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MIRA- THE MAGNETIC-FIELD-BASED IMMUNOTHERAPY FOR REMISSION UNSING ENDOWED ANTIBODIES: RESULTS OF THE STAGE 1 EXPERIMENTS AND FUTURE OUTLOOK

Abstract

An essential problem when treating cancer is the selective access and controlled destruction of tumour cells in the patient's body. After tumours have been surgically removed, individual tumour cells often remain in the body, out of which new tumours could develop. The traditional follow-up treatments of chemotherapy and radiation are often unable to destroy these cancer cells in a controlled manner. And the destruction of healthy cells might cause more harm to the patient. Based on current diagnostic methods, the possibility now exists of combining biotechnology and physics to come up with a more effective and gentle way to treat cancer. To this end, antibodies endowed with special iron nanospheres are used, as well as alternating magnetic fields which generate a force through a physical coupling that destroys the abnormal cell without harming the surrounding healthy tissue. MIRA, the Magnetic-field-based Immunotherapy for Remission using endowed Antibodies is a unique cancer therapy, highly selective, efficient, side-effect free and derived from a pulsed plasma thruster. The procedure's physical foundation is based on alternating magnetic fields whose effects were described as early as 1942 by Hannes Alfvén, a Swede who would later win the Nobel Prize. During this process, the disruption of a magnetic field generates a force effect on magnetic conductive material that lies in close proximity to it. In nature,

such effects can be seen in solar eruptions and in northern lights. In the case of MIRA, the coupling is enabled by iron nanospheres with which the antibody is endowed. The force effect on the antibodies is great enough to destroy the cell membrane, thereby irreversibly damaging the cancer cell. This facilitates gentler treatment, since its effect can be switched on and off in a targeted manner. MIRA therefore functions like a light switch, except instead of light, a therapeutic treatment is switched on and off, precisely targeting the right spot at the right time. Depending on the treatment method, this will allow for the destruction of selected (e.g. malignant) cells in one or more carefully planned sessions. Recently, MIRA was awarded a Business Incubation Centre (BIC) grant of the European Space Agency (ESA), a success that has enabled us to finish stage 1 of the MIRA prototype development process. Once the MIRA Prototype 1.0 had been finished, we could finally perform a biological efficacy test. A flow cytometric protocol for characterization and to distinguish between live and apoptotic (early and late apoptotic) cells was established. Our results showed that PBMCs marked with CD3-microbeads started to undergo apoptosis after treatment with different magnetic fields using the MIRA device. The highest effect was observed 2 hours after the treatment with 1000 kHz for 30 seconds. This paper will present the results of this test campaign and will provide an outlook on the upcoming activities to further advance the development of this promising cancer therapy.