

## Topographic Disorientation and Amnesia due to Cerebral Hemorrhage in the Left Retrosplenial Region

Aiko Osawa<sup>a</sup> Shinichiro Maeshima<sup>b</sup> Katsuzo Kunishio<sup>a</sup>

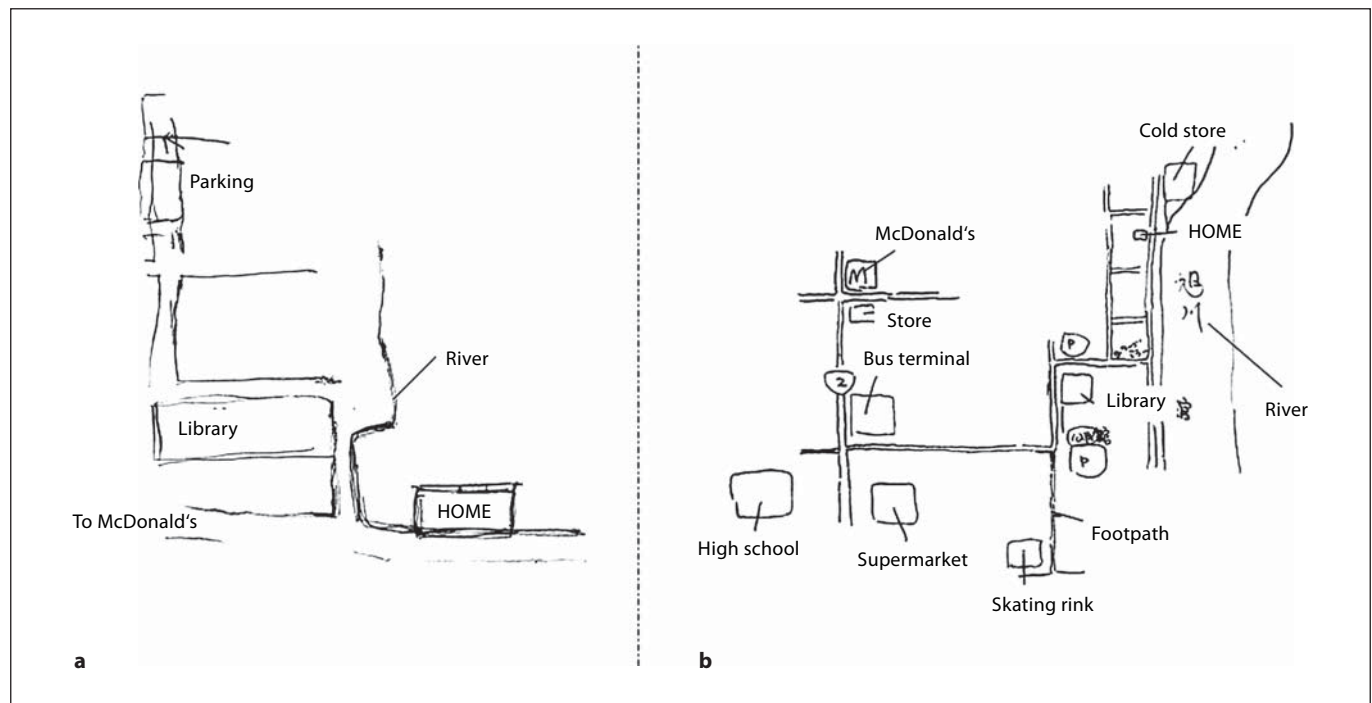
<sup>a</sup>Department of Rehabilitation Medicine, Kawasaki Medical School Kawasaki Hospital, Okayama, <sup>b</sup>Department of Rehabilitation Medicine, Saitama International Medical Center, Saitama Medical University, Saitama, Japan

Dear Sir,

Since the report by Valenstein et al. [1], it has been known that a lesion in the dominant retrosplenial region produces amnesia. On the other hand, a lesion in the same location in the nondominant hemisphere produces topographical disorientation [2]. Specifically, connections between the in-

ferior parietal lobe and the limbic system are impaired, leading to heading disorientation – a disorder in which patients are unable to remember the direction in which to go, although they are still able to recognize familiar buildings and homes [3]. In this study, we report a case of a patient

who, due to intracerebral hemorrhage in the left retrosplenial region, was unable to learn new buildings and routes (anterograde disorientation), in addition to having heading disorientation in familiar surroundings.



