

# Retrosplenial Amnesia without Topographic Disorientation Caused by a Lesion in the Nondominant Hemisphere

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We report the case of a 68-year-old right-handed man who was admitted to our hospital because of sudden onset of headache. On admission, he presented with left homonymous hemianopsia, disorientation, and recent memory disturbance; however, he had normal remote memory and digit span. He was able to recall the room layout of his house and describe the route from the nearest station to his home on a map. However, at the hospital, he sometimes lost his way because of amnesia. Computed tomography (CT) and magnetic resonance imaging revealed a subcortical hematoma in the right occipital forceps and the parietal lobe, involving the cingulate isthmus. Single-photon emission CT imaging showed reduced perfusion not only in the retrosplenial region but also in the right thalamus. These findings suggested that the retrosplenial amnesia might have been caused by the interruption of hippocampal input into the anterior thalamus. **Key Words:** Memory impairment—amnesia—cerebral hemorrhage—thalamus—retrosplenial region.

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## Introduction

Lesions of the limbic system, particularly the hippocampus or anterior thalamus, are well known to cause memory impairment. Retrosplenial cortex also plays an important role in the human memory by connecting the hippocampus with other structures involved with memory, including the anterior thalamic nuclei, septal nuclei, and mammillary bodies.<sup>1</sup> Amnesia, resulting from lesions involving the retrosplenial region, has been attributed to the damage of this vital link. Valenstein et al<sup>1</sup> reported a case

of retrograde and anterograde amnesia after hemorrhage because of an arteriovenous malformation situated close to the retrosplenium of the corpus callosum. They termed this amnesia “retrosplenial amnesia.” Lesions in the left hemisphere are common; however, lesions in the right hemisphere are rare.<sup>2,3</sup> A lesion in the same location in the right hemisphere as that in the left hemisphere produces topographical disorientation.<sup>4,5</sup> We report a case of amnesia without topographical disorientation because of intracerebral hemorrhage in the right retrosplenial region.

## Case Report

A 68-year-old man with an educational history of 9 years was admitted to our hospital. He was completely right handed with a laterality quotient of +100 when formally assessed by the Edinburgh Handedness Inventory,<sup>6</sup> and all members of his immediate family are right handed. He presented with a 3-day history of headache and had developed untidy behavior and memory disturbance over a couple of days. He had no neurological deficits except left hemianopsia and amnesia.

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Received January 3, 2013; revision received March 11, 2013; accepted March 19, 2013.

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1052-3057/\$ - see front matter

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<http://dx.doi.org/10.1016/j.jstrokecerebrovasdis.2013.03.026>

**Table 1.** Results of neuropsychological tests

	3 d	6 wk	Cutoff score
Mini-mental state examination (/30)	21	22	23/24
Digit span (forward/backward)	4/3	4/3	
Auditory verbal learning test (/15)			
Immediate	1, 5, 7, 8, 7	4, 5, 6, 5, 6	
Recognition	12	13	
Delayed	0	4	
Raven's progressive matrices (/36)	17	23	24/25
Frontal Assessment Battery (/18)	11	16	12/13
Trail-Making Test			
A	2'15"	221"	
B	Not done	3'23"	
Wechsler Adult Intelligence Scale, Third Edition			—*
Verbal IQ	72	80	
Performance IQ	57	72	
Full IQ	62	74	
Verbal comprehension	76	82	
Visual perception	54	75	
Working memory	65	76	
Process speed	66	75	
Wechsler Memory Scale-Revised			—*
Verbal memory	70	87	
Visual memory	55	88	
General memory	61	86	
Concentration/attention	72	78	
Delayed recall	59	71	
The Rivermead Behavioral Memory Test			
Screening score (/12)	4	5	5/6
Profile score (/24)	9	15	15/16
Behavioral Assessment of Dysexecutive Syndrome			
Age matched score (classification)	Impaired	Impaired	

Abbreviation: IQ, intelligence quotient.

