A study of left unilateral spatial neglect with special reference to hemianopsia

MITSUKO NAKANO
13-12, Haramachi, Isogo-ku, Yokohama 235

Two cases of left unilateral spatial neglect (LUSN) were studied. One case is of a male patient, age 44, with serious LUSN accompanying left hemiparesis secondary to cerebral infarction. However, he revealed no hemianopsia in the visual field examination conducted on the Goldmann's kinetic perimeter, although an overall minor visual constriction was detected. The fact that his visual field examination did not bring out hemianopsia despite the presence of such a serious neglect syndrome, makes this case particularly significant for the purpose of finding out the exact nature of USN. The other case, male, age 64, was also examined on the same kinetic perimeter and revealed the presence of homonymous lower left quadrantic hemianopsia. After about a month's treatment of neglect, the patient made a remarkable progress in the simple tasks such as cancellation and explaining pictures. Then, the patient's visual field was examined again. It, however, demonstrated the persistent presence of homonymous lower left quadrantic hemianopsia. In other words, improvement in the degree of neglect exhibited no correlation with the change in the dimension of hemianopsia in the Case 2 patient.

Key words: left unilateral spatial neglect, hemianopsia, Goldmann's perimeters, copying, drawing, cancellation.

Unilateral spatial neglect (USN) is a phenomenon frequently observed in patients sustaining injuries in cerebral hemispheres. It is also called unilateral spatialagnosia (USA) or unilateral spatial inattention (USI) as well as hemi-inattention. The syndrome consists in ignoring stimuli presented on one side of the body contralateral to the injured hemisphere. Its mechanism of origin is yet to be explained conclussively in spite of extensive studies. Thus, there remain many unsolved questions such as the relationship between USN and hemianopsia, which has been of particular interest to the author.

Since there are sensory disorders like hemianopsia or oculomotor disability in most left sided USN (LUSN) patients, an assumption that USN is nothing more than a combination of these sensory defects has been prevalent among clinical specialists. Battersby, Bender, Pollack, and Kahn (1956) claimed that this phenomenon was generally associated with widespread cerebral dysfunction and that it occurred when a deprivation of sensory stimuli was superimposed on the background of deficient mental functions. On the other hand, there is a negative opinion against possible existence of a causal relationship between hemianopsia and USN as discussed in Hécaen's commentary (1969) referring to his earlier discovery of exceptional cases of USN patients giving no sign of hemianopsia.

1 The author is greatly indebted to Dr. Hitoshi Onoe and Dr. Yasuo Ueoka, Department of Ophthalmology, the Jikei University School of Medicine, Dr. Tsugihiko Horiuchi, Associate Professor at the same university, Dr. Norihiko Ando, Director of Rehabilitation, Dr. Masahiro Ōhashi, Assistant Director, and the late Dr. Takao Nakano, the then Assistant Director of Psychiatry of the Kanagawa Rehabilitation Center, for their cooperation in various specialized ways in regard to obtaining valuable data concerning respective patients.

She is also grateful to Dr. Takeshi Aoi, Department of Pathology, Chiba Cancer Center Research Institute, and Mrs. Hiroko Takada for their linguistic advice in preparing this English manuscript.
Table 1
Two groups of research papers upholding opposing viewpoints regarding correlation between USN and hemianopsia

<table>
<thead>
<tr>
<th>Papers with opinions supporting possible correlation leading to the presence of causal relationship between USN and hemianopsia</th>
<th>Papers on neglect patients without hemianopsia, questioning the possibility of causal relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paterson and Zangwill</td>
<td>Ettlinger, Warrington, and Zangwill</td>
</tr>
<tr>
<td>McFie, Piercy, and Zangwill</td>
<td>Ōhashi and Saito</td>
</tr>
<tr>
<td>Denny-Brown, Meyer, and Horenstein</td>
<td>Gainotti</td>
</tr>
<tr>
<td>Battersby, Bender, Pollack, and Kahn</td>
<td>De Renzi, Faglioni, and Scotti</td>
</tr>
<tr>
<td>Lawson</td>
<td>Hécaen</td>
</tr>
<tr>
<td>Costa, Vaughan, Horwitz, and Ritter</td>
<td>Anderson and Choy</td>
</tr>
<tr>
<td>Chédru, Leblanc, and Lhermitte</td>
<td>Endō, Watanabe, and Kobayashi</td>
</tr>
<tr>
<td>Oxbury, Campbell, and Oxbury</td>
<td>Albert</td>
</tr>
<tr>
<td>Colombo, De Renzi, and Faglioni</td>
<td>Inoue and Sugishita</td>
</tr>
<tr>
<td>Bisiach and Luzzati</td>
<td>Benton</td>
</tr>
<tr>
<td>Bandō, Ugawa, and Iwata</td>
<td>Costa</td>
</tr>
<tr>
<td>Kamakura and Mitsuohshi</td>
<td>Ōdoi</td>
</tr>
<tr>
<td></td>
<td>Dillinger and Weinberg</td>
</tr>
<tr>
<td></td>
<td>Kubo</td>
</tr>
<tr>
<td></td>
<td>Ichiba</td>
</tr>
<tr>
<td></td>
<td>Satō, Yasui, Suzuki, and Kobayashi</td>
</tr>
</tbody>
</table>

