Statistical Atlases of Spatial Distribution of Glioblastoma and its Recurrence

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Purpose:
The aim of this study is to characterize the spatial distribution of glioblastoma by generating statistical atlases with respect to various clinical parameters.

Materials and Methods:
Two hundred seven patients (117 men, 90 women, age 22-88 years, mean 62) with pathology-proven glioblastoma were included in this HIPAA-compliant, IRB-approved study. Of those, 65 subjects had pathology-proven recurrence. In addition, 113 subjects had molecular subtype, and 64 subjects had genetic information related to EGFR VIII expression, 49 negative and 15 positive. We used validated, locally developed software (1) to segment both enhancing and necrotic components of tumors in all patients. Next, we mapped the tumors from individual patients into a common template using deformable registration (1, 2), and superimposed them to create statistical maps that described the spatial location of tumors with respect to age, gender, molecular subtype, size of tumor, and EGFR VIII expression. We also created maps that describe the spatial location of recurrence. We applied a chi-square test to determine whether pattern differences were statistically significant.

Results:
There were statistically significant differences when comparing patterns between men and women, younger and older patients, small and big tumors. The most frequent location for glioblastoma in all comers is the right temporal lobe. In women, there is strongly asymmetric involvement of the right temporal lobe. In younger patients, there is sparing of the anterior frontal lobes. There is asymmetric involvement of the temporal lobes, right greater than left by small tumors, whereas large tumors occur in the temporal lobes more symmetrically. The classical subtype tends to spare the frontal lobes, other subtypes do not. There is right temporal dominance for EFGR VIII negative tumors, whereas EFGR VIII positive ones tend to be more distributed. The center of recurrence usually occurs close and medial to the original tumors.

Conclusions:
Our results are very intriguing as clear spatial localization seems to emerge. Propensity for specific regions may be related to the spatial distribution of stem cells, such as the subventricular zone, spatial distribution of receptors that mediate cell growth, and topology of blood supply. This preliminary work may eventually have significant clinical implications in terms of prognosis and treatment, e.g., in terms of guidelines for surgical resection and radiation therapy.

Awards:
Dyke Award

Categories:
ADULT BRAIN, Neoplasms
207 Patients with Glioblastoma

Reference One:

Reference Two: