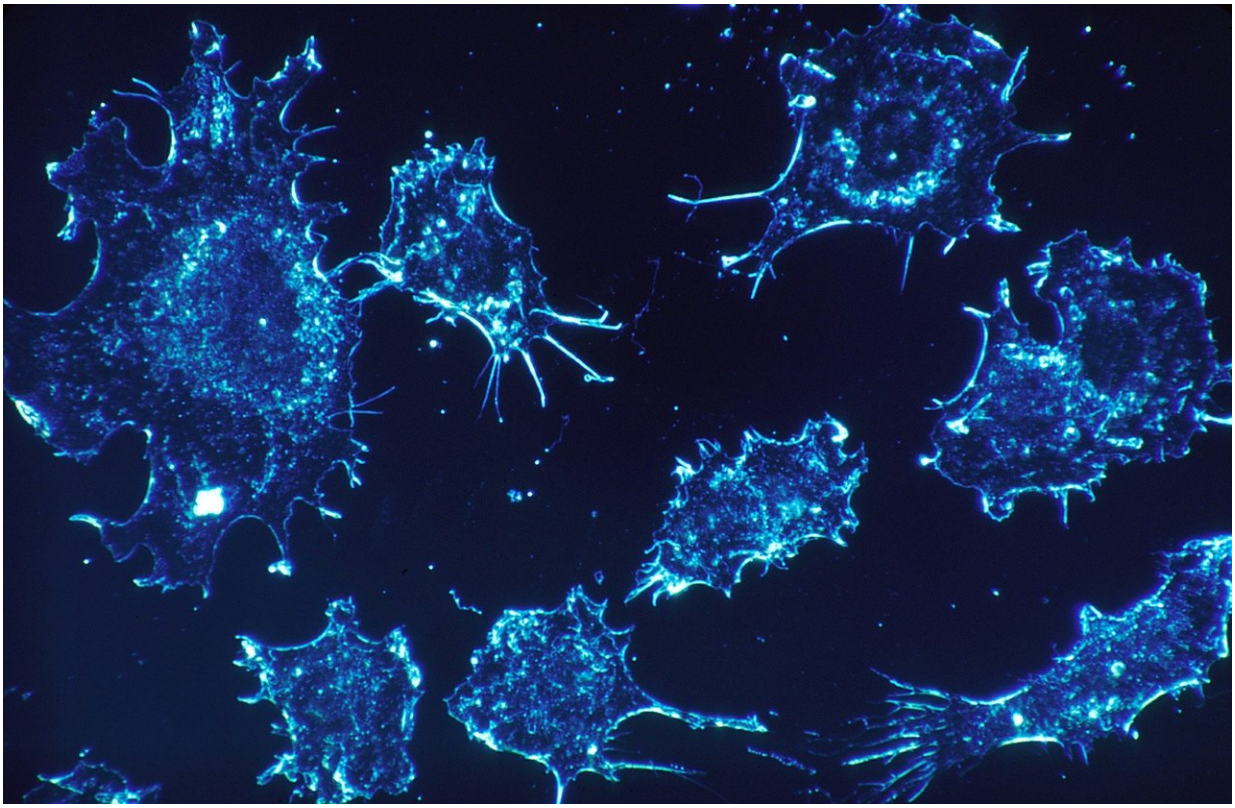
Researchers design new technology for targeted cancer drug delivery

March 3 2020



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A team of researchers at NYU Abu Dhabi has developed a biocompatible, biodegradable and economical nanocarrier for safer and more effective delivery of anticancer drugs. Thr researchers have demonstrated that the novel pH-responsive hybrid (i.e., multi-

component) nanoparticles can be loaded with a wide range of chemotherapeutics to target cancer cells, as reported in their paper published on March 3, 2020, in the journal *Communications Biology*.

Conventional chemotherapy drugs work primarily by interfering with DNA replication and mitosis (a type of cell division) in order to induce cell death in rapidly dividing cancer cells, thereby minimizing tumor growth. The limitations of conventional chemotherapy include poor solubility, short blood circulation time, lack of selectivity, toxicity to healthy tissue, drug resistance, and tumor recurrence. Consequently, it becomes necessary to administer high doses of chemotherapeutics to ensure that a sufficient amount reaches the tumor to cause the desired effect in cancer cells. Unfortunately, the high drug doses lead to damage to healthy tissue, resulting in a range of side-effects that include nausea, hair loss, fatigue, decreased resistance to infection, infertility and organ damage.

Cancer nanomedicine—the use of nanocarriers to diagnose, track, and treat cancer—has the potential to overcome the limitations of conventional chemotherapeutics. However, the practical application of many nanocarriers as cancer drug delivery systems is often hampered by a number of issues, including poor circulation stability, inadequate accumulation in target tumor tissue and inefficient uptake and/or transport in target cancer cells.

As reported in the paper, "pH-Responsive High Stability Polymeric Nanoparticles for Targeted Delivery of Anticancer Therapeutics," NYUAD's Magzoub lab in collaboration with Professor Francisco N. Barrera's lab at the University of Tennessee at Knoxville, have developed nanocarriers that that can overcome complications associated with conventional chemotherapeutics as well as current nanocarriers.

"We used a simple approach and readily available low-cost materials to

prepare biocompatible and biodegradable pH-responsive hybrid nanoparticles for the effective delivery of chemotherapeutics specifically to tumor cells," said Loganathan Palanikumar, a research associate in the Magzoub lab and first author of the study. "Thus, unlike many nanocarriers, which require complex chemistry and costly equipment and materials, our nanoparticles can be easily prepared and used by other researchers, even those with limited resources," added Palanikumar.

The nanoparticles consist of a US Food and Drug Administration (FDA)-approved polymer core wrapped with a biocompatible and biodegradable protein shell. The core can be loaded with a wide range of cancer therapeutics. Designed to prolong the blood circulation time, the protein shell also serves to ensure that the nanocarrier remains stable long enough to reach the target location. Finally, the nanocarrier is decorated with a pH-responsive peptide, developed by the Barrera lab, which facilitates the cellular uptake specifically in cancer cells within the acidic environment of solid tumors. Following efficient cellular uptake, the unique conditions within cancer cells degrade the hybrid nanoparticles and release the loaded chemotherapeutic drugs.

Palanikumar, along with cancer researchers in the Magzoub lab, Sumaya Al-Hosani and Mona Kalmouni, and Vanessa Nguyen, at the time a graduate student in the Barrera lab, with support from Research Instrumentation Scientists at the Core Technology Platforms at NYUAD, Liaqat Ali and Renu Pasricha, extensively characterized the properties of the nanocarrier in a wide range of cancer cell lines and in tumor-bearing mice. The drug-loaded hybrid nanoparticles showed potent anticancer activity, leading to a substantial reduction in tumor volume and mass and prolonged survival, while exhibiting no adverse effects to healthy tissue.

"These novel pH-responsive hybrid nanoparticles are a highly promising

cancer drug delivery platform that combines high stability with effective tumor targeting and triggered release of chemotherapeutic agents in cancer cells," said NYUAD Assistant Professor of Biology Mazin Magzoub.

More information: L. Palanikumar et al. pH-responsive high stability polymeric nanoparticles for targeted delivery of anticancer therapeutics, *Communications Biology* (2020). DOI: 10.1038/s42003-020-0817-4

Provided by New York University