SHORT REPORT

Recovery from visuospatial neglect in stroke patients

Timothy P Cassidy, Susan Lewis, Christopher S Gray

Abstract

***Objectives*—To describe the natural recovery of visuospatial neglect in stroke patients and the distribution of errors made on cancellation tests using a standardised neuropsychological test battery.**

***Method*—A prospective study of acute (< seven days) patients with right hemispheric stroke. Patients identified with visuospatial neglect were followed up for three months with monthly clinical and neuropsychological testing**

***Results*—There were 66 patients with acute right hemispheric stroke assessed of whom 27 (40.9%) had evidence of visuospatial neglect. Patients with neglect, on admission, had a mean behavioural inattention test (BIT) score of 56.3, range 10–126 (normal>129). Three of the subtests identified errors being made in both the right and left hemispaces. During follow up, recovery occurred across both hemispaces, maximal in the right hemispace. Recovery from visuospatial neglect was associated with improvement in function as assessed by the Barthel score. At the end of the study period only six (31.5%) patients had persisting evidence of neglect. On admission the best predictor of recovery of visuospatial neglect was the line cancellation test (Spearman's rank correlation $r=-0.4217$, p=0.028).**

***Conclusion*—The demonstration of errors in both hemispaces has implications for the theory that neglect is a lateralised attentional problem and is important to recognise in planning the rehabilitation of stroke patients.**

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Keywords: visuospatial neglect; lateralised and non-lateralised deficits

University Geriatric Medicine Unit, City Hospital, Edinburgh, UK
T P Cassidy
S Lewis

Department of Clinical Geriatric Medicine, Newcastle University, Sunderland District General Hospital, UK
C S Gray

Correspondence to:
Dr T P Cassidy, Newcastle General Hospital, Westgate Road, Newcastle upon Tyne, NE4 6BE.

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Visuospatial neglect is a syndrome in which the patient fails to report or respond to novel or meaningful stimuli presented to the side opposite the brain lesion.[1] The presence of neglect in stroke patients is a well established adverse prognostic factor for their successful rehabilitation.[2–4]

Studies have further shown that patients with visuospatial neglect may make errors in both their right and left hemispace on cancellation tests,[5–7] and contrary to the above definition suggest that bilateral symptoms of visuospatial neglect may arise from unilateral stroke lesions.

The objectives of our study were; (1) to define the natural history of visuospatial neglect in patients with right hemispheric stroke and (2) to examine the distribution of errors made with cancellation tests.

Methods

This was a single observer prospective study of all patients admitted to the general medical and geriatric medicine wards of the Royal Infirmary, Edinburgh with a clinical diagnosis of acute stroke (<72 hours) over a 12 month period. Stroke was defined according to World Health Organisation (WHO) criteria.[8]

All patients were assessed with a full clinical and neurological examination including assessment of their conscious level using the the motor subscale of the Glasgow coma scale.[9] Functional ability was assessed using the Barthel scale.[10]

Visuospatial neglect was assessed using the behavioural inattention test (BIT), battery which has been validated and standardised in patients with an acute stroke.[11 12] All patients were assessed (mid-morning) in a sitting position while undertaking the test, with the BIT test sheet placed directly in front of the patient's mid-sagittal plane.

The test battery was applied to all patients within seven days of a first ever right hemispheric stroke. For the purpose of this study, visuospatial neglect was defined as a total BIT score of 129 or less (maximum possible 146).[11 12]

To determine the recovery of visuospatial neglect, we divided each hemispace on the test sheet (and therefore to the right or left of body centre) into equal vertical sectors; thus recorded as left 1–3 (centre-far left) and right 1–3 (centre-far right) for line and star cancellation tests. For letter cancellation we divided each hemispace into two equal vertical sectors recorded as left 1–2 (centre-far left) and right 1–2 (centre-far right).

Serial assessments of clinical status and neuropsychological tests of stroke patients with visuospatial neglect were carried out at monthly intervals for three months.

Table 1 Mean (%) correct cancellation test (SD) scores on admission

Hemispace sector	*L3*	*L2*	*L1*	*R1*	*R2*	*R3*
Star test	10.0 (23.7)	15.5 (33.0)	20.0 (33.3)	34.9 (41.8)	43.5 (34.2)	86.0 (21.0)
Line test	21.3 (39.9)	20.7 (39.0)	29.3 (44.5)	56.0 (42.4)	70.7 (35.4)	90.0 (19.6)
Letter test	—	22.8 (38.3)	26.4 (39.3)	32.4 (33.0)	59.6 (25.7)	—

Data were collected on a standard proforma and analysed using the SSPX statistical package.

Results

There were 250 (155 women) consecutive stroke patients admitted over a 12 month period; median age 76 (range 39–95) years. Two hundred and five patients had had a hemispheric stroke (45% in the right hemisphere). On admission 57 (27.8%) had an abnormal score on the motor subscale of the GCS and were unable to be assessed fully.

Sixty six patients had a first right hemispheric stroke and normal conscious level. Of these, 27 (40.9%) had neglect as defined by a total BIT score<129.

