The association of visual field deficits and visuo-spatial neglect in acute right-hemisphere stroke patients

TIMOTHY P. CASSIDY, DAVID W. BRUCE, SUSAN LEWIS, CHRISTOPHER S. GRAY

Department of Medicine, Geriatric Medicine Unit, Royal Infirmary, Edinburgh, UK
1Department of Geriatric Medicine, University of Newcastle Upon Tyne, Sunderland District General Hospital, UK

Address correspondence to: T. P. Cassidy. Newcastle General Hospital, Westgate Road, Newcastle Upon Tyne, Tyne and Wear NE4 6BE, UK. Fax: (+44) 191 219 5049.

Abstract

Background: visuo-spatial neglect (VSN) after stroke is associated with a poor prognosis for rehabilitation. The co-existence of a visual field deficit (VFD) with VSN may be associated with impaired visuo-spatial functioning and thereby poor functional outcome.

Objective: to determine whether the presence of a VFD (i) exacerbates VSN and (ii) influences recovery of VSN.

Methods: a prospective study of consecutive acute (<7 days), right-hemisphere stroke patients who were able to undergo detailed assessment of visuo-spatial functioning and visual fields. Clinical assessment and a standardized neuropsychological test was administered by one observer, followed by independent assessment of visual fields by a second observer. Patients were followed up for 12 weeks with 4-weekly re-assessments.

Results: 44 consecutive patients (23 women) with a first in a lifetime, acute hemisphere stroke were recruited. Twenty had VSN and VFD, seven VSN only, one VFD only and 17 had normal visual fields and no neglect. The finding of a VFD was significantly associated with the presence of VSN ($P < 0.0001$). Patients with both VFD and VSN had a significantly lower score on the behavioural inattention test. One month post-stroke, this difference was no longer significant. Recovery of VSN and VFD was maximal in the first month, however VSN recovery continued for up to 12 weeks. Patients with VSN and a VFD on admission had a greater mortality at 1 and 3 months.

Conclusion: the presence of a VFD does appear to exacerbate neglect in the acute stroke patient; this effect is no longer seen after 1 month. Recovery of VSN continues independent of a VFD. Patients with neglect and a VFD have an increased mortality, probably because of greater neurological impairment.

Keywords: visuo-spatial neglect, visual field deficits

Introduction

Visuo-spatial neglect (VSN) is defined as neglect of relevant visual stimuli when doing activities on the contra-lesional side [1]. It is more common after right-hemisphere injury and the continuing presence of neglect is a poor prognostic factor for rehabilitation [2–7].

A visual field deficit (VFD) refers to a sensory disturbance within the patient’s visual field and implies damage to the optic tract, geniculo-striate pathway or occipital cortex. If no attempt is made to correct for disturbances in cortical functioning or hemiparesis, a VFD may be incorrectly associated with a poor prognosis [8].

Our objectives were to determine whether a VFD exacerbated VSN in the acute stroke patient and to determine the influence of VFD of recovery of VSN.

Method

This was a prospective study of patients admitted to the Royal Infirmary, Edinburgh, with a clinical diagnosis of acute stroke. Stroke was defined according to World Health Organisation’s criteria [9]. Patients with either a subarachnoid haemorrhage or previous stroke were excluded. All patients had a full clinical examination, including assessment of their conscious level [10]. Dependency
and function were measured by the Rankin and Barthel scales respectively [11, 12]. Cognitive function was assessed using Hodkinson’s mental test [13].

The presence or absence of neglect was assessed using a validated neuropsychological test battery, the behavioural inattention test (BIT) which has good inter-observer and inter-test reliability [14]. The test battery was applied to all first-ever right-hemisphere stroke patients within 1 week of the acute event, by a single observer (T.P.C.). VSN was defined as a total BIT score of 129 or less (maximum possible score 146). The presence or absence of a VFD was determined by a second independent observer (D.W.B.) by simple confrontation and then by oculokinetic perimetry [15].

Serial assessments of neuropsychological function and visual fields were carried out every 4 weeks for 12 weeks.

Data were collected on a standard proforma and analysed using SPSS windows.

Results

Forty-four consecutive hemisphere stroke patients (23 women) who were fully conscious and were able to participate fully in the test battery were recruited. Median age was 73 years (range 56–86), and all were seen within 1 week of their stroke (median 3 days). Median Rankin score was 5 (range 2–6) and median Barthel score 7 (range 2–20). Of the 44 patients studied, 27 (61.4%) had evidence of VSN (BIT < 129).

On admission, there were no significant differences between patients with or without VSN for age, gender, dependency or mental test score. A VFD was present in 20/27 (74%) of the VSN patients compared with 1/17 (6%) of the non-neglect patients (P < 0.0001).

When patients with VSN and VFD and VSN alone were compared, there was no significant difference between groups for age, gender, dependency or cognitive function. Patients with VSN and a VFD consistently had lower BIT scores than VSN patients with normal visual fields (Table 1).

At 4 weeks post-stroke, 15 patients had continuing evidence of VSN (six with an associated VFD). There was no significant difference between those patients with features of neglect with and without a VFD gender, age, Rankin score and cognitive function. BIT scores for the patients with neglect with a VFD were lower than the BIT scores for VSN patients with intact visual fields, but the differences were no longer significant.

