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Researchers apply new analytical technology to quantitate amount of anti-cancer drugs inside individual cancer cells

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University of Oklahoma researchers will apply a new analytical technology that could ultimately provide a powerful tool for improved treatment of cancer patients in Oklahoma and beyond. Using mass spectrometry, an analytical instrument for sensitive detection and accurate identification of molecules, the team will quantitate the amount of anti-cancer drugs present in individual cancer cells, including those in bladder cancer cells isolated from patients undergoing chemotherapy. The method will provide a means to establish ideal dosing regimens that delivers effective chemotherapeutic concentrations to patients with minimal toxicities.

Anthony Burgett and Zhibo Yang, assistant professors in the Department of Chemistry and Biochemistry in the OU College of Arts and Sciences, and affiliates of the Stephenson Cancer Center, in collaboration with Jonathan E. Heinlen, M.D., assistant professor in the Department of Urology at the OU Health Sciences Center and a Stephenson Cancer Center researcher, will fully develop the novel first-in-class mass spectrometric technology—the Single Probe—capable of performing single-cell mass spectrometry of compounds inside of living single cancer cells as a bioanalytical method to improve efficacy and toxicities of chemotherapy in patients.

"One clear lesson from scientific progress is that new technologies often lead to major advances. This new single cancer cell mass spectrometry

analysis could propel us forward to a new frontier in biological analysis, and we are excited to see where this technology, with its possible scientific and biomedical applications, could lead," said Burgett.

Currently, there are no clinical bioanalytical methods capable of determining the concentration of chemotherapeutic agents inside of a patient's individual cancer cells. A single-cell analysis method that could also assess the effectiveness of the patient-administered chemotherapeutic on the health of the individual cancer cells would give real-time relevant information about the therapeutic efficacy. Using the Single-probe, a miniaturized device with a sampling tip smaller than a cell, anti-cancer drugs inside a cancer cell can be extracted and quantified using mass spectrometry.

"Bladder cancer is a horrible disease with high costs of treatment—financially and in terms of quality of life of patients," said Dr. Heinlen. "Typically, we only know the effects of treatment weeks to months after the administration of cytotoxic chemotherapy. This technique could possibly give us insight into treatment efficacy as soon as the dose is administered. Those patients who have undergone several cycles of chemotherapy only to find the treatment was ineffective would see this as a major benefit."

If successful, this innovative research will produce a method capable of quantitating the intracellular level of a standard-of-care chemotherapeutic agent in patient single cancer cells for the first time. Further, this project would mark the first time a single-cell mass spectrometry method has been successfully used in a clinical setting, and this advancement would provide a potentially novel and powerful tool for the improved treatment of cancer patients in the state of Oklahoma and beyond.