Correlation of Biological Data and Metabolic Information on 11C-methionine PET in Primary Brain Tumors

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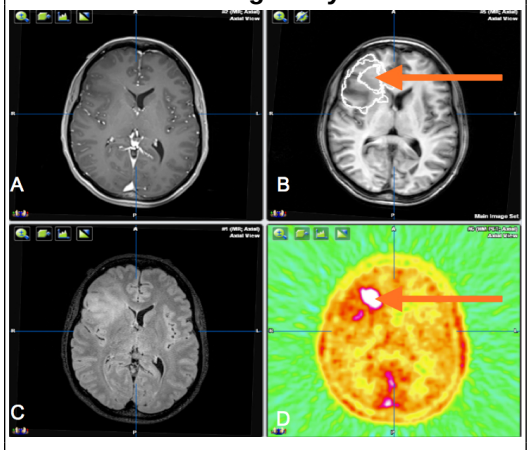
Introduction

Gliomas are highly heterogeneous tumors. Identification of aggressive tumor components, especially in Low-Grade gliomas (LGGs) and extent of infiltration are critically relevant for surgery. Structural characterization of gliomas can be depicted by: i) MRI (standard and advanced imaging); ii) Metabolic tools such as PET; iii) Intraoperative Ultrasound (IOUS). All information can be uploaded onto the neuronavigation workstation and used for guiding surgery and precise tissue sampling.

In our study we aimed assessing the correlation of metabolic information on 11C-methionine PET and biological data in patients affected by primary brain tumor and eligible for surgical resection.

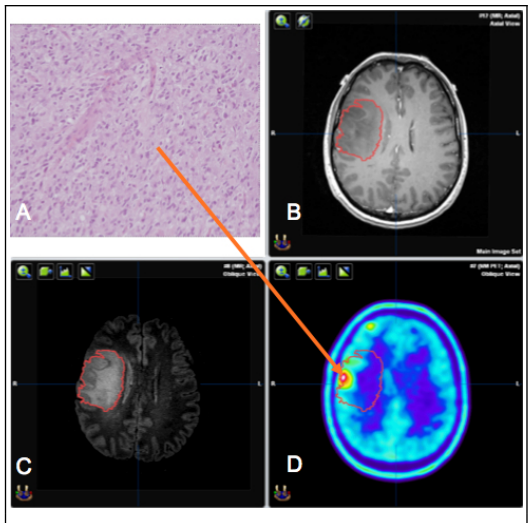
Tissue heterogeneity and PET



Gross analysis showed a certain degree of corrispondence between isotropic p map (DTI-derived metrics, see Abstract #513) and hot spots in MET PET identifying more aggressive areas within LGG (arrows).

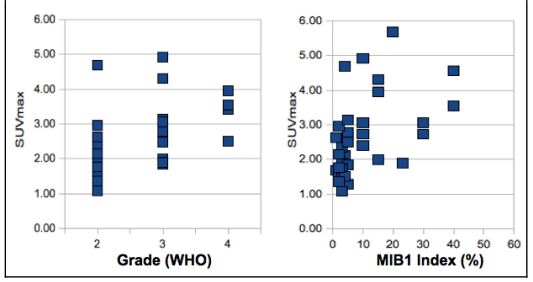
Methods

54 consecutive patients (M:F=34:20; mean age 45, range 19-77 years) affected by pathologically proven gliomas and referred to our institution for primary tumor resection were analyzed. Patients underwent pre-surgical 11C-methionine PET performed according to standard procedure and in all cases semi-quantitative and quantitative analyses were obtained considering SUVmax, SUVratio, and whole tumor metabolic activity (WTMA), expressed as a product of metabolic tumor volume and lesion SUVmean. Functional data on PET were then correlated with biological information obtained by histology (WHO grade/MIB1) and biomarkers.



Glioblastoma multiforme (WHO grade IV) without foci of necrosis on tissue sample from the “hot spot” in PET. Various grades of gemistocytic astrocytoma were identified in surrounding areas.

SUVmax relationship with Grade and MIB1 index



Results

We analysed 23 grade II low-grade gliomas (LGG), and 31 high-grade gliomas (HGG: 16 grade III and 15 grade IV).

Based on semi-quantitative and quantitative analysis, we determined a statistically significant correlation between SUVmax, SUVratio and WTMA versus tumor grading ($p<0.001$).

In our series we could also define some optimal cut-off points able of accurate differentiation between LGG and HGG, respectively SUVmax >2.8, SUVratio >2.08 and WTMA >6.63.

We determined a statistically significant correlation with tumor uptake only for IDH1 mutation, which resulted present in patients with lower SUVmax (mean 5.63 versus 2.32; $p=0.003$) and SUVratio (mean 2.99 versus 1.86; $p=0.002$).

The correlation was not confirmed for WTMA ($p=0.8$). In addition, no significant difference was found in tumor grade/MIB1 and IDH1 mutation, 1p/19q co-deletion or MGMT methylation.

Learning Objectives

To understand metabolic heterogeneity of primary brain tumors and the relevance of 11C-methionine PET in the presurgical evaluation

Conclusions

Semi-quantitative and quantitative information obtained by 11C-methionine PET significantly correlated with histological grading in primary brain tumors. Among other biological data, only IDH1 mutation resulted correlated to tumor uptake, with a prevailing expression in gliomas with lower SUVmax and SUVratio, suggesting, as supposed, a better prognosis in these cases.

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