**Fig. 1.** A map of the neighborhood of the patient. **a** The patient's drawing. **b** His son's drawing. Although the patient could recall some names of surrounding buildings, it was impossible for him to note their positions.

**Table 1.** Neuropsychological assessments

Period of assessments	2006.4 (2 weeks)	2006.5 (6 weeks)
Wechsler Adult Intelligence Scale-revised		
Verbal IQ	88	99
Performance IQ	76	96
Full scale IQ	82	98
Mini-Mental State Examination (/30)	12	24
Raven's Colored Progressive Matrices (/36)	6	23
Wechsler Memory Scale-revised		
Verbal memory	59	67
Visual memory	<50	79
Common sense memory	<50	66
Attention/concentration	<50	73
Delayed recall	<50	<50
Rivermead Behavioral Memory Test		
Total profile (/24)	2	8
Screening (/12)	1	3
Auditory Verbal Learning Test (/15)		
Immediate recall	2-4-3-4-3	4-6-7-5-5
Recognition	3	7
Delayed recall	0	0
Frontal Assessment Battery	8	14
Behavioral assessment of the executive dysfunction system		
Total profile	20: average	
Word Fluency Test (/min)		
Category (animal + fruit + vehicle)	5-3-2	11-7-8
Letter ('shi' + 'i' + 're')	4-0-2	4-4-2
Digit Span		
Forward	5	5
Backward	3	4

