

# The Incidence of Neglect Phenomena and Related Disorders in Patients with an Acute Right or Left Hemisphere Stroke

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## Summary

We studied 171 consecutive patients with an acute hemispheric stroke (69 right hemisphere, 102 left), at 2–3 days post-stroke. A standardized test battery, previously validated in patients with acute stroke, was used to detect a wide variety of neglect phenomena and related disorders.

Visual neglect was found in 82% of assessable right hemisphere patients and 65% of left hemisphere patients. Hemi-inattention was found in 70% of right and 49% of left hemisphere strokes. Tactile extinction was found in 65% of right and 35% of left hemisphere patients; allaesthesia in 57% (right), and 11% (left); visual extinction in 23% (right) 2% (left). Anosognosia was found in 28% (right), and 5% (left); anosodiaphoria in 27% (right), and 2% (left); non-belonging in 36% (right) and 29% (left).

Visual neglect occurred more commonly in left hemisphere stroke than previously reported. Although neglect phenomena and related disorders were associated with right hemisphere damage, it is possible that language difficulties obscured their presence in some patients with a left hemisphere stroke.

## Introduction

Heilman *et al.* [1] defined the 'neglect syndrome' in patients with a cerebral lesion as failure to orientate, report or respond to relevant stimuli on the side opposite to their lesion. By definition, neglect cannot be considered present if the failure to respond can be attributed to primary sensory or motor loss. The syndrome is characterized by several forms of neglect (neglect phenomena), including visual neglect, hemi-inattention, sensory extinction, visual extinction, and allaesthesia [1]. It is often accompanied by various 'related disorders': anosognosia, anosodiaphoria, non-belonging, visual-field defects, and gaze paresis.

The neglect syndrome is an established pre-

dictor of poor outcome after stroke [2–5]. Patients with the syndrome may require intensive rehabilitation programmes [6], but the natural history of the syndrome in stroke remains unclear. Furthermore, the incidence of the various forms of neglect is unknown. Some studies have excluded patients with left hemisphere stroke and others have investigated only visual neglect.

Visual neglect is the most intensively studied form of neglect in stroke, yet estimates of its incidence vary widely (33–85% in right and 0–24% in left hemisphere stroke) [3–5, 7–10]. It has been suggested that the classic association of visual neglect with right brain damage [11] might be an artefact of the difficulty of assessing dysphasic patients [5, 12, 13]. Indeed, some

studies have found visual neglect to be equally common in left and right hemisphere lesions [14–16]. This variation is largely due, firstly, to differences in the timing of examination after the stroke; secondly, to the use of different tests to detect visual neglect (which may be task specific [17, 18]); and, thirdly, to the use of small and insensitive test batteries [14, 16].

As part of a larger study describing the natural history and prognosis of the neglect syndrome in acute stroke, we sought to establish the incidence of the different forms of neglect and their related disorders in patients with left as well as right hemisphere stroke. All patients were seen at 2–3 days post-stroke. A standardized test battery, validated in acute stroke patients [14] and aged-matched controls [19], was used to detect neglect phenomena and related disorders.

### Methods

**Patient characteristics:** One hundred and seventy-one consecutive patients (mean age 72.37 years, SD 12.11, range 28–100 years) admitted to St Bartholomew's and Homerton Hospitals, in the City and Hackney Health District, London, with an acute hemispheric first stroke were recruited to the study. All patients were admitted as emergencies under the care of general physicians, except for one admitted by a geriatrician, and two admitted by neurosurgeons.

Patients were registered for the study by daily contact with the previous day's admitting medical team and were first assessed for the study at 2–3 days post-stroke, by a physician (S.P.S.) who confirmed the diagnosis of stroke, using the WHO definition [20]. Patten's criteria were used to define a hemispheric stroke [21]. Patients with subarachnoid haemorrhage were excluded from the study, as were patients whose stroke occurred more than 3 days prior to assessment.

Sixty-nine of the patients (40%) had a right hemisphere and 102 (60%) had a left hemisphere stroke. Thirteen patients (8%) had lacunar strokes; 11 of the pure motor hemiparesis variety and 2 of the sensorimotor type [22]. Ninety-one patients (53%) were women.

