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Anosognosia for hemiparesis after left-sided stroke

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ABSTRACT

In patients with left-sided lesions, anosognosia for hemiparesis (AHP) seems to be a rare phenomenon. It has been discussed whether this rareness might be due to an inevitable bias due to language dysfunction and whether the left hemisphere's role for our self-awareness of motor actions thus is underestimated. By applying functional magnetic resonance imaging (fMRI) we examined whether patients with AHP following a left hemisphere stroke show a regular, left-sided or a reversed, right-sided lateralization of language functions. Only the former observation would argue for an original role of the left hemisphere in self-awareness about limb function. In a consecutive series of 44 acute left-sided stroke patients, only one patient (=2%) was identified showing AHP. In this case, we could verify by using fMRI that lateralization of AHP and spatial neglect on the one hand and of language functions on the other hand were reversed. The present single case observation thus argues against an original role of the left hemisphere in self-awareness about limb function. We discuss the data in the context of previous observations in the literature.

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1. Introduction

Although, patients with anosognosia for hemiparesis (AHP) have obvious motor defects after stroke, they typically are convinced that their limbs function normally (Anton, 1893; Karnath & Baier, 2010). There is a long-lasting debate whether AHP is a lateralized hemispheric phenomenon (Orfei et al., 2007). Based on previous data it is well known that the phenomenon of AHP typically occurs in patients with right-sided lesions (Berti et al., 2005; Bisiach, Vallar, Perani, Papagno, & Berti, 1986; Karnath, Baier, & Nägele, 2005). Only a minority of patients with AHP have been described after left-sided lesions (Orfei et al., 2007; Ronchi et al., 2013; Stone, Halligan, & Greenwood, 1993). A similar trend has been observed when barbiturates were injected into one carotid artery (WADA test) so that one hemisphere was exclusively anaesthetized, leading to a transient hemiparesis of the opposite extremities. The authors recorded a higher frequency of AHP for this hemiparesis when the barbiturate was injected into the right carotid artery (Breier et al., 1995; Gilmore, Heilman, Schmidt, Fennell, & Quisling, 1992).

It has repeatedly been discussed that the rareness of AHP following left hemispheric damage might be due to an inevitable bias induced by the asymmetrical representation of language functions. The observation that the vast majority of stroke patients with AHP have a brain lesion involving the right hemisphere could be due to the fact that AHP in patients with left hemisphere lesions might be obscured by aphasia (e.g., Hartman-Maeir, Soroker, & Katz, 2001). One previous study thus suggested a questionnaire which used self-ratings as well as external ratings on drawings to illustrate the corresponding questions of the examiner (Della Sala, Cocchini, Beschin, & Cameron, 2009). By applying this test the authors found that up to 40% of 30 patients with left-sided brain damage showed evidence of AHP whereas only 10% had AHP using a structured interview (Cocchini, Beschin, Cameron, Fotopoulou, & Della Sala, 2009). However, another study found a preponderance of right over left hemisphere lesions in anosognosia even if the authors considered all stroke patients who could not be verbally examined for anosognosia due to aphasia precautiously as "anosognosia patients" (Starkstein, Fedoroff, Price, Leiguarda, & Robinson, 1992).

Abnormalities in the lateralization of visceral organs can lead to situs inversus which is considered a mirror image reversal of the visceral organs or single organ inversion such as dextrocardia (Aylsworth, 2001; Corballis et al., 2009; Levin, 2004). With regard to language lateralization around 95–99% of right-handed individuals have a left hemispheric lateralization for language (Corballis et al., 2009; Dorsaint-Pierre et al., 2006; Dronkers, Wilkins, Van Valin, Redfern, & Jaeger, 2004; Knecht et al., 2000; Rasmussen & Milner, 1977). While recent functional magnetic resonance imaging (fMRI) data and functional connectivity analyses have suggested that the right hemisphere might also be involved in language function (Crinion & Price, 2005; Saur et al., 2006; Seghier, Kherif, Josse, & Price, 2011; Zhu et al., 2014), only a minority of acute neurological patients are observed with reversed lateralized asymmetry of language function, i.e., with right rather than left hemisphere language dominance (Mariën, Paghera, De Deyn, & Vignolo, 2004; Padovani et al., 1992).

Thus, we here re-address the issue of a possible role of the left, language-dominant hemisphere in AHP. In particular, we were interested in examining whether in patients with AHP following a left hemisphere lesion these cases have a regular lateralization of language functions or whether the left lateralization of AHP might be related to a reversed interhemispheric language representation. While the former would argue for an original role of the left hemisphere in our self-awareness about limb function, the latter would simply demonstrate reversed lateralization of functions. We tested 66 acute stroke patients with left-sided supratentorial territorial infarctions for AHP and applied fMRI to determine whether language function is localized in the right or the left hemisphere.

2. Material and methods

We investigated a consecutively admitted series of 66 stroke patients with acute left brain lesions due to territorial infarctions documented by MRI and right-sided hemiparesis/-plegia (mean age 63 years (y), standard deviation (SD) 14 y; mean time between stroke-onset and testing 5 days (d); SD 2 d). Twenty-two of the patients had to be excluded due to severe aphasia which did not allow a structured interview. AHP was examined using the anosognosia scale by Bisiach et al. (1986) together with the diagnosis criteria of Baier and Karnath (2005): Patients who spontaneously mentioned the disorder or who reported the disorder following a specific question about the strength of the patient's limb(s) (Grades 0 or 1) were classified not showing anosognosia. Patients who did not acknowledge their hemiparesis/-plegia even after a specific question about the strength of their limb(s) or after demonstration of the deficit (Grades 2 or 3) were diagnosed as anosognosia. Furthermore, a questionnaire investigated whether the patient was unable to recognize his/her own limbs as belonging to the own body (asomatognosia); whether he/she attributed his/her own limbs to other persons (somatoparaphrenia); had a lack of appropriate concern for the paretic/plegic limb (anosodiaphoria); expressed negative feelings for his/her limb (misoplegia); gave his/her limb names (personification); felt his/her limb moving automatically (kinesthetic hallucinations); and/or was convinced that a new, intact limb had appeared (supernumerary phantom limb) (Baier & Karnath, 2008; Cutting, 1978).

The degree of paresis of the upper and lower limbs was scored with the usual clinical ordinal scale, where "0" stands for no trace of movement and "5" for normal movement. Scoring was performed separately for the strength of the proximal (upper arm, thigh) and for the distal (forearm, lower leg) part of each limb. Spatial neglect was diagnosed when the patients showed the characteristic clinical behavior such as orienting toward the ipsilesional side when addressed from the front or the left and/or ignoring contralesionally located people or objects. In addition, the Bells test was administered (Gauthier, Dehaut, & Joanette, 1989) and the corresponding Center of Cancellation (CoC) score (Rorden & Karnath, 2010) was calculated. The laterality quotient for handedness was