

## NOTE

# PURE TOPOGRAPHICAL DISORIENTATION DUE TO RIGHT POSTERIOR CINGULATE LESION

**Kaoru Katayama<sup>1</sup>, Nobuyoshi Takahashi<sup>2</sup>, Kazue Ogawara<sup>2</sup> and Takamichi Hattori<sup>2</sup>**

(<sup>1</sup>Department of Neurology, Narita Red Cross Hospital; <sup>2</sup>Department of Neurology, Chiba University School of Medicine)

## ABSTRACT

We report an 82-year-old woman who developed pure topographical disorientation after a cerebral infarction involving the isthmus of the right posterior cingulate gyrus. She lost her way in new environments such as the hospital, but not in old ones such as her own house. She correctly identified familiar or unfamiliar landscapes and buildings by photographs. Her failure to memorize a new route likely resulted from a loss of directional memory over a wide area. We suggest that the right posterior cingulate gyrus contributes to memorizing a new route.

Key words: topographical disorientation, spatial memory, cingulate gyrus

## INTRODUCTION

Topographical disorientation is a condition in which a patient is not able to find his or her way in familiar surroundings (Benton, 1969; De Renzi, 1985). With advances in neuroimaging, many cases of topographical disorientation due to focal cerebral lesion have been reported; almost all of them showed damage to bilateral or right medial temporo-occipital lobes. The mechanism in these cases was presumed to be one type of visual agnosia (see Landis, Cummings, Benson et al., 1986) or visual amnesia (De Renzi, Faglioni and Villa, 1977). Recently, Takahashi, Kawamura, Shiota et al. (1997) reported three patients who had small lesions that extended from the right retrosplenial region to the medial parietal cortex. They could identify familiar buildings and landscapes, but could not remember spatial and positional relationships between two distant locations in familiar areas. We now describe a case of topographical disorientation in new environments due to a lesion in the isthmus of the right posterior cingulate gyrus.

## CASE REPORT

An 82-year-old right-handed woman was hospitalized because she suddenly developed left limb numbness and failed to recognize her own neighborhood. On admission, she was awake and cooperative, but had slight disorientation for time and place. Her visual acuity and visual field were normal. She had no motor paresis, but had cerebellar ataxia and superficial sensory disturbance in her left limbs. No pathological reflex was observed. Magnetic resonance imaging disclosed a well-demarcated lesion of the isthmus of the right posterior cingulum and the right lateral thalamus (Figure 1). Single photon emission computed tomography with <sup>99m</sup>Tc-HMPAO showed no appreciable decreased signal both in the parietal and the occipital cortex.

One month after her admission, when she could walk about by herself, she was observed

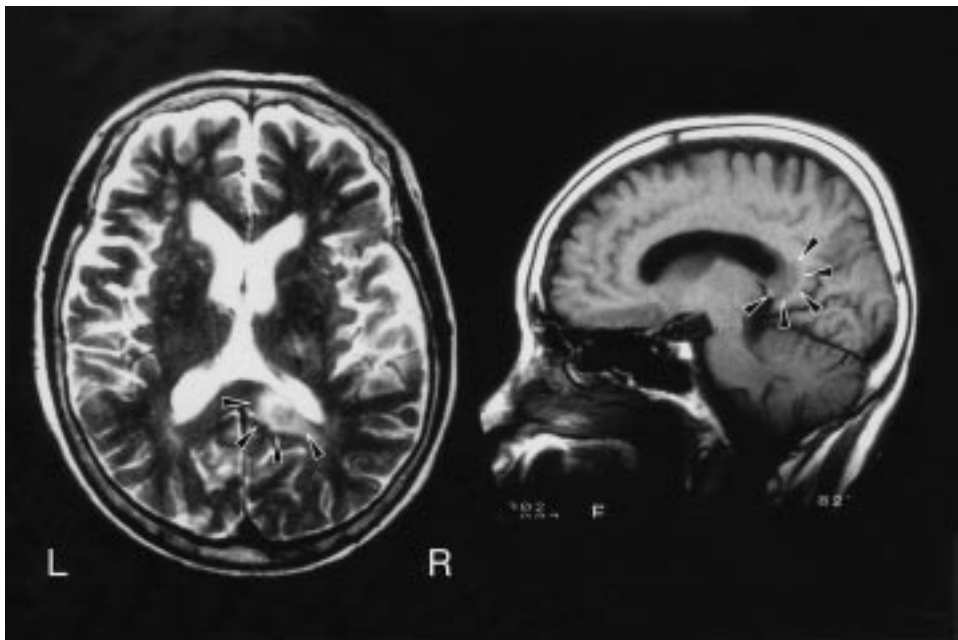


Fig. 1 – (Left) T2-weighted axial image (TR 4000, TE 112ms) showing high signal intensity lesion of the isthmus of the right posterior cingulum and the right lateral thalamus. (Right) T1-weighted sagittal image (TR 400, TE 13ms) showing low signal intensity of the isthmus of the right posterior cingulum.

losing her way in the wards. She was alert and fully cooperative. Mini-mental state examination was 24/30. She was tested on WAIS-R and obtained a verbal IQ of 83 and a performance IQ of 74. She was fluent and had normal verbal comprehension. No ideomotor or ideational apraxia was observed. There was marked topographical disorientation as described below, but no unilateral spatial neglect on line bisection and cancellation tasks. She did not demonstrate any signs of agnosia for faces, colors, or objects. She had no left-right confusion with respect to her own body and the external space. Constructional apraxia was observed when the patient copied a cube figure. Dressing apraxia was not observed.

