

SPATIAL FRAMES OF VISUAL HEMINEGLECT IN PATIENT WITH HIGH-GRADE GLIOMA: A CASE REPORT AND REVIEW OF LITERATURE

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ABSTRACT Visual hemispatial neglect is a behaviour deficit due to brain damage affecting mostly temporoparietal junction region of the right hemisphere. There is a controversial finding of various studies regarding the spatial reference of the disorder. Some study reported that space-centred neglect (egocentric) neglect and object-centred (allocentric) neglect are two dissociable disorder. In contrast, others reported that the two types of neglects are the spectrum of a disorder that share the same basic mechanism. The case presented here is a man with suspected high-grade glioma affecting the perisylvian region to the angular gyrus. Both egocentric and allocentric neglect features are revealed through the neurobehavior test performed to the patient.

KEYWORDS visual hemineglect, egocentric neglect, allocentric neglect, case report, spatial frames of hemineglect

Introduction

Visual hemispatial neglect is a behaviour consequence of brain damage, mainly affected the right hemisphere. Hemineglect is different from hemianopsia, where the sensory component remains intact in the first case. Hemineglect is the result of attention system damage. Disruption of this system of one side of the brain makes the patient attention was biased towards the side ipsilateral to the brain lesion.[1]

According to its spatial reference, hemispatial neglect can be categorized as egocentric and allocentric neglect. Initial studies reported that the two types of hemineglect are behaviorally and anatomically different. [2] However, more recent studies reported that both disorders are a spectrum of a behavioural deficit that share the same basic mechanism.[3]

Here we review the visual hemispatial neglect, including its definition, pathophysiology, neurobehavior examination and its spatial frame differentiation. We also present a case of a man

with primary brain tumor affecting his right brain hemisphere suspected of high-grade glioma. Neurobehavioral examination revealed visual hemineglect. Further examination showed both egocentric and allocentric component of his hemispatial neglect.

Case presentation

A 45-year-old right-handed Balinese man who was a fisherman, presented to our emergency department referred from a district hospital. He had been in a somnolence condition for about two days. Further information was gathered from his family who reported that the patient had been complaining severe throbbing unilateral headache for about a week before he became unconscious. His wife reported that her husband had been complaining of a mild right-sided headache for two months before his presentation to our hospital. The intensity of the headache progressively turned into severe. As the headache became progressive, the patient also complaining of a blur vision and unilateral weakness of the left side of his body. He never had a head injury, fever, nor body weight loss. Before admitted to our hospital, the patient hospitalized in a district hospital in Bali and diagnosed with having a brain tumor. The patient was somnolence at the time of presentation at the emergency department. There was a grade two papilla edema as a sign of high intracranial pressure and impression of hemiparesis of the left side of his body as his left extremities were less responsive to pain stimulus than the right extremities. At that time, the

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neurobehavioural examination cannot be conducted.

A brain computed tomography (CT) performed at the district hospital showed an intra-axial mass at the right temporoparietal lobe. The dimension of the mass was 6,03 x 6,95 x 6,08 cm with vasogenic edema surrounding the mass. The mass and the edema causing sub-falcine herniation to the left hemisphere (Picture 1). The imaging suggested a primary brain tumor suspected a high-grade glioma.

Further imaging study was performed to get a detailed picture of the tumor. The contrast of magnetic resonance imaging (MRI) examination was performed, and it confirmed the suspected high-grade glioma (Picture 2). The MRI image showed that the tumor affected the perisylvian region and angular gyrus. The surrounding edema was enormous, causing a sub-falcine herniation to the left side of the brain.

In preparation for surgical resection, the patient was managed with steroids to reduce the vasogenic edema. There was an improvement of consciousness after five days of treatment of 6 hourly 5 mg of dexamethasone. Thus, a battery of neurobehavioural examination can be performed.

We evaluated the patient at the bedside in his hospital room. He was dressed fairly and appeared his stated age. During the examination, he maintained consistent alertness and could engage throughout the assessment. The patient was well oriented that he was at the hospital, the city, date, day, month and the year. He fully understood that he was sick and said that he got a headache. The patient was aware that the left side of his body was weaker than the right side but said at that time, the strength was better than before his admission to the hospital. He denied sensory, mood and sleep disturbance. He also denied a visual disturbance.

He has no history of hypertension, hyperlipidemia and any other systemic problem. According to his brother, the patient has no history of developmental and psychiatric problems. Due to the economic situation of his parents, he only completed three years of elementary school, but he could read and write. Balinese was his main language and fairly spoke in Bahasa.

During the examination, the mood was euthymic even though he worries about his condition. He hoped that the doctors could alleviate his illness so that he can go back to his home and go to the sea again. He did not display disinhibition or apathy nor anosognosia.

