Comparing Perfusion Parameters obtained from a Single Compartment and Pharmacokinetic Modeling methods obtained from Dynamic Susceptibility Contrast Enhanced Perfusion MRI with Glioma Grade

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INTRODUCTION: Numerous methods for measuring perfusion parameters and numerous different parameters can be found in the literature for the grading of gliomas. To compare perfusion parameters obtained from two different models: 1) Indicator Dilution Model which assumes contrast material remains intravascular in single compartment; 2) Pharmacokinetic Model (PK), a two compartment model in the grading of primary glial neoplasms. Each of these parameters was correlated with histopathologically confirmed grade in primary glial neoplasms.

MATERIALS AND METHODS: Seventy-three patients with primary glial neoplasms underwent conventional MR imaging, and dynamic, susceptibility contrast-enhanced MRI (DSC MRI). Relative CBV measurements were obtained from regions of maximal abnormality relative to the contralateral normal white matter as determined from rCBV color maps of each lesion. Vp and K^{trans} measurements derived from a pharmacokinetic modeling algorithm were obtained in all tumors. Absolute measurements of CBF, CBV and MTT were made using standard algorithms and an automated method for obtaining the arterial input function. The data from the three methodologies was then compared to histopathologic grades (based on a three tiered Ringertz system) determined from specimens obtained by volumetric resection or stereotactic biopsy.

RESULTS*:* For each measure, Tukey's honestly significant difference (HSD) procedure was applied to the ranks in order to make all pairwise comparisons among the tumor grades while maintaining the familywise type I error rate for the set of comparisons at or below the 5% level. The results are summarized in Table 1.Assuming that the tumor grades are ordered as Low grade glioma < Low Grade ODG < Ana Astro < GBM, the following table shows the Spearman rank correlation of rCBV, VP, K^{trans}, CBF, CBV and MTT with tumor grade. Tumor grade was significantly positively correlated with each of rCBV, VP, CBF and CBV, but not with K^{trans} or MTT. Thus, higher grade tumors tended to be associated with higher values of rCBV, VP, CBF and CBV while neither K^{trans} nor MTT exhibited a significant linear association with tumor grade.

Tumor Grades Compared	rCBV	VP	K trans	CBF	CBV	MTT
LG glioma : LG ODG	**0.0382**	**0.0124**	0.999	0.279	0.105	0.769
LG glioma : Ana Astro	**< .0001**	**0.0001**	0.92	**0.0111**	**0.0066**	0.994
LG glioma : GBM	**< .0001**	**< .0001**	0.884	**< .0001**	**< .0001**	0.892
LG ODG : Ana Astro	0.154	0.668	0.971	0.81	0.922	0.891
LG ODG : GBM	**< .0001**	**0.0191**	0.959	**0.0023**	**0.0007**	0.975
Ana Astro : GBM	**0.0001**	0.1987	0.999	**0.0083**	**0.0011**	0.977

Table 1. P values from Tukey's HSD to compare the 4 tumor types with respect to each measure.

CONCLUSION: Cerebral blood volumemeasurements taken relative to contralateral white matter demonstrated the best correlation/prediction of glioma grade and type. This may relate to rCBV partially correcting for recirculation and leakage as well as reducing noise compared with perfusion parameters taken relative to an arterial input function. VP measurements taken from a PK model also showed good correlation with glioma grade

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