Researchers develop magnetically switchable mechano-chemotherapy to overcome tumor drug resistance

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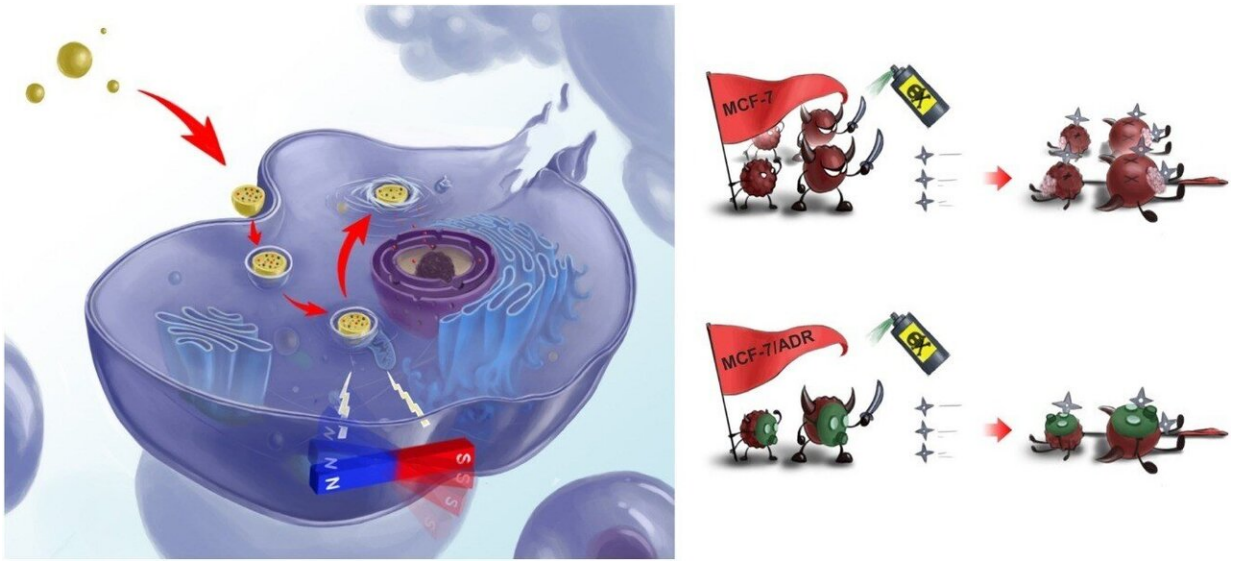

The illustration of the mechano-chemotherapy for killing tumor cells. Credit: NIMTE

Prof. Wu Aiguo's team at the Cixi Institute of Biomedical Engineering, Ningbo Institute of Materials Technology and Engineering (NIMTE) of the Chinese Academy of Sciences (CAS) developed a novel therapeutic method termed mechano-chemotherapy, which can efficiently overcome tumor drug resistance. The study was published in *Nano Today*.

As one of the most common cancer treatment patterns, chemotherapy has been highlighted with superiority for cancer remission or even cure. However, the ability of tumor cells to develop drug resistance over time remains one of the major stumbling blocks in such a therapeutic strategy. In addition, drug release techniques (e.g., pH- and redox-induced carrier self-opening) are still in their infancy, owing to the existing barriers to achieve external stimulus responsive control.

To address this problem, researchers at NIMTE designed a controllable mechano-chemotherapeutic nanomaterial, integrating $Zn_{0.2}Fe_{2.8}O_4$ magnetic nanoparticles (mNPs) and the Doxorubicin (DOX) anti-cancer drug into a poly(lactic-co-glycolic acid) (PLGA) carrier (DOX-$Zn_{0.2}Fe_{2.8}O_4$-PLGA). Thanks to its superb magnetic response, the prepared nanomaterial can be easily controlled by an external rotating magnetic field (RMF). In the meantime, the ultra-high biocompatibility of the PLGA endows the nanomaterial with high stability in physiological environment.

Regarding therapeutic outcomes, DOX-$Zn_{0.2}Fe_{2.8}O_4$–PLGA with multi functionalities enabled safe and reliable controlled drug release, efficiently overcoming drug resistance. During the healing process, the tunable RMF equipment (45mT and 2000rpm in this work) as a magnetic switch was qualified to liberate the entrapped drug. Furthermore, the inner $Zn_{0.2}Fe_{2.8}O_4$ mNPs generated a mechanical force under the external RMF, which therefore inflicted significant damage to tumor cells membrane alongside lysosome membrane and realized synergetic therapy.

The precise, non-invasive and remote mechano-chemotherapy has provided a novel therapeutic method to overcome the drug resistance of tumor cells and facilitate cancer cure, and shed light on the research of mechanical stimulation of other biological activities.

More information: Yao Chenyang et al. Magnetically switchable mechano-chemotherapy for enhancing the death of tumor cells by overcoming drug-resistance, *Nano Today* (2020). DOI: 10.1016/j.nantod.2020.100967

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