He exhibited spastic hemiparesis on the left side of his body. The motoric grade was 4 for both upper and lower extremities—no evidence of tremor and involuntary movement. Gross vision and hearing were quite normal. Throughout the examination, there was strong suspicion for left hemispatial neglect as he consistently neglected stimuli from the left space of his body. Thus, we did further neurobehaviour specific examination to evaluate this condition. The Montreal Cognitive Assessment-Indonesian Version (MoCA-Ina), line bisection test, cancellation test, reading, writing, copying, and spontaneous drawing was performed.

The total score of the MoCA-Ina was 19, suggesting a disturbance of cognitive function. Overall, the test revealed a global deficit in visuospatial perception, memory and executive function. The patient cannot finish the visuospatial tasks, including the trail making test, copying the cube drawing and the clock drawing test (Picture 3). The patient got some difficulty in identifying the animals in the naming test at the beginning. However, at last, he could name the three animals correctly.

The line bisection test and line cancellation test confirming

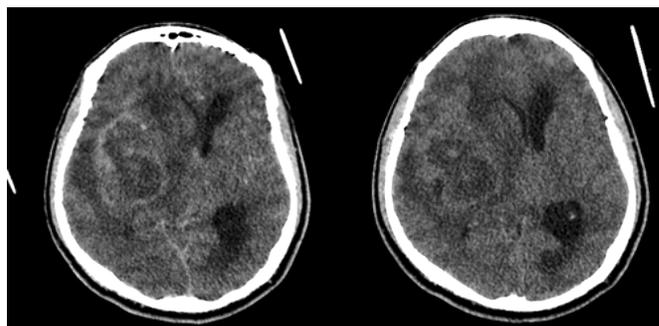


Figure 1: Plain CT scan of the brain taken at a district hospital.



Figure 2: Brain MRI with contrast confirming a high-grade glioma at the lower right parietal lobe to the superior right temporal lobe.

the left hemispatial neglect. A qualitative observation was performed by change the position of the paper relative to the patient's visual field. There was no difference in the result of both tests when test materials were moved from right in front of the patient (centre position) to the patient's right visual field. The patient still omitted the left space, confirming egocentric neglect (Picture 4).

The patient always omitted words written at the beginning of the sentence when asked to read regardless of the position of the paper. He could not identify a single word when asked to do so. During the writing task, the patient started to write from the center of the paper to the right side, although an instruction was given to start writing from the edge of the paper (Picture 5). A further test was done to confirm the hemispatial neglect. The patient was asked to copy a picture. The patient could not perfectly copy all the parts of the presenting picture. He omitted the left part of the object he copying (Picture 6).

Discussion

Hemispatial neglect, which is also called unilateral neglect, is a neurobehavioural syndrome defined by the inability or failure to report, respond, or orient to stimuli from the contralateral space of the brain lesion.[4,5,6] This syndrome is characterized by a deviation of head and eyes spontaneously toward the side, ipsilaterally to the brain lesion.[7] This behavioural bias does not



Figure 3: Visuospatial part of MoCA-INA test.

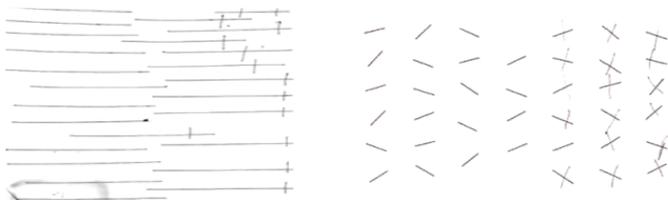


Figure 4: The line bisection test and the cancellation test.

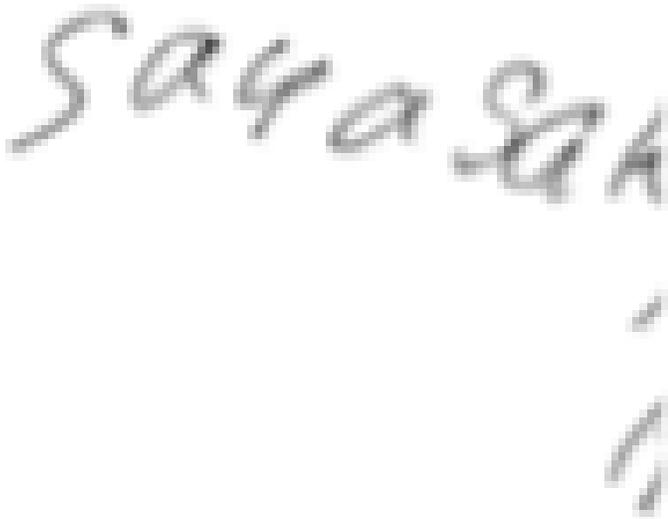


Figure 5: Handwriting produced by the patient.

