Proton MR Spectroscopic Definintion of Glioma Location: Relationship to Survival and Tumor Grade

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Objective: Supratentorial glioma location has long been suspected to be related to patient prognosis, but existing data relating glioma location to survival are conflicting. We decided to assess the relationship between the metabolic point spatial location of a supratentorial glioma, as defined by proton magnetic resonance spectroscopic imaging (^{1}H-MRSI), and the length of patient survival or tumor histopathological grade.

Methods: X-Y-Z coordinates of the ^{1}H-MRSI voxel containing maximum intra-tumoral choline were used to define tumor point spatial location in 54 individuals with a supratentorial WHO grade-II (n=19), grade-III (n=14), or grade IV (n=21) glioma. These coordinates were transformed into standard coordinates in stereotactic space. Cox proportional hazards analyses were performed to investigate the relationship between tumor location and patient survival. Multinomial logistic regression analysis was used to ascertain the relationship between tumor location and histopathological grade.

Results: We found that glioma location, as defined by ^{1}H-MRSI, accounted for 30% of the variability in length of patient survival ($p = 0.0002$). A predictive model based on both spectroscopic tumor location and histopathological grade was able to account for 70% of the variability in survival, while a model based on grade alone could only account for 58% of survival variability. Tumor location also significantly predicted survival independent of surgical debulking ($p = 0.0001$). Finally, tumor location was itself significantly correlated with histopathological grade ($r^2 = 0.25$, $p = 0.001$), with higher grade tumors consistently located closer to the midpoint of the brain (see figure 1).

Conclusions: We have shown, for the first time, that ^{1}H-MRSI-defined point spatial location of a supratentorial glioma is significantly related to survival length and to tumor grade. Specifically, survival is shortened and tumor grade is more aggressive in more deeply situated tumors. Using a spectroscopic definition of tumor location can improve prognostic accuracy in glioma patients, and may contribute to a better understanding of the dynamics of glioma invasion and malignant dedifferentiation. Such a definition may prove clinically useful when planning stereotactic radiosurgery or when evaluating the goals of surgical debulking procedures.

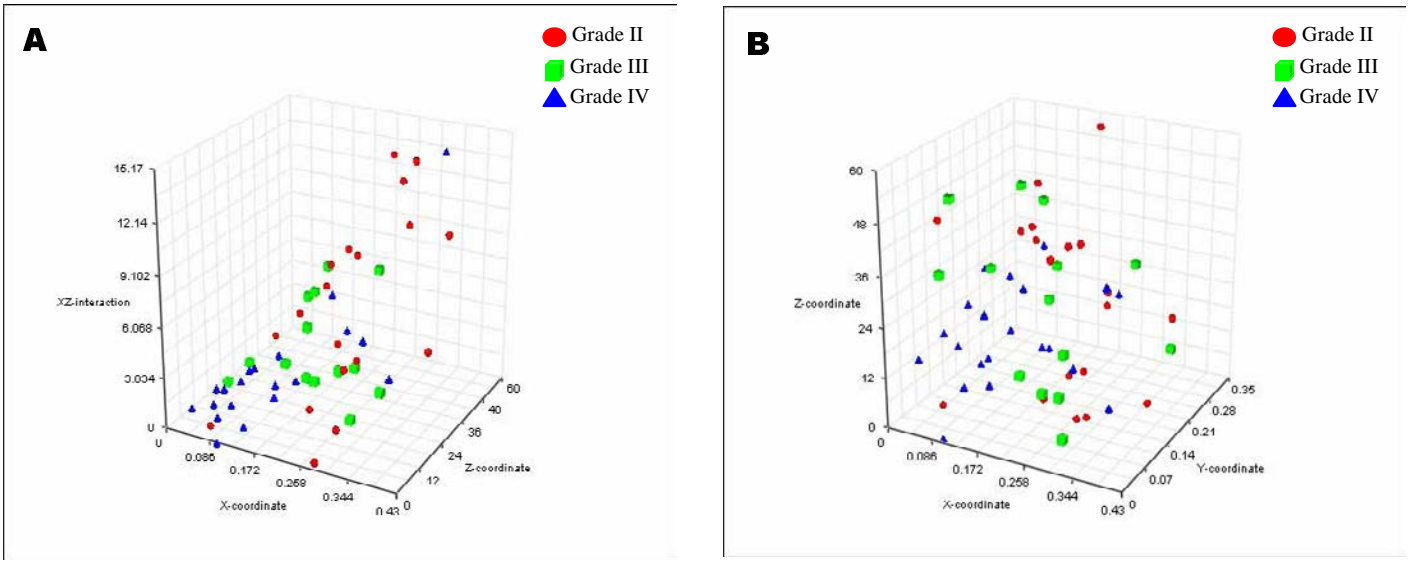

Figure 1. Scatterplots showing ^{1}H-MRSI-defined location of gliomas by histopathological grade. The origin represents the midpoint of the supratentorial space. Note the convergence of higher grade tumors to this midpoint. Convergence to the midpoint also correlated with shortened survival.