A Comparison of Signal Intensity & DCE-MRI Based Methods for Assessing Enhancing Fraction

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Purpose In GBM, EnFIAUC60>0 has been shown to correlates with DCE-MRI derived Ktrans [1]. Ktrans has previously identified as a prognosticator in GBM [2]. EnFIAUC60>0 requires a dynamic acquisition and calculation of initial area under the contrast agent concentration curve (IAUC). This adds to the scan time and requires complex post processing analysis with conversion of signal intensity changes into contrast agent concentration levels. If a similar measurement of EnF could be obtained from routine clinical imaging which would not require an additional dynamic sequence and complex post processing analysis this would be highly desirable in translating the measurement of EnF into clinical practice. The aims were to evaluate the feasibility of measuring EnF (EnFSI) from routine pre and post-contrast T1-weighted imaging and assess its relationship with Ktrans.

Materials and Methods 30 GBM were imaged pre-operatively. Imaging included pre and post-contrast T1-weighted images (TR 10 ms, TE 500 ms, slice thickness 4.0mm, 256x256) and a T1-DCE-MRI protocol (3 pre-contrast spoiled fast field echo sequences with different flip angles (2°, 10°, 16°) for calculation of baseline T1 maps (TR 3.5ms, TE 1.1ms, slice thickness 4.2mm, 128x128) and a dynamic, contrast enhanced acquisition series with identical acquisition parameters as the variable flip angle baseline T1 measurement, consisting of 100 volumes with temporal spacing of approximately 3.4 seconds, with gadolinium-based contrast agent injected as a bolus of 3ml, at 15 ml/s, at a dose of 0.1mmolkg⁻¹ of body weight after acquisition of the fifth image volume). Parametric maps of IAUC and Ktrans were generated. Volumes of interest were drawn for whole tumour (VOITumour), EnFAUC60>0 was calculated by dividing number of voxels with IAUC>0mMol.s, by total number of voxels in VOITumour. The mean change in signal intensity + 2 standard deviations for VOINawm (meanΔSINawm+2SD) was calculated. EnFSI was calculated by dividing number of voxels with signal intensity change greater than meanΔSINawm+2SD by total number of voxels in VOITumour. Agreement between measures was assessed with Bland/Altman plots. Spearman correlation analysis was performed to assess the relationships with Ktrans.

Results There was good correlation between the two measures (Figure 1). However, Bland Altman plots showed the measures were not directly interchangeable (Figure 2). The mean difference between EnFAUC60>0 and EnFSI was 0.0378 (range -0.112 to 0.264, std. dev 0.07573). Low values of EnF (<0.70) demonstrated the greatest discrepancy. Both measures demonstrated significant correlations with Ktrans (EnFAUC60>0: ρ=0.462, p<0.05 and EnFSI: ρ=0.488, p<0.01).

Conclusion EnFAUC60>0 and EnFSI are not directly interchangeable measures but both correlate with Ktrans. Further work is required to assess the prognostic utility of these measures.

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References