The patient performed fairly well on a verbal memory paired associate task. The Benton visual memory test revealed poor performance (1 correct reproduction out of a total of 16). Copying a Rey-Osterrieth figure, the patient put much effort into completing the task, and could not recall almost all parts of the figure 10 minutes later (Table I).

TABLE I  
Mean Scores of Patient on a Series of Memory Tests

Test	Scores
Paired-associate words (maximum score: 10)	6.3
Benton visual memory test	1/16
Rey-Osterrieth Figure	
Copy	16
Delayed recall	0.5

*Topographical Disorientation*

The patient was unable to find her way to the rehabilitation room, where she was taken every day, and to the lavatory, which was located 10 feet away from her room. In order to find her bearings in the ward, she relied upon visual landmarks, such as room number plates, a public telephone, the color of the doors and a flower on the heater. She could navigate successfully with a memo including a list of landmarks that indicated the route, but could not do so with a map of the ward. She did not lose her way in her house, which she had been living in for many years. She had mild impairment in route finding in the streets around her home.

*Topographical Perception and Memory*

The patient recognized the appearance of her own house and each room in it, and the streets around her home when shown photographs. Similarly, she could recognize her room and the rehabilitation room in the hospital from photographs. She was able to recall and describe the external appearance of her house and neighborhood, and the interior of the rehabilitation room. It was notable that the patient could never recall the way to the rehabilitation room in the hospital. She was able to recall the route to the railroad station or the shop near her house, but not exactly. However, she was able to describe the spatial relation between the rooms of her house.

*Spatial Memory and Perception*

A series of tests to examine the patient's spatial skills was administered. These tests can be divided into spatial memory and spatial perception tests.

*Spatial Memory Tests*

- (1) In the Corsi cube span test (Milner, 1971), the patient had a spatial span of 7.
- (2) In the spatial location test (Smith and Milner, 1981), she was able to recall the location of only 3 objects exactly out of a maximum of 16, and she confabulated more than 4 objects.
- (3) In the Milner's maze test (Milner, 1965), only 5 trials were performed because the patient refused to continue the test. In all of them, she failed to reach the goal after 100 steps. There were many broken rules, including repeated failures to go back to the preceding bolt head when she missed the route.

*Spatial Perception Tests*

- (1) She described the shape of a room in the hospital, and she guessed the distance between two objects and the distance between the door and herself.
- (2) She was unable to localize her position on a map, either in the room or in the corridor of the hospital. Even on a miniature model of the sickroom, she could not identify the position where she stood at that moment. For example, when she was asked her position when she stood in the corridor, she might indicate on the map that she was in the room. When asked her position when she stood by her own bed in the sickroom, she might point to the side of the other bed in the miniature model.
- (3) In a visually guided maze task (Semmes, Weinstein, Ghent et al., 1955), she could not trace the routes, and could not even identify the starting point.
- (4) In a mental rotation test, she showed poor performance.

## DISCUSSION

Two aspects of topographical disorientation have been described: topographical agnosia and topographical amnesia. The former refers to disorientation in which patients are unable to recognize their environment, such that familiar buildings or streets no longer serve as landmarks for finding the route. The latter refers to disorientation in which patients are unable to recall the route, but can recognize the environment. Our patient recognized from

photographs both the places that she had always known, such as her own house, and those which she had become familiar with after the disease onset, such as the rehabilitation room. She was good on spatial perception in a general sense i.e., she could guess the distance between two objects and recognize the shape of her sickroom. Therefore, her topographical disorientation may be attributed to topographical amnesia. It is certain that the patient had visual memory disturbances, as shown by the Benton visual memory test or her failed attempts to recall the Rey-Osterrieth figure. However, her topographical disorientation may not be attributable to visual memory disturbance alone.

Takahashi et al. (1997) reported three cases of topographical disorientation due to small lesions that extended from the right retrosplenial region to the medial parietal cortex. Their patients could recognize landmarks but could not recall directional relations in a wide area and lost their way both in old (home) and new (hospital) environments. Reviewing the literature, Takahashi et al. proposed that topographical disorientation deficits may be divided into two types: (1) those with perception and memory inability to recognize buildings and landscapes due to bilateral or right-sided medial temporo-occipital lobe lesions and (2) those with impairment of directional orientation between locations in a wide area, caused by lesions extending from the right retrosplenial region to the medial parietal lobe.

The lesion in our patient was localized in the isthmus of the right posterior cingulate gyrus, which corresponds to Brodmann's area 29. It did not involve the parietal cortex or the medial temporal cortex. Our case is similar to the cases of Takahashi et al. with respect to directional memory disturbance, except that our patient's topographical disorientation was confined to new environments. Recent studies of neurofunctional imaging demonstrated that spatial processing depends on a network of regions, including the posterior parietal cortex, the retrosplenial cortex, the parahippocampus, and the hippocampus (see Aguirre, Detre, Alsop et al., 1996). Sutherland and Hoising (1993) demonstrated that in rats bilateral area 29 destruction had the same effect on a place navigation task as hippocampal destruction. This study suggests that area 29 participates in the memory system, including spatial mapping. Although definite conclusions cannot be drawn from a single patient, the present case suggests that the isthmus of the right posterior cingulate gyrus contributes to the memorization of a new route but not to the retrieval of familiar routes. The latter function may be performed by the right medial parietal cortex (Takahashi et al., 1997).

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Kaoru Katayama, Department of Neurology, Narita Red Cros Hospital, 90-1 Iiidacho Narita-shi, Chiba, Japan.

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