Development of a Microscope for Fully Automated Real-Time Cancer Cell Tracking

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Glioblastoma is a brain cancer that is resistant to treatment due to the migration of individual glioblastoma cells throughout the brain. This study measured the effect of NE-100, a sigma-1 receptor inhibitor, on glioblastoma cell migration. To track this migration, a fluorescence microscope was designed and constructed. An Arduino program and printed circuit board were designed to move the microscope's objective and follow a cell. To locate a cell in three dimensions and direct the objective's motion, a C++ program using computer vision algorithms was written. This microscope was used to track glioblastoma cells over 24 hours in a three-dimensional culture. For each cell, the average migration speed and the type of migration (Brownian, subdiffusion or directed) were measured. NE-100 had no significant effect on average migration speed ($p=0.351$) or the distribution of migration types ($p=0.189$), but the sample size of the experiment ($n=3$) was small and more trials are needed in the future. Furthermore, all three types of migration were observed, suggesting that glioblastoma tumors express a variety of migration patterns. The sensitivity, low cost, and three-dimensional tracking capability of the microscope constructed make it a powerful alternative to cell migration assays. It can be used in other cell migration research to refine computational models of cancer. It can also be used in a clinical setting as a diagnostic tool to predict cancer progression and monitor treatment response. Future work will improve the microscope to track multiple cells in parallel and track cell divisions.

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