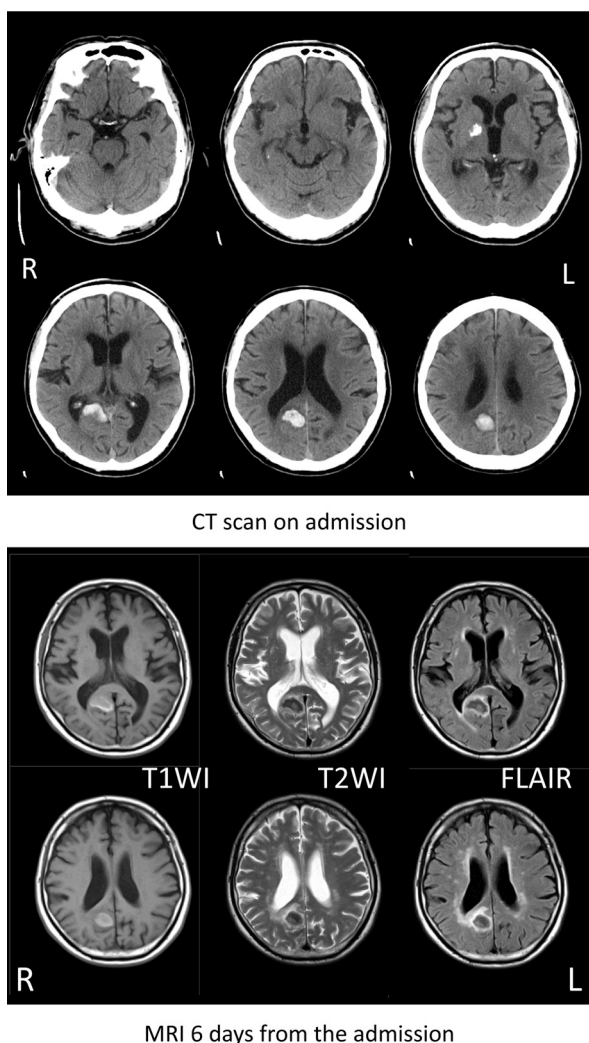
\*The median of Wechsler Scale is centered at 100, with an SD of 15.

He was alert and cooperative to a series of neuropsychological examinations, although he was in an amnesic state, with disorientation and recent memory loss.

Retrograde episodic memory concerning both personal and public remote events was nearly intact, but he had anterograde amnesia. For instance, he had no memory of whether he had received his meals and repeatedly asked for them. He even kept forgetting the most recent conversations. He did not show confabulation. His speech was fluent and not aphasic. Objective naming, letter reading, verbal comprehension, and dictation were normal. He showed constructional apraxia, but ideomotor or ideational apraxia and unilateral spatial neglect were not noted. He had no signs of callosal disconnection such as apraxia or tactile anomia in his left hand. He could recall the room layout of his house and describe the route from the nearest station to his home on a map. However, he sometimes lost his way at the

hospital because of amnesia without topographic disorientation.

Table 1 shows the results of neuropsychological tests in this patient. On the Wechsler Adult Intelligence Scale, Third Edition, his verbal intelligence quotient (IQ) was 72; performance IQ, 57; and full IQ, 62. His verbal memory was 70 and visual memory was 55 on the revised Wechsler Memory Scale. The score on the Frontal Assessment Battery was 11/18, and the word fluency test where the patient was required to produce exemplars from given categories resulted in scores of 9, 3, and 5 for the categories "animal," "fruit," and "vehicle," respectively, and where he was required to produce words that begin with given letters resulted in scores of 2, 5, and 3 for the letters "shi," "i," and "re," respectively. The level of executive functioning was classified as "impaired" on the basis of the scores of Behavioral Assessment of the Dysexecutive Function, that is, overall profile, 5, and age-corrected score, 44 (impaired).



**Figure 1.** CT scan on admission (upper) and magnetic resonance imaging tomography 6 days after the admission (lower). A subcortical hematoma was evident between the right forceps occipitalis and the parietal lobe, involving the right cingulate isthmus. A high-density area in CT scan was evident in right globus pallidus without pathologic calcification. Abbreviations: CT, computed tomography; FLAIR, Fluid attenuated inversion recovery; L, left; MRI, magnetic resonance imaging; R, right; T1WI, T1 weighted images; T2WI, T2 weighted images.

### Neuroradiological Findings

Computed tomography (CT) and magnetic resonance imaging (MRI) revealed a subcortical hematoma ( $2 \times 2.5 \times 2$  cm) between the right forceps occipitalis and the parietal lobe, involving the right cingulate isthmus (Fig 1). Single-photon emission CT imaging using Technetium-99m-labeled ethyl cysteinate dimer performed 3 days from the onset of stroke revealed reduced perfusion not only in the retrosplenial region but also in the right thalamus (Fig 2, A).

### Clinical Course

The patient was treated medically and visual field defect resolved within several days. He was discharged

from the hospital 10 days after the onset. He was able to accurately recognize familiar buildings and find his way. The amnesia gradually improved, but memory impairments were detected at 6 weeks after the onset by using neuropsychological tests. Single-photon emission CT performed 45 days after onset showed an improvement of cerebral blood flow in the right thalamus (Fig 2, B).