One hundred and twenty-seven patients underwent a CT brain scan at 3–5 days, and 44 were assessed by the Guy's Hospital diagnostic score [23] to determine whether the stroke was haemorrhagic (14 patients) or ischaemic (157 patients), according to standard cut-off points [24]. Of those who were scanned, 48 (38%) had no visible lesion, 37 (29%)

had cortical lesions, 20 (16%) had deep lesions and 22 (17%) had both. The 30-day case fatality rate was 27%.

All patients were assessed for the presence of neglect phenomena and related disorders using the following test procedures.

### Neglect Phenomena

**1. Visual neglect:** Patients were considered to have visual neglect if they ignored relevant contralateral visual stimuli on a battery of clinical bedside tests. The battery was a modified form of the Behavioural Inattention Test [25, 26], that had been validated and standardized in patients with an acute stroke [14], using data from age-matched controls [19]. It consists of the following tests: pointing to objects scattered around the room; reading a menu; cancelling lines on a piece of paper; cancelling stars; selecting coins from an array on a card; reading a newspaper article (right hemisphere patients only); copying a daisy, cube and star from the left-hand side of the page (left hemisphere patients only). Visual neglect was considered present when it appeared in a single test [14, 16], for it may be task specific and may not be present in all tests at any one time [17, 18].

**2. Hemi-inattention:** was regarded as present if the subject's general spontaneous behaviour during examination suggested an inability to orientate or respond correctly to environmental stimuli on one side, irrespective of modality (e.g. people approaching, noises or activity in the ward). Details of its assessment are given in a previous study [19].

**3. Tactile extinction:** was assessed by the technique of double simultaneous stimulation, giving bilateral stimuli a total of five times [19]. On the basis of age-matched control data, extinction was considered present if two or less of the bilateral stimuli were correctly identified [19].

**4. Visual extinction:** was assessed by double simultaneous stimulation in the same way [19].

**5. Allaeesthesia** was regarded as present if subjects consistently attributed sensory stimulation of one side to stimulation of the other or if they consistently moved the limbs on one side when requested to move the limbs on the other [1]. On the basis of age-matched control data, it was considered present if it was elicited on at least two occasions during routine sensorimotor testing [19].

### Neglect-related Disorders

**Anosognosia** (denial or lack of awareness of a hemiparesis), **anosodiaphoria** (indifference to perceived weakness) and **non-belonging** (a feeling that an

affected limb did not belong to the individual) were assessed using the method described by Cutting [7, 19]. Details of the assessment of *gaze paresis* and *visual field defects* are given in a previous study [19].

Where dysphasia or impaired consciousness prevented assessment of any neglect phenomenon or related disorder, the patient was considered to be 'unassessable' for that neurological deficit. Where these impaired the assessment of visual fields, the presence or absence of the blink response to threat was noted [27]. Strategies for testing left hemisphere patients for visual neglect are described elsewhere [14].

The association of neglect phenomena and related disorders with right or left hemisphere damage was examined using 95% confidence intervals for the difference between proportions.

## Results

Table I shows the proportion of patients who could not be assessed. Patients with a left hemisphere stroke appeared more difficult to assess for visual neglect, tactile extinction, allaesthesia, anosognosia, anosodiaphoria and non-belonging, probably owing to dysphasia.

Tables II and III show the incidence of the various neglect phenomena and related disorders 2–3 days after a right or left hemisphere

stroke in assessable patients. Visual neglect was found in over 80% of right and in 65% of the left hemisphere strokes. Hemi-inattention was present in about two-thirds of right and in half the left hemisphere strokes. Tactile extinction was present in two-thirds of right and in a third of left hemisphere strokes. Allaesthesia was present in over half the right but in fewer left hemisphere strokes. Anosognosia was found in a quarter of right but in very few left hemisphere stroke patients.

Neglect phenomena appeared to be more frequently associated with right hemisphere damage, as were anosognosia and anosodiaphoria.