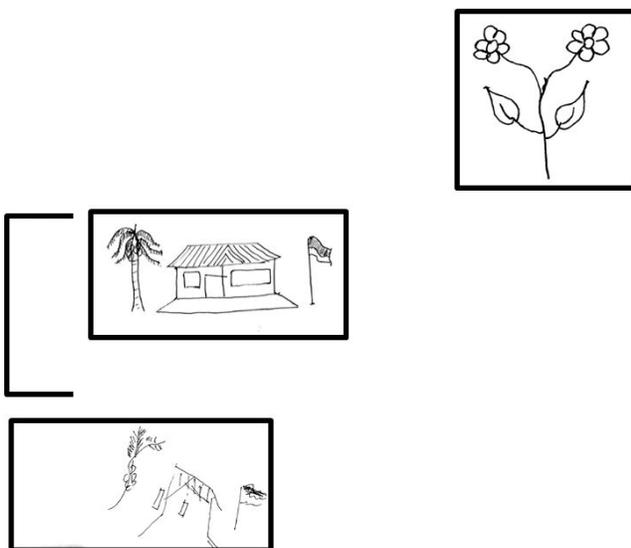


Figure 6: Drawing by copying a picture. The patient constantly omitted the left side of the objects

associate with sensory, motor or mental deficit.[5,7,8] Stroke is the most reporting cause of neglect syndrome. However, various conditions that causing brain insults such as head injury, brain surgical, and brain tumors can result in this condition.[6] Human perceptual awareness is determined by which stimuli are chosen to attend over any other novel stimuli.[1] This choice depends on the significance of the stimuli for the human. The stimuli that important for the individual goals or his biological needs will override any other novel stimuli.[4] In neglect patients, the choice is restricted due to the pathologic process in the brain that affected the attention system. Thus, the patient's attention was biased towards the side, ipsilateral to the brain lesion.[1]

A systematic review reported in 1999 documented hemispatial neglect following lesion affected both left and right hemispheres. However, the incidence of left-side neglect was substantially higher, where 12-100% of patients of 17 documented studies experienced left-side neglect.[9] It is caused by brain damage affecting the right cerebral cortex. The majority case of left hemineglect due to right hemispheric damage is linked with the domination of right hemisphere in mediating exogenous attention. There are at least two explanations of the domination of the right hemisphere in exogenous attention. First, there is an asymmetrical distribution of the neurotransmitter system. Second, it has been hypothesized that the right hemisphere can attend stimuli from both the left and right space.[10]

It is suggested that a specific neurotransmitter pathway regulates attention. There is a hemispheric asymmetry in the distribution of the neurotransmitter substances. Norepinephrine and serotonin, which is particularly important for the arousal system and environmental scanning, is released by the noradrenergic system. This system is lateralized to the right hemisphere. Part of the thalamus that connects to the right hemisphere has a higher concentration of norepinephrine than the part that connects to the left hemisphere. The evidence of this asymmetry is also found in the cortical region. The damage of structure in the right hemisphere depletes the norepinephrine pathway. This depletion causes a reduction in responsivity and rapid habituation to novel environmental stimuli.[10]

The right hemisphere can attend stimuli from both hemispace. It can distribute neural transmission responsible for the attention process across hemispatial boundaries. An investigation using electroencephalography confirmed the bilateral mediation of attention by the right hemisphere. It has also been identified that arousal function is the most affected by this system. The attentional aspect controlled by the right hemisphere is dominantly responsible for establishing human relationships with his environment. The right hemisphere modulates attention and perceptual consciousness regarding stimuli. Neglect in damage to the left hemisphere is less severe since the function covered by the damaged area will be undertaken by the right hemisphere. Also, left hemisphere damage affected the orientation aspect of attention more than the arousal aspect.[10]

As presented in our patient, the left-side-neglect is commonly associated with a lesion in the superior temporal lobe and the parietal lobe of the right hemisphere. The specific area that consistently linked with neglect in the parietal lobe was found to be the angular gyrus within the posterior parietal lobe.[11] Within the temporal lobe, the key areas are the supramarginal gyrus and the parahippocampal region. The areas serve as an information gateway from the parietal lobe to the hippocampus.[12,13] Additionally, a further study reported that lesion in the frontal cortex and subcortical areas such as the thalamus and

basal ganglia are also linked with hemineglect.[14] However, most of those studies were focused on neglect following strokes on the territory of the middle cerebral artery (MCA).[2] Studies with magnetic resonance imaging and SPECT identified that neglect related to a lesion in the right subcortical area due to stroke is considered to be a reflection of hypoperfusion in parietal and frontal regions served by the MCA.[15] There are some clinical presentations of hemineglect according to the anatomical location of the brain. The most reported and classical form is visual neglect, as identified in our case. Visual neglect correlates with the lesion in the temporoparietal junction, premotor cortex, basal ganglia, and thalamus. The patient omitted the left part of the object when he ordered to read a sentence. Paper and pencil tasks used to evaluate hemineglect are Albert's line cancellation test and line bisection test.[16] The patients will omit the lines on the neglected side (Picture 4).

