Unilateral neglect and the estimation of the body midline

C. Schütze[1, 2] & H. Hildebrandt[1, 3]

[1] ZKH Bremen Ost - Neurology [2] University of Bremen - Human Neurobiology [3] University of Oldenburg - Psychology

Abstract

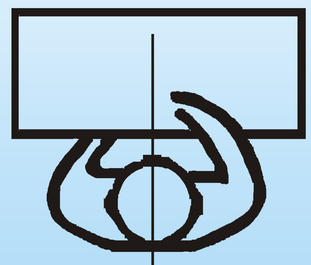
Unilateral neglect is a disturbance of spatial behavior resulting in the fact that the patients do not orient or respond to contralesional stimuli. Recent theories suggest that the neuronal transformation of sensory input into non-retinal coordinate systems is impaired and therefore the egocentric frame of reference (relative to the observer) is shifted around the vertical body midline towards the ipsilesional space (Karnath, 1998). In a simple experiment, patients with right brain damage and pure unilateral neglect (excluding patients with additional hemianopia) and healthy control subjects were asked to estimate their body midlines. Two experimental conditions were carried out: the subjects should mark the midline (a) with their eyes kept open (visual condition) and (b) without visual information (proprioceptive). The difference between the groups was significant only in the visual condition, but not for proprioceptive estimation. Furthermore, there was no correlation between the two conditions. Correlations with clinical neglect tests (star cancellation, a visual search task etc.) were found only for the visual condition, but not for the proprioceptive. There was no evidence for a systematic shift in the egocentric frame of reference and therefore the question on which level of spatial information processing hemi-inattention occurs will be discussed.

Introduction

Explanations for the occurrence of unilateral neglect vary between terms of attention (Heilman 1980), representation of mental images (Bisiach 1978) and neuronal transformation of sensory input (Karnath 1998). More precisely Karnath (1998) supposed that transformation of sensory input into spatial representation of space works with a systematic error, which leads to an ipsilesional rotation of the egocentric frame of reference. If there is evidence for a supramodal shift in the centre of the egocentric frame of reference to the ipsilesional side, ipsilesional deviation should occur within both visual and proprioceptive estimation of the body midline. Furthermore a high correlation of both estimations would be expected and both positions of subjective body midline should predict performances in clinical neglect investigation.

Materials and Methods

Clinical investigation of right brain damaged patients consisted of several tests for visual and visuomotor performance, such as line bisection, star cancellation, visual search task and neglect test from the TAP. Patients who reached defined neglect criteria (cut point) in one of the tests were included in the study (for details see table 1). Hemianopic patients were exluded. In the first experimental condition people were seated behind a table and were asked to estimate and indicate their subjective body midline in peripersonal space. The second condition required the same estimation but without visual information (propriocepive). Displacements to the left were scored as negative values, rightward deviations as positive values. All statistics were carried out by nonparametric tests (Mann-Whitney-U).



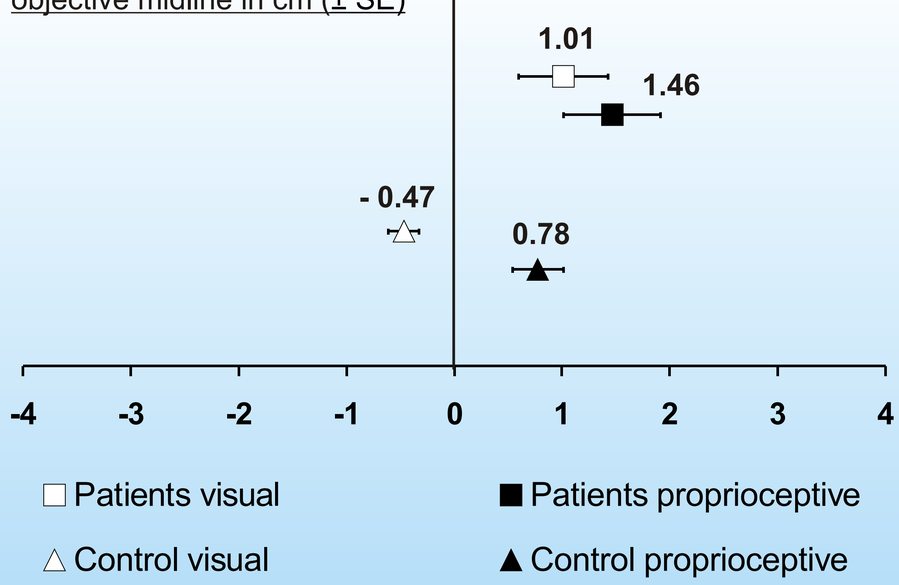
Subjects

Table 1 Demographical and clinical data

	Cut point	Patients with left-sited neglect	Control group
N		17	14
Age		59.7 (± 10.5)	47.0 (14.3)
Duration of illness (in month)		10.0 (± 17.1)	
Neglect test (Omissions left)	5 (25%)	3.76 (± 4.12)	
Visual scanning (Omissions 1st column)	5 (50%)	5.25 (± 2.84)	
Star Cancellation task (Omissions left)	5 (20%)	3.47 (± 4.20)	
Line bisection (Length 21cm)	0.6cm	1.05 (± 1.12)	

Results I

Figure 1 Deviations from objective midline in cm (± SE)



Patients and controls differed significant in the visual condition (p=.003) but not in proprioceptive estimation (p=.457).

Furthermore, no difference between visual and proprioceptive condition occurred within the patients (p=.413). However, controls showed a significant result (p=.001). For details see figure 1.

Correlations with clinical investigations of patients were only found for the visual condition with visual search task but neither with other tests nor with proprioceptive results (see table 2).

Discussion

We found the well known difference between neglect patients and controls in the visual estimation of the subjective body midline, but no difference could be observed in the proprioceptive condition. A multimodal systematic shift in the egocentric frame of reference, supposed by Karnath (1998), does not explain these findings. The non-correlation between both conditions rather indicates that distortion of the egocentric frame of reference does not concern all sensory modalities (eight neglect patients performed better with proprioceptive than with visual estimation). In addition, reduction in spontaneous visual exploration of neglect patients, as measured with clinical neglect tests, could be predicted by misplacements in the visual condition, but again this does not hold for the proprioceptive one. Estimation of subjective body midline did not predict performances in other clinical test. Chokron et. al. (2002) supposed that straight-ahead pointing tasks might be supported by an egocentric system, while visuomotor tasks (like line bisection or star cancellation) are more likely solved within coordinates of stimulus or space-related frames of reference.

Under the assumption that manifestation of left unilateral neglect after right hemisphere damage is accompanied with an ipsilesional shift of egocentric frame of reference, this shift occurs primarily in visual information processing.

Results II

Table 2 Correlations coefficients with clinical tests
(Only patients, significant coefficents are printed in bold)

	Visual	Proprioceptive
Proprioceptive	.222	
Visual Scanning Omissions	**.514**	.009
Visual Scanning Omissions 1st column	**.723**	-.041
Visual Scanning Omissions 2nd column	**.534**	.163
Neglect test Omissions left	.323	-.039
Line bisection	.438	.026
Star cancellation task Omissions left	-.311	.434

References

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