

A Novel Diffusion Tensor MR Based Approach to Evaluate Structural Features of Low-grade Gliomas

Marco Riva MD; Antonella Castellano BA; Fabio A. Raneri; Federico Pessina; Enrica Fava; Andrea Falini MD; Lorenzo Bello

MD

Università degli Studi di Milano, Milan. Humanitas Research Hospital.
Hospital and Università Vita-Salute San Raffaele, Milan.

Introduction

This study aimed at evaluating a new segmentation technique based on diffusion tensor decomposition into an isotropic (p) and an anisotropic component (q) to better characterize the tumour tissue heterogeneity. Enabling a voxel-by-voxel analysis, this technique allow the depiction of parametric changes at distinct timepoints.

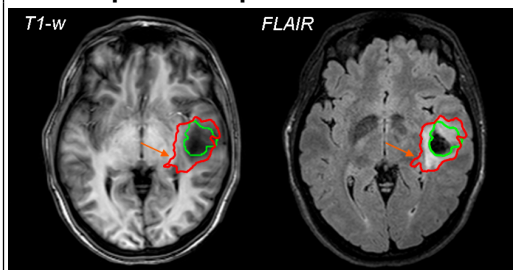
To characterize the structural heterogeneity of low-grade-gliomas (LGGs), we aimed at:

- comparing the images obtained from the p:q decomposition with the dataset acquired with FLAIR sequences
- correlating the results of segmentation with histopathological findings from image-guided tumour biopsies
- evaluating the evolution of a given lesion throughout time, when applicable, and comparing distinct imaging behaviour with clinical data (See. Abstract #1504)

Methods

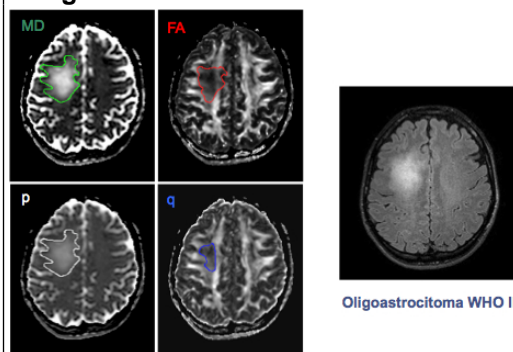
p and q maps were obtained from diffusion-tensor-acquisitions in 50 patients with primary LGGs. They were fused with DTI-FT reconstruction and volumetric FLAIR and post-GdT1-weighted images, loaded into the neuronavigation system, to be available intraoperatively.

Conventional and Advanced MRI depiction of peritumoral area



Red border corresponds to isotropic, i.e. p, segmentation, while green border to anisotropic, i.e. q, component.

Segmentation of distinct tumor areas



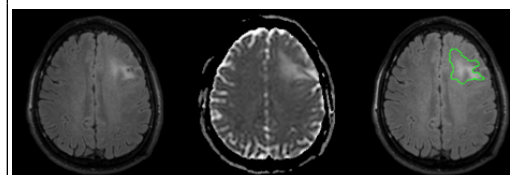
Results

p map depicted a tumour area larger than that detected in FLAIR images. The tumour ROI on q maps was located inside the area depicted on p maps. The structural heterogeneity of p and q maps did not match with the degree of heterogeneity shown by FLAIR images, or with areas of contrast enhancement.

Samples taken in p areas always revealed the presence of a LGG; samples in p areas located externally to the border depicted in FLAIR images and within p maps, were classified as infiltrative areas of LGG. Samples external to p areas was normal brain parenchyma; Samples in q areas showed regions of highly compacted tumour cells, and in tumours in which p and q maps did not match, the area of q maps showed foci of anaplasia. P:q maps also correlated with different molecular profile (MGMT status, 1p19q deletion, IDH-1 status).

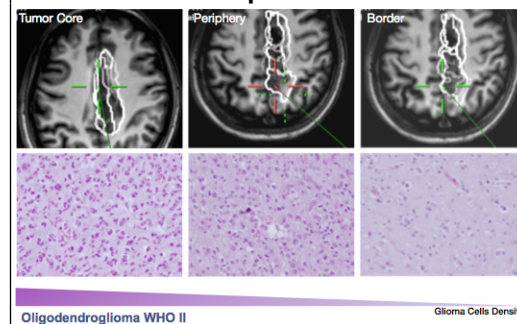
When applicable, neurophysiologic changes in stimulus threshold well correlated with the degree of changes depicted by p:q functional maps.

Peritumoral areas



The signal alteration, as depicted by the p:q decomposition, is wider than FLAIR-depicted lesion

Tissue sampling according to distinct p map ROIs



Learning Objectives

- To build the awareness regarding tumor heterogeneity through DT depiction of low grade gliomas

Conclusions

p and q maps better correlate with the degree of LGG heterogeneity than conventional MR images; this data has potential clinical implication for sampling for histological and molecular diagnosis and for better quantify the response to a given treatment over time.

References

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Wang et al., AJNR 2009
Goebell et al., Radiology 2006
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