Lab-on-a-chip offers faster means of identifying best plasma donors in COVID fight

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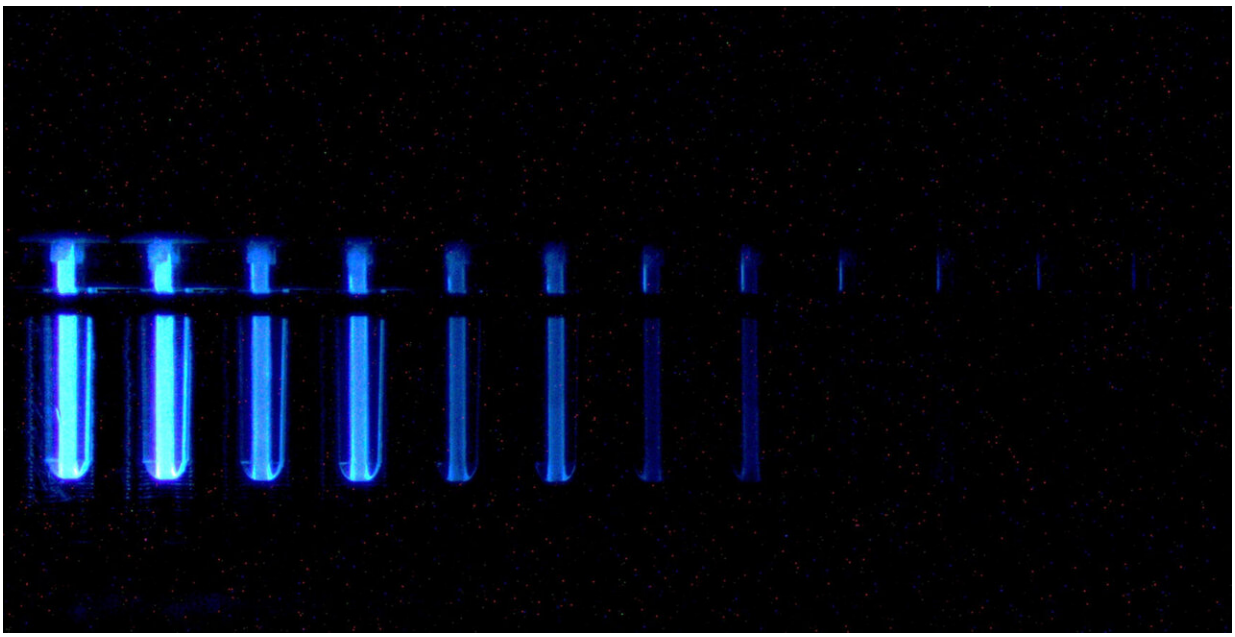

An example of the chemiluminescent imagery used to measure the concentration of SARS-CoV-2 antibodies in the convalescent plasma of COVID-19 donors using a microfluidic ELISA assay. Credit: Fan Lab/University of Michigan

A new, portable lab-on-a-chip developed at the University of Michigan can identify the presence of COVID-19 antibodies in blood with greater speed and efficiency than the current standard "enzyme-linked immunosorbent assay" or ELISA technology.

With assistance from U-M startup Optofluidic Bioassay and Hackensack Meridian Center for Discovery and Innovation in New Jersey, researchers have shown the device can identify the concentration of COVID-19 antibodies in human blood in 15 minutes. That process normally takes between hours and a few days.

And U-M's device, which is actually a miniature ELISA, can achieve its faster results with smaller amounts of blood. The work has particular value for the validation of convalescent plasma as a treatment for COVID-19. A paper on the findings is published in *Biosensors and Bioelectronics*.

"This research shows what an important role microfluidics can play in both saving lives and costs during the COVID-19 pandemic," said Xudong (Sherman) Fan, U-M biomedical engineering professor and co-founder of Optofluidic Bioassay.

Microfluidic devices shrink multiple lab functions onto a single chip measured in millimeters or centimeters. In addition to needing smaller sample sizes, they also increase accuracy. This particular system can detect concentration levels of antibodies—something that can vary greatly from plasma donor to donor.

Specifically, the U-M device detects the presence and amount of neutralizing immunoglobulin—antibodies created by the immune system within seven to 10 days of a COVID-19 infection. Only donors with high levels are likely to provide samples that could be effective in treatment, such as convalescent plasma therapy.

The treatment involves taking blood from subjects that have previously been diagnosed with COVID-19, and then separating out the plasma—the liquid portion of the blood that contains antibodies. Those antibodies are then given to patients therapeutically in an attempt to

boost the immune response.

In late August, the U.S. Food and Drug Administration authorized it as a treatment for COVID-19. The move, however, was not welcomed universally, with many medical experts saying it was too soon to determine the treatment's efficacy.

To bolster the data available on convalescent plasma treatments, more donors with high-titer antibody concentrations are needed. The methodology developed by this team provides an efficient and effective way forward.

"Convalescent plasma is a treatment that can be very effective—but for it to have the best chance to work, it needs to have rigorous standards, which include assessing the presence of high-titer neutralizing antibodies," said David Perlin, Ph.D., chief scientific officer and senior vice president of the Hackensack Meridian Center for Discovery and Innovation, and one of the new study's authors. "This paper shows how the antibody thresholds can mean a better potential COVID-19 treatment—and also better outcomes."

Screening for proper donors is typically handled by standard ELISA, which requires sample processing and a refrigerator-sized plate-reader for taking measurements. Delays are exacerbated by having to send samples to a lab for analysis.

The lab-on-a-chip approach analyzes on site and delivers quantitative evaluations with finger prick's worth of blood—8 microliters. A traditional ELISA machine requires 100 microliters to do its work.

More information: Xiaotian Tan et al. Rapid and quantitative detection of SARS-CoV-2 specific IgG for convalescent serum evaluation, *Biosensors and Bioelectronics* (2020). DOI:

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