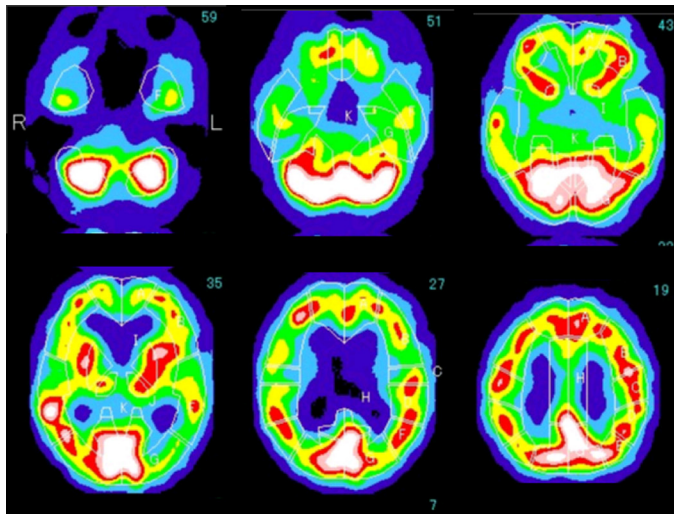
### Discussion

The sequential memory of our patient was intact, and he could recall prehospital events very well, indicating the absence of retrograde amnesia. However, he could not learn the disease name, patient room number, and the primary physician's name, suggesting mainly anterograde amnesia.

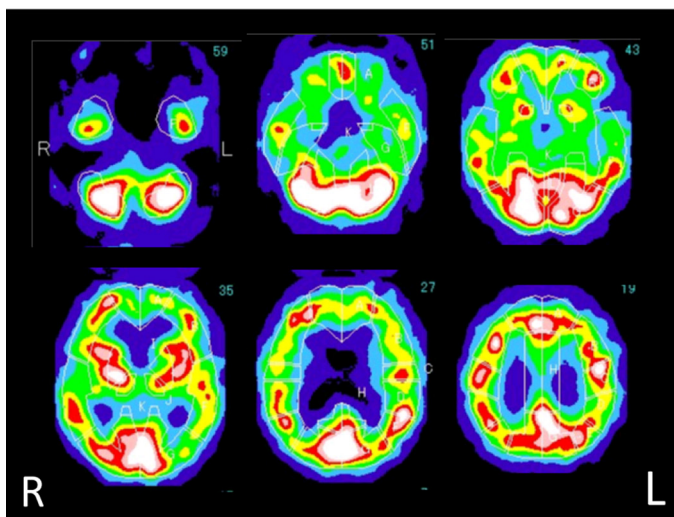
Damage to the retrosplenial region has been reported to be sufficient to induce anterograde amnesia.<sup>1-3,7-10</sup> Several etiologies of the tumor, infarction, and hemorrhage have been reported in patients with retrosplenial amnesia, but lesions in the right hemisphere are less common.

Regarding dysmnesia, the lesions in the left hemisphere are known to mainly impair verbal memory and those in the right hemisphere mainly impair visual spatial memory.<sup>11</sup> In our case, although the lesions were in the right hemisphere, both visual and verbal memories were impaired (visual > verbal). These findings suggested that the laterality of memory was not as distinct as that of language or visuospatial cognition, which was not limited to retrosplenial amnesia. In fact, some cases have been reported in which both the verbal and visual memories were impaired by the lesions in the right hemisphere.<sup>11</sup> Some experimental studies have also shown that anterograde disorientation can be caused by lesions on either side.<sup>12</sup> Thus, in our case, it seemed that the memory function was not completely lateralized congenitally, and the lesions in the right hemisphere caused damage to both verbal and visuospatial memory.

The isthmus of the cingulate gyrus connects the visual cortex in the occipital lobe with such limbic structures as the hippocampus, anterior cingulate gyrus, and anterior thalamus.<sup>13,14</sup> Lesions in the retrosplenial cortex may disrupt the connections between the anterior thalamus and hippocampus and thus cause memory disturbance. In the present case, amnesia improved only slightly with an increase in cerebral blood flow in the right thalamus. We suspected that the retrosplenial amnesia was caused by the interruption of hippocampal input into the anterior thalamus. Because the retrosplenial cortex itself is vital for memory, the remote effect might alter the impact of anterior thalamic lesions. These findings provide novel insights into the functional pathology of diencephalic amnesia and might be useful to determine the causes of posterior cingulate hypoactivity and show how distal changes in plasticity could contribute to



SPECT 3 days



SPECT 45 days

**Figure 2.** SPECT imaging performed 3 days from stroke onset at around the revealed reduced perfusion not only in the retrosplenial region but also in the right thalamus (upper). SPECT performed 45 days after onset showed an improvement of cerebral blood flow in the right thalamus (lower). Abbreviations: L, left; R, right; SPECT, single-photon emission computed tomography. (Color version of figure is available online.)

diaschisis.<sup>15</sup> Therefore, the clinical course of retrosplenial amnesia might have a good prognosis.

Topographical disorientations are usually caused by the lesions in the retrosplenial region.<sup>5</sup> Our patient could not remember the name of the previously unknown hospital ward or the layout of the hospital and often could not find the toilet located several meters away from his room. However, he could accurately recognize familiar buildings and identify them on the map. Furthermore, he could describe the route from the nearest station to his home and could draw the map. The anterograde amnesia might have been caused by the retrosplenial lesion. We, therefore, suspected that his impaired ability to remember unfamiliar landscape was because of anterograde amnesia and not because of topographic disorder.

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