## Discussion

This is the first study to report the incidence of different forms of neglect and related disorders in acute stroke affecting either hemisphere. We found visual neglect to be more common than in other studies of acute stroke [5, 7, 9, 10]. Eighty-two per cent of assessable right hemisphere strokes had visual neglect compared with 70% [5] (95% CI for difference in proportions 3%, 26%); and 43% [10] (95% CI for difference in proportions 26%, 53%). Sixty-

*Table I.* Number of patients with right and left hemisphere stroke unable to be assessed for neglect phenomena and related disorders

Neglect phenomena or related disorders	No. (%) of unassessable patients		Difference in proportions of unassessable patients (95% CI)
	Right hemisphere stroke (n = 69)	Left hemisphere stroke (n = 102)	
Visual neglect	8 (11)	28 (27)	16% (4%, 27%)
Hemi-inattention	6 (9)	15 (15)	6% (-4%, 16%)
Tactile extinction	17 (25)	59 (58)	33% (20%, 47%)
Allaesthesia*	10 (15)	56 (55)	40% (27%, 53%)
Visual extinction	9 (13)	21 (21)	8% (-4%, 9%)
Anosognosia	9 (13)	46 (45)	32% (20%, 45%)
Anosodiaphoria	9 (13)	49 (48)	35% (22%, 48%)
Non-belonging	14 (20)	54 (53)	33% (19%, 46%)
Gaze paresis	0 (0)	3 (3)	3% (-3%, 6%)
Visual field defect	8 (11)	9 (9)	2% (-7%, 19%)

\* Assessment of allaesthesia omitted in three patients.

Table II. The incidence of neglect phenomena in acute stroke

Neglect phenomenon	Right hemisphere stroke		Left hemisphere stroke		Difference in proportions: right vs left (95% CI)
	Present	Assessed	Present	Assessed	
Visual neglect	50 (82%)	61	48 (65%)	74	17% ( 3%, 33%)
Hemi-inattention	44 (70%)	63	43 (49%)	87	21% ( 5%, 36%)
Tactile extinction	34 (65%)	52	15 (35%)	43	30% (12%, 49%)
Allaesthesia	32 (57%)	56	5 (11%)	46	46% (31%, 62%)
Visual extinction	14 (23%)	60	2 ( 2%)	81	21% (10%, 32%)

Table III. The incidence of anosognosia and related disorders in acute stroke

Related disorder	Right hemisphere stroke		Left hemisphere stroke		Difference in proportions right vs left (95% CI)
	Present	Assessed	Present	Assessed	
Anosognosia	17 (28%)	60	3 ( 5%)	56	23% (9%, 36%)
Anosodiaphoria	16 (27%)	60	1 ( 2%)	53	25% (13%, 37%)
Non-belonging	20 (36%)	55	14 (29%)	48	7% ( -10%, 25%)
Gaze paresis	20 (29%)	69	25 (25%)	99	4% ( -10%, 17%)
Visual field defect	22 (36%)	61	43 (46%)	93	10% ( -6%, 26%)

five per cent of assessable left hemisphere strokes had visual neglect, compared with 40% [5] (95% CI for difference in proportions 10%, 41%). It is hard to compare our findings with those of Cutting [7] who studied stroke patients with particular reference to anosognosia. Although he gives an incidence for visual neglect of 50% in right and 0% in left hemisphere stroke, it is not clear how many of these patients were unassessable for neglect.

Our higher incidence for visual neglect can probably be attributed to our use of a larger and thus more sensitive battery [14, 16] than previous studies. Given the poorer prognosis for patients with visual neglect, and their possible need for intensive specialized treatment, the early accurate detection of such patients may have important implications for allocation of rehabilitation resources. Had we used, for example, line cancellation, as our sole test, as did Fullerton *et al.* [5], the incidence of visual

neglect would have been identical to that in their study of acute stroke. The differential sensitivity of individual tests will be the subject of a future study.

Hier *et al.* [9] reported a similar incidence of visual neglect to ours in their study of patients with an acute right hemisphere stroke (85%; 95% CI for difference in proportions -10%, 17%), despite using only one test, a drawing task. However, this figure needs to be interpreted with caution for the population was atypical of the general stroke population in that patients who were obtunded, had a lacunar infarct or a normal CT brain scan were excluded. In addition, no data were presented concerning the validity, reliability or control performance of their drawing task. This is important because firstly, the interpretation of drawing tasks may be subjective and made difficult by structural disorganization and other problems of perception or praxis [13, 28];

secondly, most patients with a stroke are over the age of 65 and up to 47% of controls in this age group perform poorly on drawing tasks [29].

We found a higher incidence of hemi-inattention in right hemisphere stroke (70%) than did Hier *et al.* (46%) [9] (95% CI for difference in proportions 4%, 43%). They defined 'neglect of left hemispace' as 'the spontaneous failure to attend or turn to visual or auditory stimuli presented from the left'. Our definition was broader in that it included assessment of eye movements, mobility, grooming and posture. This might, in part, explain our higher incidence. We found the incidence of hemi-inattention in left hemisphere stroke to be 42%. No previous study has reported on this variable.

