Biopsy targeting based on perfusion and diffusion MR related parameters

Nicolas Sauwen, Diana Sima, Sabine Van Huffel

Abstract— **There is no general agreement on which imaging modality should be considered for biopsy targeting in brain tumors. In this study, overlap between perfusion and diffusion MR related parameters is found to be low, suggesting that different biopsy sites are found using different MR parameters.**

I. Introduction

Histopathology is the golden standard for determining the WHO grade of a brain tumor. The biopsy site should correspond to the most malignant part of the tumor. However, there is currently no general agreement on which imaging modality should be considered for biopsy targeting. Diffusion and perfusion MR related parameters have been shown to be indicative of brain tumor grade. This study explores whether different MR parameters propose the same biopsy site.

II. Methods

6 glioma patients were scanned on a 3T Philips Achieva system: 2 grade II astrocytomas, 1 grade II oligodendroglioma, 3 grade IV glioblastomas. DSC-MRI was acquired with a GE-EPI sequence: TR/TE=1350/30msec, with 60 dynamic scans during the first pass of a 0.1mmol/kg body weight bolus of Dotarem (Guerbet) injected at 4ml/sec. Cerebral blood volume (CBV) was calculated using DPTools (www.fmritools.org). DKI data were acquired using the following SE-EPI sequence: TR/TE=3200/90msec, δ/J= 20/48.3msec, b=700,1000 and 2800sec/mm^2. Mean diffusion (MD) and mean kurtosis (MK) were calculated as in [1]. T2 and contrast-enhanced T1 MR images were used for manual segmentation of the tumor. CBV, MD and MK maps were co-registered to the anatomical images using SPM8 (Matlab, Mathworks, MA). Local maxima of CBV, MK and the inverse of MD (1/MD) within the tumor region of interest (ROI) were considered as potential biopsy targets. For each parameter map, all local maxima above 80% of the global maximum intensity value were included. A region growing algorithm was used to delineate regions around the local maxima, by iteratively including neighbouring voxels above the 80th percentile intensity value within the tumor ROI. Overlap between the regions of different parameters was calculated as a percentage of the number of overlapping voxels.

Nicolas Sauwen is with the Department of Electrical Engineering, ESAT-STADIUS, KULeuven, Leuven, B3000 Belgium (phone: 0032-016-321143; e-mail: nicolas.sauwen@esat.kuleuven.be)

Diana Sima is with the Department of Electrical Engineering, ESAT-STADIUS, KULeuven, Leuven, B3000 Belgium (e-mail: diana.sima@esat.kuleuven.be)

Sabine Van Huffel is with the Department of Electrical Engineering, ESAT-STADIUS, KULeuven, Leuven, B3000 Belgium (e-mail: sabine.vanhuffel@esat.kuleuven.be)

III. Results

Except for the overlap between 1/MD and MK for PAT04, all percentages of overlap were below 50%. Table 1 shows the percentage of overlap between the modalities for all patients.

TABLE I. Overlap percentages between CBV, 1/MD and MK

		Overlap [%]		
Patient	**Tumor type + grade**	**CBV-1/MD**	**CBV-MK**	**1/MD-MK**
PAT01	atrocytoma, grade II	0	0	0
PAT02	astrocytoma, grade II	19.6	23.1	4.9
PAT03	oligodendroglioma, gradeII	1.2	0.5	22.5
PAT04	glioblastoma, grade IV	0	0	53.3
PAT05	glioblastoma, grade IV	0.3	1.5	34.2
PAT06	glioblastoma, grade IV	6.3	3.5	8.5

IV. Discussion

The percentage of overlap between regions of local maxima of CBV, 1/MD and MK is below 50% in all cases except one. In a previous study, in which biopsy targets based on DSC-MRI and MRSI were compared, low overlap was found as well, suggesting that hypervascularized tumor regions might not fit with the regions of highest cell density [2]. These results suggest that different biopsy sites are found using different MR parameters.

Acknowledgment

This research was supported by the Flemish government, FWO PhD/postdoctoral grant G.0869.12.

References

[1] J Veraart, "Comprehensive framework for accurate diffusion MRI parameter estimation", in Magn Reson Med, Epub ahead of print, 2012

[2] M Wagner, "Heterogeneity in malignant gliomas: a magnetic resonance analysis of spatial distribution of metabolite changes and regional blood volume", in J Neurooncol, Issue 3, Volume 103, 2011, pp663-72