Perfusion and permeability MR imaging in differentiating tumefactive demyelinating lesions from high grade gliomas

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Introduction and Purpose

Acute tumefactive demyelinating lesions (TDLs) may present as single or multiple lesions that may mimic high grade gliomas (HGG) Although the presence of some characteristic imaging features may suggest, with a high degree of certainty, the diagnosis of TDLs, not infrequently a definitive diagnosis requires a biopsy despite clinical suspicion of demyelination. However, even the biopsy specimen may resemble a brain tumor because of the hypercellular nature of the lesions, which are often associated with large protoplasmatic glial cells with fragmented chromatin and abnormal mitosis (Creutzfeldt cells). Although multiple functional imaging methods may provide useful information for the characterization of brain mass lesions, none of them has been validated for routine clinical use. The purpose of this study is to compare differences in perfusion and vascular permeability MR imaging between TDLs and HGG.

Patients and Methods

We retrospectively reviewed 4 patients with acute TDLs and 5 patients with biopsy proven HGG (gliobastoma) in whom perfusion studies with arterial spin labelling **(ASL)**, dynamic susceptibility contrast T2*-weighted (**DSC**) and dynamic contrast enhanced T1-weighted (**DCE**) MR sequences were obtained on a 3T magnet. From the **ASL** and **DSC** sequences, the relative cerebral blood flow (**rCBF**) and the relative cerebral blood volume (**rCBV**) were calculated. Interpretation of the **DCE** sequence was performed using both an **heuristic** and a **kinetic** modelling. From the heuristic modelling we calculated the initial area under the curve **(IAUC)** (figure 1) while using the kinetic modelling we calculated the **Ktrans** (a marker of vessel permeability) (figure 2). All measurements were obtained from the contrast-enhancing areas of lesions, using the contralateral normal appearing white matter as a reference. From each measure we obtained colour maps. All measurements and maps were obtained with **Perfscape* Software, Olea Medical© or NordicNeuroLab©**.

Results

A non-parametric test (Mann-Whitney) showed significant differences ($p<0.05$) between the two groups in rCBV, rCBF, and IAUC but not in Ktrans (see Table). Representative images obtained from a TDL and from a HGG are shown in figures 3 and 4.

Table

	Mean (sd) rCBF	Mean (sd) rCBV	Mean (sd) IAUC	Mean (sd) Ktrans
TDLs	0.32 (0.31)	0.83 (0.45)	276.7 (104)	0.3050 (0.200)
HGG	9.80 (3.24)	6.25 (2.68)	1155.6 (707)	0.638 (0.280)

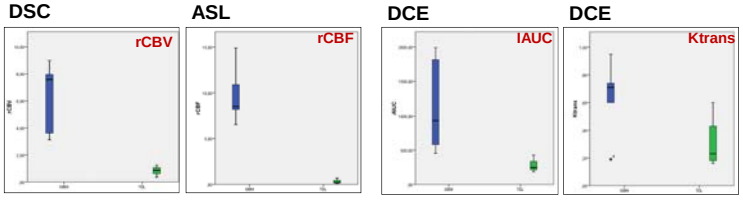
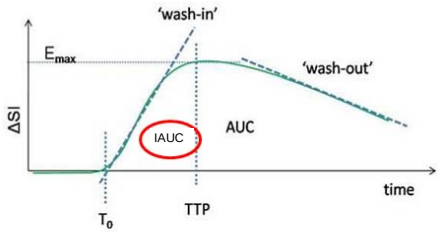
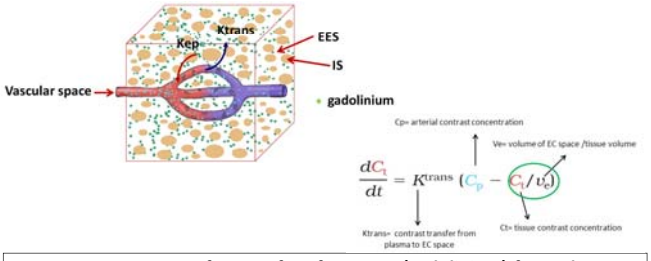


Figure 1. Heuristic modelling of DCE-MRI
(Toft et al. MRM 1999)



IAUC: Initial area under the curve; Wash-in: initial up-slope; Wash-out: down-slope; TTP: time to peak enhancement; SI: signal intensity

Figure 2. Kinetic modelling of DCE-MRI
(Toft and Kermode MRM 1991)



Ktrans rate constant for transfer of contrast (gadolinium) from plasma to extravascular, extracellular space (EES). IS: intracellular space; Kep: rate constant for transfer of contrast from EES to plasma

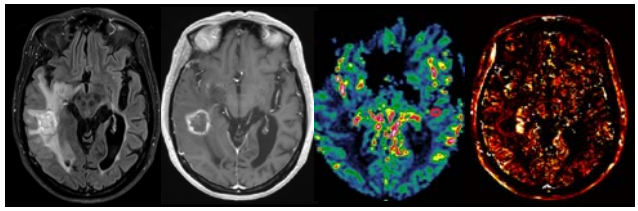


Figure 3. T2-FLAIR weighted image, contrast-enhanced T1-weighted image, and rCBV and IAUC colour maps obtained from a right temporal TDL. Observe the ring enhancing lesion in the subcortical white matter with extensive edema mimicking a high grade glioma, which shows low rCBV and IAUC

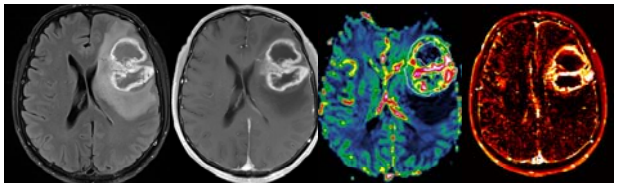


Figure 4. T2-FLAIR weighted image, contrast-enhanced T1-weighted image, and rCBV and IAUC colour maps obtained from a left temporal glioblastoma. Observe the ring enhancing lesion with extensive edema, which shows high rCBV and IAUC

Conclusions

Perfusion and permeability MR imaging can be used to discriminate between active TDLs from HGG based on the important biological dissimilarities between these two types of lesions, with HGG characterized by presence of neoangiogenesis and vascular endothelial proliferation and TDLs characterized by intrinsically normal or inflamed vessels with mild inflammatory angiogenesis.

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