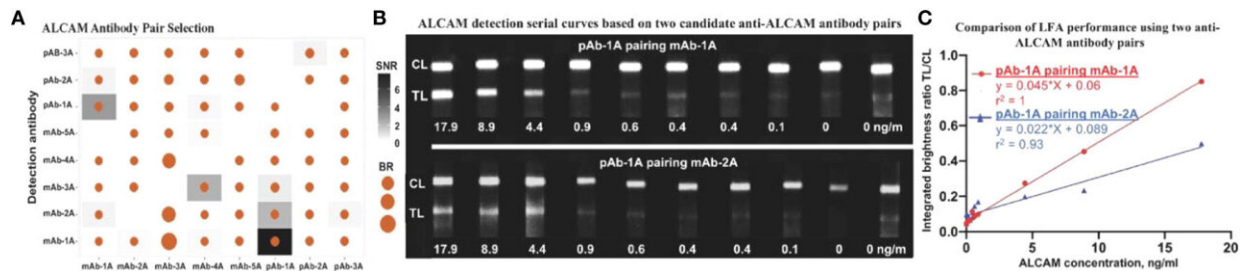# Early diagnosis and monitoring of lupus nephritis—on your smartphone

February 1 2023, by Laurie Fickman

Antibody pair selection for construction of ALCAM LFA. (A) 57 antibody pairs (eight types of antibodies were tested in all combinations and with each serving as detection Ab-the antibody conjugated onto the nanophosphors and as capture Ab-the antibody immobilized onto the LFA strip) were tested for ALCAM LFA performance, of which two pairs showed relatively high SNR and brightness ratio. (B) Serial curve of nanophosphor-based LFA were constructed for ALCAM detection in buffer. Each concentration point was singularly tested except for negative controls (0 ng/ml) in duplicate. These grayscale images were collected using a FluorChem gel documentation and were analyzed using ImageJ. (C) Integrated brightness ratio (TL/CL) as a function of ALCAM concentration showed that pAb-1A as capture antibody and mAb-1A as detection antibody achieved the highest LFA performance with high linearity (r2) of 1. The positive (17.9 ng/ml) and negative (0 ng/ml) buffer under both candidate antibody pairs were tested twice before constructing the standard curves. SNR, signal-to-noise ratio (In a given antibody pair, the integrated brightness at the TL of that positive LFA strip over the integrated brightness at the TL of that negative strip with no analyte).; BR, Brightness ratio (the integrated brightness intensity of TL over that of CL); TL, test line; C,: control line; pAb-1A, polyclonal anti-ALCAM antibody from R&D; mAb-1A, monoclonal anti-ALCAM antibody from R&D; The other antibody types tested were purchased from Biolegend, Thermo Fisher Scientific,

A team of researchers at the University of Houston is reporting the success of their new method for the early diagnosis and monitoring of lupus nephritis—at home. If you've taken an at-home COVID-19 or pregnancy test, then you've taken what is scientifically called a lateral flow assay (LFA) test, a diagnostic tool widely used because of its rapid results, low cost and ease of operation. The team applied that same technology to assessing lupus nephritis, or inflammation of the kidneys, one of the most severe complications for patients with systemic lupus erythematosus (SLE, or lupus).

The home test—with results read on a smartphone—is meant to eventually replace the gold standard for diagnosis of active lupus nephritis, an invasive kidney biopsy, with its attendant morbidity which cannot be serially repeated. The test assesses the levels of a protein-coding gene known as ALCAM.

"Urinary ALCAM (uALCAM) has shown high diagnostic accuracy for renal pathology activity in active lupus nephritis," reports Chandra Mohan, Hugh Roy and Lillie Cranz Cullen Endowed Professor of biomedical engineering, and one of the nation's leading lupus researchers, in *Frontiers in Immunology*. "The LFA tests for both non-normalized and normalized uALCAM exhibited excellent accuracies in distinguishing active lupus nephritis from healthy controls."

This test had 86% accuracy for distinguishing active lupus nephritis from all other lupus patients.

Utilizing the ALCAM biomarkers discovered by Mohan, Richard

Willson, Huffington-Woestemeyer Professor of chemical and biomolecular engineering and professor of biochemical and biophysical sciences, created the smartphone-based app and test kit based on the technology underlying home pregnancy tests.

"Periodic monitoring of uALCAM using this easy-to-use LFA test by the patient at home could potentially accelerate early detection of renal involvement or disease flares in lupus patients, and hence reduce morbidity and mortality," said Willson.

According to the Centers for Disease Control and Prevention, about 204,295 Americans have systemic lupus erythematosus, an autoimmune disease leading to chronic inflammation in multiple organs, including the kidneys. Nephritis flares are hard to recognize because their symptoms often masquerade as something else. A sufferer might think they have a cold or the flu or are just tired.

"A point-of-care testing platform's importance rests on its potential to empower patients to monitor their health status with convenience, thus allowing for early diagnosis and monitoring of disease progression. The LFA represents the most widely used rapid diagnostic POC testing platform," said Mohan.

In this work, the team used nanophosphor-based lateral flow immunoassays to demonstrate promise in facilitating home-based smartphone-enabled monitoring of disease activity in LN. These studies were carried out by biomedical graduate student Rongwei Lei, with clinical support from Dr. Michelle Petri, John Hopkins University School of Medicine.

Other contributors from the University of Houston include Binh Vu and Katerina Kourentzi Vu, William A. Brookshire Department of Chemical and Biomolecular Engineering; Sanam Soomro and Suma Nadimpalli,

biomedical engineering; Adheesha N. Danthanarayana and Jakoah Brgoch, Department of Chemistry.

"This may allow the proactive institution of therapeutics and even preventive strategies in LN, while minimizing treatment-related side effects," said Mohan.

More information: Rongwei Lei et al, A novel technology for home monitoring of lupus nephritis that tracks the pathogenic urine biomarker ALCAM, *Frontiers in Immunology* (2022). DOI: 10.3389/fimmu.2022.1044743

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