### Case Report

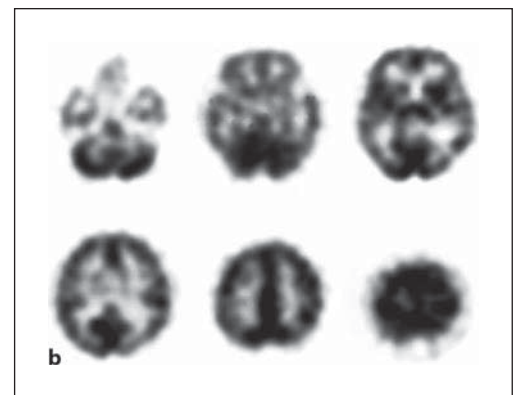
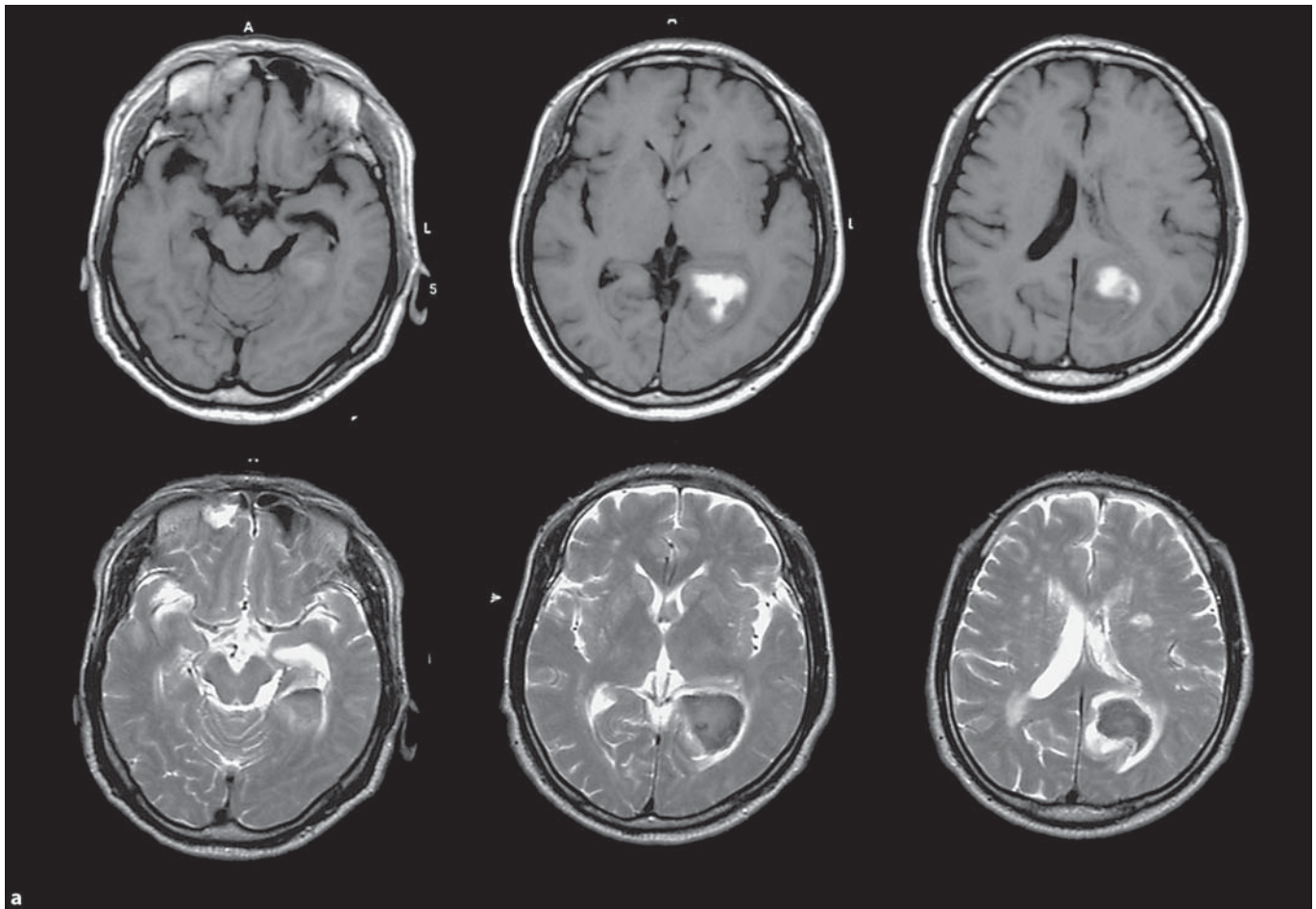
A 56-year-old, right-handed man was admitted to our hospital on March 30, 2006, with sudden onset of headache and a narrowing visual field. His son noticed that he had begun to lose his way even in familiar surroundings, and became forgetful of recent events several days before. On admission, he was alert and cooperative. He showed right hemianopsia but no sensorimotor loss. Neuropsychological examination showed recent memory loss and topographical disorientation. He was aware of his memory disturbance, but expressed no serious concern. His autobiographical memory for the events that had occurred up to the cerebral attack was excellent. For example, he could remember the previous day's news. Thus, he did not exhibit retrograde amnesia. Retrograde episodic memory concerning both personal and public remote events was nearly

intact, although the patient had an anterograde amnesia; he did not show confabulation. He scored 12/30 in the Mini-Mental State Examination, with declining performance in orientation, attention and calculation, and reproduction. On the Auditory Verbal Learning Test, immediate recall (2, 4, 3, 5, 3/15), delayed recall (0/15), and recognition (8/15) were all decreased. On the Wechsler Memory Scale, revised, verbal memory quotient was 59, while the other quotient was under 50. The results of these tests showed that he had severe anterograde amnesia. The Wechsler Adult Intelligence Scale-Revised scores were: verbal intelligence quotient (IQ) = 88, performance IQ = 76, and full scale IQ = 82 (table 1). He did not show aphasia, unilateral spatial neglect, constructional apraxia, or agrapahia, tactile objective anomia, ideomotor or ideational apraxia in the bilateral hand. He was able to recognize familiar

