Dethroning the King of Cancers: Pancreatic Cancer Diagnosis From Blood Enabled by a Cocktail of Antibody-Magnetic Nanospheres

Zheng, Audrey (School: North Allegheny Senior High School)

Pancreatic cancer is the “king of cancer” due to its aggressiveness and high lethality. Although it ranks 9th in incidence, it is the 4th leading cause of cancer-related death, and is projected to become the 2nd in US by 2030. A major problem? Late diagnosis. At stage I, the five-year survival can reach 84%, but it drops drastically to 3% if diagnosed at stage IV. Since early diagnosis is the key to winning the battle with pancreatic cancer, I developed a novel method for pancreatic cancer diagnosis that isolates pancreatic cancer-specific extracellular vesicles (EVs) from blood plasma to enable cancer mutation detection all from a simple blood draw. EVs are released by cancer cells even from early stages and EV-DNA contains the same mutations as the original cells. To isolate pancreatic cancer-specific EVs, I identified 3 pancreatic cancer-specific surface antigens through literature search. An antibody cocktail against these antigens was conjugated to magnetic nanobeads to isolate the pancreatic cancer-derived EVs from plasma. Purified EV-DNA was then analyzed for KRAS mutations, the driver mutation of pancreatic cancer, using droplet digital polymerase chain reaction (ddPCR). In a cohort of 23 pancreatic cancer patients and 10 healthy donors, KRAS mutations were detected in all patients and one healthy donor. The overall assay achieved 100% sensitivity, 90% specificity, and 91.3% discrimination. In comparison, cancer in only 17 out of the same 23 patient samples was detected using the current industry standard method. This study develops a novel method for highly sensitive pancreatic cancer detection from plasma. Further refinement and large-scale clinical trials could advance this technology toward clinical use for early diagnosis and real-time treatment monitoring.

Awards Won: