Hippocampal sclerosis diagnosis

Pathologically, hippocampal sclerosis (HS) is characterized by neuronal loss and gliosis affecting particularly the pyramidal neurons of CA1, CA3, and CA4 with relative sparing of the CA2 neurons. This can be identified in vivo with magnetic resonance (MR) imaging techniques that can reveal both morphological and signal abnormalities. The morphological changes are atrophy and loss of the normal internal architecture of the hippocampus as seen in coronal section. There is also T1- and T2-weighted signal abnormality in the hippocampus. Quantitative techniques are very good at measuring any single one of these features, but the spectrum of HS includes cases in which a single feature can occasionally be misleading. Also, quantitation focuses entirely on the hippocampus, and it is becoming clear that HS may exist in the presence of other brain pathology that may affect proper management of the patient. Therefore, quantitative measures should always be interpreted in the context of optimised imaging sequences and visual inspection. For routine clinical purposes, the relative reliance on quantitation (hippocampal volume or T2 measurements) depends entirely on the yield of visual inspection in any institution. This, in turn, depends on whether optimised imaging is performed and on the familiarity of the reporting specialist with the MRI features of HS. A technique which approaches 95-100% compared with pathology is essential in any epilepsy centre, and optimised visual analysis can achieve this. There are some cases where quantitation of a single feature can be misleading, so visual analysis should always be performed, and complements any quantitative study [1].

MRI-based composite index (HSI) with conventional MRI-based measures in hippocampal sclerosis (HS) detection and postoperative outcome estimation and hippocampal volume (HV)presented comparable good performance in HS detection, and HSI may have better sensitivity than HV in differentiating pathological HS severity [2]

Histology

The properties and structure of tissue can be visualized without labeling or preparation by multiphoton microscopy combining coherent anti-Stokes Raman scattering (CARS), addressing lipid content, second harmonic generation (SHG) showing collagen, and two-photon excited fluorescence (TPEF) of endogenous fluorophores.

Uckermann et al., compared samples of sclerotic and nonsclerotic human hippocampus to detect pathologic changes in the brain of patients with pharmacoresistant temporomesial epilepsy (n = 15). Multiphoton microscopy of cryosections and bulk tissue revealed hippocampal layering and micromorphologic details in accordance with reference histology: CARS displayed white and gray matter layering and allowed the assessment of axonal myelin. SHG visualized blood vessels based on adventitial collagen. In addition, corpora amylacea (CoA) were found to be SHG-active. Pyramidal cell bodies were characterized by intense cytoplasmic endogenous TPEF. Furthermore, diffuse TPEF around blood vessels was observed that co-localized with positive albumin immunohistochemistry and might indicate degeneration-associated vascular leakage. We present a label-free and fast optical approach that analyzes pathologic aspects of HS. Hippocampal layering, loss of pyramidal cells, and presence of CoA indicative of sclerosis are visualized. Label-free multiphoton microscopy has the potential to extend the histopathologic armamentarium for ex vivo assessment of changes of the hippocampal formation on fresh tissue and prospectively in vivo [3].

1)
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2)
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