THE USE OF INTRINSIC MAGNETIZATION TO DEFINE AND SEPARATE GLIOBLASTOMA STEM CELLS

Kyoung-Joo Jenny Park, The Ohio State University
park.1601@buckeyemail.osu.edu
Jeffrey Chalmers, The Ohio State University
Maciej Zborowski, Cleveland Clinic Foundation
Monica Venere, The Ohio State University Medical School

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Dysregulated iron and glucose metabolisms have been implicated as a distinctive feature of tumorous cells. Cancer cells regulate iron uptake, storage, and efflux in unique ways that benefit them, and studies have found that increased iron level is associated with higher cancer risks. Warburg effect (phenomenon of cancer cells relying on aerobic glycolysis as opposed to mitochondrial oxidative phosphorylation) has been widely known, and it has increased interest into the detection of cancerous cells based on the composition of cellular interior substance. In previous studies, it has been shown that by generating a magnetic energy gradient around the cells, we can induce a cell velocity exploiting the inherent magnetic properties, which is in fact increased in tumorous cells (1). Using magnetophoresis, this study analyzes the relationship between glucose and iron metabolisms as well as the possibility of identifying and separating cancerous cells within a population using the intrinsic properties of magnetic susceptibility (i.e. labeless). In addition, the effects of iron and glucose uptake on the cell growth and viability are investigated in order to further understand how iron and ROS are handled by cancerous cells. Various cancer cell lines, including GBM stem-like and non-stem cells, are incubated in media of varying iron and glucose concentrations and placed within a magnetic field. Previous, independent, molecular biology studies have indicated that GBM stem-like cells in fact do overexpress specific pathways associated with iron metabolism (2). Under the influence of the magnetic energy gradient, the magnetic susceptibility is measured using Cell Tracking Velocimetry (CTV). Also, enzymatically active cells are analyzed separately from the mixed populations of live and dead cells, and the results are compared. A positive correlation between glucose concentrations in media with the induced magnetic susceptibility suggests that glucose metabolism is implicated in upregulated iron metabolism.

Cancerous self-renewing stem-like cells that show distinctive behaviors from their non-stem counterparts, in terms of magnetic susceptibility and viability, indicate that they have different ways of handling iron and resisting oxidative stress. Moreover, quantitative magnetic susceptibility difference between stem and non-stem cells can be applied to separate and identify these two populations within a sample, to maintain its ability to self-renew and differentiate in stem-like cells, or to develop iron-based targeted therapy. The ability to separate “stem like” cancer cells from “normal” cancer cells not only provides insight into basic cancer research and the interconnectedness of iron and glucose metabolisms in GBM and other cancers, but magnetophoresis may be considered as a viable option for development of diagnostics and new anti-cancer therapeutics.