buildings with accuracy, and was also able to identify them on a map. However, the patient could not describe the route from the nearest bus stop to his home very well, nor could he draw a map (fig. 1). He was able to recall the room layout in his house, but made mistakes in recalling the physical relationship between the rooms, the corridors, and the entrance. When he actually tried to walk, the patient was able to recognize landmarks, but often got lost and did not know which way to go. The patient could not learn the previously unknown hospital ward or the layout of the hospital, and often got lost finding the toilet located several meters from his room.

### Neuroradiological Examination

A cranial CT performed on the day of onset showed a hematoma in the retrosplenial region, diagnosed as subcortical hemorrhage. Magnetic resonance imaging 3



**Fig. 2. a** Magnetic resonance imaging 3 days after onset showed hyperintense areas between the left forceps occipitalis and the parietal lobe, involving the left cingulate isthmus. **b** SPECT 10 days after onset revealed a decrease in blood flow in the left retrosplenial region.

days after onset showed hyperintense areas between the left forceps occipitalis and the parietal lobe, involving the left cingulate isthmus (fig. 2a). Single photon-emission computed tomography (SPECT) 10 days after onset revealed a decrease in blood flow in the left retrosplenial region (fig. 2b).

#### Discussion

This case demonstrates lesions confined to the left retrosplenial region, with amnesic syndrome and topographical disorientation. There have been several articles on retrosplenial amnesia since the first by Valenstein et al. [1], and this condition is regarded as due to damage to a part

of the Papez circuit. A lesion in the left hemisphere is common, but a right hemisphere lesion has also been reported, although it is rare [4]. Regarding dysmnnesia, lesions in the left hemisphere impair verbal memory, and those in the right hemisphere impair visual memory. In this case, however, although the lesions were in the

left hemisphere, both memories were impaired. Laterality of memory is not as distinct as that of language or visuospatial cognition, and is not limited to retrosplenial amnesia. In fact, there have been some cases in which both verbal and visual memories were impaired by lesions in the right hemisphere. Experiments in monkeys have also shown that anterograde disorientation can be caused by lesions on either side [5]. Thus, in our case, it seems that memory function was not fully lateralized congenitally, and the lesions in the right hemisphere caused damage to both verbal memory and visual memory, including topographical memory.

Topographical disorientation was divided into four categories of the syndrome: landmark agnosia, egocentric disorientation, heading disorientation and anterograde disorientation [6]. Landmark agnosia is characterized by an inability to use salient environmental features for orientation [7]. This is caused by damage to the right ventral occipitotemporal cortex (fusiform, lingual, and parahippocampal gyri) [8]. Egocentric disorientation describes people who are unable to represent the location of objects with respect to self, even though they are able to identify prominent environmental objects [9]. Lesions of the right posterior parietal cortex are generally responsible for this deficit [10]. Heading disorientation leads to an inability to remember the direction in which to go with respect to the external environment [2, 3]. These patients have lesions in the retrosplenial cortex (posterior cingulate). Patients with anterograde disorientation who have preserved way-finding in environments that were known prior to the onset of their impairment but who are unable to create new representations of surrounding information are classified in this category. In these patients, the impairment is caused by a right parahippocampal lesion [8, 11, 12].

Regarding sequential memory, our patient was able to recall prehospital events very well, showing no retrograde amnesia, but could not learn the name of his disease, his room number, and the name of his own primary physician, showing mainly anterograde amnesia. These symptoms seem to be consistent with those of retrosplenial amnesia.

