ICU
MANAGEMENT & PRACTICE

New Device Promises Rapid Molecular Diagnosis

A team of engineers and scientists at the University of Arizona has developed a new diagnostic device that could reduce the amount of time necessary to diagnose tissue infections. The device's novel approach to molecular diagnostics, called DOTS qPCR, is faster, more efficient and less expensive than methods currently being used in clinics, according to the research published in the journal *Science Advances*.

Pathogens and infectious diseases are typically detected using a technique called polymerase chain reaction (PCR). The method involves rapidly heating and cooling DNA molecules from a biological sample in a process called thermal cycling. This results in the amplification of the target DNA into millions, and even billions of copies. Scientists and physicians can then use the copies to identify the type of pathogen causing the infection.

The problem is that most PCR tests can take up to an hour or more, and a physician's decision-making window is typically less than 10 minutes. The physician's ability to act quickly and correctly not only makes a difference to the patient's outcome, it determines whether the infection spreads to other patients in the clinic.

"With DOTS qPCR we are able to detect amplification and identify the infection after as few as four thermal cycles, while other methods are working with between 18 and 30," says Jeong-Yeol Yoon, a professor in the Department of Agricultural and Biosystems Engineering and a joint appointment in the Department of Biomedical Engineering. "We can get from sample to answer in as little as 3 minutes and 30 seconds."

Yoon and his research group invented DOTS qPCR (droplet-on-thermocouple silhouette real-time PCR). The technology relies on the measurement of subtle surface tension changes at the interface of a water droplet suspended in an oil medium. The water droplet, which contains the target DNA to be amplified, is moved along a heat gradient in the oil to begin the chain reaction. As more copies of the target DNA are produced, they move towards the oil-water interface, resulting in measurable changes in surface tension. Notably, the size of the droplet can be measured using a smartphone camera, providing a method to observe the course of the reaction in real time.

In addition to much faster diagnosis times, researchers say the system does not require samples to be completely free of other contaminants. This can save valuable time otherwise spent preparing samples for testing.

Yoon notes that DOTS qPCR is inexpensive compared to its counterparts that employ costly and time-intensive testing methods involving fluorescence detection, lasers and dark chambers. "It's easy to use, smartphone-integrated and saves money and labour using expensive equipment," Yoon says. "This technology has a lot of commercial potential, and we'd be happy to work with industry to bring it to market."

Ultimately, his team hopes the technology will transform the operations of hospital emergency rooms, where saving time to diagnosis translates into saving lives.

Source: University of Arizona
Image credit: Dustin Harshman

Published on : Tue, 15 Sep 2015