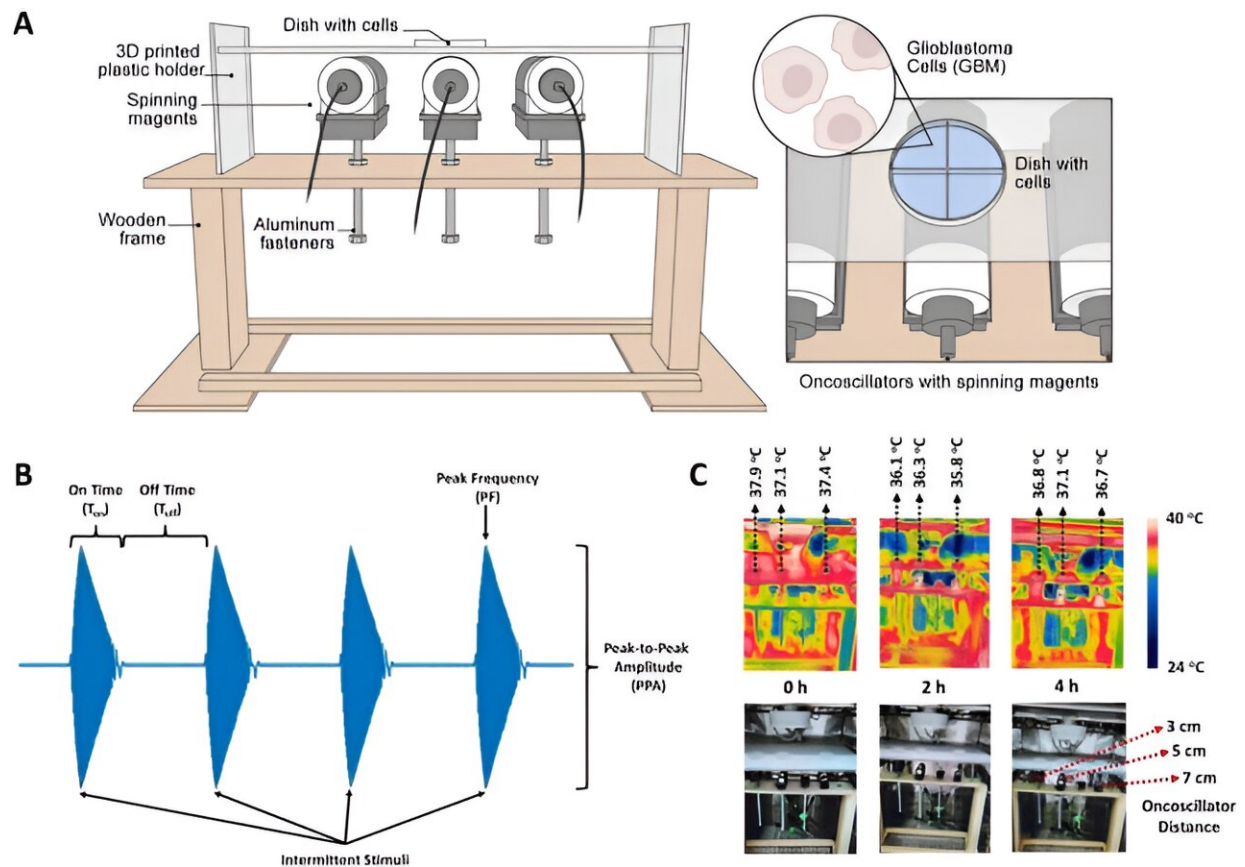


Magnetic field patterns found to cause oncolysis via oxidative stress in glioma cells

November 13 2023, by Thamarasee Jeewandara



Cell culture stimulation setup, stimulation protocol and thermal imaging during SOMF stimulation to measure temperature changes. (A) Left—A schematic diagram of the cell culture sOMF stimulation setup used in the laboratory. Right—Closeup view of a cell culture dish placed above each oncoscillator. (B) A schematic diagram showing the stimulation protocol and indicating the stimulus parameters examined in our experiments. (C) Top Thermal images show false color-coded spatial temperature variations in the incubator at three

time points during stimulation. Bottom Photographs of the apparatus and culture dishes corresponding to thermal images. To investigate whether the sOMF effects observed could be due to hyperthermia induced by stimulation we imaged the temperature of the culture dishes and the entire stimulation apparatus in the incubator during the 4-h stimulation session. To do this we used the FLIR One infrared thermal camera (Teledyne FLIR, Wilsonville, OR). We acquired images at the onset of stimulation (0 h) and at 2 h and 4 h time points during stimulation. We obtained six images at each time point and made spot measurements at the base of each culture dish placed at 3, 5 and 7 cm from the oncoscillator corresponding to PPA of ~ 5 , ~ 1 and ~ 0.42 mT. We also measured the temperature at the base of a culture dish positioned at 1.4 cm from the oncoscillator corresponding to a PPA of ~ 58 mT and found no significant increase in temperature at this position. Credit: *Scientific Reports*, doi: 10.1038/s41598-023-46758-w

Anticancer treatment strategies increasingly seek to raise [reactive oxygen species](#) (ROS) levels, cause macromolecular damage, and kill cancer cells. Electromagnetic fields can elevate intracellular reactive oxygen species to cause cancer cell death leading to the development of a new portable, wearable electromagnetic field device that generates spinning oscillating magnetic fields (sOMF) to selectively eliminate cancers.

In a new report [published](#) in *Scientific Reports*, Shashank Hambarde, and a team of scientists in neurosurgery in the U.S., characterized precise configurations and timings of spinning oscillating magnetic fields to produce cytotoxicity due to a critical rise in superoxide levels in two types of human glioma cells.

