Diagnostic chip may help hearts, cut costs

January 31 2011

Heart disease is a silent killer, but new microchip technology from Rice University is expected to advance the art of diagnosis.

During National Heart Health Month, Rice Professor John McDevitt will discuss the potential of this technology to detect cardiac disease early at the annual meeting of the American Association for the Advancement of Science (AAAS) in Washington, D.C., Feb. 17-21. Cardiac disease is the focus of one of six ongoing major clinical trials of Rice's programmable bio-nano-chips (PBNCs).

PBNCs combine microfluidics, nanotechnology, advanced optics and electronics to enable quick, painless diagnostic tests for a wide range of diseases at minimal cost.

Current clinical trials employ PBNCs to test more than 4,000 patients for signs of heart disease, ovarian cancer, prostate cancer, oral cancer and drug abuse. Versions to test for HIV/AIDS and other diseases are also in development.

"Too often, the first time people know they're suffering from heart disease is when it kills them," said McDevitt, Rice's Brown-Wiess Professor of Chemistry and Bioengineering, who will participate in a global health seminar at AAAS.

"With this test, we expect to save lives and dramatically cut the recovery time and cost of caring for those who suffer from heart ailments," said McDevitt, a pioneer in the creation of microfluidic devices for

biomedical testing. He anticipates the PBNCs, when manufactured in bulk, will cost only a few dollars each.

PBNCs analyze a patient's saliva for biomarkers associated with cardiovascular disease. Unfortunately, McDevitt said, only about half of the patients having a heart attack are diagnosed immediately via electrocardiogram. The rest require a series of time-consuming laboratory tests that take up to 12 hours to complete. PBNCs now in development deliver results in as little as 20 minutes and provide clinicians with timely information that can help them manage patients more effectively.

"A critical thing to recognize in a heart attack is that if we're able to open the blocked vessel within an hour, we've salvaged a heart muscle," said Biykem Bozkurt, the Mary and Gordon Cain Chair and Professor of Medicine and director of the Winters Center for Heart Failure Research at Baylor College of Medicine (BCM). "Thus, the patient's chance of survival is significantly improved."

Bozkurt and Christie Ballantyne, chief of atherosclerosis and vascular medicine and professor of medicine at BCM and director of the Center for Cardiovascular Disease Prevention at the Methodist DeBakey Heart and Vascular Center, are leading the trial at Houston's Michael E. DeBakey VA Medical Center, one of four sites hosting the cardiac trial that will recruit 1,000 patients.

McDevitt noted that of 5 million visits to American emergency rooms each year for chest pain, approximately 80 percent are false alarms.

"We have patients clogging the ER system and delaying the recognition of true heart attack cases because we can't, in an expeditious manner, rule out false alarms that could have been diagnosed in the ambulance or the home setting," said Bozkurt, who also serves as cardiology section

chief at the VA.

The potential cost savings for even a single patient are tremendous, said Vivian Ho, the James A. Baker III Institute Chair in Health Economics and a professor of economics at Rice.

"Treating patients in the emergency room is one of the highest costs we have in the health care system," Ho said, "particularly for heart attacks, because heart disease is the leading killer of Americans and it accounts for a large proportion of our health care costs.

"If we can identify these patients quickly so we can avoid aggressive diagnostic tests further on down the road -- for example, cardiac catheterizations and procedures that cost tens of thousands of dollars -- by instead using a relatively low-cost diagnostic chip, that's a tremendous opportunity to provide better care and lower costs," she said.

McDevitt expects PBNCs and their toaster-sized reader will ultimately find a place at many points of care -- hospitals, doctors' or dentists' offices, pharmacies and remote clinics worldwide -- where they will allow clinicians to quickly diagnose a variety of ailments.

He anticipates Rice's BioScience Research Collaborative, part of the Texas Medical Center, to be the hub of a pipeline in which chips will be programmed to spot biomarkers for many important diseases.

"PNBC technology marries medical devices and microelectronics," McDevitt said, "and it has the potential to revolutionize the flow of information in the practice of medicine while significantly reducing cost. I like to think of it as the iPhone of medicine, with the same potential to be a game changer. And it's just around the corner."

Provided by Rice University