Biopsy targeting gliomas: do functional imaging techniques identify similar target areas?

Because of the heterogeneous nature of glioma, biopsies performed should be targeted at the most anaplastic region. Several functional magnetic resonance imaging (MRI) or positron emission tomography (PET) techniques have been proposed for identifying the most anaplastic tumor area. However, it is unclear whether the recommended biopsy targets based on these various functional imaging modalities correspond with each other. Thus, the purpose was to evaluate whether they identify similar target areas. A total of 61 patients with suspected glioma were assessed within 2.3 ± 3.5 days by MRI, 18F-fluorothymidine-, and 18F-fluorodeoxyglucose-PET. Thirty-five patients underwent gross total resection and 26 were stereotactically biopsied. MRI was performed on a 1.5 Tesla broadband transmit/receive system, using a double-resonant birdcage coil. The MRI protocol comprised of sodium (23Na)-MRI (3D-radial projection imaging), proton spectroscopic imaging (1H-MRSI, point-resolved spectroscopy), arterial spin-labeling (ASL) perfusion MRI, dynamic contrast-enhanced (DCE) MRI, and dynamic-susceptibility-weighted (DSC) perfusion MRI after a single dose each of gadobenate dimeglumine. Also, apparent diffusion coefficient (ADC) maps were processed from diffusion.
tensor images. Image analysis comprised a detailed semiquantitative region of interest analysis of the different parameter values as well as visual identification of the most conspicuous tumor areas on parameter maps, for example, areas with maximum tumor perfusion, highest metabolite ratios of choline-containing compounds/N-acetyl-aspartate, or lowest ADC values within tumor tissue. Colocalization of these areas was then assessed. Regarding tumor vascularity-related parameters and tumor proliferation-related parameters, the higher the glioma grade the higher were the respective parameters in semiquantitative analysis. ADC values decreased with glioma grade. In the whole study population comprising low- (N = 15) and high-grade gliomas (N = 42), except for 23Na-MRI, there was good (>50%) or perfect (100%) agreement of the tumor areas with highest values on parameter images in the majority of cases (>80%), that is, tumor areas with increased thymidine-uptake and highest choline, both suggestive of increased tumor proliferation, and elevated microcirculation as demonstrated by DSC-, arterial spin-labeling-, and DCE-MRI. 23Na-MRI depicted the highest signal within necrotic tumor areas, but non-necrotic gliomas also showed a perfect agreement in more than 61%. 18F-fluorothymidine-PET, DSC-, and DCE-MRI, diffusion-weighted imaging as well as MR spectroscopic imaging correctly detected no glioma heterogeneity in all 15 histologically proven grade II gliomas but identified suspicious areas in all 3 nonenhancing grade III gliomas. Both imaging techniques that depict microcirculation and techniques that visualize proliferation identify similar target areas.

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