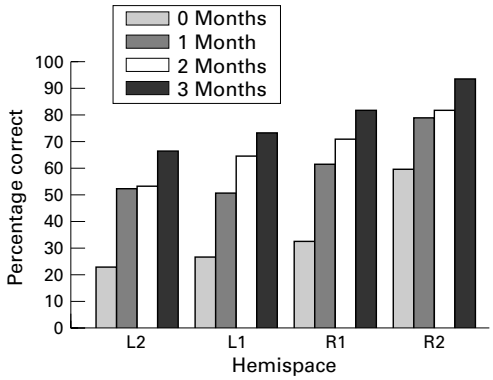
All 27 patients (13 women) were seen within a week of their stroke (median three days). Median age was 73 (range 57–85) years.

Twenty three (85.2%) of these neglect patients had a hemiparesis; three (11.1%) patients monoparesis, and one (3.7%) patient a visual field deficit and neglect without paresis. Seven (25.9%) patients had no evidence of any visual field deficit. The median Barthel score was 7; range 2–20 for these neglect patients.

Brain CT was carried out on 16 of the 27 patients. One patient had a normal scan, 13 had infarcts, and two patients had evidence of an intracerebral haemorrhage.

For the 27 patients with abnormal BIT scores on admission, there was a wide variation in the total BIT scores (mean BIT 56.3, range 10-126). During the follow up period, there was a progressive improvement in the mean total BIT scores (SD), one month 96.5 (38.3); two months 110 (36.7); three months 121.3 (28.6).

The three cancellation tests showed errors across both the left and right hemispace. There was a progressive improvement in visuospatial neglect across the left to right hemispace (table). During the three month follow up period, recovery occurred across the right and left hemispaces (figure).



Letter cancellation. Recovery in the first three months across visual field sectors.

On admission the 27 neglect patients had a mean Barthel score of 6.9 (SD 3.5). There was no significant correlation between Barthel and BIT score on admission. However, at one, two, and three months there was a significant correlation (Spearman correlation r=0.642, p=0.001; r=0.623, p=0.003; r=0.636, p=0.003; respectively) between recovery from neglect and recovery in function (Barthel score).

At the end of the study period, six patients still had evidence of neglect. Seven (25.9%) patients had been discharged home, nine (27%) were still in hospital undergoing rehabilitation, three (11.1%) were in long term care, and eight (29.6%) had died. On admission the best test of visuospatial neglect predicting discharge was the line cancellation test; no other factor seemed to predict recovery. High scores on this test were significantly correlated with discharge home (Spearman's rank correlation r=0.4217, p=0.028).

Discussion

Visuospatial neglect is an important adverse prognostic factor for rehabilitation after stroke.[2–4] Our study found a lower prevalence of neglect (40.9%) than other studies.[13] We excluded patients with an abnormal conscious level one week after stroke, and a significant proportion of these patients may have had unrecognised visuospatial neglect. It is well established however, that persisting coma is of importance for early mortality,[14] and such patients cannot participate in detailed neuropsychological evaluations.

During the study there was a progressive improvement in the cohort's mean total BIT score. Recovery seemed to take place throughout the three month period but was greatest in the first month.

All patients received standard physiotherapy and occupational therapy regimens on the wards. It is unclear whether the amount of therapy given to patients influenced recovery. However, it is postulated that each impairment should have a specific remedy—that is, attention training for unilateral neglect.[15]

Not all the patients with visuospatial neglect underwent CT. Studies have suggested that awareness should be thought of in terms of complex corticosubcortical neural circuits. This is supported by imaging studies showing functional derangement in cerebral regions far removed from, but connected with, the structurally damaged areas.[16]

The three cancellation tests (line, star, and letter) showed that errors are made in both the right and left hemispaces. The SDs were large and the group's mean results showed a continuous increment in accuracy from the far left column to the far right column. Patients were inevitably free to move their eyes; however, the test sheet was body centred and our results are consistent with previous findings.[17 18]

On admission, star and line cancellation tests had a correct score of over 85% in the far right hemispace. By contrast, the letter cancellation test score was 59.6% for the far right sector. A

patient's ability to detect stimuli is affected by the number of distracting stimuli and the difficulty of visual discrimination.[19 20] The letter cancellation test has a greater number of distracting stimuli and requires controlled information processing which is more demanding of attention.[21]

In our study the application of these simple tests seems to predict outcome. A high score on the line cancellation test on admission was associated with recovery of visuospatial neglect and discharge home. By contrast poor scores on a test with no distracting stimuli (line cancellation) suggest a more severe degree of neglect and therefore a worse prognosis.

During the follow up period there was recovery across both the right and left hemispaces. Whereas this recovery was greatest in the right hemispace, errors were still being made in these sectors. Visuospatial neglect is postulated to be a lateralised attentional problem rather than a sensory disorder.[22 23] Robertson, however, has previously found that patients with neglect have a general difficulty in deploying attention in space.[7] Alternatively, there may be a lateral gradient of attention across both hemispaces. Therefore attention is biased rightward, regardless of the absolute location of the target.[24]

On admission, there was no relation between severity of neglect and functional impairment. This reflects the many factors that may influence activities after stroke. Therefore there was no relation between function and BIT score.

Subsequently, a significant correlation between improvement in neglect and function occurred, illustrating that recovery from visuospatial neglect and recovery of daily living activities are likely to be closely linked or associated. The continuing presence of visuospatial neglect may adversely affect the ability of the stroke patient to adapt to their neurological impairments.

In conclusion, acute stroke patients who present with visuospatial neglect have a high probability of improving. The continuing presence of visuospatial neglect may be an adverse factor for rehabilitation and specific measures may be required to aid their rehabilitation.

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