Table 1 shows the names of researchers holding opposing opinions on this question. Investigators supporting the existence of causal relationship are given in the left row, and those with the data against it are listed in the right. As is evident from the list, there has been persistent disagreement in the data obtained with regard to the correlation between LUSN and hemianopsia.

One of the two major reasons for the existence of opposing viewpoints lies in the absence of any conclusive definition as well as any established method of diagnosis regarding the neglect syndrome. The other is a result of diversified methods of measurement applied to examine hemianopsia. In addition, the methods of checking the visual fields of the patients have not always been mentioned in detail by the researchers listed in Table 1.

This paper reports two cases of LUSN patients whose visual fields were surveyed by means of Goldmann’s kinetic perimetry, a standard method of visual field examination for most ophthalmologists. The patients represented considerably severe neglect symptoms including the omissions in the copying and drawing tasks as well as behavioral disorders causing difficulties in daily living activities.

Case 1

Case 1, a 44-year-old, right-handed male, had a left hemiparesis secondary to cerebral infarction which had occurred at the age of thirty-three, but he had recovered the ambulatory ability and returned to work. In 1983, at the age of forty-three, he got involved in a traffic accident and sustained a cerebral contusion in the right hemisphere. He was unconscious for about two weeks. Then, memory disturbance and disorientation followed. He was also unable to ambulate because of left hemiparesis. Starting in February 1984, he was admitted to the institute of rehabilitation medicine for twelve weeks. Although his memory was not markedly impaired, occasional disturbance of orientation and loss of topographical memory were evident. Changes in his mental status, such as sullenness,
irritability, euphoria, and confabulation as well as the lack of awareness of these disorders were observed.

On admission, he frequently collided into things on the left side of his body when he was transporting himself on a wheelchair inside the ward, and he was unaware of such behaviors. Also, when he ate food initially served on the left side of his body, he had to move the plate over to his right side. However, he had no motor disabilities such as those to turn his neck or body toward different directions.

Methods of Examining LUSN

Copying and drawing tests (The respective dates are given below). The patient copied a photographed woman’s face (Fig. 1-a, April 3, 1984), sketched the face of the physician in charge of his treatment (Fig. 1-b, April 3, 1984), and drew an imaginary picture of his own body (Fig. 1-c, March 27, 1984). Figures 1-a and 1-b clearly show that he omitted the left side of the faces, although he even copied the minute details such as the earring and a mole on the right side. Moreover, as shown in Fig. 1-a, he copied it only by using the right side and did not use two thirds of the space in the drawing paper. In Fig. 1-c, the left side of the minute design was omitted. The patients did not recognize these omissions when he was asked if there were any errors or omissions in his work just after the respective tests were finished. Furthermore, as already pointed out by Brain (1941), there were confusions in regard to various parts of the figures.

Figure 1-d dramatically elucidated the

---

Fig. 1-a. Case 1: Copying a picture of woman’s face only using the space on the right side of a sheet of drawing paper. April 3, 1984.

Fig. 1-b. Case 1: Sketch of the face of the physician treating the patient. April 3, 1984.

Fig. 1-c. Case 1: Imaginary self-portrait of the patient. March 27, 1984.

Fig. 1-d. Case 1: Drawing of a clock face. February 14, 1984.
patient's LUSN. He was instructed to draw a clock face on a sheet of drawing paper measuring 21.0 cm × 29.5 cm in size. The outcome turned out to be the placement of all the numerals in the right half of the clock face.