As shown by the above-indicated symptoms, the patient seems to have had both heading disorientation and anterograde disorientation. Regarding the location of the lesions, it has been reported that heading disorientation is associated with the cortex of the retrosplenial region (the posterior cingulate cortex) [3], and anterograde disorientation is associated with the parahippocampal gyrus. Either topographical disorientation is usually caused by lesions in the right hemisphere, while that caused by a lesion in the left hemisphere has rarely been reported [13, 14]. In a case reported by Obi et al. [13], lesions were in the left hemisphere, and the presence of transient right neglect was observed, suggesting that lateralization of visuospatial cognition may have been involved. In our case, the patient was right-handed, so lateralization is unlikely to have been affected. SPECT only revealed a decrease in blood flow in the left retrosplenial region, which coincided with the location of the lesions; findings suggestive of decreased function on the other side were not observed. Previous studies, in which the involvement of the parahippocampal gyrus in anterograde disorientation was examined in animal experiments, have reported that laterality is not associated with anterograde disorientation. Our report is the first to examine cerebral blood flow in relation to disorientation, and this case seems to be very important in examining the effects of damage to the posterior cingulate cortex and the parahippocampal gyrus on topographical disorientation.

## References

- 1 Valenstein E, Bower D, Veraellie M, Heilman KM, Day A, Watson RT: Retrosplenial amnesia. *Brain* 1987;110:1631–1646.
- 2 Cammalleri R, Gangitano M, D'Amelio M, Raieli V, Raimondo D, Camarda R: Transient topographical amnesia and cingulate cortex damage: a case report. *Neuropsychologia* 1996;34:321–326.
- 3 Takahashi N, Kawamura M, Shiota J, Kasahata N, Hirayama K: Pure topographical disorientation due to right retrosplenial lesion. *Neurology* 1997;49:464–469.
- 4 Masuo O, Maeshima S, Kubo K, Terada T, Nakai K, Itakuta T, Komai N: A case of amnesic syndrome caused by a subcortical haematoma in the right occipital lobe. *Brain Injury* 1999;13:213–216.
- 5 Olton DS: Spatial memory. *Sci Am* 1977;236:82–99.
- 6 Aguirre GK, D'Esposito M: Topographical disorientation: a synthesis and taxonomy. *Brain* 1999;122:1613–1628.
- 7 Hecaen H, Tzortzis C, Rondot P: Loss of topographical memory with learning deficits. *Cortex* 1980;16:525–542.
- 8 Aguirre GK, Dettre JA, Alsup DC, D'Esposito M: The parahippocampus subserves topographical learning in man. *Cereb Cortex* 1996;6:823–829.
- 9 Stark M, Coslett HB, Saffran EM: Impairment of an egocentric map of locations: implications for perception and action. *Cogn Neuropsychol* 1996;13:481–523.
- 10 Levine DN, Warach J, Farah MJ: Two visual systems in mental imagery: dissociation of 'what' and 'where' in imagery disorders due to bilateral posterior cerebral lesions. *Neurology* 1985;35:1010–1018.
- 11 Epstein R, DeYoe EA, Press DZ: Neuropsychological evidence for a topographical learning mechanism in parahippocampal cortex. *Cogn Neuropsychol* 2001;18:481–508.
- 12 Habib M, Sirigu A: Pure topographical disorientation: a definition and anatomical basis. *Cortex* 1987;23:73–85.
- 13 Obi T, Bando M, Takeda K, Sakuta M: A case of topographic disturbance following a left medial parieto-occipital lobe infarction. *Clin Neurol (Tokyo)* 1992;32:426–429.
- 14 Maeshima S, Ozaki F, Masuo O, Yamaga H, Okita R, Moriwaki H: Memory impairment and spatial disorientation following a left retrosplenial lesion. *J Clin Neurosci* 2000;8:450–451.

Copyright: S. Karger AG, Basel 2008. Reproduced with the permission of S. Karger AG, Basel.  
Further reproduction or distribution (electronic or otherwise) is prohibited without permission  
from the copyright holder.