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Correlation of MRI and histopathology in epileptogenic parietal and occipital lobe lesions

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Summary

Introduction: To analyze the diagnostic accuracy of MRI in patients undergoing parietal and occipital lobe epilepsy surgery.
Methods: In a retrospective study, we analyzed MRI scans and neuropathology reports of 42 patients who had undergone resective epilepsy surgery in the parietal and occipital lobe between 1998 and 2003. We evaluated, whether lesions were precisely characterized by MRI and whether lesion characterization allowed to estimate postsurgical seizure outcome.
Results: Within the categories epilepsy associated tumors, focal cortical dysplasias, vascular malformations, scarring, and others, MRI was concordant with histopathology in 36 of 42 (86%) lesions. Among the discordant lesions, one lesion was re-classified following MRI–histopathology synopsis, another two lesions represented new tumor entities (angiocentric neuroepithelial tumor, isomorphic astrocytoma) which have been described recently. Seizure freedom (Engel class I) one year following surgery was achieved in 25 patients (60%). Seizure outcome was different for lesion categories (Engel class I: epilepsy associated tumors, 62%; focal cortical dysplasias, 71%; vascular malformations, 75%; scarring, 40%), and was unchanged if no lesion was found on preoperative MRI.
Conclusion: If MRI and histopathology are discordant, not only the MRI findings may be debatable. MRI lesion detection is important, since chance of seizure freedom is low if no lesion is detected.

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Introduction

Parietal and occipital lobe seizures are relatively rare accounting for less than 10% of all partial seizures reported from comprehensive surgical series. In parietal lobe seizures, the most common subjective sensations or auras are paresthesias, dysesthesias or pain; additional parietal lobe symptoms include sexual sensations, apraxias, and disturbances of body image. Conversely, much of the parietal lobe is clinically silent in terms of seizure manifestation. Objective parietal lobe seizure manifestations (e.g. dominant parietal lobe: disturbances of language functions) are rare and most objective manifestations reflect seizure spread outside the parietal lobe. The majority of patients with occipital lobe seizures describe visual phenomena (elementary hallucinations, illusions including metomorphopsia and dyschromatopsia, viual loss) as the initial ictal manifestation.[1] However, these phenomena may also be elicited in temporo-occipital and anterior temporo-mesial structures.[2] Moreover, ictal discharges originating in the occipital lobe seizures usually rapidly spread into anterior areas.[3]

Localizing of the seizure onset was difficult and frequently erroneous in the pre-MRA area,[4] and magnetic resonance imaging (MRI) has become an important tool for localization of the seizure onset zone. Congruity of a MRI lesion, ictal surface EEG focus, and seizure semiology may allow epilepsy surgery without further invasive diagnostic procedures. In patients, in whom seizure semiology and scalp EEG recordings are inconclusive, a MRI lesion may generate a hypothesis for intracranial electrode implantation. Whether a lesion is detected by MRI, depends on the quality of the MRI scan and the expertise of the MRI reader.[5] When a lesion is detected, the risk of invasive presurgical work-up and potential epilepsy surgery must be weighted against the estimated chance of seizure freedom following surgery. In this context, two questions are of interest: (1) Are the lesions correctly characterized by MRI? (2) Does the seizure outcome following surgery depend on the type of the MRI lesion?

In the present study, we retrospectively analyzed the MRI and neuropathology reports of patients with parietal and occipital lobe epilepsies who had undergone resective epilepsy surgery between 1998 and 2003.

Methods

Study group

The study group comprised all patients with drug-resistant parietal and occipital lobe epilepsies who had a high resolution MRI and were operated following presurgical work-up at the University of Bonn Medical Center between 1998 and December 2003.

MRI

MRI was performed using 1.5 or 3 Tesla systems (Gyroscan ACS-NT, Gyroscan NT-Intera, Gyroscan Intera, Gyroscan 3 T Intera, Gyroscan 3T Achieva, Philips Medical Systems, Best, The Netherlands) according to a standardized protocol that has been described previously.[6,7] In brief, we first acquired a sagittally oriented 3D-T1-weighted gradient echo sequence with 1 mm^3 isotropic voxels. Displaying the sagittal 3D-T1-weighted gradient echo sequence, the next two sequences, an axial FLAIR fast spin echo and an axial T2-weighted fast spin echo sequence with a slice thickness of 5 mm and an interslice gap of 1 mm were angulated either along the length axis of the hippocampus or the anterior comissure—posterior comissure-line (a.c.—p.c.-line). How the slices were angulated, depended on seizure semiology and EEG findings, and was decided after patient's history was reported from the transferring epileptologist.

Next, coronal FLAIR fast spin echo (slice thickness 3 mm), coronal T2-weighted fast spin echo (slice thickness 2 mm), and coronal T1-weighted inversion recovery sequences (slice thickness 5 mm, interslice gap 0.5 mm) were obtained. If axial sequences were angulated along the hippocampal length axis, slice orientation was perpendicular to axial slices. If axial sequences were angulated along the a.c.—p.c.-line, coronal FLAIR sequence was tilted along the brain stem, but the coronal T2-weighted sequence perpendicular on hippocampal length axis. If a lesion suggestive for a tumour was detected, axial and/or coronal T1-weighted spin echo sequences (slice thickness 5 mm, interslice gap 1 mm) before and following Gd-DTPA injection were acquired.

Further pre-surgical work-up

Further pre-surgical work-up included vidoe-EEG-monitoring in all patients, whereas other investigations (ictal and interictal SPECT, Subtraction ictal SPECT co-registered to MRI (SISCOM), PET, depth electrodes, subdural grid or strip electrodes) were performed as deemed necessary in each patient.[8]

Surgery

Surgical approaches targeted to resect the epileptogenic zone while sparing eloquent cortex. The size and location of the epileptogenic zone was usually determined following the implantation of subdural