r-CBV changes: can we predict tumor behavior of low grade gliomas with rapid progression from imaging features?

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Purpose: Current WHO classification and grading of low grade glioma has significant limitation. r-CBV changes can identify patients with low grade gliomas at high risk of early malignant transformation and who might benefit from early aggressive therapy. The purpose of this study was to retrospectively and prospectively review longitudinal imaging features of low grade gliomas focusing on dynamic susceptibility-weighted contrast-enhanced perfusion MR imaging to determine whether r-CBV(relative cerebral blood volume) value in low grade gliomas can be used as an adjunct to pathologic grading.

Materials and Methods: From 2004 to 2009. among 190 pathologically proven low grade glioma(WHO grade II), fifteen patients(7.8%)(10 men, 5 women; age range, 33-64 years, 4 astrocytomas, 10 oligodendrogliomas, 1 oligoastrocytoma) showed malignant transformation. Among 15 patients, 6 patients fully, 4 patients partly were performed longitudinal MR imaging including perfusion at 3 months intervals until malignant transformation was diagnosed. The region of interest for r-CBV measurement within the tumors was normalized relative to the contralateral normal tissue. Mann-Whitney's correlation was conducted for correlation with r-CBV value and WHO histopathologic grade.

Results: Fifteen patients demonstrated progression to high grade tumors between 7 and 108 months.(mean, 48.2 months). These tumors included 8 anaplastic oligodendroglioma, 3 anaplastic astrocytoma, 3 anaplastic oligoastrocytoma and 1 glioblastoma. At the initial study, mean r-CBV value was 5.07(range, 2.87-9.32). This r-CBV value was higher than the suggested cut-off value of 1.75 for differentiating low grade glioma from high grade glioma. These patients showed a continuous increase in r-CBV value or increased number and extent of high r-CBV foci up to the point of malignant transformation. Mean r-CBV was 10.4(range,3.25-16.15) at malignant transformation. At malignant transformation, there was significant statistical difference of r-CBV between control group and malignant transformation group($p= 0.009$) even when except the case of oligodendroglioma. There was no significant difference of r-CBV between control group and malignant transformation group at initial study entry($p= 0.898$), however there was seen more wide range of r-CBV value of malignant transformation group. Cut-off value for r-CBV of low grade glioma at the point of high grade transformation is 5.3($p=0.0005$, sensitivity 83.3%, specificity 76.9%).
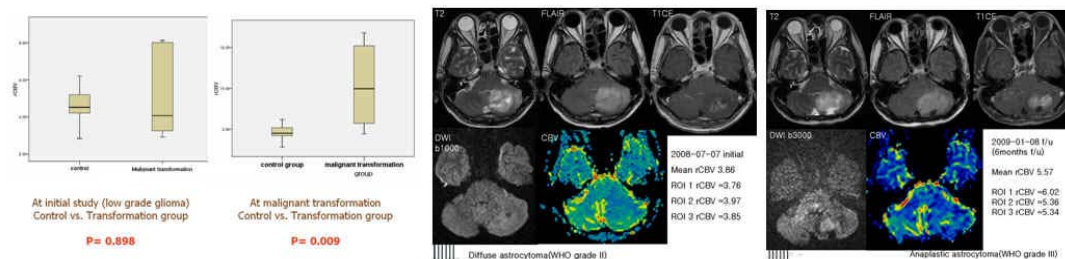
Conclusion:. r-CBV values are predictive and can be used as an accurate adjunct to WHO pathologic grading of low grade gliomas that have a propensity for malignant transformation.