We found tactile extinction in assessable right hemisphere stroke to be as common as in the study of Hier *et al.* [9] (65% vs 63%, respectively, 95% CI for difference in proportions -18%, 22%). We found tactile extinction in 35% of assessable left hemisphere strokes. No other study has reported on this variable. One study, however, found that in a group of patients with mixed cerebral pathology, tactile extinction occurred after left brain damage but less commonly than after right brain damage [30].

The only study to report the incidence of visual extinction after stroke [31] gave a combined incidence for assessable left and right stroke of 11%, similar to our figure of 13% (95% CI for difference in proportions -4%, 9%). The only study of allæsthesia after stroke was confined to patients with thalamic or putaminal haemorrhage, none of whom had neglect [32].

Of the related disorders, we found anosognosia to be less common in assessable right hemisphere stroke (28%) than did Cutting (58%) [7] (95% CI for difference in proportions 12%, 48%). Anosodiaphoria was, however, more common in our series of assessable right hemisphere strokes (27%) than in Cutting's study (4%) [7] (95% CI for difference in proportions 9%, 36%). It is not immediately clear why there should be such variation. Cutting developed a formal questionnaire to assess these disorders, which was used in this study. It is possible that, in the absence of specific

instructions as to the diagnostic criteria for these disorders, inter-clinician variability would arise. Garraway and colleagues have amply demonstrated this with respect to the introduction of new assessment protocols for stroke patients [33]. However, we found the incidence of anosognosia in assessable left hemisphere stroke to be similar (5%) to that in Cutting's study (14%) (95% CI for difference in proportions -7%, 24%). The incidence of anosodiaphoria in left hemisphere stroke was also similar in both studies (2% and 10% respectively; 95% CI for difference in proportions -5%, 21%). The similarity may relate to the difficulties of assessing patients with dysphasia. Our figure for anosognosia in right hemisphere stroke was similar to that reported by Hier *et al.* (36%) [9] (95% CI for difference in proportions -10%, 27%). It is hard to compare our figure with that of Willanger *et al.* who found anosognosia in 25% of right hemisphere strokes, for it is unclear how long post-stroke their patients were examined [34].

The incidence of a visual-field defect in assessable right hemisphere stroke (36%) is similar to that reported by Hier *et al.* (46%) [9] (95% CI for difference in proportions -9%, 30%). No other study gives a figure for visual-field defects in acute left hemisphere stroke. It should be noted that visual-field defects can occur in the absence of visual neglect and *vice versa* [35]. Clinico-anatomical studies have shown that surgery restricted to the medial occipital lobe causes restriction of visual fields but not visual neglect and that patients with posterior cerebral infarcts have isolated hemianopia unless the lesion involves the temporal or parietal lobes [36-9].

The incidence of gaze paresis in the present study was similar for right and left hemisphere stroke. This fails to confirm the findings of De Renzi and colleagues [40], who reported an association with right hemisphere stroke (35% right; 21% left). However, it should be noted that what De Renzi *et al.* regarded as the mildest form of gaze paresis, loss of spontaneous ocular scanning movements to the side opposite the lesion in the absence of a frank gaze paresis, was regarded in the present study as a 'gaze preference' [41] and as such, a form of hemi-inattention. It is not clear from their study how many



presented with this form of gaze paresis, so further comparisons are hard to make.

Our finding that neglect phenomena and most related disorders were associated with right hemisphere stroke is consistent with most other studies [5, 7, 11]. Visual neglect, which is the only neglect phenomenon to be previously studied in left hemisphere stroke, was much more common than in earlier studies. However, we did not replicate the findings of studies that reported visual neglect to be equally common in right- or left-sided lesions. These studies were based either on smaller populations, or on non-acute stroke patients or on groups of mixed, predominantly non-vascular pathology [14–16]. It is however possible that the association of some neglect phenomena and related disorders with right hemisphere stroke might still be an artefact of the difficulty of assessing dysphasic left hemisphere patients (Table I) [12, 13]. None the less, this association is consistent with the view that, although both hemispheres have the capacity to attend to contralateral stimuli, the non-dominant hemisphere is specialized for the distribution of sensory attention [42].

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