At 12 weeks follow-up, eight patients (20%) had died. Morbidity at 1 and 3 months was greater in patients with a coexistent VSN and VFD on admission than in the rest of the cohort (Table 2).

Recovery of VSN in patients with and without a VFD occurred throughout the 3-month period but was

Table 1. Behavioural inattention test scores (median and range) for visuo-spatial neglect patients with and without a visual field deficit

<table>
<thead>
<tr>
<th>Test</th>
<th>Visual field deficit (n = 20)</th>
<th>Normal fields (n = 7)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line crossing</td>
<td>13.5 (4–36)</td>
<td>23 (10–36)</td>
<td>0.172</td>
</tr>
<tr>
<td>Letter cancellation</td>
<td>7.0 (1–38)</td>
<td>20 (4–59)</td>
<td>0.063</td>
</tr>
<tr>
<td>Star cancellation</td>
<td>11.0 (3–52)</td>
<td>28 (7–47)</td>
<td>0.255</td>
</tr>
<tr>
<td>Figure and shape copy</td>
<td>0.0 (0–4)</td>
<td>3.0 (0–4)</td>
<td>0.048</td>
</tr>
<tr>
<td>Line bisection</td>
<td>0.0 (0–6)</td>
<td>4.0 (1–9)</td>
<td>0.003</td>
</tr>
<tr>
<td>Drawing</td>
<td>0.0 (0–3)</td>
<td>2.0 (0–3)</td>
<td>0.015</td>
</tr>
<tr>
<td>Total score</td>
<td>35.5 (10–120)</td>
<td>80.0 (29–126)</td>
<td>0.043</td>
</tr>
</tbody>
</table>

*aMann–Whitney.

Table 2. Mortality in stroke cohorts at admission and after 1 and 3 months

<table>
<thead>
<tr>
<th>Time</th>
<th>VSN and VFD</th>
<th>VSN</th>
<th>VFD</th>
<th>Stroke only</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission</td>
<td>20</td>
<td>7</td>
<td>1</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>1 month</td>
<td>15*</td>
<td>7</td>
<td>1</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>5 months</td>
<td>15*</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>8</td>
</tr>
</tbody>
</table>

*P < 0.05; Fisher’s exact test.
VSN, visuo-spatial neglect; VFD, visual field deficit.

258
maximal in the first month. In contrast, VFD recovery appeared to reach a plateau after the first month.

Discussion
The continuing presence of neglect after stroke is an adverse prognostic factor for rehabilitation [2–7]. Recovery is most likely to occur in the first 3 months [16]. In a previous study of stroke patients with VSN it was claimed that a visual deficit does not exacerbate visuo-spatial function [17]. In contrast, an acute study demonstrated that a VFD may exacerbate VSN, but the results were not statistically significant [18]. We performed this study using oculokinetic perimetry to explore further the relationship between VFDs and VSN.

Some interaction between neglect and restricted vision is expected. It is known that in normal subjects the ability to discriminate the length of a line falls off if the visual field is artificially restricted [19]. We found that a coexistent VFD did significantly affect VSN in the acute phase. At 4 weeks following stroke, whilst VSN patients with a VFD had lower BIT scores than patients with VSN alone, the difference was no longer significant. This may reflect a type II statistical error due to the small number of patients remaining.

Whilst a VFD was significantly associated with the presence of VSN in acute stroke, the two disorders are functionally distinct. Seven neglect patients had normal visual field and one VFD patient had no evidence of VSN. This supports the concept of a double dissociation between these two disorders [20, 21], the close association between VFD and VSN being related to anatomical contiguity.

In our patients, maximal recovery occurred in the first month. Recovery from VSN appeared to continue throughout the study period in patients with and without a VFD, with no difference emerging between the two groups. In contrast, visual field recovery was usually limited to the first month, with only 14% of patients recovering further after this. These results are consistent with the finding from a previous study, although this study was limited to 1 month of follow-up [22] and we used a more detailed technique to evaluate VFDs.

Patients with neglect and an associated VFD had a greater mortality at 1 and 3 months. This probably reflects the greater neurological damage that these patients have sustained.

Our findings suggest that VSN is exacerbated in the acute stroke patient by a VFD. By 1 month this is no longer apparent, but may reflect the small number of patients in the two groups. Recovery of neglect was not influenced by the presence or absence of a VFD and continued for 3 months. In contrast, visual field recovery mainly occurred in the first month.

Key points
- Visuo-spatial neglect after stroke usually co-exists with a visual field deficit, which may contribute to the poor prognosis in these patients.
- The presence of a visual field deficit is associated with more severe visuo-spatial neglect in the first week after stroke; by 4 weeks this effect is no longer apparent.
- Recovery of visual field deficits as measured by oculokinetic perimetry is usually complete by 4 weeks post-stroke, whereas recovery of visuo-spatial neglect continues up to 12 weeks.

Acknowledgements
We are grateful to the physicians of the Royal Infirmary, Edinburgh for allowing us to study their patients, and to the patients and their families for agreeing to take part in this study. T.P.C. was supported by a Senior Registrar Start-up Grant from the British Geriatrics Society.

References

Received 5 July 1997; accepted in revised form 11 June 1998