**Copying of sentences in lateral lines (April 3, 1984).** Given the model sentences in the upper half of paper, the patient was instructed to copy them in the lower blank space on the same sheet of paper. Figure 2 shows an example of the patient's attempt to copy the model sentences. He omitted the left part of the sentences, and tended to place the copied sentences markedly toward the right side of the paper.

**Wide range arithmetic tests (April 3, 1984).** The patient was shown twelve simple problems of addition, subtraction, and multiplication. He completely omitted the five problems on the left side of the page and incorrectly calculated the remaining seven because he failed to see the numerals given on the left side of the numbers in the problems.

**Bisecting lines (April 3, 1984).** The patient was asked to bisect four 10 cm-long straight lines drawn on a sheet of paper. At the beginning, he bisected three of them almost correctly. At that time, he did not pay attention to the one on the left side, but soon he recognized the unfinished task and performed it voluntarily.

**Cancelling figures of triangles and circles (March 27, 1984).** The patient was asked to cancel by numbering all 14 triangles scattered on a (21.0 cm × 29.5 cm) sheet of paper and mixed with 20 circles (approximately 1 cm in diameter) placed at random. Unexpectedly, he did not leave out any of the targets (Fig. 3).

Usually, when a conspicuous neglect is present, the patient always makes errors in cancellation tests. However, in spite of the presence of serious neglect symptoms as shown in the copying test, this patient handled this task perfectly. This finding seemed to be most remarkable and significant.

**Psychological Tests**

**WAIS (April 25, 1984).** The patient was examined by the Wechsler Adult Intelligence Scale (WAIS), and the following results were obtained: verbal IQ—100; performance IQ—below 69 (score 21); full scale IQ—82.

**The Bender-Gestalt test (April 28, 1984).** In the Bender-Gestalt test, the patients made no omitting errors attributable to neglect, but he manifested the following difficulties: perseveration of errors (in the tests numbered 1), rotation (1, 2, 4, and 5), distortion (3 and 6), and defective figure formation (7). It should be noted...
that these errors were impartially made on both sides.

**Ophthalmological Examination**

**Visual field examination (March 1, 1984).** Figure 4 shows the visual field of Case 1, examined by means of Goldmann's kinetic perimetry conducted by an ophthalmologist. What is meant by kinetic perimetry is a method of drawing isopors, which represent border lines between the perceptible and imperceptible areas located by changing the size and luminance of the stimuli as well as shifting the stimuli sites.

The patient gazed at the center point with his head and eyes in a fixed position. He was asked to give a sign when he perceived the luminous stimulus. The examination revealed no hemianopsia, but a minor constriction in the visual field was observed. The ophthalmologist had previously been informed of the objectives of the examination and repeatedly performed it very carefully, but the results constantly remained the same.

In order to ensure absence of hemianopsia, the patient was also examined twice by the static perimetry using the same Goldmann's instrument. He was, however, unable to fix his vision to the mark placed in the center of the screen and failed in both tests. In the static perimetry, the positions of stimuli given on the screen are fixed to examine perceptual sensitivity just by changing luminous levels of the stimuli. In this method visual sensitivity in limited areas can be examined precisely, whereas an overall visual field examination is difficult.

According to the ophthalmologist, such inconsistency in the patient's ability shown in the visual field examinations is common reflecting the great difficulty required in fixing the vision still at one point. The ophthalmologist also diagnosed that there was no apparent defect in this patient's oculomotor mechanism.

**Visual acuity examination (March 1, 1984).** Right—0.2 (naked), 1.0 (corrected); Left—0.4 (naked), 0.9 (corrected).

**CT Scan of the Brain (February 24, 1984)**

A large, irregular-shaped low density area was observed in the right frontoparietal region. Both the lateral and third ventricles were dilated and the right lateral ventricle was larger than the left. These phenomena are probably attributable to cerebral atrophy.

**Case 2**

Case 2 is a right-handed male with a left hemianopsia secondary to multiple infarction sustained in May 1979, at the age...
of 64. His left hemiparesis shortly improved to cause no inconvenience in his daily living activities. However, the physician in charge of his treatment discovered a remarkable LUSN syndrome during the USN screening tests consisting of picture copying, and sent him to the rehabilitation hospital to have him examined and placed on the LUSN treatment.

