Dokumenttyp: journal article

Autor(en) des Beitrags: Hoffmann, A; Bredno, J; Wendland, MF; Derugin, N; Hom, J; Schuster, T; Su, H; Ohara, PT; Young, WL; Wintermark, M

Titel des Beitrags: Validation of in vivo magnetic resonance imaging blood-brain barrier permeability measurements by comparison with gold standard histology.

Abstract: We sought to validate the blood-brain barrier permeability measurements extracted from perfusion-weighted MRI through a relatively simple and frequently applied model, the Patlak model, by comparison with gold standard histology in a rat model of ischemic stroke. Eleven spontaneously hypertensive rats and 11 Wistar rats with unilateral 2-hour filament occlusion of the right middle cerebral artery underwent imaging during occlusion at 4 hours and 24 hours after reperfusion. Blood-brain barrier permeability was imaged by gradient echo imaging after the first pass of the contrast agent bolus and quantified by a Patlak analysis. Blood-brain barrier permeability was shown on histology by the extravasation of Evans blue on fluorescence microscopy sections matching location and orientation of MR images. Cresyl-violet staining was used to detect and characterize hemorrhage. Landmark-based elastic image registration allowed a region-by-region comparison of permeability imaging at 24 hours with Evans blue extravasation and hemorrhage as detected on histological slides obtained immediately after the 24-hour image set. Permeability values in the nonischemic tissue (marginal mean ± SE: 0.15 ± 0.019 mL/min 100 g) were significantly lower compared to all permeability values in regions of
Evans blue extravasation or hemorrhage. Permeability values in regions of weak Evans blue extravasation (0.23 ± 0.016 mL/min 100 g) were significantly lower compared to permeability values of in regions of strong Evans blue extravasation (0.29 ± 0.020 mL/min 100 g) and macroscopic hemorrhage (0.35 ± 0.049 mL/min 100 g). Permeability values in regions of microscopic hemorrhage (0.26 ± 0.024 mL/min 100 g) only differed significantly from values in regions of nonischemic tissue (0.15 ± 0.019 mL/min 100 g). Areas of increased permeability measured in vivo by imaging coincide with blood-brain barrier disruption and hemorrhage observed on gold standard histology.