The most challenging aspect in the assessment of visual neglect is its differentiation from hemianopsia. For this purpose, the line bisection test is one of the key methods of differentiation. In visual hemineglect, the deviation of bisection is directed toward the side of the lesioned hemisphere. The contradictory result of the test is found in the case of hemianopsia.[7]

A different finding of the line bisection test in hemineglect and hemianopsia patients further confirmed the theory of attentional bias as underlying the pathology of hemineglect. The hemineglect patients do not become aware of the condition that they do not perceive stimuli from one side hemispace of their environment. Hemianopsia patients are aware of the defect in their visual field. Thus, the patient will try to compensate it by increasing their gradient of fixation toward the affected hemispace. When performing the line bisection test, the patient will search for the line in the affected hemispace resulting in a bias toward the contralesional side [17]

Further evaluation of visual neglect can be done by asking patients to draw pictures from memory or copying a picture model. Through these tests, the spatial frames of reference related to the visual neglect can be evaluated, whether it is object or space centred neglect. The first one is allocentric neglect, where the contralesional side of an object is ignored regardless of the position of the object from the patient's viewpoint.[3] Allocentric neglect is associated with a lesion in the inferior parietal lobe, especially angular gyrus.[7] The second one is egocentric neglect, where the contralesional side of stimuli is omitted concerning the position of the stimuli relative to the viewer position.[3] Egocentric has long been associated with damage to the superior temporal lobe, especially superior temporal gyrus.[7]

Line bisection test and cancellation test result of our patient revealed egocentric neglect.[13] The patient constantly neglected the left hemispace of the paper task, marked only lines on the right side of the paper (Picture 4). The clock drawing test, which was a drawing from memory task, also confirmed the egocentric neglect (Picture 3). Additionally, the patient also omitted the beginning of a sentence when asked to read and could not read a single word.

However, drawing by copying tasks revealed that there was an allocentric component in our patient's hemineglect. The patient repeatedly brought in the right space of the paper even advised to draw in the centre of the paper. He omitted the left part of an object from the sample pictures (Picture 6).

There has been a long debate on whether egocentric and allocentric neglects are two different deficits that purely dissociate or related one and another. Many studies reported contradictory

findings regarding the issues. Several studies reported results that supported the distinction between these deficits.[3] A study by Rorden et al. in 2012 supported a study by Yue et al. in the same year that argued egocentric and allocentric neglect could not be separated.

According to the latter argument, allocentric and egocentric neglect share the same basic mechanism. Whether these two deficits identified in a patient is depending on the extent of brain damage affecting the parietal and temporal lobe which associated with the severity of the hemineglect. Allocentric neglect is subclinical in a milder form of neglect. A lesion in the perisylvian region is sufficient for clinically identified egocentric hemineglect while the allocentric hemineglect requires an extension of the lesion through the angular gyrus.[3] In our patient, the tumor is so extensive that destruct those areas. Therefore, both egocentric and allocentric hemineglect was identified through the behaviour test.

Conclusion

Hemineglect is the result of attention system damage to one side of the brain hemisphere. Thus, the patient neglects stimuli from the side contralateral to the brain lesion. Hemispacial neglect can be categorized as egocentric and allocentric neglect. There are controversial findings on the spatial frames of hemineglect. More recent studies reported that both disorders are a spectrum of a behavioral deficit that share the same basic mechanism. The presentation of both types of neglect depends on the extent of the damage in the brain.

Our finding in this case supporting the argument. The patient's brain was damaged by a primary brain tumor that affected his perisylvian region and the angular gyrus. Both egocentric and allocentric hemispacial neglect was identified through the neurobehaviour examination we performed to the patient. Further study is still needed to examine the exact characteristic and underlying pathomechanism of the spatial frame of the visual hemineglect.

Ethics committee approval

This case report has approved by the Research Ethics Commission of Faculty of Medicine, Udayana University/Sanglah General Hospital.

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Conflict of interest

There are no conflicts of interest to declare by any of the authors of this study.

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