On admission to the hospital in August 1979, the patient collided into things on the left side of his body. He never made left turns while transporting himself in the ward. He usually missed food served on the left side of the table, nor did he shave the left side of his face. During the 4-month hospitalization, he was examined psychologically as well as medically and was placed on a rehabilitation program designed to improve LUSN.

Methods of Examining LUSN

Copying of pictures (September 13, 1979). Soon after hospitalization, the patient was asked to copy drawings of a flower and a truck. The model picture had been drawn on a sheet of paper (21.0 cm × 29.5 cm), and he copied them in the space available on the same sheet. Figures 5-a and 5-c are the models, and Figs. 5-b and 5-d are the copies drawn by the patient. The patient did not recognize the conspicuous omissions he made in the copies when he was asked to check his work immediately after he finished it.

Fig. 5. Case 2: Copying a drawing of flower given on the right side of the drawing paper. September 13, 1979.

Fig. 6. Cancellation test: September 13, 1979. The patient started with an apple at the far right by counting it twice and proceeded toward the left. The ones on the left side of the diagonal line were ignored and remained uncancelled.

Fig. 7. Explaining a situation picture (family gathering): September 13, 1979.
Left unilateral spatial neglect with reference to hemianopsia

(September 13, 1979). The patient was shown fifteen apples and eleven cups mixed and scattered at random (Fig. 6) on a sheet of paper (21.0 cm×29.5 cm) and was instructed to count the apples by numbering them. He missed out six apples on the left side of the paper, and did not recognize that he had overlooked them.

Explaining situations represented in drawings (September 13, 1979). The patient was shown a picture of family gathering (Fig. 7) drawn on a sheet of paper (21.0 cm × 29.5 cm) and was asked what he saw in it. He answered that it was a boy's private room and that a boy was about to enter it. When asked if he saw anything else, he replied "No."

The above three experiments clearly pointed out the presence of LUSN and the fact that the patient was unaware of his neglect.

Psychological Examinations

WAIS (September 19, 1979). The following data were obtained according to the WAIS: Verbal IQ—90; performance IQ—60; full scale—79.

The Bender Gestalt test (September 13, 1979). Omissions apparently attributable to LUSN were made in the Bender-Gestalt test marked A, 3, 4, and 7, but there were no errors other than those omissions.

Ophthalmological Examinations

Visual field examination (August 30, 1979). Figure 8 shows the visual field of Case 2 measured on Goldmann's kinetic perimeter. The examination revealed homonymous lower left quadrantic hemianopsia.

Visual acuity examination (October 25, 1979). Right—0.7 (naked), 0.9 (corrected); Left—0.7 (naked), 0.7 (corrected).

Oculomotor examination (September 27, 1979). During the tests involving drawing, copying, cancelling, counting, and explaining a situation picture, the patient's oculomotor was examined by the Nack eye-camera3 fixed on his head. No functional disabilities became obvious in his oculomotor when he was working on the tasks following the instructions as to where to look at, and there was no apparent impairment, such as paralysis, affecting the function of oculomotor itself. However, when the patient used his oculomotor at his free will, it showed an outstanding fixation to turn to the right side, practically paying no attention to the left.

CT Scan of the Brain (October 6, 1979)

The findings obtained in the scanning by following the standard techniques clear-

3 The data obtained by use of the Nack eye-camera were made available through cooperation of Assoc. Prof. J. Kawachi, Dept. of Psychology, University of Tokyo.
ly revealed the presence of a more serious atrophy in the right hemisphere than in the left, and the presence of multiple infarction of the large region involving parietal, temporal, and occipital lobes as well as the internal capsules was also observed.

Treatment of Case 2

The patient was placed on the training designed to improve his LUSN, which was observed in the clinical examinations as well as in his daily life. He was examined periodically as to how his LUSN was alleviating. The period of training frequency was twice a week. With the completion of the intensive treatment, a follow-up training was conducted when he came to the rehabilitation center for regular medical checkups once a month. The author gave him homework so that he was able to continue his rehabilitation at home.

Many earlier investigators who dealt with the training of LUSN patients, such as Carrol (1958), Lawson (1962), and Diller and Weinberg (1977), pointed out that the effects of the treatment of LUSN cannot be generalized. Accordingly, in order to enforce awareness of neglect in this patient, the author designed a number of simple tasks which were different qualitatively.

The first step in the treatment was to make the patient aware of his behavioral disorders. Thus, simple tasks including cancellation and explanation of situation pictures were assigned so that the patient would learn that he was capable of performing the tasks correctly only if he turned his head to the left to catch the targets by acquiring awareness of his LUSN which ignored the stimuli presented on his left side.

