Handheld device uses a blood sample to distinguish asthma from allergies

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(Medical Xpress)—Asthma and allergic rhinitis can cause similar systems. However, the different conditions require different treatments, so it's important to distinguish between them. Until now, diagnosing asthma has been difficult. Therefore, doctors have frequently underdiagnosed it in some situations and overdiagnosed it in others. To make diagnosis easier and more accurate, Erick Sackmann of the University of Wisconsin and his colleagues invented a handheld device that measures how fast neutrophils in a drop of blood move across a chemotactic gradient. They found the neutrophils of asthmatics move more slowly than the neutrophils of non-asthmatics. The research appears in the *Proceedings of the National Academy of Sciences*.

People with asthma suffer from chronic lung inflammation associated with airway hyperresponsiveness (AHR) and airflow obstruction. Doctors diagnose asthma by reviewing a patient's medical history and checking symptoms. For example, they might test lung function and the reversibility of AHR. However, diagnoses aren't always accurate because patients, especially children and the elderly, are not always compliant. In addition, symptoms can be intermittent and might not appear when the patient is in the doctor's office.

Consequently, doctors often do not diagnose asthma properly. Elderly patients with asthma are consistently underdiagnosed. On the other hand, a recent Canadian study showed that doctors had given 30 percent of subjects false asthma diagnoses.

To develop a more accurate way of diagnosing asthma, Sackmann and his team decided to focus not on how asthmatics breathe, but on what causes their lungs to become inflamed. Most people with asthma have high levels of white blood cells in their lung tissue and bronchoalveolar lavage (BAL) fluid. People with severe asthma, in particular, have BAL fluid with elevated neutrophil counts.

While previous studies compared neutrophil counts in asthmatics and non-asthmatics, the researchers wanted to see if there was any difference in neutrophil chemotaxis. They created a handheld device that separates neutrophils from a blood sample within minutes and then measures how fast the neutrophils travel across a chemotactic gradient.

Sackmann's team tested the device on 34 subjects, some diagnosed with mild asthma, based on symptoms such as wheezing, coughing and shortness of breath, and some of whom were not asthmatic. Some subjects had allergies, diagnosed with skin tests. The team found the neutrophils of subjects with asthma moved across the gradient much more slowly than the neutrophils of subjects without asthma did. The team thinks this is the first time anyone has performed such a test on people with mild, rather than severe asthma. The results show the device can help diagnose all forms of asthma.

More information: Characterizing asthma from a drop of blood using neutrophil chemotaxis, Eric Karl-Heinz Sackmann, *PNAS*, DOI: 10.1073/pnas.1324043111

Abstract

Asthma is a chronic inflammatory disorder that affects more than 300 million people worldwide. Asthma management would benefit from additional tools that establish biomarkers to identify phenotypes of asthma. We present a microfluidic solution that discriminates asthma from allergic rhinitis based on a patient's neutrophil chemotactic function. The handheld diagnostic device sorts neutrophils from whole blood within 5 min, and generates a gradient of chemoattractant in the microchannels by placing a lid with chemoattractant onto the base of the device. This technology was used in a clinical setting to assay 34 asthmatic (n = 23) and nonasthmatic, allergic rhinitis (n = 11) patients to establish domains for asthma diagnosis based on neutrophil chemotaxis. We determined that neutrophils from asthmatic patients migrate significantly more slowly toward the chemoattractant compared with nonasthmatic patients (P = 0.002). Analysis of the receiver operator characteristics of the patient data revealed that using a chemotaxis velocity of 1.55 ?m/min for asthma yields a diagnostic sensitivity and specificity of 96% and 73%, respectively. This study identifies neutrophil chemotaxis velocity as a potential biomarker for asthma, and we demonstrate a microfluidic technology that was used in a clinical setting to perform these measurements.

Press release

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