed recall	22
BADS	97

Screening tests showed the patient was intelligent with no frontal lobe dysfunction. He had mild anterograde amnesia and a mild decrease in attention, but no visuospatial memory problems. BADS, Behavioral Assessment of Dysexecutive Syndrome; FAB, Frontal Assessment Battery; FIQ, Full scale IQ; max., maximum; MMSE, Mini-Mental State Examination; PIQ, Performance IQ; ROCFT, Rey–Osterrieth Complex Figure Test; VIQ, Verbal IQ; WAIS-III, Wechsler Adult Intelligence Scale; WMS-R, Wechsler Memory Scale-Revised.

Discussion

The medio-parietal lobe is thought to have a key function in topographical orientation.[1, 2] The precuneus elaborates a central role in visuospatial imagery, episodic memory retrieval, self-processing operations and first-person perspective taking.[10] First-person perspective taking refers to cognitive self-awareness. The precuneus, together with the posterior cingulate cortex, is involved in processing intentions related to the self. The precuneus, together with the frontal cortex, might be processing third-person perspectives. These networks might make it possible to produce topographical and temporal "maps." Furthermore, the posterior cingulate gyrus and retrosplenial region serve as connections between the hippocampus and precuneus, and are involved in episodic future thinking in both healthy control individuals and Alzheimer's disease patients.[11] Given that topographical disorientation links with mental time travel disorder in the posterior cingulate gyrus and the retrosplenial region, these might be involved in converting time and place into internal allocentric maps. Our case presented with intercurrent symptoms of mental time travel and spatial navigation, and we suggest that the medio-parietal lobes play an essential role in allocentric map-making. Such "maps" might provide topographical orientation, and mental time of the past and future. Damage to the retrosplenial region and posterior cingulate gyrus in the left hemisphere could be related to time-length estimation and topographical disorientation. Furthermore, there are few reports of retrosplenial amnesia accompanying a sense of time flying. MacDonald Critchley described time passing too quickly, or everything looking as if moving too fast (Zeitraffer Effekt) in the case of massive space-occupying lesions within the middle third of the cerebral hemisphere.[12] The fact that the damage involved the whole length of the cingulate gyrus seems associated with this disorder. We believe there is some support for this idea in related avian models, as migratory birds have biological clocks that partially provide a basis for temporal orientation.[13] The idea, although tentative, is worthwhile, we believe. Humans, in common with other animals, might thus possess a "Navi-time" system (Fig. S4).

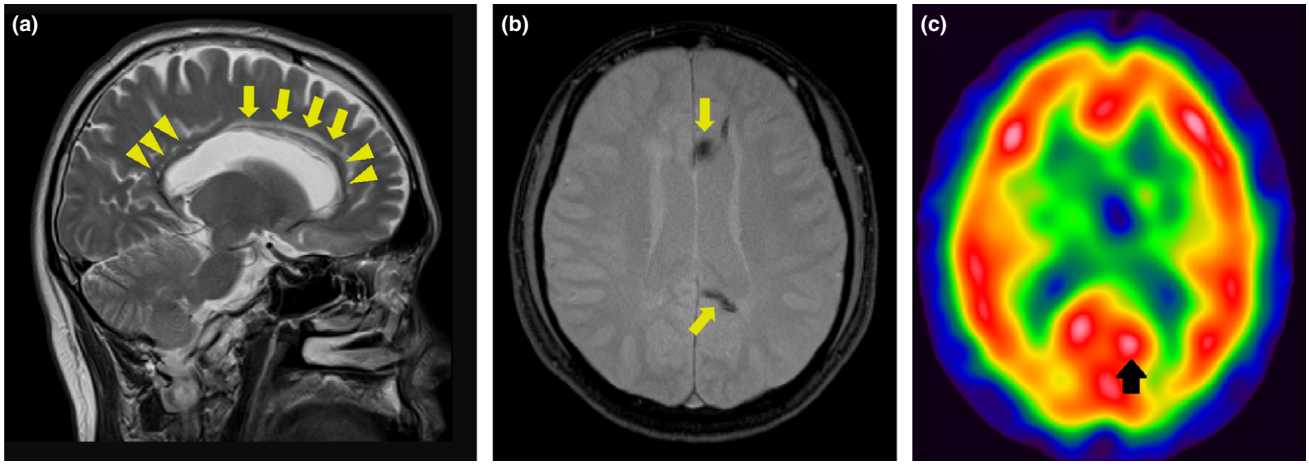

Figure 1 Brain magnetic resonance imaging and N-isopropyl-[^{123}I] p-iodoamphetamine brain blood flow single-photon emission computed tomography. (a) T2-weighted sagittal view showing the brain infarction (yellow arrow) and the brain hemorrhage (yellow arrowhead) in left anterior–posterior cingulate gyrus and retrosplenial cortex. (b) T2 short-term inversion recovery axial view showing low intensity in left anterior cingulate gyrus and retrosplenial cortex (yellow arrow). (c) N-isopropyl-[^{123}I] p-iodoamphetamine brain blood flow single-photon emission computed tomography showing a decrease mainly in the left hemispheric medio-parietal lobe (black arrow).

Ethical statement

This study was approved by The Ethics Committee of Showa University Hospital (No. 287). We obtained patient, written informed consent. All participants provided written informed consent including permission to film for publication.

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Supporting Information

Additional Supporting Information may be found online in the supporting information tab for this article:

Figure S1 Patient's fixed time schedule.

Figure S2 A sketch of the rooms layout.

Figure S3 Weekly timetable.

Figure S4 A hypothetical functional mechanism of topographical orientation in medial parietal lobes.

Video S1 Patient interview about mental time impairment and daily life.

Video S2 Patient showed mistakes in estimating the passage of time and disorientation in present time.

Video S3 Patient narrated the layout of his house as he walked around it.