In the cancellation test, which had induced omission of more than one third of the 16 targets (see Fig. 6) prior to the treatment, the patient proved himself to be capable of cancelling 39 targets out of 40 (Fig. 9) by the end of the treatment. However, with regard to relatively more complicated tasks such as copying pictures and working on written arithmetic problems, the presence of LUSN was still evident.

With regard to the picture shown to explain the situation depicted in it, the same picture (Fig. 7) shown to the patient prior to the training was used two weeks later. This time, he was able to recognize that it was a picture of family gathering and explained the whole situation minutely and precisely.

In Fig. 8, the broken lines indicate the field of vision examined on October 25, 1979, when the patient showed a remarkable improvement in the tasks dealing with cancellation and explanation of situations depicted in drawings. The similar result obtained previously on the Goldmann’s kinetic perimeter operated by an ophthalmologist also revealed that the patient had a homonymous lower left quadratic hemianopsia.

Discussion

In spite of the conspicuous manifestation of LUSN in various examinations conducted to check the existence of neglect as well as behaviors in daily life, Case 1 exhibited no sign of hemianopsia when examined on the Goldmann’s kinetic perimeter.

As to the overall modest visual constric-
Left unilateral spatial neglect with reference to hemianopsia

... which was also revealed, it was interpreted by the ophthalmologist in charge of the examination that it was confined to the extent to which even normal eyes would be vulnerable under fatigued condition and that it would practically have no actual negative effect in seeing.

Satō, Yasui, Suzuki, and Kobayashi (1984) also applied Goldmann’s kinetic perimetry in examining the visual field of a patient not exhibiting hemianopsia and neglect simultaneously. There are still some additional studies on the patients with LUSN but revealing no signs of hemianopsia in the visual field examination applying Goldmann’s kinetic perimetry, as shown by Ōdoi (1975), Kubo (1980), and Ichiba (1983).

However, according to Bandō et al. (1982), there exists a USA patient exhibiting lower left quadrantic hemianopsia to the Tübingen’s perimeter in spite of the negative response to the Goldmann’s perimeter. They, therefore, proposed that the tests, which had failed to check hemianopsia in USA patients, must have been operated inaccurately.

It is regrettable that Bandō et al. neither gave a detailed account of the method they applied to judge the presence of neglect nor explained how serious the LUSN syndrome in their patient was.

Although the Goldmann’s perimeter has both kinetic and static mechanisms for examining the visual field, this instrument is primarily known for its kinetic operation. The Tübingen’s perimeter is practically used exclusively for static examination. In general, the result detecting the existence of hemianopsia shows no difference whether the patient is examined on a kinetic instrument or a static one. However, visual deficit in the patient sustaining optic nerve disorders can be more readily detected by a static perimeter than a kinetic one. Therefore, hemianopsia which a kinetic perimeter fails to detect may sometimes be demonstrated by the static perimetry. Such a phenomenon is called the Riddoch Zappia Phenomenon (Kaji, 1978; Matsuo, Furuno, Endō, & Hara, 1975), and the rare case reported by Bandō et al. seems to exemplify it.

In this study, the Goldmann’s static function was also applied to examine the Case 1 patient. However, his insufficient gazing ability failed the measurement of his visual field by a static means. Therefore, it remains unknown whether the Riddoch Zappia Phenomenon exists in Case 1.

In Case 2, hemianopsia showed no change in its dimension even when a remarkable improvement was attained by training the patient with conspicuous neglect symptoms, indicating that no correlation exists between the degree or extent of neglect and the dimension of hemianopsia.

Thus, the data in this study obtained by means of Goldmann’s kinetic perimetry indicate that hemianopsia does not always co-exist with obvious LUSN and also that the improvement in the extent of neglect accompanied no change in the dimension of hemianopsia. Further studies, however, will be necessary to elucidate the precise relationship between LUSN and hemianopsia.

References

Bisiach, E., & Luzzatti, C. 1978 Unilateral neg-
lect of representational space. *Cortex, 14*, 129–133.


Inoue, K., & Sugishita, M. 1974 Drawings painted by a patient with hemispatial agnosia and his autopathographic recollections after recovery. *Neurological Medicine, 1*, 162–166. (In Japanese with English summary)


Received Nov. 8, 1984; accepted Jan. 24, 1987