A semi-automated 2D image coregistration technique for longitudinal studies of brain cancer models

N. Shastry Akella, Ingrid Menegazzo, Martin M. Pike, L. Burt Nabors
The University of Alabama at Birmingham, Birmingham, AL, 35294, USA

We report a 2D image coregistration technique for longitudinal evaluation of cancer growth and progression in vivo. A tool developed in MATLAB (MathWorks Inc., Natick, MA) was tested using anatomic and perfusion magnetic resonance (MR) images obtained from B6D2F1 mice injected with 4C8 glioma cells, acquired at 8.5T. Four mice were imaged after 4 weeks (baseline) and weekly thereafter, to assess growth characteristics of the resulting tumors.

MR image coregistration was semi-automated using anatomical landmarks such as the longitudinal fissure, cingulum, and cortex cerebri, as well as fiducial markers on the mouse skull, which are less prone to displacement by a growing tumor. Images from each longitudinal study were compared pair-wise with the baseline images utilizing six anatomic markers. A linear conformal transformation was applied to follow-up images to enable geometric correction that included translation, rotation, and scaling. Corrected images (offset error < 26 microns) were then used to compute tumor size, and pixel-by-pixel estimates of relative cerebral blood volume (CBV) and flow (CBF) at the same anatomic location.

The mean tumor radii increased by a factor of approximately 2.5 from week 4 to week 9, and the relative CBF and CBV in the tumor fringe increased by a factor of 2.5 to 6. Our technique is accurate and robust, and permits longitudinal quantification of tumor size and relative CBV and CBF measured using perfusion MRI. Such an approach could in turn lead to an improved understanding of disease progression and therapy monitoring.