



Auditory agnosia and auditory spatial deficits following left hemispheric lesions: evidence for distinct processing pathways

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Abstract

Auditory recognition and auditory spatial functions were studied in four patients with circumscribed left hemispheric lesions. Patient FD was severely deficient in recognition of environmental sounds but normal in auditory localisation and auditory motion perception. The lesion included the left superior, middle and inferior temporal gyri and lateral auditory areas (as identified in previous anatomical studies), but spared Heschl's gyrus, the acoustic radiation and the thalamus. Patient SD had the same profile as FD, with deficient recognition of environmental sounds but normal auditory localisation and motion perception. The lesion comprised the postero-inferior part of the frontal convexity and the anterior third of the temporal lobe; data from non-human primates indicate that the latter are interconnected with lateral auditory areas. Patient MA was deficient in recognition of environmental sounds, auditory localisation and auditory motion perception, confirming that auditory spatial functions can be disturbed by left unilateral damage; the lesion involved the supratemporal region as well as the temporal, postero-inferior frontal and antero-inferior parietal convexities. Patient CZ was severely deficient in auditory motion perception and partially deficient in auditory localisation, but normal in recognition of environmental sounds; the lesion involved large parts of the parieto-frontal convexity and the supratemporal region. We propose that auditory information is processed in the human auditory cortex along two distinct pathways, one lateral devoted to auditory recognition and one medial and posterior devoted to auditory spatial functions. © 2000 Elsevier Science Ltd. All rights reserved.

Keywords: Auditory agnosia; Auditory localisation; Auditory motion; Auditory areas; Human

1. Introduction

Auditory agnosia is defined as the impaired capacity to recognise sounds despite adequate hearing. Auditory agnosia for environmental sounds has been found without impairment of verbal comprehension after

right [7,16,28,47], left (here) or bilateral lesions [7], but has been more often reported in association with auditory agnosia for verbal material in cases of bilateral [5,15,24,27,29,33,42] or unilateral left [7,34] lesions.

Circumscribed hemispheric lesions have been shown to impair auditory spatial functions. Several studies reported selective mislocalisation within the hemisphere contralateral to the brain lesion, after right or left hemispheric lesions [14,21,26,36,38,44,50,51,53]. Other studies described deficits within the whole field following unilateral lesions and advocated either right [4,43,45] or left [37] hemispheric specialisation for auditory localisation.

Sound motion perception was found to be impaired

Abbreviations: AA, anterior auditory area; AI, primary auditory area; AIA, anterior insular auditory area; DIT, difference in inter-aural time (or phase); LA, lateral auditory area; MA, medial auditory area; PA, posterior auditory area; STA, superior temporal auditory area.

