

# A Fully Automatic Double-Echo DSC-MRI Routine Can Predict Patient Outcome after a Single Dose of Cediranib in Recurrent Glioblastoma Patients

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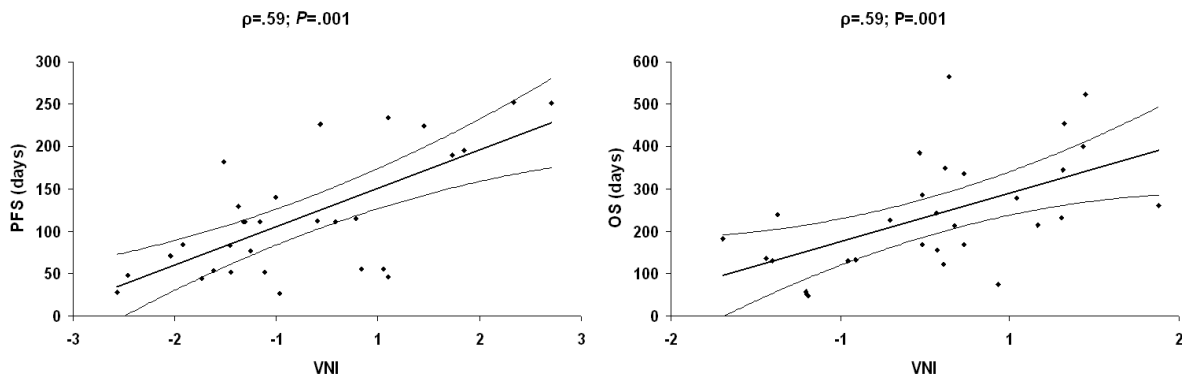
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**Purpose:** Recent studies have shown that patients with recurrent glioblastomas who receive anti-VEGF therapy (Cediranib) have a period of vascular normalization that is traceable by MRI and that MRI can also predict patient outcome after a single dose of Cediranib using a 'vascular normalization index' (VNI) (1,2). Obtaining the VNI parameter in clinical practice however, combining changes in vascular permeability ( $K^{\text{trans}}$ ), microvessel cerebral blood volume (CBV) and collagen IV levels, is time and resource demanding. In this study, we hypothesize that a double-echo dynamic susceptibility contrast (DSC) MRI acquisition and a fully automatic post-processing routine can provide similar diagnostic values.

**Methods and Materials:** 30 patients were included in this retrospective study (2). Based on automatic identification of the arterial input function and analysis of the tissue residue function (3,4), microvessel CBV maps were created from the DSC spin-echo (TE=103ms) images and a contrast agent leakage rate constant ( $K'$ ) maps were created from the DSC gradient-echo (TE=34ms) images. Logarithmic changes in mean values of CBV and mean histogram peak  $K'$  between pretreatment and day +1 after treatment start were derived from contrast enhancing tumor ROIs drawn on 2D axial T1 post-contrast images. A VNI value was obtained for each patient by Cox regression with both logarithmic values included (2). Image analysis was performed using nordicICE (NIL, Norway).

**Results:** Using Spearman Rank tests, a greater increase in CBV was seen in patients with increased progression free survival (PFS) ( $p=-.57$ ,  $P=.001$ ) and overall survival (OS) ( $p=-.41$ ,  $P=.025$ ) and a greater reduction in  $K'$  was seen in patients with increased OS ( $p=-.46$ ,  $P=.011$ ). Using Spearman Rank tests, VNI correlated significantly ( $p=.59$ ;  $P=.001$ ) with both PFS and OS (Figure 1).

**Conclusion:** In this study, we have shown that prognostic values for PFS and OS in patients undergoing anti-VEGF therapy can be assessed using a single MRI acquisition and automatic post-processing routines. The results are comparable with previous studies (2) and the minimal MR scanning (~2min) and post-processing times (~sec) may improve the clinical utility of MRI as an early imaging biomarker for tumor response to treatment.



**Figure 1:** Scatter plots with linear regressions (and 95% confidence intervals) showing the relationship between the VNI parameter and PFS (left) and OS (right). The correlations  $p=.59$  were significant at the  $P=.001$  level.

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