

## Intravoxel distribution of water diffusion rates reveals proliferative activity in human astrocytoma

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**Introduction and purpose** Proliferative activity of tumor cells is an essential parameter determining the course of the disease and affecting the prognosis. The expression of Proliferating Cell Nuclear Antigen (PCNA) has been used as a biomarker to study the proliferative activity in human astrocytomas<sup>1</sup>. The purpose of this study was to non-invasively evaluate the proliferation of human astrocytoma as measured by several DWI quantitative parameters calculated from a stretched-exponential model<sup>2</sup>.

**Materials and methods** Patients (n=59, M/F: 42/17, age range: 6-77yrs.) with histopathologically confirmed astrocytoma (WHO grades II/III/IV: n=20/15/24) were enrolled in this study. Each subject underwent multi-b factor DWI with b value extending from 0 to 3000 s/mm<sup>2</sup>. Based on the stretched-exponential model, distributed diffusion coefficient (DDC) maps and  $\alpha$  maps were calculated. Freehand regions of interest (ROIs) were placed in the solid part of the tumors, repeated three times, and then the mean value of DDC and  $\alpha$  were obtained for statistical analysis. For the assessment of PCNA expression, a total of 43 astrocytoma excisional biopsies were retrieved after surgery (WHO grades II/III/IV: n=20/9/14).

**Results** DDC value had significant difference between any two groups among grade II, grade III and grade IV astrocytoma ( $p < 0.05$ ). For  $\alpha$  value, there were significant differences between grade II and grade III ( $P < 0.05$ ), but not for grade III and grade IV ( $P > 0.05$ ). There was a significant negative correlation between DDC value and the PCNA labeling index ( $r = -0.458$ ,  $p = 0.002$ ), but for  $\alpha$  value, the correlation was not significant ( $r = 0.171$ ,  $p = 0.274$ ).

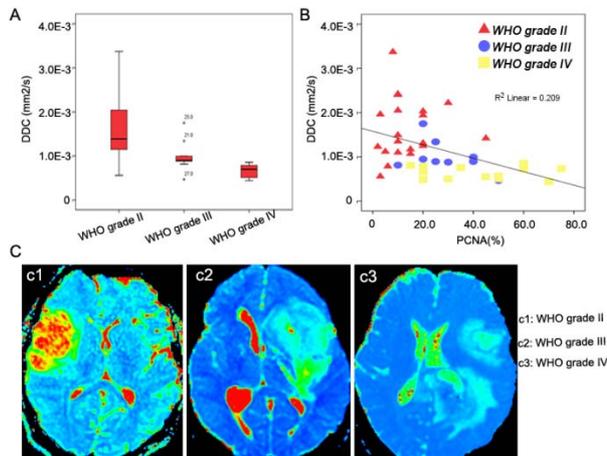


Fig.1 A: DDC has significant difference between different grades in human astrocytoma. B: DDC was negatively correlated with PCNA expression. C: DDC maps of WHO grade II (c1), grade III (c2) and grade IV (c3) astrocytoma.

**Conclusion** DDC could effectively evaluate the grade of human astrocytoma, but  $\alpha$  value just could distinguish low-grade and high-grade tumors. Moreover, a significant correlation was found between DDC and PCNA expression. DDC value, which represents intravoxel distribution rates, could be used as a sensitive biomarker for monitoring the proliferative activity of human astrocytoma.

### Reference

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2. Bennett KM, Schmainda KM, Bennett RT, et al. Characterization of continuously distributed cortical water diffusion rates with a stretched-exponential model. *Magn Reson Med* 2003; 50(4):727-34.