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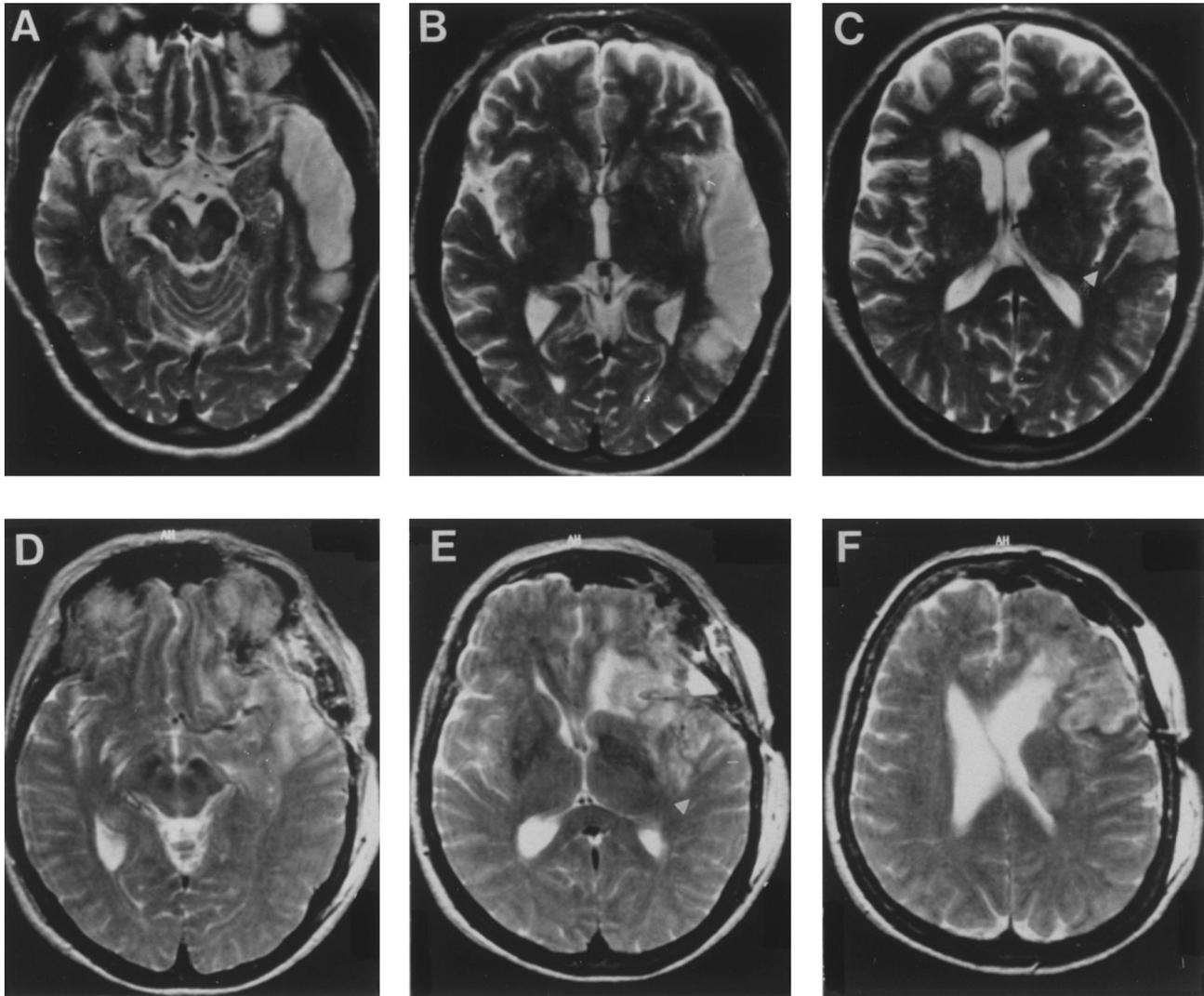


Fig. 1. MRI of FD (A–C) and SD (D–F) showing T2-weighted images from horizontal sections. Heschl's gyrus is indicated by arrow head in C and E. Left is shown to the right.

in the hemifield contralateral to hemispherectomy [38]. Recently, a deficit of sound movement perception was reported in association with right [3,20] or left parieto-temporo-insular lesions [3].

Visual information pertinent to recognition and to localisation is processed along two distinct pathways [22,32,35]. Electrophysiological studies in non-human primates suggest that a similar dichotomy exists in the auditory system [40], but there is currently no confirmation from lesion studies. Furthermore, the human auditory cortex might be organised differently, since it is linked from very early stages to speech processing [11,52]. Non-verbal auditory recognition and localisation appear, however, to depend on either hemisphere (see above) and may be treated in either hemisphere along two distinct pathways.

We describe here two cases of auditory agnosia with spared auditory spatial capacities following left hemi-

spheric lesions. Two other cases demonstrate that left unilateral lesions can indeed lead to auditory spatial deficits.

2. Case history and methods

Patient FD was a 54-year-old, right-handed male bricklayer who suffered a left temporal infarction (Fig. 1). Auditory evoked potentials recorded three weeks after the infarction demonstrated normal I to V waves; late potentials were not searched for. Neuropsychological assessment was performed four weeks after the onset of the symptoms. Spontaneous speech was fluent and profuse, with very rare semantic paraphasias. Auditive-verbal comprehension was severely deficient with major difficulty in understanding instructions (three simple orders out of five were exe-

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