The [antioxidant Trolox](#) reversed the cytotoxic effect of spinning oscillating magnetic fields on glioma cells to indicate the role of reactive oxygen species in producing the onset of [cancer](#). The outcomes highlight the link between the physics of magnetic simulation and anticancer

action to facilitate a new and safe non-invasive device-based treatment strategy to attenuate several glioma types.

Regulating the tumor microenvironment with reactive oxygen species

Reactive oxygen species play a significant role in regulating normal cellular processes, including developmental cell proliferation, differentiation, [cell death](#), and immune defense mechanisms, as well as [cell plasticity](#).

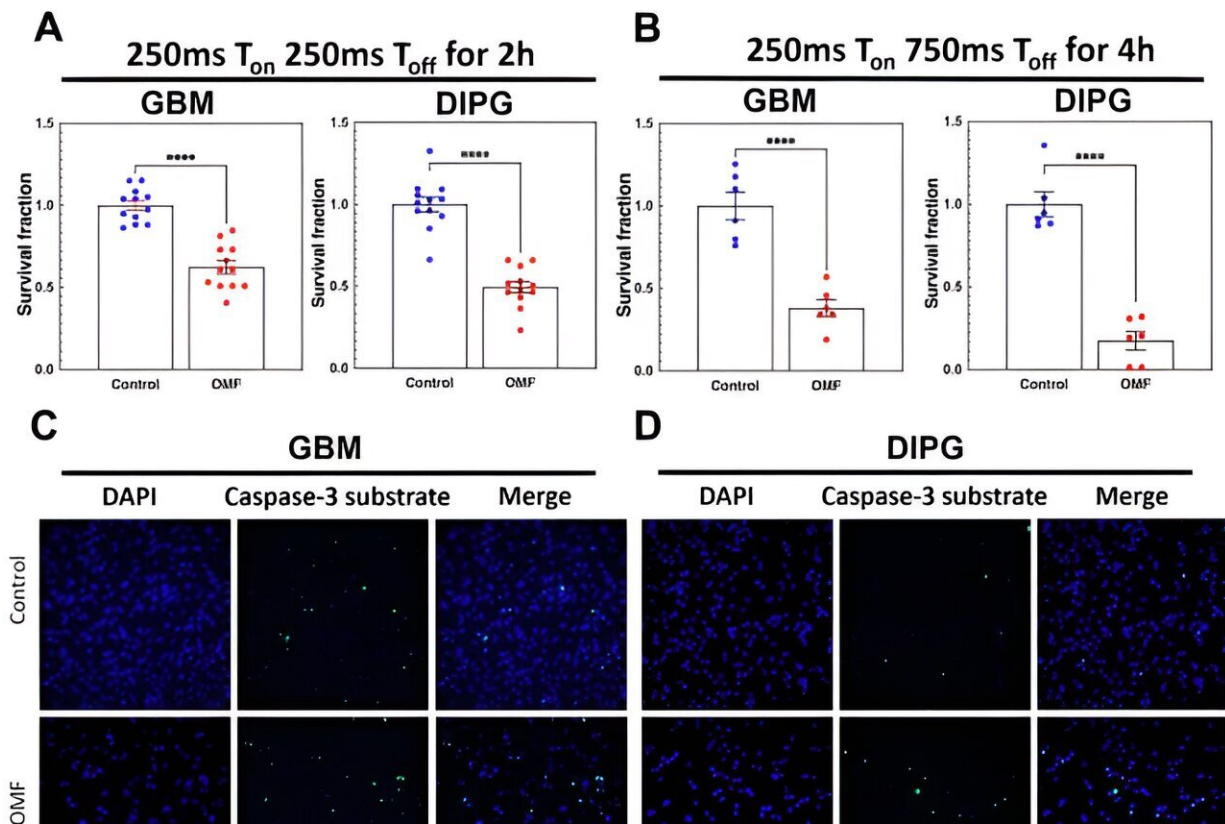
The role of reactive oxygen species is significant during [cancer cell proliferation](#), and tissue invasion, with [attributes provided to](#) cellular aging and neurodegeneration.

Cancer cells have high levels of reactive oxygen species due to increased oxidative metabolism and dysfunctional mitochondria. Abnormally high levels of reactive oxygen species can cause cell apoptosis, therefore increased reactive oxygen species in cancer cells can be an [adequate treatment strategy](#).

Stimulating with an electromagnetic field

Aside from drugs, stimulation by electromagnetic field generating devices can raise the reactive oxygen species level in cancer cells to induce cell death of [malignant tumor cells](#) in vitro.

While these devices have shown safety and efficacy for integration in mouse tumor xenograft models, large patient trials remain to be conducted. Human cancer cells have produced variable results to show the increase and decrease in reactive oxygen species levels.



sOMF exposure causes ROS-dependent reduction in colony formation and cell death in GBM and DIPG cells. (A and B) Scatter with bar graphs show survival fraction in clonogenic cell survival assay for GBM (GBM115) and DIPG cells from independent experiments with each data point shown as a dot ($n = 12$). Error bars show SEM. Stimulation parameters are mentioned above bar graphs. (C and D) Representative images of caspase-3 activity increase 12 h after 4-h sOMF exposure in GBM and DIPG cells. (E and F) Scatter with bar graphs show survival fraction in clonogenic cell survival assay in the presence and absence of Trolox ($20 \mu\text{M}$) for GBM (GBM115) and DIPG cells ($n = 4$). Error bars show SEM. ** p

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