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Left hand tactile agnosia after posterior callosal lesion

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ABSTRACT

We report a patient with a hemorrhagic lesion encroaching upon the posterior third of the corpus callosum but sparing the splenium. She showed marked difficulties in recognizing objects and shapes perceived through her left hand, while she could appreciate elementary sensorial features of items tactually presented to the same hand flawlessly. This picture, corresponding to classical descriptions of unilateral associative tactile agnosia, was associated with finger agnosia of the left hand. This very unusual case report can be interpreted as an instance of disconnection syndrome, and allows a discussion of mechanisms involved in tactile object recognition.

1. Introduction

Tactile agnosia refers to the inability to recognize objects after tactile presentation, in the absence of sensorial impairments, aphasia or general cognitive deterioration. Tactile agnosic patients can recognize the same objects when presented through different modalities (Saetti and De Renzi, 1999).

Classical research on tactile agnosia has distinguished primary (apperceptive) from secondary (associative) recognition defects (Wernicke, 1895). The former (sometimes defined as morphagnosia) would be characterised by the inability to discriminate objects' elemental features (e.g., weight, roughness), while the latter would correspond to a specific impairment in object recognition, with spared elementary perceptual discrimination.

Many studies have identified the inferior parietal cortex and the adjacent insular cortex as crucial for tactile discrimination of perceptual features with the contralateral hand (Caselli, 1997). For instance, Reed et al. (1996) described a patient who developed right hand tactile agnosia after a left parietal lesion, while Saetti and De Renzi (1999) observed bilateral morphagnosia in a patient with a bilateral hemorrhagic parietal lesion.

As regards associative tactile agnosia, instead, modern descriptions are quite rare, to the point that the concept itself of a selective defect of tactile object recognition without subtle impairments of elementary tactile apperception has been questioned (see Platz, 1996). In a study on a consecutive sample of patients affected by neurological diseases, however, Caselli (1991) could identify seven patients with unilateral

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impairments of tactile object recognition in whom the observed pattern could match that expected in the case of tactile associative agnosia (no evidence of elementary tactile imperception); the brain lesion in these patients involved the left or the right inferior parietal cortex, or the surrounding temporal or insular cortex (Caselli, 1991). In a subsequent study, Caselli (1993) confirmed that a picture resembling contralesional associative tactile agnosia can be found after lesions of inferior parietal or posterior insular cortex.

Apart from the studies by Caselli (1991, 1993), a few modern detailed clinical descriptions of patients affected by associative tactile agnosia are available. Endo et al. (1992) described a patient with a bilateral lesion of the parietal lobes and of surrounding cortex, who developed tactile agnosia in his right hand (while the left hand could not be tested). Platz (1996) provided a detailed description of a patient with a lesion of the right supramarginal gyrus who could not recognize objects with his left hand; in this case report, a wide battery for perception of elementary tactile features did not disclose relevant defects. More recently, Nakamura et al. (1998) reported a patient with bilateral associative tactile agnosia after a bilateral lesion of the subcortical white matter underlying angular gyrus; also in this case, elementary defects of tactile perception had been carefully excluded.

Modern neuropsychological case reports suggested a role of bilateral parieto-temporal cortex in tactile object recognition and recent functional neuroimaging studies in normal subjects have demonstrated that tactile recognition of objects activates a wide neural network mainly centred on inferior parietal cortex and prefrontal cortex bilaterally. The inferior parietal cortex would be considered as the specific region that processes object identity (a sort of tactile ''what'' system; Reed et al., 2004, 2005; Amedi et al., 2001; Bonda et al., 1996), while prefrontal areas could be involved in integrating information about structural features of the manipulated objects (Burton, 1984), or in planning and selecting appropriate responses (Schumacher and D'Esposito, 2002).

Callosal lesions usually do not determine disorders of tactile object recognition that can be classified within the term of associative tactile agnosia. In fact, it is often maintained that callosal lesions are related to specific impairments in naming objects tactually presented to the left hand (left hand anomia), within the context of a disconnection syndrome (Geschwind and Kaplan, 1962). For instance, Nagumo and Yamadori (1995) reported a patient who developed left hand tactile anomia together with finger agnosia and autotopoagnosia for the left body side after a callosal infarction. Another paradigmatic case of inter-hemispheric disconnection has been reported by Marangolo et al. (1998), who observed left hand tactile anomia, apraxia and dysgraphia in a patient with a parasagittal lesion involving the trunk of the corpus callosum and the splenium.

In the present paper we describe a patient with left hand tactile agnosia that matched features classically reported in associative tactile agnosia, due to a focal lesion involving the posterior third of the trunk of the corpus callosum. Such an unusual pattern of unilateral defect in tactile object recognition allowed us to shed new light on neural mechanisms subtending tactile object recognition.

2. Case report

AB is a 24-year old, right-handed tailor, with 8 years of formal education. In June 2003, while driving her car, the patient suddenly experienced involuntary mirror movements of her hands: while her right hand was engaged in one activity, her left hand performed the same motor pattern, but mirror reversed; these movements caused discomfort and also some difficulties in carrying out current activities. The patient could not control such spontaneous motor activity, but this symptom disappeared in a few hours; since then, however, AB experienced lack of ownership for her left arm and leg, difficulties in dressing herself, and some memory defects for recent events. A neurological examination performed 10 days after onset was unremarkable: elementary motor and sensory functions were preserved, no pyramidal or extrapyramidal sign was present. Brain MR scan revealed a demarcated, parasagittal hypointense lesion involving the posterior part of the trunk of the corpus callosum, and sparing the splenium (Fig. 1). PET scan was normal.

The subjective disturbances and memory defects for recent events spontaneously disappeared in one month. The patient did not develop further symptoms in the following months, but only occasionally she still complained of lack of ownership for her left hand and of mirror movements, seldom occurring in daily activities. Seven months post-onset the patient came to our observation during a routine follow-up visit and underwent a neuropsychological evaluation.

3. Neuropsychological assessment

At that time, the patient was alert and cooperative; her speech was fluent and communicative, and she did not show verbal comprehension difficulties (she scored 35/36 on the token test; De Renzi and Faglioni, 1978). AB could correctly recognize and name visually presented objects, and did not show difficulties in performing transitive (tool use demonstration; De Renzi et al., 1968; De Renzi and Lucchelli, 1988) and intransitive gestures upon verbal command or to imitation with either hand (De Renzi and Nichelli, 1980). She could copy simple and complex geometrical drawings flawlessly (Spinnler and Tognoni, 1987).

The patient did not present asymmetries in exploration tasks in the extrapersonal (star cancellation; Halligan et al., 1989) or in the personal space (comb and razor test; Beschin and Robertson, 1997). However, in unilateral or bilateral tactile stimulation of the hands, she correctly detected unilateral stimuli and extinguished a few (2/10) left-sided stimuli in the condition of bilateral stimulation; she also erroneously referred to her right hand some (2/10) unilateral stimuli presented to her left hand (tactile allochiria). Clinical examination did not disclose extinction in auditory or visual modalities.

In the same testing session, the patient proved unable to correctly localize tactile stimuli delivered to fingers of her left hand (5/17 correct responses), but also made two errors for stimuli delivered to her right hand (15/17 correct). Administration of Semenza and Goodglass' (1985) verbal and non-verbal tests for identification and localization of body